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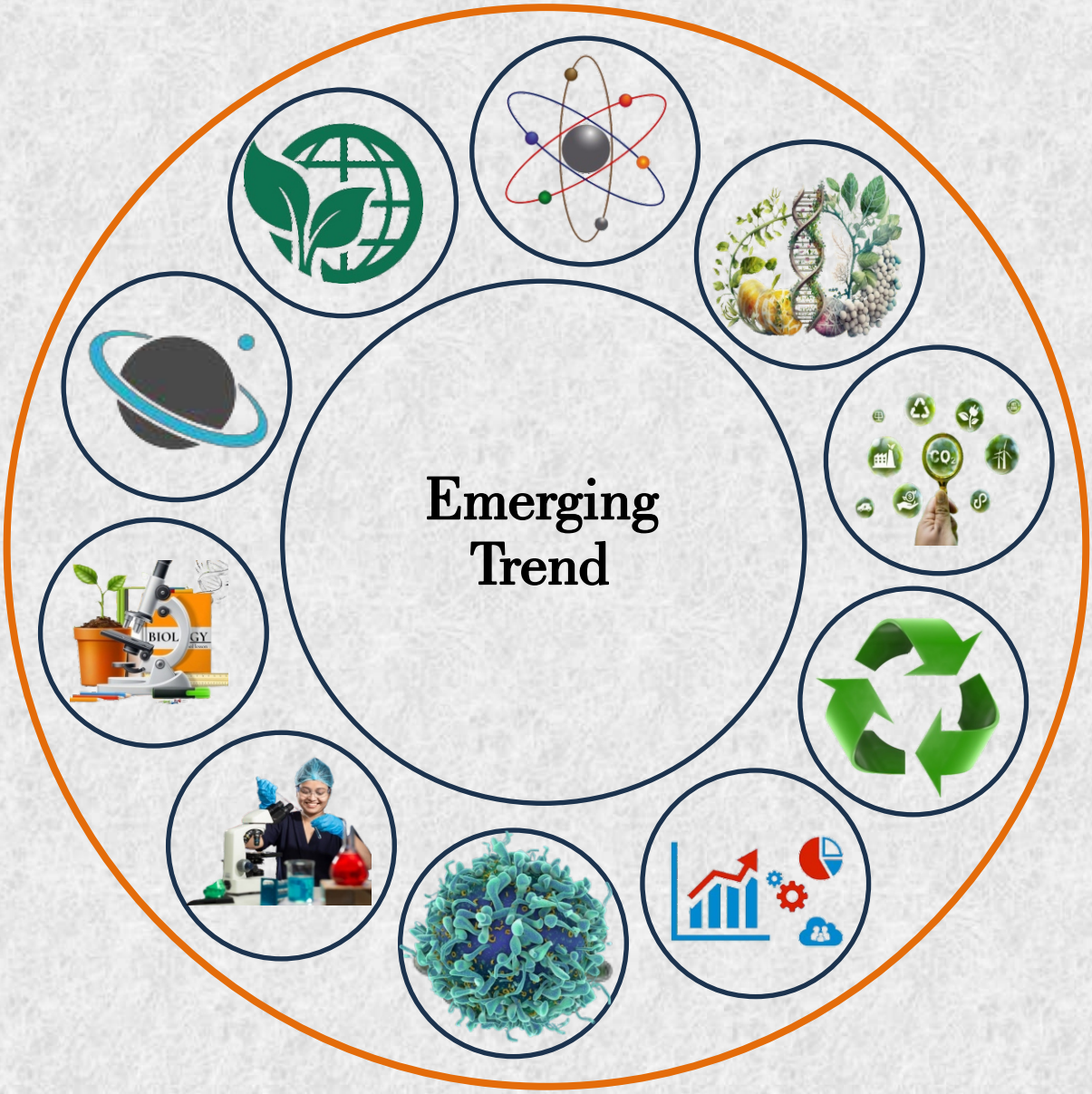
Emerging Trend in Sciences and Allied Sciences



Editors

Prin. Dr. Vilas Patil

Dr. Digvijay Kumbhar

Dr. Pratishtha Nagane

Mr. Agastirishi Toradmal

Dr. Sunita Arya

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Editors

Prof. Dr. Vilas V. Patil
I/C Principal
Akhil Bhartiya Maratha Shikshan Parishad's
Shri Shahu Mandir Mahavidyalaya, Parvati, Pune-411007 (MH)

Dr. Digvijay S. Kumbhar
Department of Zoology
Dada Patil Mahavidyalaya, Karjat, Dist.- Ahmednagar (MH)

Dr. Pratishtha N. Nagane
Department of Botany
Dada Patil Mahavidyalaya, Karjat, Dist.- Ahmednagar (MH)

Mr. Agastirishi B. Toradmal
Department of Geography
Prof. Ramkrishna More Mahavidyalaya, Pradhikaran, Akurdi, Pune (MH)

Dr. Sunita Arya
Department of Zoology
Dayanand Girls P.G. College, Civil Lines,
Kanpur - 208001

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Preface

We are happy to welcome the idea of publishing a book on relevant topic, "Emerging Trend in Sciences and Allied Sciences". Further, it is good that the articles from various disciplines are included in the book. The scholars from life sciences, physical science, mathematical science, earth science, Chemical Science and allied sciences have attempted to identify the current trend and to provide ideas to doing the recent study.

The disease management, structural deterioration of ecosystems, crop destruction, climate change, Geospatial Techniques for Groundwater, The Power of Artificial Intelligence in Nature Conservation, Management broad idea regarding causes of environmental issues in India, Recyclable Nanoparticles and their Applications in Organic Transformation, impact of irrigation, Graphene: Fundamentals and Applications, Biodiversity of Mosquitoes, coastal management etc. This exhibits how variety of topics have been discussed in the book. The book provides open forum for the scholars and even graduate students to discuss further so that they can think about strategic planning to use emerging strategies in sciences.

Renowned researchers, scientists, educators, and business professionals have contributed pieces to the book. We would especially want to express our gratitude to the researchers and specialists whose contributions have made this book better.

Date: *25 February 2024*

Editors

Emerging Trend in Sciences and Allied Sciences

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Facts And Perception About Snakes, Snake Bite and Its Management: A Review

Ajaz A. Wani
Associate Professor and Head,
Dept. of Zoology Govt.PG college Bhaderwah, J&K
Younis Rashid
Assistant professor
Department of Botany Govt.PG college Bhaderwah, J& K
Email: aahilajaz@gmail.com

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Abstract:

Snakebites are a serious public health problem in many regions of the world, particularly in rural areas lacking medical facilities. The World Health Organization (WHO) estimates that 81,000–138,000 people die each year from snakebites worldwide. Venomous snakebite and its effects are a source of fear for people living in southern Nepal. As a result, people have developed a negative attitude towards snakes, which can lead to human-snake conflicts that result in killing of snakes. About 48 People from different walks of life which includes farmers, teachers, businessmen, students and others were interviewed regarding their perception about snakes. The study reveals that 46/ respondents feared from snakes,33/ respondents dislike snakes and 25/ like to kill all the snakes particularly venomous snakes.

Key Words: Snakes, Perception, Snake bite, Management, Venomous.

Introduction:

Due to a long co-evolutionary history with snakes, both humans and non-human primates evolved specific neural mechanisms for rapid snake recognition. [1-3] Snakes are thought to have evolved from either burrowing or aquatic lizards, perhaps during the Jurassic period, with the earliest known fossils dating to between 143 and 167 Ma ago. However diversity of modern snakes appeared during Paleocene. Among evolutionarily irrelevant (neutral) stimuli, snake pictures act as strong distractors. [4] and are detected faster than, for example, flowers and mushrooms, but not faster than stimuli of modern threats such as guns.[5]

Snakes belongs to class reptiles and is probably the most misunderstood and universally disliked animals in the world since times immorial. These are elongated, limbless, carnivorous reptiles of the suborder Serpentes. Like all other squamates, snakes are ectothermic, amniote vertebrates covered in overlapping scales. Many species of snakes have skulls with several more joints than their lizard ancestors, enabling them to swallow prey much larger than their heads (cranial kinesis). In order to accommodate their narrow bodies, their paired internal organs (such as kidneys) appear one in front of the other instead of side by side, and most have only one functional lung. Whereas on

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the other hand Lizards have evolved independently have elongate bodies without limbs or with greatly reduced limbs at least twenty-five times via convergent evolution as a result leading to many legless lizards.[6] These limbs less lizards resemble to snakes, but several legless lizards have eyelids and external ears, which snakes lack, although this rule of differentiation is not universal.

Snakes are found on every continent except Antarctica and on most smaller land masses; exceptions include some large islands, such as Ireland, Iceland, Greenland, the Hawaiian archipelago, and the islands of New Zealand, as well as many small islands of the Atlantic and central Pacific oceans.[7] Moreover Sea snakes are widespread throughout the Indian and Pacific oceans. There are thirty families of snakes currently recognized, comprising about 520 genera and about 3,900 species.[8] The size of snakes ranges from 10.4 cm-long i.e Barbados thread snake to the reticulated python of 7.5 meters (22.8 ft. approximately) in length.[9] Whereas fossil species *Titanoboa cerrejonensis* was 12.8 meters (42 ft) long. [10]

The snakes have been generally categorized as poisonous and non-poisonous. Venomous and poisonous animals are a considerable origin of global morbidity and mortality. There are about 216 species of snakes identifiable in India, of which 52 are known poisonous. The major families of snakes in India are Elapidae which includes common cobra (*Naja naja*), king cobra and common krait (*Bungarus caerulus*), viperidae includes Russell's viper, saw scaled viper (*Echis carinatus*) and pit viper and hydrophidae (the sea snakes). [11]

General features of poisonous Snakes:

Poisonous snakes generally possess the following character

1. Vertically elliptical shaped cat like pupil.
2. A small depression (termed pit) between the eyes and nostrils.
3. Triangle shaped head e.g. Copperheads and rattle snakes, exception- Elapids.
4. Underside scales of tail go completely all the way across in a single row from the anal plate; the very tip of the tail may possess two scale rows.
5. Head and body both are seen during swimming time.
6. Generally of multiple colors.
7. Emitting a warning rattle (a dry, whirring sound)

Classification of Snake Venom:

Snake venom can be classified into four categories based on their clinical effect.

Neurotoxins: Elapid and sea snake venoms have significant neurotoxicity. The toxins that alter the structure and function of nervous system. Following an elapid bite, paralysis is first detectable as ptosis and external ophthalmoplegia appearing as early as 15 minutes after the bite. This effect is caused by neurotoxins. These toxins can act either pre-synaptically or post-synaptically resulting in blocking transmission at neuromuscular junctions leading to paralysis of skeletal muscle. It is important to note that these neurotoxins do not cross blood brain barrier and do not alter consciousness [12]

Hemotoxicity: The toxins that effects the blood. Hemotoxicity is chiefly caused by anticoagulants, procoagulants, fibrinolysins, haemorrhagins and haemolysins. These

hemotoxins produce clinical symptoms such as haemorrhage and anemia [13].

Cytotoxicity: Edema, blisters and necrosis are frequently seen at the site of bites caused by Viperidae or Elapidae. These are due to local effects of cytotoxic components [14].

Myotoxicity: Skeletal muscle damage caused by snake venom myotoxins can be local or systemic leading to skeletal muscle breakdown, muscle weakness, pain, tenderness, and myoglobinuria. Sea snake venom contains myotoxins that cause myalgias, myopathy and rhabdomyolysis [15].

Cardiotoxicity: Viper and elapid venom can cause direct myocardial damage manifesting as arrhythmias, bradycardia, tachycardia or hypotension.

Shock: A variety of factors contribute to shock. They include fright, hypovolemia (due to extravasation of fluids and blood loss), myocardial depression, haemorrhage into the adrenals and pituitary and increased kinin production (as in Viper bite).

Symptoms: Signs or symptoms of a snake bite may vary depending on the type of snake, but may include:

Puncture marks at the wound.

Redness, swelling, bruising, bleeding, or blistering around the bite.

Severe pain and tenderness at the site of the bite.

Nausea, vomiting, or diarrhea.

Labored breathing (in extreme cases, breathing may stop altogether).

Rapid heart rate, weak pulse, low blood pressure.

Disturbed vision or blurred vision.

Metallic, mint, or rubber taste in the mouth.

Increased salivation and sweating.

Numbness or tingling around face and/or limbs.

Abnormal blood clotting and bleeding. Severe bleeding can lead to a hemorrhage or kidney failure.

Low blood pressure, a faster heart rate and a weaker pulse.

Difficulty breathing, or in serious cases, complete loss of breath.

Weakness in your muscles and numbness in the face or limbs.

Perception about Snakes:

A total of 48 interviews were carried out from September 2023 to Nov.2023.Out of 48 respondents 38 were male and 10 were female, and both the sexes were in the age group of 18 to 50 years. The respondents include 22 agriculturists (farmers),8 belong to business class,9 were teachers 6 were students and 3 belongs to other professions. The result indicated that 16(33/) respondents dislike snakes,12(25/) would like to exterminate all the snakes particularly venomous and 20 (46) feared from snakes.

It was further observed that farmers were most negative towards snakes and teachers were most ambivalent towards them, whereas other shows mixed reactions.

Management of Snake Bite:

First Aid:

Person should take these steps if a snake bites them: Seek medical attention as soon as possible (call local Emergency Medical Services).

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Antivenom is the treatment for serious snake envenomation. The sooner antivenom can be started, the sooner irreversible damage from venom can be stopped.
Driving oneself to the hospital is not advised because people with snakebites can become dizzy or pass out.
Take a photograph of the snake from a safe distance if possible. Identifying the snake can help with treatment of the snakebite.
Keep calm.
Apply first aid while waiting for EMS staff to get you to the hospital.
Lay or sit down with the bite in a neutral position of comfort.
Remove rings and watches before swelling starts.
Wash the bite with soap and water.
Cover the bite with a clean, dry dressing.
Mark the leading edge of tenderness/swelling on the skin and write the time alongside it.
Do not do any of the following:
Do not pick up the snake or try to trap it. NEVER handle a venomous snake, not even a dead one or its decapitated head.
Do not wait for symptoms to appear if bitten, get medical help right away.
Do not apply a tourniquet.
Do not slash the wound with a knife or cut it in any way.
Do not try to suck out the venom.
Do not apply ice or immerse the wound in water.
Do not drink alcohol as a painkiller.
Do not take pain relievers (such as aspirin, ibuprofen, naproxen).
Do not apply electric shock or folk therapies.
Management of snake bite
The patient should be reassured and moved to the nearest hospital as quickly as possible. Active movements should be as minimal as possible. The bitten part should be immobilized with a splint or sling. Tourniquets and compression bandages are potentially dangerous as they can cause gangrene, increased fibrinolysis and bleeding in the occluded limb, peripheral nerve palsies and intensification of local envenomation. The only indication for their use is in case of severe elapid or sea snake bites where the delay in reaching a medical centre is likely to be more than 0.5 hours but less than 2-3 hours. Here compression / tourniquet delay absorption of the venom and so help retard onset of respiratory muscle paralysis. Tourniquet should be tight enough to occlude the lymphatic and venous flow but not the arterial flow. A useful guide is that it should be loose enough to permit a finger to slip under it. The tourniquet should be released for 30 seconds every 15 minutes to allow slow release of venom into circulation, thereby enabling its neutralization. The tourniquet should only be released after the first dose of antivenom is given. [16] The bite wound should be gently wiped with sterile cotton gauze. In case of incoagulable blood or oozing from puncture wounds only use the intravenous route for medication.

Treatment/ Evaluation in Hospitals:

A bite is considered to have been poisonous in case any of the following features are present:

Swelling, blistering or necrosis at the site of the bite and its extension.
Hypotension / shock
Haemorrhage
Laboratory evidence of coagulation defect.
Neuroparalytic manifestations.
Arrhythmias / bradycardia / tachycardia.
Myoglobinuria.

Monitor pulse, blood pressure, respiratory rate, and muscle weakness hourly. Local swelling and necrosis should also be charted hourly. Examine gingival sulci carefully for bleeding. Monitor ECG and CPK, serum transaminases, blood urea and serum creatinine daily. Serum electrolytes, especially potassium, should be estimated 6 hourly in case of sea snakebite.

Coagulation profile should be tested 6 hourly (especially for viper bites). A useful test for venom-induced defibrinogenation is the 20-minute whole blood clotting time. A few milliliters of venous blood is put in a clean test tube and kept aside for 20 minutes. It is then tipped to see if it has clotted or not. Incoagulability indicates systemic envenomation by Vipera or Echis species. Other sensitive tests are plasma prothrombin time and fibrinogen degradation product estimation. Platelet count should be estimated twice daily.

Urine should be examined for microscopic haematuria and active sediments. Output should be monitored in case of renal failure.

The most important decision in managing a case of snakebite is to decide whether to administer antivenom or not. There is evidence that in patients with severe envenomation, the benefits of this therapy far outweigh the risk of reactions. [17] Haemostatic abnormalities such as spontaneous systemic bleeding, incoagulable blood, or thrombo-cytopaenia. It is almost never too late to give anti-venom as long as systemic signs of envenoming persist. Antivenom has been shown to be effective up to 2 days after sea snake bite and in patients still defibrinated weeks after viper bite. anti-venom available in the Armed Forces is a polyvalent equine antiserum. This is effective against the 4 most important venomous snakes in India, namely, Cobra, Common Krait, Russell's viper and saw-scaled viper. The antiserum is available in a lyophilized form and has to be reconstituted with 10 ml sterile water for injection. The dose required depends on the clinical state of victim.

The antivenom is diluted in approximately 5ml / Kg body weight of isotonic saline or 5% Dextrose and is administered as a slow intravenous infusion over 1-2 hours. This method is preferred over the ‘push’ technique where the undiluted serum is pushed intravenously at a rate of 4 ml/minute. Response to antivenom is dramatic and rapid. Neurotoxic signs may improve within 30 minutes but usually take several hours. Spontaneous systemic bleeding usually stops within 15 - 30 minutes and blood

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coagulability is restored within 6 hours of antivenom provided a neutralizing dose has been given. Antivenom therapy should be repeated if severe signs persist after 1 - 2 hours or if blood coagulability is not restored within 6 hours. In case of severe neurotoxicity, the dose may have to be repeated half hourly till progression of weakness stops. In viper bites the antivenom should be repeated every 6 hours till clotting profile returns to normal and progression of local swelling ceases.

Supportive treatment/ Therapy:

1 Tetanus prophylaxis

2. Antibiotics are indicated only in cases of severe envenomation with significant local reaction

3. Surgical debridement of dead tissue

4. Fasciotomy for compartment syndromes

5. Management of respiratory paralysis: Airway patency and toilet should be ensured. Ventilatory support must be considered and instituted early. The "Tensilon test" should be done as follows: Atropine sulphate (0.6 mg for adults and 0.02-0.05 mg/Kg for children) should be given I/V followed by Edrophonium chloride (10mg for adults and 0.25 mg for children) I/V. Patients who respond convincingly can be maintained on neostigmine methyl sulphate (50 - 100 µg/Kg body weight) and atropine four hourly or by continuous infusion.

6. Hemostatic disturbances usually respond well to antivenom treatment. In case of severe bleeding fresh frozen plasma, cryoprecipitates, & platelet concentrates may be required. There is no role for heparin.

Conclusion:

People with predisposed negativity towards snakes were not proponents of snake conservation. Fear, negativity, ambivalence towards, and ignorance about, snakes and the need for snake conservation were strong indicators of the propensity to harm or kill snakes. It seems that if wanton killing of snakes continues, local snake populations will decline, and rare and endangered snake species may even become locally extirpated. Moreover, inappropriate perception and knowledge about snakes and snakebites may put BZ people at increased risk of venomous snakebite. Therefore, intensive, pragmatic educational efforts focused on natural history and ecology of snakes and prevention of snakebite should be undertaken in communities and at schools and universities.

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Sickle Cell Disease: Causes, Pathophysiology, Diagnosis and Therapy

Nand Lal
Priya Prajapati
Department of Life Sciences and Biotechnology
Chhatrapati Shahu Ji Maharaj University
Kanpur – 208 024, U.P., India
Email: nl_pr@yahoo.co.in

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Abstract:

Sickle cell disease is the monogenic blood disorder and caused by a single nucleotide mutation in the β-globin gene that swaps the hydrophilic glutamic acid at position six with the hydrophobic valine. Damaged red blood cells cause chronic haemolysis and haemolytic anaemia, resulting in extreme pain, organ damage, and early death. Although environmental factors like cold temperature and air quality, infections, fetal haemoglobin level, and genetic subtypes play a role in the disease's symptoms, knowledge of the disease's phenotypic expression is still restricted. To decrease acute problems, only four FDA-approved medications are available. Haematopoietic stem cell transplantation is the only curative treatment for Sickle cell disease, but has major risks and problems. In addition to emphasizing the crucial role of a multidisciplinary approach in providing medical treatment of patients with sickle cell disease, this chapter discusses the evaluation and treatment of the sickle cell disease.

Keywords: β-globin gene, diagnosis, sickle cell disease, Symptoms, Therapy

Introduction:

Sickle cell disease (SCD) refers to a group of monogenic blood diseases that include mutations in the gene encoding the beta subunit of haemoglobin, and affects around 8 million people globally (SCD Collaborators, 2023). The disease is highly prevalent in the populations of India, South Asia, the Middle East, the Mediterranean, and Sub-Saharan Africa. SCD is caused by a single nucleotide mutation in the β-globin gene that swaps the hydrophilic glutamic acid at position six on chromosome 11 with the hydrophobic valine (Adebiyi *et al*., 2019; Hoppe and Neumayr, 2019). Under hypoxic or acidic conditions, the resultant haemoglobin S (HbS) polymerizes, causing erythrocytes (Red Blood Cells, RBCs) to become hard sickles with reduced deformability and shortened lifespan. Damaged RBCs cause chronic haemolysis and haemolytic anaemia, resulting in extreme pain, organ damage and early death in SCD patients. Despite being the first molecular illness with a genetic foundation discovered more than 60 years ago, therapeutic options for SCD are still quite limited and the average life expectancy of patients is very low (Galadanci *et al*., 2019).

2. Sickle Cell Disease:

2.1. What exactly Sickle Cell is?

Normal haemoglobin RBCs are disc-shaped, flexible, and can readily pass

through both big and small blood vessels in order to transport oxygen throughout the body. RBCs of the sickle shape are rigid and can adhere to blood channel walls; causing blockages that delay or stop blood flow (Fig. 1). Stiff strands of abnormal haemoglobin can also grow inside RBCs. The condition gets its name from the sickle-shaped RBCs that are caused by these stiff strands, which can alter the shape of the cell. Remaining parts of the body cannot get oxygen from sickle cells. This may cause a pain crisis, which is the abrupt onset of extremely painful symptoms. These situations of pain can happen suddenly and frequently necessitate a trip to the hospital for proper treatment. Sickle cells are also more likely to rupture because they cannot easily shift shape.

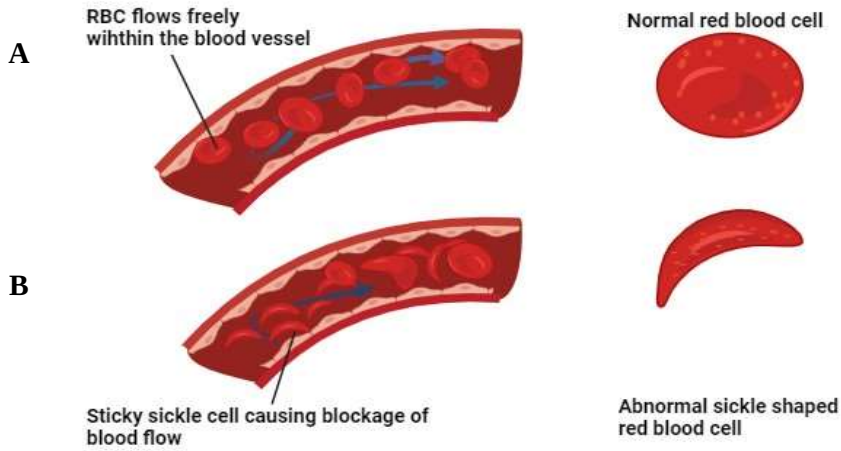

FIG 1. RBCs with crescent shapes and typical RBCs. A. RBCs are seen naturally flowing in a blood vessel in the first photograph. A cross-section of a healthy RBC with healthy haemoglobin. B. RBCs with an irregular crescent form are seen obstructing blood flow in blood arteries. The haemoglobin insert, making an unusually stiff rod.

Sickle cells have a lifespan of just 10 to 20 days, compared to the 90 to 120 days of normal RBCs. To replace sickle shaped cells, the body continuously produces new RBCs. In contrast, the body may struggle to keep up with the pace of cell death in SCD. RBC numbers as a result are often lower than in those who do not have SCD. This situation, called anaemia, can make someone less energetic. A series of blood abnormalities known as SCD are typically inherited. In other situations, this takes on a stiff sickle-like shape. Sickle cell anaemia issues typically manifest between the ages of 5 and 6 months. Seizures (also known as sickle cell crisis), anaemia, swollen hands and feet, bacterial infections, and stroke are just a few of the health issues that might develop. With ageing, chronic discomfort might occur. In wealthy nations, people typically live between 40 and 60 years. When a person inherits two defective copies of the β-globin gene (HBB), which makes haemoglobin, one from each parent, the result will be sickle cell anaemia. The location of this gene is on chromosome 11. Depending on the precise mutation in each haemoglobin gene, there are various subtypes. Temperature fluctuations, stress, dehydration, and high altitude can cause attacks. A person with sickle

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cell trait is stated to have one defective copy, but often exhibits no symptoms. These folks are also referred to as carriers. Blood tests are used to diagnose the condition, and in certain nations all newborns are screened. Pregnancy can also provide for a diagnosis.

The two approaches to managing sickle cell anaemia are maintenance of health and management of complications. While managing sickle cell complications is based on the specific type of problem, the aim of health maintenance is to screen for and identify risk factors as well as early indicators of complications (Lanzkron *et al.*, 2018). Vaccinations, antibiotics, plenty of water, folic acid supplementation, and painkillers are among possible treatments for SCD patients. Blood transfusions and the medication with hydroxyurea may also be used in other surgeries. A transplant of bone marrow cells can cure a tiny percentage of patients. African, Americans, including those of African origin (12 of whom carry the sickle cell gene), South and Central American Hispanics in the United States, Middle Easterners, Asians, Indians, and Mediterranean are suffering from sickle cell anaemia. Because sickle cell anaemia symptoms can appear as early as 4 months of age, early diagnosis is crucial. In the US, the disease is routinely checked for in all infants. Before a baby is born, sickle cell anaemia can be identified by testing amniotic fluid or placental tissue samples. Before getting pregnant, individuals with the sickle cell gene can talk about their options with a genetic counsellor.

2.2. Types of SCDs:

There are various forms of SCD and a specific form of SCD a person has, is determined by the genes they receive from parents. The most typical SCD forms/kinds are:

HbSS People receive one gene for haemoglobin 'S' from each parent. A defective form of haemoglobin called haemoglobin S makes RBCs sickle and stiffen. This is typically the most severe type of the illness, also known as sickle cell anaemia.

HbSC People get the ‘S’ gene for haemoglobin from one parent and the ‘C’ gene for another type of defective haemoglobin. This is, typically mild SCD.

Beta-thalassemia in HbS People inherit the beta-thalassemia gene from one parent and the haemoglobin ‘S’ gene from the other parent. 'Zero' (HbS beta0) and 'Plus' (HbS beta) beta thalassemia are the two subtypes. SCD is typically severe in HbS beta thalassemia patients. A HbS beta thalassemia patient is susceptible to mild SCD.

Rare SCD subtypes include **HbSD**, **HbSE**, and **HbSO** Both the gene encoding for an aberrant kind of haemoglobin ('D', 'E' or 'O') and the gene encoding for the haemoglobin 'S' gene are inherited by people with these variants of SCD. The severity of these uncommon SCD subtypes varies.

2.3. Pathophysiology:

Haemoglobin S produces polymers with significantly lower solubility and molecular stability under anoxic conditions. Haemoglobin S transforms into a ‘tactoid,’ gel-like substance containing haemoglobin crystals, when it is deoxygenated (Fig. 2). The concentration of HbS and the presence of other haemoglobins are two additional elements that may affect this phenomenon. Polymer production, a result of the sickling process, is the progressive development of parallel arrays of filaments. Erythrocytes can

take on a distinctive biconcave sickle shape with a hard membrane as a result of changes in haemoglobin structure, which eventually cause repetitive sickle-membrane destruction. Sickle cells alter the structure and cause a loss of potassium while increasing intracellular sodium and calcium. The latter is caused, at least in part, by defective adenosine triphosphatase (ATPase)-dependent Ca^{++} pumps and, at least in part, by membrane calcium permeability. Haemoglobin S has a significantly reduced affinity for oxygen compared to haemoglobin A. High 2, 3-diphosphoglycerate (2, 3-DPG) concentrations further diminish this affinity. It is a glycolytic intermediate that is known to interact with deoxygenated β-globin subunits in sickle erythrocytes to decrease haemoglobin's affinity for oxygen. Reduced oxygen affinity and lower haemoglobin levels further boost haemoglobin S-polymerization and sickling, which ultimately result in excruciating crises. There are numerous and intricate systems that cause the sickling process. Dehydration of erythrocytes, which raises haemoglobin concentration in erythrocytes, is a prerequisite for polymerization's kinetics. As a result, ion transport systems including K^+ and Cl^- co-transport, and Ca^{++}activated K^+ channels are essential for the dehydration of sickle cells. Erythrocyte dehydration may typically be stopped via the Gardo's channel. The Gardo's channel, either by itself or in concert with K-Cl co-transport, is crucial for cell dehydration in SCD. The potassium-chloride co-transporter (KCC), a transport system that controls volume in reticulocytes, malfunctions routinely in SCD, causing haemoglobin concentration and reticulocyte sickling. A non-selective cation leak route is activated in a portion of sickle erythrocytes by polymerization brought on by the deoxygenation of HbS. This sickling-induced route activates the Gardo's channel upon calcium entrance. Rapid KCl and water loss are mediated by this. Unusual KCC activity in sickle reticulocytes can promote a series of events where sickle and Gardo's channel activation reinforce one another to dehydrate the erythrocytes. SCD has a complicated and multisystemic pathogenesis. The first step in this process is the polymerization of the HbS under hypoxic pressure, which shortens the lifespan and changes the form, structure, and function of RBCs. The disease's hallmark is chronic haemolytic anaemia, which is caused by the highly sticky crescent-shaped RBCs, along with other SCD-related events, in practically every organ. These set off a number of pathophysiological factors that influence neutrophils, platelets, and vascular endothelium, among other things, along with a series of other pro-inflammatory processes. Neutrophils, monocytes and platelets are activated as a result of interactions between erythrocytes with a crescent shape and the vascular endothelium. Cell adhesion molecules including P- and E-selectins are upregulated by neutrophil interactions with erythrocytes and endothelium. RBCs, neutrophils, and monocytes combine to create the aggregate of activated platelets. Continuous haemolysis and the release of cell-free haemoglobin also result in the destruction of haemopexin and haemoglobin, a reduction in Nitrous Oxide (NO) bioavailability and malfunction of the vascular endothelium. Chronic organ damage is the result of these and other occurrences. Based on oxygen response flow changes through the Emden-Meyerhof (EMP) or hexose monophosphate (HMP) pathways, erythrocyte energy metabolism is regulated. The amount of oxygen in

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RBCs affects how much ATP, NADH, 2, 3-diphosphoglycerate (EMP), and NADPH (HMP) are formed. This is a result of ongoing competition for binding to the cytoplasmic domain of band 3 membrane protein (cdB3) between deoxyhaemoglobin and important Emden-Meyerhof Pathway enzymes (Rogers *et al.,* 2013). The crucial elements of the ankyrin complex are band 3 and protein 4. They use ankyrins to link the spectrin cytoskeleton to related protein and lipid bilayer membranes. It is well known that cdB3 sequestration in oxygenated erythrocytes favours NADPH production and HMP flow due to enzymatic inactivation. It has been hypothesized that sickle haemoglobin interferes with the formation of cdB3-based regulatory protein complexes, increasing the susceptibility of erythrocytes from sickle cell anaemia patients to oxidative stress. The inflammatory event typical of SCD sets off a chain of events involving neutrophils, platelets and vascular endothelium. This disorder has been shown to restrict HMP flux, NADPH and glutathione recycling, and reduce resistance to oxidative stress. Haemolysis and haemoglobin release deplete haemopexin and haptoglobin, which in turn causes endothelial dysfunction (Fig. 2) and decreased nitric oxide bioavailability with underlying consequences of chronic organ injury. Multiple organs and systems are impacted by the complicated genetic blood illness known as SCD. The main contributing factors are endothelial dysfunction brought on by haemolysis, upregulation of the inflammasome signalling pathway gene expression, changes in blood flow brought on by greater capacity for erythrocyte adhesion leading to vascular occlusion, and iron-regulated gene expression associated with alterations caused by haemoglobin S polymerization. Toll-like receptor 4 (TLR4) expressions in peripheral blood mononuclear cells is increased 200-fold as a result of the latter. Its ligand, lipopolysaccharide (LPS), stimulates the expression of the pro-inflammatory cytokine Interleukin-6 (IL-6), which is produced by monocytes and macrophages. This process is thought to involve intracellular iron (Domingos *et al.,* 2020).

These things happen in concert with others to encourage vascular occlusion, which causes discomfort, end-organ damage, and sickle cell anaemia disorders. Poor clinical outcomes in SCD have been demonstrated to be associated with high levels of the pro-inflammatory cytokines IL-6 and interleukin 8 (IL-8) (Sundd *et al.,* 2019). Haemoglobin S tetramers become deoxygenated and bind, which induces polymerization as erythrocytes travel through tissues with a high oxygen demand. An important early event in the pathophysiology of SCD is this one. Sickle cell illness is brought on by the deoxygenation of haemoglobin S and the production of lengthy polymeric filaments, which distort RBC's. shape and an early haemolysis and stiffness is caused. Cellular dehydration also plays a role in this phenomenon. The amount of polymerization is inversely associated with haemoglobin F content and erythrocyte haemoglobin S concentration. These events are controlled by the co-inheritance of HbF, β-thalassemia, or the genetic persistence of the S and C alleles. Children with SCD have higher plasma levels of Asymmetric Dimethylarginine (ADMA), which have been linked to tricuspid regurgitation, pulmonary hypertension and sickle cell retinopathy. Blood's biorheology or flow characteristics are influenced by factors like haematocrit level, plasma viscosity

and RBC deformability. Typically, sickle cell anaemia causes a low haemoglobin concentration. RBC passage through capillaries and post-capillary arteries can be hampered in SCD by persistent haemolysis, increased plasma viscosity from sickle cells, and decreased blood flow in the microcirculation of regions with high oxygen demand. Furthermore, inflexible and non-deformable sickle erythrocytes might result in the development of damaged erythrocyte membranes, making adhesion molecules and abnormal binding processes more accessible. Pro-inflammatory interactions with cells involve adhesion molecules such phosphatidyl serine (PS), basal cell adhesion molecule-1/lutheran (B-CAM-1cff/Lu), integrin-associated protein (IAP), and intercellular adhesion molecule-4 (ICAM-4). Additionally, endothelial cells may contribute to vascular occlusion (Fig. 2) by promoting it (Kato *et al.*, 2017).

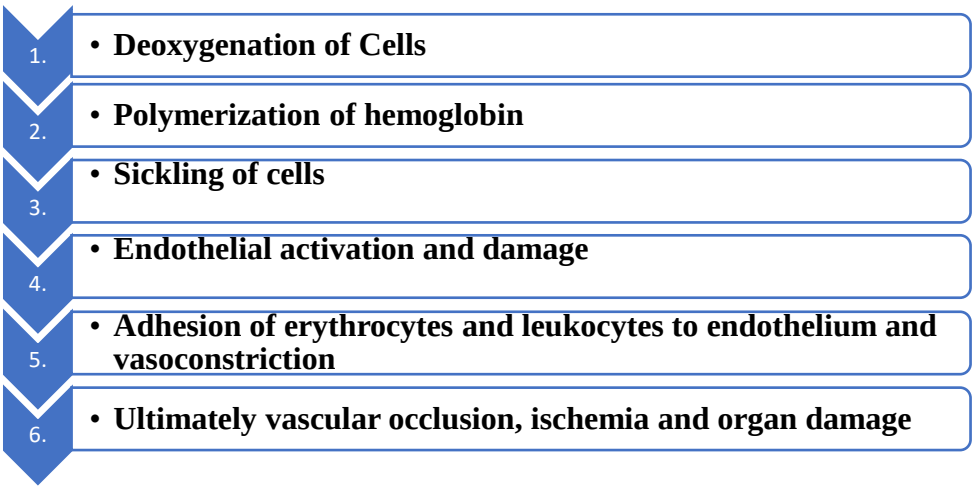

FIG 2. Sequence of events during development of Sickle cell disease.

2.3. Symptoms:

Babies are born with SCD because it is a genetic condition, however, the majority do not experience symptoms of the illness until they are 5 to 6 months old. Fetal hemoglobin is present for the first six months of life, but it gradually diminishes and HbS starts to predominate, leaving patients fully asymptomatic. Sickle cell anaemia symptoms might differ from person to person and grow rapidly as the time passes. Depending on the kind of problem and the body system impacted, the clinical appearance of sickle cell disease might vary. Below is a description of a handful of the typical presentations.

Vaso-Occlusive Crisis (VOC) :

This is how SCD is most frequently presented. The primary pathophysiologic cause of acute pain, microvascular occlusion, results in ischemia and hypoxia, tissue and vascular damage, inflammation, and the release of inflammatory mediators, all of which cause nociceptors to fire. Pain and inflammation are exacerbated after reperfusion. Patients might have acute, incapacitating pain anywhere in the body, although the back,

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pelvis, chest, abdomen, and long bones are the most common places for complaints. Dactylitis symptoms, which include discomfort and swelling in the hands and feet, can appear as early as six months of age. Most of the time, there are no trustworthy indicators or tests to determine whether or not VOC-related pain is present.

Acute Chest Syndrome (ACS):

The emergence of a new pulmonary infiltrate on chest radiography along with fever and respiratory symptoms such as tachypnea, coughing, and chest pain is known as acute comparative lung disease, or ACS. It is hypothesized that ACS results from increased pulmonary microvasculature adhesion to sickled erythrocytes caused by hypoxia and an inflammatory mediator. The process is accompanied by a decrease in nitric oxide (NO), an antioxidant that would typically offset it. Fever, cough, dyspnea, chest discomfort, and decreased air entry are the most prevalent symptoms in individuals with ACS. A lung exam may also reveal rales and occasionally wheezing. If ACS is not treated right away, it can quickly worsen into hypoxemia and respiratory failure. Mycoplasma, Streptococcus pneumonia, and chlamydia are the most common infectious organisms when identified.

Infections:

Due to their functional asplenia and weakened immune systems (higher bone marrow turnover and decreased complement activation), patients with sickle cell disease (SCD) are particularly vulnerable to infections with encapsulated pathogens. Significant progress has been made in lowering the prevalence of bacterial infections and sepsis thanks to the widespread use of the pneumococcal vaccine and penicillin prophylaxis in children.

Pulmonary Hypertension (PHTN) :

PHTN has a 2%–5% death rate and an incidence of 6%–10%. It is thought that modifications to endothelial cells and medial smooth muscle are a major contributing factor to PHTN. Reduced exercise capacity is the main clinical finding (45% of patients fall into class III or IV of the NYHA). Enhanced tricuspid valve regurgitated jet velocity on echocardiography, elevated NT-proBNP (N-terminal pro-brain natriuretic peptide), and elevated pulmonary pressures on right cardiac catheterization are among the diagnostic findings.

Cerebrovascular Accidents (CVA)/Stroke:

Children as young as two years old may experience a CVA, and 11% of SCD patients may experience a stroke by the time they are 20 years old. Nonetheless, silent cerebral infarcts (SCI) linked to small-vessel disease are more frequent than overt strokes; by the age of 14, 34% of SCD patients had SCI. When transcranial Doppler is introduced to patients with sickle cell disease (SCD) at the age of two years old, it is an effective screening tool for CVA risk.

Pulmonary Embolism (PE) :

Patients with SCD have a greater incidence of PE. Compared to individuals without SCD, the yearly incidence of SCD in patients is 50–100 times higher.

Renal Complications:

With sickle cell disease (SCD), renal problems are exceedingly prevalent; in adults, 30% experience chronic renal failure. This is because the renal medulla's low pH, high osmolality, and low partial pressure of oxygen, all lead to erythrocyte dehydration and vaso-occlusion. Common diagnostic findings include proteinuria and microalbuminuria.

Eye Complications:

Occlusion of the peripheral retinal vasculature causes proliferative retinopathy, the most prevalent ophthalmologic consequence of sickle cell disease (SCD) and up to 70% more common in hemoglobin-stimulating cells (HbSC).

Splenic Sequestration:

Splenic sequestration, a potentially fatal SCD consequence, is defined by an abrupt drop in hemoglobin levels. This condition is more common in children and can cause severe abdominal discomfort and circulatory collapse, particularly in cases of HbSS anemia. This is because of a splenic auto-infarction that happens at the age of six. Adults with HbSC and other hemoglobinopathies, however, can exhibit this. The low-flow kind of **priapism** linked to stasis, hypoxia, and ischemia is typified by SCD. Chronic hemolysis and elevated bilirubin turnover lead to the development of **cholelithiasis** and biliary sludge.

Osteonecrosis:

Osteonecrosis, which is caused by increased pressure from increasing erythrocyte marrow or vascular blockage, commonly affects the femoral and humeral heads. There are situations when surgery is necessary.

Aplastic Crisis:

The erythropoiesis-inhibited aplastic crisis caused by parvovirus B19 can lead to cardiovascular decompensation and severe anemia. Usually lasting seven to ten days, this self-limiting infection has the potential to be lethal.

2.3.1. Issues That Affect the Entire Body:

Acute Pain Emergency: It happens suddenly when SCD limits blood flow and is also known as SCD or vaso-occlusive crisis. This pain is acute burning, or throbbing. Nearly any part of the body can experience pain, and it can happen in several places at once. The abdomen, chest, lower back, arms and legs are typical pain-affected locations. The crisis/pain can be caused by moving to high altitude, dehydration, illness, biological stress and change in temperature. Often people do not know what is causing the crisis.

Chronic pain: Chronic pain is a common yet challenging condition to understand. Usually, it differs from severe pain or pain brought on by organ injury.

Delay in puberty and growth: Children with SCD may develop more slowly than typical children due to anaemia, and take a longer time for achieving sexual maturity.

Infections: The spleen plays a critical role in preventing several types of infections. A compromised spleen raises the risk of developing certain infections such *Chlamydia*, *Haemophilus influenza type B*, *Salmonella*, and *Staphylococcus* if one has sickle cell anaemia.

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Joint Issues: Sickling of the hip bone, as well as less frequently sickling of the shoulder, knee, and ankle, limits oxygen supply and results in avascular or aseptic necrosis, which severely affects joints. Pain and issues with walking or joint movement are some of the symptoms. Painkillers, surgery, or joint replacement may eventually be needed.

Issues with Pregnancy: Pregnancy can raise a person with SCD's risk of high blood pressure and blood clots. Premature birth, low birth weight, and miscarriage are among risks that are increased by this syndrome.

2.3.2. Issues That Only Impact Specific Body Parts:

Rapid Heart Failure: The lungs may run out of oxygen as a result of sclerosis forming in the pulmonary blood vessels. In addition to causing chest pain, fever, and breathing difficulties, it can harm lung tissue. One such instance of a medical emergency is acute chest syndrome.

Spleen Enlargement: The spleen is an organ that aids in the body's ability to fight infections and eliminate harmful materials. Old blood cells are removed from the blood, and destroyed RBCs that have SCD may get stuck in the spleen. As a result, the spleen grows faster than usual. There are fewer RBCs available for blood circulation when RBCs get lodged in the spleen, which can cause severe anaemia. The left side of the abdomen may also hurt as a result of an enlarged spleen.

Eye Issues: Blood vessels in the eye, most frequently the retina, might be harmed from sickle cell anaemia. The retina's blood vessels may enlarge uncontrollably, obstruct flow, or haemorrhage. Retinal detachment may occur, which cause the loss of eyesight.

Gallstones: The gallbladder is a digestive assist that is a little sac-like structure underneath the liver. The next step is the breakdown of haemoglobin into bilirubin. Gallstones, which develop in the gallbladder, are stones that can arise from bilirubin. During the process of haemolysis, which is the breakdown of RBCs, haemoglobin is released.

Heart Issues: Coronary artery disease and pulmonary hypertension are two examples of heart issues. Due to iron overload, frequent blood transfusions might harm the heart.

Kidney Issues: Sickle cell anaemia can make it difficult for the kidneys to concentrate urine to the proper level. These issues frequently start in early childhood.

Leg Ulcers: Sickle cell illness can cause leg ulcers, which typically start out small before spreading. While some ulcers resolve rapidly, others linger for a long time. After they have recovered, certain ulcers come again, which may typically appear in sickle cell anaemia patients after the age of 10.

Liver issues: a rare, but deadly type of liver damage called intra-hepatic SCD is brought on by sickle cells obstructing blood arteries in the liver. The liver tissue cannot receive extra oxygen because of this obstruction. Iron overload brought on by frequent blood transfusions can cause liver damage. These episodes can happen repeatedly and are sudden. Children frequently make a full recovery, but some adults can experience chronic issues that may result in liver failure.

Priapism: Priapism is an unwelcome, occasionally protracted, and uncomfortable erection. This occurs when sickle cells obstruct the blood flow from an erect penis. If the

problem remains permanently, then this may harm the penis. Priapism that lasts more than four hours requires medical attention.

Silent brain injury: Silent brain injury, also known as silent brain damage, is not present as a stroke-like symptom. Magnetic resonance imaging scans can be used to identify this brain injury, which is quite frequent. Learning challenges, decision-making issues, and trouble keeping a job are possible effects of a silent brain damage.

2.3.3. Severe Effects from Anaemia:

Mild to moderate anaemia is frequently present in people with sickle cell anaemia, however severe anaemia can also happen. It may be fatal to have severe anaemia. A newborn or infant with SCD may experience severe anaemia for one of two reasons:

Aplastic crisis: Typically, parvovirus B19 infection results in aplastic crisis. Slap Syndrome or Fifth Disease are other names for this condition. Even though parvovirus B19 is a reasonably frequent illness, SCD can cause severe anaemia because the bone marrow temporarily stops producing new RBCs.

Spleen Sequestration Crisis: The spleen filters blood and eliminates old blood cells. RBCs may become caught in the spleen and expand more quickly than usual in persons with SCD. There are fewer RBCs available for blood circulation, when RBCs get lodged in the spleen, and it can cause severe anaemia.

2.4. The Causes:

Because SCD is inherited, it may affect entire families. One faulty haemoglobin S gene is inherited from each parent, resulting in SCD. When the haemoglobin S gene is inherited from just one parent and the normal haemoglobin gene, haemoglobin A, is inherited from the other parent, then the individual has sickle cell trait. Sickle cell anaemia patients are often in good health. Flexible RBCs are transformed into stiff sickle-shaped cells by haemoglobin S. These sickle cells obstruct blood flow, which can hurt and harm organs. A person who carries the haemoglobin S gene has sickle cell trait. As a result, if they have children, they can pass it on to them. The likelihood of a child acquiring SCD increases if one of the parents also has sickle cell trait or another deficient haemoglobin gene, such as β-thalassemia, haemoglobin C, haemoglobin D, or haemoglobin E. This is so because either parent may pass a faulty haemoglobin gene to their offspring.

Given that each parent in the aforementioned figure 3 possesses one normal haemoglobin A gene and one haemoglobin S gene, this means that each child possesses:

- There is a 25%, or one-fourth, chance, of inheriting two healthy haemoglobin A gene. There is no sickle cell trait or illness in this youngster.
- One normal haemoglobin A gene and one haemoglobin S gene are equally likely to be inherited, or 50% or 1/2.
- The likelihood of inheriting two haemoglobin S genes is 25%, or one-fourth, in this child. There is sickle cell anaemia in this child.

It is crucial to keep in mind that every time this couple produces a kid, there is a 25% risk that the second child will also have SCD if the first child has the condition. The sickle cell trait, sickle cell illness, and regular haemoglobin levels can all be

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inherited by both males and females.

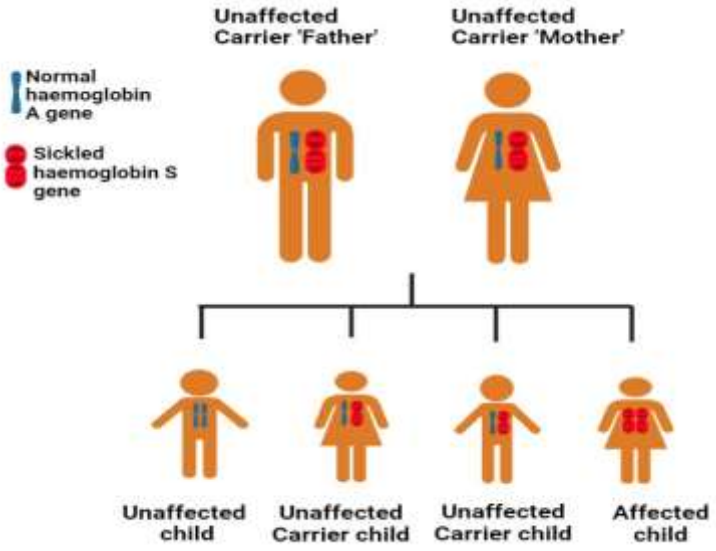

FIG 3. Hereditary Model of SCD.

2.5. Diagnosis:

Often, all doctors need to identify SCD in a straightforward blood test. RBCs having SCD exhibit an aberrant sickle-like shape and die before the actual lifespan. RBCs that contain abnormal haemoglobin molecules are bent, stiff, and sticky. This restricts blood flow and results in blockages since it is challenging to travel through narrow blood vessels. A specific gene is often present in two copies in each person, one from each parent. In most cases, a person with the sickle cell trait-defined as having one mutant copy of the HBB gene-does not experience the symptoms of sickle cell illness. But SCD is a condition that affects persons who have two faulty copies of the gene. A variety of screening procedures can be performed to detect the presence of sickle cell anaemia. A quick blood test that looks for aberrant haemoglobin proteins is used to screen for the SCD.

Genetic Guidance:

SCD patients and parents of newborns with the condition are frequently referred for genetic counselling to understand more about their unique diagnosis. In order to make informed reproductive decisions, such counselling also assists prospective parents in determining the likelihood of having a child who would inherit the disease.

Newborn/Pregnancy Screening:

A little amount of amniotic fluid or placenta from parents having SCD can be tested for the condition prior to delivery. Not the defective haemoglobin protein, but the mutant HBB gene, is the focus of these prenatal tests. Blood testing for aberrant haemoglobin proteins is a common component of newborn screening programmes in several nations, including the US. Patients who test positive for abnormal haemoglobin may only have the symptoms of SCD, rather than the disease itself. Therefore, more

testing is required in order to provide a firm diagnosis. For elimination of false results of SCD, blood test can be done again. Depending on the sort of defective haemoglobin that the patient's body is making, there are various varieties of sickle cell anaemia. The sort of aberrant haemoglobin a person is making can therefore be determined using more precise blood testing. Patients with SCD should routinely submit to blood and urine testing in order to monitor any potential side effects, such infections and renal issues. Because sickle cells build up in the tiny blood arteries of the brain, people with sickle cell anaemia are more likely to get a stroke. By the age of 20, 11% of sickle cell patients are predicted to suffer a stroke, with the risk peaking between their second and fifth years of life. Using sound waves to measure blood flow in the brain, Transcranial Doppler Ultrasonography (TCD) is a painless treatment that can be used to locate locations with restricted blood arteries and estimate the risk of stroke. Patients can start receiving treatment to lower their risk if necessary by assessing their stroke risk.

2.6. Therapy:

For some sickle cell anaemia patients, the only available treatments are bone marrow and blood transplants. A doctor could provide medicine or blood transfusions after an early diagnosis to treat the consequences of chronic discomfort. Sickle cell anaemia in neonates should first manifest before 8 weeks of age. Babies with sickle cell anaemia should visit a haematologist, a doctor who specializes in treating blood diseases like sickle cell anaemia.

2.6.1. Medicine That Prevents Diseased RBCs:

Adults and children aged 4 and above, who have sickle cell anaemia, are treated with Voxelate. RBCs are prevented from sickling and adhering to one another by oral medicines. This lowers the risk of anaemia, lessens the death of certain RBCs, and enhances blood flow to organs.

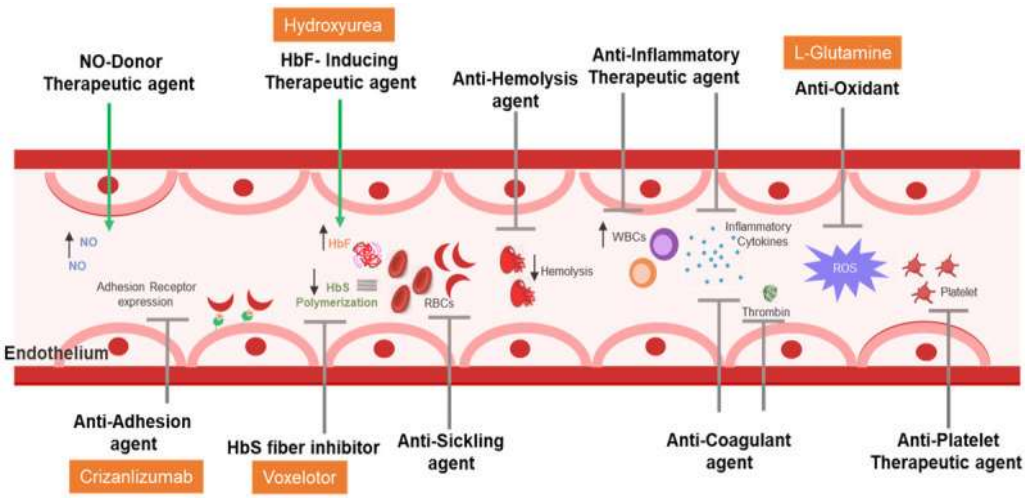

FIG 4**:** Possible molecular approaches for drug therapy (After Abdel-Hadi *et al.*, 2023).

Headache, diarrhoea, abdominal pain, nausea, exhaustion, and fever are examples of potential adverse effects. Rarely, allergic reactions might happen and lead to skin rashes,

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hives, and slight breathing difficulties. Person should inform the doctor if any of other medicines are being consumed by them. Medicines for pain crises and vascular occlusion for those with SCD, including adults and children older than 16, crizanlizumab-tmca is approved. The medication, which is injected into a vein using an intravenous (IV) line, aids in preventing blood cells from adhering to blood vessel walls and obstructing blood flow, which would otherwise result in an inflammatory and painful crisis. Possible side effects include fever, back ache, joint pain, and nausea.

2.6.2. Drug Used to Lessen or Avoid Some Consequences:

An oral medication called Hydroxyurea has been proven to lessen or stop some sickle cell anaemia problems. Various possible molecular approaches for drug therapy for SCD are summarized in Fig. 4.

Use by Adults: Sickle cell haemoglobin i.e. haemoglobin SS or haemoglobin S, the number of bouts of pain attacks and acute chest syndrome is decreased by hydroxyurea, according to numerous investigations in individuals with thalassemia. Additionally, it treated anaemia and lessened the need for hospitalization and blood transfusions.

Use in Children: Research in kids with severe SS or S-thalassemia has found that hydroxyurea (HU) decreased the number of vaso-occlusive crises and hospitalizations. In a study of infants with haemoglobin SS or S-thalassemia between the ages of 9 and 18 months, hydroxyurea decreased the frequency of painful episodes and demonstrates the incidence of dactylitis (painful swelling of the hands and feet). There is no data on the efficacy or safety of hydroxyurea in infants less than 9 months.

Pregnancy: Pregnant women are not advised to consume hydroxyurea. Most medical professionals agree that hydroxyurea can help people with sickle cell anaemia that experience numerous painful episodes, recurrent mammary crises, or severe anaemia. For usage on a regular basis by anaemic individuals, decreased platelet or white blood cell counts are potential adverse effects. Usually, these side effects go away as soon as the patient stops taking the medication. When a patient restart taking hydroxyurea, doctors typically prescribe lesser doses.

2.6.3. Pain relievers:

L-glutamine has been licensed by the FDA for use in persons over the age of 5 to lessen the frequency of pain attacks and demonstrated to reduce hospitalization. The medication is administered as a powder to be used with beverages or foods like oats or apple syrup. Nausea, tiredness, chest pain, and musculoskeletal pain are possible adverse effects. Since L-glutamine medication is not well studied in people, Acetaminophen and ibuprofen, two over-the-counter painkillers, can be used to treat mild to moderate pain. For extreme pains, doctors may recommend stronger medications known as opioids. For moderate and severe pain, opiates with or without NSAIDs are indicated. More recently, Ketamine in sub-dissociative doses has shown to reduce opiate use.

2.6.4. Infection-prevention medications:

Penicillin used twice daily can lower the likelihood that the youngster will develop a dangerous bloodstream infection. Penicillin liquid should be given to newborns. Children who are older can take pills. When a child turns five, many medical

professionals discontinue prescribing penicillin. Due to the increased risk of sickle cell anaemia, particularly in patients with haemoglobin SS or haemoglobin S0 thalassemia, some doctors prefer to continue giving this antibiotic for the remainder of their lives. Penicillin should be taken for the remainder of one's life by those who have had their spleen surgically removed (splenectomy) or who have pneumococcal infection.

2.6.5. Transfusion:

Blood transfusions may be prescribed by doctors to treat and/or avoid particular SCD problems. Among these transfusions are:

- **Acute blood transfusions** are used to treat severe anaemia-related problems. When patients have experienced an acute chest crisis, acute stroke, or multiple organ failure, doctors may also recommend blood transfusions. Before surgery, sickle cell anaemia patients typically receive blood transfusions to reduce the risk of complications.
- **Regular or continuous blood transfusions** can help people who have had an acute stroke lower their risk of having another stroke.
- **RBC transfusions** increase the number of RBCs and provide normal RBCs, which are more flexible than RBCs containing sickle haemoglobin. Children who have abnormal Transcranial Doppler (TCD), Ultrasonography readings are also advised to receive blood transfusions. This method is employed by certain doctors to manage issues that do not respond to hydroxyurea. Patients who take hydroxyurea too frequently may also require blood transfusions from their doctors. Alloimmunity is a disorder that could result in complications. Due to infection and iron overload, this can make it challenging to match blood units for upcoming transfusions. Children with abnormal transcranial Doppler (TCD) ultrasound readings are also advised to have blood transfusions because this can lessen the risk of developing a first stroke.

This method is employed by some medical professionals to manage issues that do not get better when treated with hydroxyurea. In cases where hydroxyurea side effects are too severe, medical professionals may also administer blood transfusions. Alloimmunization is a typical problem. When a recipient of transfusions produces antibodies against the blood is being given, this condition is known as alloimmunity, which makes it challenging to match blood units for subsequent transfusions. Additionally, infections and iron excess might also happen.

2.5.6. Transplantation of bone marrow and blood:

A blood and bone marrow transplant is now the sole treatment for SCD, however it is not suitable for everyone. Many sickle cell patients lack close genetic relatives and are therefore ineligible to donate blood. To increase their chances of a successful transplant, patients need donors who are closely matched to them. Nowadays, the majority of transplants are performed on children with SCD who also have co-morbidities like stroke, acute chest attacks, and recurrent pain attacks. Usually, these transplants employ matched donors. Adults are more likely than children to need bone marrow and blood transplants. Many hospitals are looking at fresh approaches to assist more sickle cell patients acquire transplants, including older bone marrow and blood transplantation methods for children and adults. When the donor and recipient are related

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and HLA-matched, around 85% of children who have blood and bone marrow transplants recover fully. Despite a high success rate, there are always hazards involved in transplantations. Seizures, life-threatening infections, and other clinical issues are examples of complications. Only 5% of those who receive these transplants pass away. The recipient's organs may be attacked by transplanted cells. Graft-versus-host illness refers to this. Although many consequences are prevented by medications, they are nevertheless possible.

2.5.7. A possible treatment for the acute type of sickle cell anaemia is gene therapy.

Researchers at the National Heart, Lung, and Blood Institute (NHLBI) are looking into how gene therapy can lead to the development of new SCD treatments and cures. Gene therapy seeks to treat or cure disease by replacing missing or damaged genes or correcting existing ones to enhance cellular function. It is used in the lab to alter stem cells after researchers obtain blood or bone marrow from patients. Without a suitable donor, patients with SCD may be cured by gene therapy, which alters the patient's own haematopoietic stem cells. The blood can be injected with modified stem cells. The cells subsequently proceed to the bone marrow region within the bone through the circulation. Once the cell has entered the bone marrow, it will start to create healthy, unsickled RBCs, and soon, new RBCs will begin to form. The FDA has approved CRISPR CAS9 gene editing for curing sickle cell anaemia, which will significantly aid in somewhat lessening the issue of this illness.

There have been some successful clinical trials using gene editing therapy recently. It is now possible to utilize gene editing technologies like CRISPR to correct the β-globin gene deficiency (Germino-Watnick *et al.*, 2022). In this case, a single base error is corrected and a functional β-globin gene is restored using a gene editing technique applied to the patient's bone marrow stem cells in a lab. Subsequently, the cells are reinfused into the patient, populating the bone marrow and generating “normal” β-globin. The effectiveness of this treatment depends on ensuring that the sole modification done to the cells' genome is what is needed, and that the correction of the β-globin gene does not unintentionally cause any other issues. This will be utilized more frequently as editing technology advances and strategies are put in place to guarantee there are no off-target impacts.

These days, SCD is also treated with gene silencing. The haemoglobin gene switches from fetal to adult form when the γ-globin genes are down-regulated soon after birth, and this process is caused by a protein that is encoded by the BCL11A gene. Through the use of short hairpin RNA, the BCL11A gene is silenced, eliminating the negative regulation and increasing the transcription of γ-globin. Bone marrow stem cells ($CD34^+$) were engineered using a lentivirus with the BCL11A silencing short hairpin RNA in a phase 1 trial involving six individuals. Bone marrow stem cells ($CD34^+$) were engineered using a lentivirus with the BCL11A silencing short hairpin RNA in a phase 1 trial involving six individuals. At a median follow-up of 18 months, all six patients in this small trial had increased HbF expression (58.9 to 93.6%) (Esrick *et al.*, 2021). All individuals experienced a decrease in additional SCD-related problems, and patients did

not report any VOC occurrences. Two individuals with sickle cell disease and β-thalassemia each underwent BCL11A gene silencing using Crispr/Cas9 editing in a first-in-human study (Frangoul *et al.*, 2021). Therefore, there was no indication of off-target editing when autologous $CD34^+$ stem cells were altered via electroporation. The patients were given the modified $CD34^+$ stem cells following myeloablation. Both patients reported elevated levels of allelic editing in their blood and bone marrow and a rise in HbF after more than a year. The β-thalassemia patient achieved transfusion independence, whereas the SCD patient's VOC was abolished (Frangoul *et al.*, 2021).

In any case, we believe that the diagnosis and course of therapy should be in accordance with the most recent worldwide standards and evidence-based recommendations, and that formal clinical trials can be used to assess the safety and effectiveness of innovative medications and therapies. Additionally, clinical judgments must be individualized for each patient and grounded in their unique SCD characteristics.

7. Conclusion and Future Perspectives:

Most SCD patients can now be cured by autologous transplantation of genetically modified haematopoietic stem cells due to developments in CRISPR/Cas9 technology (Lal and Prajapati, 2023). Because it is affordable, simple to use, and extremely successful, CRISPR editing is one of the leading choices for treating anaemia disease. The necessity for high editing efficiency and low off-target effects are just two of the obstacles involved in bringing a gene editing-based treatment approach for SCD to the clinic. For secure clinical applications, a quantitative comprehension of the genotypic and phenotypic effects of various mutations in CRISPR/Cas9-edited SCD $CD34^+$ cells are necessary. The development of engineering techniques that allow for high yields of polyclonal and highly proportionate genetically modified cells to be long-term repopulated in HSCs is still a difficulty. Additionally, little is known about how SCD pathophysiology affects HSPC viability and engraftment potential, particularly in patients who have endured years of chronic inflammation linked to SCD. Our understanding of the impact of chronic systemic inflammation and poor erythropoiesis associated with HSPCs from SCD patients is currently limited because the majority of in vivo transplantation research related to SCD has been carried out with cells from healthy persons. Gene editing results and engraftment potential can be strongly impacted by individual variations in the source of HSPCs and SCD pathophysiology, including patient status. The survivability and capabilities of SCD HSPCs are probably influenced by genetic and environmental variables. Ex vivo gene editing techniques currently used have certain drawbacks. HSCs often make up a very modest portion of $CD34^+$ cells in SCD patients. It is invasive to take HSCs out of the bone marrow. Low blood counts and infections are among the negative effects of chemotherapy that myeloablative chemotherapy patients also face. HSC pluripotency and engraftment potential are lost as a result of in vitro culture and gene modification. Ex vivo gene editing-based therapy may also be unaffordable for some patients because of the high expenses associated with the need for highly specialized facilities and the technological know-how necessary. Because in vivo treatment can be minimally invasive and cost-effective, it is more

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accessible in resource-poor locations and may be able to overcome the constraints of ex vivo gene editing. To achieve both high in vivo delivery and high editing efficiency, as well as to make in vivo gene editing a clinically effective method, there are considerable obstacles to overcome. A partnership between the NIH and the Bill and Melinda Gates Foundation is working to create in vivo gene editing therapy for SCD.

Using this gene editing technique, a lot of cell line genotyping and phenotyping has already taken place. The therapeutic effects are vast, including inhibition of viral infection, restoration of handicapping disorders such as muscular dystrophy, and tumour eradication in cancer models. Overall, it is simple to understand why the CRISPR field is so enthusiastic. Without a doubt, the CRISPR/Cas9 system will transform scientific investigation into the treatment of allergy and immunological illnesses. A safe and ethical use of developing technology for basic research and therapeutic reasons must be enabled by laws and regulations that have been prepared by the relevant authorities. Researchers are hopeful that as their work in this area continues, they will soon have the answers to these issues. A remarkable accomplishment in treating diseases at their source, tolerates symptom relief and introduces fresh medicinal approaches. Scientists are still working on CRISPR-Cas9's proverbial ‘tip of the iceberg’. Proteins produced by genes through their expression continue to serve both a metaphorical "weapon" and an environmental ‘trigger’ in biology. Examples of behavioural and lifestyle variances between identical twins, as well as plant changes without genetic manipulation, demonstrate that we are not genetic slaves or exterminated by our genes. In the future, epigenetics would have a significant impact on how diseases develop and behave.

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Geospatial Techniques for Groundwater Management

Prof. Mahendra Singh
Principal, K K College, Etawah, 206001, India
Prof. Esha Yadav
Department of Zoology, Brahmanand College, Kanpur, 208004, India
Email: esha1880@gmail.com

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Abstract:

Groundwater is the primary natural resource for drinking, irrigation, agriculture, and industrial purposes and the fresh groundwater reserves are rapidly depleting. There has been a significant increase in the usage of potable water globally due to the growing needs of the world population. Annually, there are lots of fluctuations in groundwater levels which must be analysed frequently to manage groundwater resources efficiently. However, detecting and analysing them manually is a tedious process. The geospatial techniques help the users to store, conserve and manage groundwater resources effectively. In today's world, there are many geospatial techniques developed to understand the availability of groundwater from which commonly used tools and techniques of groundwater analysis are discussed in this chapter to help the researchers. These tools and techniques have enabled us to understand the importance of evaluating and monitoring groundwater resources.

Introduction:

Geographical Information System (GIS) is a computer-based tool for collecting, storing, trans-forming, retrieving and displaying spatial data from the real world. GIS provides facilities for data capture, data management, data manipulation, analysis, and the presentation of geographical data. GIS is not simply a system for making maps, a GIS is an analytical tool as well. The geographical data represent phenomena from the real world in terms of their position in a known coordinate system, their attributes that are unrelated to position and their spatial interrelations with each other. The spatial relations describe how they are linked together. Remote sensing (RS) and geographical information systems (GIS) provide cost-effective and time-effective means of assessing and managing groundwater resources (Mallick *et al.* 2014)

The recent emergence of geospatial techniques has paved the way for innovative and successful approaches to groundwater discovery (Mandal *et al*., 2021). Unlike the traditional methods, these new methods are fast, inexpensive, time-saving, and can even be deployed in inaccessible areas (Serele *et al*., 2020). A preliminary assessment of probable groundwater locations can be done using remotely sensed images before any detailed evaluations and drilling are done (Arulbalaji *et al*., 2019). Through the integration of remote sensing (RS) and geographic information systems (GIS), numerous researchers have succeeded in delineating groundwater resources in different parts of the

world (Faujia *et al.*, 2021; Goswami and Ghosal, 2022).

Ground Water Management:

Groundwater is an essential source of irrigation, drinking water, and industrial water, but it is often overused in certain regions. GIS can be used to monitor and inspect water resources through comprehensive maps of groundwater resources, taking into account quality information that comes from remotely sensed images and sensors installed in the field. GIS (Geographic Information System) is an essential tool for managing water supplies, as it helps to visualize and assess spatial data related to water resources. This includes creating detailed maps of water treatment plants, reservoirs, pipelines,(Kokane et al., 2021) and distribution networks, assessing population density, and other useful data(Khatri et al., 2022). Additionally, GIS can be used to analyse water supply scenarios like the demand for water in a particular area to give insight to develop effective strategies for managing water sources. Ultimately, GIS plays a major role in ensuring the sustainable management of water resources. GIS also allows the integration of real-time data from sensors and monitoring devices, enhancing the ability to respond promptly to any issues or disruptions in the water supply. This valuable information aids in optimizing the operation and maintenance of these systems, minimizing leaks and water losses, and strategically planning for future infrastructure demands. Moreover, the multi-criterion decision-making (MCDM) tool in GIS allows for a comprehensive assessment of different criteria or factors involved in the site selection process such as rainfall patterns, topography, soil type, land use, and proximity to water sources.

Satellite Data:

Satellite data provide quick and useful baseline information about various factors that directly or indirectly control the occurrence and movement of groundwater such as geomorphology, soil types, land slope, land use/land cover (LULC), and drainage patterns. Nowadays, there are a large number of satellites used for observing the earth and atmospheric features. According to the purpose of their use, the satellite system is divided into two groups

1. Earth Resource Satellite
2. Environmental Satellite

Earth Resource Satellite:

They provide the information of same area relatively infrequently (days) with relatively high resolution e.g. Landsat (Land Satellite) (USA), IRS (Indian Remote Sensing) (India), OKEAN (Russia), SPOT (Satellite Positioning and Tracking) (France), ERS (European Remote Sensing) (ESA and Canada), JERS and ADEOS (Japan), RADARSAT (Canada), CBERS (China-Brazil Earth Resources Satellite) (China).

Environmental Satellite:

They provide the information of same area relatively frequently (hours) with relatively low resolution e.g. NOAA (National Oceanic and Atmospheric), INSAT (Indian National Satellite System) (India), GOES (Geostationary Operational Environmental Satellite) (USA), GMS (Geostationary Meteorological Satellite) (Japan) (Jensen, 2000).

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Groundwater Potential Zones:

The GWPZ can be spatially predicted by the use of various influencing factors of hydrogeological importance. However, it is important to note that the degree of influence of factors on groundwater occurrence varies, and this may depend on space and time. Apart from the fact that groundwater potential prediction involves consideration of many factors obtainable from different sources, the process might also require inputs from many experts, field observations and geophysical investigation (Mallick *et al*., 2014) In the past, several researchers have used RS and GIS for the delineation of groundwater potential zones (GWPZs) (Mukherjee *et al*., 2012) with good and effective results as the outcomes are in good correlation with field measurements.

MCDM has been recognised as an important analysis tool in the environmental decision-making process for formulating and addressing the spatial issues of challenging decision objectives (Regan *et al*., 2007; Yatsalo *et al*., 2007; Adiat *et al*., 2012). GIS-MCDM can be defined as a process that transforms and combines geographical data and value ranking (the decision-makers preferences) to obtain information for decision-making. MCDM determines a preference ordering among several available options (Agarwal and Garg, 2016). The decision-maker's preferences depend upon the relative importance of the options according to many 'criteria', which are identified by experts or stakeholders (Adiat *et al*., 2012). Accordingly, MCDM methods are employed to combine the criteria scores obtained for each option into an overall preference ranking or choice of option.

Various Methodology for Groundwater Potential Zonation:

1. Analytic Hierarchy Process (AHP):

AHP is one of the best multi-criteria decision-making methods that was originally developed by Prof. Thomas L. Satty in 1980. In short, it is a method to derive ratio scales from paired comparisons. The input can be obtained from actual measurements such as price, weight, etc. or subjective opinions such as satisfactory feelings and preference. The AHP is the source of several other variants, such as the geometric mean approach (Barzillai *et al*., 1987), stochastic REMBRANDT (the multiplicative variant of AHP) and various modifications to incorporate risk and fuzzy concerns. AHP is easier, is more flexible and requires less cognitive skills. AHP has gained importance in terms of interactive graphical user interfaces, automatic calculation of priorities and inconsistencies and several ways to process a sensitivity analysis. AHP's major innovation was the introduction of pairwise comparisons. It employs a consistent way of converting such pairwise comparisons into a set of numbers representing the relative priority of each criterion. The AHP procedure has been applied for Decision Support Systems (DSS) including data mining and machine learning and so many applications.

2. **Weighted overlay Analysis:**

Weighted overlay analysis is generally performed to investigate the groundwater potential zones. Geospatial data used to analyse weighted overlay analysis is toposheets, soil maps, geology, geomorphology, and rainfall data from various government

departments such as Public Works Department (PWD), aquifer details such as specific yield, porosity, permeability, and transmissivity are gathered from Central Groundwater Board (CGWB). Digital Elevation Model (DEM), Soil data and Land use Land cover (LULC) can be collected from online resources such as USGS earth explorer, BHUVAN, EARTH DATA, Indian Remote Sensing, and GIS websites etc. The multiple factors involved to analyze weighted overlay analysis are rainfall, drainage, slope, soil, geomorphology, geology, lineaments, lithology, land-use land- cover, permeability, specific capacity and transmissivity. The data collected is enhanced and digitized in Arc GIS Software to generate various thematic maps such as slope, drainage density, lineament density, lithology and rainfall, etc., with the data management tools of ArcGIS. This method is beneficial to establishing potential zones of groundwater and the abstractions of groundwater can be conserved, managed, and planned in an improved way (Saini *et al*., 2012, Rajaveni *et al*., 2017, Suganthi *et al*., 2013, Pavani *et al*., 2022).

3. Spatial Interpolation:

The interpolation involves the calculation and locating of the position of an unknown data point or area by using and creating a relationship between the known and the unknown positions. Other forms of data that can be estimated using interpolation include precipitation, elevation, water table, snow accumulation, and population density. The spatial interpolation technique can be applied to analyse many other factors such as hazard mapping, estimating soil moisture, rainfall and missing rainfall data, the spatial distribution of soil, mapping of physical and hydro-physical properties of soil and many more methods (Xiao et al., 2016). Spatial data interpolation methods are of different types, such as TIN (Triangulated Irregular Networks), IDW (Inverse Distance Weighted) method, RBF (Radial basis functions) Trend Surface analysis, Kriging and polynomial techniques. ArcGIS geo-statistical module is utilized to determine the variability of Spatiotemporal groundwater levels. Different interpolation models were evaluated by IDW, GPI (Global polynomial interpolation), LPI (Local polynomial Interpolation), TSPLINE, OK (Ordinary Kriging), SK (Simple Kriging), and UK (Universal Kriging) to generate the groundwater level model, absolute errors, mean errors and root-mean-square errors are calculated for each method to choose the best-fit model.

4. **LISA (Local Indicators of Spatial Autocorrelation):**

LISA involves the correlation between the surrounding area and then data for the given area is calculated. When an area with unsymmetrical boundaries or boundaries with a lot of fluctuation is required to be calculated then the information of the areas surrounding the given area must be taken into account involving spatial correlations which indicate the local points of data. The LISA Cluster Map depicts significant sites that are colour-coded according to the type of spatial autocorrelation. The LISA for each observation indicates the amount to which similar values are clustered spatially around that observation. Concepts of LISA can also be determined to map salinization and its trace elements in the groundwater. To assess the groundwater quality and its availability geospatial techniques were applied to sustainable groundwater management. Depth to water level and electrical conductivity data are collected for the study area. Later

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statistical analysis, gradient analysis, surface interpolation, and LISA techniques were used to analyze the availability and quality of groundwater (Gunaalan *et al.*, 2018).

Factors Affecting Groundwater Management:

The interactions between several factors influence the distribution and development of groundwater reserves (Fig. 1). Some important factors are:

I. Geomorphology
II. Geology
III. Land use/land cover
IV. Topography
V. Lineament density
VI. Drainage density

Geomorphology:

Geomorphology is the study of the form of the earth (landform), its description and genesis. It is a branch of earth science, which has grown after the advent of aerial photographs and satellite data. Geomorphology, along with information on soil, water and vegetation has become one of the essential inputs in planning for various developmental activities. The geomorphology of an area depends upon the structural evolution of geological formation. Geomorphology reflects various landforms and structural features. Many of the features are favourable for the occurrence of groundwater and are classified in terms of groundwater potentiality. The geomorphic units of the basin can be divided into the moderately dissected lower plateau, low dissected lower plateau, pediment-peneplain complex, anthropogenic terrain and water bodies. Among these pediplain are good in groundwater potential.

Geology:

The geology of a region plays a critical role by providing important information regarding the hydrogeological aspects on which the nature of groundwater recharge potentiality has been dependent (Chowdhury, 2010). Geology describes the structure of the earth beneath its surface and the processes that have shaped that structure. Geology has been consistently affirmed as an important factor for groundwater recharge because the geological units of an area play a crucial role in regulating the porosity and permeability of aquifer supplies (Benjmel *et al*., 2020; Ifediegwu, 2022).

Land use/land cover:

The land use/land cover of a certain area depends on geomorphology, agro-ecology, climate and human-induced activities. It is one of the factors affecting groundwater occurrence and availability (Hussein *et al*., 2017). Supervised image classification was conducted to classify and to identify the type of LULC and four classes were identified. And those are namely cultivated land, grassland, forest and shrub. Variations in land use and land cover (LU/LC) brought on by humans have impacted hydrological elements. In the case of groundwater recharge potentiality, land use land cover of a region plays a vital role, as after the rainfall events the initial penetration of water into the aquifer depends upon the type of land use land cover of that particular

region (Nag *et al.*, 2022). Groundwater resources are negatively impacted by the increased urbanization of areas in two fundamental ways: first, by blocking up aquifers with concrete, which prevents natural recharge; second, by polluting groundwater through drainage leaks and industrial waste and effluents.

Topography:

Topography exerts control on the rate at which precipitation seeps into the ground and this affects the availability of groundwater reserves (Ghosh *et al*., 2020). Low-lying spots have a higher chance of enhancing water infiltration than steep-sloping terrains (Roy *et al*., 2020; Andualem and Demeke, 2021). Based on this, a slope map should be incorporated which is a measure of the degree of steepness of a place representing a topographic component in the analysis (Arulbalaji *et al*., 2019). The slope map of the area was generated from ASTER GDEM using the slope tool in ArcGIS. The slope output map was expressed in degrees and categorized into five classes using the natural breaks method. The highest rank of 9 was given to the lowest slope sub-class 0–2.4 while the lowest ranking of 1 was given to the highest slope sub-class 15–38. As a secondary topographic index, TWI calculates the regulation of topography on hydrological processes (Phong *et al*., 2021). Using the raster calculator in ArcGIS, the Topographic Wetness Index (TWI) was derived from ASTER GDEM using slope radians and tan slope maps as input variables. Based on the direct interrelationship between TWI and groundwater potential, the TWI values were reclassified as very low (3.7–6.5), low (6.6–8.5), good (8.6–11) very good (12–14), and excellent (15–22). Thus, low scores were assigned to low TWI values and vice versa.

Lineament Density:

Lineaments are natural surface elements such as joints, faults, folaitions or bedding planes interpreted directly from satellite imagery, geophysical maps or aerial photographs (Danso and Ma, 2023). The relationship between lineaments and groundwater is studied by Mabee *et al.*, 1994 and Sander *et al*., 1997. They agreed that a high-density lineament indicates in general the presence of groundwater. Hung *et al.*, 2002. suggested that fractured rocks could be analysed by studying lineaments with the help of lineaments indices. Lineaments indices are defined as lineaments frequency, length, and degree of intersection. Areas with higher lineaments serve as good places for groundwater development (Algaydi et al., 2019). In this sense, lineament density was generated as an input factor for the study, and retrieved from ASTER GDEM and the line density tool in ArcGIS helped with the delineation. Areas with higher lineaments were given higher ratings and vice versa.

Drainage Density:

A drainage basin is a natural unit draining runoff water to a common point. This map consists of water bodies, rivers, tributaries, perennial and ephemeral streams, and ponds. Drainage density and type of drainage give information related to runoff, infiltration relief and permeability, the closeness of spacing of the channel as well as the nature of the surface material. Dendritic drainage indicates homogenous rocks, and the trellis, rectangular and parallel drainage patterns indicate structural and lithological

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controls. The coarse drainage texture indicates highly porous and permeable rock formations. The drainage density characterises the runoff in an area. The drainage density map was created from the stream order map using the line density tool in ArcGIS. Since a direct relationship exists between drainage density and surface runoff, areas with high drainage densities tend to contribute less to groundwater recharge. This means that an inverse relationship exists between drainage density and groundwater recharge (Roy *et al.*, 2020) hence the lesser the drainage density, the higher the probability of recharge or potential groundwater zone. The entire drainage map is divided into five categories Very poor, Poor, Moderate, Good and very good. Areas within the highest drainage density category were given a lower rating of 1 to reflect very poor groundwater potential while those within the lowest drainage density bracket were given the highest rating of 9 to indicate very good groundwater potential.

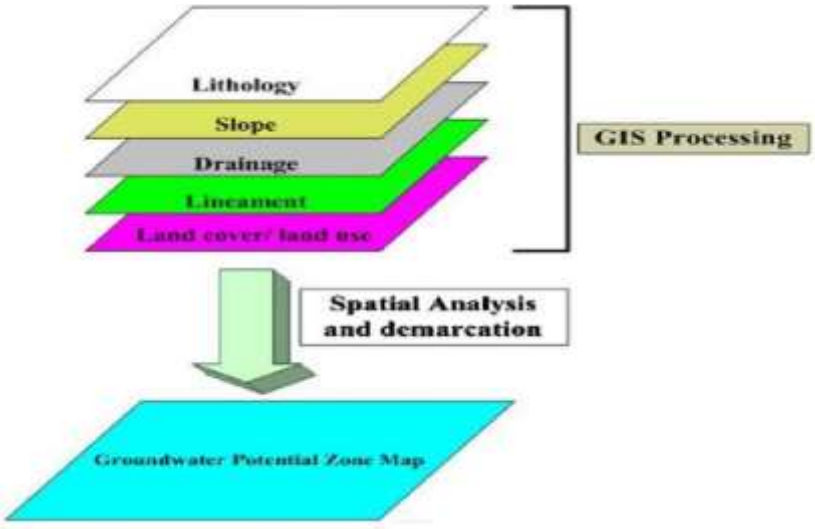

Fig. 1: Factors affecting Groundwater Potential Zone Mapping

Conclusion:

Groundwater is a vital natural resource that plays an important role in the development of rural as well as urban areas. Groundwater has a limited extent and volume. The tremendous increase in the demand for groundwater for household, agricultural and industrial use leads to the concept of water resource management. Geospatial techniques permit rapid and cost-effective natural resource survey and management (Rawala *et al*. 2016; Reddy *et al*., 2018). There is a lot of research going on the water resource management. Based on the observer and expertise different people use different methods for the calculation of groundwater potential zonation.

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Mosquitoes of Lucknow: A Brief Description of Survey of Selected Sites conducted between 2018-2019

Shilpa Nandan
***Kalpana Singh**
Department of Zoology,
University of Lucknow, Lucknow- 226007, UP (India)
Email: biomusicology.india@gmail.com

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Abstract:

This study presents the findings of a comprehensive survey conducted in selected sites in Lucknow region (*viz*. Neelmatha, Vrindavan Colony, SGPGI, Telibagh, Topkhana, Alambagh, Arjunganj, Banglabazar and Utraitia) between 2018 and 2019, focusing on the mosquito population at selected sites. The study aimed to characterize the diversity, abundance, and distribution of mosquitoes in the area, shedding light on their ecological dynamics and potential implications for public health.

The survey employed a range of methodologies, including field observations, trapping using various techniques such as light traps, gravid traps, and CO2 traps, as well as collection of specimens for morphological and molecular analysis. Sampling was conducted across different habitats including urban areas, rural settings, water bodies, and peri-urban environments to capture the full spectrum of mosquito species present.

The results of the survey revealed a diverse array of mosquito species inhabiting the Lucknow region, with variations in species composition and abundance observed across different sites and seasons. Notable species identified included *Aedes aegypti* and *Aedes albopictus*, vectors of diseases such as dengue, chikungunya, and Zika virus. The survey also documented the presence of *Anopheles stephensi* mosquitoes, vectors of malaria, and *Culex quinquefasciatus* mosquitoes, vectors of diseases like West Nile virus and lymphatic filariasis.

Furthermore, the survey provided insights into factors influencing mosquito abundance and distribution, such as habitat characteristics, climatic conditions, and human activities. These findings contribute to a better understanding of mosquito ecology in the Lucknow region and can inform the development of targeted vector control strategies to mitigate the risk of mosquito-borne diseases.

Overall, this abstract serves as a synopsis of the survey's objectives, methodologies, and key findings, offering valuable insights into the dynamics of mosquito populations in the Lucknow region and their implications for public health.

Key words: Mosquito, *Aedes*, *Anopheles*, *Culex*, Lucknow

Introduction:

"Mosquitoes are the greatest mass murderers on planet earth" -Katherine Applegate

Mosquitoes are ubiquitous insects with significant ecological, economic, and

public health implications worldwide. In regions like Lucknow, India, where diverse habitats and climatic conditions prevail, mosquitoes play a crucial role in disease transmission and ecosystem dynamics (Anandh et al., 2017, Vujic et al., 2013). Understanding the composition, abundance, and distribution of mosquito species in such areas is essential for effective vector control and disease management strategies (Amarasingh et al., 2014, Singh et al., 2019).

The period between 2018 and 2019 witnessed a concerted effort to conduct a comprehensive survey of mosquitoes in the Lucknow region. This survey aimed to provide a detailed description of the mosquito population across selected sites, shedding light on their ecological dynamics and potential implications for public health. By employing a range of methodologies, including field observations, trapping techniques, and specimen analysis, the survey sought to capture the full spectrum of mosquito species present in the area.

This introduction sets the stage for the detailed exploration of the survey findings, highlighting the importance of understanding mosquito ecology in Lucknow. It outlines the objectives of the survey, emphasizing the need to elucidate factors influencing mosquito abundance and distribution, such as habitat characteristics, climatic conditions, and human activities. Additionally, it underscores the significance of this research in informing targeted vector control measures to mitigate the risk of mosquito-borne diseases in the region.

As we delve into the survey results, we embark on a journey to unravel the intricate relationship between mosquitoes, their environment, and public health in the Lucknow region. Through this exploration, we aim to contribute to a deeper understanding of mosquito ecology and empower efforts to protect communities from the threats posed by mosquito-borne diseases.

Materials & Methods

Survey was conducted in Lucknow, Uttar Pradesh at selected sites namely. It is situated at 26.30 & 27.10 North latitude and 80.30 & 81.13 East longitude 123 meter above sea level.

Study period:

This study has been conducted in 24 months of time period in 2018 & 2019. This survey has been conducted in selected sites/areas of Lucknow like Neelmatha, Vrindavan Colony, SGPGI, Telibagh, Topkhana, Alambagh, Arjunganj, Banglabazar and Utraitia. at these places various types of artificial habitat and natural habitat were present of mosquito larvae.

Mosquito collection:

In mosquito larvae collection was done by dipping method by 1000 ml beaker from different artificial habitat and natural habitat in which discarded containers, tyres, tree holes, cemented tanks were included. Mosquito larvae were transferred in vials after collection and kept in 70% alcohol then were bought to laboratory for further identification & study.

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Mosquito identification:

Collected samples were bought for Identification University of Lucknow, Department of Zoology laboratory for adult emergence and these were morphologically identified on their species level by the Entomology Consultant of CDRI, Lucknow, Uttar Pradesh using standard key & catalogues.

Result:

From January 2018 to December 2019, more than 4500 larvae of mosquito species were collected in four different areas of Lucknow, Uttar Pradesh (Neelmatha, Vrindavan colony, SGPGI, and Telibagh Topkhana, Alambagh, Arjunganj, Banglabazar and Utraitia). Collected larvae were from four different mosquito species, including three different genera *viz*. *Aedes aegypti*, *Aedes albopictus*, *Anopheles stephensi*, and *Culex quinquefasciatus*. Two species of the *Aedes* genus, *Aedes aegypti* and *Aedes albopictus*, as well as one species each of *Anopheles* (*Anopheles stephensi*) and *Culex* (*Culex quinquefasciatus*) has been recorded from four different sites of Lucknow city.

Difference between *Aedes*, *Anopheles* and *Culex*

Mosquito Type	***Aedes***	***Anopheles***	***Culex***
Appearance	Small, black or dark-coloured with white stripes on legs and body	Slender with long legs, brown in colour	Small, brown or Gray with speckled wings
Habitat	Urban areas and breed in standing water found around homes or in artificial containers	Found in rural and suburban areas & breed in clean, freshwater habitats such as ponds and lakes	Common in urban areas and breed in standing water found in catch basins, storm drains, and artificial containers
Biting Behaviour	Aggressive biters and prefer to bite during the day, especially in the early morning and late afternoon	Bite primarily at night, with peak biting activity at dawn and dusk	Bite at night, with peak biting activity at dawn and dusk
Diseases Transmitted	Zika virus, dengue fever, chikungunya, yellow fever	Malaria	West Nile virus, encephalitis, and other arboviruses

Mosquito Type	*Aedes*	*Anopheles*	*Culex*
Resting Position	Rest with their body parallel to the surface they are resting on	Rest with their body at an angle to the surface they are resting on	Rest with their body parallel to the surface they are resting on
Flight Range	Fly short distances, typically within 100-500 feet of their breeding site	Fly longer distances, up to several miles	Fly short to moderate distances, typically within 1-3 miles of their breeding site

(Binod 2023).

Genus *Aedes*

Two species of the *Aedes* genus, *Aedes aegypti* and *Aedes albopictus* have been recorded from four different sites of Lucknow city as described below.

Aedes aegypti, also known as the "yellow fever" mosquito, is a significant vector for the transmission of yellow fever. Yellow fever is a dangerous disease prevalent in tropical regions of the Americas and Africa, particularly during the summer season, when mortality rates increase in cities near rivers. In 1881, Carlos Finlay, a Cuban physician, proposed the theory that yellow fever is transmitted solely by *Aedes aegypti*. This hypothesis was later confirmed by a United States Army committee formed in 1990, which included researchers such as Walter Reed, Jasee W. Lazear, James Carroll, and A. Agrmonte (Nelson et al., 1986).

Subsequently, the *Aedes* sylvatic cycle of yellow fever was discovered in the Americas, involving mammals, particularly monkeys, and mosquitoes. A similar sylvatic cycle exists in Africa, with *Aedes africanus* and *Aedes luteocephalus* being the primary species involved, along with the peri-domestic Aedes simpsoni cycle (Nelson et al., 1986). Currently, *Aedes aegypti* is the most important vector for Dengue fever. Dengue, commonly known as "break bone" fever, has been present for centuries. In urban areas of Asia, the disease is transmitted primarily by *Aedes aegypti*, while in semi-urban areas, transmission occurs through *Aedes* subgenus *stegomyia*, *Aedes albopictus*, and *Aedes scutellaris*. In Malaysia, sylvatic transmission has also been observed, particularly in the *Aedes* (*finlaya*) *niveus* subgroups. Although Dengue is often not fatal, it can sometimes lead to severe outcomes.

In 1977 and 1978, Dengue serotype 1 spread to various countries, including the Caribbean, Central America, Mexico, Northern South America, and even Texas in the United States. The most severe form of Dengue, known as Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS), was reported in the Philippines in 1954. These forms of the disease are particularly fatal, especially among children aged 2-13

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years (Nelson et al., 1986).

Dengue, a mosquito-borne disease, has become highly prevalent and poses a significant public health concern in tropical and subtropical regions worldwide. Over the past 50 years, the incidence of Dengue has increased by 30 times globally. The World Health Organization (WHO) has identified Dengue as one of the neglected tropical diseases, highlighting its importance in the field of public health (Welsh et al., 2010).

Each year, thousands of Dengue cases are reported, leading to an increase in mortality rates. In the previous year, there were recorded 20,000 deaths and 264 disability-adjusted life years (DALY) per million populations. Mortality due to Dengue is higher among children and adolescents, with the impact varying by age group and region. Dengue is endemic in Africa, the Eastern Mediterranean, the Americas, the Western Pacific, and Southeast Asia. The regions most affected by Dengue are North and South America, the Western Pacific, and Southeast Asia (Miah et al., 2020).

Estimates suggest that each year, there are 390 million Dengue infections, of which 96 million manifests clinically, with varying degrees of severity. Another study found Dengue prevalence estimates in 129 countries, with 3.9 billion people getting infected, and Asia alone accounting for 70% of the actual burden (Ridwan, 2020). While the burden of this global disease remains uncertain, initial studies indicate an increase in Dengue fever cases in recent years (Joob et al., 2020).

According to the WHO, most cases of Dengue are asymptomatic, some cases are underreported, and a few cases are misclassified. Dengue fever is considered one of the most dangerous among the ten fevers listed by the WHO in 2019, based on studies conducted in several countries (Epelboin et al., 2020). The number of reported Dengue cases has been steadily increasing. In 2010, there were 2.2 million cases, which rose to 4.2 million in 2019.

The largest number of Dengue cases to date was recorded in 2019. Approximately 1.8 billion people residing in the South East Asia Region (SEAR) and the Western Pacific Region (WPR) are at risk of Dengue, with India among the 10 Dengue-endemic countries in SEAR, except for the Democratic People's Republic of Korea. In 2016, SEAR countries reported 0.5 million cases, with 40% from Indonesia and 26% from India (Ridwan, 2020).

In the Americas region, 2.38 million cases were reported, with Brazil alone reporting nearly 1.5 million cases, nearly three times more than in 2014 (WHO, 2014). In 1996, Delhi experienced a severe Dengue outbreak, with 10,252 cases and 423 deaths recorded. In India, at that time, there were 16,517 Dengue cases and 545 deaths reported. Dengue outbreaks have been repeatedly reported in various states and union territories in India. The number of Dengue cases has shown an upward trend in recent years, with the highest number of cases reported in 2017. However, in 2020, India alone reported 157,315 Dengue cases, indicating a peak compared to 2019. It is worth noting that this data was only recorded until March 2020. Due to the COVID-19 pandemic and subsequent lockdown measures, Dengue cases declined. Until October 2020, there were 202 Dengue cases and 12 deaths recorded. The case fatality rate (CFR) declined to 3.3%

in 1996, 0.3% in 2014, and remained steady at 0.2% in 2015 and 0.1% in 2019 (NVBDCP, 2020).

Dengue virus (DV) is primarily transmitted from an infected person to another individual through the bite of female *Aedes* mosquitoes. In India, the main vectors responsible for Dengue transmission are *Aedes aegypti* and *Aedes albopictus*. *Aedes aegypti* is the primary vector in urban areas, while Aedes albopictus has also been found to be responsible for Dengue cases in many states of India. However, other mosquito species such as *Aedes polynesiensis* and *Aedes niveus* have been implicated as secondary vectors in some countries.

The life cycle of *Aedes* mosquitoes is greatly influenced by climatic conditions, particularly temperature and rainfall. These factors play a crucial role in determining the population dynamics and activity of *Aedes* mosquitoes. *Aedes* mosquitoes are primarily active during the daytime and have a limited flight range of up to 400 meters (NVDCP, 2020).

All over the world 950 species of *Aedes* genus are found which transmits deadly pathogens in few cases.

Aedes aegypti is believed to have originated in Africa, and within this species, three forms have been identified: *Aedes aegypti aegypti* (the typical form), *Aedes aegypti formosus*, and *Aedes aegypti queenslandensis* (which is darker, smaller, and found in forested areas). *Aedes aegypti* mosquitoes are primarily found in tropical and subtropical regions. They thrive during the summer season and do not survive in winter (Nelson et al., 1986).

The distribution of *Aedes aegypti* expanded from the United States to Argentina in the early 1990s. Initially, mosquito control efforts in North and South America were successful, particularly through the removal of mosquito breeding sites. However, the long-term maintenance of mosquito eradication programs requires sustained financial backing. Unfortunately, due to a lack of financial support, these programs were eventually discontinued, leading to the re-establishment of *Aedes aegypti* within its pre-eradication range (Nelson et al., 1986).

Aedes aegypti is found in 23 states of the United States, including the southeastern region, stretching up to the east coast as far as New York, Indiana, and Kentucky (Darsie & Ward, 2005). In some areas, the population of *Aedes aegypti* has decreased due to competition with *Aedes albopictus*, another mosquito species. However, *Aedes aegypti* remains a common mosquito in urban areas of southern Florida and cities in Louisiana (Nelson et al., 1986).

The life cycle of *Aedes aegypti* consists of four stages: egg, larvae, pupa, and adult.

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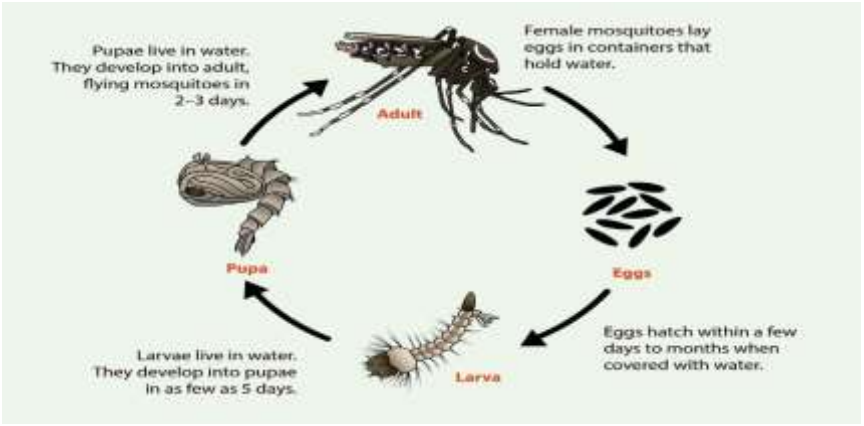


Life Cycle of *Aedes* (Espanol Spanish 2022)

Ecology of *Aedes aegypti*:

Habitat of *Aedes aegypti* is near about to human habitat, these are anthropophilic (Alongkot *et al*., 2005) and these are found mostly in urban areas (Julien *et al*., 2016). *Aedes* mosquitoes feeds human blood, these mosquitoes lay eggs on the side of container kept near human houses, when rainfall starts then breeding also starts & egg converts to larvae, it takes one week of time to be pupa from larvae and takes two days of time to become adult from pupa. *Aedes* mosquito mostly likes aquatic habitat to live, they can easily thrive in tree holes & toilet like areas. They like dark and coolest place to live, in human house they prefer to live behind curtains & almirah. *Aedes aegypti* adapts environment due to which they are most resilient (lively). They have ability that if humans are using control measures or if there are natural phenomena like drought then also, they are capable & very quick to bounce back. Due to environment adaptation nature of these mosquitoes, their eggs can survive even without water, which is also called "desiccation" (Eliningaya *et al*., 2018).

As we eliminate larvae & pupa from any site, then also their population increases in two weeks because eggs stick on side of container starts hatching when there is rainfall. Recently it has been found that *Aedes aegypti* are capable to do immature development in septic tanks and in result they produce thousands of *Aedes aegypti* because they response continuously according to changed environment & adapts environment. It's expected that may be control measurement could stop its habitat & dispersal as well (Eliningaya *et al*., 2018).

***Aedes albopictus*:**

Aedes albopictus comes in class: Insecta, order: Diptera, family: Culicidae and common name is yellow fever mosquito.

Aedes albopictus (skuse) was documented first in Texas of United States in 1985 (Springer & Wuithiranyagool 1986). Then, after few years *Aedes albopictus* was found in Jacksonville site tire dump of Florida (O'Meara et al., 1997) but at that time this species was dispersed throughout eastern state including all of Florida's 67 countries

(O'Meara et al., 1997). When there was arrival of *Aedes albopictus* then in was figured including downfall in abundance & distribution of *Aedes aegypti*. In competition there were many reasons to exclude *Aedes aegypti* through *Aedes albopictus*:

A. Sterility of offspring from intra-specific mating

B. Reduced fitness of *Aedes aegypti* from parasites brought in with *Aedes albopictus*

C. Superiority of *Aedes albopictus* in larval resource competition (Lounibas et al., 2002).

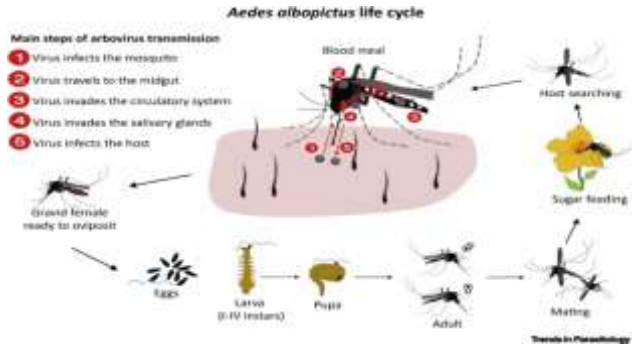
Aedes albopictus are competent vector of many viruses, which includes Dengue fever as well (CDC, 2001) and Eastern equine encephalitis virus (Mitchell *et al*., 1992). Life cycle of these mosquito runs near about human habitat, they prefer container breeding & standing water, they are day time feeder and often rests in shady area (Koehler *et al*., 1997). Asian tiger mosquito feeds early morning & late afternoon, they are aggressive biter & host of these mosquitoes are man, as well as domestic & wild animals (Hawley et al., 1988).

Distribution:

In subtropical region of North America distribution of *Aedes albopictus* is along with temperature and since past few years there has been high expansion of *Aedes albopictus* in United States. In 1985, *Aedes albopictus* was first documented in Texas for first time and at present in 26 states & in 866 counties has been established (CDC, 2001). Throughout world distribution of *Aedes albopictus* is included along with some regions of Asia and in introduction Caribbean (mortality & morbidity weekly report 1989) along with tropical & subtropical are also included (O'Meara et al., 1997).

Life cycle and morphology of *Aedes albopictus:*

Life cycle of *Aedes albopictus* consists of four stages egg, larvae, pupa & adult.



(Giovanni et.al.,2020).

Ecology of *Aedes albopictus*:

Aedes albopictus are also known as Asian tiger mosquito, they belong to family of Culicidae, and these mosquitoes are present in tropical & subtropical areas of south-east Asia. But since past few years these species have been spread in many countries through international travel & transport (Scholte *et al*., 2007). *Aedes albopictus* eggs are

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water resistant & are able to survive for several days (Juliano *et al*., 2005). These are aggressive day biter mosquitoes and they feed human, reptiles & birds (Eritja *et al*., 2005). Biting rate of these mosquitoes may be 30 – 48 per hour (Cancrini *et a*l., 2003). If there is large range of temperature then also these mosquitoes are able to survive (Delatte *et al*., 2009).

Aedes albopictus breeding place are mostly water holes, small restricted water bodies which are surrounded by vegetation. Ecological flexibility of these mosquitoes allows making colony in man-made sites & urban areas. These mosquitoes breed in abandon containers like flowerpots, birdbaths, soda cans and mostly in tyres. When decaying leaves of neighboring trees falls in tyres or containers then chemical is produced due to which for breeding, they get a very good substrate (Eritja *et al*., 2005).

Genus *Anopheles*

One species each of *Anopheles* (*Anopheles stephensi*) has been recorded from four different sites of Lucknow city as described below.

Anopheles stephensi:

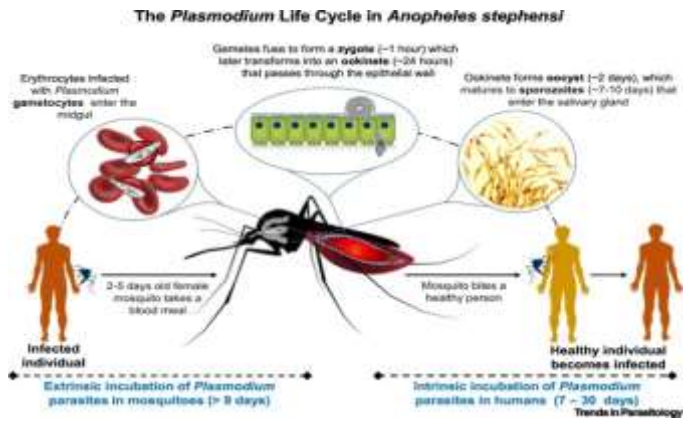
The primary vector of malaria disease, it originated in the Arabian Peninsula and Asia. Specifically, *Anopheles stephensi* was identified in 2012 in Africa, specifically in the city of Djibouti (Faulde et al., 2014), followed by Ethiopia, Somalia, and Sudan (Carter et al., 2018; Ahmed *et al*., 2021). This vector has three types (type, intermediate, and mysorensis) according to the number of ridges and egg dimensions. Two races (*A. stephensi sensu stricto* and *A. s. mysorensis*) are abundant in the environment (Ishtiaq et al., 2021). Intermediate forms of *Anopheles* are the potential malaria vector for both urban and rural environments. The variety forms are found in rural areas and are considered poor malaria vectors due to their zoophilic nature (Sinka et al., 2011). Approximately 12% of all malaria cases found in India is linked to *Anopheles stephensi* (Tikar et al., 2011).

Distribution:

Anopheles stephensi is a subtropical species that is predominantly found on the Indian subcontinent (with the exception of Sri Lanka and Nepal) (Malhotra et al., 2000) and is also prevalent throughout the Middle East and South Asia, including Bahrain, Afghanistan, Saudi Arabia, India, Bangladesh, Egypt, Iran, Oman, Iraq, Thailand, Pakistan, and China (Dash et al., 2007). *Anopheles stephensi* was first identified on the African continent in Djibouti, on the Horn of Africa, in 2012 (Faulde et al., 2014; WHO, 2020), while it was discovered in Ethiopia, Sri Lanka and Sudan in 2016, 2017 and 2019 respectively (Carter et al., 2018; WHO, 2020).

Life cycle and morphology of *Anopheles Stephensi:*

Life cycle of *Aedes stephensis* consists of four stages egg, larvae, pupa & adult. *Anopheles stephensi* has two phases in its life cycle: terrestrial and aquatic. The aquatic phase consists of eggs, larvae, and pupae, while the terrestrial phase consists only of the adult stage.



(Farah et.al.,2021).

Ecology of *Anopheles stephensi*:

The larvae of *Anopheles stephensi* may be found in swamps, ponds, marshes, streams and other sources of water holding places in rural areas (Rueda et al., 2007). In spite of this, they also live in small spaces like tree holes, leaf axils, and artificial containers (Harbach et al., 2007). Only stone pots and earthenware containers are preferred by the larvae of *Anopheles mysorensis* (Sinka et al., 2011). *Anopheles stephensi* can also withstand high salinities. It has been observed to spawn easily in water with salinities that are comparable to or even higher than those of sea water (Manouchehri et al., 1976). Additionally, *Anopheles stephensi* reproduces in a variety of urban water-bodies, but primarily in man-made containers, overhead tanks, ground-level water-tanks and walls (Jeyabalan et al., 2003). The majority of larvae feast on water-suspended bacteria and particulate debris. Females consume blood meals, which aid in the production of fertile eggs, while adult males consume floral nectar later in development (Harbach et al., 2007).

Management of *Anopheles stephensi*:

Environmental changes, indoor residual insecticide spraying, community education, spatial repellents, insecticide-treated bed nets, and biological control are just a few of the management strategies that can be employed to lower the risk of malaria transmission. *Anopheles stephensi*'s rapid spread into East Africa could complicate malaria control efforts and call for a review of current malaria preventive initiatives to take into account the potential contribution of this mosquito to urban malaria transmission (Benelli and Beier, 2017, Sougoufara et al., 2017).

Genus *Culex*

One species *Culex* (*Culex quinquefasciatus*) has been recorded from four different sites of Lucknow city as described below:

***Culex quinquefasciatus*:**

Around the world, subtropical and tropical regions are home to *Culex quinquefasciatus*. It has a medium size and is frequently called a southern house

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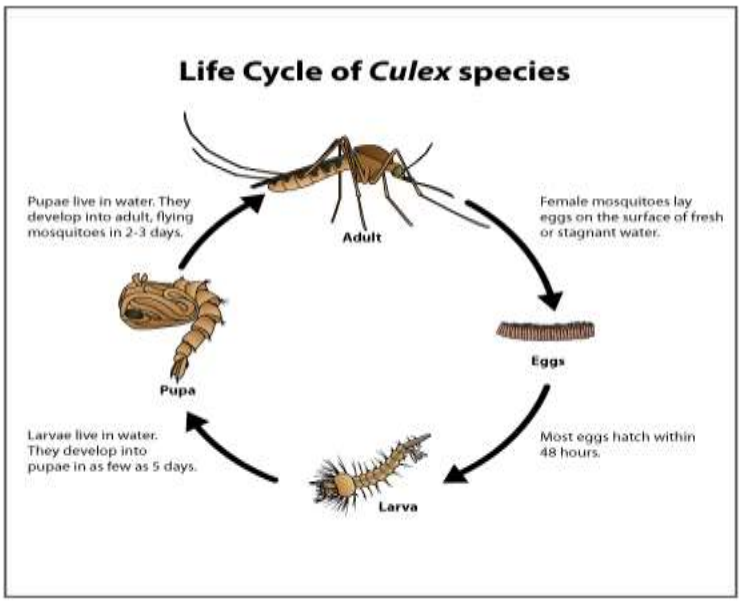
mosquito. It can transmit diseases like West Nile virus, filariasis, avian malaria, Japanese encephalitis, St. Louis encephalitis, and filariasis (*Wuchereria bancrofti*). In 1823, it was first discovered in the Mississippi River, USA. It is believed that it originated in Asia and was colonized in Africa after transmission through a slave ship. (AMCA. 2005).

Distribution:

A sub-tropical species called *Culex quinquefasciatus* is typically found between the latitudes of 36°N and 36°S. It is found in South America, North America, New Zealand, Asia, Australia, Middle East and Africa. It cannot be found in cold or dry regions (Barr. 1957).

Life cycle and morphology of *Culex quinquefasciatus:*

Life cycle of *Culex quinquefasciatus* consists of four stages egg, larvae, pupa & adult.



(Espanol Spanish 2022).

Ecology of *Culex quinquefasciatus*:

In addition to flooded latrines, flooded open cement drains, kitchens, ground ditches, wells and ponds and water collected from housetop tanks, *Culex quinquefasciatus* is also prevalent in household water. The most suitable condition for breeding is contaminated surface water that is rich in organic matter (Weinstein et al., 1997). According to Derraik et al., (2002), this species also reproduces in phytotelmata, shallow ponds, and man-made habitats including septic tanks, wells, drains, and other tiny containers (Laird, 1995)

Management of *Culex quinquefasciatus*:

Cultural control:

The most effective approaches to reduce the spread of illnesses by decreasing mosquito bites are through personal protection, chemical control and the elimination of breeding sites. Long sleeve clothes and bug repellent are advised due to the nocturnal

feeding nature of *Culex quinquefasciatus*. Limiting outdoor activity also reduces the chance of getting bitten by *Culex quinquefasciatus*. Humans are responsible for creating aquatic habitats that are rich in nutrients for *Culex quinquefasciatus*. This kind of aquatic ecosystem must be eliminated by avoiding overwatering plants, regular replacement of water in pet bowls, removing unwanted containers, and maintaining mosquito eating fish populations in ponds. Old tires must be removed, water-holding containers must be covered, and obstructions must be cleared from drainage ditches. Large aquatic habitats (waste water containers and storm water basins) made by humans must be eliminated (O'Meara, 2014).

Conclusion

The comprehensive survey of mosquitoes conducted in the Lucknow region between 2018 and 2019 has provided invaluable insights into the ecological dynamics and public health implications of mosquito populations in the area. Through meticulous field observations, trapping methodologies, and specimen analysis, the survey captured a diverse array of mosquito species, shedding light on their abundance, distribution, and potential disease vectors.

The findings of the survey underscore the complexity of mosquito ecology in Lucknow, influenced by a myriad of factors including habitat characteristics, climatic fluctuations, and human activities. Notably, the presence of disease vectors such as *Aedes aegypti* and *Aedes albopictus* highlights the ongoing threat of mosquito-borne diseases such as dengue, chikungunya, and Zika virus within the region. Additionally, the identification of *Anopheles stephensi* and Culex *quinquefasciatus* mosquitoes emphasizes the importance of continued vigilance in malaria and other vector-borne disease control efforts.

The implications of this research extend beyond academic discourse, informing practical measures aimed at mitigating the risk posed by mosquito-borne diseases in Lucknow. By elucidating the factors driving mosquito abundance and distribution, the survey provides a foundation for targeted vector control strategies, encompassing habitat management, insecticide application, and community engagement initiatives.

As we reflect on the findings of the survey, it becomes evident that effective mosquito control requires a multifaceted approach, integrating scientific research, community participation, and policy interventions. Moving forward, continued surveillance and research efforts will be essential to monitor changes in mosquito populations and adapt control strategies accordingly. By collaborating across disciplines and engaging stakeholders at all levels, we can strive towards a future where communities in Lucknow and beyond are better protected from the threats posed by mosquito-borne diseases.

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Unleashing The Power of Artificial Intelligence in Nature Conservation

Ritwik Sharma
Sheiling House School, Kanpur
Email: ritwiksharma2010@outlook.com

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Abstract:

In the harmonious interplay between humanity and the natural world, the stakes have never been higher. Conservationists are faced with the formidable task of preserving biodiversity and safeguarding ecosystems in the face of unprecedented challenges. This chapter delves into the pivotal role played by Artificial Intelligence (AI) in redefining the landscape of conservation efforts. From reimagining wildlife monitoring to optimizing resource allocation, AI emerges as a transformative force in the ongoing quest for sustainable coexistence. In this chapter, we are going to see that how AI can help us imagine, recreate and solve problems we face over time.

Keywords: Agriculture, Artificial Intelligence, Biodiversity**,** Resource, Wildlife.

Introduction:

In the intricate tapestry of ecological preservation, the fusion of Artificial Intelligence (AI) and conservation science has emerged as a transformative force. This chapter explores the unprecedented role played by AI in the relentless pursuit of safeguarding biodiversity and preserving our planet's delicate ecosystems.

AI, with its capacity for real-time monitoring, predictive analytics, and data-driven decision-making, is redefining the landscape of conservation efforts. From the heart of wildlife reserves to the vast expanses of agricultural landscapes, intelligent technologies are becoming invaluable tools in the hands of conservationists.

As we journey through the pages that follow, we will uncover exemplary conservation projects harnessing the power of AI. From the precision monitoring of endangered species to the optimization of resource allocation, each endeavour reflects the promise of a future where technology and conservation converge seamlessly.

Yet, as we embrace this frontier, ethical considerations and responsible governance must accompany technological advancements. This chapter unfolds the stories of innovation and responsibility, showcasing how AI, when wielded judiciously, becomes a catalyst for a sustainable and resilient coexistence between humanity and the natural world.

Eyes in the Wild - AI in Wildlife Monitoring:

- **Wildlife Tracking and Identification:**

In the heart of the wilderness, AI acts as an invaluable ally in tracking and identifying elusive species. The advent of camera traps equipped with AI-driven image recognition technologies has revolutionized wildlife monitoring. These unobtrusive devices capture candid glimpses of animal behavior, enabling researchers to track and

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understand populations with unparalleled precision.

Additionally, drones equipped with sophisticated AI algorithms take to the skies, offering a bird's-eye view of remote habitats. Beyond their breathtaking aerial cinematography, these drones play a pivotal role in anti-poaching efforts. AI empowers them to identify and track endangered species, providing real-time data to conservationists and law enforcement agencies. (Brickson, Zhang, Vollrath, & Hamilton, 2023)

- **Illegal Activity Detection:**

Satellite imagery analysis, driven by AI algorithms, acts as a vigilant guardian against illicit activities. From the sprawling Amazon rainforest to the vast African savannas, AI identifies and monitors potential threats such as illegal logging and poaching. The speed and accuracy with which AI processes vast datasets enable conservationists to respond swiftly, protecting endangered ecosystems from harm. (Mohanta, 2021)

Decoding Nature's Patterns - AI in Data Analysis:

- **Biodiversity Insights:**

AI's prowess in handling vast datasets becomes evident in the realm of biodiversity analysis. Species distribution modeling, powered by AI algorithms, provides scientists with invaluable insights into migration patterns and ecosystem health. Conservation decisions are increasingly informed by the nuanced understanding derived from AI-driven data analysis, ensuring more effective strategies for biodiversity preservation. (Rani, Singh, & Arya, 2024)

- **Climate Intelligence:**

As the climate crisis looms large, AI steps into the realm of climate change modeling. Predictive analytics, driven by AI algorithms, analyze complex climate data to anticipate shifts in weather patterns. This invaluable information aids conservationists in designing adaptive strategies to mitigate the impact of climate change on vulnerable ecosystems.

Precision Conservation:

- **Resource Optimization:**

In the delicate balance between conservation and human development, AI contributes by optimizing resource allocation. By identifying critical areas for protection and prioritizing conservation projects, AI ensures that limited resources are utilized efficiently. Moreover, in the realm of precision agriculture, AI promotes sustainable land use practices, minimizing the ecological footprint and preserving natural habitats.

- **Precision Agriculture: The Green Revolution 2.0:**

The intersection of AI and agriculture marks a paradigm shift in sustainable land use. AI algorithms analyze soil health, weather patterns, and crop performance to optimize agricultural practices. This not only maximizes yields but minimizes the environmental impact, reducing the need for chemical inputs and preserving biodiversity within and around agricultural landscapes. (Sharma, Dadheech, & Kumar, 2023; Arya, 2018)

Engaging the Public - AI in Citizen Science:

- **Crowdsourced Conservation:**

The fusion of citizen science and AI-powered tools creates a powerful synergy for conservation efforts. Citizen scientists contribute data through various initiatives, and AI processes this information at scale. The collective power of public engagement and AI-driven analysis enables large-scale data collection, enhancing our understanding of biodiversity and ecosystem dynamics.

- **Education through Immersion:**

Beyond data analysis, AI contributes to public engagement through immersive experiences. Virtual and augmented reality, powered by AI, create educational platforms that transport individuals into the heart of conservation challenges. These experiences foster a deeper connection with nature and cultivate a sense of responsibility toward environmental stewardship(Patwardhan & Kokane, 2022).

Safeguarding Against Threats - AI in Disease Monitoring:

- **Wildlife Health Surveillance:**

AI's role extends to monitoring wildlife health, particularly in the context of disease surveillance. Early detection is paramount, and AI algorithms analyze data to identify patterns indicative of disease spread. This proactive approach enables conservationists to implement measures to prevent the transmission of diseases that could devastate both animal and human populations. (Brickson, Zhang, Vollrath, & Hamilton, 2023)

- **One Health Approach: Bridging Gaps Between Human and Animal Health:**

AI contributes to a holistic "One Health" approach, recognizing the interconnectedness of human, animal, and environmental health. By monitoring zoonotic diseases and identifying potential outbreaks in wildlife populations, AI supports a proactive stance in preventing the spillover of diseases from animals to humans.

Looking Ahead - Predictive Analytics for Conservation:

- **Anticipating Habitat Changes:**

The forward-looking capabilities of AI in predictive analytics offer a glimpse into the future of conservation. By analyzing data trends, AI helps conservationists anticipate habitat changes. This foresight allows for the proactive planning of measures to protect vulnerable species, ensuring their survival in a rapidly changing world

- **Ethical Considerations and AI Governance in Conservation:**

As AI becomes increasingly integrated into conservation practices, ethical considerations and governance frameworks are paramount. This section explores the responsible use of AI in conservation, addressing issues such as data privacy, bias, and the need for transparent decision-making processes. (Dubey, 2023)

- **Urban Planning and Smart Cities:**

AI-powered solutions to optimise transportation and energy use. With more people living in cities across the globe, the idea of smart cities is becoming more and more popular. AI technologies are revolutionising urban living by streamlining public

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transit, reducing energy use, and improving traffic patterns(Khatri et al., 2022). AI-enabled smart grids facilitate real-time energy distribution monitoring and control, lowering waste and encouraging the incorporation of renewable energy sources(Singh et al., 2022) (Rayhan, 2023).

AI In Action: Examples of Conservation Projects Powered by AI:

- **Wildlife Monitoring with Trail Guard AI:**

The Trail Guard AI project, developed by Intel and the National Geographic Society, uses AI-powered cameras to detect and alert authorities to potential poaching activities. The cameras, strategically placed in wildlife reserves, analyze images in real-time and send alerts if human or vehicle presence is detected in prohibited areas, helping to combat illegal hunting.

- **Instant Wild:**

The Zoological Society of London's (ZSL) Instant Wild project utilizes AI to monitor and identify species in their natural habitats. By deploying camera traps connected to a cloud-based platform, the system can recognize and classify animals automatically. This data aids in population monitoring, research, and conservation planning.

- **Smart Parks in Africa:**

Several national parks and wildlife reserves in Africa have implemented smart park technologies that utilize AI for wildlife monitoring and anti-poaching efforts. Drones equipped with AI algorithms patrol vast areas, identifying and tracking animals, as well as detecting signs of illegal activities. These technologies enhance the efficiency of park rangers and contribute to the protection of endangered species.

- **Conservation FIT:**

The Conservation FIT project, led by the Wildlife Conservation Society (WCS), uses Artificial Intelligence to identify and track individual animals based on their unique physical characteristics. By analyzing camera trap images, the system can recognize specific patterns like the markings on a cheetah's coat or the stripes on a tiger, enabling more accurate population estimates and monitoring efforts.

- **Google's Global Fishing Watch:**

Global Fishing Watch, a collaboration between Google, SkyTruth, and Oceana, employs AI to track and combat illegal fishing activities. The platform uses satellite data and Artificial Intelligence to analyse vessel movements and identify suspicious behaviour. By monitoring global fishing activities, the project helps enforce fishing regulations and promote sustainable practices. (Global, 2016)

- **Microsoft's AI for Earth:**

Microsoft's AI for Earth initiative supports various conservation projects by providing access to AI tools and resources. It’s working can be described as, A scientist or volunteer captures an image of an animal that has distinctive patterns. The user uploads the image to the cloud, or The AI pulls them from social media searches. Then, pattern recognition is used by computer vision models to determine the species

and individual animal identification. Then, using Wildbook, users can track their preferred animals. Scientists can track individual movements, animal interactions, and population trends with the use of aggregated data. (Microsoft, 2024)

Wildbook:

Wildbook, an open-source platform developed by the Wild Me organization, uses AI to identify and track individual animals based on their unique markings, scars, and features. It has been applied to various species, including whales, sharks, and giraffes, enabling researchers to monitor populations and understand migration patterns. (Wildme, 2024)

Conclusion

In conclusion, the symbiotic relationship between AI and conservation efforts stands as a beacon of hope. From the heart of the wilderness to the realms of data analysis and public engagement, AI is a potent force driving innovation in conservation. As we navigate the complexities of preserving our planet's biodiversity, AI emerges as a steadfast companion, offering novel solutions and empowering humanity in the ongoing pursuit of harmonious coexistence with the natural world. The future of conservation is undeniably intertwined with the capabilities of Artificial Intelligence, and together, they pave the way for a more sustainable and resilient planet.

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Synthesis of Acid-Functionalized Magnetically Recyclable Nanoparticles and their Applications in Organic Transformation

Shripad M. Patil
Ashwini V. Bedre
Dada Patil Mahavidyalaya, Karjat-414402, Ahmednagar, Maharashtra, India.
Email: ashwinibedre102@gmail.com

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Abstract:

The current work created universal and adaptable techniques for functionalizing ferrite magnetic nanoparticles (MNPs) with the surfaces of different functionalized chemicals and metal oxide. It has been proven that the surface of different functionalized compounds and metal oxides contains ferrite nanoparticles (MNPs). Co-precipitation-prepared samples were coated with varying TEOS ratios using the Stobber process. We describe a range of organic reactions, including multi-component, cyclization, condensation, oxidation-reduction, coupling, and some additional reactions, that were performed under different reaction circumstances employing ferrite magnetic nanoparticles. The benefits of this catalyst include the absence of any time-consuming workup or purification under moderate reaction conditions, as well as the production of outstanding yields with a quick reaction time.

Keywords: Silica Coated Nanoparticles, Acid functionalized compounds, Organic reactions, etc.

Highlights:

- Specific Topic
- Specific Area of Research
- Acid-functionalized ferrite magnetic nanoparticle promoted multicomponent reaction and acylation reaction

Introduction:

Developing environmentally friendly and sustainable organic reactions that are either solvent-free, catalyst-free or carried out in an aqueous media has been the focus of excellent research efforts. [1-11] A green and sustainable method of removing hazardous compounds is used to reduce pollution in organic synthesis, as it typically includes the use of several solvents that may be poisonous, combustible, and detrimental to both humans and the environment. [12-14] To minimize waste or byproducts, use the least amount of energy necessary, and employ less poisonous, corrosive, and hazardous solvents or catalysts, the organic synthesis should be conducted utilizing the method of the conversion of reaction into the product. [15] It is safe, inexpensive, simple to use, reusable, less dangerous, and readily worked from reaction, following the principles of sustainable chemistry. [16-19]

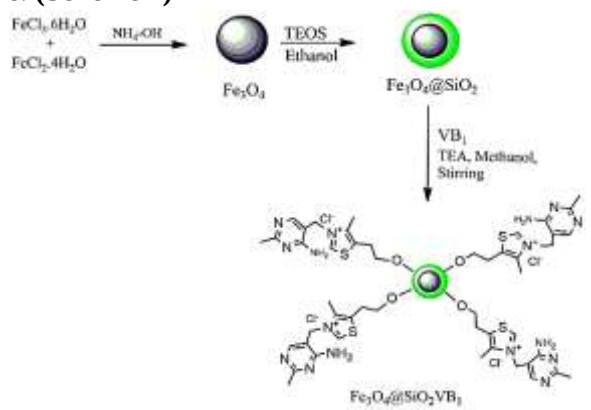
The use of magnetic nanoparticles (MNPs) as different catalysts has grown in the past few years. The benefits of this catalyst include the creation of a sustainable and

environmentally friendly method for organic conversion through the use of recyclable catalyst and less hazardous, mild, or solvent-free reaction conditions. Techniques produce high product yields and are simple to use from the reaction. [20-25] The catalyst used in organic processes exhibited distinct catalytic capabilities that were reinforced by the production of magnetic nanoparticles. Following the reaction's conclusion, the catalyst was once more recycled after being separated using an external magnet. Centrifugation and traditional filtering are avoided in the lack of purification. This method works well for separating many metals, including nickel, cobalt, and ruthenium. [26-29] Ferrite magnetic nanoparticles are simple to work with and manufacture. The catalyst may be recycled for the subsequent reaction and is less harmful. [30] The process of creating ferrite magnetic nanoparticles by co-precipitation. Pure Ferrite magnetic nanoparticles are produced when Fe (II) and Fe (III) are converted using the reduction procedure. This process results in a precipitate that is black and is easily separated by an external magnet. [31] When harmful chemicals, catalysts, and solvents are present in organic transformation processes, the focus on environmental pollution grows. As a result, different green reagents, catalysts, and solvents are used in the reaction and pollution control processes when developing and designing synthetic methods. [32-34]

Synthesis and Application of Nanoparticles in Organic Reactions:

A variety of synthetic techniques for creating distinct ferrite magnetic nanoparticles have been documented in the literature; a selection of these techniques is presented below. This is a significant usage for acid-functionalized nanocatalysts, which are produced and employed in many organic processes.

F. Abbasi, M. Abdoli-Senejani, and N. Azizi [35] are reported as green and highly efficient silylation of hydroxyl groups with hexamethyldisilazane in the presence of thiamine hydrochloride supported ferrite nanoparticle. Thiamine hydrochloride supports magnetic nanoparticle synthesis by using silica coating magnetic nanoparticle and thiamine hydrochloride in the presence of tri ethyl amine and methanol reaction mixture stirring at room temperature for about 24 h. After completion of the reaction nanoparticle was separated by a magnet this nanoparticle again was acidified with HCl and dried well at room temperature. **(Scheme 1)**



Scheme 1. Synthesis of thiamine hydrochloride supported silica-coated nanoparticles

The reaction which (1mmol) alcohol or phenol protected by using (1 mmol)

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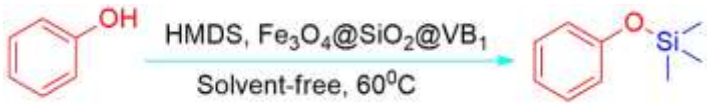
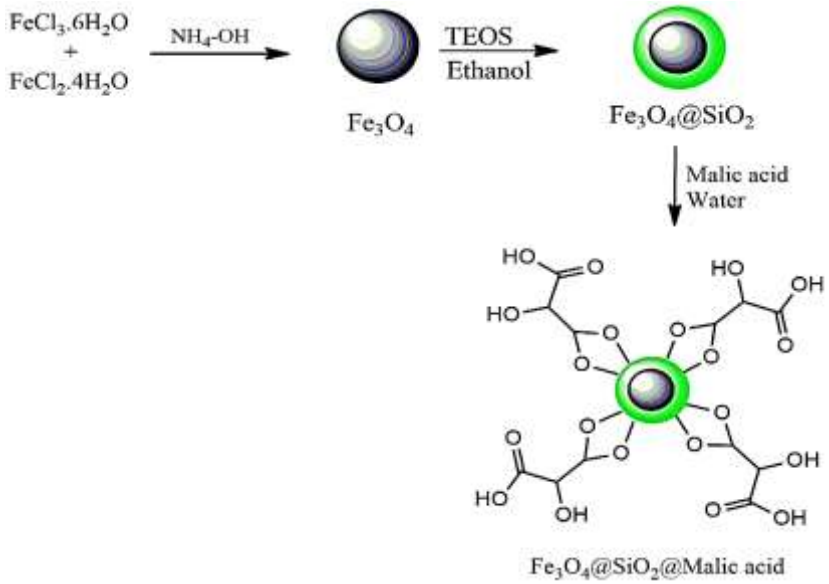
HMDS in the presence of silica coating thiamine supporting magnetic nanoparticle (10 mg) reaction mixture under stirring at 60°C. Monitor reaction by TLC. After completion of the reaction extract with diethyl ether and nanoparticle separated by using a magnet, this nanoparticle was again recycled. The ether layer evaporates to give a pure product. In this reaction excellent yield of product and also gives chemo selectivity of the reaction. The nanoparticle gives four times reaction without any loss of functionality. **(Scheme 2)**

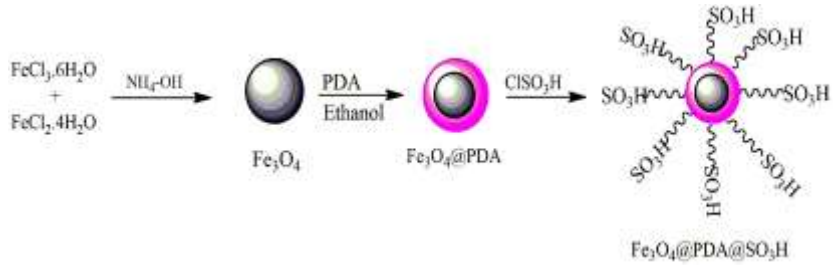


Scheme 2. Protection of phenol derivatives using thiamine hydrochloride nanoparticles

S. Ghafoor and S. Ata [36] reported that the synthesis of malic acid-supported silica coating nanoparticles is applicable in the remediation of cadmium and nickel from aqueous solution. Green acid functionality by malic acid supported silica coating magnetic nanoparticle is prepared by the sol-gel method. This catalyst was prepared from silica-coated magnetic nanoparticles and malic acid in an aqueous medium this reaction mixture was stirred at 90°C for about 2 hours. After completion of the reaction, nanoparticles were separated by using an external magnetic wash with deionized water about four times and dried well at room temperature. **(Scheme 3)** The synthesis of this malic acid nanoparticle are effective catalyst for the removal of heavy metals like cadmium and nickel from the wastewater resource. The acid functional group is a good property of absorption of metal ions from the water. This paper also studies the effect of pH by the separation of metal.

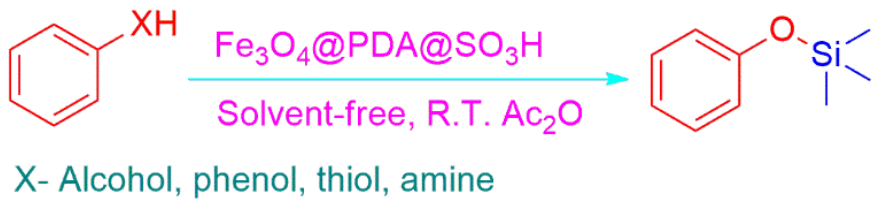


Scheme 3. Synthesis of thiamine hydrochloride supported silica-coated nanoparticles



Scheme 4. Synthesis of Polydopamine chlorosulfonic acid supported silica-coated nanoparticles

H. Veisi, S. Taheri, and S. Hemmati [37] reported a novel ionic liquid supporting silica coating magnetic nanoparticle which was synthesis by using ferrite magnetic nanoparticle (1g) and polydopamine (1g) in aqueous ammonium hydroxide added in the solution and stirring well. After a few hours separate out this nanoparticle by magnet. And the last step this nanoparticle again acidifies by using chlorosulfonic acid added about 1 mL dropwise addition in the presence of (20 ml) DCM solvent and stirring 20 min. Finally, the nanoparticles were separated by the magnet and dried well. **(Scheme 4)** Polydopamine chlorosulfonic acid supported magnetic nanoparticle well developed and used to synthesize of acylation of phenol, amine & thiol functional group by using acetyl anhydride in the presence of Fe_3O_4-PDA@SO_3H under solvent-free conditions.



Scheme 5. Acylation of amine, phenol, thiol, and alcohol by using Polydopamine chlorosulfonic acid supported silica-coated nanoparticles

Acetic anhydride (1mmol), Aniline (1mmol), and added Fe_3O_4-PDA@SO_3H (30 mol%) magnetic nanoparticle and reaction mixture stirring well for about 30 min. Monitor the TLC completion of the reaction. After completion of the reaction ethyl acetate and filtered evaporates ether layer to give a pure acylation product. **(Scheme 5)** Magnetic nanoparticles were again recycled, washed with ethanol, and dried well. In this reaction, the Aromatic amine and the primary amine have faster reaction takes place than the secondary amine. In this reaction scheme, acylation also takes place in the hydroxyl and thiol functional groups.

R. Gupta, M. Yadav R. Gaur, G. Arora, and R. Sharma [38] reported that the novel ionic liquid supporting magnetic nanoparticles was synthesized by using silica coating ferrite magnetic nanoparticle by sol-gel method. Catalyst synthesis by two steps, the silica-coated magnetic nanoparticle, 3-chloropropyltrimethoxysilane (CPTMS) to form Fe_3O_4@SiO_2@CPTMS. This catalyst reacts with N-butyl imidazole to form (IL-Cl@FMSNP). And finally, this nanoparticle reacts with sodium acetate to form acetate-

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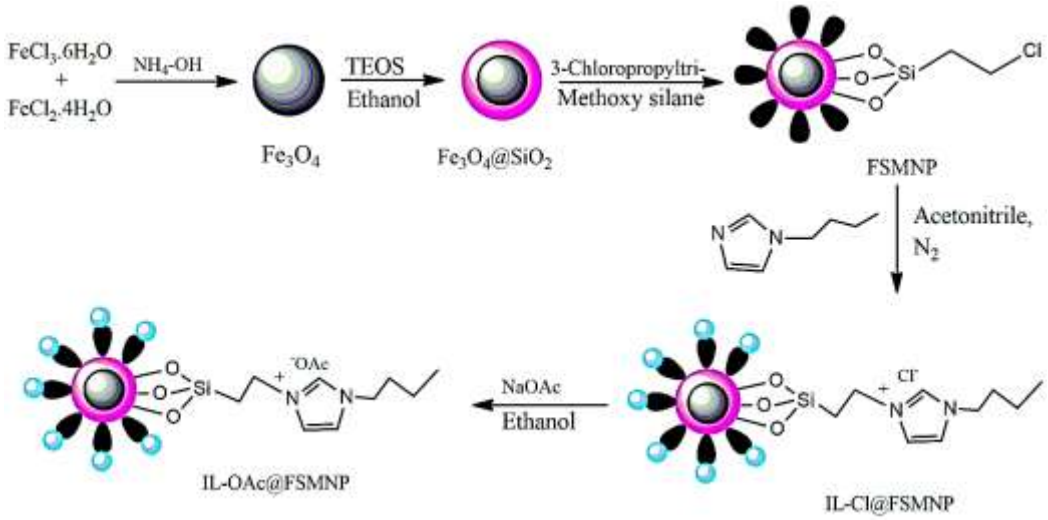
based butyl imidazolium ionic liquid (IL-OAc@FMSNP). **(Scheme 6)**



Scheme 6. Synthesis of IL-OAc@FSMNPs supported silica-coated nanoparticles

Synthesized ionic liquid supporting magnetic nanoparticle which is used for the synthesis of N-aryl 2-oxazolidinone derivatives gives a selective product. The reaction between aromatic amine (2 mmol), ethylene carbonate (8 mmol), and the amount of nanoparticle (10 mg) catalyst added to this reaction mixture stirred at 120°C about 12h. Completion of reaction monitored by using TLC. Finally, the reaction mixture was extracted by using ethyl acetate and separated magnetic nanoparticles by using an external magnet, washing well with deionized water and the catalyst was recycled. Evaporate the ethyl acetate layer to give pure selectivity of this product. **(Scheme 7)**

Scheme 7. Synthesis of N-aryl 2-oxazolidinone derivative catalyzed by IL-OAc@FSMNPs nanoparticles

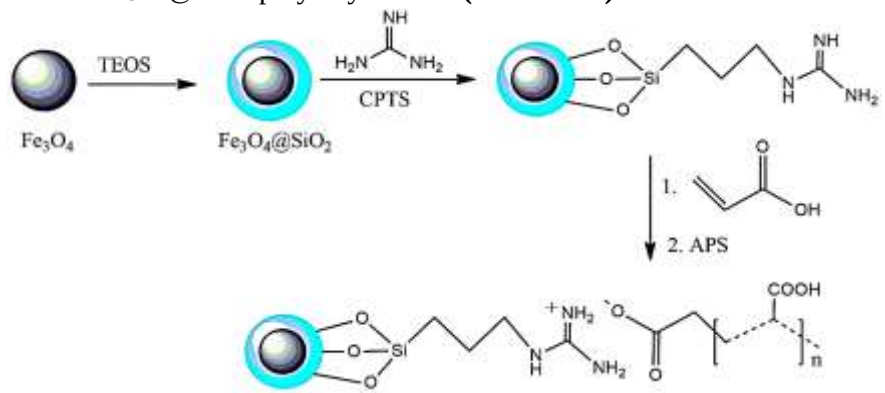
K. Azizi et al. [39] reported the sulfated boric acid nanoparticle which was synthesized by using boric acid and chlorosulfonic acid. The silica-coating magnetic nanoparticle (1 g), $SOCl_2$ (1 mL), and dichloromethane reaction mixture were stirred for 1h in an ice bath. After a few min added acetone and boric acid and continuously stirring 12h. This nanoparticle was collected by using a magnet wash with deionized water. This occurs in silica-coated boric acid nanoparticles. Silica coated boric acid nanoparticle (2 g) in DCM stirring reaction mixture about 10 min. adding the chlorosulfonic acid (5 ml) dropwise at room temperature and this reaction mixture was again stirred for 4 h. After completion of the reaction collected nanoparticle by using an external magnet and dried well in an oven at 80°C overnight. To form the sulfated boric acid-silica coated magnetic nanoparticle. **(Scheme 8)**

Hantzsch ester synthesis by using silica coating sulfated boric acid by using ethyl acetoacetate (2 mmol) aromatic aldehyde (1 mmol) and ammonium acetate (1 mmol) in ethanol at added (10 mmol) magnetic nanoparticle at 60°C stirring 20 min to form 1,4 dihydropyrimidine derivatives. **(Scheme 9)**

Scheme 8. Synthesis of sulfated boric acid supported silica-coated nanoparticles

Scheme 9. Sulfated boric acid supported silica-coated nanoparticles catalyzed under Hantzsch synthesis

P. Mohammadi and H. Sheibani [40] reported that the synthesis of quinidine-acrylic acid-supported silica-coated nanoparticles is used to prepare pyrane and Chromene derivatives. The nanoparticle was prepared from $FeCl_2.4H_2O$ and $FeCl_3.6H_2O$ was dissolved in de-ionized water under nitrogen stirring well to form Fe_3O_4 nanoparticle. The nanoparticle was separated using an external magnet and dried well. In the second step, the Nanoparticle (1 g) was dissolved in ethanol, and added guanidine mixture was sonicated for about 5h then separated nanoparticle by using an external magnet and washing with ethanol. Finally, Fe_3O_4@SiO_2-guanidine (500 mg) nanoparticle was dispersed in de-ionized water added acrylic acid (1 mL) and ammonium persulfate (0.25 g) as an indicator mixture was heated at 70°C for 5h. Then separate the nanoparticles using an external magnet wash them with ethanol many times dry them well to obtain Fe_3O_4@SiO_2-polyacrylic acid. **(Scheme 10)**



Scheme 10. Synthesis of polyacrylic acid supported nanoparticles

Synthesis of tetrahydro benzo [*b*] pyrane by Knoevenagel-Michael cyclo

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condensation using multi-component condensation reaction containing several aromatic aldehydes, malononitrile, and dimedone reflux at 70°C at the appropriate time and in the presence of water as a solvent. Then, also preparation of 3, 4-dihydropyrano[*c*] Chromene derivatives were prepared through a three-component condensation reaction containing verities aromatic aldehydes, Malononitrile, and 4-hydroxy coumarin using the same reaction conditions then completion of the reaction extract with ether and filter it. Evaporate the solvent to give a crude product. The nanocatalyst could be recycled by using an external magnet and reused in a model reaction a minimum of 6 times without any significant loss of catalytic properties. **(Scheme 11)**

Scheme 11. Synthesis of tetrahydro benzo [*b*] pyrane derivatives under polyacrylic acid supported nanoparticles

Conclusion:

The synthesis of silica nanoparticles by using tetra ethyl ortho silicate coating with different organic acids. A catalyst is used in the reaction and acts as a green acid catalyst, Nano catalyst is highly active and also recyclable. Magnetic nanoparticles were made by using green catalysts like thiamine hydrochloride, Malic acid, boric acid, chlorosulfonic acid, Ionic liquid, etc. Synthesized magnetic nanoparticles are used for organic reactions like acylation, cyclization, and multi-component reactions. The green chemistry approach to the synthesis of such a catalyst is the best catalyst for organic reaction. To date, the best results are found with silica-coated ferrite nano particles due to their activity and capacity to recycle.

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Graphene: Fundamentals and Applications

Yogesh Pathak
Department of Physics,
Karmaveer Bhaurao Patil Mahavidyalaya, Pandharpur [MS], India.
Suraj Haral
Department of Physics,
Maharaja Jivajirao Shinde Mahavidyalaya, Shrigonda [MS], India.
Dr. Sanjay Thube
Department of Physics,
Dada Patil Mahavidyalaya, Karjat [MS], India.
Pravin More
Department of Physics,
Ahmednagar College, Ahmednagar [MS], India
***Email**: drpathakyogiraj@gmail.com*

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Abstract:

Graphene is gapless semiconductor which is extracted from graphite and shows properties like flexibility, light weight, very high electrical conductivity which leads to several industrial, medical, electrical, sports applications, thermal conductivity of ranges from 4840 to 5300 W/mK at room temperature.

Keywords: Graphene, Structure, Properties, Sensors, Medical, Industrial Etc.

Introduction:

Graphene is an allotrope of carbon in which atoms arranged in a hexagonal lattice nanostructure e in a single layer, means it has hexagonally arrayed sp^2 bonded carbon atoms [1]. Graphene word is combination of “graphite" and the suffix “_ene”, which reflects graphite is allotrope of carbon containing several double bonds with carbon-to-carbon distance of 0.142 nm. Atoms in Graphene are attached with other three adjacent carbon atoms by delocalised which leads the valance band extend in whole sheet. Graphene is well known for synthesizing different functional materials for large varieties of applications because of its extensive properties like light weight [2], plane structure, broader surface area, super conductivity, good chemical stability, high strength, flexible and better electron mobility. [3-4].

Structure of Graphene:

In 1947 P.R. Wallace has investigated graphene theory to study the electrical properties of graphite [5]. However, in 2004 the monolayer graphene sheets were synthesized first time by Andre Geim and Konstantin Novoselov and got the Nobel prize for this discovery in 2010. They used ‘Scotch tape method,’ for synthesis of graphene form grahite where monolayers are isolated by mechanical exfoliation [6]. The following fig. shows hexagonal structure observed by scanning tunnelling microscope (STM)

images of graphene supported on silicon dioxide substrates which conforms presence of graphene on the subtrate's lattice by causing rippling in the images and are not intrinsic [8-9].

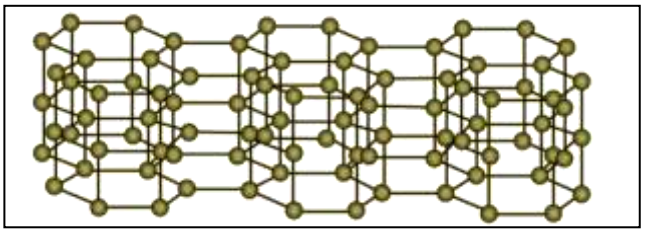

Fig. Structure of Graphite.

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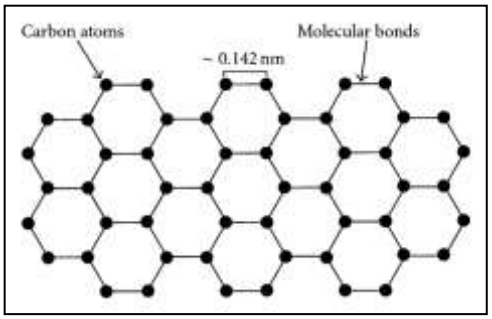

Fig. Structure of Graphene [7].

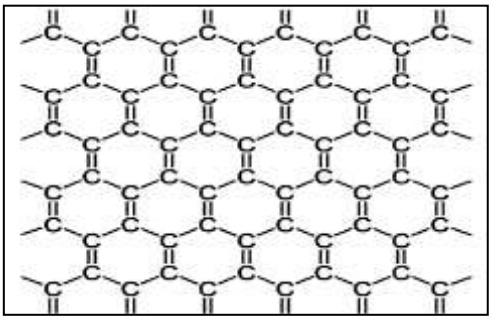

Fig. Structure of Graphene.

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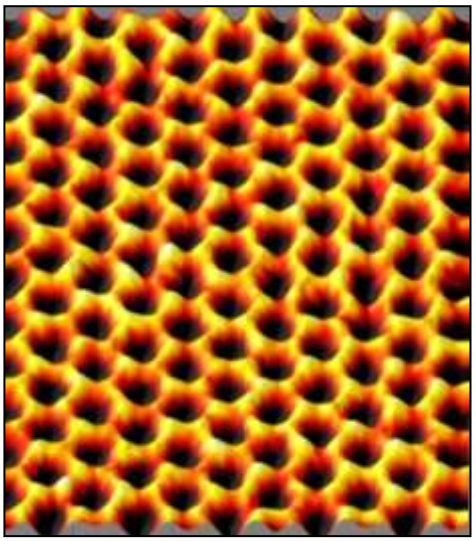

Fig. Scanning probe microscopy image of graphene.

Ref. https://upload.wikimedia.org/wikipedia/commons/thumb/5/53/Graphene_SPM.jpg/170px-Graphene_SPM.jpg

There are different Types of Graphene i.e. Monolayer graphene and multilayer graphene where in monolayer one layer of carbon set up in 2 dimension, sp^2 hexagonal honeycomb like structure. Whereas two layer structure known as bilayer, three layer is known as triple and four or more is known as multilayer graphene. The thickness of gaphen varies as per number of layers such as for monolayer graphene is 0.335nm, for

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bilayer thickness is 0.81 nm, for triple layer is 1.285 nm and 1.78nm for four layer.

Properties of Graphene:

A) Mechanical Properties of Graphene:

Graphene is an extremely light material, even it is lighter than paper, having planar density is of 0.77 mg/m^2 and area of hexagonal carbon ring is of 0.052 nm^2. It also has the strongest and hardest crystal structure of any known material [10]. Due to the carbon bonds strength graphene is the most strongest material and has 130 giga Pascal's tensile strength which is 200 hundred times higher than steel. Graphene shows good elastic property means able to regain original size after strain [11]. It is also possible that one gram of a single sheet of graphene is enough to cover a whole area of football field. For heat sensitive elements graphene is an ideal material. The main heat transfer medium in graphene is phonons. Graphene exhibits extremely high thermal conductivity which ranges from 4840 to 5300 W/mK at room temperature [12].

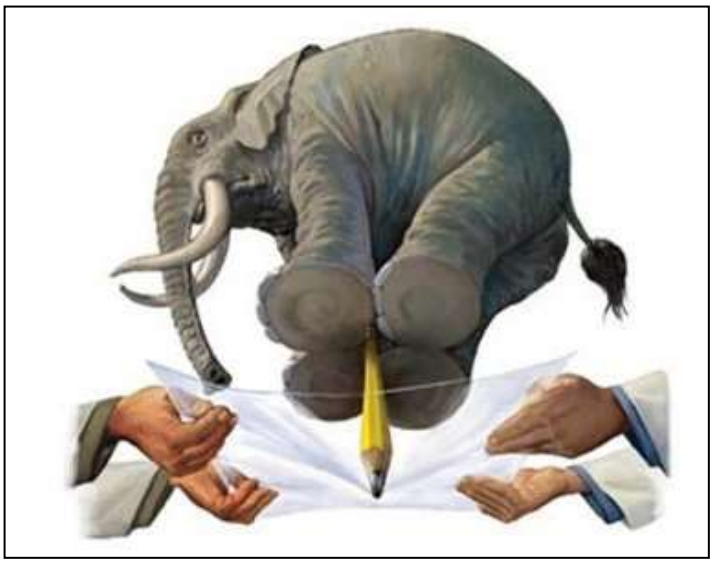


Fig. show that strength of graphen where an elephant balanced pencil to penetrate a sheet of graphene.
https://avadaingraphene.com/wp-content/uploads/2022/10/blogstrenght.jpg

B) Electrical Properties of Graphene:

The most important property of graphene is that in graphene both holes and electrons acts as charge carriers since it is a semi-metal so it shows high electrical conductivity [13]. The atomic number of carbon is 6, from electronic configuration 2 electrons present in innermost shell and 4 electrons present in outermost shell. Only these 4 outermost electrons take part and plays important role in chemical bonding. Therfore in graphene pi (π) electron which is free electron from each carbon atom is responsible for electrical conduction and is located above and below of the graphene sheet. These highly mobile electrons help to boost C-C bonds in Graphene [14]. At room temperature Graphene has low resistivity than other material.

C) Optical Properties of Graphene:

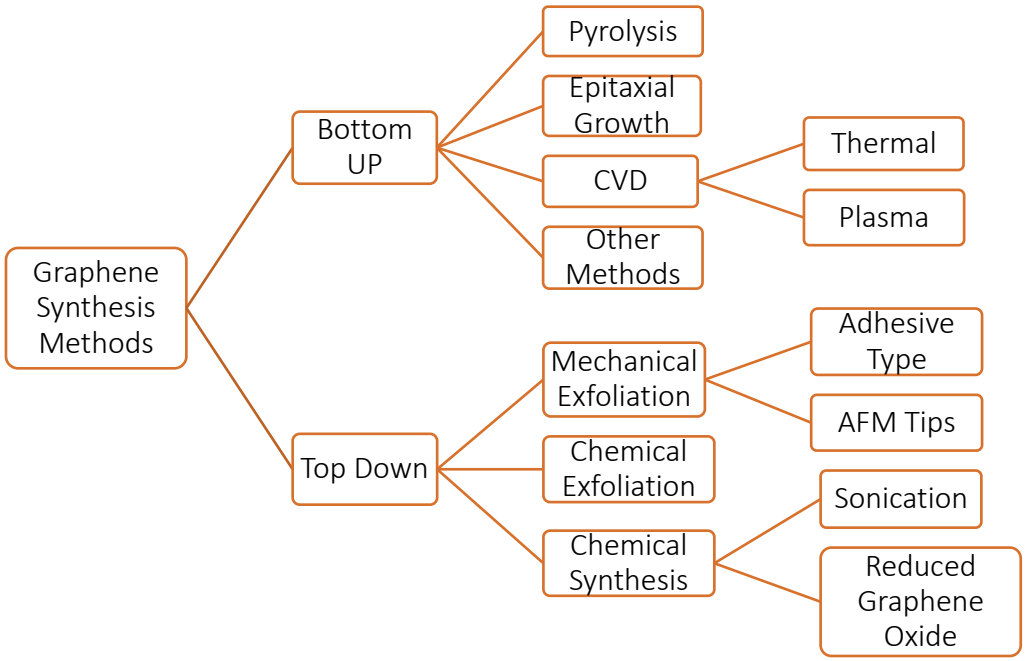
Graphene absorbs only 2.3% of the intensity of light since it is nearly transparent. Thus suspended graphene does not have any color. It can use for making transparent conductor. Graphene emits some form of photoluminescence. Graphene's opacity of pa ˜ 2.3% equates to a universal dynamic conductivity value of $G = e^2/4$, (±2-3%) over the visible frequency range [15].

Due to all above properties of graphenes', one day with help of Graphene it will possible to design transistors and other electronic devices much thinner than devices made from traditional materials.

Synthesis Techniques of Graphene:

Graphene synthesis is nothing but the process of extracting graphene from graphite. Different techniques for synthesis of graphene are available which plays crucial role in production of different structures and properties of graphene. Such as single, double, tipple and multi layer with various applications in science and technology like production of memory devices, sensors, device for energy storage and so on [16].

Following are the different synthesis methods of graphene.



Applications of Graphene:

1. **In Energy Industries:**
   - For developing lighter, flexible and transparent solar cells
   - For production of high capacity, light weighted, durable, Graphene based Li-ion batteries having longer self-life, gives faster charging response and can be used in wearable electronics since it shows flexibility property.
   - **It is used in Nuclear Power stations for production of heavy water: graphene membranes.**

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- **It is used in Alcohol Distillation process**
- **It is used in fuel cells to enhance efficiency and durability.**
- **In food industries for food packaging, water purification, desalination, crop protection and food security.**

2. **In Medical Sector:**
   - Graphene based devices can be used to carry drugs in chemotherapy towards tumors of cancer.
   - Graphene based sensors detects cancer cells in the early stages of the disease.
   - Fro photo thermal therapy graphene based electronic devices can be used.
   - Graphene based sensors are sued in diabetes monitoring.
   - It is possible to extract and filtered out chemicas, drugs and waste materials from blood by using graphene.
   - It is used in Tissue Engineering and Cell Therapy.
   - Graphene in combination with other material can be used for creating low cost and eco-friendly and environment friendly, transparent and flexible ultraviolet sensors.
   - Biosensor made from graphene can be used for HIV detection and diagnosis.
   - With some modifications and other materials, CVD graphene can detect THZ radiation successfully.
3. **In Electronics Field:**
   - For Generation of florescent or Leds
   - For development of supertransistors
   - Graphene can be used for waterproof electronic devices
   - Graphene based thin film to be used in touchscreens.
   - It is used in production of flexible displays.
   - It is used in robotics, optoelectronics and optical sensors.
   - Used in security sensors.
4. **In Sports Field:**
   - Used for making shoes, helmets, cloths rackets, Electronic Tattoos and Fitness Tracking.
5. **In Other sectors:**
   - **Cement** graphene can be a great reinforcement material in construction.
   - Can be used in coating of bricks and stones for making water-proof houses.
   - Graphene in the carbon-fiber coating of the aircraft's wings.
   - **Military Protective Equipment**
   - Corrosion Protection for Glass
   - Used as a **Anti-corrosion Oil and Gas Pipes**

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Transforming Honey Bee Rearing Through Artificial Intelligence: Advancements and Applications

Dr. Rahul Patil
Department of Zoology
PDEA's Annasaheb Waghire College, Otur, Tal-Junnar, Dist.-Pune
Email- *rahulp2966@gmail.com*

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Abstract:

The integration of Artificial Intelligence (AI) in honey bee rearing is rapidly reshaping traditional beekeeping practices, offering innovative solutions to address the challenges facing honey bee populations. This chapter provides an in-depth exploration of the applications of AI in honey bee rearing, drawing insights from various sources including academic literature, industry reports, and technological innovations. By leveraging AI technologies such as neural networks, machine learning, and computer vision, beekeepers can enhance hive monitoring, disease detection, breeding programs, pollination management, and resource optimization. Real-world examples and case studies demonstrate the transformative potential of AI in revolutionizing beekeeping practices and ensuring the sustainability of pollination-dependent agriculture.

Keywords: Artificial Intelligence, Honey Bee Rearing, Hive Monitoring, Disease Detection, Pollination Management

Introduction

Honey bee populations in India and around the world are facing unpredicted challenges, ranging from habitat loss to pesticide exposure and the impacts of climate change. The health of bees and the pollination services they offer are seriously impacted by these problems. India's beekeepers are using modern Artificial Intelligence (AI) technology to support their management and raising of honey bees as a reaction to these difficulties. This chapter explores the various ways that artificial intelligence (AI) might be applied to beekeeping, highlighting how it can modernise conventional methods and guarantee the longevity of pollinator populations.

There are several advantages when integrating AI into honey bee rearing, from improved hive monitoring to more effective disease identification and control. Beekeepers may remotely track hive conditions in real-time with AI-powered sensors and monitoring systems, which enables prompt responses in the event of disease outbreaks or environmental stresses. Additionally, early illness and pest detection minimises the impact on hive health and production thanks to AI-driven diagnostic tools that beekeepers may utilise. Beekeepers may make educated judgements on hive management by utilising machine learning algorithms and computer vision techniques to analyse hive data and find patterns suggestive of illness or stress.

One notable application of AI in honey bee rearing is in the optimization of pollination services. Artificial intelligence (AI) systems can identify the best pollination

routes and timings for maximising agricultural yields and pollination efficiency by looking at environmental factors and hive data. In addition, breeding programmes and genetic analysis are made easier by AI technology, giving beekeepers the ability to choose for desirable features like disease resistance and honey output. Beekeepers in India can ensure that honey bee populations continue to contribute to agriculture and ecosystem health by enhancing the overall resilience and productivity of bee populations via the incorporation of AI-driven solutions.

AI has also shown to be quite helpful in recent years in solving problems with resource management and hive optimisation. Artificial intelligence (AI) systems can forecast honey output, nectar flow, and pollen availability by evaluating past hive data and environmental variables. This prediction allows beekeepers to optimise queen rearing, hive management, and feeding strategies. This data-driven strategy helps ensure the long-term viability of beekeeping businesses in India by maximising honey output while also fostering colony health and lifespan.

In conclusion, beekeeping techniques in India have advanced significantly with the use of Artificial Intelligence (AI) technology in honey bee rearing. Beekeepers can monitor hive health, identify illnesses, maximise pollination services, and enhance breeding programmes with previously unheard-of accuracy and efficiency by utilising AI-driven solutions. AI has enormous potential to improve beekeeping techniques in India and solve issues affecting honey bee populations. As it develops and becomes more widely available, this might pave the way for a future in which ecosystems and bees coexist peacefully.

Applications of Artificial Intelligence in Honey Bee Rearing:

1. Hive Monitoring and Management:

AI-powered sensors installed in beehives collect various data points such as temperature, humidity, sound, and movement. These sensors continuously monitor the hive environment, providing valuable insights into hive health and productivity. For instance, if there's an abnormal increase in temperature or a change in humidity levels, it could indicate the presence of disease or stress within the colony. Machine learning algorithms analyze this data in real-time, identifying patterns and anomalies that may signify disease outbreaks, queen failure, or hive swarming. By receiving timely alerts, beekeepers can intervene promptly, implementing necessary measures to prevent colony losses and maintain hive health (Atria Innovation, 2019).

Example: Suppose AI-powered sensors detect a sudden increase in hive temperature beyond the normal range. Machine learning algorithms analyze this data and identify it as a potential sign of Varroa mite infestation, a common honey bee parasite. Upon receiving the alert, beekeepers can promptly implement mite control measures, such as treating the hive with acaricides or introducing biological control agents, thus preventing the spread of the infestation and minimizing colony losses.

2. Disease Detection and Management:

AI algorithms play a crucial role in early detection and management of diseases in honey bee colonies. By analyzing images of honey bee brood, AI can identify subtle

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signs of infection, disease, or parasitic infestation that may go unnoticed by the human eye. Early detection allows beekeepers to implement targeted intervention measures, preventing the spread of diseases and minimizing their impact on colony health (Contaval, 2016).

Example: AI algorithms analyze images of honey bee brood and detect irregular patterns indicative of American foulbrood, a highly contagious bacterial disease. Upon detection, beekeepers can isolate the affected colony, remove infected brood frames, and administer appropriate antibiotics to control the spread of the disease and prevent further colony losses.

3. Breeding Programs and Genetic Selection:

Machine learning algorithms analyze genetic and phenotypic data to identify genetic markers associated with desirable traits in honey bees, such as disease resistance, honey production, and temperament. By leveraging AI-driven genetic analysis, beekeepers can make informed decisions in breeding programs, selectively breeding honey bee colonies with superior traits to improve the overall resilience and productivity of bee populations (Molinetti, 2019).

Example: AI analysis reveals specific genetic markers associated with hygienic behavior in honey bees, a trait linked to resistance against diseases like American foulbrood and chalkbrood. Beekeepers can selectively breed colonies with a higher frequency of these markers, gradually improving the overall disease resistance of their apiaries and reducing the need for chemical treatments.

4. Pollination Management and Crop Monitoring:

AI-driven pollination management systems utilize drone imagery to assess flower abundance, pollination rates, and crop health in agricultural fields. By analyzing this data, beekeepers and farmers can optimize pollination services, strategically placing hives to maximize pollination efficiency and enhance crop yields (Secretaría de Agricultura y Desarrollo Rural, 2015).

Example: Using AI-driven analysis of drone imagery, beekeepers identify areas within a crop field with low flower abundance and suboptimal pollination rates. Based on this information, beekeepers strategically relocate hives to these areas, ensuring more effective pollination and ultimately leading to higher crop yields for the farmer.

5. Hive Optimization and Resource Management:

AI algorithms analyze historical hive data, environmental variables, and weather forecasts to predict honey production, nectar flow, and pollen availability. By leveraging these predictive analytics, beekeepers can optimize hive management practices, such as feeding, hive manipulation, and queen rearing, to maximize honey yield and colony health (Universidad Tecnologica Nacional - Facultad Regional Buenos Aires, 2019).

Example: AI analysis of historical hive data predicts a forthcoming nectar flow period based on weather forecasts and environmental variables. In anticipation of increased nectar availability, beekeepers strategically provide supplemental feeding to colonies to stimulate brood production and honey storage, maximizing honey yield during the nectar flow period.

Conclusion:

The integration of Artificial Intelligence (AI) in honey bee rearing presents unprecedented opportunities to revolutionize beekeeping practices and ensure the sustainability of pollination-dependent agriculture. By harnessing the power of AI technologies, beekeepers can monitor hive health, detect diseases, optimize pollination services, and improve breeding programs with unparalleled precision and efficiency. As AI continues to advance, its potential to address the challenges facing honey bee populations and enhance beekeeping practices remains limitless, offering a promising future where bees thrive and ecosystems flourish**.**

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Bioenergy: A potential fuel for future

Sangita Kulkarni
Supriya Gawade
Department of Botany,
Dada Patil Mahavidyalaya, Karjat Dist. Ahmednagar
Email: Sangitakulkarni69@gmail.com

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Abstract

Bioenergy is one of the efficient potential renewable fuel for future like Biogas, Biomethanol, Biohydrogen, Bioplastic. etc. obtained from the biomass. Bioenergy production not only complete the need of biofuel it also help in waste water treatment, waste disposal. In the present scenario, due to population increase, the fossil fuel resources are getting depleted. Therefore ther is a need to develop renewable energy resources like bioenergy. This energy can be used for different purposes including cooking, electricity and transportation. There are different bioenergy resources like algal biomass, Agriculture crops and residue, Solid waste, Industrial waste. The Biomass conversion into Bioenergy is done through different biochemical and Thermochemical processes.

Keywords: Bioenergy, Biofuel, Biomass, Renewable.

Introduction

India is a country of large natural resources. But due to expontential increase in population in last few centuries, the natural resources like fossil fuels are deleting at an alarming rate or getting polluted with time. Thus, to cope up with the ever-increasing demands of the energy resources by the population, Alternatives energy resources need to be exploited. One such alternatives can be Bioenergy.

On a global scale, population growth, rapid urbanization, industrialization, and economic development have led to an alarming amount of garbage being generated. Through different routes of waste-to-energy conversion, municipal solid waste appears to be an economically viable and attractive resource for producing green fuels (Gautam, R., *et.al*. (2009).

In present scenario, the urbanization and industrilization has resulted into development of industries which have increased the demand for energy sources. The fossil fuel are not enough to fulfill the energy demands, thus renewable alternatives energy sources like bioenergy can be useful and attention must be given to environmental awareness of it(Patwardhan & Kokane, 2022). Biofuel, a sustainable renewable substitute for traditional fossil. As a result of global warming and the depletion of traditional fuels global fuel market is looking for a new, renewable natural fuel source. Various countries have experienced radical changes in their energy systems since the end of the 20th century, sparked by economic crisis and growing awareness of the society is

need to replace fossil fuels with renewables (Costa, F. R. *et al, (*2020*)*. Rural Africa relied on wood for cooking upto present day but due to deforestation they need to switch to alternative energy source for this purpose many people use residues from agriculture (Tucho, G. T. & Nonhebel, (2015). Traditional economic activities rely heavily on fossil fuels for energy but they are non-renewable and entire supply of goods and services may get deflected (Chaowana, P. *et al., (*2023). About 32% of the total primary energy use in the country is still derived from biomass and more than 70% of the country's population depends upon it for its energy needs. Ministry of New and Renewable Energy has realised the potential and role of biomass energy in the Indian context and hence has initiated a number of programmes for promotion of efficient technologies for its use in various sectors of the economy to ensure derivation of maximum benefits. For efficient utilization of biomass, bagasse-based cogeneration in sugar mills and biomass power generation have been taken up under biomass power and cogeneration programme.

Bioenergy is energy generated from biomass, which consist of living organism mainly plants. It is a type of renewable energy produced from organic matter stored in biomass. Biomass mainly include energy crops, agriculture crop residue, forestry residue, algae, municipal waste, wet waste. Biomass materials used for power generation include bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust etc. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas.

The energy is used as source of electricity, cooking, transportation, and power generation. In general, employing different plants as feedstocks to create biofuels, such as maize, wheat, rice, soybeans, and sugarcane, has proven successful. The biomass conversion can be done with gasification, pyrolysis, conventional combustion and anaerobic digestion.Biofuels are categorized into four generations-based feedstock or biomass used in first generation biofuel produced from edible biomass like sugar beet, sugarcane, wheat, corn. In second generation produced from non-edible biomass like wood, straw, grass here carbon emission is less as compare to first generation biofuel. In third generation algal biomass is used and in fourth generation biofuel production genetically modified crops but it is currently the process is ongoing (Muthuraman & Kasianantham (2023).

The bioenergy products include biofuel, Bioethanol, Biohydrogen, Solvents like ethanol, butanol, or acetone) are used to produce bioenergy these substances provide a viable alternative to petrol for the transportation industry. Polyhydroxyalkanoates (PHAs) are the natural substance for the creation of biodegradable plastics (Kleerebezem & van Loosdrecht, (2007)

Sources of Bioenergy

Algal Biomass:

The algal biomass is considered a third-generation biofuel, can be grown in any kind of water, even in waste water and sea water and doesn't require fertile soil. Due to its high energy content, fast growth rate per unit area, algae have become a popular

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feedstock for biofuels (Prabakaran & Karthikeyan,(2023) The microalgae and seaweeds can contribute to produce biodiesel that helps in reduction in amount of land needed because they are thought to produce more energy per hectare in water (Mujeeb *et.al* ,(2016).

Agriculture crops and residue:

Various agricultural crops and residues are good source of biomass and bioenergy. Hemp (*Cannabis sativa* L.) stalk is used as a source of bioenergy. It is the fastest growing plant with unique fiber characteristics and desirable fuel characteristics. It has the potential to be a sustainable, renewable source of bioenergy, reducing reliance on fossil fuels, which are harmful to the environment because they pollute the air and environment during their production and use, deplete ozone levels. Hemp has a high energy output for the generation of solid fuel and biogas that is comparable to or greater than that of the majority of energy crops popular in Northern Europe (Prade *et.al*, (2011). Cotton straws and corn plant are a common agricultural waste in Turkey, and having a huge potential as a clean energy source (Civelek Yoruklu *et. al*., (2020); Singh *et. al.* (2021). The Sugarcane bagasse obtained from industry, is a rich source of cellulose, hemicellulose, and lignin and can be used as a biofuel, feedstock for animals and as a packaging material (Wani et.al., (2023).

Chaowana, P. *et al.* reported that manure of cattle, pigs and other animals is mostly used as fertilizers and biogas through anaerobic digestion. Methane is produced through anaerobic digestion of cattle manure , human excreta and agriculture residue is used as purpose of cooking and lightning in many part of the world (Gautam, R., et.al.(2009).

Methods of production There are different methods used for production of biofuels as a source of bioenergy.

1. Dilution Process

In the dilution process, vegetable oil and waste oils are thinned by mixing with a solvent or diesel fuel in certain proportions. It is common method of biodiesel production. peanut oil, rapeseed oil, sunflower oil and waste oils are used for biodiesel production.

2. Microemulsion

Microemulsion is a method used to reduce the high viscosity of vegetable oils is microemulsion with short chain alcohols such as methanol, ethanol or 1-butanol.

3.Pyrolysis Method

During pyrolysis biomass is heated rapidly at high temperature in an oxygen free environment. due to heating that biomass breakdown into vapor, gas, charcoal then that vapors are condensed into liquid. Pyrolysis is an effective method for evaluating industrial and urban wastes in addition to obtaining fuel. Among other methods, pyrolysis is also easy and efficient (Aktaş, E. et. al (2020).

4.Transesterification Method

Transesterification is the most common way to produce biodiesel. Transesterification is a chemical process in which vegetable oils are converted into

alternative fuels, which reduces viscosity.

5. Anaerobic digestion

Anaerobic digestion, a natural process, involves the removal of organic compounds from a waste stream while generating a valuable product, such as methane-rich biogas. By producing biodiesel, new opportunities will be created for diversifying income sources, promoting employment in rural areas, developing long-term replacements for fossil fuels, and reducing greenhouse gas emissions, enhancing the decarbonization of transportation fuels and enhancing energy security (Mujeeb, et.al, (2020). Bioenergy production not only complete the need of biofuel it also help in waste water treatment, waste disposal. Bioenergy production from solid waste help our society many ways like maintain hygiene, it also help to rural people to participate in education related activities like reading and study in dark , also to get employment ((Gautam, R., et.al. (2009).

Conclusion

The fossil fuels are limiting due to their exhaustive use. Thus, Bioenergy can be a potential renewable resource for the future and an alternative substitute to the fossil fuel which can be beneficial to mankind.

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Statistical Analysis of COVID-19 Impact on Indian trade due to the supply chain industry

Dr. Ashok S. Mhaske
Department of Mathematics,
Dada Patil Mahavidyalaya, Karjat, Dist-Ahmednagar
Email: mhaske.math@gmail.com

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Abstract:

This research article seeks to capture the issues, demanding situations and implications of the COVID-19 pandemic on deliver-chain in India. India turned into significantly stricken by the coronavirus (COVID-19) pandemic in various sectors. India introduced its first lockdown in March 2020. The markets reacted differently to the crisis, which changed into meditated of their growth rate. The car marketplace turned into hit the hardest through the lockdown, as it showed the most terrible growth. Even as maximum industries have been shaken to their core, economic, actual property, and expert offerings had been anticipated to incur massive losses. Attributable to the lockdown, many Indians located themselves without a work. In might also 2020, the unemployment tiers reached a new high with more than 27 percent of the United States of America's hard work pressure unemployed. Manufacturers and distributors have determined it hard to replace or top off their inventory and gadget or machinery, because of supply-chain disruptions globally. Importers and exporters have also discovered it tough to supply or bring in items across maximum global borders, because the seaports, which is the primary course for worldwide change of products, have been impacted by using restrictions and the slowdown of commercial sports of major buying and selling partners.

Keywords: Covid-19, Supply Chain, Statistics, Analysis, Regression

Overview of the pandemic and how it has caused supply-chain disruption:

International stores have been at risk of shock in the major export countries due to COVID-19. This is particularly dangerous because of factors that may delay the continuous flow of crude oil, goods and services from these exporting countries and trading partners. COVID-19 has disrupted global operations in all sectors of the economy and industry. Production breaks, restrictions on the movement of people and goods, closure of borders, restrictions on the supply of goods, and a decrease in the number of trade and business activities are the result of the exit of measures to close COVID-19(Kokane, Ashraf, et al., 2021). For the past eleven and a half years, China has emerged as the world's largest exporter, one of the world's largest production and distribution centers, contributing to the supply of finished and finished products to countries rely on China for trade. More than 65% of the total Indian Active Ingredients (API) imported came from China. India is facing delays in the supply, production and

distribution of its pharmaceutical products due to the epidemic. Globally, the supply of critical materials such as protective equipment (PPE), crude oil and other medical products and equipment has been delayed due to increasing global demand and restrictions on the export of these goods. With the implementation of the closure, the transport sector, where the global supply chain operations, is still partially closed. Statistics show that no less than 90 countries have imposed closures since March 2020 and when the peak figures in April 2020, approximately 3.9 billion people were closed. The transportation industry, which accounts for about 90% of the world's $ 12 billion trade, is affected by the epidemic. With this in mind, the World Trade Organization (WTO) estimated that global trade would decrease by 13% to 32%, by volume, by the end of 2020. Construction, electronic and automotive parts will be the most affected due to the complexity of their value and supply chains. COVID-19 also exposes the dangers of global food supply chains. The financial implications of COVID-19 on trade and supply chain are significant. This means that the transport of marine and air goods is adversely affected by COVID-19. The United Nations Organization (UN) estimates that world trade is projected to contract by about 15% by 2020 amid a sharp decline in global demand and a disruption of global supply of goods. The World Bank estimated a 5.2% decline in global GDP by 2020 due to COVID-19. At a lower level, COVID-19 will lead to job losses, reduced revenue and a decrease in business activity. Later, families may look for smaller products, thus disrupting the operations of supply companies(Kokane, Priya, et al., 2021)(Patil et al., 2021).

Regression Lines:

Regression lines are useful in forecasting procedures. A regression line is a line which is used to describe the behavior of a set of data. It gives the best trend of the given data. Its purpose is to describe the interrelation of the dependent variable (y variable) with one or many independent variables (x variable).

Data Analysis using the Least Square Regression:

Linear regression finds the straight line. It is also known as the least squares regression line. It represents in a bivariate dataset. Let us suppose that y is a dependent variable and x is the independent variable. The population regression line is Y = mx + b Where b is the constant and m is the regression coefficient and x is the value of the independent variable.

Using following step, we can calculate linear regression line

Step 1: For each (x, y) point calculate x^2 and x*y

Step 2: find $\sum x,\ \sum y\ , \sum x * y\ , \sum x^2$

Step 3: Slope m = $\frac{n\sum xy - \sum x\ \sum y}{n\sum x^2 - (\sum x)^2}$ where n= Number of data points

Step 4: Calculate Intercept b: $b = \Sigma y - m\ \Sigma x$

Step 5: Linear Regression line: $y = mx + b$

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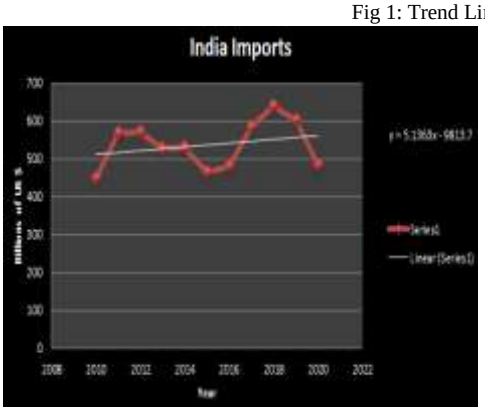
Table 1: History of Indian Exports Trade (last eleven years)

India Exports		
Year	**Billions of US $**	**% of GDP**
2020	$474.15B	18.08%
2019	$529.02B	18.43%
2018	$538.64B	19.94%
2017	$498.26B	18.79%
2016	$439.64B	19.16%
2015	$416.79B	19.81%
2014	$468.35B	22.97%
2013	$472.18B	25.43%
2012	$448.40B	24.53%
2011	$447.38B	24.54%
2010	$375.35B	22.40%

Table 2: History of Indian Imports Trade (last eleven years)

India Imports		
Year	**Billions of US $**	**% of GDP**
2020	$482.45B	18.39%
2019	$601.58B	20.96%
2018	$639.01B	23.66%
2017	$582.02B	21.95%
2016	$480.17B	20.92%
2015	$465.10B	22.11%
2014	$529.24B	25.95%
2013	$527.56B	28.41%
2012	$571.31B	31.26%
2011	$566.67B	31.08%
2010	$449.97B	26.85%

Fig 1: Trend Line of Indian Imports



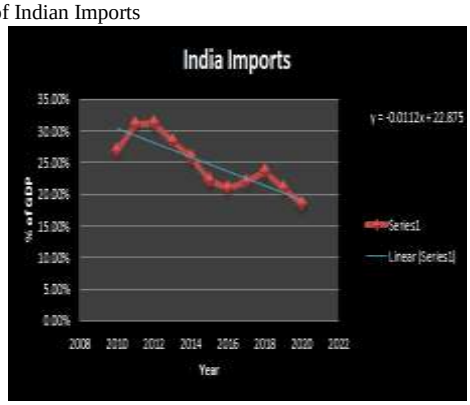
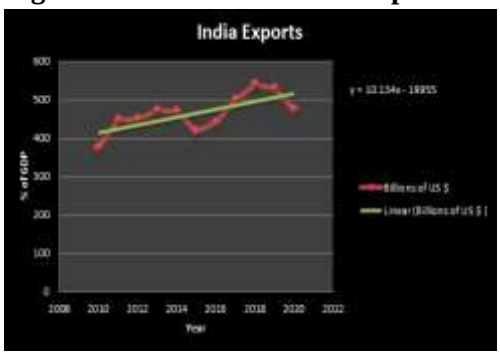
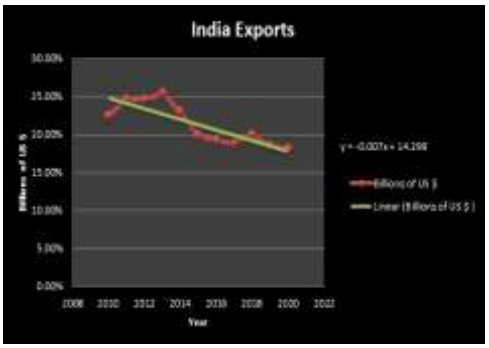


Fig 1: Trend Line of Indian Exports





Result:

Export	
1	India exports for 2020 was **$474.15B**, a **10.37% decline** from 2019.
2	India exports for 2019 was **$529.02B**, a **1.79% decline** from 2018.
3	India exports for 2018 was **$538.64B**, a **8.1% increase** from 2017.
4	India exports for 2017 was **$498.26B**, a **13.33% increase** from 2016
Import	
1	India imports for 2020 was **$482.45B**, a **19.8% decline** from 2019.
2	India imports for 2019 was **$601.58B**, a **5.86% decline** from 2018.
3	India imports for 2018 was **$639.01B**, a **9.79% increase** from 2017.
4	India imports for 2017 was **$582.02B**, a **21.21% increase** from 2016.

Upcoming Year Forecasting:

Export		
1	India exports for 2021 was **$525.814B**, a **15.20% decline** from 2020.	Linear Regression Line: 1) y = 10.134x - 19955 2) y = -0.007x + 14.299 (Export and GDP)
2	India exports for 2022 was **$535.94B**, a **14.50% decline** from 2021.	
Import		
1	India imports for 2021 was **$561.3662**, a **23.98% decline** from 2010	Linear Regression Line: 1) y = -0.0112x + 22.875 2) y = 5.1363x - 9813.7 (Export and GDP)
2	India imports for 2022 was **$566.4999**, a **22.86% decline** from 2021	

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Conclusion:

India was greatly affected by the coronavirus (COVID-19) pandemic in various sectors due to supply chain brake. From given analysis we can observe that India trade exports may decline nearly 15% and Import trade nearly 23%. Supply chain brakes tremendously effect on Gross domestic product ratio.

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A Scientific Review on Veterinary Diseases with Special Reference to Mastitis and Protozoal Infections

T. K. Sarode
D. S. Kumbhar
Department of Zoology,
Dada Patil Mahavidyalaya Karjat. Dist. Ahmednagar (M.S.), India.
Email: tejassarode74@gmail.com

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Introduction:

Veterinary infectious diseases significantly threaten the health of livestock, domestic animals and wildlife. Diagnosis of veterinary infectious diseases is often challenging (**Rampacci *et al.* 2023**). Such studies include infectious-disease-causing pathogens, its epidemiology, various diagnostic methods, immune responses by host, treatment and prevention. Early and accurate diagnosis is crucial for the effective monitoring and control of diseases, particularly zoonotics. Animal diseases in general and veterinary diseases in particular have the potential to pose negative impacts on consumers, producers, and economies as a whole. A growing demand for animal sourced food worldwide requires safe and efficient production systems (**Kappes *et al.* 2023**). The increased focus on livestock production for promoting food security has a wide scope and attending an issue surrounding food safety, moving beyond a primary focus on productivity. While consumption of animal sourced foods, especially milk and meat provides important micro and macronutrients for physical and cognitive development (**Grantham *et al.* 2007**), there exists a risk of disease transmission by consumption of contaminated foods (**Vipham *et al.* 2020**).

Dairy business or milk production from dairy animals is much popular among the farmers. As the farmers can feed the animals with crop after harvested byproducts and earn some economy from the byproducts of animals like milk, urine slurry, cow dung fertilizer, etc. The conventional or indigenous breeds of milking cattle are not much potent in milk production. In 1970, India set in motion the 'White Revolution', the world's biggest dairy development program, led by Dr. Verghese Kurien, popularly known as 'Operation Flood'. Under this programme, the exotic breeds like Holstein Frisian were introduced in dairy farming sectors so as to increase the milk production on high level, i.e. one average Hf crossbreed can yield up to 20 liters of milk in 24 hrs. (2 milking of 12 hrs. interval). When there is a high yield of milk, there is a much depletion in animal's body vitality; if improper nutrition or unfavorable climate can trigger some clinical conditions that can affect animal health (i.e. disease) and ultimately economic loss is there.

Veterinary Diseases:

Animal and plant diseases pose a serious threat to food security, food safety, national economies, biodiversity and the rural environment worldwide. New challenges,

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viz. climate change, regulatory developments, changes in the geographical concentration and size of livestock holdings. make this an appropriate time to assess the state of knowledge about the impact that diseases have and the ways in which they are managed and controlled (**Wilkinson, 2012**).

Most reared indigenous cow breeds are Khillar, Gir, Sahiwal, Tharparkar, Laal Kandhari, ND. Milk of these indigenous breed is very much popular among the peoples for daily diet use as the belief and truth of its highly nutritious and nourishing nature. Exotic breeds used in dairy farming are Holstein Frisian, Jersey, Girolando Breeds; while the most adopted breeds for dairy farming are Hf Crossbreeds (HfX), Jersey Crossbreeds (JyX). Here are some common diseases that can cause exponential economic loss in dairy farming having exotic crossbreeds.

Mastitis:

Mastitis is said to be most loss causing disease in dairy farming or milk production units. The mastitis is almost worldwide threat to a dairy farming, as it is fatal to the animal also. The two types of mastitis is seen dairy cattle, viz. clinical and sub-clinical mastitis. Causative agents for clinical mastitis are mainly some streptococcus and staphylococcus species. Some fungal species like candida can also show this type of mastitis. In clinical mastitis mostly coli forms are causative. The disease can be transmitted with the pre infected milk settled on concrete surface or common use of milking machines to infected and non-infected animal. The affected organ is mammary glands (udder) of cattle.

Mode of infection:

Generally, the pathogens enter the udder through teat canals when the animal sits on the infected or non-sanitized floor. Most sensitive period of infection is when the animal sits as soon as milking is done. Also during the dry cow period, due to improper drying methods, the pathogens can be invaded. Mostly adult lactating cattle are susceptible to the disease, but it can be seen in heifers also; one such case was reported at Rashin village, Ahmednagar district of MH. The clinical signs and symptoms includes, inflammation of udder, discolored fowl liquid instead of milk, curd like formation of milk inside udder, anorexia (poor appetite), fever of range from 103 to 105 ^{o}F.

Controversies:

If diagnosed late or misdiagnosed or untreated, the clinical mastitis can lead to formation of gangrene, eventually formation of endotoxin and death of an animal. The gangrenes could be treatable but there may be sometimes loss of the infected part of udder due to tissue necrosis.

Treatment:

Treatment for mastitis includes use of injectable like Cephalosporin group - Ceftriaxone, Cefoparazone, Ceftizoxime, Cefquinome; Penicillin group- Amoxicillin. Fluoroquinilone group includes Enrofloxacin, Marbofloxacin. Intramammary preparation used are generally combination of drugs- E.g. Yelantra tubes (Manufacturer- MSD animal health. Content- Tetracycline, Neomycin, Bacitracin and Prednisolone); Cobactan lc tubes (Manufacturer- MSD animal health. Content- Cefquinome); Mastiwok

tubes (Manufacturer- Vetoquinol. Content- Cefoparazone).

Post-recovery Complications and Prevention:

In severe infection cases, recovery is challenge for veterinarians. If achieved it remains with some permanent or temporary complications like fibrosis of udder and teat, low milk yield, abortions, etc. Prevention can be done by using sanitation of floor, use of tit dipping solution after milking, use of milking machines, washing cattle and floor with suitable agents, adopting free cattle farm i.e. without concrete floors.

Fig. 1: Gangrene in Acute Mastitis

Protozoal Infections

Some protozoan infections like Thileria, Anaplasma or Babesia are fatal to the cattle. Some protozoal infection like babesia can also affect the indigenous cattle breeds that are generally stubborn.

A. Thieleriosis-

The causative agent is a protozoa named *Thieleria annulata, T. parva and T. mutans.* The disease is transmitted through ticks. The clinical signs and symptoms become vigorous in 2 to 4 days; fever ranging from 105 to 107 ^{o}F, anorexia, pale yellow mucus membranes of vagina and eyelids (hemolytic jaundice), swollen prescapular or precrural lymph nodes. Sub-clinical findings includes depletion in Hb and RBC count and presence of protozoa on RBC in blood smear.

Treatment and post-recovery complications:

Antiprotozoal drug like buparvaquone, diminazene aceturate are used. Use of tetracycline and ceftriaxone to treat secondary infections, use of hematinic injection like iron dextran, administration of liver and hematinic oral supplements. It includes long term anorexia, introduction of pica mode of activity, low milk yield, low absorption or assimilation of fats and other nutrient.

Prevention: Vaccine named Rakshavac T gives immunity against *T. annulata*.

B. Anaplasmosis:

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The causative agent for this disease is a protozoa named *Anaplasma marginale.* It is a tick-borne disease.

Clinical Signs and sub-clinical findings:

Sign and symptoms are generally seen in episodes for long period of time that may be up to 15 to 40 days, fever ranging from 103 to 105 ^{o}F, pale yellow mucus membranes of vagina and eyelids (hemolytic jaundice), swollen prescapular or precrural lymph nodes may be or may not be seen depending upon cross infections. Sub-clinical findings includes depletion in Hb and RBC count and presence of protozoa on RBC in blood smear.

Treatment and post-recovery complications:

Antiprotozoal drug like imidocarb are used tetracycline Use of tetracycline and ceftriaxone to treat secondary infections, use of hematinic injection like iron dextran, administration of liver and hematinic oral supplements. It includes long term anorexia, introduction of pica mode of activity, low milk yield, low absorption or assimilation of fats and other nutrient.

Prevention: Practical vaccine is not available yet.

C. <u>Babesiosis</u>: The causative agent for Babesiosis is a protozoa named *Babesia bovis.* It is a tick-borne disease.

Clinical Signs and sub-clinical findings:

Red or bloody urine that becomes redder on each next urination, fever ranging from 103 to 106 ^{o}F, orange spotted mucus membranes of vagina. Generally, the disease never gives time for subclinical findings.

Treatment and post-recovery Complications:

If not treated on time, it may lead to death of an animal within 24 hrs. or less. Antiprotozoal drug like imidocarb are used, use of tetracycline or ceftriaxone to treat secondary infections. It include long term anorexia, debility in animal, hypoxia condition usually for long duration.

Prevention:

As the disease can be transmitted fast in herd, the drug imidocarb can be used as treatment as well as prophylaxis.

Fig.2: Yellow Vaginal Mucus Membrane and Coffee Colored Urine in Protozoal Infections.

Conclusion:

The occurrence and impact of animal disease and health on markets and livelihoods is complex and is varying from region to region across the globe. This review has identified selected, current knowledge surrounding the impacts of and attention to animal disease via. Mastitis and some protozoan diseases. We acknowledge that this broad review is not in-depth assessment regarding the mechanisms or behavioral issues and implications of animal health in global and regional markets, as well as not fully directs livestock-wildlife interactions. The impact of veterinary disease on food security and human health concerns has focused attention on merging economics with epidemiology in future.

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Raga Therapy: Music as Alternative Therapeutic Modality

Kalpana Singh
Bio-musicology Research Laboratory
Department of Zoology
University of Lucknow, Lucknow- 226007, UP (INDIA)
Email: biomusicology.india@gmail.com

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Abstract:

This chapter explores the profound impact of Indian classical music as an alternative therapeutic modality in treatment of diseases and disorders particularly life style generated & stress related disorders such as Anxiety, Depression, Hypertension, even Diabetes etc. Tracing its roots from ancient civilizations to modern medical practices, the chapter elucidates how music has been employed for healing, relaxation, and self-expression across cultures and time periods. It delves into the emergence of music therapy as a formal practice in the 20th century, elucidating its clinical applications in addressing physical, emotional, cognitive, and social needs. Drawing on neuroscientific research, the chapter elucidates how music affects the brain, activating regions involved in emotion, memory, and motor function, and stimulating the release of neurotransmitters such as dopamine and oxytocin. Furthermore, it discusses the diverse applications of music in healing, ranging from pain management in hospitals to self-care practices for stress relief. Ultimately, the chapter underscores the transformative potential of music in promoting healing, relaxation, and emotional well-being, highlighting the need for its integration into holistic approaches to health and wellness.

Keywords: Raga Therapy, Music Therapy, Bio-musicology, Zoo-musicology, Physiology, Stress Disorders

Introduction

"Raga therapy means healing through the raga. Raga therapy implies curing through the ragas. It is the information on the most proficient method to utilise raga for curing. Lullabies composed in Southern India employ the Neelambari raga to enable babies to fall asleep easier. This sleep-inducing element of the Neelambari raga is attributed to its soothing melodic structure, relaxed pace, and stretched out notes, enabling us to fall asleep easier.

Ragas are the foundational melodic modes in Indian classical music. Each raga is a unique combination of musical notes, intervals, and patterns that define its characteristic mood, emotion, and aesthetic essence. Beyond their musical structure, ragas hold a profound significance in Indian culture and philosophy, often evoking specific emotions, seasons, times of day, and even cosmic energies. Ayurveda, the ancient medical science of India, encompasses this branch that delves into the art of healing through music – a practice known as raga chikitsa, ragam chikitsa, raga vidya or

raga therapy. While not extensively prevalent in contemporary times, a cadre of Indian classical musicians and scholars has devoted itself to exploring and implementing this therapeutic form of music.

The essence of Indian music lies in its capacity to evoke distinct emotions and sentiments within the listener's mind, body, and soul. Therefore, it's no surprise that this genre is exceptionally suited for therapeutic purposes. Raags, the melodic modes in Indian music, are classified based on the most suitable time of day for their rendition and the dominant rasa, or emotion, they elicit.

Each musical note and mode maintains a profound connection with subtle and tangible frequencies in the natural world. Legend has it that the illustrious composer Tansen possessed the ability to ignite lamps through his rendition of the fiery Raag Deepak, and to conjure rainfall through the melodies of Raag Miyan Ki Malhar. Reportedly, Tansen even crafted Raag Darbari Kanada to alleviate Emperor Akbar's evening stress.

In contemporary times, practitioners of raga chikitsa emerge from both the Hindustani and Carnatic musical traditions. They experiment with the efficacy of different ragas in aiding individuals suffering from physical or mental afflictions.

In the realm of alternative therapeutic modalities, music holds a unique position. Its ability to evoke emotions, stimulate memories, and synchronize bodily functions has long been recognized across cultures and throughout history. From ancient civilizations to modern medical practices, music has been employed as a tool for healing, relaxation, and self-expression. In this chapter, we delve into the multifaceted role of music as a therapeutic modality, exploring its psychological, physiological, and emotional effects on individuals undergoing various forms of healing.

History of Raga Therapy

The history of raga therapy is deeply intertwined with the ancient cultural heritage of India and its rich tradition of music and healing. This therapeutic approach, rooted in Indian classical music, has been practiced for centuries and has evolved over time to address various aspects of health and well-being.

The foundation of raga therapy is embedded in the Indian classical music tradition, both Hindustani and Carnatic. Historical texts and treatises on music, such as "Natya Shastra" by Bharata Muni, discuss the emotional impact of different ragas on the human psyche. Ragas were categorized based on their ability to evoke specific emotions and moods.

During the medieval and Mughal eras, music gained prominence in the courts of emperors and rulers. Musicians like Tansen, in the Mughal court of Akbar, were known to possess an in-depth understanding of ragas and their therapeutic effects. Legends about Tansen's ability to invoke specific elements of nature through his music highlights the belief in the healing power of ragas.

Despite shifts in cultural and historical contexts, the practice of raga therapy persisted in various forms across India. It was often passed down through oral traditions, from guru to disciple. In the 20th century, the interest in traditional healing practices and

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alternative therapies led to a renewed focus on raga therapy. Musicians and scholars began to explore and document the therapeutic effects of specific ragas.

In recent decades, scientific research has begun to validate the healing potential of raga therapy. Studies have examined the impact of specific ragas on physiological parameters, brain activity, and emotional well-being. This scientific validation has contributed to the integration of raga therapy into mainstream healthcare practices and wellness programs.

A raga is an intricate blend of musical notes, intervals, and patterns, meticulously crafted to evoke a specific emotional state. To unveil the essence of a raga, musicians often employ two modes: alaap and gat. Alaap unfolds as a delicate, note-by-note exploration, marked by a serene tempo free from rhythmic constraints. In contrast, gat takes on a livelier tempo, adhering to a defined rhythmic cycle that adds a rhythmic dynamic to the melodic tapestry.

A notable study conducted by the Speech and Language Laboratory, Cognitive Neuroscience, National Brain Research Centre, India, in collaboration with the Centre for Integrative Neuroscience and Neurodynamics, School of Psychology and Clinical Language Sciences, UK, delved into the intricate relationship between ragas and human emotions. Involving 122 participants, the study invited them to immerse themselves in the alaap and gat renditions of 12 diverse ragas. This sonic journey revealed remarkable insights: each raga wove a distinct emotional narrative, tonal intervals within rhythms acted as reliable indicators of emotional responses, and the tonal makeup of the composition ultimately dictated the experienced emotion.

Beyond the psychological theories, this connection between music and emotion raises a fundamental question: How does music wield such transformative power? From a cognitive perspective, our emotional responses to music are not just a product of the sound; they emerge from the amalgamation of personal experiences, subjective appraisal, and inner evaluation. In this symphony of emotions, ragas stand as a particularly resonant force, conveying feelings that words often struggle to capture.

A fascinating validation of this connection comes from a study by Balkwill and Thompson (1999), which invited Western listeners unfamiliar with Hindustani music to decipher the emotional essence of various ragas. Astonishingly, even devoid of cultural context, these listeners accurately interpreted the intended emotions conveyed by the ragas. This intriguing link between ragas and emotions substantiates the timeless belief in the transformative power of music.

The Science of Sound: How Music Affects the Brain

Advancements in neuroscience have shed light on the intricate ways in which music affects the brain. Functional imaging studies have shown that listening to music activates various regions of the brain involved in emotion, memory, and motor function. For example, the amygdala, which is associated with emotional processing, responds to the emotional content of music, while the auditory cortex processes the sound itself.

Moreover, music has been found to stimulate the release of neurotransmitters such as dopamine, which is involved in reward and pleasure, and oxytocin, which

promotes bonding and social connection. This neurochemical response to music helps explain why it can induce feelings of relaxation, joy, and euphoria.

Applications of Music in Healing

Music is used in a variety of therapeutic settings to promote healing and well-being. In hospitals, music therapy is integrated into pain management programs, surgical procedures, and rehabilitation protocols to reduce anxiety, alleviate pain, and improve motor function. In psychiatric settings, music therapy helps individuals with mood disorders, anxiety disorders, and schizophrenia to express themselves and develop coping skills.

Outside of clinical settings, individuals often turn to music as a form of self-care and stress relief. Practices such as listening to calming music, playing a musical instrument, or singing in a choir have been shown to reduce stress levels, lower blood pressure, and improve mood.

Understanding Music Therapy

In the modern context, the formal practice of music therapy emerged in the 20th century, gaining recognition as a legitimate therapeutic modality. Music therapy is defined as the clinical use of music interventions by a trained therapist to address physical, emotional, cognitive, and social needs of individuals. It is based on the understanding that music can engage the brain and body in ways that promote healing and well-being.

Music therapists work with a wide range of populations, including children with developmental disorders, individuals with mental health issues, patients undergoing medical treatments, and older adults with dementia. Through techniques such as improvisation, lyric analysis, and guided relaxation, music therapists help clients express themselves, manage stress, and improve communication skills.

In the intricate tapestry of Indian classical music, the concept of raga transcends mere melodies. Each raga is more than a collection of musical notes; it embodies a unique essence, capable of evoking emotions, connecting with nature, and even fostering healing. One of the fascinating dimensions of raga is its association with different times of the day, a connection that holds profound implications for well-being and therapeutic applications.

The Mood of Time: Just as the hues of the sky change with the progression of the day, ragas too reflect the shifting emotional landscape. Various ragas are believed to be attuned to specific times of the day – morning, afternoon, evening, and night. Each time of day carries its own distinct mood, and ragas are carefully crafted to harmonize with and enhance these moods. The alignment between ragas and time seeks to create a resonance between the music and the environment, inviting listeners to embark on an emotional journey synchronized with nature's rhythm.

Morning Ragas: The tranquil hours of the morning are often accompanied by ragas that radiate serenity and freshness. These ragas, like Bhoopalam and Todi, are designed to awaken the mind gently, easing the transition from slumber to wakefulness. Morning ragas are believed to invigorate the senses, foster clarity of thought, and set a

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positive tone for the day ahead.

Afternoon Ragas: As the sun ascends to its zenith, ragas like Bhimpalasi and Brindavani Sarang come into play. These ragas infuse the afternoon with a touch of contemplation and introspection. They provide a sense of calm amidst the day's activities, allowing for reflection and relaxation.

Evening Ragas: The evening heralds a time of winding down and introspection. Ragas like Marwa and Puriya Dhanashri resonate with the deeper emotions that often surface during this time. These ragas are believed to facilitate emotional release, offering a space to process thoughts and feelings accumulated throughout the day.

Night Ragas: As the world embraces the quietude of the night, ragas like Malkauns and Darbari Kanada take center stage. These ragas exude a sense of mystery and depth, inviting listeners to delve into their inner realms. Night ragas are thought to be conducive to introspection, meditation, and even spiritual contemplation.

The association between ragas and time holds implications for healing and well-being. Just as each raga resonates with a specific emotional landscape, it can potentially align with an individual's internal rhythms. The therapeutic potential of this alignment lies in the ability of ragas to harmonize emotions, evoke feelings of tranquility, and facilitate emotional release.

Modern research is increasingly delving into the scientific underpinnings of this phenomenon. Studies have explored the impact of specific ragas on brainwave patterns, hormonal responses, and overall emotional states. This intersection of ancient wisdom and contemporary science highlights the potential for raga therapy – a holistic approach that utilizes ragas to address stress, anxiety, and other emotional imbalances.

Enlisted below are ragas, their time associations and the essence they generate

Time	Raga	Benefit
		emotional strength, Devotion and
	Raga Bhairavi	Peace
	Raga Bhairava	Peace Integration, Compassion
4am - 7am	Ragas Ramakali & Jogiya	Peace & Serenity
	Raga Komala Rishabha Asawari	serenity
	Raga Deshkara	Increased Energy
	Raga Jaita	Dynamism
	Raga Gurjari Todi	Compassion, Patience
	Raga Todi	Joy
7am - 10am	Raga Alahiya Bilavala	Peace and Happiness
	Ragas Gauda & Vrindavani Saranga	wisdom
	Raga Shuddha Saranga	Success, Knowledge
	Raga Ahir Lalita	Joyfulness
10am - 1pm	Raga Vrindavani Saranga	Greater Energy
	Raga Multani	Achievement, Affuence
1pm - 4pm	Raga Madhuvanti	Happiness

	Raga Samanta Saranga Raga Bhimapalasi	Creativity Life
4pm - 7pm	Ragas Kafi & Madhuvanti Raga Mishra Pilu Raga Puriya Dhanashri Raga Marwa Raga Puriya Kalyana	Creativity and Happiness Celebration & Joyfulness Relaxation Coherence, Happiness Harmony
7pm - 10pm	Ragas Puriya & Rageshri Raga Hansadhwani Raga Maru Bihaga Raga Desh Raga Durga Raga Maru Bihaga	Harmony and Rejuvenation Celebration & Happiness Compassion Joy Integration Compassion
10pm - 1am	Raga Darbari-Kanhra Raga Bageshvari Raga Gunji Kanada Raga Abhogi Raga Malkaunsa	Restful Quality of Sleep Relaxation & Rest Better Sleep Peaceful Slumber Restful Sleep, Tranquility
1am - 4am	Raga Sohini & Bhatiyara Raga Basanta Raga Sindhu Bhairavi Raga Lalita Raga Nata Bhairava	Healthy Mind and Body Love & Happiness Gentleness Peace & Tranquillity Serenity

Raga-Time-Healing Effect Association

S. No.	Carnatic Raga	Hindustani Raga	Benefits	Time
1	Abheri	Dhanasri, Bimplasi	affects the human mind positively and control it for days and weeks on end.	Late Morning
2	Abhogi	Abhogi Kanada	Peaceful Slumber, for a very good appetite	Night
3	Amrutavarshini	Malhar Ushana vyathi nasini	(alleviates diseases related to heat)	Rainy season; midnight
4	Ananda bhairavi	Bhairavi	Supresses stomach pain Reduces kidney type problems. Regulates blood pressure	Early Evening
5	Antardwani		Excellent for Meditation and to calm a turbulent mind	
6	Arabhi		Implants positive energy and rejuvenates the mind. Relief when physically tired.	All time Raga
7	Bageshri, Sudha	Bageshri	arouses a feeling of	Mid Night

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	Bhairavi		Relaxation & Rest, stability, depths and calmness. Also used in treatment of diabetes	
8	Bauli	Bibhash	Relief from Chronic Stresss	Early Dawn
9	Behag	Bihag	Useful in the treatment of sleep disorders.	Late Night
10	Bhairavi		Provides relief from T.B, Cancer, Severe Cold, Phlegm, Sinus, toothache	any time of day
11	BhoopaaLam		Begin the day in a calm pace. Calms a turbulent mind.	Early Dawn
12	Bilahari	Bilahari	is associated with love. Ensures one vigour	Late Morning
13	Brindavanasar anga		For Wisdom, Success, Knowledge, Joyfulness and Greater Energy	Early Afternoon
14	Chakravaham	Ahir Bhairav	Brings down blood pressure. Relief for Arthritis, Rheumatic disorder, Muscular & Joint pain. Gives free relaxed feeling and mitigates dust allergies	Day Break
15	Chandrakauns	Chandrakauns	in treatment of heart ailments and diabetes. Relief from Sinusitis and sore throat, urinary track infection	Late Night
16	Charukesi		Helpful for heart ailments. Rejuvenates the mind, Enlivens the singer and listener.	All Time
17	Darbari Kanada	Darvari Kanada	Great relief from Headache (Acute), Migraine, Mind Concentration, Grief, Mental shock, Restful Quality of Sleep	Late Night
18	Dharmavathi	Madhuvanti	To ward away depression and bring happiness, during treatment for skin disease, relief from Peptic Ulcer	Late Evening
19	Dheera Shakarabhara nam	Bilawal	Helpful for heart ailments. Cures mental illness, soothes the turbulent mind and restores peace and harmony.	Evening
20	Dhwijavanthi	Jaijaiwanti	Provides relief from cold and	Late Night

			headache. Quells paralysis and psycho disorders of the mind	
21	Gamaka Samandam	Multani	Prescribed for skin disease, Achievement, Affuence	Afternoon
22	Ganamurthe		Helpful in diabetes	
23	Gaurimanohari		generate a state of well being or sowkhya bhava, decreases stress and tension, Induces peace and tranquility of mind.	All Time Raga
24	Hamasanandi Kamavardhini	Puria Dhanashri	Relaxation, evokes sweet, deep, heavy, stable state of mind and prevents acidity. Relief when physically tired	Evening
25	HamirKalyani	Hamir/Hamvir	Relaxes tension with its calming effect and brings down BP to normal 120/80.	Late Evening
26	Hamsanadam		Evokes state of Purity, Love, Harmony and Compassion. Highly Psychological Effect	
27	Hamsadwani	Hansadhwani Raga	eases tension and provides relaxation. Celebration & Happiness, evokes a very pleasing effect on the nerves. Energy giving. Provides good thinking, chaitanya. Sarvarogaharini (panacea)	Late Evening
28	Hamsanandi Puria,	Sohini	evokes sweet, deep, heavy, cloudy and stable state of mind and prevents acidity. Relief from Mental shock	Night
29	Hari Kambhoji	Khamaj	Useful in the treatment of sleep disorders.	Late Night
30	Hemavathi		Good for joint and back pain	
31	Hindolam	Malkauns	Gives relief from Vatha Roga, B.P, Gastritis and purified blood. Helps to cure low blood pressure. Evokes a Restful Sleep and Tranquility	Late Night
32	Jhonpuri	Jaunpuri	Apan disease, constipation, Intestinal Gas Urinary tract infection, colic pain	Morning
33	Kaambhoji		The mood created evokes memories of Joy, Contentment, Hope, and	Late Evening

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			desire as expressed in the 'Siva-tattva-ratnakara'	
34	Kalyani		Gives energy and removes tension and acts as general tonic. Dispels the darkness of fear; Gives motherly comfort and increases confidence. Kalyani means mangalam. Recited with faith and devotion, it is believed to clinch marriage alliances. Helpful for heart aliments	All Time
35	Kamavardhini /Pantuvarali	Purvi	Relief from cold and headache, keeps the mind stable. Works on the whole human system	Dusk
36	Kanada Bahar,	Miyan Ki Malhar	For patients suffering from insomnia and need a peaceful sonorous sleep. Useful in the treatment of sleep disorders.	midnight; any time Spring season
37	Kapi	Pilu	Helps in depression, anxiety. Reduces absent mindedness	All Time
38	Karnatakadev agandhari	Bhimpalashri, Dhan asri	Affects the human mind positively and control it for days and weeks on end	Late Morning
39	Kedaaram		Gives energy and removes tension	Morning
40	Kedara Gowla Desh		Promotes happiness and ward off depression. Gives the listener serenity, peace, inner joy, right valor, universal love and patriotism	Late Night
41	Kharaharapriy	a Kafi	strengthens the mind and relieves tension. Curative for heart disease and nervous irritablility, neurosis, worry and distress. Evokes a humid, cool, soothing and deep mood, Useful in the treatment of sleep disorders.	any time; midnight
42	Kiravani Kirwani		Promotes dhyana (meditation) at mental and physical levels. Helps in joint and back pain remedy.	Night
43	Kokilam		Helps to prevent stone	

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			formation, burning sensations, sleeplessness and anxiety.	
44	Lalita		Peace & Tranquillity	Early Dawn
45	Madhyamavati Megh,	Madhyamadi Sarang	Clears paralysis, giddiness, pain in legs/hands, etc. and nervous complaints.	Night - Monsoon
46	Madhuvarshini		Good for nerves. Cures diseases like slight headache, sleeplessness, and sinus problems	
47	Maru Bihaga		Compassion	Early night
48	Marwa		Coherence, Happiness	Evening
49	Mayamalava Gowla	Bhairav	Very Auspicious raga, This raga has the power to neutralize toxins in the body. Practicing it in the early hours of the morning, in the midst of nature will enhance the strength of the vocal chords. Soothing for Cancer patients	Dawn, Morning
50	Mohanam Bhupali		Useful for the treatment of migraine headache. Gives tremendous relief to patients of high blood pressure. It filters out the ill-effects of kama (desire for sex) , krodha (anger) and moha (lust), bestowing immense benefits on the listener. Also cures indigestion, and depression.	Evening
51	Nalina Kanthi	Tilak Kamod	evoke a very pleasing effect on the nerves.	Late Night
52	Nata Bhairavi	Asavari	cures headache and psychological disorders. Cures low blood pressure.	Late Morning
53	Nattai Kurinji	Rageshri	Harmony and Rejuvenation	Night
54	Neelaambari		For Good Sleep	Late Evening
55	Pantuvarali		works on entire body	
56	Phalamanjari	Patamanjari	Vomiting, less gastric fire, Anorexia	
57	Poorvikalyani	Pooriya Kalyan (Poorvikalyani)	Anxiety, Leucorroea, Dysmenorrhoea, Abdominal	All Time Raga

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			pain, Promotes Harmony and Pleasant Feeling	Preferably After Sunset
58	Puriya		Harmony and Rejuvenation	Early Evening
59	Pushpalathika	Vrindavani Sarang	Greater Energy	Afternoon
60	Rageshri		Harmony and Rejuvenation	Late Night
61	Ranjani		helps to cure kidney disorders	
62	Rathipathipriya		Adds strengh and vigor to a happy wedded life. This 5 swara raga has the power to eliminate poverty. The prayoga of the swaras can wipe off the vibrations of bitter feelings emitted by ill will.	Late Night
63	Saramathi		Elevates from depressed state. Cures undiagnosed crying and irritability in children. For sleeplessness, itching, eye and ear problems, skin problems, and the problems of hearing irregular sounds	
64	Saranga	Shyam Kalyan, Chayanat, Kedar	Insomnia, Mental retardation, Memory impairment, tonsilitis , Rhinitis, Upper respiratory infections	Early Night
65	Sarasangi	Nata Bhairav	Arthritis, Rheumatic disorder, Muscular & Joint pain	Morning
66	Shankaraabha ranam		Cures mental illness, soothes the turbulent mind and restores peace and harmony. If rendered with total devotion for a stipulated period, it can cure mental disorders said to be beyond the scope of medical treatment. It also is said to have the power to shower wealth.	any time of day
67	Shanmukhapriya		Instills courage in one's mind and replenishes the energy in the body.	All Time
68	Shuddha Saveri	Durga raga	eases tension and provides relaxation. Evoke a very pleasing effect on the nerves.	Late Night

69	Sindhu Bhairavi	Sindhu Bhairavi	For a Healthy Mind and Body, Love & Happiness, Gentleness, Peace & Tranquillity, Serenity, very pleasing for nerves, also helps to cure diabetes	Dawn
70	Sivaranjani		Useful for memory problems. Powerful raga for meditation; bestows benevolence of God. Removes sadness, ushana roga santi (diseases related to excess heat).	Good for general Night
71		Sohini & Bhatiyara	Healthy Mind and Body	Early Morning
72	Subha Pantuvarali		Alleviates mental dilemmas and indecisiveness	Morning
73	Suddhadhany asi		Remover of sorrows. Gives a happy feeling. Tonic for nerves. Cures rhinitis and migraine.	
74	Sunada Vinodini	Hindol	Relieves Body pain, low backache, musculoskeletal and neuralogic pain, Rheumatoid arthritis, Osteoporosis, Useful in blood purification.	Seasonal
75	Surutti		Mitigates stomach burn, insomnia, fear, disgust	
76	Thodi Bhairavi		Arthritis, Rheumatic disorder, muscular & joins pain, heaviness	morning; any time
77	Vachaspathy		A high energy raga as it invokes a sudden rush of energy flow in the mind of listeners, capable of removing fatigue and promoting relaxation. Bestows a stable state of mind and generates a state of well being or sowkhya bhava.	All Time Raga
78	Vakulabharanam		Alleviates asthma, bronchitis, heart disease, depression, skin disease and skin allergy	
79	Valaji Kalavati		Very effective to soothen Labour pains (Acute),	Late Night

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			Insomnia, evoke a very pleasing effect on the nerves.	
80	Varali		Good for vayu tatva, heart, skin ailments and gastric problems.	
81	Vasantha	Basant	Controls high and low blood pressure, cures heart as well as nervous diseases. Heals nervous breakdowns. Gives relief from Vatha Roga, B.P, Gastritis and purifies blood.	any time Spring season
82		Malhar	Useful in the treatment of asthma and sunstroke.	
83	Yamunakalyani		Gives freshness and dynamism. Relief for Arthritis, Rheumatic disorder, Muscular & Joint pain. Increased fetal movements experienced by the mother.	Late Evening when lights are put on

Courtesy (https://anuradhamahesh.wordpress.com/)

Conclusion

The increasing recognition of the therapeutic benefits of ragas is shedding light on a safe alternative to many medical interventions. In this context, the appeal of simple, repetitive musical rhythms adorned with low-pitched swaras, such as those found in bhajans and kirtans, has endured over time. These musical traditions serve as timeless sedatives, offering a promising substitute for synthetic analgesics, which often entail unwanted side effects. Their remarkable capacity to induce relaxation has been corroborated through observations of alpha-level brainwave activity. Furthermore, there is evidence suggesting that they may initiate favorable hormonal shifts within the body (Crandall, 1986).

One of the most promising advancements for Raaga Chikitsa is its integration into mainstream healthcare. As our understanding of the mind-body connection deepens, healthcare providers are increasingly acknowledging the value of complementary therapies like music therapy, including Raaga Chikitsa. In the future, we can anticipate witnessing more hospitals, clinics, and mental health facilities incorporating Ragam Therapy as part of their treatment offerings.

Technological advancements, particularly in artificial intelligence and machine learning, are facilitating the development of personalized music therapy programs. In the future, individuals may have access to Ragam Therapy playlists tailored to their specific emotional and psychological needs. These playlists could be dynamically adjusted based on real-time monitoring of the individual's well-being. The digital age has ushered music therapy, including Raaga Chikitsa, into the virtual realm. We can anticipate the emergence of more mobile apps and online platforms that provide access to therapeutic

ragas and guided music therapy sessions. These tools have the potential to make music therapy more accessible to a broader audience.

Raaga Chikitsa has the capacity to complement and enhance other healing modalities such as yoga, meditation, and mindfulness practices. Collaborative efforts between practitioners of different disciplines can lead to holistic wellness programs that comprehensively address physical, mental, and emotional well-being. As Raaga Chikitsa gains popularity, efforts to preserve and promote the cultural heritage of Indian classical music will also be important. Initiatives aimed at safeguarding traditional ragas, instruments, and teaching methods will help maintain the authenticity and purity of this therapeutic practice.

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Solar Thermal Energy Storage: For a Green Future

Suraj Haral
Maharaja Jivajirao Shinde Mahavidyalaya, Shrigonda [MS], India
Yogesh Pathak
Karmaveer Bhaurao Patil Mahavidyalaya (Autonomous), Pandharpur [MS], India
Dr. Sanjay Thube
Dada Patil Mahavidyalaya, Karjat [MS], India
Email: surajharal@gmail.com

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Abstract:

In our daily activities, the energy plays a very crucial role. From smartphone in our hand to the rocket in a space, we need various forms of energies. With the rapid industrialization our energy requirement is increasing and with this the pollution is also increasing. There are so many bad impacts of current non-renewable energy sources on environment. The use of solar energy is a promising solution to address the growing demand for sustainable energy. This chapter explores the various types of solar thermal energy collectors, various applications and benefits of solar thermal energy, types of solar thermal energy storage methods. It highlights the design, construction and working of solar thermal energy storage with parabolic point focusing type solar collector with sensible heat thermal energy storage. It concludes that harnessing solar thermal energy and its storage is a sustainable solution for future power generation.

Keywords: Solar thermal energy, Solar collector, Parabolic concentrator, Thermal energy storage, Sensible heat storage.

1. Introduction:

Today energy is our prime requirement after food, cloth & shelter. The sources of energy were changed with time. Human is always in search of new energy sources which are more feasible. From last few decades the rate of energy consumption was increased in a huge amount. This energy requirement is mostly fulfilled by the non-renewable energy sources like crude oil, natural gas, coal, nuclear power etc. these non-renewable energy sources easily available and are handy to use. We use these energy sources for electricity generation, transportation, manufacturing industries, space missions, domestic use, agriculture etc. But with the energy, they are major contributor of environmental pollution. Due to burning of fossil fuels, large amount of carbon gases are generated which is a main reason behind the global warming and air pollution. To minimize the environmental pollution, we need to shift towards the environment friendly energy sources and need to increase environmental education[1]. There are number of renewable energy sources like solar energy, hydroelectricity, wind energy, tidal energy etc. which can be take a place of non-renewable energy sources. Solar energy is good alternative which is available everywhere on earth in a sufficient amount. All other

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renewable energy sources are indirect form of solar energy.

Solar radiation spectrum mainly contains visible radiation, IR radiation and UV radiation. The value of solar constant is 1367 w/m^2[2] at the top of atmosphere and on earth is about 1000 W/m^2 [3], the total solar radiation at sunniest region per day is about 7 kWh/m^2 [2]. Solar energy can complete our energy need but the main problem is its availability. In a whole day we get the sunlight in day time only. For night we have to depend on another source of energy. To overcome that availability issue, energy storage is a great option. In day time we can store excess amount of energy and utilize it in absence of sun. by creating a huge amount of storage, we can also counter the seasonal sunlight fluctuations.

We are using energy for number of applications and for that energy of different forms are used. The most popular and common form of energy in current scenario is electricity. Because of its ease of use, it can be easily converted to other forms of energy. It is easy to transport from one location to another. After electricity, heat or thermal energy is most used form of energy. Currently we use oil, coal, wood, natural gas etc. to generate heat. But while shifting towards the ecofriendly energy sources, we should acquire heat from renewable energy sources. Using solar thermal collectors, heat energy can be easily harnessed in a day time. For night time another source of energy can be used or use electricity for thermal purpose. But it's not economical as well as practical to use green electricity generated from solar PV cell and stored in batteries for generation of heat. Because to produce a small amount of heat, large amount of electricity is required. As our goal is to use entire energy from renewable sources, we should search an alternative instead of burning fossil fuel. For that we can use thermal batteries. Solar thermal energy is stored in the form of heat, and that stored heat can used when there is no sunlight. This thermal battery can bridge the gap between demand and supply of solar thermal energy. Depending upon our applications, the storage system may differ, like some applications requires heat of lower temperature where as some applications needs heat of very high temperature. So, the maximum temperature is a key point of any thermal storage system, we can design & construct it according to desired application.
There are basically three methods of thermal storage [3].

1.1. Sensible heat thermal storage:

In this type of thermal storage, a storage material is heated without changing the phase, and given heat is stored in the material. The amount of heat stored is depends on the specific heat of material, mass of material and the range of temperature through which it is heated. This is simplest method of thermal energy storage.

1.2. Latent heat thermal storage:

In latent heat thermal storage, heat is given to the storage material to change its phase at constant temperature. That heat is stored in the form of latent heat. The storage capacity of this method is depending on the latent heat of material, mass of material, specific heat of material in both phases and the temperature range.

1.3. Thermo-chemical heat thermal storage:

In this type of thermal storage heat is stored in the chemical form. If some heat is given

to the thermo-chemical material, there is change in their chemical composition until the heat is there. If we extract the same amount of heat, they are going back to their original chemical structure. Among the all methods, thermos-chemical storage has higher energy density.

2. Solar thermal energy collector:

The device which receives the solar radiation and convert it to usable heat is known as solar thermal collector. There are various types of solar collectors having different operating temperature. Based on the construction and concentration ratio solar collectors are classified in to two categories [4].

1. Non-concentrated type solar collector
2. Concentrated type solar collector

In solar thermal collector, concentration ratio is an important parameter. It is a ratio of area of collection to the actual absorbing area. Concentration ratio indicates in what amount the solar radiation is concentrated on a given absorbing area. The temperature of collector is mainly depending upon the concentration ratio CR. Higher the CR, temperature of collector is also high.

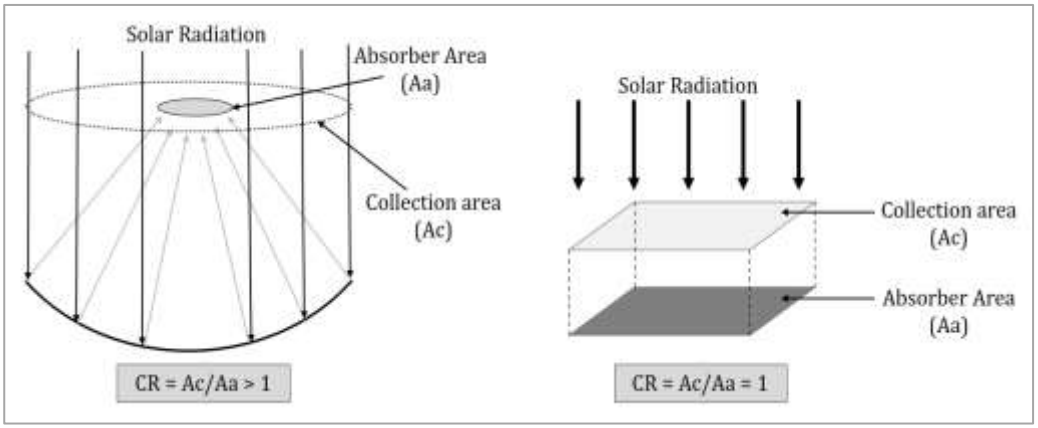

Fig. 2: - Concentrated & non-concentrated type solar collectors [3].

2.1. Non-concentrated type collector:

In this type of collector, there is no any reflective surface used to concentrate the solar radiation. The sunlight coming from sun is used as it is. Hence the absorbing area is same to that of collection area. The concentration ratio of non-concentrated type thermal collector is equal to one. Examples of non-concentrated collector are [5].

1. Flat plate collector
2. Evacuated tube collector
3. Solar dryer
4. Solar distillation plant etc.

These collectors are easy to construct and having low cost. They do not require any tracking mechanism. Due to low CR, their operating temperature is low (up to 100º C [4]). This temperature may vary with the location and the design of collector. These

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types of collectors are not used in high temperature applications. They are mostly used to heat water, oil, air to keep home warm etc. The absorbers used in these collectors are coated with black coloured material having very high absorptivity to absorb maximum radiation incident on it. Absorber has hollow cavity through which the fluid is passed. During this flow the heat is exchanged between absorber and fluid. The hot fluid is come out through the outlet.

There are number of factors affecting the performance of collector like covering plate of absorber, coating of absorber, spacing between absorber and glass cover, tilt angle, temperature of fluid at inlet, external air flow, local solar constant, insulation of absorber from remaining sides etc.

Advantages:

i. They are very simple to design, construct and cost effective.
ii. They do not require any tracking mechanism or not contain any moving parts; therefore, maintenance is also very less.
iii. They can absorb direct as well as diffused solar radiation.

Disadvantages:

i. Since, there is no concentration the absorber area should be large to collect large amount of heat. Larger absorber area results in larger thermal loss.
ii. Since there is no tracking mechanism, absorber plane is not always perpendicular to the sun rays, therefore there is not efficient collection of heat.
iii. Due to lower concentration ratio, they cannot be used in higher temperature applications.

2.2. Concentration type solar collector:

In these types of collectors one or more reflector are used to concentrate the solar radiation on a small area. If the collection area is very much greater than absorber area, the concentration ratio becomes large. Peak or maximum temperature of collector is a function of CR. As we increase the CR, we will get the higher peak temperature.

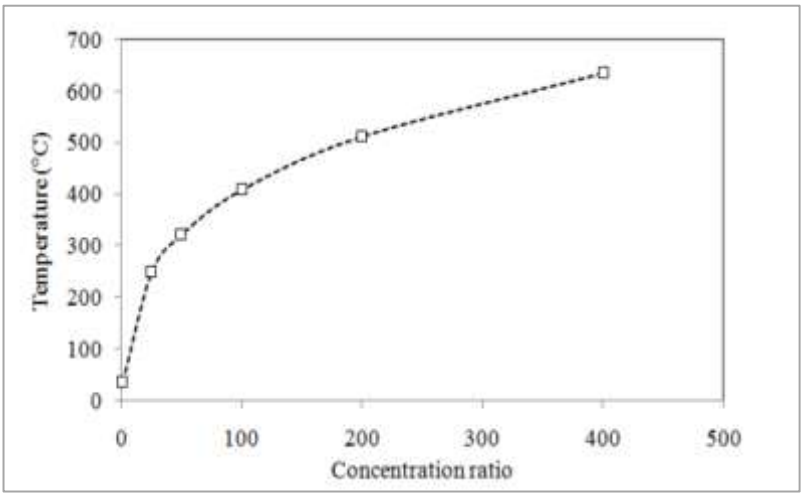

Fig. 3: - Relation between Concentration Ratio & maximum collector temperature at an average solar constant 800 W/m^2 [6].

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Types of Concentrated collectors are

Line focusing type concentrator	Point focusing type concentrator
a. Radiation is concentrated on a focal line b. They need a single axis tracking mechanism c. Maximum temperature of collector is low d. CR is quite low e. Ex. Parabolic trough collector, Compound parabolic collector	a. Radiation is concentrated on a focal point b. They need a two-axis tracking mechanism c. Maximum temperature of collector is high d. Can achieve a high CR e. Ex. Parabolic dish collector, Heliostat field collector

These collectors are used to generate steam, oil heating, air heating, industrial applications, electricity generation, cooking and many more thermal applications. These collectors continuously track the sun; hence the efficiency of thermal collection is more than non-concentrated type collectors.

3. Solar thermal energy storage:

If we consider the availability of solar radiation, it is available only for few hours in a day. We cannot use solar energy as per our convenience. Instead, we use it as per its availability. This is the main drawback of solar energy. The variation in sunlight during a day is very small when compared with the seasonal availability. In monsoon period specially in Maharashtra (India), there is no proper sunlight for two to three months. It's a huge gap. The storage of energy can overcome this demand and supply. We can store the heat in the form of electricity, and this electricity is again converted in to heat; but this storing method is not economical. Storing the heat as it is using thermal storage method is more cost effective. It is more efficient because there is no need of conversion. There are few challenges in thermal storage are

i. Harnessing thermal energy with proper high temperature.
ii. Transfer of heat
iii. To minimize the heat loss
iv. Selection of storage material for high energy density

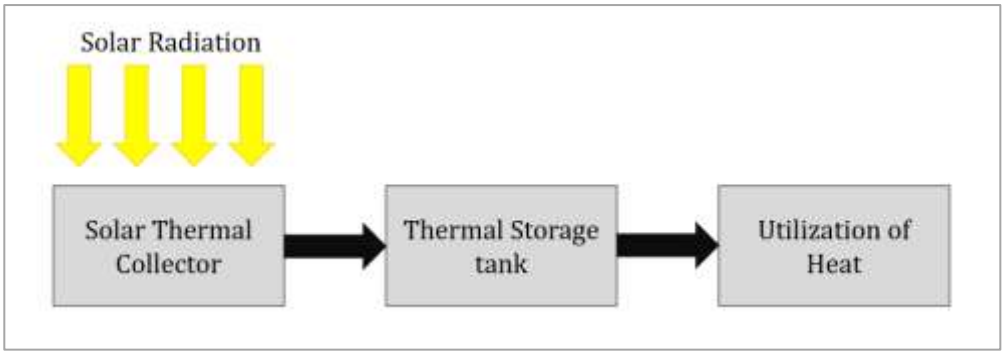

Fig.1: - Block diagram of solar thermal energy storage system.

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In broader view the structure of solar thermal energy storage system is shown above. There are various blocks have specific functions.

A typical setup of solar thermal energy storage system (STESS) using parabolic collector & sensible heat storage method is shown below.

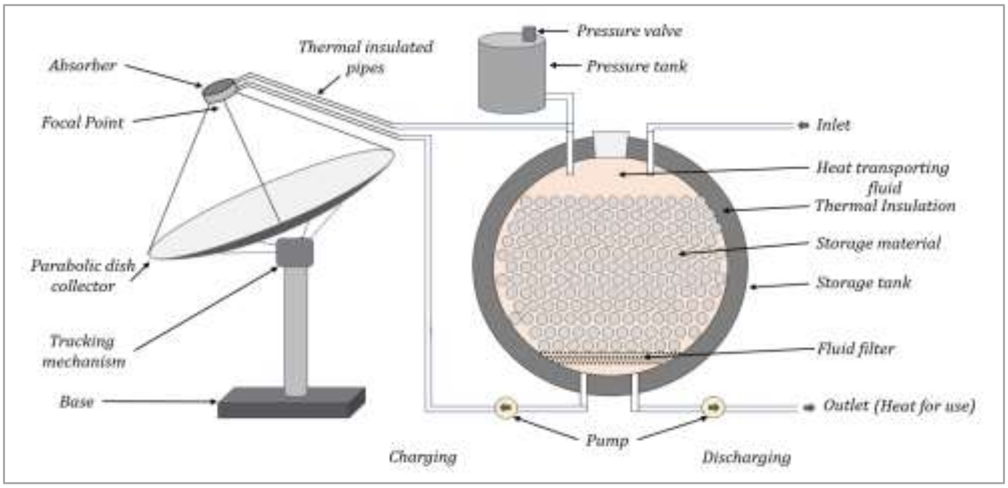

Fig. 4: - Solar thermal parabolic collector with sensible storage tank.

This storage system contains main four blocks

1. Collection of solar thermal energy
2. Transportation of heat
3. Storage of heat
4. Utilization of heat

The STESS is designed as per the application where heat is used at various temperature levels. It provides an uninterrupted thermal energy supply.

Point focusing type parabolic solar collector:

This module is used to collect the solar radiation and convert it in to a thermal energy. In above collector, metallic sheets (aluminium, steel, copper etc. [8]) are used to make a parabolic reflective surface used to concentrate the thermal energy focal point. For better reflection the inner side of dish is finely polished. A proper tracking mechanism is installed for the parabolic collector to track the sun. the shape of parabola is designed as per the equation for proper focusing.

$x^2 = 4fy$ ………………………………………………... (1) [8]

Where f is focal length

Transportation of heat:

The collected heat at focus is transported to the storage tank by using heat convection method. A liquid or gas can be used as a heat transporting fluid (HTF). Water, oil, vapour etc. [5] are used as HTF. Heat absorbing chamber through which HTF if flowing if fixed at the focus of collector. Heat absorbed by absorber is exchanged with HTF, hence HTF comes out from outlet of absorber is gets heated. The inlet and outlet of an absorber are connected to thermal storage tank via pump as shown in figure 4. A pump is used to control the flow of HTF through the heat circulation system. Heat

circulation pipes, storage tank, pump and outer side of absorber are well insulated with a high-quality thermal insulator to stop the heat loss.

Thermal storage tank (TST):

A spherical shape steel container with desired volume is used as a TST. Due to spherical shape, we get a maximum volume with a minimum surface area which is useful to prevent heat loss. A mesh filter is placed at the bottom of TST to filter the HTF. Small beads of solid sensible storage material are filled above the filter. Small space is kept empty at the top to counter the thermal expansion of storage material. One pressure capsule is connected to circulation system to adjust the expansion and pressure of HTF. Hot HTF enters TST from top and passes through the porous structure of sensible storage material and reach the bottom. During this flow, heat is transferred from HTF to storage material and the temperature of TST goes increasing. If HTF is circulated through the whole system again and again, the heat is transferred from collector to storage tank until their temperature becomes equal. This is also known as equilibrium condition. The heat stored in TST at equilibrium is given by the equation.

$$Q = \int_{T_r}^{T_f} [m_s C_s + m_f C_f] dt \quad \text{..... [3]}$$

$$Q = \left[m_s C_s + m_f C_f\right] [\, T \,]_{T_r}^{T_f}$$

$$Q = \left[m_s C_s + m_f C_f\right][T_f - T_r] \quad \text{..... (2)}$$

Where, Q- amount of heat stored

T_r- room temperature

T_f- maximum temperature of TST

m_s- mass of storage material

C_s- specific heat of storage material

m_f- mass of HTF inside the storage tank

C_f- specific heat of HTF

Utilization of heat:

The storage of heat in TST can be used for various applications. heat utilization process is similar to heat storing process, the only difference is direction of heat flow. In utilization same HTF transfers heat from TST to utilization chamber. In this process the heat of storage material is decreasing which is also known as discharging process. Since, there is no perfect insulator or circulation system, some part of heat is lost during the transportation and storage.

4. Applications of solar thermal energy storage:

There are various applications where we use energy in the form of heat.

1. Heating and cooling of residential building.
2. Solar water heating.
3. Solar drying of agricultural and animal products.
4. Salt production by evaporation of seawater.
5. Solar cookers.
6. Solar engines for water pumping.

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7. Solar Refrigeration.
8. Solar water distillation
9. Solar electric power generation from steam.
10. Solar furnaces etc.

Different energy sources used in current time are mostly non-renewable or exhaustible. In next few decades they are going to end, but our energy requirement is not decreases, actually it is increasing day by day. So, we need a solid energy source which is long lasting and reliable. These requirements are meets with the solar energy. One more important reason behind giving preference to solar energy is the pollution. Current energy sources are mainly responsible for pollution which can be minimized by adopting solar energy. By considering all pros and cons, there is no doubt that, solar energy is our future…

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A Geographical Review of Modern Agricultural Practices

Dr. Ashish S. Jadhav
Department of Geography, Mudhoji College, Phaltan, Dist. Satara
Prof. Swati S. Shinde
Department of Electronics, Mudhoji College, Phaltan, Dist. Satara
Email: ashishjadhav8261@gmail.com

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Abstract:

Agriculture is the backbone of the Indian economy. India is the country with 70% population living in the villages and having agriculture as the major earning source. India's the total population depends upon the agriculture sector. The farmers are using the traditional method of agriculture. It has affected on the productivity of agriculture. The use of hybrid seeds, irrigation and modern practices of agriculture has changed the farming picture. After adapting the modern techniques of agriculture, the productivity of agriculture has been increased. Due to the increase in the productivity, it has been possible to fulfill the need of food of increasing population. But majority of the farmers are unknown about such agricultural technologies. In the light of this, present study has been undertaken.

Keywords: backbone, productivity, hybrid seeds, modern practices, modern techniques agricultural technologies.

Introduction

Agriculture is the backbone of the Indian economy. India is the country with 70% population living in the villages and having agriculture as the major earning source. The farmer's lot is reeling under poverty since ages. The successive government has cared to increase the productivity. The new techniques thus invented and practiced elsewhere. Should be introduced for the poor farming community in our country to enhance the production and also bring down the skyrocketing prices of agriculture products. Agricultural production improvement, cropping practices and maximizing the harvest are perhaps the oldest of human occupation, which continue to be of highest priority in most region of the world till date, because hunger continues to exist.

At times in many parts of the world, crop production trends economics of cultivation distribution and consumption demand of different crops however naturally uneven depending on the geographical area and population growth even in within and area it has fluctuated during a decade, year of seasons hence during recent decades there has been a concentrated effort all over the globe to make each specific zone self-sufficient in terms of food requirements(Dushing et al., 2022). We have accumulated knowledge of production of improved legumes, oil-seeds, fiber crops sugar and search crops and narcotics, greater emphasis has been placed on aspect such as global distribution climatologically requirements land preparation, agronomic practices

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availability of improved verities and post harvested technologies(Kokane & Jaybhaye, 2019).

Significance of Study

India's the total population depends upon the agriculture sector. The farmers are using the traditional method of agriculture. It has affected on the productivity of agriculture. In the present era, new agricultural technologies are invented. But majority of the farmers are unknown about such agricultural technologies. In the light of this, present study has been undertaken.

Objectives

- To Identify the New Agriculture Technology.
- To Study the Effects of New Technology on Agriculture Production.

Data Base & Methodology

The present study is a theoretical study. The study is depending upon secondary data. The data is collected through references books, research magazines and unpublished environmental projects. The researcher has discussed with the farmers.

Discussion

The use of hybrid seeds, irrigation and modern practices of agriculture has changed the farming picture. Now with more yield of crop per acre, you can see variety of threshing machines operating in the farms during harvesting time. While talking about farm machinery let us look to the alarming figure of farm accidents. Due to either negligible or over confidence operators of these machines give scant respect to safety. Many farmers have got their fingers cut, just for not ensuring cover over moving parts. And yes, there are many tractor accidents as tractors and trolleys have become preferred mode of travel particularly for marriage parties. As far as micro irrigation systems are concerned all the advanced world class technologies in drip, sprinkle and other systems are available in India.

Non-conventional energy sources like Gobar gas, wind energy, solar pumps and protection systems of electrified fences can be seen at many places. Thanks to IREDA and their state agencies. Agricultural engineering institutes in the country have developed various tools and invented new equipments to meet the needs of common farmer. Indian scientists and small entrepreneurs do not lag behind. They have developed many small tools, which are invented by scientists in developed countries. CFTRI, Mysore is a leading organisation in food processing. They have developed a host of technologies to suit modern life style. Defense research organisation has developed various food technologies to meet the needs of defense personnel.

A) Impact of Modern Agricultural Techniques

1. Management of Tillage
2. Methods of Irrigation-Sprinkler, Drip, Water Storage
3. Rain Water Harvesting
4. Selection of Seeds and Plants
5. Use of Integrated Weed Management

6. Use of Proper Fertilizers, Pesticides and Herbicides-Nonorganic-Organic Farming
7. Methods of Harvesting
8. Storage Facilities
9. Greenhouse Technology

1. Management of Tillage

- To make soil loose and porous
- To operate the soil
- To have the repeated exchange of atmospheric air with soil air
- To increase the soil temperature
- To control the weed
- To remove the sutbbes of previous crops
- To destroy the insect
- To incorporate organic manure and fertilizers in the soil
- To invert the soil to improve fertility

2. Methods of Irrigation-Sprinkler, Drip, Water Storage

- Flood Irrigation
- Overhead Irrigation
- Sprinkler, Drip
- Water Storage

3. Rain Water Harvesting

- To reduce run off loss
- To avoid Flooding of roads
- To meet the increasing demands of water
- To raise the water table by recharging ground water
- To reduce ground water contamination
- To supplement water supplies during lean seasons

❖ **Rainwater can be mainly harvested by anyone of the following methods**

- By storing in tanks or above or below ground
- By constructing pits, tube wells, lagoons, trench or check dams on small rivulets
- By recharging he ground water

❖ **Advantages of Rainwater Harvesting**

- Low cost
- Little maintenance cost
- Helps in recharging aquifers, improves ground water quality.
- Helps in improving soil moisture and reduces soil erosion by minimizing runoff water

4. Selection of Seeds and Plants

Any material used for planting propagation, whether it is in the form of seed of food fodder, fiber and vegetable crop or seedlings, tubers, bulbs, rhizomes, roots, cutting

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or grafts and other vegetative propagated material is defined as seed.

- **Types of Seeds**
- Hybrid seed
- Composite seed
- Mutants
- HYV
- Tissue culture
- Nano culture

5. Use of Integrated Weed Management

- Prevent weed resistance to herbicides
- Shift in crop-weed competition in favor of crops
- Prevent weed shift towards perennial nature
- Danger of herbicides reduce in soil or plant can be minimized
- Minimum environment pollution
- Contributes to Economic crop Production

6. Use of Proper Fertilizers, Pesticides and Herbicides-Nonorganic-Organic Farming

Bio-fertilizers are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed or composting areas with the objective of increasing the numbers of such micro-organisms and accelerating those microbial processes which augment the availability of nutrients that can be easily assimilated by plants. Bio-fertilizers harness atmospheric nitrogen with the help of specialized micro-organisms which may be free living in soil or symbiotic with plants.

'Microbial inoculants' are carrier-based preparations containing beneficial micro-organisms in a viable state, intended for seed or soil application, designed to improve soil fertility and help plant growth by increasing the number of desired micro-organisms in plant rhizosphere. Microbial Inoculants- In soil the activities of Nitrogen fixation, mobilisation of plant nutrients and degradation of ligno-cellulotic wastes are being carried out by a large number of micro-organisms. Artificially multiplied cultures of selected micro-organisms augment the natural recycling of organic resources. There are different types of microbial inoculants.

- **Nitrogen Fixers**
- Symbiotic- Rhizobium, inoculants for legumes.
- Non-symbiotic- For cereals, millets, and vegetables.

  a) Bacteria-

  i) Aerobic- Azatobacter, Azomonas, Azospirillum.

  ii) Anaerobic- Closteridium, Chlorobium

  iii) Facultative anaerobes- Bacillus, Eisherichia

  b) Blue green algae- Anabaena, Anabaenopsis, Nostoe

  i) Phosphate solubilizing micro-organisms.

ii) Cellulolytic and lignolytic micro-organisms.

iii) Sulphur dissolving bacteria.

iv) Azolla.

A. Rhizobium Inoculant

Agronomic importance- Response to Rhizobium inoculation has been amply demonstrated with most of the legumes- ahar, urd, mung, gram, soybean, etc. Besides, legume cultivation also leaves behind a naturally nitrogen enriched soil for subsequent cultivators.

B. Azotobacter Inoculants

Azotobacter inoculants on onion, wheat, rice, brinjal, tomato, cabbage, sugarcane, oat, barely, maize, potato can increase 7-12 % crop yields.

C. Blue Green Algal Inoculants

These algae also possess photosynthetic activity. Besides they excrete vitamin B12, auxins and ascorbic acid which contribute to growth of rice plants.

D. Azolla-an Organic Manure

Crop response- Soil application is more beneficial than dual culture method; 10 tonnes fresh Azolla/ha is equivalent to 25-30 kg N/ha and increasing application rate from 5-20 tonnes/ha has direct response in grain yield of paddy.

- **Pesticides and Herbicides**

- Pesticides- Role in agriculture to improve crop yield, role of controlling disease
- Herbicides- The chemicals used for Killing the weed or inhabiting growth weeds are called Herbicides.

- **Nonorganic-Organic Farming**

Organic farming for reducing the cost of cultivation and to increase the profitability could use acid-delinted seeds in order to avoid seed borne pathogenic infections and achieve optimum plant stand. If fuzzy seeds are used, however, higher seed rate is to be used in order to achieve the same goal.

7. Methods of Harvesting

Harvesting is the process of gathering mature crops from fields, physically removing the crop, cooling, storing, cening, soaring, packing up to the point of farm processing or shipping to the wholesale or consumer market, Tractor harvesting.

8. Storage Facilities

- Room Storage- The room should have high plinth and good ventilation.
- Pit Storage- 60-75 cm deep, 2.5 m long and wide, some cool, shady places, water sprinkled inside the pits to cool it.
- Cold Storage- This is the best method of storing as temp and humidity can be regulated in such storage. R.F. for cold storage.

9. Greenhouse Technology

This technology is advanced artificial and manmade technology that technology is any season any crop production available for any time greenhouse technology a very important present day.

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6. Conclusion

After adapting the modern techniques of agriculture, the productivity of agriculture has been increased. Due to the increase in the productivity, it has been possible to fulfill the need of food of increasing population. Taking agricultural practices, the farmers should aware the land as a natural resource to be transmitted the next generations in the healthy form. The traditional farming farmers are unable to get the production as per the requirement. Due to the lack of knowledge about properties of soil, fertilizers, irrigation facilities to overcome these problems modern agricultural practices are introduced which consists of following things:

- ✓ Use of Modern Equipment's for Plugging.
- ✓ Selection of Proper Seeds, Irrigation Facilities.
- ✓ Use of Proper Fertilizers, Pesticides, Manures.
- ✓ Use of Machines for Harvesting.
- ✓ Use of Modern Methods for Storage of Seeds, Farm Products.
- ✓ Use of Organic Agriculture should be followed on Large Scale.
- ✓ Use of Green House Technology.
- ✓ Use of Integrated Weed Management.
- ✓ Use of Bio-fertilizers, Bio-pesticide.

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Bio-musicology: A Musically Therapeutic perspective in Uttar Pradesh, India

Monika Yadav
Kalpana Singh
Bio-musicology Research Laboratory, Department of Zoology, University of Lucknow, Lucknow- 226007, UP (INDIA)
Email: biomusicology.india@gmail.com

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Abstract

This chapter explores the potential of music therapy in the context of Uttar Pradesh, India's culturally rich and diverse state. Music therapy, leveraging traditional melodies and rhythms, offers a holistic approach to health and well-being, addressing stress management, mental health support, and community engagement. In Uttar Pradesh, where stress-related disorders and mental health challenges might prove to be challenging, music therapy might aid as a non-invasive and culturally relevant intervention. Integrating music therapy into healthcare settings enhances patient care and promotes social cohesion. Education and awareness initiatives foster understanding and acceptance of music therapy's benefits, while research and innovation drive evidence-based practice and program development. By harnessing Uttar Pradesh's cultural heritage and collaborative spirit, music therapy emerges as a promising avenue for promoting health and harmony in the region.

Key words

Music Therapy, Bio-musicology, Uttar Pradesh, Health, Wellness, Alternative medicine

Introduction

Indian music therapy is highly therapeutic, subjective and may be suited to meet individual needs while focusing on the spiritual upliftment. Its goal is to achieve union heightened state of awareness and feelings, and harmony in a musical sense is not employed. The spiritual basis of Indian music therapy promotes the expression of devotion in the subject [16, 17, 18].

Indian Music therapy is raga-based and alters physiology in a way that may relieve anxiety, promotes relaxation, and causes sleep. It also, by bringing about gentle stimulation and enhances the attention span. This raga-based approach to music therapy is subjectively customized in that its modulation through swara allows the singer to fashion the music to the listener's preferences and listening habits. Indian music therapy is different from Western music therapy in its focus on deep devotional feelings [18].

Studies suggest the positive effect of music therapy on depression scores; however, their lack of rigorous quality standards requires studies to be conducted. Unpublished research corroborates these findings and also indicates the improved cognitive and behavioral outcomes as well as emotional healing [18].

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Indian music therapy has provided promising evidence of being a credible alternative therapy to rehabilitation of patients of schizophrenia, dementia, autism, insomnia, and substance abuse, as well as disorders of speech and coordination, and in relieving terminal cancer pain [16, 17, 18].

Indian music therapy gives following benefits: Positive effects on mood, improved concentration and attention, aids in coping mechanisms and relaxation, help in understanding the person's inner self, image, and personality and provides a better awareness of self and environment and thus produces a positive impact on social interactions [16, 17, 18].

The mechanisms by which the music therapy operates include: Offering a mode for emotional expression without the use of words, The composition of music in a band offers a social environment, The composition of music is brings about motivation and is rewarding in itself as the pleasure in listening to music lessen the flattened affect and lack of motivation or meaning, in depressed individuals [16, 17, 18].

Previous research has demonstrated the influence of music, including classical music, on physiological and behavioral changes in animals and humans including rodents [19].

There is growing interest in music interventions and music therapy in healthcare. Music interventions have a wide applicability, and the low cost, lack of side effects and ease of use make it an interesting intervention [1] [2][3]. Music interventions involve application of music in order to improve a clinical outcome, and can be administered recorded or live. Music interventions are thought to not only exert their effects in humans by improving relaxation or providing distraction for a specific situation, but also to achieve specific physiological changes in the human body. The exact mechanism of action remains unknown [4] [5]. Music listening can influence a person's emotions and moods by activating specific pleasure areas in the limbic system, such as the nucleus accumbens, amygdala, and hippocampus [11][12] [13]. It cannot be excluded that such effects also occur in animals. Some studies in rodents indeed have shown that music exposure enhanced the expression of neuropeptides in the limbic system, which are known to be involved in pleasure and reward control [6] [7] [8] [9] [10]. Moreover, several experimental studies in healthy rodents and in rodent disease models found similar effects as reported in humans, such as enhanced spatial ability, improved neuroplasticity, anxiety reduction, blood pressure lowering and increasing immune function [14] [15]. The outcomes of systematic experimental studies in animal models could be of value in understanding the working mechanisms of music interventions and extending clinical applicability of therapies. To answer the question whether music interventions exert effects on brain structure, neurochemistry, behavior, immunology, and physiology in rodents, we need to study them thoroughly by empirical studies conducting experiments.

In 2019, Kozma et al. [6] have presented the creation of a rodent cooperation test as a social cognition model. The recently created rat cooperation model is rapid and has a high enough throughput to be useful in the discovery of potential chemicals for

social cognitive enhancers. In 2019, Salah et al. [4] have recommended the techniques for emotional behavioral testing in rodent models of immature epilepsy. The behavioural testing panels we developed for our mouse seizure models with pronounced amygdalo-hippocampal involvement were detailed in this study.

In 2020, Buscheret al. [2] have presented a free and open-source raspberry Pi-based operant box for evaluating rodent behaviour. The construction and usage of a unique, open-source, raspberry Pi-based operant chamber for the purpose of using audiovisual-based behavioural testing in rats are described in depth in the study. In 2020, Machado et al. [5] have examined for single-unit recordings in rodent ex vivo and in vivo acute preparations, a flexible and modular Electrode-based instrument. In this study, a Electrode-based device that can be readily included into all wet-bench labs and permits interchangeable extracellular recordings of brain activity between in vivo and ex vivo preparations was designed.

In 2021, Vargas et al. [3] have defined the causes and restrictions of rodents' acoustic variation. In order to investigate the evolution of signal elaboration, this research proposed a paradigm for the development of mechanistic and functional investigations that are mutually instructive. In 2021, Saréet al. [8] have defined highlighting potential confounds affecting variability and reproducibility in behavior testing in rodents. This essay emphasized the variables that have been identified as having an impact on behavioural interventions. Our objective is to raise knowledge of the elements that might influence rodent behaviour and to stress the importance of comprehensive reporting of procedures.

In 2022, Zenget al. [7] have proposed a procedure for employing a four-channel recording setup to measure the auditory brainstem response in mice. This study described a four-channel recording methodology for ABR in mice. In this work, the steps for animal preparation, ABR recording equipment setup, click- and tone-evoked ABR recordings, and data analysis are covered in detail.

Benefits of Music Therapy in Uttar Pradesh

Music therapy holds significant potential in the context of Uttar Pradesh, contributing to holistic health and well-being in various ways [20]:

Cultural Heritage: Uttar Pradesh is renowned for its rich cultural heritage, including vibrant music traditions such as Hindustani classical music, folk music, and devotional music. Music therapy leverages these cultural assets, incorporating traditional melodies, rhythms, and instruments to promote healing and well-being.

Stress Management: With rapid urbanization and modern lifestyles, stress-related disorders are on the rise in Uttar Pradesh. Music therapy offers a non-invasive and accessible approach to stress management, helping individuals relax, reduce anxiety, and cope with everyday stressors through the soothing power of music.

Mental Health Support: Uttar Pradesh faces challenges in mental health care due to limited resources and stigma associated with mental illness. Music therapy serves as a complementary approach to conventional treatments, offering emotional support, self-expression, and empowerment for individuals with mental health conditions.

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Healthcare Integration: Integrating music therapy into healthcare settings, such as hospitals, clinics, and rehabilitation centers, enhances the quality of care and patient outcomes. In Uttar Pradesh, initiatives to incorporate music therapy into existing healthcare services can improve access to holistic care and promote patient well-being.
Community Engagement: Music has the unique ability to bring people together, fostering a sense of community and belonging. In Uttar Pradesh, music therapy programs can be tailored to specific communities, addressing local health needs and promoting social cohesion through shared musical experiences.

Education and Awareness: Educating healthcare professionals, educators, and the general public about the benefits of music therapy is essential for its widespread adoption. Awareness campaigns, workshops, and training programs can raise awareness about music therapy's efficacy and encourage its integration into various settings across Uttar Pradesh.

Research and Innovation: Investing in research and innovation in music therapy enhances its evidence base and effectiveness. Collaborative research projects between academic institutions, healthcare providers, and cultural organizations in Uttar Pradesh can advance understanding of music therapy's mechanisms and applications, leading to innovative approaches for health promotion and treatment.

In summary, music therapy holds promise as a culturally relevant and accessible approach to promoting health and well-being in Uttar Pradesh. By leveraging the state's rich musical heritage and fostering collaboration across sectors, music therapy can contribute to a healthier and more harmonious society in Uttar Pradesh.

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Pharmacognostical and Phyto-Physicochemical Screening of *Magnolia Champaca* L.

T. C. Kulkarni
A. V. Bedre
I. M. Patil
Prof. Ramkrishna More Arts, Commerce and Science College, Akurdi, Pune
S.S. Pokale
Dr. B. N. Purandare Arts, SMt. S. G. Gupta Commerce and Science College, Lonavla, MS. India 410403
Email: truptik279@gmail.com

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Introduction:

Hippocrates (460-380 BC), the father of medicine classified herbs according to their essential qualities; moist and dry, hot and cold and successfully developed a system of diagnosis and prognosis using herbs. Herbalism also termed as herbal medicines or phytomedicine or phytotherapy is the study of pharmacognosy and use of various medicinal plants. Plants with medicinal properties referred as medicinal plants or medicinal herbs have been discovered and used as traditional medicines worldwide. Medicinal plants are considered as safe for the treatment of various diseases and infections [1]. Plants synthesize thousands of chemical compounds with varying properties viz. defence, insecticidal, antioxidant, antifungal, antifungal, antibacterial etc. the composition of secondary metabolites and essential oils differ in different plants and plant parts as well. Medicinal plants are considered as a storehouse of numerous bioactive compounds with varying therapeutic properties. According to world health organization (WHO), various kinds of drugs are obtained from medicinal plants and about 80% world's population depends on traditional medicines for primary healthcare needs [2].

The Plant: *Magnolia Champaca* L.

Magnolia champaca is a large evergreen tree of 18-21 m. It is a medium-tall tree attaining a height of 33-35 m. or more. The bark is light gray, smooth and about 2 cm. thick. *M. champaca* belongs to family Magnoliaceae and consist of 12 genera and 220 species containing evergreen trees and shrubs [3].

Taxonomic positions of the plant:

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta -- Vascular plants
Super division: Spermatophyta -- Seed plants
Division: Magnoliophyta -- Flowering plants
Class: Magnoliopsida -- Dicotyledons
Subclass: Magnoliidae

Order: Magnoliales
Family: Magnoliaceae -- Magnolia family
Genus: *Magnolia L.*
Species: *Magnolia champaca L.*

Fig.1. Morphology of M. champaca L. Plant
(**Source:** https://en.wikipedia.org/wiki/Magnolia_champaca)

Macroscopic characteristic of Plant:

Roots: Branched taproot
Stem: Erect, free, aerial, branched and woody
Bark: Bark thick, rough, blaze light brown, young shoots silky
Leaves: Simple, alternate, stipulate, stipule convolute; petiolate, ovate, entire, acute, unicostate reticulate. The ends of the twigs are hairy. The medium sized oval leaves are lance
shaped and pointed at both ends, and green with fine hair on the lower surface. Leaves 13-25
cm ×5.0-9.0 cm, finely acuminate with undulated margin, pubescent underneath, glabrous, shiny above, lateral veins about 16 pairs, lanceolate with slender petiole..
Flowers: Bracteate, pedicellate, complete hermaphrodite, actinomorphic, hypogenous, large in size, axillary, solitary, pale to deep yellow with fragrant.
Inflorescence: Solitary, axillary.
Perianth: Usually 9 perianth leaves are sepalloid and inner 6 lobes are petalloid or all the

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9-perianth lobes are petalloid.

Fruits: Elongated ball like, slightly bent, initially green in colour later tuned to pale grey to rough. Fruits are in chain, aggregate of follicles, consist of long clusters of capsules, at maturity opens at the back by two valves.

Pharmacognostical Properties Of *Magnolia Champaca* L.

M. champaca possesses a large number of pharmacognostical activities *viz.* diuretic, anti-microbial, antiulcer, anti-diabetic, anti-inflammatory, burn-wound healing, anti-oxidant (free radical scavenging), analgesic, anti-cancer, cytotoxic, anti-hyperglycemic, Leishmanicidal, anti-infective, anti-fertility, anti-helmintic, cardioprotective, anti-fungal, carminative, astringent etc. The plant was traditionally been used to treat cough, bronchitis, diarrhea, hypertension, dyspepsia, rheumatism, fever and inflammation. various plant parts contains wide spectrum of secondary metabolites and essential oils. Dried root and bark: abscesses, purgative, inflammation, constipation, dysmenorrhea, stimulanat, expectorant, astringent and febrifuge; Flowers and flower buds: ulcers, skin disease, wounds, antidote to snake and scorpion venom, foetid discharge from nostrils; Flower buds: herbal preparations for diabetes, Flower oil: cephalalgia, oetipthalmia, Flowers: stimulant, antispasmodic, tonic, stomachic, bitter and cool remedies and are used in dyspepsia, nausea and fever; Fruits: ulcers, skin diseases and Leaves: colic.

The pharmacognostical activities are subjected to preparation of plant parts extracts by using various solvent systems, ethanol, methanol, dichloromethane, aqueous (water), hexane, ethyl acetate, hydro-alcoholic etc.

Phyto-Physicochemical Screening Of *Magnolia Champaca* L.

Phytochemical evaluation of various plant parts of *Magnolia champaca* is the step next to extraction of different constituents found in extract, carbohydrates, alkaloids, amino acids, saponins, steroids, glycosides, flavonoids, phenols, proteins, oils, triterpenoids etc. extensive studies has been undertaken on chemical composition of M. champaca seeds and flowers [4]. The leaf of *M. champaca* constitute wide spectrum of compound composition [5-15] *viz.* Naphthalenemethanol 7.70%, Acetic acid 6.68%, 2, 3-Butanediol 6.46%, Phenol 6.25%, Andrographolide 4.56%, 5-Dodecyne 3.61%, Pimaric acid 3.08%, Ortho-Formylphenoxyacetic acid 2.80%, Succinamic acid 2.78%, Benzoic acid 2.66%, Methyl β-d-galactopyranoside 2.45%, 2-Propanone, 1-hydroxy- 1.93%, Trimethoxyvinylsilane 1.81%, Androstane-3%, 17-diol, 17-methyl- 1.59%, Cyclooctane, (methoxymethoxy) 1.52%, 1, 2-Benzenediol 1.44%, Propane, 1-bromo-2-methyl- 1.34%, Octadecatrienoic acid 1.19%, 1-Pentyl-hexobarbital 1.13%, Hydroquinone 1.12%, 1-Alanine, N-isobutoxycarbonyl-, butyl ester 1.01%, Benzofuran, 2, 3-dihydro 0.96%, (E)-3(10)-Caren-4-ol 0.91%, 1-Alanine, N-allyloxycarbonyl-, undec-10-enyl ester 0.83%, Heptenoic acid 0.73%, Imidazole-5-pentanoic acid 0.70%, Bisnor-7-desoxycholic acid 0.68%, 2, 5-Dimethoxy-4-(methylsulfonyl) amphetamine 0.67%, Valeric acid 0.65%, 2-Furanmethanol 0.64%, 5-Eicosyne 0.63%, Tromethamine 0.55%, 2-Cyclopenten-1-one, 2-hydroxy- 0.54%, Glycerin 0.50%, 1-Pentyl-hexobarbital 0.50%, Pholedrine 0.47 and 11 unidentified

compounds 22.97%.

The flower composition of *M.champaca* is 9,12-Octadecadienoic acid, methyl ester, (E,E)- 39.55 %, 2-Propanone, 1-phenoxy 25.50%, Benzofuran, 2,3-dihydro- 9.89%, 5,8,11,14-Eicosatetraenoic acid, methyl ester, (all-Z)- 7.05%, Butanoic acid, 2-methyl-3-oxo-, ethyl ester 4.10%, 7-Oxabicyclo[4.1.0]heptanes, 1-methyl-4-(2-methyloxiranyl)- 3.69%, 7-Oxabicyclo[4.1.0] heptanes, 1-methyl-4-(2-methyloxiranyl)- 2.95%, Oleic acid 2.79%, Camphorsulfonic acid 1.98% and 3 unidentified compounds 2.50% [16].

Conclusion:

Natural remedies used traditionally worldwide due to low cost, safety and lack of side effects. Extensive literature survey proved that, *Magnolia champaca* is a rich source of ethnomedicines found to be effective against various diseases in ayurveda and unani system of medicines; as it is having wide range of phyto-chemicals. Along with ethnomedical and pharmacological properties, *M. champaca* acts as an antioxidant and free radical scavenger in the ethanolic, methanolic and aqueous extracts. *M. champaca* also exhibits an antibacterial activity against various gram positive and gram-negative bacteria.

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Effect of Weather Conditions on Animal Behaviour

Rachana Singh
Department of Zoology, Dayanand Girls P.G. College, Kanpur
E-mail: rachanasingh12jan@gmail.com

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Abstract

Climate change is expected to exert an overwhelming negative effect on livestock, health and welfare. The negative effects of climate change on animal health and behaviour will be the consequence of combined changes of air temperature, frequency and magnitude of extreme weather events and may be both direct and indirect. Animals respond to physical, chemical, climatic and biological stimuli from their surroundings. Animals are sometimes exposed to inclement weather. A combination of low temperature, wind and rain or wet snow can adversely affect an animal's heat balance. Climate change in expected to impact most parts of an ecosystem. Some animals have very specific climatic adaptation. Such as requirements for snow, sea ice, or temperatures within a narrow range for hibernation.

Keywords: Temperature, Climate, Animal

Introduction:

Different animals react differently to different weather conditions. However, in general, weather conditions can affect animal behavior in a number of ways. For example, weather conditions can affect the availability of food and water, which can in turn affect the behavior of animals that rely on these resources. Additionally, weather conditions can affect the ability of animals to find shelter, which can lead to animals being more or less active depending on the weather.

The six common types of weather create all weather conditions. With the right humidity wind, atmospheric pressure, temperature, clouds and precipitation, a rainstorm happens. On Earth, the common weather phenomena include wind, cloud, rain, snow, fog and dust storms. Less common events include natural disasters such as tornadoes, hurricanes, typhoons, and ice storms. Weather is made up of multiple parameters, including air temperature, atmospheric pressure, humidity, precipitation, solar radiation and wind.

Most terms trial animals do seek shelter.... Rain seems to annoy most species; however, even aquatic animals. Some animals hibernate, or sleep, while other animals go to warmer areas in the winter. When animal goes to a warmer place it is called migration. Finally other animals adapt to survive in the snow and cold temperature. Climate is expected to exert an over whelming negative effect on the health of animals (Robinowitz and Conti 2013)**.** The direct effect of climate change on health may be due to increased temperature and intensity of heat waves (Gaughan *et al.,* 2009). To understanding how animals respond to weather conditions is a fundamental topic in

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evolution, ecology, and conservation, especially in a time of major environmental change. Birds are an ideal group in which to investigate these relationships because they occur in almost every ecosystem across the globe. In recent time, research examining the effect of weather on birds has focused predominantly on the impact of climate change (Crick, 2004, Dunn and Winklex, 2010; Sekercioglu *et al.*, 2012; Riddell, *et al.*, 2021). Short-term or localised changes in temperature, rainfall and wind can strongly influence individual behaviour, life history, physiology and morphology, with consequences at the population and species levels.

How does cold affect animal behaviour?

In general, cold weather can have a number of effects on animal behavior. For example, cold weather can make it more difficult for animals to find food and water, which can lead to them being less active. Additionally, cold weather can make it more difficult for animals to find shelter, which can lead to them being more susceptible

Animal and birds must act differently during the winter to survive. People stay inside, wear warm clothes, turn on heat and eat warm food. On other hand animals hibernate or sleep while other animals go to warmer areas in the winter.

Animals travel to other places where the winter is warmer and they can find food to eat. According to *Cermen Willings* Some bird, but not all, migrate south. Some animal hibernate for part or all of the winter animal hibernate to save their energy and don't need to eat. They store food as body fat and use this fat as energy during hibernation. Some squirrels and mice hibernate. Bears are happens as they wake up to move around little but not to eat.

But on other hand many animals remain and stay active in the winter and adopt to the changing weather. The animals make changes in their behaviour or bodies. To keep warm, they may grow thicker fur. Animal mostly breed during late winters or you can say in spring season or summer. In very cold areas, animals wait until summer, when the ice begins to melt, to migrate, mate and forage for food. Cold weather can significantly impact the behavior of animals in various ways:

1. Migration: Many animals, like birds and mammals, migrate to warmer climates during colder months to adapt their selves.
2. Hibernation: Some animals, such as bears and certain rodents, enter in to the process of hibernation to save energy and survive the cold winter months.
3. Increased activity: Certain species become more active during cold weather, either for search of food or to engage in activities like mating or defense.
4. Changes in feeding habits: Cold weather can affect the availability of food sources, leading animals to alter their feeding habits or search for alternative food sources.
5. Thermoregulation: Animals may adjust their behavior to regulate body temperature, such as basking in the sun or huddling together for warmth.

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6. Social behavior: Some species shows changes in social behavior during winter, such as forming larger batchs or exhibiting increased aggression as they compete for limited resources.

Overall, cold weather can have great effect on the behavior of animals, influencing their movements, feeding habits, and social interactions as they adapt to survive in challenging environmental conditions.

How does summer affect animal behaviour?

Animals in the summer period have the peak of their activity. They go hunting, reproduce and in this time of the year they start to store energy, that will be really necessary for them in the winter and autumn time. Animals also find ways in the summer to locate and conserve water and avoid being active during the hottest parts of the day. Small organism like bacteria and viruses, increase their growth, creating a greater chance for the spread of disease. In dry areas, summer heat can be very dangerous and many animals seek protection underground and venture out mostly at night cold blooded animals like Lizards and snakes must warm themselves in the sun's rays. Animals especially change their patterns and behaviors based on the cycle of seasons. Many animals breed so that they give birth in the spring and raise their young in the summer, when food is plentiful. Heat stress can contribute to the occurrence of lameness in dairy and beef cows (Shearer 1999)**.** The contribution of heat stress to lameness is perhaps due to increased output of bicarbonate (Cook and Nordland, 2009)**.**

How does weather affect animal health?

Weather conditions can also cause diseases or trigger epidemics among animals. Many animals get weaker during the winter due to harsh weather, which makes them more susceptible to becoming sick.

The direct effects of climate change on health include temperature - related illness and death. Whereas indirect effects include those derived from the influence of climate on microbial density and distribution, food and water shortages, or food borne diseases.

Some diseases like Ketosis and liver lipidosis are very common in animal. Ketosis is a metabolic disease that occurs when animal is in a severe state of negative energy balance and accumulates ketone bodies which derive from incomplete catabolism of fat (Lacetera *et al.,* 1996), (Basirico *et al.,* 2009) describe liver lipidosis. Heat stress may impair the function of the immune system in food-producing animals (Lactera, 2012)**.** A series of studies have described a greater risk of mortality during the hottest months (Dechow and Goodling 2008; Vitali *et al.,* 2009).

It was also reported that during the severe and prolonged heat waves in Europe (2003), thousands of pigs, poultry and rabbits died (Vitali *et al.,* 2015)**.** Climate is one of many factors which is expected to exert an overwhelming

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negative effect on health of humans and animals (Robinowitz and Conti 2013).

Conclusion:

Human-induced climate change has contributed to changing patterns of extreme weather across the globe; from longer and hotter heat waves to heavier rains. From a broad perspective, all weather events are now connected to climate change. While our understanding of how climate change affects extreme weather is still developing, evidence suggests that extreme weather may be affected even more than anticipated.A number of studies have shown that climate change is already having an impact across a range of species, including phenological shifts (Parmesan and Yohe 2003), geographic range shifts and contractions (Parmesan 2006; Tingley et al. 2012), and population and species extinctions (Parmesan 1996; Beever et al. 2003;)

We can protect animals by eating less animal meat, especially red meat, will decrease our reliance on animal-based products that drastically harm the environment. There are several things we can do to protect the climate.

- Use less energy most greenhouse gases are emitted by power plants, industry and traffic.
- Produce clean energy
- Recycle more and create less trash
- Reduce water waste

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Sustainable City Planning: Geospatial Technologies for a Smarter Future

Dr. Ganesh Madhe
Department of Geography, Shri Shahu Mandir Mahavidyalaya, Pune -09
Email- *ganeshkmadhe@gmail.com*

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Introduction

The Role of Geospatial Technologies in Indian Urban Planning is crucial for sustainable development. The use of geospatial technologies enables accurate data collection, analysis, and visualization, which are essential for effective urban planning.

Geospatial technologies play a crucial role in the sustainable development of Indian cities. With a rapidly growing population and urbanization, the need for efficient city planning has never been more evident. Geospatial technologies such as Geographic Information Systems, remote sensing, DGPS and GPS have become integral tools for urban planners in India.

These technologies aid in the collection, analysis, and visualization of spatial data, allowing for informed decision-making in various aspects of urban planning, including infrastructure development, land use management, transportation systems, and disaster management. In the Indian context, the effective utilization of geospatial technologies is essential for creating sustainable and resilient cities that can cater to the increasing urban population while minimizing environmental impact. By incorporating geospatial technologies into the urban planning process, Indian cities can achieve smarter, more efficient development that addresses the unique challenges and opportunities present in the Indian scenario.

The Indian government launched the five-year Atal Mission for Rejuvenation and Urban Transformation 2.0 (AMRUT 2.0) scheme on October 1, 2021. The scheme's other components include capacity building, storm water drainage, urban transport, and the development of green spaces and parks. The scheme's goal is to provide universal coverage of water supply to all households through functional taps in all statutory towns and coverage of sewerage/septage management in 500 AMRUT cities.

Background

The strengthening institutional capacity for sustainable urban development and service delivery under Atal Mission for Rejuvenation and Urban transformation (AMRUT 2.0) aims to improve access to basic urban services by accelerating policy actions and reforms. The structural urban reforms are linked to improving water supply and sanitation service delivery outcomes and local revenue under AMRUT 2.0 with the aim of making cities water secure through circular water practices including water source conservation, rejuvenation of water bodies, ground water management and reuse of treated water.

One of the important facets of this mission is to build capacities of states and the urban

local bodies (ULBs) to manage, implement, monitor, and evaluate AMRUT 2.0 program while ensuring that all the processes and measurement guidelines addresses and encompasses cross-cutting issues like climate change and mainstreaming gender equality and social inclusion (GESI).

About AMRUT 2.0- Sector Focus

AMRUT 2.0 Mission was launched on 1 October 2021. Its main aim is to provide basic urban services to households and build amenities in cities for improving the quality of life for all especially the urban poor and disadvantaged people as a national importance with the foremost priority of making cities water secure. Mission envisages providing assured supply of 2.68 crore new household tap water connections and universal household coverage of sewerage/septage services in 500 AMRUT cities with 2.64 crore new sewer connections. Other important priority areas include rejuvenation of water bodies, development of well- maintained green spaces and parks to increase the cities' amenity value and urban aquifer management. Moreover, the Mission has a reform agenda centered around strengthening the ULBs and in making cities water secure. These reforms include areas like reduction in non-revenue water, utilization of treated and recycled water to meet city's water demand, 24x7water supply, rejuvenation of water bodies, geographical information system (GIS) based master plans of the cities etc.

1.1 Hon'ble Prime Minister, during his address to the nation on 15 August 2019 stated, nearly half of the households do not have water. women have to travel two to three km to fetch water. we need to work in the field of water conservation, irrigation, rainwater conservation, rejuvenation of water bodies, desalination of sea water and treatment of wastewater. To holistically address these issues, he announced the launch of Jal Jeevan Mission.

1.2 Earlier, to facilitate ease of living to citizens, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), was launched in 500 cities on 25 June 2015, as a first focused national water Mission.

1.3 AMRUT aimed to provide universal coverage of water supply by providing 1.39 crore household tap connections. Likewise, coverage of sewer/ septage connections were proposed to increase from 31% to 62% by providing 1.45 crore connections. So far, 1.12 crore tap connections and 87 lakh sewer connections have been provided. Sewage treatment plants of capacity 1,800 MLD have been created; out of this 907 MLD is being reused. This Mission has decreased disease load and improved quality of life of all, especially women in terms of time and energy saved to be put to constructive use.

1.4 Sustainable Development Goal 6.4 aims to substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity, by 2030. In order to meet (SDG 6), and to extend ease of living in water sector from 500 to all statutory towns, Atal Mission for Rejuvenation and Urban Transformation 2.0 (AMRUT 2.0) has been launched. This will also ensure 100% coverage of sewerage/ septage management in 500 AMRUT cities.

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Atal Mission for Rejuvenation and Urban Transformation 2.0 (AMRUT 2.0)

2.1 AMRUT 2.0 is a step towards AatmaNirbhar Bharat with aim of making the cities 'water secure' and providing functional water tap connections to all households. This will be achieved through circular economy of water by effecting water source conservation, rejuvenation of water bodies and wells, recycle/ reuse of treated used water, and rainwater harvesting by involving community at large. This Mission will be run as people's program i.e. Jan Aandolan. Mission also targets to provide 100% sewage/ septage management in 500 AMRUT cities.

2.1.1 Mission will focus on empowering States/ UTs and cities for efficient implementation of projects in the spirit of cooperative and competitive federalism by providing flexibility to the States/ UTs to formulate, plan and implement the projects. CA released can be utilized for projects in any of the ULBs as per physical/ financial progress of the projects.

2.2 Ensuring community participation:

Mission will co-opt women and youth for concurrent feedbacks about its progress. Women SHGs will be involved in water demand management, water quality testing and water infrastructure operations. A concerted effort will be made to train women to test water quality in all the cities. This training program will be spearheaded by PHEDs or water and sewerage boards under the overall guidance of urban development department at the State level.

2.3 Mission has a reform agenda focused towards financial sustainability and water security of ULBs. Meeting 20% of water demand through recycled water, reducing non-revenue water to less than 20% and rejuvenation of water bodies are major water related reforms. Reforms on property tax, user charges, and enhancing credit worthiness of ULBs and urban planning are other important reforms.

2.4 Mission will encourage smart elements to be incorporated in every project. Mission will have a sub-Scheme on well rejuvenation.

2.5 Capacity building programs will be conducted for all stakeholders including contractors, plumbers, plant operators, students, women and citizens. Technical institutions will be roped in for assessment of Mission outcomes. Students will be engaged for survey of projects and outputs through gig economy model.

2.6 Technology Sub-Mission will help in identifying the proven and potential global technologies in water sector. Entrepreneurships / start -ups involved in low-cost indigenous equipment and processes will be encouraged.

2.7 Mission will be paperless and monitored on a robust technology-based monitoring & evaluation platform.

Components of AMRUT 2.0

3.1 Projects

ULBs will submit detailed City Water Balance Plans (CWBPs) and City Water Action Plans (CWAPs) through online portal covering proposed projects in the thrust areas. The projects will be prioritized based on following outcomes with the focus on improving sustainability and efficiency in water sector:

i. Universal coverage of water supply;
ii. Sewerage, septage management and recycle/ reuse of treated used water; and
iii. Rejuvenation of water bodies (including urban wetland) and creation of green spaces.

3.2 Administrative & Other Expenses (A&OE)

A&OE will be fully funded by the Centre and shall be utilized to cover the cost of preparing CWBPs, Program Management Units (PMUs), Detailed Project Reports (DPRs), Project Implementation Units (PIUs), Project Development and Management Consultants (PDMCs), development of Aquifer Management Plans and Independent Review and Monitoring Agencies (IRMAs). It will also be used for capacity building. Detailed information on A&OE funds is in Article 7.4

3.3 Reforms

Mission has a reform agenda on ease of living of citizens through reduction of non- revenue water, recycle of treated used water, rejuvenation of water bodies, augmenting double entry accounting system, urban planning, strengthening urban finance etc. Successful implementation of reforms will be incentivized. Reforms are described in Article 7.5 and Article 8.

3.4 Technology Sub-Mission

Technology Sub-Mission will encourage start-up ideas and private entrepreneurship, and commissioning them into the pilot projects after screening of expert committee. Sub-Mission will also encourage innovative light house projects which will be partly funded. This component is detailed further in Article 10.

3.5 Information, Education and Communication

Information Education and Communication (IEC) including Behavior Change Communication under AMRUT 2.0 is envisaged as a key strategy for spreading awareness on conservation of water and enhancing water use efficiency among the masses. This component is detailed further in Article 14.

3.6 Pey Jal Survekshan

Pey Jal Survekshan is proposed in cities as a challenge process to assess the compliance of service level benchmarks with respect to quality, quantity, and coverage of water supply, sewerage & septage management, extent of reuse & recycle of used water, and conservation of water bodies in the city. Pey Jal Survekshan will instill healthy competition among cities and act as a monitoring tool and Mission accelerator. This component is detailed further in Article 9.

3.7 Community Participation with focus on woman self help groups to be co-opted in management of water infrastructure and quality assessment. This will be facilitated through National Urban Livelihood Mission (NULM) management unit.

3.8 Outcome based funding is the most important defining feature of this Mission. The cities will submit roadmap for outcomes to be achieved by them during the mission period.

3.9 Evidence based evaluation of outcomes using online monitoring platform combined with citizen feedback through gig economy will enable community partnership.

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3.10 Public Private Partnership (PPP) projects are mandatory in million plus cities and at least a minimum of 10% of total fund allocation at the city level shall be committed to PPP projects.

4. Projects

4.1 Mission will focus on achieving functional outcomes through project implementation under Amrut 2.0 as one of the means. While formulating the projects, it should be ensured that households of informal settlements and low-income groups are duly considered. These admissible projects/ need to be prioritized as per functional outcomes envisaged in the table below:

Sl. No.	Functional outcomes	Admissible elements of Projects
1	Providing universal piped water supply with household water tap connection	Water source improvement and augmentation in the city Fresh Water treatment Water distribution system in uncovered areas Augmentation of existing water distribution system Sustainability of quality and quantity of water supply Reuse of treated used water Provision for 24x7 water supply# Smart solutions like SCADA Last mile connectivity to households (Not exceeding ₹ 3,000 per HH)
2	Providing universal coverage of Sewerage and septage management in 500 AMRUT cities and promoting circular economy of water	Sewerage network Interception and Diversion (I&D) infrastructure Sewage Treatment Plants (STPs) Tertiary Treatment with end-to-end reuse plan (preferably in PPP mode) Faecal sludge and Septage management (FSTP cum STP Plant & collection mechanism) Provision/ augmentation and rehabilitation of sewerage systems with end-to-end treatment and reuse Tapping of used water for recycling Identifying the bulk users of recycled used water and facilitating sale of used water to potential users (e.g. industrial clusters such as textile/ leather/ paper/ power plants/ railways, etc.) Smart solutions like SCADA Last mile connectivity to households (Not exceeding ₹ 3000 per HH)
3	Rejuvenation of water bodies to	Rejuvenation of wetlands, water bodies by desilting, strengthening the embankments, and stone packing.

In AMRUT cities, projects on 24x7 water supply with drink from tap facility may be taken up. These projects should cover at least one ward or DMA with at least

2,000 households in the contiguous manner. Projects costing up to 20% of the project fund allocation for water supply projects in AMRUT cities may be taken up for 24x7 water supply. Additional funding for such projects will be admissible in form of reform incentive.

4. Fund allocation

4.1 The total indicative outlay for AMRUT 2.0 is ₹ 2,77,000 crore including central share of ₹ 76,760 crore for five years from FY 2021-22 to FY 2025-26.

4.2 The central budgetary allocation for various Mission components will be as under:

S.no	Mission component	Central Allocation (₹ Cr)
1	Projects	66,750
2	Incentive for Reforms (8% of project CA allocation)	5,340
3	Administrative & Other Expenses (A&OE) for States/ UTs (3.25% of project CA allocation)	2,169
4	Administrative & Other Expenses (A&OE) for MoHUA (1.75% of project CA allocation)	1,168
5	Technology Sub-Mission (1% of project CA allocation)	667
6	IEC Activities (1% of project CA allocation)	667

4.3 Ongoing AMRUT projects will be funded with central assistance up to 31 March 2023. No funds will be released for any AMRUT project incomplete by that date and it will become the responsibility of the State/ UT to complete them from their own resources.

5. Public Private Partnerships (PPP):

Projects amounting to at least 10% of total project allocation for all cities with population above ten lakhs in a State will be mandatorily taken up in PPP mode. Projects with focus on selling treated water to industries and other users may be the potential projects for implementing under PPP mode. Such projects can be taken up in Hybrid Annuity Model (HAM) or any other suitable model. Viability gap funding for such projects will be provided through CA. CA will be 50% of the viability gap subject to maximum of 30% of the project cost. Balance viability gap will be borne by State/ ULB. Total viability gap will not exceed 60% of project cost.

5.5.1 States/ UTs and ULBs may augment their share of funding through alternative sources like raising municipal bonds, accessing capital markets, loans/ credits, State grants and central finance commission grants etc.

5.5.2 States/ UTs may avail loan from the funds earmarked by multi-lateral/ bilateral agencies like ADB, KFW, AFD and World Bank etc.

6. Mission Implementation

6.1 Memorandum of Understanding (MoU):

States/ UTs and ULBs have accepted a tripartite Memorandum of Understanding (MoU)

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with MoHUA. This MoU represents collective intent of MoHUA, State/ UT, and ULBs towards making urban India 'Water-secure' by effecting water source conservation, rejuvenation of water bodies and wells, recycle/ reuse of treated used water, and rainwater harvesting by engaging the community at large. MoHUA, States/ UTs and ULBs shall align themselves to the roles and responsibilities as per the MoU.

6.2 The implementation of Mission will be paperless. Preparatory steps (CWBP, CWAP, SWAP, reform roadmap), project planning, reform outcome achievement reporting, functional outcome reporting, evidences reporting, progress reporting and claims will be made on a robust online technology platform. Industry, community and implementing agencies will be onboarded on a colloborative platform.

6.3 City Water Balance Plans (CWBPs):

6.3.1 CWBPs will comprise details of water sources including water bodies, water treatment and distribution infrastructure, area-wise water coverage, status of NRW and sewerage network including STPs etc. (Annex- 1 illustrative). ULBs will compile baseline data on household water tap and sewer/ septage connections, and gaps in service delivery will be worked out. Based on assessed gaps, potential projects will be identified targeting functional outcomes.

6.3.2 State and ULBs will target to achieve universal coverage of water supply to all households in all ULBs and sewer/ septage connections in 500 AMRUT cities through projects proposed under AMRUT 2.0, ongoing AMRUT projects and projects/ initiatives funded by State/ ULB funds, XV FC grants, funding from external sources and PPP etc. The extent of gaps proposed to be filled through each of aforementioned sources will be clearly identified. CWBPs will be filled on the online formats provided for this purpose on the portal. CWBP should also be published on respective ULB and State websites.

6.4 City Water Action Plans (CWAPs):

6.4.1 CWAP will comprise the list of projects proposed by the ULB in the priority sectors of water supply; sewerage/ septage management; rejuvenation of water bodies including green spaces & parks. It will be ensured that projects are taken up with a view to meet 20% of city water demand through recycle/ reuse of treated used water. The projects proposed under AMRUT 2.0 and ongoing/ proposed projects through sources other than AMRUT 2.0 in three sectors will be provided (Annex-2a, Annex 2b & Annex 2c are illustrative). CWAPs will be submitted to SHPSC by State Mission Director online on Mission portal.

6.4.2 Projects amounting to at least 10% of total project allocation for all cities with population above ten lakh (million plus cities) in a State will be mandatorily taken up in PPP mode. Such projects maybe identified in the CWAPs.

6.4.3 ULBs will furnish year-wise roadmap of providing household water tap connections with a view to achieve universal coverage of water supply (Annex- 2d illustrative). Likewise, roadmap of achieving universal coverage of household sewer/ septage connections in 500 AMRUT cities will also be furnished (Annex-2e illustrative).

6.5 State Water Action Plans (SWAPs):

6.5.1 SWAPs will be prepared by State Mission director by aggregating CWAPs

submitted by the ULBs. SWAPs will comprise entire list of projects, city-wise and sector-wise, proposed to be undertaken by States/ UTs. Cost of projects taken up will exclude cost of land acquisition. SWAP will include project wise number of proposed new household water tap connections, sewer connections and coverage of existing water tap and sewer connections to be augmented, which shall be outcomes of such projects. The projects to be implemented in PPP mode will be clearly identified. It will be ensured that projects are taken up only when land is available with clear title without any disputes. SWAPs will be submitted on portal to Apex committee in three tranches as per Annex-3 (illustrative).

The first tranche will be submitted within five to nine months, second tranche within twelve to sixteen months and third tranche preferably within twenty-four months of launch of Mission. It can be submitted in advance also.

6.5.2 SWAPs will be approved by SHPSC before progressing to Apex Committee. State High Powered Steering Committee (SHPSC), while approving the SWAP will consider the following:

i. SWAP is oriented towards achieving desired functional outcomes such as universal coverage of water supply and sewerage/ septage management,

ii. Water body rejuvenation and parks & green spaces parks have been taken in specified proportion,

iii. Water supply projects oriented towards 24x7 water supply in AMRUT cities have been taken,

iv. There is no duplication of projects with AMRUT or any other government schemes,

v. Low economic and informal settlements are duly included in SWAP,

vi. At least meeting 10% of fund allocation in PPP projects as mandated have been included for million plus cities,

vii. Projects facilitating Rural-Urban Synergy have been taken up wherever feasible,

viii. Every city should achieve universal coverage and become water secure through either AMRUT 2.0 or any other funding. State assures that all the cities are moving in this direction,

ix. It will also be ensure that used water (waste water) is treated and put to reuse to meet 20% of cities water demand and 40% of Industry water demand in aggregate at the state level.

x. Projects being proposed in SWAP will have O&M for at least five years to be funded by way of levy of user charges or other revenue streams. Project cost will exclude O&M. ULBs shall fund O&M through an appropriate cost recovery mechanism in order to make them self-reliant and cost effective.

6.6 Urban Aquifer Management Plan

6.6.1 The Aquifer Management Plan will focus on maintaining positive groundwater balance in urban aquifer systems. The cities will strategize groundwater recharge augmentation by developing a roadmap for improving rainwater harvesting within city limits. Cities will conduct aquifer mapping with technical support from Central Groundwater Board (CGWB)/ State Groundwater Board/ other agencies to identify

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recharge and discharge zones and integrate aquifer management into urban planning. Cities will develop an annual groundwater balance report to ascertain the current and future availability of groundwater.

6.6.2 The template for aquifer mapping shall be made available to the ULBs along with a technical guidance manual on urban aquifer management following the Mission launch. Urban Aquifer Management Plan shall be submitted within 24 months from the launch of Mission by 500 AMRUT cities.

6.7 Implementation of projects

Projects as per approved SWAP will be planned, tendered, awarded and implemented by ULBs. Where ULBs do not have adequate capacity, specialized parastatal agencies will implement the projects. In order to ensure efficient implementation of projects, the States/ UTs, ULBs should follow an approach wherein end-to-end support for project design, development, implementation and management is provided to ULBs/ States/ UTs by external entities (PDMCs). Maintenance and upkeep of the assets created will be responsibility of the State/ UT/ ULB. Smart elements will be part of the projects.

6.8 Monitoring of projects

The achievement of mission objectives will be monitored through an online module. This module will directly be the precursor for availaing funds. Therefore, the portal needs to be regularly updated by State/ UT/ ULB functionaries for flow of information and sanctioning of funds. The fields to be updated will include physical progress, financial progress, documents required for seeking central assistance, photographs, videos, third party reports, etc. The progress reported on portal will be randomly verified through citizen/ third party feedback. Implementing agencies and community stakeholders will also be facilitated to access the portal and upload the progress and feedback.

6.9 Replacement of projects

6.9.1 The projects approved by the Apex committee will not be replaced in normal course. However, in case some projects are required to be replaced due to unavoidable circumstances, State Mission Director will submit such proposal to SHPSC along with justification. The SHPSC will be competent to approve replacement of projects costing up to 10% of respective tranche of SWAP in admissible project components of AMRUT 2.0. Replacement of projects beyond 10% of respective tranche of SWAP, if approved by SHPSC shall be sent to the Apex committee with proper justification for consideration and approval. No expenditure shall be booked against any project proposed to be replaced.

6.9.2 The SHPSC, while considering replacement of projects, shall ensure that there is no duplication of projects through replacement, overall State allocation is not exceeded, new proposed projects are in line with Mission objectives.

Conclusion

The AMRUT 2.0 scheme holds great potential for the development and rejuvenation of cities in India. By focusing on key areas such as improving public transport, slum rehabilitation, and health insurance penetration, the scheme aims to address crucial aspects of urban development and contribute towards achieving

Sustainable Development Goal 1 in India. By consolidating existing research and identifying futuristic research niches, the scheme can benefit from evidence-based decision-making and ensure effective implementation
(Singh & Jayaram, 2020). With the AMRUT 2.0 scheme, India has the opportunity to not only improve the quality of life for its citizens but also drive economic growth and value-capturing financing. This conclusion highlights the potential of the AMRUT 2.0 scheme to meet the objectives of poverty eradication, better housing, and employment generation in India. Overall, the AMRUT 2.0 scheme has the potential to bring about positive change and contribute towards sustainable urban development in India. In conclusion, the AMRUT 2.0 scheme is a promising initiative that addresses critical aspects of urban development in India.

In conclusion, the AMRUT 2.0 scheme holds great potential for the development and rejuvenation of cities in India. By focusing on key areas such as improving public transport, slum rehabilitation, and health insurance penetration, the scheme aims to address crucial aspects of urban development

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Biodiversity of Mosquitoes: Seven Years (2013-2019) Account with special reference to *Anopheles* (Diptera: Culicidae)

Reena Kumari Chaudhary
Kalpana Singh*
Laboratory Of Applied Zoology & Bio-Musicology, Department of Zoology University of Lucknow, Lucknow- 226007, Up (India)
Email: *Biomusicology.India@Gmail.Com*

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Abstract:

This chapter presents a comprehensive overview of the biodiversity of mosquitoes over a ten-year period, with a focus on the *Anopheles* genus (Diptera: Culicidae). Mosquitoes are of significant public health concern due to their role as vectors of various infectious diseases, including malaria, dengue fever, and Zika virus. Understanding the biodiversity of mosquitoes, particularly the *Anopheles* species, is crucial for effective vector control strategies and disease prevention efforts.

Over the past decade, extensive surveillance and monitoring efforts have been conducted to assess mosquito populations and species distribution across diverse habitats and regions. This study collates and analyzes data from these surveillance programs to provide insights into the temporal and spatial dynamics of mosquito biodiversity, with a special emphasis on Anopheles mosquitoes.

Key findings highlight the diversity of mosquito species encountered, variations in species abundance and distribution over time and geography, and ecological factors influencing mosquito populations. The prevalence and distribution of *Anopheles* mosquitoes, known vectors of malaria, are examined in detail, shedding light on their habitat preferences, seasonal fluctuations, and potential implications for malaria transmission dynamics.

Furthermore, this abstract discusses the implications of mosquito biodiversity findings for public health interventions and vector control strategies. By identifying high-risk areas and target species populations, informed decision-making can guide the implementation of mosquito control measures, such as larval habitat management, insecticide application, and community-based interventions.

Overall, this ten-year account of mosquito biodiversity, with a special focus on *Anopheles* mosquitoes, contributes to our understanding of vector ecology and disease transmission dynamics. By elucidating the intricate interactions between mosquitoes, their habitats, and human activities, this study informs evidence-based approaches for mitigating mosquito-borne diseases and promoting public health in affected regions.

Key Words: Biodiversity, Mosquito, *Anopheles*, Culicidae, Survey, Vector, Malaria

Introduction:

Mosquitoes are an important family of pests from the standpoint of people's

health. Mosquitoes coexist with humans in spite of many attempts to control and manage them. They have adopted themselves with man and animals. Mosquito vector-borne problems have become a major problem all over the world, mostly in tropical and subtropical zones. WHO has confirmed that mosquito vectors are a dangerous enemy for humans because of their transmission of numerous dreadful diseases around the world (WHO, 1996). Mosquito management and control are challenging due to the presence of synthetic pesticides. Nowadays many and more plant extracts are being tested for mosquitocidal properties. Medicinal plants comprise a potential source of bioactive compounds, so these are known as nontraditional sources for controlling larval mosquitoes due to their harmless properties for the environment and humans. Herbal plants are biodegradable and cost effective. Implementation of medicinal plant products for mosquito vector regulation is an alternative to synthetic pesticides because biologically active plants have great potential for larvicides efficiency. Botanical derivatives are used for mosquito larvae, as a substitute for synthetic insecticides and are eco-friendly for mosquito control in spite of man-made chemicals (Sukumar *et al*., 1991). About two hundred insects have resistance potential to many existing pesticides (WHO, 1995). Synthetic pesticides are harmful, and their effects on the environment and human beings are much more deleterious than those of medicinal insecticides. So, plant pesticide use is increasing every day.

Anopheles mosquito is a significant vector for transmitting malaria, a deadly disease that affects millions of people worldwide. The *Anopheles* genus consists of over 460 recognized species, with varying geographical distributions and vectorial capacities. Molecular techniques, such as DNA sequencing and polymerase chain reaction (PCR), have been instrumental in identifying and classifying different Anopheles species. Anopheles mosquitoes are known vectors for malaria parasites of the *Plasmodium* genus. Understanding the ecological factors that favor *Anopheles* mosquito proliferation is vital for implementing targeted control measures. *Anopheles* mosquitoes have developed resistance to various insecticides commonly used in vector control programs. Strategies for managing insecticide resistance in *Anopheles* mosquitoes are continuously evolving to mitigate its effects on malaria control efforts. Climate change and environmental factors play a significant role in the distribution and behavior of *Anopheles* mosquitoes. Sri Lanka had aknowledged 24 *Anopheles* vector species comprising *Anopheles jeyporiensis* in 2015 and *Anopheles stephensi* in 2017 (Dharmasiri *et al.*, 2017). Among them *Anopheles culicifacies* was observed as solo malaria vector till the initial of 1980s in the country. Enzyme-linked immunosorbent assay (ELISA)-based data had been exposed that *Anopheline* pool infected with malaria parasites comprises: *Anopheles annularis, Anopheles barbirostris, Anopheles aconitus, Anopheles nigerrimus, Anopheles vagus Anopheles pallidus, Anopheles nigerrimus, Anopheles varuna, Anopheles subpictus, Anopheles varuna, and Anopheles tessellatus* (Gunathilaka *et al.*, 2015). More than 30 *Anopheles* species have been recorded throughout Iran, but only eight are considered malaria vectors: *Anopheles culicifacies, Anopheles sacharovi, Anopheles maculipennis, Anopheles pulcherrimus, Anopheles d'thali, Anopheles*

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fluviatilis, Anopheles stephensi, and Anopheles superpictus (Sedaghat & Harbach, 2005; Djadid *et al*., 2009; Azari-Hamidian, 2009).

Diversity of the Mosquito Fauna in different Habitats:

Li *et al*., (2013) studied on temperature, relative humidity and sunshine may be the effective predictors for occurrence of malaria in Guangzhou, southern China, 2006-2012. Malaria is vector- borne diseases spread by the genus *Plasmodium*. Malaria diseases cases are mostly found in Africa and South East Asia but malaria has become largest endemic problem more than half century in Southern China, Guangzhou. Weather factors had important correlation with the malaria dieseases. Difference in meteorological variables and climatic characteristics affected to malaria incidence in different regions. That study was done in laboratory conditions between time period of years 2006-2012 from National Notification Diseases Report System (NNDRS) on the basis of changes of relative humidity, meteorological data, atmospheric pressure, average temperature and wind velocity from the Guangzhou meteorological Bureau of southern China. The aim of this study was to identify the co- relation between meteorological factors and malaria incidence report. The results were calculated to increases 0.90% malaria cases to rise 1^0C temperature respectively 3.99% cases noticed by rising one persent relative humidity and 0.68% malaria cases were calculated by incrising one hour sunshine value.

Rajesh *et al.*, (2013) studied on inspection of container breeding of dengue vector in Tiruchirappalli district, Tamil Nadu, India. This mosquito survey was performed between months of September 2012 to March 2013 in Turaiyur, Thottiyam, Musiri, Mannachanallur, Manaparai and Vaiyampatti in Tiruchirappalli district Tamil Nadu, India. Tiruchirappalli district situated in the core ofTamilnadu and spread around 4404 square kilometers area. During the survey period total 118 no of containers and some tree holes were examined. Collection of larvae were done from outdoors using dipping metheds by dipper according to container and location. Larvae and pupae of *Aedes agypti* were transferred in research laboratory for emergence and adult mosquitoes were identified. All 118 water containers were examined but 38 containers only were observed positive result for dengue. That survey result revealed that two dominant mosquito species were identified *Aedes aegypti* (45%) and *Aedes vittatus* (45%). That study proved that *Aedes aegypti* and *Aedes vittatus* two species mostly predominant in Tiruchirappalli district. Hence the study revealed that habitat identification of breading mosquito was cooperative starting of awareness and helpful to controlling of mosquito borne disease.

Singh *et al.*, (2013) work done on dynamics of forest malaria spreading in the Balaghat district, Madhya Pradesh, India. This epidemiological survey was conducted in the Balaghat district of Madhya Pradesh state in India to know the changing aspects of malaria transmission of forest area where indoor residual spray (IRS) and pesticides treated traps were used for mosquito vector controlling. Community based survey were established from during January 2010 to December 2012 in the Baihar and Birsa Public Hospitals of district Balaghat for exploring of malaria situatios. Epidemiological and

entomological investigation involved, pyrethrum spray catches, indoor resting collections and light trap catches. Anopheles mosquitoes were analyzed by using ELISA methods to exposure of *Plasmodium* circumsporozoite protein. Result revealed that Plasmodium falciparum contamination were observed 0.80% of all infections. P. malariae 0.75% P. vivax 16.5% and all remain vectors were varied combination of contaminations of P. falciparum, P. malariae and P. vivax. There were more than, 30% contaminations were recorded in babies below 6 months in the age. Generally overall a developing trend in malaria infection positivity was detected between the year of 2010 to 2012 and chi-square value= 663.55; P= 0.0001. Twenty five *Anopheles culicifacies* mosquito species (sibling species C, D and E) were found positive for circumsporozoite protein of P. vivax (56%) and P. falciparum (44%). Furthermore 2 An. fluviatilis species were observed positive for *P. falciparum* and 1 for *P. vivax*. *An. fluviatilis* sibling species was observed vectors in the forest towns for firstly time in the India. Results indicated that study towns were suffering permanent malaria communication inspite of insecticide treated nets (IRS) indoor residual spray. Hence there is requirement for new indoor residual pesticides which had wide-ranging coverage of inhabitants with long lasting pesticide tested net for effective controlling of mosquito vectors.

Massebo *et al*., (2013) studied on mosquitocidal susceptibility and blood meal origins of *Anopheles arabiensis* mosquito specie from Chano in South-West Ethiopia. This survey was done in Chano village around north of Arba Minch area of South-West Ethiopia, during periods of May 2009-April 2010. This town was situated at 6°6.666′ N and 37°35.775 E ′ altitude of 1,206 m above the ocean level. Three villages were named sub-villages 1, 2 and 3. The sub-village 3 was placed around the distance of 1350 to 1850 m from of lake and three main irrigation watercourse passed through the village. That watercourse was stable, well-constructed to flow into cultivational areas outside of villages. Maize growing and animal husbandry were their main income source of livings of inhabitant farmers and thier main crops were bananas and mangoes. Animal husbandry were usually done in the open conditions, but some separated roofed. Blood meal sources of anopheles arabiensis aggregated using Centers for Disease Control and Prevention (CDC) light traps and pyrethrum spray catches (PSC) from human residences and hand-held mouth aspirators from outdoors of living quarters were observed using direct enzyme-linked-immunosorbent assay (ELISA). The *Anopheles arabiensis* was major species of *anopheline* mosquito, that region and animals were main source of blood meals. *Anopheles arabiensis* had developed resistance to available pyrethroid insecticides and insecticides were important for malaria control program.

Amani *et al*., (2014) worked on characteristics of larval habitats and ecology of *Anopheline* mosquito vector in Aligudarz country Luristan province, western Iran. This descriptive study was conducted for investigation of larval biology in selected 7 countryside districts of Aligudarz County, during April- November 1997 and larvae were collected through dipping methods. Breeding sites of larvae features were clean or muddy, running or stagnant, vmegaent-amtioande or natural places and sunshine location. Over-all of 9 620 no of third and fourth instars of *Anopheles* were collected

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from 115 upbringing sites of 22 villages following some species viz.:, *Anopheles d'thali, Anopheles turkhodi Anopheles marterii sogdianus, Anopheles claviger Anopheles apoci, Anopheles superpictus Anopheles stephensi and Anopheles maculipennis S.L. Anopheles apoci, Anopheles maculipennis S.L and Anopheles stephensi* were ammased firstly in Aligudarz County . *Anopheles superpictus* (93.18%) were maximum succeeded and distributed all over region. Mostly rever edge (54.8%), rice fields (12.2%) and grassland (8.7%) temporary, immobile or running water and full sunlight area.

Lehmann *et al*., (2014) worked on deviation of seasons in spatial dispersion of *Anopheles gambiae* mosquito vector in sahelian village: Evidence for aestivation. This survey study was implemented during between September 2008 and March 2013 in the Thierola, minor rural town of the Malian Sahel containing 300 inhabitants, and people in their 130 houses. Thierola was parted three kilometers from the adjacent Zanga village and six kilometers far from another Bako village. The approximately 80 percent population lived in main nearby village made by quadrangular bricks, mud-roof houses. Variations in three-dimensional distribution of mosquito vector in the Sahelian community were studied to explored about sources of mosquito vectors during dry time of year, no any mosquito breeding site were found during this time sources of *Anopheles gambiae* Giles maight be local resident shelters used by hibernating mosquitoes from distant populations. Mosquito vectors scattering was mostly collected in the period of dry season, where some houses had densities 7 to 24-fold greater than estimated and high-density community in duration of the dry season varied from rainy season. Mostly high-density houses throughout the dry season different between years till when locality was quite established village. The red zone areas moved between firstly and lastly of dry season. In the duration of wet season, red zone areas were reasonably stable nearby of main larval place and the location of red zone areas in rainy season and firstly and lastly in the dry period between years. Particular season and focal red zones are uneven with forecasts established on appearance other mosquito vectors from distant neighborhoods in dry season, but are reliable with expectations based on native community used by hibernating mosquito vectors. Selected red zones of Sahelian villages controlling of vector not effected because of the degree of aggregation was moderate, hotzone areas were not predicted simply and not causes of their inhabitants. But, inspecting in the dry-season residences maight be extremely expensive if one time they could be selected, identified and predicted.

Ishak *et al.*, (2014) studied on potential of environmental and nutritional factors of density of larvae *Anopheles Spp.* in Coastal Endemic Bulukumba, Indonesia. Survey was conducted between to months of April-June 2014 of Bulukumba seaside in district of Gantarang Ujung Bulu, Ujung Leo, Bonto Bahari, and Bonto Tiro. Location for this survey was selected on the base of reported data of malaria cases of Bulukumba health care centre. Anopheles Spp mosquitoes habitats, showed criteria of presence and exclusion of breeding sites by sampling method and larvae of Anopheles spp presense were confirmed at breeding site of Bulukumba coast. This survey study was designed to explore of the direct and indirect of nutrition and ecological factors on density of larva,

Anopheles spp around the coastal region of Bulukumba. This survey research involved environmental study and environment samples included 50 facts of selected breeding area, were preferred based on criteria level. Data collection were directed by using in-situ measurement method and laboratory assessment. Survey results evaluated that the maximum total effects on nutrition and environment factors on the larval density of *Anopheles* spp mosquitoes, and value were calculated 0,454 (45,4%) but all remaining 54,6 % was described by another aspects outside model. This survey conclusion was of (direct and indirect influence) environmental and nutrition factors to the density of larvae of *Anopheles* spp. at Bulukumba coastline.

Suganthi *et al*., (2014) survey of mosquito richness in and around tribal residential regions. This survey was conducted for evaluation to larval diversity, density and preference upbringing areas of *Aedes, Culex* and *Anopheles* species in Sitheri hills of Dharmapuri district, Tamil Nadu in India. Samples water were collected using dipping technique by using tube dipper according to container for over all the seasons of 2012 year. Total 460 containers were examined in all eight towns. This survey was confirmed that eight dominant mosquito species were observed in this study *Aedes aegypti* (45%), Aedes *albopictus* (15%), Aedes *vittatus* (23%), C*ulex quinquefasciatus* (9%), *Anopheles subpictus* (4%), *Culex nilgricus* (1%), C*ulex tritaeniorhynchus* (1%) and C*ulex gelidus* (2%). It was detected that main breeding sources were mud pots, cement tanks, grinding stones, tree holes, metal vessels, rocky holes, old tyres, stagnant water area, rice field, canals, cement tanks and plastic containers. Result of this study concluded that *Aedes aegypti* and *Aedes vittatus* species were mainly predominant, and villages of Sitheri and Selur had more populations of container breeding mosquito on this region. The study is convenient to generating awareness and controlling of mosquito-borne diseases because of having high capacity to communicate pathogens (parasites) in human bodies.

Singh *et al.,* (2014) studied on vector effect and bionomics of *Anopheles subpictus* malaria vector in India an overview**.** Survey was conducted in various regions of country, India where no any infection found related to diseases caused by malaria vector *An. subpictus*. But some researchers were successful to investigate gland positive mosquitoes out of 10452 dissected. *Anopheles subpictus* mosquito vector had been identified such as significant malaria vector in Sri Lanka country and other countries (Malaysia and Maldives). *Anopheles subpictus* mosquito vector had been noticed to show significant role of malaria diseases communication and as secondary vector in convinced regions of Odisha and coastal zones of south India. *An. subpictus mosquito species* were broadly spread that breed's variety of fresh and saline water habitations. Various species were a complex of four sibling species temporarily nominated as: sibling species A, B, C and D, but the role of these sibling species in malaria diseases communication were not mentioned. There is limited investigation study presented related to this mosquito species in India, so that it would be prudent to review of the bionomics and the role of *An. subpictus* in malaria diseases communication in Indian perspective. Advance studies are requisited on this biological science related of *An. subpictus* and role in malaria communication in other country under the impact of

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varying ecological environments.

Kenawy, (2015) reported on species found presently in the Egypt but all of them only *An. sergentii*are and *An. pharoensis* were confirmed. These were 2 vectors Review of *Anopheles* Mosquitoes and Malaria in Ancient and Modern Egypt. The research article analysed about the position of *Anopheles* mosquito vectors and malaria situation in the olden and recent Egypt on the basis of availability of distributed reports. Only 11 no of *Anopheles* having features of low infectivity, zoophilic tendency and short durability transimissed unstable malaria prvailed in Egypt. In the immunological examination of Egyptian mummified bodies scientist had prooved that maximum dominance of *P. falciparum* malaria vectors in olden Egypt. Mostly malaria diseases was widespread in almost all the parts of Egypti but dominance had displayed stably decline by the year 1990. With termination time of year 1998 till now totally testified cases were imported generally from the Sudan still approximately some local assimilated cases were informed in the El Faiyoumand Cairo. Hence recent epidemic of *vivax* (23 cases) and *falciparum* (1 case) were happened May 2014 in Aswan Governorate fastly point out that malaria was recurring in country.

Edalat *et al*., (2015) age determination and mosquitocidal capability of malaria mosquito *Anopheles Stephens* Liston (Diptera: Culicidae) in malaria spreading in Southern Iran.This survey was conducted at Hormozgan Region which situated at south direction of between 25° 24'-28° 57' N latitudes and 52° 41'-59° 15' E longitudes, area 181,471 km2; population 1,518,000) is placed in southeastern Iran, this Region is included many countries and Jask, Minab and Banda-Abbas are three countries having tropical climate condition, main areas of malaria problem of Hormozgan. For that reason, anti-malaria measurind activity was conducted in this areas including house-spraying with residual insecticides. Maximum and minimum mean temperature was recorded 34 °C for August and 14.5 °C for January months separately and average yearly rainfall was recorded approximately 120 mm. This survey was done to defined population changing aspects of mosquito *Anopheles stephensi* in relation for transmission of malaria in April 2011 to March 2012. Collection of mosquito done by method of total catching of Human and Animal bait collection, Pit shelter Window trap and CDC light traps. *An. stephensi* showed dominant (endophagic and endophilic) behavior and blood feeding were observed, 9.00-10.00 P.M, and 1.00 2.00 A.M. The survival and life probability of species were 4, 0.82 and five days, separately and vectorial capability measured 0.028. The conclusion, summer and rainy season conditions supported density, persistence and durability of *An. stephensi* and result showed significant malaria transmission.

Taye *et al.,* (2016) studied on seasonal dynamics, longevity, and biting response of mosquito vectors *Anopheline* in Southwestern Ethiopia. That work was done from June to December month in 2012 in Seka-Chekorsa district, Jimma zone, southwestern Ethiopia and nine house were decided to consider *Anopheles* mosquitoes potential. For collection of female *Anopheles* mosquitoes used CDC light traps and were set indoor and outdoor condition. In that study were found that all *anopheles* mosquitoes were related

to *Anopheles gambiae senso lato Giles, An. coustani senso lato Laveran* and *Anopheles pharoensis* Theobald species and their dominating percentage were recorded 69.7%, 22.7% and 7.6% sequentilly. *Anopheles gambiae* s.l. equality rate mesured more before the spray task and biting action were 1800 and 2100 hour. Duration of living time were 3.4 to 12.5 day. Highest presence of mosquitoes were noticed in July and August month. It was important technique to control mosquito vectors.

Diedhiou *et al*., (2016) reported on characterization and dissemination of *Anopheline* larval habitations in flooded regions of Dakar suburbs.This cross-sectional 1 year investigation was conducted between 2013 (wet season) and 2014 (dry season) during the water-logged zones of outskirts of Dakar to illustrate of habitats anopheline larve. All water bodies were selected including various characteristic ex: turbidity, size, type of water body and distance from human residences. Total of 908 and 278 larval territories were observed in the duration of wet season and dry season, separately. Significant relation had observed between wet season and anopheline larval places which comprised puddles, pools, drain channels, canals and streams. Anopheles larvae were observed mostly in the clean waterbodies which positioned within 10 meter distence to human residences but in the dry season only ponds were as host anopheles larvae. *Anopheles* larve territory were meaningfully most fastly in the Department of Rufisque during wet season (univariate analysis, $P = 0.006$) and in the Department of Guediawaye during dry season (multivariate analysis, $P = 0.036$). Malaria vector recognized was *Anopheles arabiensis*.

Huestis *et al*., (2017) reported on photoperiodic reaction of sahelian malaria mosquitoes *Anopheles coluzzii* and *An. arabiensis*. Survey was conducted throughout big area of sub-Saharan Africa; communication of seasonal malaria diseases depends on density of mosquito but transmission of malaria upcoming on zero in the dry season but reach on the peak in the wet season. Malaria mosquito's survival decreases in dry season where no larval breeding sites are existed. Results revealed that short photoperiod alone to lesser level, lowe temperature found in early night dry season which improved longevity for mosquito species of *An. coluzzii* was 30%, $P < 0.001$) while not effective of *An. arabiensis* mosquito. Body size improved in dry season but not increased in relative lipid content species of *An. coluzzii* while body size of *An. arabiensis* decreased body size in these situations. In this study evaluation was done between responses of *An. Coluzzii* and *An. arabiensis* mosquito species to changes in photoperiod and high temperature and definitely based on induce dullness in *An. coluzzii* under smaller photophase and lesser night temperature.

Gbaye *et al.,* (2017) worked on and spatial dissemination and richness of mosquitoes in three ecological regions of Ondo State Nigeria. This investigation was conducted in the Western State-owned of Nigeria. This State was included 3 environmental regions ex. rain forest, mangrove forest and savannah forest. Yearly mean of rainfall observed nearly 4000 mm and temperature were noted approximately (20.6 to 33.5)^{0}C and in this survey twenty sample positions casually disseminated. Every selected areas were experimented by using dippers aspirators and tubes during January 2015 to

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December 2016. There were plantifullness of tanks, plastics gutters, ponds, tree holes and old useless tyres. Sample collection were done by using a dipper which was attached with plastic cup with 350 ml volume with long handle. This research was commenced in 3 environmental zones of Ondo State to conclude the richness and three-dimensional scattering of various mosquito species in their ecological regions. results evaluated that twelve mosquito vector species were belonging to three genera which include five various species of *Culex (Cx. duttoni, Cx. pipiens, Cx. andersoni Cx. quinquefasciatus,* and *Cx. trigripis) and* four *species of Aedes (Ae. albopictus, Ae. palpalis, Ae.aegypti, and Ae. vittatus)* and also three *species of Anopheles (An. funestus, An.gambiae and An. arabiensis).* Hence this investigation displayed that *Cx. quinquefasciatus mosquito species* was the mostly predominant *Culex* species detected in the site of Idanre and ESE Odo whereas *Cx. andersoni* were main, and *Ae. aegypti species* were mostly leading in allover of locations excluding Ese Odo. *An. gambiae species* had observed in maximum occurrence in all environmental areas.

McCann *et al*., (2017) worked on variation in indoor resting abundance of *Anopheles* mosquito and relative effects of larval habitat adjacency and insecticide-treated bed net use. Asembo area of Rarieda district in the western Kenya is a rural public society, around 60,000 publics covered about 200 km area. Where Maximum residents are of farmers, which controlled by small range of cultivation and small places of land made for family purpose and their collections of houses were further organized into rural community. Whereas their houses were highly distributed inside of villages, margins of 79 towns in Asembo was discernable only by inhabitants. Asembo stands in plains along the coasts of Lake Victoria. Rainfall occurs in two modes seasonally but local displacement occasions might occur yearly. In this survey 525 houses were tested for indoor-resting mosquitoes of 8 by 8 kilometre range study area by using method of pyrethrum spray. Analytical ideal location of larval habitat of that land verified previously and providing derivations of catalogs of habitant of larvae proximity to houses. Using geostatistical regression models, the association of larval habitat proximity, using methods of long-lasting insecticidal nets, house physical appearance as: roof type and wall type, and also about of variables: (cooking pattern in house, people sleeping in their house and animal farming) within richness of mosquito in houses were measured. Results revealed that mosquito vector richness were very low amount (mean value was 1.1 adult mosquito of *Anopheles/* house). Larvicidal habitant proximity was a strong forecaster of *Anopheles* mosquito richness. But some houses which were without long lasting insecticidal nets had observed more female adult mosquito: *Anopheles gambiae* s.s., *Anopheles arabiensis* and *Anopheles funestus* and value were: (95% CI 0.49, 0.48–0.50; 0.39, 0.39–0.40; 0.60, 0.58–0.61) in comparision of the houses where people used long-lasting insecticidal nets value were: (95% CI 0.87, 0.85–0.89; 0.84, 0.82–0.86; 0.38, 0.37–0.40). Results recommend that long lasting insecticidal nets used to decreasing vector richness, and their larval source. Management of malaria dieseases in this area reduced malaria by using many mosquito reducing programs and techniques.

Nikookar *et al*., (2017) studied on species composition and abundance of mosquito larvae in relation with their habitat characteristics in Mazandaran province, northern Iran. In this study larvae were ammased from 120 artificial and natural habitations in thirty towns of sixteen counties with pipette and dippers once-a-month during May to December 2014 in the Mazandaran Region, northern Iran. Larval habitation features were detailed on the based of conditions of theie breeding habitats which were stable or short-term, running or stagnant, natural. Association between ecological variables and larval density was evaluated by using Chi-square tests. Thoroughly, 19,840 larvae were ammased and acknowledged from 3 genera, 16 species. *Culex pipiens* and *Anopheles maculipenn* s.l. were prevailing species and ammased with maximum density in plain regions. Mostly larvae were ammased from natural territories (60.34%), comprising; marshy areas, river edge and swamplands with stationary water bodies, shadow-sun, muddy land and water at 20–25°C temperature sunlight. *An. maculipennis* s.l. were found in river sides and rice fields and, marshlands and waste tires were main habitats for *Cx. pipiens* in the region. Statistical analysis shown important connection among existence of *An. maculipennis* s.l., *Culex mimeticus, Cx. pipiens*, *Cs. Annulata* and *Culex torrentium* with each of the environmental variables ($P < 0.001$). These findings are essential in expanding our knowledge of the vectors ecology specially the type of habitat preference and will be beneficial in larval control programs.

Ikpa *et al*., (2017) worked on infectivity and distribution of *Anopheles* mosquitoes and asymptomatic malaria contamination in home-setting of Gboko, Nigeria. This survey was carried out to conclude the distribution and infection rate of *Anopheles* species, malaria contaminations in the Gboko. Mosquitoes were ammased various sites Pyrethrum Spray Catches (PSC), whereas malaria analysis was conducted malaria test. Purpose was recognized and distinguished the main vectors of malaria communication to determine occurrence of malaria diseases that could serve as a reservoir for malaria diseases communication with local vector. Result indicated, Anopheles mosquito species were captured from that region observed less than ten percent and maximum no of mosquito species were *Culex* and minor no of *Aedes* mosquito species. *Anopheles gambiae* and *Anopheles funestus mosquito species* were recognized and implicated in malaria spread meaningfully mostly plentiful in camparision to *An. funestus*, 25.80% ($x2= 13.24$, $df= 3$, $p= 0.004$). Though, comparative infection was not meaningfully dissimilar ($x2= 0.24$, $df = 1$, $p= 0.63$). That results point out while malaria vectors maight accepted collective scattering, which may cause a even configuration of malaria diseases contamination in the area so that there was requirement to intercede with the asymptomatic waterbodies of malaria problem, accessible for constant vector communication of the illness in Gboko.

Yazdi *et al.*, (2017) studied on and species composition and diversity of mosquitoes (Culicidae: Diptera) in Noor county, northern Iran. This research investigation was commenced to conclude richness, fauna, distribution and activity of mosquito (larvae and adults) in the Noor Province, of northern Iran. This study was carried out during August 2012- November 2013 in the urban and rural peripheries of

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Noor region. They were visited once-a-month regularly in each part of natural larval upbringing sites for example: shallow wells, river beds, sewer, marshylands, holes, artificial upbringing places as ponds and rice fields for collection of larvae. Collection of adult mosquitoes, were done by survey method from the places sach as human bedrooms and animal residences, store rooms, toilets, cowsheds, stables and coop. over-all 844 no of larvae and 1484 no of adult mosquitoes were captured in this survey. Result revealed that 665 Culicinae larvae: 501 were *Cx. pipiens* 75.3%, 56 *Cx. theileri* 8.4% and 108 *Cx. mimeticus* 16.2%. And 179 no of Anophelinae larvae: 96 *An. hyrcanus* 53.6% and 83 *An. maculipennis s.l.* 46.4%. Among 889 no of adult Culicinae: 495 *Cx. pipiens* 55.7%, 238 *Cx. mimeticus* 26.8%, 156 *Cx. theileri* 17.6%, and from 595 no of adult Anophelinae 371 *An. hyrcanus* 62.4% and 224 *An. maculipennis* 37.7%. *Anopheles hyrcanus* with 96 larvae 53.6% and 371 adults 62.4% and *Cx. pipiens* with 501 larvae 75.3% and 495 adults 55.7% indicated maximum distribution and richness in the province.

Arcosa *et al.*, (2018) studied on description of artificial habitats of mosquito vectors *Anopheles darlingi* (Diptera: Culicidae) in the Brazilian Central Amazon. *Anopheline* samplings were conducted in the metropolitanarea city of Manaus on three artificial larval habitats (dams, clay pits, fish ponds) placed on Highway and Puraquequara/Brasileirinho in dry seasons of 2011 and 2012. This investigation fish ponds of larval habitat were permanent and semi-permanent and partially covered and sunshiny due to presence of vegetation. Results showed that artificial larval habitats were similar to natural habitat, higher larval density and maximum abundance of *An. triannulatus* and *An. darling* species. All hanging solids and phosphorus were correlated with existence of (*An. trianulatus* and *An. braziliensis*) in dams and (*An. albitarsis, An. peryassui* and *An. nuneztovari*) in fish ponds. Hence calculated variables and *Anopheles* species distribution in local larval territories of themetropolitan Manaus region.

Okwa & Adetutu, (2018) studied on breeding and oviposition water sites of mosquitoes in Ojo area, Lagos State, Nigeria. It was smallest state in the association, 22% of 787 square kilometers included of lagoons and streams. Urban city has tidal swamps breeding huge mosquito species. This survey was conducted area of the campus with some ecological modifications due to road creation on the express route and work was done in the rainy season June-July months 2017. Malaria problem was found in various breeding places of mosquito and this investigation conducted at various breeding water areas, physicochemical aspects and cues for oviposition and growth of mosquito species during rainy season. Experiment detected that mosquitoes oviposited in ten vessels constantly. Two mosquito species were identified, *Anopheles* and *Culex* specie and oviposition activity was observed *Anopheles* spp (57.2%) more than *Culex* spp (42.7%). polluted water included more *Culex* species while rainy water included more *Anopheles* species. logged water had included minimum no mosquito of both species. Hence it's proved that no significant change in temperature and Ph ranges of all water sampleso of both vessels. This study suggests that mosquito control programmes must preferred at breeding areas. Application of environmental hygiene conducted by cleaning

drainages and gutters near around houses will go a long way. People should aware about to control of mosquito borne diseases.

Ismail *et al*., (2018) studied on Biting Habits in day time of Mosquitoes Associated with Mangrove Forests in Kedah, Malaysia. This study were supervised at Segantang Garam, Merbok, Kedah mangrove woodland, this forest situated between (05_38052.80 0 N, 100_24030.50 0 E) and (05_38054.80 0 N, 100_24030.50 0 E). Study was executed of inland area, which contains of Rhizophora mangrove plant species. Plant management and restoration efforts, spread of mangrove forests at largest conservation places in Malaysia. However information related to mosquitoes not recorded which (directly and indirectly) linked with mangrove woodlands. To study the potential health risk to humans active within and in close vicinity of mangrove forests, this research focused on the day biting habits of mosquitoes in mangrove forests of Kedah, Malaysia. The bare leg catch (BLC) method was used to collect adult mosquitoes during a 12-h period from 7:30 a.m. to 7:30 p.m. in both disturbed and less disturbed areas of mangroves. In total, 795 adult mosquitoes from 5 genera and 8 species were collected, and over 65% of the total mosquitoes were collected from the less disturbed area. The predominant species from the less disturbed area was Verrallina butleri; in the disturbed area the dominant species was Culex sitiens. The peak biting hour differed for each species, with *Aedes albopictus* and *Cx. sitiens* recorded as having a bimodal biting activity peak during dawn and dusk. For Ve. Butleri an erratic pattern of biting activity was recorded in the less disturbed area but it peaked during the early daytime for both collection points. Overall, the distinct pattern of day biting habits of mosquitoes within mangroves peaked during dawn and dusk for the less disturbed area but was irregular for the disturbed area throughout the day. The presence of vectors of pathogens such as *Ae. albopictus* for both areas raises the need for authorities to consider management of mosquitoes in mangrove forests.

Stephenson *et al*., (2019) worked on interpreting feeding patterns of mosquitoes in Australia along with an ecological lens: and analysis of blood meal. Vector-borne parasites contribute worldwide problem of sickness and infections lots of people yearly. Mosquito vector nourishing is life-threatening to spread the pathogens and so it is essential to understanding the feeding manners of mosquito vectors. In this study explored blood meal records in two techniques; firstly used novel odds ratio analysis and another method by calculating Shannon's diversity scores and after this process they found each mosquito vector had a matchless feeding pattern with various vertebrates, signifying (species-specific nourishing configurations). This Collected feeding patterns detected across the Australia, were not described by intrinsic variables ex. Larval habitations. They studied about consequences for disease communication by mosquito vector species, that categorized as general-feeders (*Aedes vigilax* and *Culex annulirostris*) or special feeders (*Aedes aegypti*) on potential effects of mosquito host choice. Thus generally they found that however existing blood meal survey in Australia were beneficial for inspecting mosquito feeding behaviour, standardisation of blood meal study methods and investigation, containing combination of vertebrate surveys, would

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developed expectations of the influence of mosquito vector-host interfaces on disease biology. Their investigation will be used in future as broad framework to investigate mosquito-vertebrate connection, where host accessibility data not available, in global systems.

Gunathilaka *et al*., (2019) reported on extensive study on distribution, abundance and bionomics of effect of malaria vectors in Mannar district of Sri Lanka. This study were conducted for complete information of distribution about malaria diseases vectors in the Mannar district of Sri Lanka. Previous study were specified that only seven no of mosquito species of anophelines found viz., *An. culicifacies*, *An. subpictus, An. barbirostris, An. peditaeniatus, An. nigerrimus, An. Jamesii*, and *An. maculatus* but it had been numerous changes in the distribution of anophelines presently in that district. This intomological investigation was directed once-a-month including indoor hand gathering, cattle-baited net collection, window trap gathering, cattle-baited shelter gathering, and survey of larvae during June 2010 to June 2012. Correlation of 7 abiotic variables of the upbringing territories were observed by using the Pearson's correlation coefficients to define relations of climatic variables and anopheline densities. All the 74,181 mosquitoes were belonging to 14 species were verified and *An. subpictus* was mainly found from entire methods demonstrating 92% (n=68,268) of total anopheline group. But *Anopheles culicifacies* were not detailed during this survey period. In these surveys acknowledged 12 upbringing territories containing drains, waste water collections and lagoon water collections, were not detailed such as breeding homes in earlier records. Result revealed that mean of liquefied oxygen of waste water sample was 3.45±0.15mg/l and mean of conductivity and salinity of lagoon water samples were 34734±1974 μs/cm and 21105±1344mg/l separately. Hence the study updated data about vector bionomics and *Anopheline* distribution.

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Mycorrhizal Fungi and Plant Health: Symbiotic Relationships for Sustainable Agriculture

Mr. Kailash S. Lokhande
Department of Botany, S.S. Jaiswal College, Arjuni/Mor., Dist. Gondia (M.S), India.
Email: kailash1707@gmail.com

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Abstract:

Mycorrhizal fungi play a pivotal role in enhancing plant health and vitality through symbiotic associations with the roots of most terrestrial plants. Chapter explores the intricate mechanisms underlying mycorrhizal symbiosis and its profound implications for sustainable agriculture. The review highlights the diverse types of mycorrhizal associations, including arbuscular, ectomycorrhizal, and ericoid mycorrhizae, elucidating their unique roles in nutrient uptake, water acquisition, and stress tolerance.

Furthermore, chapter delve into the biochemical and molecular signals mediating the communication between plants and mycorrhizal fungi, unveiling the fascinating intricacies of this symbiotic relationship. Through this mutualistic interaction, mycorrhizal fungi facilitate the absorption of essential nutrients, such as phosphorus, nitrogen, and micronutrients, thereby enhancing plant growth, resilience, and productivity. It also explores practical applications of mycorrhizal fungi in sustainable agriculture, including their use as biofertilizers and soil conditioners to improve soil fertility and reduce the reliance on chemical inputs. Chapter also examine the potential of mycorrhizal fungi to mitigate abiotic stresses, such as drought, salinity, and heavy metal toxicity, thus contributing to the resilience of crops in the face of environmental challenges.

Overall, this Chapter underscores the significance of mycorrhizal fungi in promoting plant health and sustainability in agricultural systems. By harnessing the power of mycorrhizal symbiosis, farmers can optimize nutrient use efficiency, reduce environmental impacts, and foster resilient agro-ecosystems capable of meeting the demands of global food security in a changing climate.

Keywords: Mycorrhizal fungi, Symbiotic associations, Sustainable agriculture, Biofertilizers, Plant health, Agro-ecosystems.

Introduction:

Mycorrhizal symbiosis, the mutually beneficial relationship between fungi and plant roots, holds profound implications for sustainable agriculture. This symbiosis is widespread in nature, with the majority of terrestrial plant species forming associations with mycorrhizal fungi. Understanding its implications is crucial for enhancing agricultural sustainability.

Mycorrhizal fungi extend the reach of plant roots, increasing their surface area for nutrient absorption. In return, plants provide the fungi with carbon compounds. This

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symbiotic exchange is particularly vital for phosphorus uptake, as mycorrhizal fungi can access phosphorus in soil organic matter and insoluble forms, making it more available to plants. This enhanced nutrient acquisition can reduce the need for synthetic fertilizers, promoting sustainable nutrient management practices (Fitter, Helgason, and Hodge 2011).

Mycorrhizal associations improve plant water uptake efficiency, especially under drought conditions. Fungal hyphae act as extensions of the plant root system, accessing water sources that may be beyond the reach of plant roots alone. This increased resilience to drought stress is of paramount importance in the face of climate change, where water scarcity is becoming more prevalent in many agricultural regions (Abdalla et al. 2023).

Mycorrhizal fungi play a crucial role in soil aggregation and structure. Their hyphal networks bind soil particles together, creating stable aggregates that improve soil porosity, aeration, and water infiltration. Moreover, mycorrhizal fungi can enhance soil organic matter decomposition and nutrient cycling, contributing to overall soil health and fertility. Healthy soils are the foundation of sustainable agriculture, as they support robust plant growth and minimize environmental degradation (Gupta 2020).

Mycorrhizal symbiosis can confer resistance to soil-borne pathogens, thereby reducing the need for chemical pesticides. Some mycorrhizal fungi produce antifungal compounds or induce plant defense mechanisms, protecting plants from pathogenic attack. This natural disease suppression mechanism enhances crop resilience and reduces the environmental impacts associated with pesticide use (Xavier and Boyetchko 2004).

Mycorrhizal fungi contribute to ecosystem stability and biodiversity by facilitating nutrient cycling and supporting diverse plant communities. By promoting the growth of native vegetation and enhancing ecosystem resilience, mycorrhizal symbiosis plays a crucial role in maintaining biodiversity within agricultural landscapes (Field et al. 2020).

There are several diverse types of mycorrhizal associations, each characterized by distinct structural and functional features. The main types include:

Arbuscular Mycorrhizae (AM):

Arbuscular mycorrhizae are the most widespread and ancient form of mycorrhizal association, occurring in approximately 80% of plant species. In AM, fungal hyphae penetrate the root cells of the host plant, forming highly branched structures called arbuscules and vesicles within the root cortex. These structures facilitate nutrient exchange between the fungus and the plant, particularly phosphorus and nitrogen. AM associations are typically found in a wide range of plants, including many agricultural crops, grasses, and most herbaceous plants (Jakobsen, Smith, and Smith 2003).

Ectomycorrhizae (ECM):

Ectomycorrhizal associations are characterized by the formation of a dense network of fungal hyphae around the plant root, without penetrating the root cells. The fungal hyphae form a sheath, or mantle, around the root tip and extend into the surrounding soil, forming a hyphal network known as the Hartig net within the root

cortex. ECM associations are commonly observed in trees, particularly in temperate and boreal forests, as well as in some shrubs and woody plants. These associations are important for nutrient uptake, particularly in forest ecosystems, and can enhance plant growth and resistance to environmental stresses (Kumar and Atri 2018).

Ericoid Mycorrhizae:

Ericoid mycorrhizal associations are specialized symbioses found predominantly in plants belonging to the Ericaceae family, such as heathers, blueberries, and rhododendrons. In ericoid mycorrhizae, fungal hyphae penetrate the outer layers of root cells and form a dense network within the root cortex. These associations are adapted to acidic and nutrient-poor soils, where they play a crucial role in nutrient acquisition, particularly nitrogen and phosphorus. Ericoid mycorrhizae are common in heathland and moorland ecosystems, where they contribute to plant growth and ecosystem functioning (Straker 1996).

These diverse types of mycorrhizal associations demonstrate the adaptability of fungi and their importance in facilitating nutrient uptake, enhancing plant growth, and contributing to ecosystem functioning in a wide range of habitats and plant species.

The biochemical and molecular signals mediating communication between plants and mycorrhizal fungi are fundamental to the establishment and functioning of mycorrhizal symbiosis. This intricate signaling network involves a series of interactions between the two partners, orchestrated by a variety of signaling molecules and pathways. The process of mycorrhizal symbiosis begins with the recognition of fungal symbionts by plant roots and vice versa. This recognition is mediated by signaling molecules, including chitin oligomers derived from fungal cell walls, and plant-derived signaling compounds such as strigolactones. Perception of these signals triggers a cascade of molecular events in both the plant and fungal partners, leading to the activation of symbiotic programs and the formation of symbiotic structures (Requena et al. 2007). Once the initial signals are perceived, signal transduction pathways are activated in both plants and fungi to facilitate symbiotic interactions. These pathways involve the transmission of signals from the cell surface to the nucleus, leading to changes in gene expression and physiological responses. In plants, symbiosis-related signaling pathways often involve components such as receptor-like kinases, calcium ions, and transcription factors, which regulate the expression of symbiosis-related genes. Similarly, fungi utilize signaling pathways, including protein kinases, G-protein-coupled receptors, and cyclic nucleotide signaling, to respond to plant signals and initiate symbiotic programs (Gianinazzi-Pearson et al. 2007). Once symbiotic structures, such as arbuscules or Hartig nets, are established, the exchange of nutrients and metabolites between plants and fungi occurs. This exchange is facilitated by specialized transporters and channels located in the symbiotic interface. Plant-derived carbon compounds, such as sugars and lipids, are transferred to the fungal partner to fuel fungal growth and metabolism. In return, mycorrhizal fungi provide plants with essential nutrients, including phosphorus, nitrogen, and micronutrients, acquired from the soil through their extensive hyphal network. The biochemical and molecular signals involved in plant-fungal

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communication also play a crucial role in regulating the development and functioning of mycorrhizal symbiosis (Boyno and Demir 2022).

Mycorrhizal fungi offer various applications in sustainable agriculture, contributing to soil health, nutrient management, crop productivity, and environmental resilience.

Improved Nutrient Uptake:

Mycorrhizal fungi enhance the uptake of essential nutrients, particularly phosphorus, nitrogen, and micronutrients, by forming symbiotic associations with plant roots. This can reduce the need for synthetic fertilizers, promoting sustainable nutrient management practices and minimizing nutrient runoff into waterways (Kalamulla et al. 2022).

Enhanced Drought Tolerance:

Mycorrhizal associations improve plant water uptake efficiency and tolerance to drought stress. Fungal hyphae extend into the soil, accessing water sources beyond the reach of plant roots and facilitating water absorption. This can help crops withstand periods of water scarcity, contributing to resilience in drought-prone regions (Pavithra and Yapa 2018).

Reduced Dependency on Chemical Inputs:

By promoting nutrient uptake and enhancing plant resilience to environmental stresses, mycorrhizal fungi can reduce the reliance on chemical inputs such as fertilizers and pesticides. This not only lowers production costs for farmers but also minimizes the environmental impact associated with excessive fertilizer use and pesticide runoff (Hooker et al. 1994).

Soil Health and Structure:

Mycorrhizal fungi play a crucial role in improving soil structure, aggregation, and fertility. Their hyphal networks bind soil particles together, creating stable aggregates that improve soil porosity, aeration, and water infiltration. This enhances soil fertility, promotes microbial activity, and reduces soil erosion, contributing to long-term soil health and sustainability (Jeffries et al. 2003).

Biofertilizers and Soil Conditioners:

Mycorrhizal inoculants can be used as biofertilizers and soil conditioners to enhance soil fertility and plant growth. These inoculants contain spores or propagules of beneficial mycorrhizal fungi, which can be applied to seeds, seedlings, or soil to establish symbiotic associations and promote healthier root systems. This can improve crop yields, especially in nutrient-poor soils, and support sustainable agricultural practices (Igiehon and Babalola 2017).

Bioremediation and Soil Restoration:

Mycorrhizal fungi have the ability to degrade organic pollutants and sequester heavy metals in contaminated soils, contributing to bioremediation efforts and soil restoration. Their hyphal networks can immobilize and detoxify pollutants, facilitating their degradation by soil microorganisms. This application has potential implications for cleaning up polluted sites and restoring degraded lands for agricultural use (Leyval et al.

2002).

Climate Resilience:

Mycorrhizal associations can help mitigate the impacts of climate change on agriculture by enhancing crop resilience to abiotic stresses such as heat, drought, and salinity. By improving nutrient uptake, water efficiency, and stress tolerance, mycorrhizal fungi enable crops to better withstand environmental fluctuations and maintain productivity in changing climates (Wong 2022).

The applications of mycorrhizal fungi in sustainable agriculture offer promising solutions for improving soil health, nutrient management, crop resilience, and environmental sustainability. By harnessing the potential of mycorrhizal symbiosis, farmers can adopt more environmentally friendly and economically viable agricultural practices that promote long-term sustainability and resilience in food production systems (Hart and Trevors 2005).

Discussion:

The findings presented in this chapter underscore the pivotal role of mycorrhizal fungi in promoting plant health and vitality, highlighting their significance in sustainable agriculture. By exploring the intricate mechanisms underlying mycorrhizal symbiosis, we have gained insights into how these symbiotic associations contribute to nutrient uptake, water acquisition, and stress tolerance in plants.

The review has elucidated the diverse types of mycorrhizal associations, including arbuscular, ectomycorrhizal, and ericoid mycorrhizae, each with unique roles in enhancing plant resilience and productivity. This diversity underscores the adaptability and versatility of mycorrhizal fungi in various ecological contexts.

Furthermore, this chapter exploration into the biochemical and molecular signals mediating plant-fungal communication has unveiled the fascinating intricacies of this symbiotic relationship. Through mutualistic interactions, mycorrhizal fungi facilitate the absorption of essential nutrients such as phosphorus, nitrogen, and micronutrients, thereby promoting plant growth and productivity.

The practical applications of mycorrhizal fungi in sustainable agriculture have also been thoroughly examined. Their use as biofertilizers and soil conditioners offers promising alternatives to chemical inputs, thereby improving soil fertility and reducing environmental impacts. Additionally, their potential to mitigate abiotic stresses such as drought, salinity, and heavy metal toxicity further underscores their importance in enhancing crop resilience in the face of environmental challenges.

Conclusions:

In conclusion, this chapter emphasizes the profound implications of mycorrhizal fungi in promoting plant health and sustainability in agricultural systems. By harnessing the power of mycorrhizal symbiosis, farmers can optimize nutrient use efficiency, reduce environmental impacts, and foster resilient agro-ecosystems capable of meeting the demands of global food security in a changing climate.

Moving forward, further research is warranted to deepen our understanding of the ecological, biochemical, and molecular aspects of mycorrhizal symbiosis. Such

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investigations will not only enhance our knowledge of these intricate relationships but also pave the way for innovative approaches to sustainable agriculture that leverage the potential of mycorrhizal fungi. Ultimately, the integration of mycorrhizal fungi into agricultural practices holds great promise for addressing the challenges of food production while minimizing environmental degradation.

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Blumea Lacera - An Aromatic Weed with Medicinal Properties: A Review

Ashwini Bedre
Trupti Kulkarni
[1] Prof. Ramkrishna More Art's, Commerce and Science College, Akurdi Pune-411044
Shripad Patil
[2] Rayat Shikshan Santha, Dada Patil Mahavidyalaya, Karjat, Ahmednagar-414402
Email: patilshripad55@gmail.com

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Abstract:

This study supports and strengthens the multifaceted therapeutic potential of a wild herbaceous medicinal plant and its sensible uses to increase the effectiveness of healing and reduce adverse effects. Geographically, the *Blumea lacera* (Kukraundha) is found in tropical and temperate climates all throughout the nation, with altitude of up to 1000 meters above sea level. In order to improve knowledge of the anticipated mode of action of chemical ingredients and their effects and to support the creation of innovative drug designs, products, and formulations, this review article is enhancing the scientific evidence and compiling the postulates. Reviewing the effectiveness of plants in treating a range of illnesses under various medical systems, such as Ayurveda, homeopathy, and allopathy, was the goal of this study. The moment has come to securely and efficiently harness the therapeutic potential of ethnomedicines in order to preserve the information that has been passed down through traditional healers and antiquated literature. In order to provide a reasonable chance of an original result, scientific attempts have been made to combine data from traditional literature with information based on current research.

Keywords: Medicinal plant, Ayurveda, Traditional healers, *Blumea lacera*, Ethnomedicines

Introduction:

Blumea lacera is a member of the Asteraceae family of medicinal plants. lumea lacera is an upright annual plant that has a noxious turpentine smell. Blumea acera is a plant often found by roadsides. It is also known as Susksampatra, Kakaronda, Siyalmutra, and Janglimulli. Herb with a long stem and corymbose branches that smells camphoraceous. This perennial weed has yellow blooms that resemble groundsel and obovate, deeply serrated leaves. The entire plant is covered in long, silky hairs. It can be seen spreading out freely in roadside patches, drying ponds along drains, and riverbanks. For its green roots and leaves, Blumea lacera is grown over most of India (Unnati Goti, Pooja Desai, 2020).

The world's desire for herbal medications is growing at an unprecedented rate because they are safer, more effective, less addicting, more lively, and Herbal medications provide several crucial characteristics, including immune-stimulating effects and the ability to concurrently activate and check extensive hormonal

and enzymatic driven metabolic pathways. Since ancient times, plants have been used as treasure troves for cosmeceuticals, nutraceuticals, and medicines across human civilization. Plants have been utilized for medicinal reasons in many treatment systems to treat and prevent infectious, acute, and chronic illnesses and disorders in humans as well as in animals. Herbal remedies are unique among other forms of therapy because of their immune-stimulating, immune-protecting, immune-modulating, and adaptogenic properties. The natural and reasonable amalgamated mixture of macro and micro molecules assists in enhancing safety, effectiveness, and potency of herbal medications (Agarwal, et.al, 1995, Rao, et.al, 1977, Zahan, et.al, 2015, Joshi, 2011).

Additionally, ethnomedicines provide safer and more effective alternatives to conventional treatments for a range of illnesses. The Asteraceae family includes the *Blumea lacera*. One of the biggest dicot families is Asteraceae. It is commonly known that dicot seeds, including those from nuts, oil seeds, and legumes, contain a significant quantity of phytic acid. The phytase enzyme-based breakdown of phytic acid is facilitated by processing techniques such germination, soaking, fermenting, blanching, roasting, frying, and boiling, which all lower the phytate concentrations. The presence of 12.82 mg/100 g of phytate in *Blumea lacera* leads to the demineralization of calcium, iron, magnesium, manganese, copper, and other minerals (Rao,et.al, 1977, Zahan, et,al, 2015, Ragasa, et,al, 2007). Despite the fact that phytate, cyanogenic glycoside, and alkaloids have unfavorable qualities, it is discovered to be a source of several other variables that promote health (Laakso, et,al, 1989, Oudhia, et,al, 1998, Hasan, et,al, 2015). Its antioxidant properties prevent HIV-1 replication, cardiovascular diseases, diabetes, hyperlipidemia, and a number of free radicals that cause cancer. Additionally, it has been shown to have antileukemic action (K562 cells), inhibit gastric adenocarcinoma cells (AGS), breast ductal carcinoma cells (MDA-MB 4355), and colorectal adenocarcinoma cells (HT-24), as well as alleviate certain stress-induced non-communicable problems. Because of the large complex of chemical compounds it contains, including terpenoids, cyanogenic glycosides, alkaloids, steroids, saponins, phenolics, and flavonoids, this plant is known as a coprophilous plant (Ragasa et. al, 2007, Laakso, et,al, 1989, Oudhia P, et,al, 1998, Hasan, et,al, 2015).

Coprophilous plants have a high potential for producing new drugs, and it is also thought that these plants have antibacterial, antiprotozoal, antiviral, antifungal, and antioxidant properties that could open up new avenues for the development of novel antibiotics to combat various pathogens that are becoming increasingly resistant to treatment. Antioxidants are known to exist in the form of secondary metabolites such as flavonoids, polyphenols, and phenolic acids, which scavenge free radicals. The detrimental effects of oxidative stress are prevented by the antioxidants. In addition to its potential medical uses, it might be useful in the organic growth of medicinal plants that exhibit allelopathic effects against certain species such as Echinochloa colona, Cyperus rotundus, Eleusine coracana, Cynodon dactylon, Setaria glauca, Eclipta alba, and Ageratum conyzoides. Though its organic cultivation techniques and GACP (Good Agriculture Cultivation Practices) may fairly enhance the percentage of active

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constituents and up shoot the healing properties through genuine planting material and its excellent in quality agri-produce, the kukaraundha can be observed throughout the nation in its natural state (Tomar, 2017, Khair, 2014, Singh, 2019, WHO, 2016).

Plant Taxonomy: Kingdom: Plantae, Phylum: Tracheophyta, Class: Equisetopsida, Subclass: Magnoliidae, Order: Asterales, Family: Asteraceae, Subfamily:Asteroideae, Genus: Blumea, Genus: lacera Botanical Name: Blumea lacera , Vernacular Name: Kukraundha, Common Name: Malaya Blumea

Geographical Source:

It may be found up to 1000 meters above sea level across the nation in tropical and subtropical climates. It is believed to be a plant with strong resistance and allelopathic effects on other herbs (Akter, et,al, 2015, Singh, Mittal, 2014, Singh, et,al, 2010).

Plant Morphology:

Blumea lacera is a perennial herbaceous plant with a camphoraceous scent that grows to a height of 40-90 cm. It is bitter, acrid, astringent, thermogenic, anti-inflammatory, refrigeratorant, styptic, and antiscorbutic. Its leaves are 4–13 cm in length and 37 cm in width (Gaur, 1999).

Fig. *Blumea lacera* plant

Plant Parts used: whole plant (Leaves, roots, flowers)

Chemical Constituents:

Components of therapeutic value can be discovered in many plant parts. Worldwide, the leaves are more widely and often used for medicinal purposes. In order to increase the medicinal advantages, the leaves should be collected in January or February before 50% of the plant has flowered, according to WHO guidelines for good harvest processing methods. Camphor, (Z)-lachnophyllum ester (which demonstrated

cytotoxic activity against MIF-7 and MDA-MD-231 human tumor cell lines), (Z)-lachnophyllic acid, nerolidol, gernacrene, monoterpene glycosides, flavonoids, -farnesene, dihydroxy-trimethoxy flavone, diacetyl glucopyranoside, -caryophyllene, campesterol, -humulene, amyrin, amyrin acetate, lupeol, lupeol acetate, hentriacontane, -sitosterol, cineol, and citrol are among the essential chemical constituents found in the herb (Khandekar, et,al, 2013, Satyal, et,al, 2015).

Applications:

India is a developing nation with abundant biodiversity spread over 21 agroclimatic zones. The therapeutic plants are biosynthetic units that abundance of secondary metabolites, or active chemical compounds, which might act as lead molecules for more study, product development, and formulation. *Blumea lacera* is widely distributed up to 1000 meters above sea level in India's tropical and subtropical regions. It has been proven to be effective in a number of therapeutic systems. One of the most important herbaceous plants for healing purposes, *Blumea lacera* (Kukraundha), has a wide range of medicinal substances, including terpenoids, alkaloids, cyanogenic glycosides, flavonoids, phenolics, and saponins. If the recommended consumption dosages of alkaloids, cyanogenic glycosides and phytates exceed the limit, there is a possibility of deadly adverse effects. Thus, it is important to highlight the practical and reasonable uses of bluema. Processing techniques like seed germination, leaf shade drying, decoction of dried plant parts, syrup, ointments, etc., may be crucial in regulating and maximizing the amounts of therapeutically valuable components (Lalit Raj Singh, 2019).

Specific uses in different systems of healing:

Blumea lacera is used in many different medical systems, including as Ayurveda, Homoeopathy, Unani, Siddha, and Allopathy, to treat a wide range of physical illnesses. It is used in Ayurveda to treat Vranaropan, Atisaar, Sotha, Jalodar, Sandhivaat, and Raktagranthi. Its essential oil is known as Muqawwi-e-Aam in the Unani system. It is renowned for its Zof-e-Meda, Kasir-e-Riyah, and Mudirr-e-Baul as well. Its mother tincture is commonly used as a febrifuge and to treat bleeding piles in the homoeopathic system. "Narakkarandai" is utilized in the Siddha healing system to treat anthelmintic, deobstruent, and threadworm infestation. Anti-inflammatory, diuretic, antidiabetic, anthelmintic, antipyretic, antibacterial, anti-atherothrombosis, expectorant, and anxiolytic properties are among the most common and widespread uses of it in allopathy (Gaur, 1999).

Medicinal and Ethnomedicinal uses:

It is advised to use leaf juice to get rid of intestinal worms. Additionally, leaf juice is recommended for wound healing, diuretic action, fever cure (febrifuge), and antipyretic purposes. To treat renal lithiasis, a paste made from leaves is applied to the lower belly, causing diuresis. To relieve piles, a mixture made from leaves and mustard seeds is applied. The paste of leaves and black pepper powder is used as an antidote to treat dog bites. Leaves include a wide range of chemical components, such as triterpenoids, phenolic compounds, alkaloids, cyanogenic glycosides, etc. All kinds of

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colds are treated with the Swaras of leaves mixed with honey. The Swaras of leaves is used to treat generalized body heat and fever. To cure leucorrhoea, pellets are made from the dried powder of leaves and seeds. Different Anupaan have varying therapeutic effects, and before prescribing medication, the patient's Prakriti and Anupaan bheda are essential instruments for obtaining more therapeutic advantages (Joshi, 2011, WHO, 2017, Singh, 2008, Raghunathan, Mitra,1982).

Conclusion:

The potential for *Blumea lacera* L to treat a range of illnesses has been demonstrated by ethnomedical practices and other medical systems. It has enormous potential to treat a wide range of human illnesses and ailments. Lead compounds for the development of novel drugs and product formulation may be found through additional screens and research. Herbal medicines are the most secure means of achieving novel results when treating acute, chronic, and resistant strains of various bacterial, fungal, and viral infections.

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Study on Laplace Transformation and its Application in Science and Engineering Field

Santosh C. Rudrawar
Dept. of Mathematics Siddharth College Jafrabad Dist-Jalna
Dr. Ganesh L. Rokade
Dept. of Mathematics JES College Jalna
Madhuri R. Adalinge
Dept. of Computer Science and Management, Mudhoji College, Phaltan, Satara
Email: santoshrudrawar240@gmail.com

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Abstract:

In this paper we propose to discuss about properties and application of L.T. in various fields. Many researchers, Scientists and Mathematicians used L.T. to find solution for their problems. In this paper we will try to solve mixture problems. This helps for the study in the field of Science and Engineering.

Key Words: Laplace transforms, Properties, Differential equation, Mixture problems, Application

Introduction:

In this paper overview of properties of L.T. with definition and its application in Engineering and applied Science. The Laplace transform is integral transform which is denoted by$\mathcal{L}[f(t)]$. The solution of linear, ordinary differential equation with constant coefficients such as the third order equation $af'''(t) + bf''(t) + cf'(t)df(t) = g(t)$ can be solved by first obtaining the general form conditions. A various systematics way of solving this equation into an algebraic equation and has the added incorporate advantage the boundary conditions form the beginning. Furthermore, if $f(t)$ represent function with discontinuities other methods fail where Laplace transform method can succeed.

Definition of L.T.

If $f(t)$ is a function of t defined for all $t \geq 0$ then $\int_0^\infty e^{-st} f(t)dt$ is defined as L.T. of $f(t)$ provide the integral exists and is denoted by $\mathcal{L}[f(t)] = \int_0^\infty e^{-st} f(t)dt = F(s)$.

The Laplace transform of function $f(t)$ exist when the following sufficient conditions are satisfied

i) $f(t)$ is piecewise continuous. ii) $f(t)$ is of exponential order.

Properties of L.T. [1]

- **Linearity Property**

If $\mathcal{L}[f_1(t)] = F_1(s)$ and $\mathcal{L}[f_2(t)] = F_2(s)$ then $\mathcal{L}[af_1(t) + bf_2(t)] = aF_1(s) + bF_2(s)$ Where a & b are constants.

- **First Shifting Theorem**

If $\mathcal{L}[f(t)] = F(s)$ then $\mathcal{L}[e^{-at}f(t)] = F(s+a)$

- **Second Shifting theorem**

If $\mathcal{L}[f(t)] = F(s)$ then $g(t) = f(t-a), t > a$

$= 0 \qquad t < a$

Then $\mathcal{L}[g(t)] = e^{-as}F(s)$

- **Multiplication by** t

If $\mathcal{L}[f(t)] = F(s)$ then $\mathcal{L}[t^n f(t)] = (-1)^n \frac{d^n}{ds^n}F(s)$

- **Division by** t

If $\mathcal{L}[f(t)] = F(s)$ then $\mathcal{L}\left[\frac{f(t)}{t}\right] = \int_s^\infty F(s)\,ds$

- **L.T. of Derivative**

If $\mathcal{L}[f(t)] = F(s)$ then $\mathcal{L}[f'(t)] = sF(s) - f(0)$

- **L.T. of Integrals**

If $\mathcal{L}[f(t)] = F(s)$ then $\mathcal{L}\left[\int_0^t f(t)\,dt = \frac{F(S)}{S}\right]$

- **L.T. of Unit Step Function $u(t)$**

$u(t) = 0 \quad t < 0$

$\quad = 1 \quad t > 0$

$$\mathcal{L}[u(t)] = \frac{1}{s}$$

- **L.T. of Periodic function**

If $f(t)$ is a piecewise continuous periodic function with period T then $\mathcal{L}[f(t)] = \frac{1}{1-e^{-Ts}}\int_0^T e^{-st}f(t)dt$

Application [2]

Let us suppose that a large mixing tank initially holds s_0 gallons of a solution in which x_0 pounds of a substance S is dissolved. Let another solution containing $x_1\ lb/gal$ of S, flows into the tank at a given rate $r_1 gal/min$.

When the solution in the tank is well stirred it in pumped out at a given rate $r_2 gal/min$. Let $x(t)$ denote the amount of substance S (measured in pounds) in the tank at time t. Then the rate at which x change with time t is given by

$$\frac{dx}{dt} = (input\ rate\ of\ S) - (Out\ put\ rate\ of\ S) = R_1 - R_2 \qquad 1$$

Now the input rate R_1 at which S enters the tank is the product of the inflow concentration $x_1\ lb/gal$ of S and the inflow rate $r_1 gal/min$ of the fluid. Note that R_1 is measured in lb/min thus we have

$$R_1 = (x_1\ lb/gal) \times (r_1 gal/min) = x_1 r_1 lb/min \qquad 2$$

Let $s(t)$ denote the number of gallons of solution in the tank at time$t$. Then the concentration of S in the tank as well as in the out flow in $(x/s)\ lb/gal$ at any time t. Hence the out put rate R_2 of S is given by

$$R_2 = ((x/s) lb/gal) \times (r_2 gal/min) = (\frac{xr_2}{s}) lb/min \qquad 3$$

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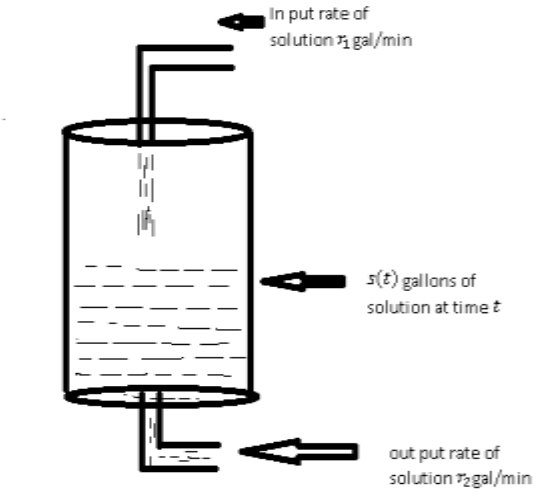
From equation 1,2 & 3

$$\frac{dx}{dt} = x_1 r_1 - \left(\frac{x r_2}{s}\right) \qquad 4$$

Which is a first order differential equation on solving 4 we obtain the amount of substance S in the tank at any time t.

By use L.T. we try to find solution under the condition i) if $r_1 = r_2$then clearly $s(t) = s_0 = constant\ value$



ii) x_0 may be zero and x_1, r_1, r_2 are non zero

$$\frac{dx}{dt} = x_1 r_1 - \left(\frac{x r_2}{s}\right)$$

Taking L.T. both side $\mathcal{L}\left[\frac{dx}{dt}\right] = \mathcal{L}[x_1 r_1] - \mathcal{L}[\frac{x r_2}{s}]$

Using L.T. derivative property

$$p\mathcal{L}[x] - x(0) = \frac{x_1 r_1}{p} - \frac{r_2}{s}\mathcal{L}[x]$$

Use $x_1 r_1 = k\ and\ \frac{r_2}{s} = m$ 5

$$p\mathcal{L}[x] - x(0) = \frac{k}{p} - m\mathcal{L}[x]$$

$$[p+m]\mathcal{L}[x] = \frac{k}{p} + x(0)$$

$$\mathcal{L}[x] = \frac{k}{p(p+m)} + \frac{x(0)}{(p+m)}$$

Taking I.L.T. both side

$$x = k\mathcal{L}^{-1}\left[\frac{1}{p(p+m)}\right] + x(0)\mathcal{L}^{-1}\left[\frac{1}{(p+m)}\right]$$

$$x = \frac{k}{m}[1 - e^{-mt}] + x(0)e^{-mt}$$

By equation 5

$$x = \frac{x_1 r_1 s}{r_2}\left[1 - e^{-\frac{r_2}{s}t}\right] + x(0)e^{-\frac{r_2}{s}t}$$

This solution give amount of substance S in the tank at any time$t$.

Eg.. Initially 50 pounds of salt is dissolved in a large tank having 300 gallons of water. A brine solution in pumper into the tank at a rate of 3 gal/min and well stirred solution is then pumped out at the same rate. If the concentration of the solution entering is $2lb/gal$ find the amount of salt in the tank at any time. How much salt is present after 50 min?

$$x = \frac{x_1 r_1 s}{r_2}\left[1 - e^{-\frac{r_2}{s}t}\right] + x(0)e^{-\frac{r_2}{s}t}$$

This solution give amount of substance S in the tank at any time$t$.

$t = 0, x(0) = 50\ pounds, r_1 = r_2 = 3\ gal/min, s = 300\ gallons, x_1 = 2\ lb/gal$

$$\therefore x = \frac{2 \times 3 \times 300}{3}\left[1 - e^{-\frac{3}{300}t}\right] + 50e^{-\frac{3}{300}t}$$

$x = 600 - 550e^{-\frac{1}{100}t}$

Is amount of salt in the tank at any time t

Now find $t = 50\ min, x = ?$

$$x = 600 - 550e^{-\frac{50}{100}} = 600 - 550e^{-0.5} = 266.41lb$$

Conclusion:

Through this paper we present the application of L.T. in mixture problem solve easly.L.T. is very effective tool to simplify many complex problems in Science and Engineering field.

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Green Synthesis and Characterization of Bioactive Silver Nanoparticles Using Turmeric Leaves Extract

R. D. More
S. D. Chavan
S. P. Moharir
Department of Chemistry,
Siddharth Arts, Commerce and Science College, Jafrabad, Dist.Jalna-431206 (M.S.)
Email id- rahuldmore2@gmail.com

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Abstract:

The purpose of this topic is to describe a simple, rapid, eco-friendly and economically feasible green synthesis of Nobel nanoparticles such as AgNP's using Turmeric leaves powder extract as reducing agent. In the present study Turmeric leaves powder extract which contain flavonoids, phenolic compounds were used as stabilizing agent and the phytochemicals present in the extracts act as reducing agent. The synthesis of AgNP's was monitored by using UV-Vis spectrophotometer; the UV spectroscopy shows absorbance at 426 nm.

Keyword: Green approach, UV–Vis-Spectrophotometer, SEM and TEM

Introduction

Nanoparticles having large surface area to volume ratio due to nanoscale and size of Nanoparticles. This is the main advantage of Nanoparticles [1] Nanoparticles shows completely new and enhanced properties based on specific characters such as size, and morphology due to increase in surface area [2,3]. The metal nanoparticles show excellent antibacterial properties and which are useful in variety of fields such as catalysis [4], bio-molecular detection, diagnostics [5], optical receptors, biolabeling and sensors [6]. The greener synthesis of nanoparticles are superior than any other conventional methods, as they are one step, simple, cost-effective, ecofriendly and often result in more stable materials [7]. Green synthesis of silver nanoparticles using plant extracts and micro- organism have been suggested as more valuable alternative to conventional chemical and physical methods. Use of Plant extracts for the synthesis of silver nanoparticles has more advantages than microorganism due to ease of scale up, less biohazard, easily availability and elaborate process of maintain cell cultures [8]. Turmeric belongs to the family Zingiberoside [9] parts of turmeric leaves which are safe and nutritious for human consumption [10] they possess high natural antioxidant properties and antibacterial activity against gram positive and gram-negative bacteria [11,12]. In the present study we establish that an aq. extract of turmeric leaves were used for the reduction of Ag+ into Ag metal and check the antimicrobial activity.

Experimental Methods

Silver nitrate (AgNO3) was purchased from Sigma– Aldrich Chemicals. All

glassware were sterilized with nitric acid and further with distilled water and dried I oven before use. Turmeric leaves were collected from campus of Siddharth College, Jafrabad, Dist. Jalna, Maharashtra, India.

Preparation of Plant root extract

Fresh turmeric leaves were collected from campus of Siddharth College, Jafrabad, Dist. Jalna, Maharashtra, India. The turmeric leaves were washed with tap water to remove impurities. The plant leaves dried under shade for 1 week, the dried leaves were grinded in a mixer grinder into the powder form. Same process repeated 4 to 5 times. The aqueous extract of turmeric leaves was prepared by using 12 g of powder of leaves which was added to 100 mL of deionized water at 60 °C to 80 °C for 25 min. This extract was filtered through Whattmann filter paper No-1. The filtered extract was stored in refrigerator at 4°C for further studies.

Green synthesis of silver nanoparticles (AgNPs) The silver nitrate (A.R.) used in this study was obtained from Sigma–Aldrich Pvt.Ltd Mumbai, India. Aqueous solution (1 mM) of AgNO3 was prepared in deionized water. For synthesis of silver nanoparticles, the Erlenmeyer flask containing 90 mL of AgNO3 (1 mM) was reacted with 10 mL of the aqueous leaves extract of turmeric leaves and stirred on magnetic stirrer heated at 800C for 1 hour, for the reduction of Ag+ ion from AgNO3 to synthesize AgNPs. The solution turns yellowish to dark brown indicating the formation of silver nanoparticles. The bio reduction of silver ion was also monitored by the UV-spectrophotometer.

Characterization of silver nanoparticle:

The reduction of silver ions by leaves extract were performed instrumentally investigated by using UV- Visible spectrophotometer (Model EQ-826, Equip- tronics Pvt. Ltd.). The UV-visible absorption spectrophotometer with optical absorbance between 200 to 600 nm was used.

composition of the particles.

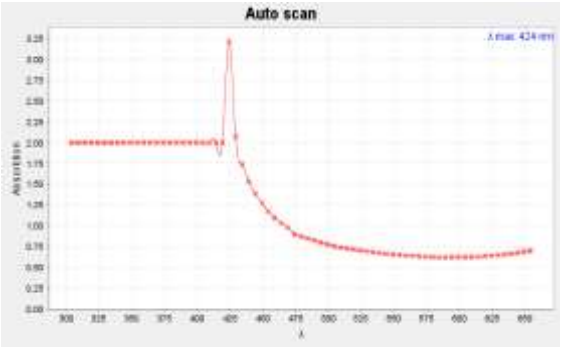

Fig.1 UV–Vis spectra of silver nanoparticle containing solutions synthesized from Ginger root extract samples and AgNO3 after 1 h of reaction (424 nm)

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Result and discussion

Colour change and UV-vis spectroscopy

The initial formation of silver nanoparticles is represented by a change in the colour of the solution from yellowish to brown [13]. The addition of plant extract of Zingiber officinale into aqueous solution of AgNO3 (1mM) led to the instantaneous change in the colour of solution yellowish to brown within 1hr. reaction due to excitation of surface plasmon vibrations. The surface plasmon resonance band AgNP observed at 420-430 nm similar to those reported in literature [14]. From the UV-vis spectra recorded, indicate that most rapid bio-reduction of silver ions was achieved using turmeric leaves extract as reducing agent. The visuals colour change and UV-vis spectra revealed that formation of AgNPs within 1 hr.

Conclusion

The biological synthesis of silver nanoparticles is rapid, simple, safe, one-step, cost effective, eco- friendly and novel synthesis route for preparing silver nanoparticles was carried out using turmeric leaves extract as a reducing and capping agent at given temperature.

Future plan

The synthesized silver nanoparticles can be characterized by UV-visible spectrophotometer, SEM-EDX and TEM analysis.

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Circular Economy: Approach for Sustainable Development

Smt. Punam Mehta
Govt. PG College Narsinghgarh
Email: *punampauranik007@gmail.com*

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Abstract:

One cannot change the past but future can be shaped on the basis of the work of today's. The sincere work towards the sustainable development is taken very enthusiastically all over the world. Governments are deciding their policies (tax exemption, CSR, EPR) as per achieving the zero-waste concept. Circular economy which emphasizes on increasing the product life, is one of the measure initiatives which can lead to protection of natural resources and making them available for future generations. Present chapter discuss on the key concept and principles of circular economy along with the challenges in its implementation also discussed in detail. It also talks about the India's efforts (both government initiative and startups) in achieving the zero-waste goal through circular economy.

Keywords: circular economy, sustainable development, startups, product life.

Introduction:

When it concerns with the conservation of resources available in environment, two main terms come into mind which are

1.Circular Economy

2.Green Economy

Both works in the direction of saving resources. On one hand circular economy forces on reducing the waste and improving the life cycle of different products and on the other hand green economy enforces the use of biodegradable products. Thus both intended in the direction of sustainable development and make resources in reach for future generations.

Circular Economy:

At present, as the paying capacity of human beings has increased, people are not that sincere about reusing the concept of materials which was rooted in Indian culture.
Now, the linear economy concept is becoming prevalent which can be defined as produce, use and dispose of the materials. It leads to generation of more waste and thus polluted. Circular economy term is of immense importance for being future oriented in all domains of life. Not only industries but people also practiced this concept for better tomorrow.

"When materials are designed and produced in a manner that can be reused again and again with some modifications and have a long product life generating a minimum amount of waste or zero waste. Economy promoting such types of materials for achieving sustainable goals is defined as a Circular economy."

As per Walter Stahel (1970) who is the Father of circular economy, product life

enhancement ultimately serves in the direction of circular economy.[1]

Principle of Circular Economy:

1. Don't over-purchase products.
2. Think before generating waste.
3. To make optimum use of products.
4. To repair the products as far as possible.
5. To minimize the waste
6. To recycle and redesign the waste and convert it into other useful products.
7. To remove products harmful for the environment.

Challenges of Circular Economy:

1. Lack of expected quality in recycled products
2. Lack of professionals in the field
3. Lack of interest of Supplier
4. Lack of government support
5. Lack of customer enthusiasm
6. Uncertainties in the recycled end products
7. Overpricing of recycled /redesigned products
8. Lack of Availability of secondary materials than raw one
9. Lack of public awareness
10. Unsystematic Urbanization

Ways to promote Circular Economy:

1.Incentives and subsidies from Government

Companies need to be supported by the government in the form of subsidies and incentives for their work. In country like India, section 80jjA of income tax allow a 100% tax exemption on profit for initial 5 years. MoEFCC and MoHUA supports financially to those who are involved in sustainable practices of waste management. State governments are also providing subsidies on bill of electricity consumption, land for sustainable practices on lower rate etc. Also, relaxation on custom duty and Good and service tax (GST) also reduced considerably.[2]

2.Reorient customer towards recycled products

As the per capita income is raised, people are more attracted towards new and luxurious products. So many products are not of their need but over purchasing pile up the products and ultimately leads to generation of waste. So there is a strong urge to reorient customers towards the necessity of recycled products.

3.Strengthening the components of Supply chain

Supply chain sustainability is very much affected by Digital transformation. Now with the help of AI and ML it is possible to estimate the risk and gain involved in product life cycle. This is helpful in minimizing losses and thus serving towards circular economy.[3]

4.Corporate social responsibility CSR

In India, as per company act 2013, CSR is mandatory it Encourages corporate to enhance and better product with redesign and reuse concepts. Many firms like

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Reliance, TCS, HUL, Adani enterprises Ltd, Infosys etc. are actively engaged in working towards the CSR.[4]

5.Promoting studies on purchasing behavior of customer

Buying behavior is a measurable factor in deciding the recycled product. Thus, studies like survey, interview, group discussion, open forum must be encouraged in hybrid mode so that product could be redesigned in an optimum manner.

6.Promotion of research and innovation in the direction of recycling of products.

New and advanced technology should be encouraged so that recycled products improvise regularly(Patwardhan & Kokane, 2022). ICWMR (India) works in association with TERI and IPCA with four thrust areas such as ASSESS, Skills, STRIDE, CAP. [5] BARC also has a dedicated unit for the same. Moving on the same path LARPM Bhubaneshwar developed four types of materials through e waste which are durable for about 5-10 years.[6][7]

7.Building adequate information network

Lack of information kills the biggest and best ideas so a transparent and accountable information network must be developed for those who are involved in different steps of circular economy concepts like scrap collection unit, transportation unit, segregation unit, Resource recovery unit, production unit, Marketing unit, R&D unit etc.

8.Collaboration among government, industries and customers

Many good policies have been developed before but in absence of proper communication among units which make and implement decisions, with whom decisions is being practiced, all the efforts are waste of resources. Isolation among stakeholders should be removed. As now humans have to woke up from deep sleep as no more time has left. Humans have to unite up to save the resources.

9. Promoting Minimalist way of living

Our Indian culture advocates to use resources as per need. Any misuse of resources is always assumed as a misconduct. Many people across the globe are preferring minimalist approach for a peaceful life and saving the resources for future generations(Patwardhan & Kokane, 2022).

World efforts:

In 2015, the COP21 decided to work on Paris Agreement (195 countries) which urges not to raise the

In 2022, the COP27 took place in Egypt and took important decisions regarding climate change and ensuring mother Earth clean. On the world platform mission Life was started by Indian prime minister Shri Narendra Modi.194 nations.[8]

India's efforts:

NITI Ayog formulated CE cell CSIR - Indian institute of Petroleum (Dehradun) has developed a RUCO van which converts used cooking oil into biofuels.

CSIR- Central Road research institute has prepared roads using waste obtained from steel industries.[9]

Startups like Namo e-waste (New Delhi) are working in the direction of

recycling and redesigning of collected e waste like old mobiles, PCs, laptops etc. [10] Anthill creation (Banglore) worked in the same path but different segments of the economy by recycling and reusing tyres and making playgrounds in the city.[11] Kabadiwala (Bhopal)) manages a network of kabadiwala and provides pick up services to collect their scrap in 40 categories and thus contributing towards the circular economy concept effectively.[12]

Conclusion:

As Resources are limited, it is necessary to work with them efficiently and effectively. A proper value chain network of producers, manufacturer, supplier, user, scrap collection agencies and recycling firms is necessary to move in the direction of gaining sustainable development goals of zero carbon emissions by 2050.Circular economy promotes reuse of the products, recycle the waste products and redesign the scrap for another useful work. This concept can be achieved through proper intervention of government and also with the active support of public. Thus, collaborative work among different stakeholders is the need of hour. Such type of efforts indeed lead to greener and prosperous tomorrow and save the mother Earth.

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Biodiversity of Fishes in Kanpur

Dr. Anupam Dubey

Dr. Shalini Shukla

** D.G. College, Kanpur.

Email: shalinishukla343@gmail.com

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Abstract:

Kanpur, a bustling city situated on the banks of the Ganges River, has amassed a diverse collection of aquatic fish species. This abstract delves into the intricate web of ecological interactions and conservation challenges surrounding the fishes of Kanpur. Through a thorough research spanning a lot of months and review of existing literature, this study will bring to light the remarkable richness and distribution patterns of fishes inhabiting Kanpur's aquatic ecosystems. Despite their ecological significance, Kanpur's fish populations face multifaceted threats including habitat degradation, pollution and over fishing, thus the result ie. the risk of species declines and loss. This abstract underscore the urgency of conservation efforts, advocating for the safe management strategies that prioritize habitat restoration, pollution control, and sustainable fisheries practices. By combining scientific research with community engagement and policy interventions, we can endeavor towards safeguarding the invaluable biodiversity of fishes in Kanpur for generations to come.

Keywords: Diversity, Ganga River, Population

Introduction:

Kanpur, a lively city located in the northern state of Uttar Pradesh, India, is famous and revered for its advancement in leather industries. Apart from that, it is also known for its rich biodiversity in the aquatic regions. Being located along the banks of the holy river Ganges, Kanpur teems with a diverse array of fish species which add to the region's heritage and ecosystem.

In this chapter, we will learn and explore the variety of fish species that inhabit the waters of the bustling city of Kanpur.

1. The Ganges River: Lifeline of Biodiversity

- The Ganges River, also known as the holy river and worshipped by the people of India as their mother, is also the mother of Kanpur's aquatic ecosystem.
- The river's vast expanse and the associated water bodies, including lakes and smaller tributaries, offer a conducive habitat for a wide range of aquatic species.
- Its waters inhabit a multitude of fish species, each playing a vital role in the river's ecosystem. Some of the notable fish families found in this region include Cyprinidae (carps), Bagridae (catfishes), and Clupeidae (herrings and relatives).
- Cyprinidae: This family is prominent in Kanpur's waters, with species like the Rohu (Labeo rohita) and the Catla (Catla catla) being particularly prominent. These fishes

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are not only ecologically significant but are also vital for local fisheries and aquaculture.

- Rohu (Labeo rohita): considered to be an everyday meal in the diets of many locals , the Rohu is a commercially valuable fish that is priced for its deliciopus taste and nutritional value . it thrives in slow moving waters of the Ganges River and is known for its resilience.
- Catla (Catla catla): Another prized species , the Catla is known for its beautiful , silver – coloured body and deeply forked tail . It is particularly found in the deeper parts of the river. alongside Rohu, the Catla forms the backbone of the local fishing industry.
- Mrigal (Cirrhinus mrigala): This species of fish is recognized by its distinctive carp – like shape and elongated dorsal fin. it is a common sight in the rivers and ponds of Kanpur. It is priced both for its meat, aswell as its ability to control aquatic vegetation, which makes it a prime candidate for aquaculture.
- Mahseer (Tor spp.): This species is nicknamed as "the tiger of the river", and is a prized game fish thriving in the rivers of Kanpur. It is especially known for its strength and resilience.

Clupidae species:

Hilsa (Tenualosa Ilisha): This species of fish is also referred to as "the queen of fishes". It migrates upstream from the Bay of Bengal to the rivers in Kanpur. Since it migrates annually, its migration is celebrated by local communities.

Ecological Roles and Importance:

The fish species in Kanpur play extremely pivotal roles in maintaining the health and balance of the aquatic ecosystem. They serve in nutrient cycling, sediment redistribution, and serve as prey for a variety of predators, including birds, mammals, and larger fish. Also, they are an integral part of the local communities' livelihoods, providing food, employment, and recreational opportunities. All in all, they provide sustainability to the local communities and maintain aquatic equilibrium.

Threats to Fish Biodiversity:

The rich aquatic biodiversity of Kanpur is unfortunately, under siege. This is due to the arious anthropogenic activities. Pollution from industrial discharges, untreated sewage, and agricultural runoff has severely degraded water quality, impacting fish health and habitats. Overfishing and habitat destruction, including riverbank erosion and the construction of barriers that block migration routes, further contribute to the situation. Climate change also poses a looming threat, altering water temperatures and flow patterns, which can disrupt breeding cycles and distribution patterns of fish species.

Endangered Species and Conservation Efforts:

Despite the abundance of fish fauna in Kanpur's waters, several species are faced with the threat of extinction due to habitat degradation, pollution and even overfishing.

A few endangered species are:

Gangetic Dolphin (Platanista gangetica): Even though it is not a fish, the Gangetica Dolphin serves the role of an indicator of the health of the Ganges ecosystem. Pollution and habitat loss has severely impacted its population, so much so that this

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species is now in the category of Endangered.

Indian Soft-shelled Turtle (Nilssonia gangetica): Another inhabitant of the Ganges, The Indian Soft-shelled Turtle is prized for its meat and shell, that leads to overexploitation. Conservation efforts are underway to prevent its extinction.

Recognizing the critical state of Kanpur's aquatic ecosystems, several conservation initiatives have been undertaken. These include efforts to improve water quality through the treatment of industrial and domestic wastewater, habitat restoration projects, aswell as the implementation of sustainable fishing practices to prevent overexploitation. Community engagement and awareness programs are also crucial in fostering a sense of stewardship among local populations.

Conclusion:

The biodiversity of fishes in Kanpur is a testament to the ecological richness of the Ganga River. It underscores the importance of concerted conservation efforts to safeguard this diversity against the backdrop of environmental challenges. As we move forward, a balanced approach that combines scientific research, policy implementation, and community participation will be paramount in preserving the aquatic heritage of Kanpur for future generations.

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Introduction of Carbohydrates

Mr. Bhau A. Bulakhe
Dr. Kiran D. Dhawale
Maharaja Jivajirao Shinde Mahavidyalaya Shrigonda [MS], India
Email: bhaubulakhens@gmail.com

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Abstract:

Carbohydrates are widely distributed in plant and animal tissues. Carbohydrates have taken a lot of heat in body Carbohydrates are most important and readily available source of energy. It is a part of a healthy diet for both kids and adults. Carbohydrates may also include their derivatives which produce such compounds on hydrolysis. They are the most abundant organic molecules in nature and are also referred to as "saccharides". The carbohydrates which are soluble in water and sweet in taste are called "sugars". The carbohydrates can be structurally represented as Open chain structure. Hemi-acetal structure. Haworth structure.

Keywords: Cabohydrates, Hawarth Formula, Isomer of carbohydrate, Killani-Fischer reaction, Wohl's reaction.

Introduction:

Carbohydrates are the main source of energy for human body. Most abundant constituent of plants and animals. In Plants the produce by Photosynthesis in presence of chlorophyll. Carbohydrates are biomolecules which are essential for all living organism for various processes. Carbohydrates are also called saccharides (Greek: Sakcharon means sugar). Carbohydrates are classified as monosaccharides, disaccharides, oligosaccharides, polysaccharides. Monosaccharides cannot be hydrolyzed further into simpler form. Disaccharides give two monosaccharides on hydrolysis. The Common Examples of carbohydrate are Glucose, Sucrose or Table sugar, Lactose, Starch, and Cellulose etc. Carbohydrates are polyhydroxy aldehyde or polyhydroxy ketone, or the substances which on hydrolysis give a polyhydroxy aldehyde or polyhydroxy ketone.

Classification:

Classified on basis of:

a) Crystalline or Amorphous
b) Number of carbon atoms.
c) Presence of aldehyde or Ketonic Group.
d) Hydrolysable or Nonhydrolyzable property.
e) Solubility of water.

2.2 Three Major Class

1. Monosaccharide
2. Oligosaccharide
3. Polysaccharide

Monosaccharide:

A carbohydrate that cannot be hydrolyzed to a simpler carbohydrate.

a) They are Crystalline

b) sweet taste

c) Soluble in water

d) Basic unit of carbohydrates

They have the general formula $\mathbf{C_nH_{2n}O_{n,}}$ where n varies from 3 to 7. Monosaccharide is classified by their number of carbon atoms

a) Ketose: a monosaccharide containing a ketone group e.g Fructose

b) Aldose: a monosaccharide containing an aldehyde group. E.g Glucose

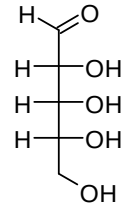
Carbon Atoms	General Term	Aldehyde	Ketone
3	Triose	Aldotriose	Ketotriose
4	Tetrose	Aldotetrose	Ketotetrose
5	Pentose	Aldopentose	Ketopentose
6	Hexose	Aldohexose	Ketohexose
7	Heptose	Aldoheptose	Ketoheptose

D- and L- enantiomers

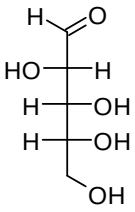
2.3 Types of Aldoses and Ketoses:

Aldopentoses

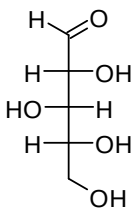
Aldopentoses: C_5, three chiral carbons, eight stereoisomers



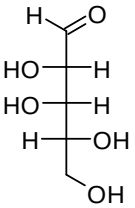
D-Ribose



D-Arabinose



D-Xylose



D-Lyxose

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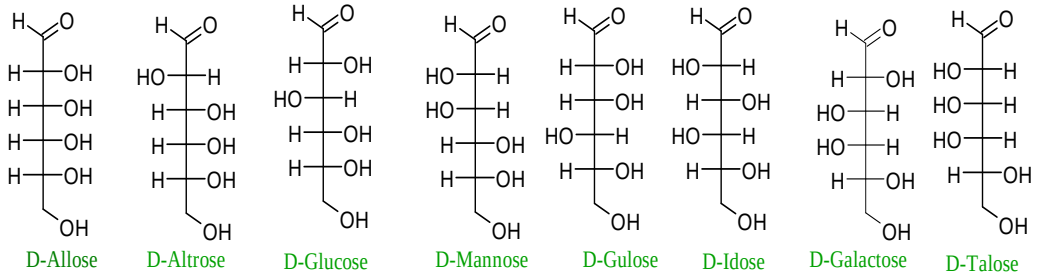
Aldohexoses: C_6, four chiral carbons, sixteen stereoisomers



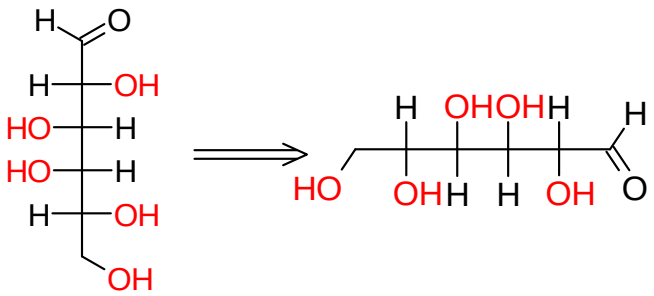
1. Guide to Drawing Haworth Structures:

Step-1 Turn the Fischer projection in clockwise by 90^0

Step-2 Fold the horizontal carbon chain in to a hexagon rotate the groups on carbon 5, and bond the oxygen on carbon 5 to carbon one

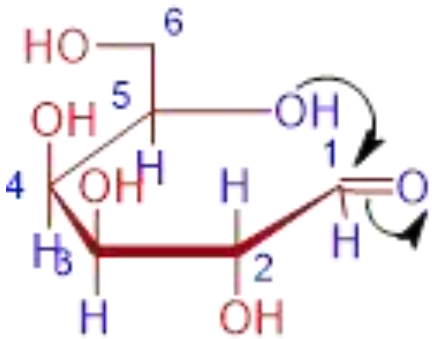
Step-3 Draw the new –OH group on carbon one below the ring to give the alpha anomer or above the ring to give the beta anomer

Fold the horizontal carbon chain into a hexagon, rotate the groups on carbon 5, and bond to the O on carbon 5 to carbon 1.



Place the carbon 6 group above the ring. Write the — OH group on carbon 2 below the ring and the — OH groups on carbon 3 and carbon 4 above the ring. The group on Right side in Fischer formula is drawn below the ring in Haworth formula and Left-hand side drawn on above the ring

α-D-Glucopyranose



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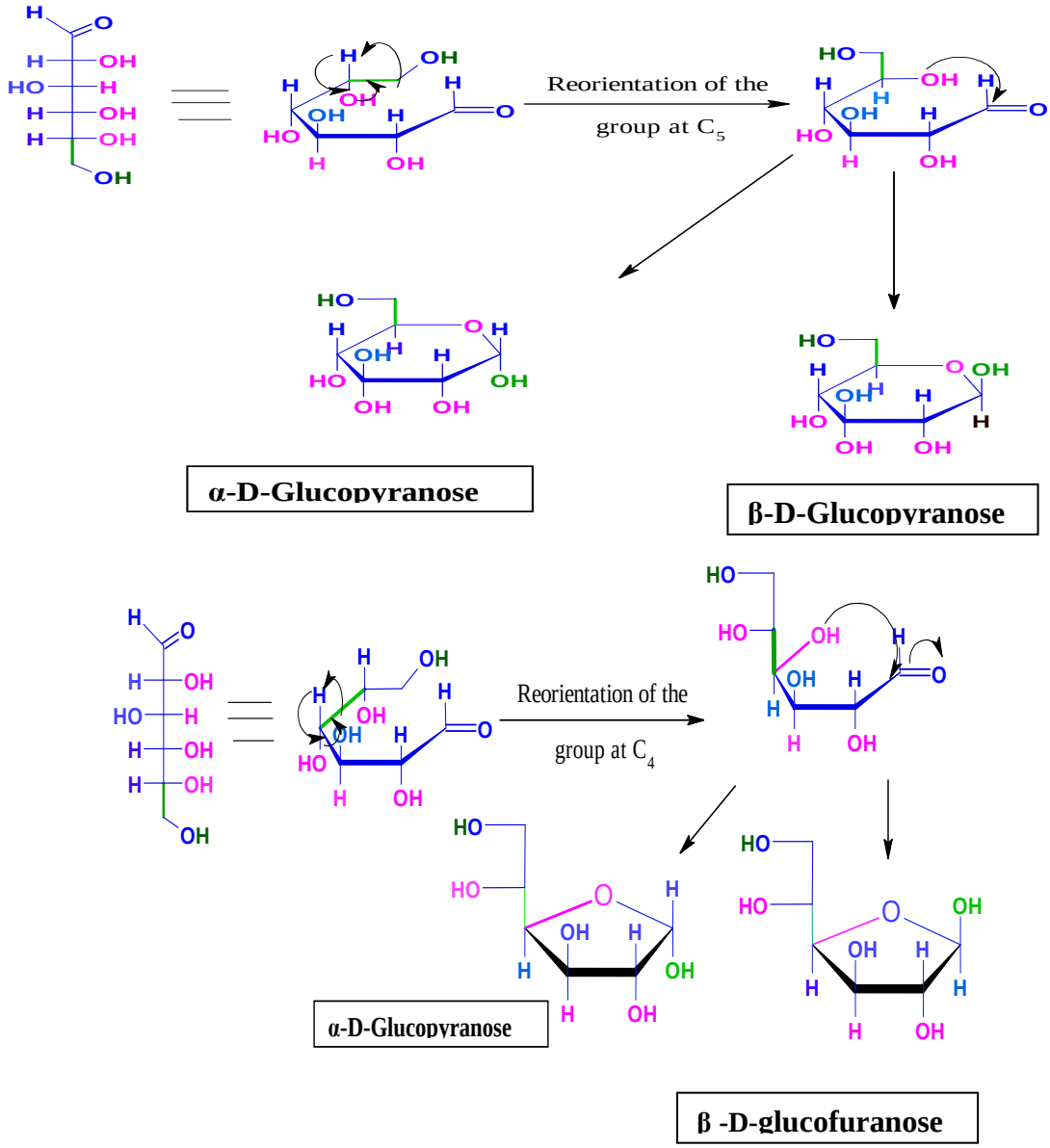
3.1 Haworth formula of D glucose:



3.2. Disaccharides:

1. The carbohydrate which on hydrolysis with acid or enzyme yields two molecules of monosaccharide is called disaccharide.
2. Non reducing: The linkage of two monosaccharide through their reducing group resultant saccharide is disaccharide. E.g. Sucrose

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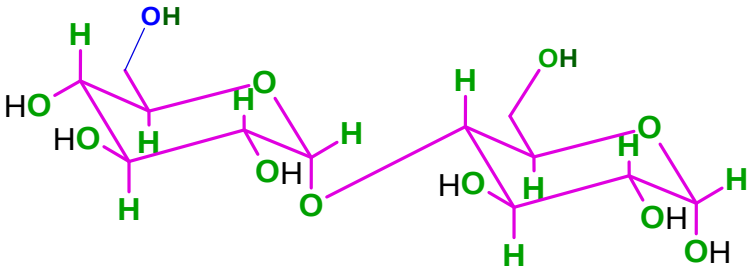
3. Reducing: The linkage of two monosaccharide through their reducing group of one monosaccharide with non-reducing of other the resultant saccharide is reducing. E.g. Maltose
4. Structure of Sucrose: Sucrose obtained from sugarcane, beetroots etc.

Maltose:

1. It is a reducing sugar.
2. It reacts with phenyl hydrazine gives osazone.
3. It reduces by tollen's and Fehling solution.
4. It shows mutarotation.
5. Osazone of maltose has only two phenyl hydrazine used.
6. It concludes that contains only one free carbonyl group.



2. Evidence and defects of open chain structure of monosaccharide

Polyhydroxy Aldehyde

a) Glucose does not form bisulphite compounds.
b) It does not give colour of Schiff's reagent.
c) Glucose shows mutarotation i.e. exist in two isomeric forms.
d) Normal aldehyde reacts with two moles of methanol to form

Polyhydroxy Ketone:

a) Fructose does not form Bisulphite compound.
b) It Shows Mutarotation to formed two isomeric structures does not show open chain structure.
c) Monomethyl glycoside and fructosides do not exhibit the phenomenon of mutarotation.
d) Normally Ketone react with two moles of methanol to give a ketal but fructose react with one mole hence cannot explain open chain structure.

3. Important terms:

Enantiomers: The isomers which are non-superimposable mirror image of each other is called enantiomers.

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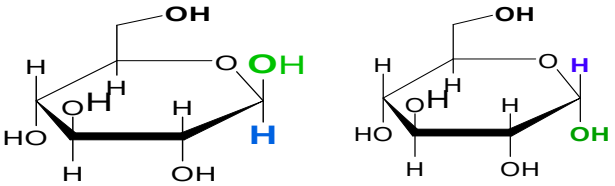
Disteriomers: The isomer in which are not mirror image of each other or they differ of specific rotation or direction or both.

Anomers: The stereoisomer of mono0saccharide which differ in the configuration only at anomeric carbon atom are called anomers.

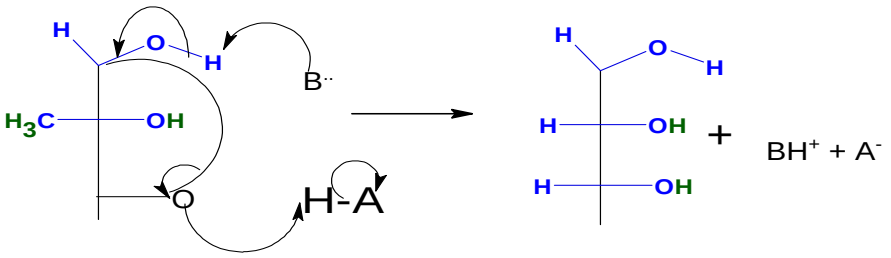
Anomeric carbon: The formation of ring structure in monosaccharide creats a new chiral center of asymmetric carbonyl carbon is called anomeric carbon.



Mutarotation of glucose

The change in specific rotation of a carbohydrate in aqueous solution without any other change in the properties is known as mutarotation.

1. When monosaccharide dissolved in water the optical power of the solution gradually changes.
2. It reaches to constant value.
3. E.g. When freshly prepared aqueous solution of glucose crystallization with Water or ethanol below 50 ^{0}C has specific rotation +112^0 and this solution allowed to stand the rotation fall to +52.5^0 which remains constant. Same like crystallization in hot pyridine or hot water is +19^0 but on standing to obtained +52.5^0 which is constant. According to Lowry in 1925 mutarotation takes place only in amphiprotic solvent.
4. Mutarotation is arrested in pyridine and cresol solution i.e. mixture of pyridine and cresol solution.
5. In mutarotation ring opening and closing in inverted position.
6. It has been suggest that open chain form occurs by simultaneous addition and elimination of a proton hence both acid and base must be present.
7. The ring opening takes place through protonation and deprotonation.
8. Ring closure take place similar mechanism the other anomer formed.
9. It will have constant value.



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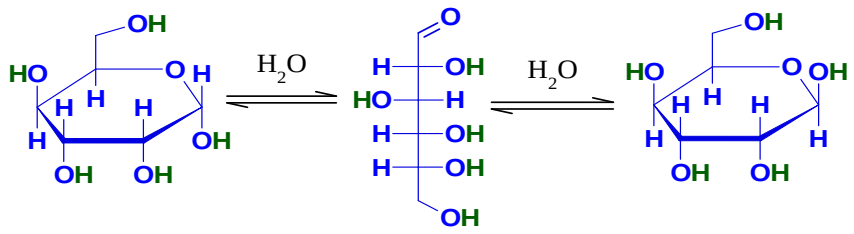
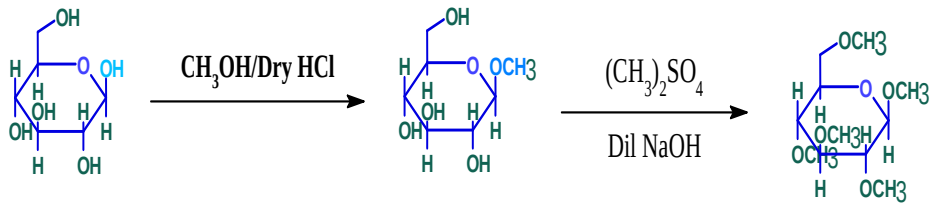


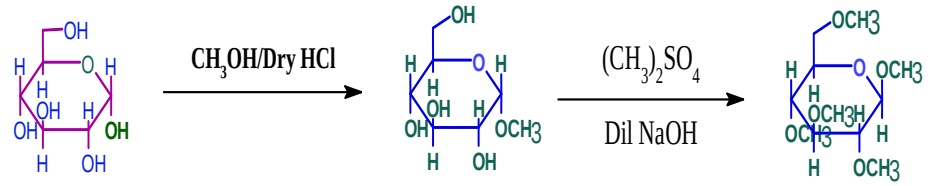
[α] = +112⁰ **[α] = +19⁰**

α -D-Gucopyranose **Open chain structure** **β-D-Glucopyranose**

1. Reactions with carbohydrates:

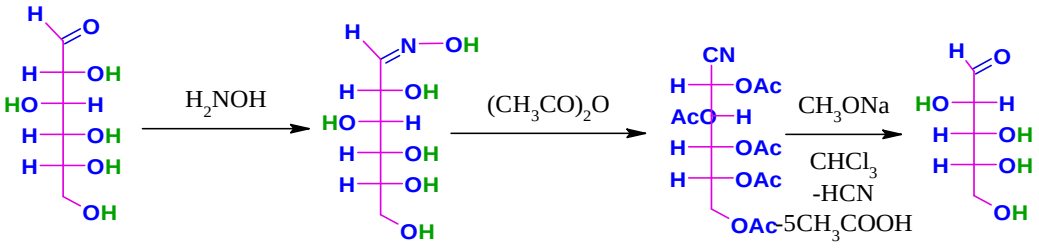
1.1 Methylation of Glucose





7.2 Wohl's Method

It is a method the converting an aldose into a lower aldose. D-glucose is first converted in to an oxime which then treat with acetic anhydride when dehydration and acetylation take place giving penta acetyl cyanide. This on treatment with sodium meth oxide in chloroform or ammonical silver nitrate get deacetylated, at the same time a molecule of hydrogen cyanide removed in the formation of D-arabinose



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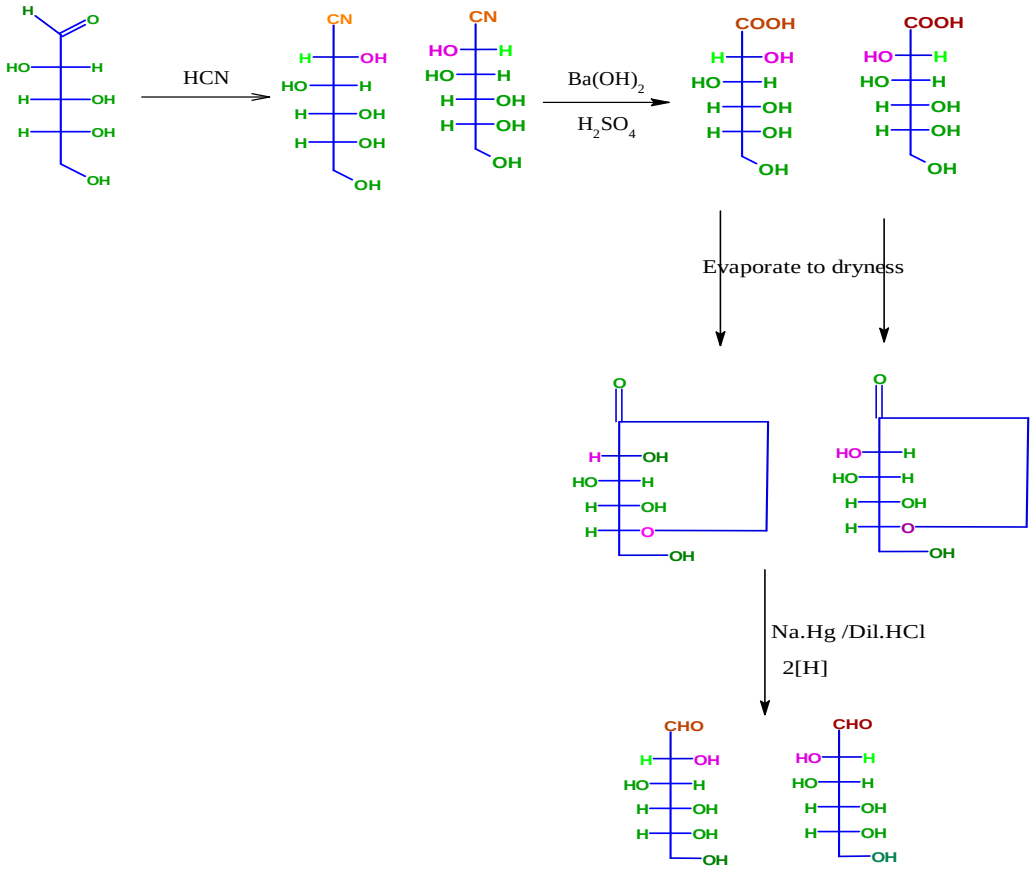
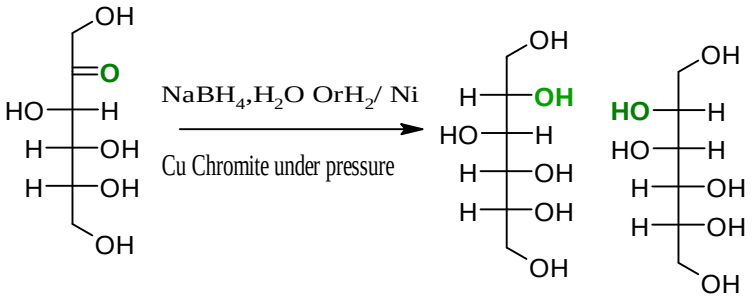
7.3 Killani-Fischer Synthesis:

It is a method converting aldose in to aldose containing one more carbon atom. In 1886 Heinrich Kiliani Showed that aldose can be converted in to two isomeric compounds. Containing one more carbon. *The entire method of converting an aldose in to two higher aldoses is known as Killani-Fischer synthesis.* Addition of hydrogen cyanide to arabinose gives two distriomeric cyanohydrins to generate new asymmetric center. this mixture on hydrolysis gives two aldonic acids. Then lactone is reduced with sodium amalgam and dilute sulphuric acid to get respective aldohexose.



7.4 Reduction of fructose



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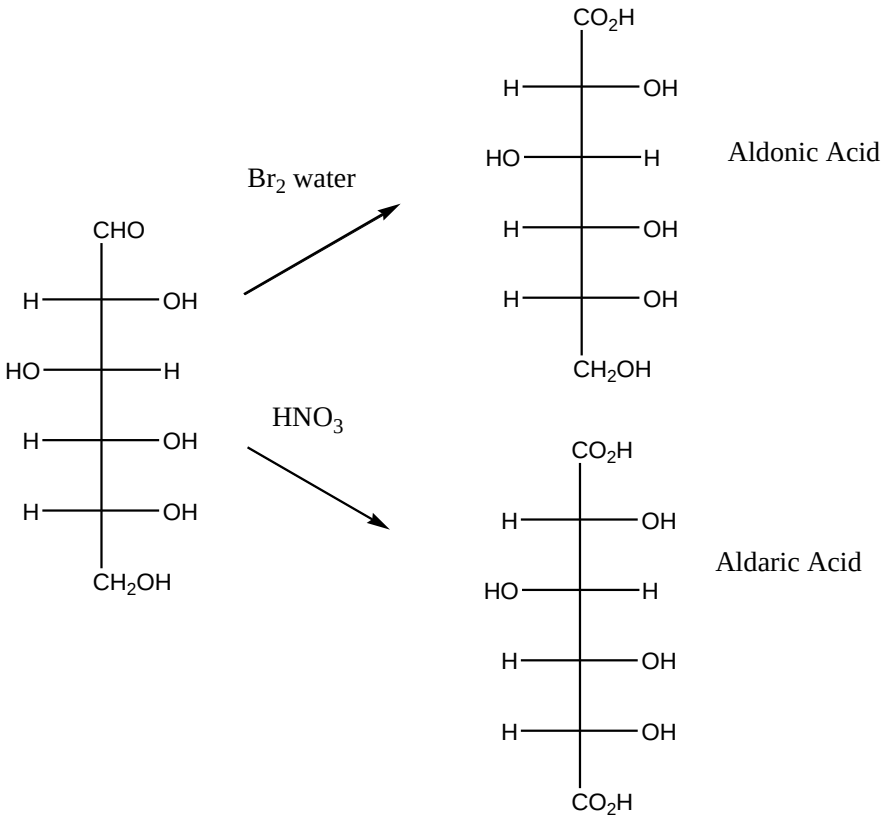
7.5 Oxidation of glucose:



Reference Book:

1. Essential Molecules of Life. Book • Second Edition • 2009. Authors: Robert V. Stick and Spencer J. Williams
2. Carbohydrate Metabolism in Rats with Adrenocortical Transplants book ... Philip Morrison 1904- Richardson.
3. Carbohydrates: the Essential Molecules of Life by Robert Stick and Spencer J. Williams

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Music Therapy: Healing Power of Music

Nikita Katiyar
Kalpana Singh
Bio-musicology Research Laboratory,
Department of Zoology, University of Lucknow,
Lucknow- 226007, UP (INDIA)
Email: biomusicology.india@gmail.com

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Abstract:

Music is generally defined as the art of arranging different sound to create a combination of form, melody and rhythm. In the domain of holistic health and well-being, one remarkable tool has continually proven its efficacy in promoting physical, emotional, and mental wellness is music therapy. Music therapy is nowadays popular among the society of people who are conscious for their mental and physical health. The power of music to heal, soothe, and inspire has been recognized for centuries, and in recent years, it has gained increasing prominence in the field of complementary medicine. In this chapter, we will see the transformative world of music therapy, exploring its effect and different ways it contributes to overall health and wellness.

Key Words: Music Therapy, Bio-Musicology, Zoo-Musicology, Stress Management, Health & Wellness

Introduction:

Modern life style and dietry choices in today's era are the main causes for the increment of diseases like cardiovascular, type 2 diabetes, hypertension, sleep-apnea and some types of cancer (Senapati *et al*., 2015). Some non-communicable diseases like obesity are the leading risk factor globally in terms of accountable deaths. Nowadays, life style disorders are becoming more common, affecting younger as well as older population, especially in urban areas (WHO, 2011). Lack of physical activity in a day-to-day life is one of the leading causes of physiologically stressed lifestyle results in increased levels of risk factors like high blood pressure (hypertension), dyslipidemia (abnormal amount of lipids mainly cholesterol or fats in the blood), diabetes (high blood glucose), respiratory diseases which acts parallel and in a synergistic manner on the various body metabolic pathways (Senapati *et al*., 2015). It is said that the diet-related key changes in the developmental process of an organism include an increased production of reactive oxygen species as well as an oxidative stress. The organism suffering from stress usually responds with the variety of changes like behavioral, biological and cognitive changes (Nagaraja *et al*., 2006) and among them stress is one of them. Stress is a state of the disturbed homeostasis results in increased catecholamines and glucocorticoids due to the activation of sympathoadrenal and hypothalamic-pituitary-adrenal (HPA) axes (Kaltsas & Chrousos, 2007). The sympathetic adrenomedullary (SAM) system and hypothalamic pituitary adrenal/interenal axis

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(HPA/HPI) are the two key players in the stress responses of the vertebrate (Chrousos and Gold, 1992). The key players mobilize energy to fight with immediate danger, aided for the redistribution of the oxygen and other nutrients to the active organ and tissues and changes behavior accordingly, eg., increased escape behavior and decreased foraging (Koolhaas *et al.*, 2011; Sapolsky *et al*., 2000). The degeneration of neurons caused by the hormone glucocorticoid under stressful condition has been also observed, that may be linked to an increase in the generation of reactive oxygen species (ROS), which can directly damage cellular proteins of the body i.e., DNA and lipids. Stress as a marker for animal's health and well-being is a focus of many studies. Since the physiology of animal's express response to the stressor by the enhancement of their glucocorticoid levels, that's why there has been much interest of the researcher in measuring these hormones (Terlouw, 2015) and the glucocorticoid response also helps individuals in future stressor encounters by memorizing the stressful circumstances and responses (Taborsky *et al*., 2022).

One of the major risk factors for cardiovascular diseases and cerebral diseases is hypertension due to the increased stress and blood pressure (Mc Gill *et al*., 2001). Several studies have indicated that music therapy may affect cardiovascular health; in particular, it may bring positive changes in blood pressure levels and heart rate, thereby improving the overall quality of life. Hence to regulate physiology of the body, music therapy may be regarded as significant complementary and alternative medicine (Chatterjee and Mukherjee, 2020).

Music, a universal language that transcends borders, has been an integral part of human culture since long. It has the power to evoke emotions, stimulate memories, and inspire creativity but beyond its aesthetic and entertainment value, music also possesses therapeutic potential (Sarkar and Biswas, 2015). This chapter delves into the world of music therapy, exploring how it has emerged as a valuable tool for enhancing wellness and promoting good health. Indian music consist emotions and its complexity provide specific therapeutic essence (Hedge, 2017). We can realize that in case of Indian music qualitative effect is more accepted and experienced instead of quantitative measurable outcomes. But for the evidence-based music therapy we need some quantitative research. Music therapy is a structured, evidence-based practice that utilizes music to address physical, emotional, cognitive, and social needs. It involves the use of music interventions in a therapeutic context, guided by trained and certified music therapists. These professionals assess an individual's needs and create customized music-based experiences to achieve specific therapeutic goals.

Power of music:

The healing power of music has been recognized for centuries, with historical records dating back to ancient civilizations such as the Greeks and Egyptians. Today, modern science supports the notion that music can have a profound impact on both mental and physical health. Music therapy is based on the idea that music can serve as a powerful medium to achieve therapeutic goals. It is conducted by trained and certified music therapists who possess a deep understanding of both music and psychology. Music

listening and music making have played a huge role in treating disorders of mind and body, that can be seen in throughout history.

In the year 2008, Dr. Teppo Sarkoma, Associate Professor, University of Helsinki did a study on those patients who were suffering from a stroke in the middle cerebral artery of one hemisphere of the brain. Those patients were exposed to the music therapy (slow tuned western music) for two months. After the treatment those patients exhibited the greatest recovery in verbal memory and attentions as compared to the patients who were not exposed to music.

1. Stress Reduction and Relaxation:

Stress arises as a natural human response, urging us to tackle the difficult tasks, challenges and threats that we encounter in our life. According to the report of world health organization (WHO) at 21st February, 2023 Stress affects both the mind and our body. A little bit stress exerts positive pressure on us to perform daily activities but longer time stress can cause physical and mental health problems. One of the most significant benefits of music therapy is its ability to reduce stress and promote relaxation. As per Sandstrom and Russo (2010) the music i.e., high in valency and low in arousal affects positively in the recovery of the heart rate and skin conductance levels after giving stress. Listening to calming music can lower cortisol levels, decrease heart rate, and induce a sense of calm. Many experimental research suggests that the context of music listening is highly artificial so it might be more effective and ecologically valid to do experimental study on music therapy in people's natural habitat (North et al., 2004; Van Goethem and Sloboda, 2011). Music therapists often use techniques such as guided imagery and progressive muscle relaxation paired with soothing melodies to help clients manage stress.

2. Cognitive Enhancement:

Music therapy can be particularly effective for individuals with cognitive impairments, such as those with Alzheimer's disease or traumatic brain injuries. Music has the power to stimulate cognitive functions, improve memory, and enhance overall cognitive abilities. Therapists use techniques like rhythmic auditory stimulation to engage clients in activities that promote cognitive skills (Attouiet al., (2015).

3. Emotional Expression and Regulation:

Music provides a safe and non-verbal outlet for expressing emotions. For individuals who struggle to communicate their feelings verbally, music therapy can be a valuable tool. Through playing instruments, writing songs, or simply listening to music, clients can process and regulate their emotions effectively (Chen et al., 2021).

4. Pain Management:

Music has been shown to reduce the perception of pain and discomfort. It distracts individuals from their pain, triggers the release of endorphins, and can even lead to reduced reliance on pain medications. In clinical settings, music therapy is integrated into pain management programs to improve patient comfort (Exbrayat and Brun, 2019).

5. Social Connection:

Group music therapy sessions can foster a sense of community and social

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connection. Sharing the experience of making music together promotes social interaction and communication, which can be especially beneficial for individuals with autism spectrum disorders or social anxiety (Nayaket al., 2020).

Discussion:

As our understanding of the mind-body connection deepens, the role of music therapy in promoting wellness and good health is likely to expand. Advances in neuroscience and technology will continue to shed light on how music affects the brain and body, leading to more targeted and effective interventions. In conclusion, music therapy stands as a remarkable boon for wellness and good health, harnessing the age-old power of music to heal, restore, and elevate the human experience (Papadakakis et al., 2019). Its holistic approach, individualized treatments, and versatility make it a valuable addition to the toolkit of healthcare professionals, enriching the lives of countless individuals on their journey to well-being. With its rich history and promising future, music therapy continues to harmonize the worlds of art and science, proving that the universal language of music can indeed heal the soul. As we move forward, it is essential to recognize and celebrate the potential of music therapy as a transformative force for holistic health, a testament to the enduring connection between music and the human spirit (Stefani and Biasutti, 2016).

Humans and animals both possess the capability to perceive a broad spectrum of sound frequencies. Prolonged exposure to loud noises can result in various consequences. A prevalent response is the disruption of ongoing activities and a degradation of the environmental quality. Impairment of the sense of hearing hinders the ability of both humans and animals to thrive in their respective habitats (Masterton *et al*., 1969). Noise is defined as sound that is undesirable, whether it occurs continuously or sporadically. It can be characterized by factors such as its frequency, volume, frequency distribution, and the pattern of sound pressure over time (Burn, 2008).

Acknowledgement:

The Authors are grateful to University of Lucknow for providing infrastructural facilities.

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Silken Horizons: Pioneering Advances in Extensive Sericulture

Sunita Arya
Department of Zoology
Dayanand Girls P.G. College, Kanpur
Email: sunitaarya_kn15@csjmu.ac.in

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Abstract:

Sericulture, the art and science of rearing silkworms for the production of silk, has experienced remarkable advancements in recent years, particularly in the domain of extensive sericulture. This chapter provides an in-depth exploration of the latest innovations, techniques, and technologies that have revolutionized extensive sericulture practices. From improved mulberry cultivation methods to innovative pest and disease management strategies, this chapter delves into the cutting-edge developments that have enhanced the productivity, sustainability, and profitability of sericulture on a large scale.

Keywords: Agriculture, Pioneering Advances, Sericulture, Silk

1. Introduction

Definition of Extensive Sericulture:

Extensive sericulture refers to the large-scale cultivation of mulberry trees and rearing of silkworms for silk production, often involving mechanized processes and modern agricultural practices. Unlike traditional sericulture, which is characterized by small-scale, labor-intensive operations, extensive sericulture focuses on maximizing yields and efficiency through the application of advanced techniques and technologies.

Importance of Extensive Sericulture:

Extensive sericulture plays a crucial role in meeting the growing demand for silk on a global scale. With increasing consumer preference for sustainable and ethically produced textiles, there is a growing need for sericulture practices that prioritize efficiency, environmental stewardship, and animal welfare (Fred, et al. 2018). Extensive sericulture offers a pathway to achieving these goals by leveraging technological innovations and modern agricultural practices.

Overview of Traditional Sericulture Practices:

Traditional sericulture practices, characterized by manual labor and rudimentary techniques, have been the cornerstone of silk production for centuries. However, these practices are often inefficient, labor-intensive, and environmentally unsustainable. In contrast, extensive sericulture represents a paradigm shift towards modernization, mechanization, and sustainability in silk production.

2. Advances in Mulberry Cultivation

Introduction of High-Yielding Mulberry Varieties:

One of the key advancements in extensive sericulture is the development and introduction of high-yielding mulberry varieties. These varieties are specifically bred to produce larger leaves with higher nutritional content, thereby enhancing the growth and

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productivity of silkworms. By selecting mulberry varieties that are well-suited to local climatic conditions and soil types, sericulturists can optimize yields and minimize resource inputs. Mussrie, Dunda, Gangnani, Rampur, Joharji, Resham Majri-1, Resham Majri-8, s26 and Saraswati, etc. good genotypes of mulberry plants. (Beera, et al. 2011)

Adoption of Precision Agriculture Techniques:

Precision agriculture techniques, such as soil testing, nutrient management, and irrigation scheduling, have revolutionized mulberry cultivation in extensive sericulture. By utilizing data-driven approaches to optimize inputs and maximize yields, sericulturists can achieve higher levels of productivity while minimizing environmental impact. For example, precision irrigation systems can deliver water and nutrients directly to the root zone of mulberry plants, reducing water wastage and improving efficiency. (Sudhakar, Vijaya, et al. 2019)

Utilization of Organic Farming Practices:

In response to growing consumer demand for organic silk products, many sericulturists have embraced organic farming practices in mulberry cultivation. These practices eschew synthetic fertilizers, pesticides, and herbicides in favor of natural and sustainable alternatives. By adopting organic farming practices, sericulturists can minimize chemical residues in silk products, enhance soil health, and promote biodiversity on their farms. (Ercisli and Read 2001)

Integration of Mulberry Cultivation with Agroforestry Systems:

Another promising trend in extensive sericulture is the integration of mulberry cultivation with agroforestry systems. Agroforestry involves the simultaneous cultivation of trees, crops, and livestock on the same piece of land, promoting ecological resilience and enhancing productivity. By incorporating mulberry trees into agroforestry systems, sericulturists can diversify their income streams, improve soil fertility, and provide habitat for beneficial insects and wildlife (Arya 2018)

3. Sustainable Silkworm Rearing Practices

Development of Disease-Resistant Silkworm Breeds:

Disease outbreaks can decimate silkworm populations and devastate silk production. To address this challenge, researchers have developed disease-resistant silkworm breeds that exhibit enhanced immunity to common pathogens. By selectively breeding silkworms for disease resistance, sericulturists can mitigate the risk of disease outbreaks and improve the reliability of silk production.

Optimization of Feed Formulations for Improved Growth:

Nutrition plays a critical role in the growth and development of silkworms. To optimize silkworm growth and silk production, sericulturists have focused on developing and refining feed formulations that provide the optimal balance of nutrients. By incorporating ingredients such as mulberry leaves, soybean meal, and vitamins and minerals, sericulturists can ensure that silkworms receive the nutrition they need to thrive (Amalendu, Kunjupillai and Beera 2013).

Implementation of Eco-Friendly Rearing Methods:

In response to concerns about the environmental impact of sericulture, many

sericulturists have adopted eco-friendly rearing methods that minimize resource use and waste generation. These methods include the use of biodegradable bedding materials, recycling of silkworm waste as organic fertilizer, and the integration of natural predators to control pest populations. By prioritizing sustainability in silkworm rearing practices, sericulturists can reduce their ecological footprint and promote the long-term viability of silk production.

Automation and Mechanization of Silkworm Rearing Processes:

Advancements in automation and mechanization have transformed silkworm rearing processes, making them more efficient, cost-effective, and scalable. Automated systems for feeding, watering, and temperature control can significantly reduce labor requirements and improve productivity. Similarly, mechanized systems for cocoon harvesting and silk reeling enable sericulturists to process larger quantities of silk in less time, thereby increasing overall efficiency and profitability.

4. Innovative Pest and Disease Management

Biological Control Methods for Pest Management:

Conventional pest control methods, such as chemical pesticides, can have negative impacts on the environment and human health. To address this challenge, sericulturists have increasingly turned to biological control methods for pest management. These methods involve the use of natural enemies, such as parasitic wasps and predatory insects, to control pest populations. By harnessing the power of nature, sericulturists can effectively manage pest outbreaks while minimizing the use of synthetic chemicals (Chaudhary, Arya and Singh 2021).

Application of Pheromone Traps and Attractants:

Pheromone traps and attractants are another valuable tool in the sericulturist's arsenal for pest management. These devices emit synthetic pheromones that mimic those produced by female moths, thereby attracting male moths and disrupting their mating behavior. By strategically placing pheromone traps and attractants in and around mulberry plantations, sericulturists can reduce moth populations and minimize damage to silkworms and mulberry leaves.

Utilization of Microbial Pesticides:

Microbial pesticides, derived from naturally occurring microorganisms such as bacteria, fungi, and viruses, offer a safe and environmentally friendly alternative to chemical pesticides. These biopesticides target specific pests while minimizing harm to beneficial insects and other non-target organisms (Arya, Prakash and Dwivedi 2021). By incorporating microbial pesticides into their pest management strategies, sericulturists can effectively control pest populations while preserving ecosystem balance.

Integrated Pest Management Strategies:

Integrated pest management (IPM) is a holistic approach to pest management that combines multiple strategies, including biological control, cultural practices, and chemical interventions, to minimize pest damage while reducing reliance on synthetic pesticides. By integrating pest monitoring, pest forecasting, and targeted interventions, sericulturists can optimize pest management efforts and minimize environmental impact

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(Arya and Dubey 2013).

5. Enhancements in Silk Processing

1. Cocoon of tussar silk and its reeling process

Introduction of Eco-Friendly Degumming Techniques:

Degumming is the process of removing sericin, a natural protein found in silk fibers, to improve the luster, texture, and dyeability of the silk. Traditional degumming methods involve the use of harsh chemicals, such as sodium carbonate and soap, which can have negative environmental consequences. In response to these concerns, researchers have developed eco-friendly degumming techniques that utilize enzymatic or microbial agents to break down sericin without the need for harsh chemicals. These techniques not only reduce environmental impact but also produce silk with superior quality and properties.

Automation of Silk Reeling Processes:

Silk reeling is the process of unwinding silk filaments from cocoons and winding them onto spools to form raw silk yarn. Traditionally, this process has been labor-intensive and time-consuming, requiring skilled workers to manually reel silk filaments from cocoons. However, advancements in automation technology have revolutionized silk reeling processes, enabling sericulturists to automate many aspects of the process, including cocoon boiling, filament unwinding, and yarn winding. Automated silk reeling systems are faster, more efficient, and less labor-intensive than traditional methods, resulting in higher productivity and lower production costs.

Innovation in Silk Dyeing and Finishing Methods:

Silk dyeing and finishing are critical steps in the production of high-quality silk products. Traditional dyeing methods involve the use of synthetic dyes and chemical additives, which can have negative environmental and health impacts. To address these concerns, researchers have developed innovative dyeing and finishing methods that utilize natural dyes, eco-friendly chemicals, and water-saving techniques. These methods not only reduce environmental impact but also produce silk with vibrant colors, soft textures, and superior performance characteristics.

Quality Control Measures for Ensuring Premium Silk Production:

Quality control is essential for ensuring that silk products meet the highest standards of quality, consistency, and performance. To achieve this goal, sericulturists implement rigorous quality control measures throughout the production process, from mulberry cultivation to silk processing. These measures include regular monitoring of silkworm health and productivity, testing of silk filaments for strength and purity, and inspection of finished silk products for defects and imperfections. By maintaining strict quality control standards, sericulturists can ensure that their silk products command a premium price in the marketplace and satisfy customer expectations for quality and performance.

6. Adoption of Digital Technologies

Implementation of Precision Farming Technologies:

Precision farming technologies, such as GPS-guided tractors, drones, and satellite imaging, enable sericulturists to optimize resource use, minimize waste, and maximize yields. These technologies provide real-time data on soil moisture, nutrient levels, pest infestations, and other key parameters, allowing sericulturists to make data-driven decisions about crop management practices. By harnessing the power of precision farming technologies, sericulturists can achieve higher levels of productivity, efficiency, and sustainability in mulberry cultivation and silkworm rearing.

Use of IoT Devices for Real-Time Monitoring:

The Internet of Things (IoT) revolutionizes sericulture by enabling real-time monitoring of environmental conditions, crop health, and production processes. IoT devices, such as sensors, cameras, and weather stations, collect data on temperature, humidity, light levels, and other variables, transmitting this data to cloud-based platforms for analysis and visualization. By accessing real-time insights into their operations, sericulturists can identify issues, optimize workflows, and make informed decisions to improve productivity and profitability.

Application of Drones for Crop Surveillance:

Drones are increasingly used in sericulture for crop surveillance, pest monitoring, and field mapping. Equipped with high-resolution cameras and sensors, drones can capture aerial imagery of mulberry plantations, enabling sericulturists to identify areas of stress, detect pest infestations, and assess crop health. By conducting regular drone flights over their fields, sericulturists can proactively manage issues, optimize inputs, and maximize yields (Sudhakar, Hanumantharayappa, et al. 2018).

Integration of Big Data Analytics for Decision Support:

Big data analytics harnesses the power of advanced algorithms and machine learning techniques to analyze large volumes of data and extract actionable insights. In sericulture, big data analytics can be used to analyze historical production data, weather patterns, market trends, and other factors to optimize decision-making processes. By leveraging big data analytics, sericulturists can identify patterns, trends, and opportunities that may not be apparent through traditional methods, enabling them to make more informed and strategic decisions.

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7. Market Trends and Economic Implications

Analysis of Global Silk Market Dynamics:

The global silk market is influenced by a variety of factors, including consumer preferences, fashion trends, economic conditions, and geopolitical events. Sericulturists must stay abreast of market trends and dynamics to remain competitive and profitable. Key trends in the global silk market include increasing demand for sustainable and ethically produced silk products, growing consumer interest in organic and natural fibers, and rising disposable incomes in emerging markets.

Impact of Extensive Sericulture Advancements on Silk Industry:

The advancements in extensive sericulture have had a transformative impact on the silk industry, driving improvements in productivity, quality, and sustainability. By adopting modern agricultural practices, leveraging technology, and prioritizing sustainability, sericulturists can enhance their competitiveness and profitability in the global marketplace. Additionally, extensive sericulture creates employment opportunities, stimulates economic development, and supports rural livelihoods in silk-producing regions.

Economic Benefits for Sericulture Practitioners:

Extensive sericulture offers numerous economic benefits for sericulture practitioners, including increased yields, reduced production costs, and higher returns on investment. By adopting advanced techniques and technologies, sericulture practitioners can improve their efficiency and profitability, enabling them to reinvest in their operations, expand their businesses, and improve their livelihoods. Moreover, extensive sericulture creates value-added opportunities downstream in the silk supply chain, such as silk processing, manufacturing, and retailing, further contributing to economic growth and development.

Challenges and Opportunities in Commercializing Extensive Sericulture:

While extensive sericulture offers significant opportunities for commercialization and growth, it also presents challenges and risks that must be addressed. These challenges include access to capital and credit, market volatility, competition from synthetic fibers, and regulatory barriers. Sericulture practitioners must navigate these challenges while capitalizing on opportunities to differentiate their products, expand into new markets, and create value for consumers.

8. Future Directions and Conclusion

Potential Areas for Further Research and Innovation:

Despite the considerable advancements in extensive sericulture, there are still many opportunities for further research and innovation. Key areas for future research include the development of drought-tolerant mulberry varieties, the optimization of silkworm feed formulations, the integration of renewable energy sources into sericulture operations, and the development of sustainable silk dyeing and finishing methods. By investing in research and innovation, sericulture practitioners can continue to improve their practices, enhance their competitiveness, and contribute to the sustainability of the silk industry.

Forecasts for the Future of Extensive Sericulture:

Looking ahead, the future of extensive sericulture appears bright, with continued growth, innovation, and sustainability. Advances in technology, coupled with changing consumer preferences and market dynamics, are driving the evolution of sericulture practices towards greater efficiency, productivity, and environmental responsibility. Sericulture practitioners who embrace these changes and adapt to emerging trends will be well-positioned to thrive in the global marketplace.

Summary of Key Advancements and Their Implications:

In summary, extensive sericulture has experienced significant advancements in recent years, driven by innovation, technology, and sustainability. From improved mulberry cultivation methods to innovative pest management strategies, these advancements have enhanced the productivity, quality, and sustainability of silk production. By embracing these advancements and continuing to invest in research and innovation, sericulture practitioners can build a more prosperous, resilient, and sustainable silk industry for future generations.

Call to Action for Continued Investment in Extensive Sericulture Research and Development:

In conclusion, extensive sericulture holds great promise as a sustainable and economically viable source of silk production. However, realizing this potential requires continued investment in research, development, and innovation. Governments, industry stakeholders, and research institutions must collaborate to support sericulture research and development efforts, promote technology transfer and adoption, and create an enabling environment for sericulture practitioners to thrive. By working together, we can unlock the full potential of extensive sericulture and build a more sustainable and prosperous future for the silk industry.

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A Review of Developments in The Study of Geography

Dr. Sadhana S. Khandar (Bhendkar)
Post Graduate Department of Geography
Government Vidarbha Institute of Science & Humanities, Amravati
Email: *sadhanakhandar@gmail.com*

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Abstract

Geography is a very ancient subject. Earth and various things on it have been studied in geography since ancient times. As it is related to the earth and various geographical discoveries on it, the curiosity of knowing the information of different things was in the minds of the geography scholars from long ago, so the knowledge of geography increased and the study of this subject became deeper. As a result, the definition of this subject has also changed since the beginning.

The present paper reviews the developments in the study of geography in the last few years.

Key Words: Geography, Development, Scope, Modern, Concepts

Introduction

Geography is a scientific subject. A coherent arrangement of knowledge is science. Science is the structured and systematic knowledge of natural phenomena through observation, experimentation, and observation. The discovery of the truth of the laws of nature is knowledge, and its coherent arrangement is science.

In order to organize the knowledge in a coherent way, this knowledge is divided into many branches of science that is why geography is considered as an advanced branch of science. And like any other subject, geography is an ancient subject. Listen, it's a matter of curiosity. Therefore, many scientists have tried to put their more fundamental emphasis on this in an attempt to satisfy the curiosity. Therefore, the horizons of geographical knowledge increased. In this subject you can learn this subject from very low level to high level.

Objective of the Study

The objectives of the present paper are as follows,

1. To discuss the modern and scientific nature of the geography
2. To discuss the development of Geography study in last few years

Data Source & Research Methodology

The present discussion is mainly based on the secondary source of data. The information required is collected from pre-published literature, including research reports, books and materials on the Internet. A newly presented paper is written in one's own words by reconstructing the information collected

Definition of Geography

The word Geography is made up of two words ‘Geo’ and ‘Graphy’. ‘Geo’ means Earth and ‘Graphy’ literally means description. Hence from this the science which

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describes the earth was first defined as related to geography. But many geographers seem to have different definitions of geography.

1) **Alexander von Humboldt: -** “Geography is the distribution of various inventions on earth and their interrelationship.”
2) **Ptolemy: -** "Geography is the places on earth and their relation to each other."
3) **Karl Ritter: -** "Geography is the branch of knowledge which studies the diversity of the earth's surface in relation to mankind."
4) **Richard Hartshorne: -** “Geography is the science of accurately, coherently and coherently describing and elucidating the changing features of the earth's surface.”

Nature of Geography

i) Descriptive Nature –

In the early days, geography was defined as the description of the earth, and on the basis of the available information, the elements of geography were studied in a descriptive manner. E.g. Various travelogues, description of terrain like rivers, mountains, forests etc.

ii) Distributional Nature -

After the 15th century, there was a lot of progress in the means of transportation. More and more information about Earth became available from traders, travelers etc. Therefore, the information about the new regions on the earth increased and this information were divided into different parts and the geographically similar regions were combined based on the geographical elements of the specific region. In which region, which geographical features are found? The study of this was included in geography. This is called study of distribution. In this century, the nature of geography became distributive in this way.

iii) Scientific Nature -

From the 18th century, geography began to be studied scientifically. How and why any phenomenon happens on earth. Various elements of geography started to be studied in such a way that what could be the reasons behind this. During this time, geography is the science of the relationship between earth and humans. It was defined as such. So geography got a scientific form, so this subject started to be studied in a scientific and scientific way.

iv) Modern Nature –

After 1950, the pace of human life increased due to the revolutionary changes in the field of transportation and communication, information about geographical factors started to be widely available.

Due to the development of population growth, migration, man's development of control over nature, geographic information system, remote sensing, qualitative and quantitative assessment of the relationship and interaction between different geographical elements has started. An objective analysis was made possible.

Thus, the nature of geography is dynamic and variable and it is a science that changes with time.

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Scope of Geography

As the knowledge of geography increased, the scope of geography developed. In geography, nature and human beings are studied. The natural elements of the earth are not only geography, but animals, plants, birds, human life, human wealth are also studied in it. Geography is not just the study of land or climate. The study of interrelationship between climate, crops, plants, birds and human life is also important in this. The earth is viewed from the point of view of the abode of man, the most intelligent creature on earth. Man uses the earth's resources for himself. The existence of human beings is not possible without nature, that is, the surrounding geographical factors affect human beings.

Physical elements include elevation, land, climate, rivers, seas, plants, animals, minerals; these elements are mainly studied in natural geography. Also, space, spheres, formation of the earth, interior of the earth, rocks, tectonic movements, earthquakes, volcanoes, mountains, plateaus, plains, rivers, glaciers, wind, its function, ocean formation, coastlines, tides, tides, ocean currents, air, weather, Solar power, temperature, atmospheric pressure, humidity clouds, precipitation, vegetation, minerals, type formation, ground water, etc. are studied in this.

The human factor includes settlements, businesses, factories, transportation facilities, irrigation facilities, population.

Man is an active factor; he brings about many changes in nature. E.g. Building cities, building factories, building roads, building dams, and farming are studied in many aspects.

Study Methods of Geography

Each discipline has a specific method of study. Different tools and techniques have to be used for this. Geography is primarily a science of observation. Eight methods of study are used in geography.

1) Empirical Approach
2) Theoretical Study Approach
3) Surveying Study Approach
4) Subject Study Approach
5) Regional Study Approach
6) Analytical Study Approach
7) Map-Photograph Normative Study Approach
8) Integrated Approach

Development in the Study of Geography

A conceptual revolution in geography in the last 15 years has changed the overall nature of geography. Total 6 concepts are important in this.

1 Location and Place
2 Movements and Distance
3 Route Network
4 Route Connections and Hierarchy
5 Resources

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6 Scale

1 Location and Place

This concept is called the foundation of geography. An event that occurs is an event that occurs at a place. The location of a place can be shown to us in many ways. The method of describing a place with the help of latitude and longitude is important. It can tell the exact location of any place on earth.

2 Movements and Distance

It is another important concept in modern geography. Geographical movements are very important in the study of geography. Like water flowing from rivers, wind, glaciers, movement of sea water, movement of percolating water in the ground or numerous movements of human beings on the surface of the earth from the microscopic movement of the surface.

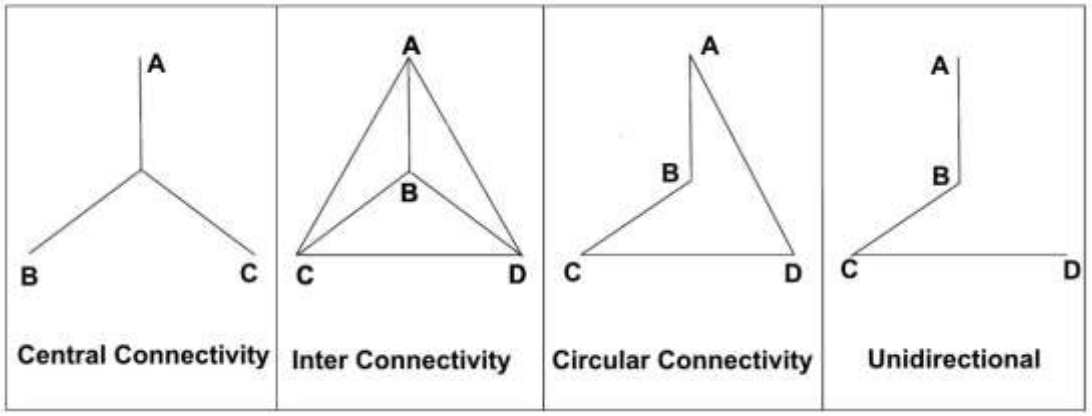
The amount of interaction between two elements depends on the distance. This leads to an increase in inter-city exchange in nearby cities, while as the distance increases, exchange decreases. The volume of movement is higher between the two major cities. This is known as action-process. Some of these movements are regional in nature. It includes the intra-city movement of people in a particular city.

3 Route Network

Pathways can be of many types. Road networks play an important role in spatial research. International waterways, inland waterways, railways and roads, and airways are important modes of transportation. Many types of routes often combine to form a network. These include how specific types of routes developed within the route network, considering where new routes should be established, and planning for different transport routes(Kokane et al., 2021).

If four cities are to be connected to each other by roads and railways, the roads have to be created with proper balance of distance, time and traffic.

Just as there is a network of transportation and communication tools, the researcher has to consider the information network or how the information is disseminated. Where is the information used? Information flow can be determined by considering who, where, how and how fast it goes. It is used for regional planning or dissemination of new schemes.



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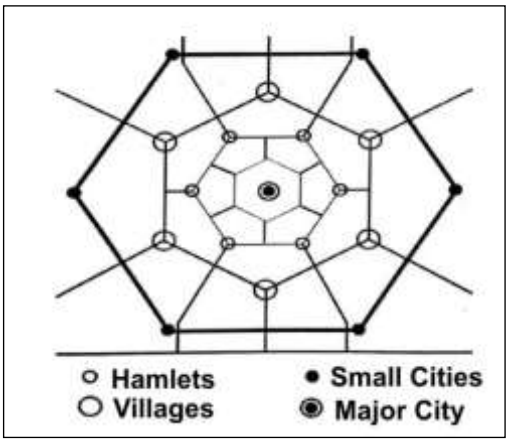
4. Route Connections and Hierarchy

Traffic comfort increases when road networks are established and where different routes intersect. And where two lines cross each other, route connections are formed and important connections are formed if there are railway lines at the same place. The concept of network and connectivity is useful and important. A certain structure and hierarchy is found in the study of the cities in a specific wide area and their relationship with each other and its size. In Germany, as studied by Christler, connected cities are found in the case of central cities. E.g. A small city and a large city at a certain distance from it and a larger city within the structure of a large city are called Central Places.



Connected cities cater to the main services and needs of the surrounding region and their service areas are generally hexagonal in shape. The three hexagons together form the area of a city of a higher tier than that city. In this way, a hierarchical structure of the city serving a larger area is created. In this hierarchy, the three lower tier hexagons are called the K3 structure by Christler. This concept is used when considering the development center of the country.

5. Resources

Resource development and utilization is an important concept in geography. What is resourcefulness? How much to develop her? How to do such questions arise.

Resourcefulness is the foundation of all movement, from simple occupations like lumbering to modern industry. Strategic distribution of resources is important in this, as is the ability to identify and develop resources. In the development of this concept, there are parts such as perishable resources and non-perishable resources.

6. Scale

Scale is also a traditional concept. How large or small the scale to use is still important when creating a map. The land use of a farm and the land use of a state are different. Therefore, the part of generalizing one study to another and considering the difficulties involved is rooted in this concept.

Along with these six important concepts in modern geography, using mathematics, statistics, modern mathematics and theory, and using simulative models,

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modern geography tries to anticipate possible events and provide more objective guidance.

Also, GIS and Remote Sensing have been widely used in geography for some time now. Due to this, research in geography has gained momentum. Its inclusion in the study of geography is a great advance.

Since geography is a co-ordinate science, it reviews all natural and social phenomena. So, geography is both natural and social science at the same time. So, geography is a separate science with its own place.

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Sericulture: Types of Silk

Jaipal Bhargava
Kalpana Singh
Laboratory of Applied Zoology & Bio-musicology,
Department of Zoology, University of Lucknow, Lucknow- 226007, UP (INDIA)
Email: *biomusicology.india@gmail.com*

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Abstract

The chapter on "Types of Silk" offers a comprehensive exploration of the diverse world of silk, presenting an in-depth analysis of various silk varieties, their origins, characteristics, and cultural significance. Silk, renowned for its luxurious texture, remarkable strength, and shimmering appearance, has captivated human civilization for centuries. From the fine and delicate mulberry silk to the rustic charm of Tussar silk, each type of silk embodies a unique blend of tradition, craftsmanship, and natural beauty.

The chapter begins by introducing the concept of silk and its historical importance, tracing its origins to ancient civilizations and highlighting its enduring allure in modern-day fashion and industry. It then proceeds to examine some of the most notable types of silk, including mulberry silk, Tussar silk, Eri silk, Muga silk, and spider silk, providing insights into their production methods, characteristics, and applications.

Through a detailed exploration of each silk variety, the chapter elucidates the intricate processes involved in silk cultivation, rearing, and processing, shedding light on the artistry and craftsmanship behind silk production. Furthermore, it delves into the cultural significance of silk, showcasing how silk weaving traditions have shaped the identities and economies of communities around the world.

The chapter also discusses the contemporary relevance of silk, exploring its role in sustainable fashion, technological innovation, and cultural preservation efforts. By examining the environmental impact of silk production and the challenges facing the silk industry, the chapter offers a holistic perspective on the complexities of silk-making in the modern era.

Keywords: Silk, Mulberry Silk, Tussar Silk, Eri Silk, Muga Silk, Spider Silk, Fagara Silk, Coan Silk

Introduction

Silk, often referred to as the "queen of textiles," is a luxurious and versatile fiber that has captivated human civilization for centuries. Its shimmering appearance, soft texture, and remarkable strength make it highly prized in the realm of fashion, textiles, and industry. However, not all silk is created equal. There are various types of silk, each with its own unique characteristics, production methods, and applications. In this chapter, we will explore some of the most notable types of silk, their origins, and their

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uses.

Silk, often hailed as the epitome of luxury and elegance, has enchanted humanity for millennia with its exquisite beauty, remarkable strength, and unparalleled softness. From ancient civilizations to modern-day fashion runways, silk remains a symbol of opulence, sophistication, and refinement. Yet, beyond its undeniable allure lies a world of diversity and complexity, where different types of silk weave tales of tradition, craftsmanship, and cultural heritage.

In this chapter, we embark on a journey to explore the fascinating realm of silk, delving into the myriad varieties that grace the textile landscape. From the classic elegance of mulberry silk to the rustic charm of Tussar silk, each type of silk carries its own story, shaped by the unique habitats, traditions, and production methods of its origin.

As we unravel the intricacies of silk production and delve into the characteristics of various silk types, we will uncover the rich tapestry of human ingenuity and creativity woven into the fabric of silk-making. From the painstaking cultivation of mulberry trees to the delicate process of silk reeling and weaving, the artistry and craftsmanship behind silk production reflect centuries of tradition and innovation.

Moreover, the significance of silk extends far beyond its aesthetic appeal, encompassing cultural, economic, and ecological dimensions. Silk production has played a pivotal role in shaping the economies and identities of communities around the world, fostering traditions and livelihoods passed down through generations.

In this exploration of silk, we will not only celebrate its beauty and versatility but also delve into its cultural heritage, environmental impact, and contemporary significance. From the remote villages of Assam, where muga silk is painstakingly harvested, to the bustling silk markets of China, where centuries-old traditions meet modern innovation, silk continues to captivate and inspire with its timeless allure.

In conclusion, the chapter on "Types of Silk" provides a comprehensive overview of the multifaceted world of silk, celebrating its beauty, versatility, and cultural heritage. Through its meticulous analysis and engaging narrative, the chapter invites readers to embark on a journey through the enchanting realm of silk, where tradition meets innovation, and natural beauty abounds.

Types of Silk:

Indeed, the silk industry utilizes various species of silk moths, but only a subset of these species is used for silk production. Silk can be classified into different types based on the species of silk worms that produce them. The most common types of silk are mulberry silk and non-mulberry or wild silk. Mulberry silk is derived from domesticated moths, whereas non-mulberry silk comes from wild or semi-domesticated moths. Non-mulberry silk can be further categorized as insect and non-insect types (Mohanty, 1998).

India has the unique distinction of producing all these commercially viable silk varieties. These varieties are classified as univoltine, bivoltine, and multivoltine based on the number of generations produced each year (Gautam *et al.*, 2022). Each of these varieties has its own characteristics and uses in the silk industry, contributing to the diversity and richness of India's silk production.

Mulberry Silkworm:

The mulberry silkworm (*Bombyx mori* L.) is extensively cultivated worldwide and is believed to be domesticated, with its origins traced back to either India or China. This silkworm species is monophagous, meaning it feeds exclusively on the leaves of the mulberry plant (*Morus alba*). The climatic conditions favourable for mulberry cultivation contribute to the thriving growth of mulberry silk moths (Mohanty, 1998). The mulberry silkworm belongs to the family Bombycidae within the order Lepidoptera. These silkworms are completely domesticated and reared indoors (Gautam *et al.,* 2022).

The complete life cycle of the mulberry silkworm spans approximately fifty days. This includes ten days in the egg stage, 25-30 days in the larval stage, and a ten-day period in the pupal stage. During the mature larval stage, the silkworm secretes silk from its mouth to construct a cocoon (Shaha *et al.,* 2022).

In India, the main mulberry silk-producing states are Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu, and Jammu and Kashmir, collectively accounting for 92% of the country's raw silk production. These states have favourable conditions for mulberry cultivation and sericulture (silk production) (Mohanty, 1998).

Tasar Silkworm:

Tasar silk is known for its copperish colour and is primarily used in furnishing centers. Tasar silkworms are plant-feeders and rely on specific primary and secondary food plants for their sustenance. The genus *Antheraea*, which includes Tasar silkworms, comprises more species of sericigenous insects than any other genus (Mohanty, 1998).

Tasar silk is produced by different eco-races of Tasar silkworms, which are primarily influenced by natural environmental conditions. There are two main types of Tasar silkworms: tropical and temperate. The species *Antheraea mylitta* feeds on various host plants such as *Terminalia tomentosa* (Asan), *Terminalia arjuna* (Arjun tree), *Ziziphus mauritiana* (Ber), *Terminalia catappa* L. (Badam tree), *Quercus spp*. (Oak), *Terminalia tomentosa* (Indian laurel), and *Shorea robusta* (Sal) (Bambhaniya *et al.*, 2017).

The major Tasar silk-producing states in India include Jharkhand, Odisha, Chhattisgarh, West Bengal, and Andhra Pradesh. Tasar silk rearing plays a vital role in the livelihoods of many tribal communities in these regions (Gautam *et al.,* 2022).

Oak Tasar:

The Oak Tasar variety of Tasar silk is produced by the silkworm species *Antheraea proyeli* J., which is abundant in the sub-Himalayan belt of India. These silkworms feed on natural food plants, particularly oak trees. The distribution of oak plants covers a wide area of forest in India, spanning from Jammu and Kashmir in the west to Manipur in the east. The regions encompassed by this belt include Himachal Pradesh, Uttar Pradesh, Assam, West Bengal, Sikkim, Arunachal Pradesh, Mizoram, Meghalaya, and Nagaland, providing suitable conditions for rearing the temperate Tasar silkworm. It is worth noting that there are four species of temperate Tasar silkworms found in these regions (Bukhari *et al.,* 2019).

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Eri Silkworm:

The term "Eri" is derived from the Sanskrit word "Erenda" and refers to the castor plant. Eri silk, also known as Errandi, is produced by the silk moth species *Philosamia ricini*. The culture of Eri silk has ancient roots, and Assam has been a unique hub for Eri silk production since ancient times, with historical records dating back to 1779. Eri silk can be either white or brick red in colour.

Eri silk moths are domesticated and classified as multivoltine, meaning they have multiple generations within a year. The cocoons spun by Eri silk moths have a copperish colour. Eri silk is primarily used to make wraps, known as chaddars, in various industries.

While Eri silk culture is most prominent in Assam, it is also practiced on a smaller scale in other states such as Bihar, Manipur, West Bengal, Odisha, and Tripura. In Assam, Eri silk production is often a communal endeavour, involving the participation of local communities (Bukhari *et al.,* 2019; Mohanty, 1998; Bhat, 2014).

Muga Silkworm:

Muga silk is a highly prized variety of silk known for its golden yellow colour. It is obtained from a semidomesticated multivoltine insect and is predominantly cultivated in the state of Assam, India. When the larvae of the muga silkworm feed on the leaves of the Megankori plant, they produce a type of silk called mejankori silk. Mejankori silk is known for its attractive appearance, toughness, and creamy white shade.

In the muga silk culture, special attention is given to preserving the pupae, as they are allowed to complete their life cycle and transform into moths. This practice is known as "Ahinsa silk" or non-violent silk, as the pupae are not killed in the process. The resulting silk thread retains its beauty and quality even after the transformation of the pupae into moths.

The muga silkworm is found on various trees, including Som (*Persea bombycine*), Soalu (*Litsea monopetala*), and Dighloti (*Litsea salicifolia*). These trees serve as the primary host plants for the muga silkworm (Mohanty, 1998; Sahu, 2015; Tikader *et al.*, 2013).

Anaphe silk:

Anaphe silk is a type of silk produced by silkworms belonging to the genus *Anaphe*. This silk is obtained from the pupal cocoon of the *Anaphe* silkworm species found in the forests of Kakamega in southern and central Africa. The people living near the Kakamega Forest are involved in the production of silk using *Anaphe* silkworms.

The cocoons of *Anaphe* silkworms can be degummed to extract the silk fibers, which have a brown colour and are known for their high quality. Various species of Anaphe silkworms contribute to the production of this silk, including *Anaphe moloneyi* Druce, *Anaphe panda boisduava*, *Anaphe reticulata* Walker, *Anaphe ambrizia* Butter, *Anaphe carteri* Walsingham, *Anaphe venata* Butter, and *Anaphe infracta* Walsingham (Mbahin *et al*., 2012; Mohanty, 1998).

The utilization of *Anaphe* silk by local communities in Africa highlights the diversity of silk production and the importance of different silkworm species in various regions of the world.

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Fagara silk:

The Atlas moth (*Attacus atlas*) is indeed the largest species of moth in the world. It belongs to the genus *Attacus* in the family Saturniidae. The genus *Attacus* is primarily found in Australia and consists of fourteen known species, with eleven of them being limited in number (Peigler, 1989).

The silk produced by the Atlas moth and some related species or races, such as those found in China and Sudan, is known as Fagara silk. The cocoons spun by these moths are approximately 6 cm long and light brown in colour, attached to peduncles of varying lengths ranging from 2 to 10 cm.

Attacus atlas is a multivoltine species, meaning it can undergo multiple generations within a year, and its life cycle typically lasts between 62 to 100 days. The larvae of *Attacus* atlas are highly polyphagous, which means they feed on a wide variety of plants, including flowers. The specific leaves consumed by the caterpillars can influence the colour of the silk, with yarns and textiles produced from larvae that feed on different types of leaves potentially exhibiting darker brown colours (Gautam *et al.*, 2022).

Coan Silk:

Coan silk fiber is obtained from the larvae of the moth species *Pachypasa otus*. These larvae are found in the Mediterranean region, specifically in countries such as southern Italy, Romania, Greece, and Turkey. The Coan silk moth is a polyphagous insect, meaning it feeds on a variety of plants. Its diet includes the leaves of pine trees, cypress, ash, juniper, and oak.

The cocoons spun by the Coan silk moth have a white coloration. In ancient times, the silk from these cocoons was highly valued and used to create crimson-dyed clothes worn by Roman celebrities. The Coan silk was known for its quality and luxurious appearance (Mohanty, 1998).

Mussel silk:

The silk produced by mussels is commonly referred to as "fish wool." This unique silk is obtained from the bivalve mollusk. Specifically, the mussel species *Pinna squamosa* is found in the surface waters along the Italian and Dalmatian coasts of the Adriatic Sea.

Mussels use a durable brown fiber called byssus to anchor themselves to rocks or other surfaces. This byssus fiber is harvested, combed, and then spun into silk-like threads. The production of mussel silk is primarily carried out in Toronto and Italy, where the process of obtaining and processing the byssus fibers is undertaken (Jolly *et al.*, 1979).

Spider Silk:

Spider silk is indeed a fascinating and remarkable material. Spiders, belonging to the phylum Arthropoda, have evolved unique spinning capabilities that allow them to produce various types of silk. It is estimated that there are over 70,000 spider species, each with their own specialized behaviours and silk-producing abilities, such as spinning webs, creating nests, and capturing prey.

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The silk produced by spiders is considered to be one of the oldest and most mystical materials on Earth. Spiders have been honing their silk-spinning abilities for hundreds of millions of years, resulting in a marvel of nature. Spider silk is known for its exceptional strength and durability.

Different spider species produce different types of silk, each with its own unique properties. Some examples of spider species known for their silk production include *Nephila madagascariensis*, *Miranda aurantia*, and *Epeira*. Spider silk is renowned for its strength, surpassing the strength of steel on a weight-to-weight basis. It is also highly elastic and has impressive resistance to breaking.

It is worth noting that the silk produced by certain insects, such as silkworms, is also remarkable in its own right. However, the silk produced by spiders is often considered to be even stronger and more resilient than insect silk (Gertsch, 1979).

Overall, spider silk is a testament to the incredible adaptability and ingenuity of nature, and it continues to inspire scientists and researchers in various fields, including materials science and biotechnology.

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Role of Geospatial Technology for Crop Management

Ekta Singh
Sakshi Walker
Department of Botany St. John's College, Agra, India
Jai Kumar
Centre for Geospatial Technologies, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
Email: jaikumar0070@gmail.com

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Introduction:

Geospatial technology is used to collects and analyzes the geospatial data (data includes information related to locations on earth's surface). And it is a collection of several techniques such as Geographic Information System (GIS), Global Positioning System (GPS) and Remote Sensing (RS). These systems have been used in collecting, mapping, analyzing the dispersal and forecasting the scenario of insect pests, diseases and crop yield.

As we know, Geospatial Technique is not something which is new, the history of these techniques started from 1832, that year there was a cholera outbreak in Paris, and French cartographer Charles Picquet produced one of the earliest heat maps illustrating the concentration of disease cases. Following the Paris model, physician John Snow expanded when cholera invaded London in 1854. Using spatial analysis of the data, he not only created a map that shows the locations of cholera deaths but also demonstrated the link between contaminated water sources and cholera. Later, it was Dr. Roger F. Tomlinson who first coined the term geographic information system (GIS). Since then, desktop geospatial technology has given way to cloud-based systems. (https://www.heavy.ai/learn/geospatial). At present, it is continuously evolving and in today's world we can use Geospatial techniques in a number of fields such as education, public safety, weather, environment, human health, Crop/Plant disease etc(Kokane et al., 2021)(Jaybhaye et al., 2023)(Khatri et al., 2022).

Global Positioning System is a satellite and ground-based radio navigation and locational system that determines the exact places on the earth's surface. It was developed by the US Department of Defence (DoD) and used for many civilian purposes. We can also use GPS in precision agriculture. Accurate, automated position tracking with GPS receivers allows farmers and agricultural service providers to take down geo-referenced data and apply variable rates of inputs to smaller areas within larger fields.

Geographic Information System is used for analysis, simulation, and model-building purposes. The software provides a structure for presenting data in the form of maps for visual analysis as points, lines and areas, but the power of GIS goes far beyond the maps. In fact, mapping is a minor part of the use of GIS. The databases that are

associated with GIS and the tools to manipulate those data sets, are powerful tools for organizing, analyzing, and interpreting data **Huang *et al.*, (2008) (Khatri et al., 2022).**

Remote sensing refers to the noncontact measurement of radiation reflected from crops, which is determined by the interaction between the electromagnetic spectrum and the soil or plant. Remote sensing is a technique that has been widely used in **precision agriculture** since the past 25 years. Airborne type of remote sensing has been a likely and convenient tool for insect pest management and weed detection. Furthermore, remote sensing using satellite information proved to be a promising tool for forecasting and monitoring the distribution of many species. It will help farmers in the early detection of insect pests and diseases like mite infestation in cotton fields using multi-spectral systems, which depend on color changes in canopy resemblance over time. In agriculture, integrated RS and GIS technology offers enormous prospects for cost-effective treatment of crop stress sources. (S. Walker & J. Kumar 2021).

Application in Detection of Disease in Crop plants:

In order to detect disease in crop plants we can consider geospatial techniques. These approaches possibly reduce the risk of crop damage and the financial burden on farmers or Producers intended for purchasing fungicides, bactericides etc. Maize Streak Virus is a major problem in Sub-Saharan Africa and basis of excessive damage for farmers economically. In order to get better understanding of Maize Streak Virus that how the Virus Originated and Transfer form vector to healthy plant Dhau ***et al.*, (2018)** conducted a study to detect and map the Maize Streak Virus using RAPIDEYE SATELLITE imagery with Robust Random Forest Algorithm. To Examined the maize sreak virus Redeye sensors provide a precise result of 82.75% and Vegetation Indices united with Redeye upgraded the total outcome by 3.4%. Near Infrared, Blue, Red-edge was most important spectral band of Redeye to monitor the Maize Streak Virus.

Dutta ***et al***., (2014) conducted a study of disease in potato crop in Bardhaman district of West Bengal, India. Potato crop is majorly grown in this region & at this point Late Blight disease caused by *Phytophthora infestans* extensively affect the potato crop. The late blight or potato blight occurs in humid region (britanica.com) likewise (A. Basu 2009) also states that Late blight appears regularly between 1st and 3rd week of January in the West Bengal and 12.8 degree Celsius to 21.7-degree Celsius temperature, relative humidity 65-98%, sunshine hours 0.5 and rainfall 5.6-6.3 mm. suitable for disease infestation. The resulted values of NDVI and LSWI in diseased plants were lesser as compared to healthy plant, also SWIR (Shortwave Infrared) reflectance was high in case of disease plant because the water level decreased in diseased plants.

Application in Detection of Insect Pest in Crop plants:

In order to detect insect pest in crop plants we can consider geospatial techniques. These approaches possibly reduce the financial burden on farmers or Producers intended for purchasing pesticides. The early finding can also thinkable and it will later assistance in precision application of Pesticides. Remote Sensing technique termed SPOT-5 used to detect Rice plant Hopper in Malaysia also Satellite multispectral

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imagery a sensor was used to monitor the green color of plant produced by visible and Near Infrared Radiation (NIR) Ghobadifar, ***et al***., (2014).

A study conducted to recognize the dispersal of *Ommatissus lybicus* which is also known as dubas bug. Remote Sensing techniques such as LANDSAT, SPOT and IKONOS were used to observe the variations in palm productions with in season. Airborne Visible/ Infrared Imaging Spectrometer AVIRIS were also used to identify the level of severity of damage caused by dubas bug Al-khindi, ***et al***., (2017).

Application in Plant Health Recognition:

In current realm, there are ample category of stresses that crop plants deal with such as biotic stress which causes due to Pathogen like Fungi, Bacteria, Virus, Phytoplasmas (It is a large group of phloem inhibiting bacteria which are pathogenic on plants and transfer from one plant to another through phloem feeding insect) Nematodes, Weeds and Insect pests. It has been reported that Plant diseases, insect pests and weeds cause 30 to 40 % damage in production **(**Md. Arshad Anwer & Garima Singh 2019**).** The insects that attack, destruct and kill crop plants, they can cause harm to agricultural crops in diverse ways such as sucking, boring and cutting etc. Agricultural crops/plants of the world are damaged by more than 100,000 diseases (caused by fungi, bacteria, viruses, and other microorganisms) 30,000 species of weeds, 10,000 species of insects, and 1000 species of nematodes Dhaliwal ***et al.,*** (2010)**.**

Abiotic stress which includes phytotoxicity (adverse effect of chemical on plants), harsh temperatures, water scarcity, poor soil, and, are main limiting factors that can affect agricultural productivity, production and ultimately food security**. (**Md. Arshad Anwer & Garima Singh 2019**)**. Moreover, climate change will give rise to the emergence of new pest and disease and this will create greater loss in crop production. Climate change is a significant change in average weather conditions, such as warming, wetter, or drier conditions, that affects the agricultural environment over decades or longer periods. Therefore, it affects the development of plant pests and diseases. Weather components like air temperature, soil temperature, humidity, rainy season, wind, irrigation and other factors affect the occurrence of crop diseases. Therefore, it is one of the main factors that limit crop production. Whether it is a biotic factor or abiotic factor that affects the crop plant it may harm the health of that particular plant/crop plant. Several geospatial techniques were extensively used to analyze the plant health. Several Researchers have proved that Remote Sensing is a promising technology that can be used to distinguish between healthy and unhealthy plant**.** Singh ***et al***., (2016) utilized Remote sensing data; prepared Severity Index, distribute plant into five grade (0-5) healthy, normal, low moderate and high.

We can also use NDVI (Normalize Difference Vegetation Index) to differentiate between healthy and diseased plant:

NDVI is used to quantifies vegetation by measuring the difference between near-infrared (which reflected back by vegetation) and red light (which absorbed by vegetation).

The NDVI is calculated by using formula: NDVI = (NIR — RED)/ (NIR + RED). The NDVI formula generated value between -1 to +1 and this value reflects the vegetation whether it is healthy or unhealthy. If the vegetation is healthy, it reflects more near- infrared (NIR) and green light as compare to another wavelength. But it absorbs more red and blue light. Satellites like Sentinel-2, Landsat, and SPOT produce red and near-infrared images. According to Dutta, ***et al***., (2014) they used Remote Sensing and indices such as NDVI (Normalized Difference Vegetation Index) and LSWI (Land Surface Water Index) to find out the difference between healthy and unhealthy potato crop. The Data were obtained from Cloud free satellite of IRS-PC AWiFS and EDS-Terra MODIS. Study also suggested that due to disease in potato crop absorption of sunlight (incident light) changes in both visible and Near Infrared range because of lowering Chlorophyll pigment similarly other pigment and change in internal structure of plant.

Application in Crop Plant Disease and Insect Pest Forecasting:

Forecasting means predict something which would be happen in future. To deal with the crop plant disease insect pest forecasting, we dependent on technology, geospatial techniques are useful in forecasting. Forecasting methods are based on the models that utilize data on weather parameters, farmer's eye estimates, agro meteorological conditions, remote sense crop reflectance observations etc. according to **Rani *et al*., (2018)**. Remote sensing is a technique by which we obtain data that reveals the plant health; remotely sense data is based on electromagnetic radiation which reflected back from plant. Research was conducted in China to forecast and monitor disease and pest in crop plant; to study and detection Locust population and a disease wheat rust caused by fungus (*Puccinia triticina)* Field hyper spectral data and UAV hyper spectral images were used. Furthermore, the wheat rust and locust the data from remote sensing images such as GF, Landsat, and Sentinel were also obtained. A system was also developed based on WebGIS platform to perform the future prediction and management of disease & locust population. The conducted research also focuses on site specific application of chemical pesticides.

Application in Soil Health and Fertility Assessment:

Soil health and fertility are important aspects for crop growth. Soil contains vital nutrients (micronutrients and macronutrients) and water that are available to the plants for proper plant development. In recent year, Soil health is rapidly declining due to various factors like pollution, sealing, overgrazing, waterlogging, excessive use of agricultural chemicals, and erosion. Soil erosion is also diminishing the soil health and fertility. It is essential to determine soil health and fertility status for planning effective practices for site-specific management or precision agriculture. Geospatial techniques are promising tools in soil health and fertility assessment because this might be helpful for agriculture. A study conducted in southern China; they were used SFI (SOIL FERTILITY INDEX) as an indicator of soil fertility which used to evaluate the soil fertility in rice growing region. They were estimated the SFI by using NIR Spectra. The results showed NIR spectroscopy advanced the assessments effectiveness of soil fertility

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within the cultivated paddy rice regions of southern China Yang *et al.,* (2020). There was another study conducted in Jianghan Plain in China, they use GIS geographic information systems (GIS) and the soil basic niche-fitness model (SBNFM) to evaluate the soil fertility, Soil samples were collected the soil samples from topsoil and tested for pH, organic matter (OM), total nitrogen (TN), etc. their results showed the soil fertility of cultivated land and categorized accordingly from medium to high fertile soil Nie *et al.,* (2016).

Application in Crop Yield Forecast:

Crop yield monitoring and forecasting are valuable for any country to be able to make decision on food production. Specially, country like India which has highest population in world and large proportion of population depends on agricultural activities. Crop yield forecasting is vital in terms of food security, national Policy decision etc. Field surveys, statistical regressions between historical yield and in-season variables (agrometeorological, remotely sensed data), crop simulation models, or the integration of statistical modeling with dynamic process-based crop simulation models are some methods used to estimate crop yield. Additional factors that may be included in the model include soil conditions and the global climate etc. (B. Basso and L. Lie 2019**).** The Model based estimation is possible because of geospatial technologies Zahra *et al.,* (2023).

According to Boutika *et al.,* (2022) MODIS- derived Normalized difference Vegetation Index (NDVI) and EVI (Enhanced Vegetation Index) can be used to forecast crop yield. The study was conducted in major crop producing districts of Uttarakhand. Stepwise Regression and Least Absolute Shrinkage and Selection Opertaor (LASSO) methods were used to forecast crop yield using YIELDCAST- DSS software developed by India Meteorological Department (IMD) with Indian Agricultural Statistics Research Institute (IASRI).

In another research, the yield of potato tuber crops on three 30-ha center pivot irrigated fields in an agricultural scheme situated in the Eastern Region of Saudi Arabia was predicted using remote sensing and GIS techniques. Two vegetation indices, the soil adjusted vegetation index (SAVI) and the normalized difference vegetation index (NDVI), were produced from Landsat-8 and Sentinel-2 satellite pictures that were taken during the potato growth stages. Based on vegetation health statements, vegetation index maps were created and zoned, and stratified random sample points were then established. Two to three days before harvest, potato yield samples were gathered. They were then associated with the nearby NDVI and SAVI, where yield prediction algorithms were created and applied to produce prediction yield data Gaadi ***et al.,*** (2016).

Applications in Land use/ Land cover Assessment:

Currently, where the amount of arable land decreases, feeding billions of people is becoming increasingly difficult in this day and age. For this reason, we must maximize the advantages of using natural resources as efficiently as possible. Geospatial techniques offer a great platform for evaluating a piece of land's suitability for a certain use Ghosh *et al., (*2022). The understanding of land use and land cover aids the process of creating plans that balance competing uses, development needs, and preservation activities(Singh

et al., 2022). Several problems, such as the loss of forested land, the decline in the amount of productive land, and the increasing urbanization, are prompting land use research.
In agricultural resource management, LU/LC refers to the physical characteristics and use of land in a particular area, including vegetation cover, soil type, and water availability. Zahra *et al.,* (2023). The Land use and Land cover data might be helpful for farmers as they can make decision on crop suitability according to soil types, water availability.

According to Kumar *et al.,* (2020)**,** The Churu district of Rajasthan state, India, had its land use land cover (LULC) classified by using a hybrid classification technique. They used the 1998, 2008, and 2018 Landsat imagery to measure the type and rate of spatiotemporal LULC changes. Eleven classifications of land use were identified in the research region based on a field survey and standard classification schemes. The findings showed that throughout the whole study period from 1998 to 2018, crop land and agriculture dominated the district of Churu's land use, whereas natural vegetation, or forest areas, made up the least amount of the district's land cover.

According to (P. Arulbalaji 2019) the technique remote sensing and GIS used to map the dynamics of land cover and usage in the Salem district of Tamil Nadu, South India. To evaluate the changes in land use and land cover, data from the Landsat Thematic Mapper for the years 1992, 2001, and 2010 as well as data from the Operational Land Imager for the year 2015 were used. The study employed the Maximum Likelihood algorithm, a supervised classification approach, to categorize the remote sensing data. The findings show that between 1992 and 2015, there was a decline of almost 398 km2, 250 km2, 45 km2, and 16 km2 in deciduous woods, croplands, agriculture and plantation lands, and water bodies, respectively. Alongside, there has been an approximate growth of 288 km2, 293 km2, and 128 km2 in evergreen and semi-evergreen forests, built-up areas, mines, and barren plains, respectively.

Conclusion:

In the area of the management of disease and insect pests, geospatial techniques play an important role, as this includes geographic information systems, remote sensing, and global positioning systems. All these techniques together give information about the location, timing, and images or maps of the study area. These techniques yield significant results in finding better ways to manage disease and insect pests in crops. If we know how to manage stressed crops, we can greatly assist farmers while also reducing crop damage.

Geospatial techniques offer numerous benefits when managing crop plants. These include the ability to track water supplies and predict droughts, assess the financial and environmental impacts of human activity and natural phenomena, anticipate pest attacks and crop yield losses caused by disease-causing microbes, and are a time- and money-efficient method. NDVI, a statistical technique, is also employed in the study to produce results in precision farming and crop monitoring. A key component of precision farming is NDVI. It aids farmers in keeping an eye on the condition of their crops and identifying trouble spots. Using NDVI imaging, farmers can implement targeted

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interventions that improve insect management, fertilizer application, irrigation, and crop yields while reducing resource waste.

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The use of geospatial technology in the preservation of Medicinal plants

Tarnija Shahi
Sakshi Walker
Department of Botany, St. John's College, Agra, India
Jai Kumar
Centre for Geospatial Technologies, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India
Email: jaikumar0070@gmail.com

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Introduction

The history and importance of medicinal plants holds a profound significance in the development of Human civilization. The Indian Subcontinent is one of the rich repositories of medicinal plants. More than 100 genera of plants which are being used in traditional medicinal practices in different part of world belong to India, our country provide best quality and quantity of medicinal plants and stands second in ranking in terms of export (Prasathkumar et al.,2021) . The relationship between humans and medicinal plants dates back to 1000 of years ago and has played a prominent role in the development of Medicine and healthcare. If we look out for the records of human history the inherent connection between mankind and nature has manifested in countless ways. One remarkable facet of this bond lies in the utilization of plants for medicinal purposes. Plants have been used for medicinal purposes since long even before prehistoric period. Among ancient civilizations, India has been known to be a rich repository of medicinal plants (Prasad et al., 2019). Over 7000 species of plants are used from the times immemorial by various healthcare system in the country (Ved et al.,1998). India's ancient wisdom and profound understanding of therapeutic values of plants have been carefully preserved and passed down through Oral tradition and ancient texts.

The history and importance of medicinal plants are intertwined with the story of human survival and progress. The Ayurvedic practice is about 3000 years ago, most of the medicines in Ayurveda are plant based (Kumar et al.,2017) . From ancient texts like Sushruta Samhita and Charak Samhita to the modern era of scientific exploration medicinal plants have consistently played a pivotal role in healthcare and wellness (Bhatt et al.,2022). Both Sushruta Samhita and Charak Samhita are cornerstones of Ayurveda. It revolves around the idea that medicinal plants possess unique healing energies, and by harnessing these energies, one can achieve optimal health and well-being.

Medicinal plants have been integral to human health and well-being for centuries, providing a rich source of therapeutic compounds that form the basis of traditional medicine systems worldwide (Islam et al., 2021). Medicinal plants have been a cornerstone of healthcare from centuries, providing remedies for various diseases and ailments (Petrovska et al.,2012) . The diverse array of bioactive compounds found in these plants contributes to their efficacy in treating various ailments. Some examples are

as follows - Plants like

Aloe vera (Aloe Barbadensis):

Basically, known for its soothing properties, aid in skin healing i.e. pigmentation and inflammation reduction (Surjushe et al.,2008). Also, it is known for its mucilaginous gel, accelerates wound healing, reduces inflammation, and exhibits antimicrobial properties, making it a staple in skincare.

Ginseng (*Panax ginseng*):

Renowned in traditional Chinese medicine, is believed to enhance energy levels and promote overall well-being. It is deeply rooted in traditional Chinese medicine, is celebrated for its adaptogenic qualities, purportedly enhancing vitality, cognitive function, and resilience to stress.

Turmeric (*Curcuma Longa*):

With its active compound curcumin, exhibits potent anti-inflammatory and antioxidant properties also address conditions such as arthritis, promotes blood circulation and treats overall joints related problems.

Ashwagandha (*Withania somnifera*):

Ashwagandha is an adaptogenic herb known for its stress-relieving properties. It is used to boost immunity, improve stamina, and support overall well-being (Ahmad *et al.*,2017).

Tulsi (*Ocimum sanctum*):

As per the article given by (Cohen et al.,2014) Tulsi is also known as "Mother medicine of nature" and "Queen of herbs". Tulsi has antimicrobial properties and is used to treat respiratory ailments, fever, and stress-related conditions. It is considered sacred and so-called Holy basil; it is one of the most prominent species in Hindu culture.

Furthermore, the calming effects of Chamomile and Lavender make them popular choices for addressing stress and promoting better sleep. The versatility of medicinal plants extends to addressing respiratory issues, with Eucalyptus and Peppermint (Kokkini *et al.*,2003) offering relief from congestion and facilitate smooth breathing.

Embracing the therapeutic potential of medicinal plants aligns not only with historical wisdom but also with a sustainable and holistic approach to healthcare (Tandon *et al.*,2017). As scientific exploration gets deeper into the complex biochemistry of these botanical treasures, the future holds promising developments in utilizing medicinal plants for treatments and enhancing the overall well-being of individuals.

Why Conservation is needed?

In the phase of rapid environmental changes, habitat destruction, and overexploitation, the conservation of medicinal plants has become a critical endeavor. Preserving the biodiversity of these plants is not only essential for maintaining the delicate ecological balance. Here are some major factors given regarding conservation of Medicinal plants-

Biodiversity Preservation:

Medicinal plant conservation is crucial for maintaining biodiversity, as these

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plants often contribute unique compounds that support ecosystem health (Rao *et al.*, 2003).

Cultural and Traditional Importance:

Many medicinal plants hold cultural and traditional significance for indigenous communities, emphasizing the need for conservation to preserve cultural practices and knowledge.

Pharmaceutical Discoveries:

According to (Ojaha *et al.*,2021) Conserving medicinal plants is essential for discovering new pharmaceutical compounds, as these plants often serve as sources for potential drugs and treatments.

Economic Benefits:

Medicinal plants contribute to the economy through herbal medicine, traditional healing practices, and the pharmaceutical industry, making their conservation important for sustainable economic development.

Ecological Balance:

Medicinal plants play a role in maintaining ecological balance by supporting pollinators, preventing soil erosion, and influencing nutrient cycles.

Threats to Medicinal Plants:

Habitat destruction, overharvesting, climate change, and invasive species pose significant threats to medicinal plants, underscoring the importance of conservation efforts.

Geospatial technology, a powerful tool in the modern era, plays a crucial role in the conservation of medicinal plants. (Nimasow et al 2016) “The connection of Geography and Technology allows us to map, monitor, and manage the distribution and health of these valuable plant species”. In a world where biodiversity is under severe threat, understanding the role of geospatial technology in medicinal plant conservation is essential for the management and the preservation of traditional medicine. (Gamal et al 2020) However, factors such as deforestation, climate change, and illegal harvesting pose significant challenges to the survival of these plants. This is where geospatial technology steps in, offering innovative solutions to address such issues.

One key aspect of geospatial technology in medicinal plant conservation is mapping. Through Satellite Imagery and Geographical Information Systems (GIS), researchers can create detailed maps of the distribution of medicinal plants. These maps help to identify hotspots of biodiversity, allowing them to focus on areas with higher density of medicinal plants. By understanding the geographical patterns of these plants, conservation methods can be applied to the specific regions, maximizing their effectiveness. Furthermore, geospatial technology enables real-time monitoring of medicinal plant populations. Through Remote Sensing, scientists can track Changes in vegetation cover, identify threats such as deforestation and assess the overall health of medicinal plant ecosystems. This dynamic monitoring allows for timely intervention, ensuring that conservation measures are proactive rather than reactive.

Hence, Geospatial technology is crucial in plant conservation as it enables

detailed mapping of plant habitats, helping us understand where different species thrive. By monitoring changes over time, it provides valuable information about the health of plant populations and ecosystems. This information guides conservation efforts, allowing scientists and policymakers to make informed decisions about protection measures and sustainable land use. This technology also facilitates the creation of databases that store spatial information that helps researchers in ongoing studies.

Talking about the conservation and management of medicinal plants, this technique comes in the major role. By studying the location and requirement of medicinal plants, harvesters can use some conservative practices that don't harm plants. This approach promotes a balance between human needs and environmental preservation, ensuring that medicinal plants continue to thrive for future generations. The role of Geospatial Technology in medicinal plant conservation is very multi-dimensional. Ultimately, by enhancing our understanding and management of plant diversity, geospatial technology plays a vital role in preserving the richness of our ecosystems for the upcoming generations.

Medicinal Plant Diversity and Distribution pattern:

India serves a rich and diverse variety of medicinal plants, contributing to the country's traditional healthcare systems. With a climate ranging from tropical to temperate, and diverse geographical features, India's landscape supports the growth of a large range of medicinal flora.

From the Himalayan region with its alpine meadows and diverse climatic zones to the Western Ghats, Indo-Burma, Nicobar Islands and the Gangetic plains, each region consisted of unique plant species with therapeutic properties (Chandra *et al*., 2018).

The Northeastern States, characterized by their lush forests, are bank of biodiversity, featuring plants like *Artemisia, Panax*, and *Zingiber officinale* (Shankar *et al*.,2013).

Coastal regions, such as the Eastern Ghats and Western Ghats (Konkan belt), support plants like *Centella asiatica* and *Saraca asoca.*

Ayurveda, one of the world's oldest healing systems is dependent heavily on the use of these medicinal plants. The biodiversity encompasses herbs, shrubs, and trees, each holding potential for various medicinal applications. Plants like Neem, Turmeric, Ashwagandha, and Tulsi are important to traditional remedies, addressing ailments ranging from skin conditions to respiratory issues. The indigenous knowledge passed down through generations highlights sustainable practices, ensuring the conservation of these valuable resources.

However, challenges such as habitat loss and overexploitation threaten this diversity (Niteshwar *et al*.,2014). Efforts in research, conservation, and sustainable harvesting are crucial to preserving the wealth of medicinal plants in India, not only for traditional medicine but also for potential pharmaceutical advancements and global well-being.

Ayurveda, Siddha, and Unani traditions have evolved in tandem with these regional variations, tailoring herbal remedies to the local ecosystems. While the diverse

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flora meets the healthcare needs of different regions, it also presents challenges in terms of conservation and sustainable utilization. Efforts to document, cultivate, and protect these region-specific medicinal plants are required for preserving India's rich herbal heritage and promoting sustainable healthcare practices.

Factors affecting Medicinal Plants:

Threats to Medicinal Plant Species:

Medicinal plant species face numerous threats, both natural and anthropogenic, which affects their survival badly. Habitat destruction, driven by activities such as deforestation, urbanization, and agricultural expansion, poses a significant threat to the ecosystems that host these valuable plants. Additionally, climate change further contributes to these threats by rapid temperature change, affecting the balance of ecosystems.

Habitat Loss and Fragmentation:

There are many biodiversity hotspots in India, known for its rich biodiversity, has witnessed substantial habitat loss due to human activities (Shen *et al*.,2016). The clearing of land for agriculture, logging, and infrastructure development has led to the fragmentation of habitats, disturbs the distribution of medicinal plants like *Rauvolfia serpentina* (Sarpagandha), used in traditional medicine for its antihypertensive properties.

Overharvesting and illegal Trade:

The Himalayan region has experienced overharvesting of valuable medicinal plants such as *Picrorhiza kurroa* (Kutki) due to high demand in traditional medicine and pharmaceutical industries. Overharvesting, often coupled with unsustainable harvesting practices, has resulted in the depletion of natural populations and threatens the survival of these species.

To understand the depth of these challenges, data from the International Union for Conservation of Nature (IUCN) reveals that a considerable number of medicinal plant species are categorized as threatened or endangered (Jain et al.,1984), (Dhyani et al.,2016) . For instance, the Red List of Threatened Species indicates that approximately 31.4 % of plant species are currently at risk due to various conservation challenges.

In navigating these challenges, the conservation of medicinal plants requires a multidimensional approach that integrates ecological research, community involvement, and the strategic use of Geospatial Techniques. The following sections will delve into the role of geospatial techniques in addressing these challenges and promoting the sustainable conservation of medicinal plants.

Role of Geospatial Techniques:

Mapping Medicinal Plant Habitats:

Geospatial techniques, including Geographic Information Systems (GIS) and Remote Sensing, play a crucial role in mapping the habitats of medicinal plants. Satellite imagery and GIS technology enable researchers to identify and delineate specific areas where medicinal plants thrive. For example, a study utilizing GIS may reveal the distribution of *Artemisia annua* (Sweet Wormwood), a key plant for antimalarial drugs, across

different regions, helping in the establishment of conservation zones.

GIS in Medicinal Plant Conservation:

Geographic Information Systems offer powerful tools for analyzing spatial data and making informed decisions in medicinal plant conservation. By overlaying data on plant distribution with environmental variables, GIS helps identify priority areas for conservation.

Remote Sensing Applications:

Remote sensing technology aids in monitoring land cover changes and vegetation health. In the case, of *Boswellia serrata* (Indian Frankincense), which yields a resin with anti-inflammatory properties, remote sensing can track changes in the forest cover to assess potential threats and guide conservation strategies (Khamis *et al*.,2016). Data from satellite sensors provide valuable insights into forest dynamics and the impact of land-use changes on Boswellia populations.

Also, there are some statistical methods like, the use of vegetation indexes, such as the Normalized Difference Vegetation Index (NDVI), has become a valuable tool in plant research, providing critical insights into vegetation health, growth, and ecological dynamics. NDVI and other indexes are calculated from remote sensing data, primarily satellite imagery, and offer a quantitative measure of vegetation cover and photosynthetic activity.

Vegetation Health Assessment:

NDVI is widely used to assess the health and vitality of vegetation. By comparing the differences in reflectance of near-infrared and red-light bands, NDVI can indicate the amount of green biomass and chlorophyll present in plant canopies. Researchers can monitor changes in NDVI over time to detect stress, disease, or environmental factors affecting plant health.

NDVI i.e Normalized Difference Vegetation Index is a Remote Sensing method which is used to monitor health and productivity of Vegetation cover.

FORMULA FOR NDVI: NDVI = (NIR – RED) / (NIR + RED)

Monitoring Habitat Changes:

This technology allows researchers to track changes in vegetation and land use that affect the growth and distribution of medicinal plants. As Remote sensing relies on data collected from satellites, aircraft, or drones equipped with sensors (Ding et al.,2023). These sensors capture information, such as visible and infrared light, to create detailed images of the Earth's surface. By analyzing satellite imagery and spectral data, scientists can identify suitable areas for the cultivation of specific medicinal plants, assess their health, and detect endangered zone such as deforestation or habitat degradation. By comparing images taken at different time points, the alterations can be identified easily in the habitat. This could include deforestation, and changes in vegetation cover. And changes are highlighted as areas where the land cover has evolved over time.

Application In Soil quality monitoring:

Geospatial technology has reformed soil analysis, it offers a comprehensive approach to understand the dynamics of soil composition and health. This application

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integrates Geographical Information Systems (GIS), Remote Sensing, and Global Positioning System (GPS) technologies, and provide a powerful tool for researchers and environmentalists. One key benefit lies in the spatial representation of soil properties is the creation of detailed maps that highlight variations in soil texture, fertility, and moisture content across a given area. These maps, generated through the help of Satellite Imagery and ground-based data and this method helps farmers to make informed decisions regarding nutrient management of the particular area. GPS not only improves the accuracy of soil maps but also enables real-time monitoring of field activities. Farmers equipped with GPS devices can optimize the application of fertilizers and pesticides, reducing input costs and minimizing environmental risks.

Assessing Threat Levels and Vulnerability:

The assessment of threat levels to medicinal plant species, such as *Taxus baccata* (English Yew), involves integrating geospatial data on habitat loss, climate change impacts, and harvesting pressures. A study by (Nimasow et al.,2016) used GIS to model the vulnerability of *Taxus baccata* populations in response changing climate conditions, providing valuable insights for conservation planning.

Integrating Field Data with Geospatial Information:

Field data collection is a crucial component of monitoring medicinal plant populations. Geospatial techniques facilitate the integration of field data with spatial information, allowing for a comprehensive understanding of population trends. In the conservation of different species, researchers do combine field surveys with GIS mapping to assess the distribution and abundance of this medicinal herb in different ecosystems.

As per the discussion, it is very clear that applications of geospatial techniques in monitoring and assessing medicinal plant populations are far easier and more accurate. The integration of geospatial data into medicinal plant conservation strategies has proven effective in addressing conservation challenges.

As we explore the various applications of geospatial techniques, it becomes clear that these technologies offer a smart approach to tackling the challenges faced by medicinal plant conservation.

Components of Geographic Information System (GIS):

Hardware Components:

GIS involves various hardware components that are essential for data input, processing, and output. These include:

- Computers: High-performance computers are used for data processing and analysis.
- Input Devices: Devices like GPS receivers, digitizers, and scanners are used for capturing spatial data.
- Output Devices: Printers and plotters are used for producing maps and reports.

Software Components: GIS software is the core of the system, providing tools for data manipulation, analysis, and visualization. Some key GIS software includes:

- ArcGIS: Developed by Esri, ArcGIS is one of the most widely used GIS platforms for mapping and spatial analysis.

- QGIS: An open-source GIS software that offers powerful capabilities for mapping, analysis, and data editing.
- Google Earth: While not traditional GIS software, Google Earth provides an intuitive interface for visualizing spatial data.

Data Components: Data is a fundamental component of GIS, categorized into two types:

- **Spatial Data**: Includes information about the location and shape of geographic features. Examples are points, lines, polygons, and raster images.
- **Attribute Data:** Contains information about the characteristics of spatial features. Attributes are stored in tabular format and can be linked to spatial data.

Global Positioning System (GPS):

GPS is a crucial component for capturing accurate spatial data. It involves a network of satellites that provide real-time positioning information, allowing for precise data collection in the field.

Remote Sensing:

Remote sensing technologies, including satellites, drones, and aerial platforms, capture data about the Earth's surface. Remote sensing data is often integrated into GIS for mapping and monitoring purposes.

Conclusion

In conclusion, the integration of geospatial techniques into medicinal plant conservation has proven to be a transformative approach, providing invaluable insights and tools for sustainable management. From mapping medicinal plant habitats to assessing threats and vulnerabilities, geospatial tools enhance precision in conservation planning.

Geospatial techniques offer an overall understanding of medicinal plant ecosystems, allowing researchers to assess distribution patterns, monitor changes, and formulate targeted conservation strategies. Ongoing technological advancements, such as drone technology and machine learning, promise to further enhance the capabilities of geospatial techniques. These innovations open new ways for detailed monitoring and assessment of medicinal plant populations.

As we stand at the intersection of traditional floral wealth and cutting-edge technology, we can navigate the complexities of environmental changes, emerging threats, and the relationships between medicinal plants and their habitats. Through collaborative efforts and a commitment to sustainable practices, we can ensure that the rich repository of medicinal plant diversity continues to thrive for generations to come.

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Nature's Apothecary: Exploring the healing potential of Indian Medicinal Plants

Dr. Seema Pandey
A.N.D.N.N.M. Mahavidyalaya, Kanpur

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Abstract:

India's rich biodiversity is a treasure trove of medicinal plants, each exhibiting potent therapeutic properties. This chapter will delve into the importance of Indian medicinal plants in healthcare, exploring their historical significance, current utilization, future prospects and many more. Through a review, we will understand the diverse healing traditions and modern scientific advancements, highlighting the critical role of these plants in promoting human health and well-being. From ancient Ayurveda to modern-day pharmacology, we shall uncover the various benefits of Indian medicinal plants and advocate for their continued exploration, conservation, and integration into global healthcare systems.

Keywords: Medicinal plant, Biodiversity, Therapeutic

Introduction:

In the modern society, reliance on modern medicine is becoming a necessity. It's easy to ignore the simple yet profound contributions of medicinal plants to human health and well-being. For millennia, plants have served as the primary source of medicine for various cultures and traditions around the globe. The use of medicinal plants has been integral to the preservation and promotion of health, such instances are found from the ancient wisdom of Ayurveda and Traditional Chinese Medicine as well as indigenous healing practices. India's cultural heritage is deeply mixed with the use of medicinal plants for healing and well-being. With over 7,000 species of plants known for their medicinal properties, India boasts a diverse pharmacopoeia that continues to inspire research and innovation in the field of healthcare.

Historical Significance:

The roots of India's herbal healing traditions can be traced back to ancient texts such as the Vedas and the Charaka Samhita. Ayurveda, the ancient Indian system of medicine, emphasizes the comprehensive approach to health, focusing on maintaining the balance between mind, body, and spirit. Many of the herbs mentioned in these ancient texts are still used in modern day medicines, which serves as a testimony to their enduring effectiveness.

Their floral history is as rich and diverse as human civilization itself. Some more ancient texts such as the Ebers Papyrus from ancient Egypt and the works of Hippocrates in ancient Greece record the use of plants for treating ailments ranging from fevers to digestive disorders. In many indigenous cultures, traditional healers possess deep knowledge of local flora, passed down through generations, which forms the backbone of their medical practices.

Current Utilization:

In modern-day India, medicinal plants continue to serve a pivotal role in healthcare, especially in the rural areas, where knowledge and availability of modern medicines are limited or negligible. Traditional healers, known as vaidyas, continue to suggest herbal remedies based on centuries-old knowledge passed down through generations.

In recent decades, there has been a revival of interest in medicinal plants within the scientific community. Researchers are increasingly opting for the traditional knowledge systems to uncover new therapeutic compounds and revalidate the legitimacy of traditional remedies. Many modern pharmaceuticals trace their origins back to natural sources, with over 50% of prescription drugs being derived from or inspired by plants. Modern pharmaceutical companies are turning to Indian medicinal plants at a rapid rate so they could serve as a source of novel drug compounds, driving research and development in the field of natural medicine.

Therapeutic Potential

Indian medicinal plants offer a wide scope of therapeutic benefits. These benefits range from relieving common ailments like coughs and colds to treating chronic conditions such as diabetes and hypertension. Plants like Neem (Azadirachta indica), Tulsi (Ocimumtenuiflorum), and Turmeric (Curcuma longa) are renowned for their anti-inflammatory, antimicrobial, and antioxidant properties, making them valuable assets in the fight against disease.

Challenges faced and Conservation efforts

Despite their immense potential and capability to drastically change the pharmaceutical world to one that is more practical and productive,

The Indian medicinal plants are faced with numerous challenges such as habitat loss, overexploitation, and unsustainable harvesting practices. Climate change is a leading factor in the endangerment of these plant species and their medicinal value.

Importance of preserving biodiversity cannot be over exaggerated when it comes to medicinal plants. Losing these species would not only deprive us of potential cures but also disrupt equilibrium balance of the ecosystem and traditional healing practices. Efforts to conserve medicinal plants must therefore go hand in hand with broader conservation initiatives. However, there is hope left as the conservation efforts are gaining momentum, and initiatives to promote sustainable harvesting and cultivation.

Some key strategies can be: -

1. **Habitat Protection:** Establish protected areas and botanical gardens to conserve natural habitats.
2. **Sustainable Harvesting:** Control and balance harvest quantities and seasons to prevent overexploitation.
3. **Cultivation:** Encourage the cultivation of medicinal plants to reduce pressure on wild populations.
4. **Community Engagement:** Involving local communities in the conservation efforts and empowering them to manage resources sustainably.

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5. **Policy Advocacy:** Favor for policies that prioritize conservation and enforce regulations against illegal harvesting.
6. **Education and Awareness:** Raising awareness about the importance of medicinal plants for health and biodiversity conservation can help people by giving them agist of the cause and empowering them to take actions for the same.
7. **Collaboration:** Collaborate with stakeholders to leverage expertise and resources for effective conservation.

As read earlier, medicinal plants offer a wide range of remedial benefits, from treating common ailments to combating life-threatening diseases. Some notable examples include:

1. **Sweet Wormwood (Artemisia annua):** The source of artemisinin, the sweet wormwood is a key ingredient in the most effective treatment for malaria.
2. **Pacific Yew (Taxusbrevifolia):** The bark of this tree yields paclitaxel, a chemotherapy drug used to treat various cancers.
3. **Opium Poppy (Papaversomniferum):** From which morphine and codeine are acquired, provides essential pain relief in medicine.
4. **Turmeric (Curcuma longa):** Curcumin in turmeric has anti-inflammatory and antioxidant properties, and is used for treating arthritis, digestive issues, skin conditions, and respiratory infections.
5. **Ginkgo (Ginkgo biloba):** Ginkgo contains flavonoids and terpenoids that enhance cognitive function, memory, and concentration, and may alleviate symptoms of age-related cognitive decline and dementia.

Holistic Health and Wellness:

Beyond their meditative properties, medicinal plants offer a holistic approach to health and wellness. Many traditional healing systems accentuate the interrelatedness of mind, body, and spirit, viewing illness as an imbalance that affects the whole person. By embracing medicinal plants into our healthcare practices, we not only treat symptoms but also address basal imbalances and promote overall well-being.

Future Directions:

As we continue to bring to light the mysteries of the natural world, the potential of medicinal plants remains vast and largely untouched. Advances in fields such as ethnobotany, pharmacognosy, and molecular biology hold promise for discovering new medicinal compounds and improving our understanding of traditional healing practices. However, we must keep in mind that it's crucial that we approach this work with respect for indigenous knowledge, cultural diversity, and ecological sustainability.

Conclusion:

The importance of Indian medicinal plants in healthcare cannot be undermined. From ancient Ayurvedic remedies to modern pharmaceutical innovations, these botanical treasures continue to improve human lives and inspire scientific progress. As we navigate the complexities of a rapidly evolving healthcare landscape and make drastic improvements, let us not forget the sagacity of our ancestors and the healing power of nature's pharmacy. By preserving and harnessing the potential of Indian medicinal plants,

we can pave the way for a healthier and more sustainable future for all.

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Role of Artificial Intelligence in Agriculture — the Future of Farming

Prof. Dr. Varsha Sanjay Khude
Department of Botany, Devchand College,
Arjunnagar, Tal. Kagal. Dist. Kolhapur.
Email: drvashakhude81@gmail.com

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Abstract:

The growth of the global population, which is projected to reach 10 billion by 2050, is placing significant pressure on the agricultural sector to increase crop production and maximize yields. To address looming food shortages, two potential approaches have emerged: expanding land use and adopting large-scale farming, or embracing innovative practices and leveraging technological advancements to enhance productivity on existing farmland Pushed by many obstacles to achieving desired farming productivity, limited land holdings, labor shortages, climate change, environmental issues, and diminishing soil fertility, to name a few, the modern agricultural landscape is evolving, branching out in various innovative directions. Farming has certainly come a long way since hand plows or bull-drawn machinery. Each season brings new technologies designed to improve efficiency and capitalize on the harvest. However, both individual farmers and global agribusinesses often miss out on the opportunities that artificial intelligence in agriculture can offer to their farming methods.

Introduction:

Benefits of AI in agriculture:

Recently, using the words AI and agriculture in the same sentence may have seemed like a strange combination. After all, agriculture has been the backbone of human civilization for millennia, providing sustenance as well as contributing to economic development, while even the most primitive AI only emerged several decades ago. Nevertheless, innovative ideas are being introduced in every industry, and agriculture is no exception. In recent years, the world has witnessed rapid advancements in agricultural technology, revolutionizing farming practices. These innovations are becoming increasingly essential as global challenges such as climate change, population growth together with resource scarcity threaten the sustainability of our food system. Introducing AI solves many challenges and helps to diminish many disadvantages of traditional farming. Use of AI in agriculture Increase yields, reduce costs, and develop a more sustainable ecosystem. Following are some of the benefits of AI in agriculture

1) Data-based decisions:

The modern world is all about data. Organizations in the agricultural sector use data to obtain meticulous insights into every detail of the farming process, from understanding each acre of a field to monitoring the entire produce supply chain to gaining deep inputs on yields generation process. AI-powered predictive analytics is

already paving the way into agribusinesses. Farmers can gather, then process more data in less time with AI. Additionally, AI can analyze market demand, forecast prices as well as determine optimal times for sowing and harvesting. Artificial intelligence in agriculture can help explore the soil health to collect insights, monitor weather conditions, and recommend the application of fertilizer and pesticides. Farm management software boosts production together with profitability, enabling farmers to make better decisions at every stage of the crop cultivation process.

2) Cost savings:

Improving farm yields is a constant goal for farmers. Combined with AI, precision agriculture can help farmers grow more crops with fewer resources. AI in farming combines the best soil management practices, variable rate technology, and the most effective data management practices to maximize yields while minimizing minimize spending. Application of AI in agriculture provides farmers with real-time crop insights, helping them to identify which areas need irrigation, fertilization, or pesticide treatment. Innovative farming practices such as vertical agriculture can also increase food production while minimizing resource usage. Resulting in reduced use of herbicides, better harvest quality, and higher profits alongside significant cost savings.

3) Automation impact:

Agricultural work is hard, so labor shortages are nothing new. Automation provides a solution without the need to hire more people. While mechanization transformed agricultural activities that demanded super-human sweat and draft animal labor into jobs that took just a few hours, a new wave of digital automation is once more revolutionizing the sector. Automated farm machinery like driverless tractors, smart irrigation, fertilization systems, IT-powered agricultural drones, smart spraying, vertical farming software, and AI-based greenhouse robots for harvesting are just some examples. Compared with any human farm worker, AI-driven tools are far more efficient and accurate.

4) Optimizing automated irrigation systems:

AI algorithms enable autonomous crop management. When combined with IoT (Internet of Things) sensors that monitor soil moisture levels and weather conditions, algorithms can decide in real-time how much water to provide to crops. An autonomous crop irrigation system is designed to conserve water while promoting sustainable farming practices.

5) Detecting leaks or damage to irrigation systems:

AI plays a crucial role in detecting leaks in irrigation systems. By analyzing data, algorithms can identify patterns and anomalies that indicate potential leaks. Machine learning (ML) models can be trained to recognize specific signatures of leaks, such as changes in water flow or pressure. Real-time monitoring and analysis enable early detection, preventing water waste together with potential crop damage. AI also incorporates weather data alongside crop water requirements to identify areas with excessive water usage. By automating leak detection and providing alerts, AI technology enhances water efficiency helping farmers conserve resources.

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6) Crop and soil monitoring:

The wrong combination of nutrients in soil can seriously affect the health and growth of crops. Identifying these nutrients and determining their effects on crop yield with AI allows farmers to easily make the necessary adjustments. While human observation is limited in its accuracy, computer vision models can monitor soil conditions to gather accurate data. This plant science data is then used to determine crop health, predict yields while flagging flag any particular issues. In practice, AI has been able to accurately track the stages of wheat growth and the ripeness of tomatoes with a degree of speed and accuracy no human can match.

7) Detecting disease and pests:

As well as detecting soil quality and crop growth, computer vision can detect the presence of pests or diseases. This works by using AI to scan images to find mold, rot, insects, or other threats to crop health. In conjunction with alert systems, this helps farmers to act quickly in order to exterminate pests or isolate crops to prevent the spread of disease. AI has been used to detect apple black rot with an accuracy of over 90%. It can also identify insects like flies, bees, moths, etc., with the same degree of accuracy. However, researchers first needed to collect images of these insects to have the necessary size of the training data set to train the algorithm with.

8) Monitoring livestock health:

It may seem easier to detect health problems in livestock than in crops, in fact, it's particularly challenging. Thankfully, AI can help with this. For example, a company called Cattle Eye has developed a solution that uses drones, cameras together with computer vision to monitor cattle health remotely. It detects atypical cattle behavior and identifies activities such as birthing. Cattle Eye uses AI and ML solutions to determine the impact of diet alongside environmental conditions on livestock and provide valuable insights. This knowledge can help farmers improve the well-being of cattle to increase milk production.

9) Intelligent pesticide application:

By now, farmers are well aware that the application of pesticides is ripe for optimization. Unfortunately, both manual and automated application processes have notable limitations. Applying pesticides manually offers increased precision in targeting specific areas, though it might be slow and difficult work. Automated pesticide spraying is quicker and less labor-intensive, but often lacks accuracy leading to environment contamination. AI-powered drones provide the best advantages of each approach while avoiding their drawbacks. Drones use computer vision to determine the amount of pesticide to be sprayed on each area. While still in infancy, this technology is rapidly becoming more precise.

10) Yield mapping and predictive analytics:

Yield mapping uses ML algorithms to analyze large datasets in real time. This helps farmers understand the patterns and characteristics of their crops, allowing for better planning. By combining techniques like 3D mapping, data from sensors and drones, farmers can predict soil yields for specific crops. Data is collected on multiple

drone flights, enabling increasingly precise analysis with the use of algorithms. These methods permit the accurate prediction of future yields for specific crops, helping farmers know where and when to sow seeds as well as how to allocate resources for the best return on investment.

11) Automatic weeding and harvesting:

Similar to how computer vision can detect pests and diseases, it can also be used to detect weeds and invasive plant species. When combined with machine learning, computer vision analyzes the size, shape, and color of leaves to distinguish weeds from crops. Such solutions can be used to program robots that carry out robotic process automation (RPA) tasks, such as automatic weeding. In fact, such a robot has already been used effectively. As these technologies become more accessible, both weeding and harvesting crops could be carried out entirely by smart bots.

12) Sorting harvested produce:

AI is not only useful for identifying potential issues with crops while they're growing. It also has a role to play after produce has been harvested. Most sorting processes are traditionally carried out manually however AI can sort produce more accurately. Computer vision can detect pests as well as disease in harvested crops. What's more, it can grade produce based on its shape, size, and color. This enables farmers to quickly separate produce into categories — for example, to sell to different customers at different prices. In comparison, traditional manual sorting methods can be painstakingly labor-intensive.

13) Surveillance:

Security is an important part of farm management. Farms are common targets for burglars, as it's hard for farmers to monitor their fields around the clock. Animals are another threat whether it's foxes breaking into the chicken coop or a farmer's own livestock damaging crops or equipment. When combined with video surveillance systems, computer vision and ML can quickly identify security breaches. Some systems are even advanced enough to distinguish employees from unauthorized visitors.

Challenges of AI in agriculture

Many people perceive AI as something that applies only to the digital world, with no relevance to physical farming tasks. This assumption is usually based on a lack of understanding of AI tools. Most people don't fully understand how AI works, especially those in non-tech-related sectors, leading to slow AI adoption across the agricultural sector. Although agriculture has seen countless developments in its long history, many farmers are more familiar with traditional methods. A vast majority of farmers are unlikely to have worked on projects that involved AI technology. Also, AgTech providers often fail to clearly explain the benefits of new technologies and how to implement them. A huge amount of work must be done by technology providers to help people understand the application of AI in agriculture. Considering the benefits of artificial intelligence for sustainable farming, implementing this technology may look like a logical step for every farmer. However, there are still some challenges to overcome.

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1) Large upfront costs:

While AI solutions can be cost-effective in the medium-to-long-term, there's no escaping the fact that the initial investment can be very expensive. With many farms and agribusinesses struggling financially, adopting AI may be impossible for the time being, especially in the cases of small-scale farmers and those in developing countries. However, the cost of implementing AI may drop as technologies develop. Businesses also have the opportunity to explore funding resources such as government grants or private investment.

2) Reluctance to embrace new technologies and processes:

Unfamiliarity often makes people hesitant to adopt new technologies creating difficulties farmers to fully embrace AI, even when it offers undeniable benefits. Resistance to innovation alongside some reluctance to take a chance on new processes holds back the farming methods development as well as the sector's profitability in general. Farmers need to understand that AI is only a more advanced version of simpler technologies for field data processing. To convince agricultural workers to embrace AI, the public and private sectors should provide motivation, resources, and training. Governments must also develop the regulations needed to assure workers that the technology is not a threat.

3) Lack of practical experience with new technologies:

Aspects of the agricultural industry differ in their technological advancement around the world. Some regions could leverage all the benefits AI, though there are some hurdles in countries where next-gen agricultural technology is uncommon. Technology companies hoping to do business in regions with emerging agricultural economies may need to take a proactive approach. In addition to providing their products, they must offer training and ongoing support for farmers and agribusiness owners who are ready to take on innovative solutions.

4) A lengthy technology adoption process:

In addition to a lack of understanding and experience, the agricultural sector generally lacks the infrastructure needed for AI to work. Even farms that already have some technology in place may find it difficult to move forward. Infrastructure is also a challenge for AgTech providers and software companies. One of the main ways to overcome this is by approaching farmers gradually: for instance, offering the use of simpler technology first, such as an agricultural trading platform. Once farmers get used to a less complicated solution, providers can add additional tools and features.

5) Technological limitations:

As AI is still developing, the technology will have constraints. Accurate models depend on diverse, high-quality data, which can be scarce in agriculture. For robots with sensors, limitations can make adapting to changing farming environments difficult. Overcoming these limitations requires ongoing research and analysis of data. Farmers should also remain involved with decision-making rather than entirely handing control over to AI. Monitoring AI decisions manually is likely to be useful during the early stages of adoption.

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6) Privacy and security issues:

There is still a general lack of regulations relating to the use of AI across all industries. Particularly, implementing AI in precision agriculture and smart farming raises various legal questions. For example, security threats like cyberattacks and data leaks may cause farmers serious problems. It's even conceivable that AI-based farming systems could be targeted by hackers with the aim of disrupting food supplies.

What is the future of AI in agriculture?

AI is sure to play an increasingly large role in agriculture and food sustainability over the coming years. Technology has always been at the forefront of agriculture, from primitive tools to irrigation to tractors to AI. Each development has increased efficiency while reducing the challenges of farming.

More importantly, the benefits of AI in agriculture are undeniable. Smart farming tools, intelligent automation, and AI-powered products perform repetitive time-consuming tasks so workers can use their time for more strategic operations that require human judgment. Increasingly affordable computer vision alongside agricultural robotics has the potential to accelerate AI advancement in farming. AI has the tools to address the challenges posed by climate change, environmental concerns, and an increasing demand for food. It will revolutionize modern agriculture by improving efficiency, sustainability, resource allocation on top of real-time monitoring for healthier and higher-quality produce.

However, you can't just buy AI and start using it. AI is not something tangible it's a set of technologies that are automated through programming. In essence, an AI algorithm mimics the way people think it learns first, and then solves problems based on data. AI-driven transformation of agriculture will require changes in the industry. Farmers need to be educated and trained for using AI.

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Coastal Ecosystem in Effective Climate Change Adaptation (Cca) and Disaster Risk Reduction (Drr) Measures

Nivas M. Desai
Department of Botany,
Dapoli Urban Bank Senior Science College, Dapoli 415712
Vaishali S. Shewale
PG Department of Zoology,
Sadguru Gadge Maharaj College, Karad 415124
Email: - *nivasdesai88@gmail.com*

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Abstract:

The worsening of overall environmental sustainability is one of the main causes of increase in physical as well as socioeconomic vulnerability. The increasing intensity of natural disasters, natural hazard or climatic extreme into a disaster are due to the tremendous degradation of natural resources. The improper and unscientific developmental activities in the recent past, have adversely affected the environment that are resulted into exponential increase in instability of ecosystem thus making it more susceptible to climate related disasters. The local geo-climatic conditions and other socioeconomic issues are less considered during the so-called development. The deforestation and degradation of mangrove vegetation during the last few decades has been the most prominent and major reason for the present state of deteriorated environmental situation in the coastal belt. The remarkable population pressure and increasing needs and greed has weakened our most valuable natural coastal resources, below the threshold level created increase of vulnerability to natural disasters.

Mangrove ecosystem is unique because land and water meet here to create an environment with a distinct structure, diversity and flow of energy. It comprises most productive and diverse array of habitats than any other ecosystems. Mangrove biodiversity provides services essential for helping people adapt to the impacts of climate change and disaster risks. Recently, "ecosystem-based adaption" (EbA) and "ecosystem-based disaster risk reduction" (Eco-DRR) have gained increasing attention in risk management. Both the approaches accentuate the importance of this productive ecosystem in effective climate change adaptation (CCA) and disaster risk reduction (DRR) measures. Not only this, it helps to build on other practices like conservation and ecosystem restoration that seeks to increase the resilience of ecosystems. Thus, there is urgent need in designing and implementation of EbA and Eco-DRR strategies in a coastal region as part of an overall climate change adaptation or DRR strategy, on local as well as national level.

Keywords: Ecosystem-based adaption, climate change, disaster risk reduction, coastal ecosystem, mangroves, coral reef.

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Introduction:

The climate change impact on the society is more frequent and occurring earlier than the predicted time. The impact is more pronounced in the form of floods, drought, increase in the heat wave, increased storm intensity and causing major and long-term effect on the ecology as well as economy. The 2016 Global Risk Report rates extreme weather occurrences as the second-highest danger in terms of likelihood, while the risk of failure of climate change adaptation and mitigation as the top risk in terms of impact. The 2016 Global Risk Report rates extreme weather occurrences as the second-highest danger in terms of likelihood, while the risk of failure of climate change adaptation and mitigation as the top risk in terms of impact. The human activities such as over population, urbanization increasing the disaster risk though additional development pressure in the sensitive zones like coastal system and low-lying areas. Biodiversity and ecosystems providing the essential services for the Ecosystems and biodiversity provide crucial services that aid humans in adapting to the effects of climate change and catastrophe risks. In recent years, risk management has paid more attention to "ecosystem-based adaptation" (EbA) and "ecosystem-based disaster risk reduction" (Eco-DRR). These techniques stress the role of ecosystems in successful climate change adaption (CCA) and disaster risk reduction (DRR) strategies, and they draw on existing activities that aim to promote ecosystem resilience, such as conservation and ecosystem restoration and Eco-DRR have gained popularity because they benefit people, ecosystems, and biodiversity, allow for longer-term planning for CCA and DRR, are less expensive than traditional engineered infrastructure, and emphasize community participation and the use of traditional and local knowledge systems. EbA and Eco-DRR can achieve multiple policy objectives, including local, regional, and national strategies for climate change, disaster risk reduction, and sustainable development, among others, due to their participatory nature and cross-sectoral approaches to adaptation and disaster risk reduction. Major international accords, such as the Paris Agreement and the Sustainable Development Goals, have emphasized the importance of improving environmental and societal resilience to climate change and catastrophe risk. To mitigate the risk of climate effects and hazards, governments are increasingly incorporating ecosystem-based methods into national plans and policies — examples have been compiled in CBD Technical Series No. 85. (Lo 2016). However, there is still a disconnect between policy formulation and execution. The goal of these recommendations is to aid in the development and implementation of EbA and Eco-DRR plans as part of a larger climate change adaptation or DRR strategy at several scales, including local, subnational, and national levels.

The Role of Ecosystems Management for Disaster Risk Reduction:

The frequency of natural-hazard-related disasters continues to climb, wreaking havoc on human lives, livelihoods, assets, and economies. Over 2.2 million people have died in natural hazard-induced catastrophes (excluding epidemics) over the world in the last three decades (1975-2008), resulting in USD 1,527.6 billion in economic damages. Disasters jeopardize livelihoods and progress toward achieving the Millennium

Development Goals and reducing poverty. Storms, floods, landslides, and droughts will become more dangerous as a result of climate change and the predicted rise in the frequency and intensity of extreme weather events. From 1988 to 2007, hydrological, meteorological, or climatological disasters accounted for 76 percent of all disasters, accounting for 45 percent of all deaths and 79 percent of all economic losses caused by natural hazards. The 2004 Indian Ocean tsunami sparked a global interest in promoting ecosystem management approaches for disaster risk reduction, drawing increased international attention to the role of coastal ecosystems as natural barriers to coastal hazards and leading to major initiatives such as the Mangroves for the Future (MFF) Programme. Climate change and unpredictability, along with globally broad ecosystem degradation, necessitate solutions that are not only cost-effective, but also locally accessible and adaptable. Ecosystem-based techniques, which are currently used by local communities as part of their livelihood plans and obviously provide risk reduction benefits, are thus a viable option. While ecosystems management is not a new idea, more evidence is needed to construct the case and show how ecosystems management may be optimized for disaster risk reduction, making it easier for communities, disaster management practitioners, politicians, and decision makers to adopt it.

Why are ecosystems important in reducing catastrophe risk?

Ecosystems are thought to play a role in catastrophe risk reduction in two ways. To begin with, ecosystems such as wetlands, forests, and coastal systems can limit physical exposure to natural hazards by acting as natural protective barriers or buffers, reducing hazard consequences. Landslides, flooding, avalanches, storm surges, wildfires, and drought are among natural dangers that can be mitigated by well-managed ecosystems. Mountain forests in the European Alps, for example, have a long history of being maintained to prevent avalanches and rockfall. National rules for forest protection management in Switzerland were created in collaboration with local forest managers and scientists, and the government offers financial incentives to manage forests for hazard mitigation. Several European countries, including Germany, the Netherlands, the United Kingdom, Eastern European countries bordering the Danube River and Switzerland are attempting to mitigate floods by removing built infrastructure and restoring wetlands and river channels to improve water retention capacity. In Argentina, large swaths of natural forest have been set aside for flood management, as a low-cost alternative to costly infrastructure with added ecological advantages. Ecosystems also reduce social-economic susceptibility to hazard consequences, which is the second way they reduce catastrophe risk. While it is tempting to focus just on ecosystem conservation and hazard regulation functions, ecosystems also support human livelihoods and supply basic items such as food, fiber, medicines, and construction materials, all of which are critical for human security and catastrophe resilience. Mangroves, coral reefs, and seagrass beds, for example, are essential resources for local livelihoods because they enable fishing and tourist activities, in addition to providing coastal hazard protection. Wetlands are being restored in China to avoid flooding while also giving other social and economic advantages that might lessen susceptibility to disasters. The World Bank is working in

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Mexico on a large-scale coastal wetland and mangrove swamp project. Coastal protection against storms and seawater intrusion owing to a restoration project Communities' water supply and food production will be impacted by rising sea levels. Ecosystems that are well-managed are more robust to the effects of catastrophic events and can recover more quickly than ecosystems that have been degraded.

Environmental Management for Coastal Hazard Mitigation:

Ecologically harmful behaviors are causing an increasing percentage of the destruction caused by 'natural' disasters throughout the world. Many ecosystems have been weakened to the point where they are no longer robust or able to endure natural catastrophes, paving the way for 'unnatural disasters,' which are those that are more frequent or severe as a result of human activity. We are unravelling the strands of a sophisticated biological safety net by damaging forests, manipulating rivers, filling up wetlands, and altering the climate. According to the statistical models, settlements within ten kilometers of the shore would have experienced an increase in mortality if mangroves had not been present. According to the paper, "statistical evidence of this life-saving impact is strong" and "very substantial" even after accounting for other environmental and socioeconomic variables. To assess the influence in decreasing the vulnerabilities of coastal communities to coastal hazards and development at large, it is necessary to understand the coastal environment and the distinctive ecosystem services it provides.

The importance of understanding the coastal environment:

The term "coastal ecosystem" has no clear meaning. In the Millennium Ecosystem Assessment, regions with fewer than 50 meters of depth on the seaward side of the coastline and a maximum height of 100 kilometers or 50 meters landwards from the coast (whichever is closer to the sea) were examined. A coastline is the line that separates the sea from the land. Due to the ongoing tidal movement, it is impossible to create a precise line that may be termed a shoreline. The phrase "coastal zone" refers to a geographic area where processes of sea-land interaction take place. The coastal zone is defined by the Millennium Ecosystem Assessment (MEA) report as a smaller region of terrestrial land affected by maritime impacts such as tides and marine aerosols. However, because the word coastal zone is more commonly employed in the context of coastal management, its meaning varies per nation. Coastal ecosystems are unusual in that they combine land and water to form a habitat with a particular structure, variety, and energy movement. They have a broader range of habitats than any other environment. Coral reefs, mangroves, tidal wetlands, sea grass beds, barrier islands, estuaries, peat swamps, and other ecosystems all supply their own unique set of products and services. The coastal environment supports a diverse range of plant and animal species due to its diverse habitats. Habitats also interact with one another and are interdependent. With 1.6 million kilometers of coastline, the coastal zone is claimed to cover over 18 percent of the globe's surface. There are 123 countries on the planet having coastlines. Many of the coastlines are becoming more urbanized. Coastal cities make up two-thirds of the world's population, with 14 of the world's 17 major cities located along coastlines. Eleven of these cities are in Asia, including Mumbai, Bangkok, Jakarta, and Shanghai. Around

40% of the world's population lives near the shore, with 20% living within 25 kilometers, 29% within 50 kilometers, and 39% within 100 kilometers.

Hazards and vulnerability on the coast:

Natural and hydro meteorological (atmospheric, hydrological, or oceanographic) risks are the most common types of coastal hazards. Floods, flash floods, debris and mud floods; tropical cyclones, storm surges, torrential rains and wind storms, tsunami; coastal erosion; harmful algal blooms; submarine mudslides; and global climate change hazards such as sea level rise, surface sea temperature rise, and frequent storms are among them. Human-caused risks like as pollution from industrial and domestic effluents, as well as oil spills, threaten the coasts. In terms of the duration of an event and its impact on life and property, the extent of each hazard's impact varies. While certain risks, such as tsunamis and storm surges, are only temporary, each one has a significant impact per unit of time. They do a lot of harm in a short amount of time. Tsunamis, on the other hand, occur infrequently near the Indian Ocean's coastline. Other risks, such as coastal erosion and pollution, arise over time. As a result, they are processes rather than occurrences. The effect per unit of time is minimal. Any harm they produce is done in a slow and cumulative manner. Short-duration, high-impact events may be quickly identified and recorded. The cumulative effect of processes such as pollution generally has a higher influence over a longer period of time than high-impact events. Some dangers, such as hazardous algal blooms, may not result in deaths, but they do have an impact on health, which has an impact on daily living and the economy. Some risks, such as rising sea levels, may not result in death, but they have the potential to disturb life. Coastal erosion will not result in any deaths, but it will have a significant impact on populations, livelihood, and infrastructure along the shore. To establish the type of threat, you must first define the type of danger. The frequency of their occurrence, the regional distribution of their affects, and the size of the impacts connected with them will all aid in the analysis of these risks. Hazards can turn into catastrophes, interrupting life and inflicting significant loss of life, livelihood, and property, such as the recent Asian tsunami (2004) and the Orissa super cyclone on India's eastern coast (1999). Due to a variety of causes, most coastal towns, particularly in poor nations, lack enough ability to cope with such catastrophic events and are thus prone to dangers. Geographical (slope, elevation, shoreline features); climatic (temperature rise); demographic (population, gender, age, density); social (literacy and education, insurance, health); economic (livelihood, property); physical (houses, roads, bridges, cyclone shelters, transportation and communication systems); environmental (availability and quality of natural resources, quality of ecosystem services); developmental (type of developmental act); Many studies have demonstrated that excellent environmental management would strategically enhance and strengthen the coastal hazard mitigation strategy, therefore there has been a lot of interest in understanding the link between environmental variables and coastal hazards in recent years.

Ecosystem services' contribution to coastal hazard reduction:

Ecosystems are the intricate interactions between species, including people, and

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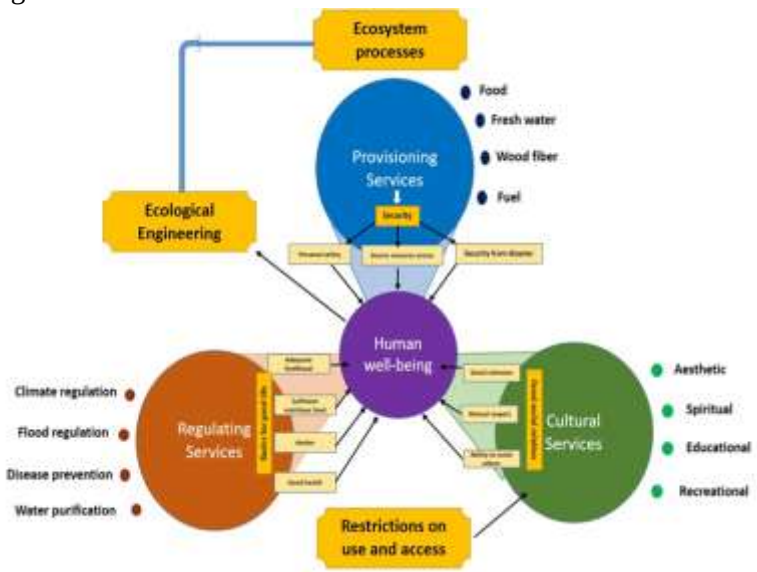
their physical surroundings, such as water and soil, as we all know. Coastal ecology, as previously said, is unique in that it provides a variety of services that benefit people, other living species, and the physical environment. Provisioning, which includes the production of food, fuel fodder, medicine, and fuel; regulating, which includes the control of climate, floods, storm surges, and disease; supporting, which includes nutrient cycles and crop pollination; cultural, which includes spiritual and recreational benefits; and preserving, which includes guarding against uncertainty through the maintenance of diversity (1). According to a preliminary assessment of the overall economic value of ecosystem services, the coastal zone delivers products and services worth around 43 percent of the projected total value of global ecosystem services, which corresponds to more than 12.6 trillion USD in economic terms (1). The value of ecosystem services, on the other hand, is difficult to quantify. The majority of individuals regard ecosystem services as gratuitous and do not place a value on them. Coral reefs, estuaries, marshes, and lagoons are important coastal ecosystems that give immediate advantages such as food (fish, crustaceans, mollusks, seaweeds), clean water (shallow aquifers, surface fresh water), fuel, and lumber (mangroves and other coastal vegetation). They provide coastal populations with a range of livelihood options such as fishing, tourism, and aquaculture, consequently improving their socioeconomic situations. They also provide services like as pollinating crops, keeping soil nutrient balance, delivering clean water, and so on, all of which contribute to the betterment of socioeconomic situations indirectly. Improved socioeconomic conditions reduce catastrophe susceptibility.

Regulating services, on the other hand, play a direct role in minimizing vulnerability. For example, one of the most significant services in the fight against climate change is climate regulation. Water and flora absorb the main greenhouse gas (CO2), which is then stored in biomass, soil, and water. Soil bacteria also regulate other greenhouse gases, such as methane (CH4) and nitrous oxide (N2O). They manage soil erosion and regulate the hydrological cycle. The photosynthesis process, which is carried out by coastal vegetation and sea weeds, produces oxygen and hence aids in the balancing of atmospheric gas concentrations. Floodwaters are held back by wetlands, which reduces flood damage. Mangroves and coral reefs, in particular, operate as speed breakers, reducing the impact of coastal storms and severe tides. In addition to supplying fuel wood, lumber, and fishery supplies for coastal populations, mangrove forests serve an important role in land stabilization by trapping sediments, cycling nutrients, processing pollutants, and sustaining nursery habitats for marine creatures. Sand dune systems function as sediment reserves, shoreline stabilization, and wind speed reduction. Seagrasses, which typically populate soft-bottom sections of the oceans from the tropics to the temperate zones, play an important role in shoreline and dune stabilization.

Changing coastal ecosystem:

Both natural and artificial influences have substantially altered the coastal ecology during the last 50 years. These variables have caused one or more changes, either directly or indirectly, in one or more habitats in the coastal ecosystem, and have even had cascade consequences. Natural processes such as wind and wave activity, for

example, have caused coastal erosion, although the process has taken several years and has been sluggish. Anthropogenic influences appear to have contributed to the fast changes in coastal ecosystem degradation that have been documented in recent years, according to the global trend.



Because coasts are the center of various economic activity, there is a significant commercial interest in coastal development. Ports, tourism, industries, destructive fisheries (use of dynamite and cyanide, bottom trawling), destruction of mangrove and coastal vegetation, mining (sand, coal, minerals), aquaculture, infrastructure (buildings, roads, transportation), and urbanization are all contributing to habitat shrinking, loss, and conversion to support commercial activities. As a result, eutrophication, pollution, and salinization of estuaries are increasing; sea levels are rising owing to climate change; and alien species are invading, posing a danger to coastal biodiversity. The demand on coastal resources, such as fish, coastal flora, minerals, and sand, is increasing due to overexploitation. The coastlines are rapidly declining due to habitat loss, degradation, and overexploitation of coastal resources, diminishing the ecosystem's potential to provide ecological functions. This has made the shoreline more susceptible, rendering coastal populations more subject to risks and affecting their livelihood.

Hazard mitigation through environmental management:

The link between the environment, development, and disasters is unmistakable. Environmental management also serves as a risk management tool. However, a thorough grasp of the environment's multifaceted function, as well as the underlying link between coastal environmental management and hazard reduction, is essential.

• Natural hazards are physical phenomena that are influenced directly by societal processes. Pollution, for example, and global warming as a result of anthropogenic greenhouse gas emissions;

• Healthy ecosystems frequently supply natural defenses;

• Degraded ecosystems impair community resilience;

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• Environmental degradation is a danger in and of itself;

If not addressed, environmental consequences can pose a severe threat to people's lives and livelihoods; this remains a major concern. As a result, there is a lot of ambiguity and a lack of clarity when it comes to disaster risk reduction methodologies and procedures in coastal management. As a result, there is a limited focus on research and policy measures. While it is well acknowledged that catastrophes have an impact on ecosystems, it is frequently overlooked that conserving ecosystem services may save lives and safeguard livelihoods. As a result, many practitioners have yet to apply the exciting notion of leveraging environmental tools for catastrophe mitigation (2).

Coastal hazard prevention using an ecosystem approach:

The 'ecological approach' to managing the coastlines is evolving internationally in awareness of the usefulness of coastal ecosystem services in providing protection against coastal hazards, especially those caused by climate change impacts. With its different habitats providing a range of management issues, it is felt that today's key and most cost-effective disaster risk reduction strategies are the conservation of coastal ecosystems and solid environmental management, and that this is a constructive way of looking at development. The value of 'the ecosystem approach' for coastal management stems from the fact that it considers the environment to be 'essential' to decision-making and planning. It takes environmental considerations into account while making development decisions. It considers the elements that cause change as well as their effects on the environment. Several experts believe that an ecosystem approach is helpful in preserving ecosystem services and keeping safe beaches, and that it is thus important for coastal managers to consider.

Conclusion:

The impacts of climate change on society are occurring earlier and more frequently than predicted. Climate change and disasters can occur suddenly, such as intense rains and flash floods. In other situations, they can occur gradually (slow on-set impacts), such as ocean acidification induced death of corals and, in turn, depletion of

the fisheries dependent on corals which sustain and support society. To overcome this burning issue Hybrid approaches can be a ray of hope which could include nature-based solutions, green infrastructure, grey-green options, and building with nature solutions. EbA, Eco-DRR and related approaches generate additional environmental, economic, and social benefits beyond adaptation and disaster risk reduction. Climate change mitigation should be possible via conservation or restoration of forests, coastal vegetation, or peatlands, which enhance carbon sequestration and also by prevention of deforestation and land degradation, which aids in limiting further greenhouse gas emissions. For marine ecosystem coral reefs and coastal vegetation can dissipate wave action and protect shorelines, wetlands accommodate flood flows, and forested mountains and slopes can stabilize sediments, protecting from landslides. Other approaches related to EbA and Eco-DRR include community-based adaptation, natural water retention measures, integrated water resources management, green/blue infrastructure, ecological restoration, and others. There are multiple issues that need to be considered when planning and implementing EbA and Eco-DRR, including addressing trade-offs and limitations, ways to realize multiple benefits and enhance synergies, and addressing solutions across appropriate temporal and geographical scales. Eco-DRR) should consider principles that are core to adaptation and DRR practice.

Thus, the Ecosystem Approach can make a valuable contribution to managing disaster risk and mitigating the impacts of disasters. An ecosystem approach to disaster risk reduction is one where ecosystems make a key contribution to enhancing people's livelihoods. The Ecosystem Approach is an effective strategy to manage or restore ecosystems and their services while focusing on human livelihood needs

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Development at the cost of Ecosystem Destruction

Dr. Pratima A. Pawar
Dada Patil Mahavidyalaya, Karjat, Ahmednagar, MS, India.
Email: pratimap79@gmail.com

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Abstract:

The present paper deals with optimal utilization of natural resources in developmental activity is one of the modern environmental priorities. This is on the grounds that the association and the executives of creation influence the climate, which strongly influences both the prosperity of society and disturbance to natural resources. Natural expenses are turning into a significant instrument for the economy and the climate change. As of now, regardless of an enormous number of deliberate turns of events, there is no strong reason for the development of natural pointers that sufficiently describe the collaboration of the nature conservation and the climate and monetary navigation at all levels. The article explains the substance, order, execution assessment framework, ecological sustainability. The creators show ways to deal with the valuation of anthropogenic harm, not set in stone by the disparity of normal and worth pointers. Priority must be given to agro forestry and social forestry. Tree planting ought to be incorporated into the various government and social projects priority given to local trees.

Key words- Ecological sustainability, Development, conservation, Plantation.

Introduction:

Maharashtra is the third largest state in India and about 17% of its area is covered by forests. The Intent to protect wildlife set aside 10,051,529 square kilometers as protected area, an area that constitutes approximately 3.26% of the geographical area as a protected area. The Northwestern Ghats, known as the Sahyadri's, are characterized by low, high & medium altitudes up to 1000 meters to 1400 meters in some places (Kalasubai, Mahabaleshwar). The area is mostly composed of basalt, a volcanic rock formed by the cooling of Deccan lava flows.The traps of the Deccan are mostly flat, resulting in flat mountain ranges. The forces of erosion have been at work for millions of years, turning flat peaks into gradual or abrupt free falls in many places. Many plains are weathered layers of laterite soil that support a strong growth of woody vegetation, e.g. Bhimashankar & Mahabaleshwar forests. However, the area has been extensively crowded and under tourist pressure.

That development has been driven by efforts over the years to identify areas of importance for biodiversity & uniqueness, as well as an unwavering commitment to the conservation of the state's wildlife. Compared to 1988 when Maharashtra had 28 sanctuaries, in 2021 it had 6 National Parks, 50 Nature Reserves & 14 Sanctuaries for a total of 70 sanctuaries. It is prestigious that out of 14 protected areas &

50 nature reserves, the state has been able to enable notification of six tiger reserves, making it the tiger capital of the country.

Observed Reasons:

The most serious issue in the conservation is deficient and quick vanishing land cover. Woodland cover is genuinely compromised by the rising interest for wood items. For agriculture, vast tracts of forest have been cleared. In 2011 and 2012, 14,574 cases of illegal tree felling were reported in the state. Plant diseases, insects, and pests infest large areas of forest cover, resulting in a significant loss of forest wealth. For instance, a great many hectares of sal timberlands are being undermined by sal drill for which no healing measures have been embraced up to this point. Old strategies for stumbling, planting and so on are practiced in the woodland region. Low forest productivity and a lot of waste result from this system. Absence of logical procedures of developing timberlands is additionally another serious issue.

The process of plantation and sapling happens at a very low rate in the state. Expansion in populace has expanded the interest for timberland items bringing about cutting of huge number of trees. Infringement on the woods land: Taking into account the earnestness of dispersion of land to landless individuals, the public authority has been regularizing such infringement. The state's encroaching forest area was 86,213 hectares in 2011 and 2012.

One most significant reason for consumption has been unapproved development by nearby individuals. The researchers have represented the reduction in timberland region because of the expansion in spatial degree of ranches and agrarian fields. Urbanization and industrialization is likewise another issue: Industrialization and Urbanization needs land, so this has driven wide. The few reasons for ecological degradation is Wind Farms on Plateaus and Hillocks Environmental impact assessment is not mandatory for wind mills eructation. Very few studies investigate the impact of wind mill erection on Indian avian species, such as Pande et al. (2013).

This area was threatened not only by insensitive tourism, but also by 4,444 indiscriminate development activities carried out without proper environmental impact assessment. Poaching and biotic attack due to excessive traffic, especially during flowering, threatened the natural habitat of the plain. Unfortunately, the villagers surrounding this plateau are quite poor and their literacy is also quite low. They are aware of their adjacent natural heritage, but have only recently become aware of future threats to their environmental wealth, which directly or indirectly contribute to their own livelihoods. In such areas protection and true development must complement each other. Meeting current needs should not jeopardize the availability of natural resources for future generations of its inhabitants.

Habitat destruction for Development of dam repositories, huge scope decimation of timberlands occurred in the state breaking the normal environmental equilibrium of the area. Floods, dry seasons and avalanches become more pervasive in such regions. Exhaustion of Normal Vegetation: The travel industry advancement has put strain on normal vegetation. Forests frequently endure negative effects of the tourism as

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deforestation brought about by fuel wood assortment and land clearing. Mining has prompted deforestation moreover. Individuals have utilized minerals since they existed. The times of human improvement have agreed with the utilization of minerals. The advanced metropolitan modern economy can't get by without minerals and metals, so we can't stop mining. Some significant open cast mining movement adversely affects the normal vegetation. Brushing - Successful arrangements are direly expected to beat extension down of animals' creation in timberland regions and advance supportable touching frameworks that will stop the pattern of corruption and relinquishment on cleared timberland lands.

Recomendatation:

It is necessary to initiate practices like ecological & environmental sustainability with wind farm projects & start strict regulation on their implementation immediately on the ground. In plains with existing wind farms, it is possible to integrate such conservation practices. In fact, developing habitats & improving natural processes through soil & water conservation measures can become social responsibility activities of wind companies. Considering the long-term impact of such projects on the natural capital on which humanity depends, it is necessary to question our lifestyles & development patterns that fuel our increasing demand for electricity. There is room for further research into various aspects of habitat and biodiversity, ecosystem stress and changes in ecosystem services such as rocky plateaus caused by wind farms.

The general purpose of the study was to provide an overview of the progress of hotspots and natural heritage protection works and to plan future activities with the active participation of people's, state, national and international organizations. Discussions focused on the protection of biodiversity, the preservation of the natural beauty of the region, the continued agricultural productivity of the region through pollination, nutrient cycling and increasing biodiversity & the environmental development of such places. The efforts of local communities, young people, scientists, academicians, entrepreneurs, eco-tour organizers, transporters, food package suppliers, guides, trainers, government representatives (forestry, environment, and development), NGOs and media are needed for overall and sustainable development.

We must put an end to careless forest cutting. Intensive afforestation development plans is required. High yielding plants & trees region wise plantation is required. We ought to establish the trees and grass on the land at every possible place & select the indigenous local species. Most recent procedures of preparing and conservation are important to keep away from wastage. To make, a comprehensive inventory of forest resources is required. A precise evaluation of our recourses & their appropriate use. Ancestral relying upon moving kind of development ought to be furnished with substitute wellsprings of business. Individuals related with woods insurance ought to be appropriately prepared. To put forth attempts to utilize methane gas disregarding involving fuel wood for homegrown use in country regions. We ought to rehearse the cattle raising, taking into account the ability to touch the land. Seeds of trees needed to be planted in far off regions through air administrations. Local individuals ought to be

instructed about the climate, its significance and protection. Lawful denial on agrarian infringement on woodland land should be there. Priority must be given to agro forestry and social forestry. Tree planting must to be incorporated into the various government and social projects.

Conclusion:

Sustainable development is the only way to stop development at the expense of ecosystem destruction. There is a great need for conscious efforts to shift the mindset of the laymen towards nature conservation. Only the use of eco-friendly resources and eco-friendly methods can safeguard the planet for future generations.

The history of the environment law in India started with the implementation of environment laws that allow the government to adopt statutory rules for the promotion of sustainable development. However, despite the existence of these laws, various anthropocentric activities have caused a lot of litigation in the country. The human being, being the most intelligent of all the creatures, after suffering so much damage to its own life understood the importance of the environment. Therefore, progress at the expense of the environment or life is indistinguishable since all that is necessary for human survival is a healthy environment.

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Patents of Successfully Marketed Drugs Obtained from Phyto-Glycoside Sources and their Biological Action: A review

***Dr. Asha B. Kadam**
Dr. Dadasaheb S. Wadavkar
Viswas P. Jaybhay
P. G. Department of Botany, Dada Patil Mahavidyalaya Karjat, Ahmednagar, Maharashtra, India.
Email- ashakadam16@gmail.com

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Abstract

Natural products and their structural analogues have historically made a major contribution to pharmacotherapy, especially for cancer and infectious diseases. Nevertheless, natural products like phytoglycosides also present challenges for drug discovery, such as technical barriers to screening, isolation, characterization and optimization, which contributed to a decline in their pursuit by the pharmaceutical industry from the 1990s onwards. In recent years, several technological and scientific developments including improved analytical tools, genome mining and engineering strategies, and microbial culturing advances are addressing such challenges and opening up new opportunities in drug discovery. Consequently, interest in natural products such as phytoglycosides as drug leads is being revitalized, particularly for tackling antimicrobial resistance. Here, we summarize recent technological developments that are enabling natural product-based drug discovery, highlight patent of successfully marketed drugs and discuss their biological action.

Keywords- Phyto-Glycoside, Natural products, Drug discovery, Patent.

Introduction

Glycosides are numerous physiologically active substances. Antibiotics, hormones, sweeteners, alkaloids, flavonoids, and other significant classes of chemicals are included in the group of substances known as glycosides (C. Spanou et.al, 2012). Sometimes the activity of the glycosidic residue is important for the improvement of pharmacokinetic parameters. Numerous crucial tasks for glycosides are played by them in living things (L. H. Kushi, et.al., 1999). Inactive glycosides are the primary form of chemical storage in many plants. These can be made active through enzyme hydrolysis, which separates the chemical from the sugar component and makes it usable. Such phyto-glycosides are widely employed in medicine (J. C. Mathers, 2008).

Illustrations of Phyto-Glycosides Used as Medicine

Cardiac glycosides, which are present in many plants, are employed as drugs. Digitoxin (also known as Cardoxin® and Lanoxin®), digitalis, and digitoxin are a few examples of cardiac glycosides. The cardiac glycoside medications oleandrin, bufalin, and ouabain are also available. Digoxin is the cardiac glycoside most frequently

administered (Ziff O.J. et.al, 2015).

The foxglove plant *Digitalis lanata*, contains the therapeutic cardiac glycosides digoxin and digitoxin, which are well-known examples (Whayne T.F., 2018). The cardenolide and sugar molecules make up the digoxin molecule. Its molecular weight is 780.95 Da. and its chemical formula is C41H64O14.

Cardiotonic, sulphur, anthocyanin, cyanogenetic, anthraquinone, coumarin, flavonoids, and saponin are a few examples of glycosides. A cardiac glycoside called proscillaridin is found in *Drimia maritima* and *Scilla* plants (*Scilla maritima*) (Vahadettin Bayazit et.al, 2010). Significant antioxidant, anticancer and antitumor, hepatoprotective, anti-inflammatory, anti-diabetes, antiviral, antibacterial and antifungal, and other biological activities were demonstrated by flavonoid C-glycosides (C. Spanou et.al, 2008).

Numerous crucial tasks for glycosides are played by them in living things. Inactive glycosides are the primary form of chemical storage in many plants (S. Kaeothip et.al, 2008). These can be made active through enzyme hydrolysis, which separates the chemical from the sugar component and makes it usable (P. Pornsuriyasak et.al, 2006). Such plant glycosides are widely employed in medicine.

Most of these phyto-glycoside hydrolases are involved in the metabolism of cell wall polysaccharides. Their involvement in glycan biosynthesis and remodulation, energy mobilisation, defence, symbiosis, signalling, secondary plant metabolism, and glycolipid metabolism are among their additional functions (Patel S., 2016). Bioactive substances have physiological effects that could advance health (Bessen H.A. et.al., 1986). They are being researched for the purpose of preventing diseases including heart disease, cancer, and others. Lycopene, resveratrol, lignan, tannins, and indoles are a few examples of bioactive substances (Groves M.J. et.al., 1991)

Process of Action

Cardiac glycosides prevent the Na+-K+ ATPase from working properly in cardiac and other tissues, which results in intracellular Na+ retention and elevated intracellular Ca2+ concentrations due to the action of the Na+-Ca2+ exchanger (Ziff OJ et.al., 2015).

Biological activity or pharmacological activity in pharmacology refers to the favourable or unfavourable effects of a medication on living things. This activity is exhibited by the substance's active ingredient or pharmacophore when a medicine is a complex chemical mixture, though it can be altered by the other ingredients (Vahadettin Bayazit et.al, 2010).

The sodium/potassium-ATPase (sodium pump) in the plasma membrane of cardiac myocytes is bound by digoxin and inhibited. This inhibition raises the level of intracellular sodium, which raises the level of intracellular calcium, raising cardiac contractility (Blaustein M.P. et.al. 2003).

The sodium-potassium ATPase in the myocyte is where digitalis mostly works. The ATPase is reversibly inhibited, leading to higher intracellular sodium concentrations. As intracellular sodium concentration increases, sodium is transported

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outside the cell through a different channel in exchange for calcium ions (Ried L.D. et.al., 1990).

Digoxin is most frequently used to treat irregular heartbeats (arrhythmias), including atrial fibrillation, as part of a strategy to reduce the heart rate (Ahmed A et.al, 2014). The aim is to reduce the strain on the heart because, over time, this can cause the heart muscle to deteriorate and result in heart failure (Chekman I.S., 2008).

Summary and Perspectives

Natural plant-derived glycosides are used for various therapeutic purposes. Increased knowledge of beneficial and toxic effects is warranted. This is particularly relevant for plant sterols for which beneficial and potentially harmful effects have been reported in the patented form. In future better insight is needed regarding the biological effects, bioavailability and metabolism of glycosylated sterols prior to any clinical use in prevention and treatment of diseases.

The therapeutic value of infusion of glycosidases in treatment of inherited deficiencies in man has been demonstrated for a number of diseases. In recent years, according to various patent data production of such glycosidase increasingly occurs in plant platforms that offer several advantages. The ubiquitous plant glycosidases themselves might conceivably find therapeutic applications in humans and might have potential to treat inherited glycosidase deficiencies in man (Kytidou et al., 2018).

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A Brief Review on Bioprospecting of Passiflora

Manasi Patil
Ahilya Waghmode
Sharada Ghadage
Department of Botany & Plant Protection, Sadguru Gadge Maharaj College, Karad
Poonam Panaskar
Nivas Desai
Dapoli Urban Bank Senior Science College, Dapoli
Email: manasipatil202@gmail.com

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Abstract:

Passiflora (Passion fruit) is an important agricultural product that is used extensively in the fruit's business. This plant belongs to the Passiflora genus and can be found in tropical and subtropical climates around the world. Passion fruit grows extensively throughout Central and South America, with larger output in the latter region. Brazil is the world's top grower and consumer of passion fruit. This fruit is grown on a modest scale in Malaysia due to the availability of adequate growing conditions and the increase in consumer demand. In recent years, researchers have demonstrated increased interest in the passion fruit plant due to its phytotherapeutic capabilities, ethnobotanical uses, chemotaxonomic information, and the interaction of the plant with its environment; these features have been proposed as selection criteria. Several Passiflora species have been used to cure a wide range of diseases.

Key words: Passiflora, phytotherapeutic, ethnobotanical, pharmaceutical

Introduction:

The family Passifloraceae includes the genus Passiflora, which contains about 400 species (Montanher et al., 2007; Beninca et al., 2007). Passiflora is primarily found in warm, tropical climates. Passiflora derives its name from the Latin phrase "Passio."In 1529, Spanish discoverers found and named the "Passion of Christ" as a symbol (Kinghorn, 2001; Dhawa et al., 2004). Passiflora is a woody climber that is used decoratively in gardens. In India, Passiflora is known as passion fruit, while locals of Maharashtra call it Krishna Kamal. Passiflora was commonly used as traditional medicine in West India, Mexico, South America, the Netherlands, Italy, and Argentina, among other countries. It is also discussed in Indian traditional medical systems including Ayurveda, Siddha, and Unani.

Several phytochemicals were detected in the plant study (Dhawan et al., 2004). Ripe fruits are edible (The Wealth of India 2001). Some studies have indicated that plants can aid with opiate withdrawal, anxiety, insomnia, attention deficit hyperactivity disorder, and cancer (Akhondzadeh et al., 2001; Reginatto et al., 2006; Ichimura et al., 2006; Rowe et al., 2004). The goal of this review is to present information about the Passiflora genus, including its morphology, active substances, and pharmacognostical

and pharmacological qualities. These plants have been connected to a wide range of pharmacological effects.

Natural substances have sparked widespread attention as a source of potential drug development in biomedical research. The contemporary pharmaceutical sector relies heavily on natural medications, with more than half of pharmacological ingredients sourced from plant-based sources (Krief et al., 2004). Plants are known to generate phytochemicals, which have anticarcinogenic, anticancer, antibacterial, and antioxidant properties. These substances include flavonoids, phenolic acids, and tannins (Tavassoli and Djomeh, 2011). Research has focused on the identification of clinically relevant antibacterial medicines and functional foods from natural resources for pharmaceutical and nutraceutical applications (Sajid et al., 2012). Furthermore, the growing interest in traditional ethnomedicine could lead to the discovery of new medicinal molecules. Passion fruit is an exotic fruit known for the stunning beauty of its bloom and sweet aroma. In the past few years, experts have demonstrated greater curiosity in the passion fruit plant because of its phytotherapeutic capabilities, ethnobotanical applications chemotaxonomic knowledge, and the plant's connection with its surroundings. These factors have been proposed as selection criteria for potential sources of natural molecules of pharmaceutical relevance. Although several studies have been conducted to investigate the ethnobotanical characteristics and medical applications of passion fruits, little is known about their phenolic content, antioxidant capabilities, and other biochemical aspects. To address this gap, the current study was conducted to investigate the Nutraceutical properties of fruits for potential usage in value-added products.

Morphology Passiflora stems is herbaceous and woody. During germination and early growth, the leaves are alternating, simple, and whole. Later, they are lobed or palmate, imparipinnate, petiolate, stipulate, and have auxillary tendrils that originate from the sterile pedicels. Flowers are bisexual, having five petals and five sepals alternately arranged. The petals and sepals are similar in size and hue. The sepals are recognised by a green hookat at their tip. The enormous hollow receptacle, resembling a cup, contains numerous filamentous appendages between the petals and stamens. These brilliantly coloured appendages make the distinctive crown. Three to five stamens are placed at the top of the gynophore; filaments are filiform, free, or monoadelphous, with two-celled anthers that divide lengthwise. Carpels 3 to 5 are joined, stigmas are clavate or peltate, and the superior ovary is unilocular, with many ovules on the parietal placentation. The fruits are single-celled, indehiscent berries, and the seeds are plentiful. Passiflora involves insect pollination. Cellular twisted glandular trichomes with a smooth surface and wavy anticlinal epidermal. The remarkable corona developments, powerfully scented blooms, and nectar produced in the receptacle all help to attract insects. The petiole contains extrafloral nectar (Dhawan et al. 2004). The exotic genus Passiflora includes several species that are grown in gardens for their stunning attractive blossoms. P. edulis (purple passion flower) is the best-known species. It produces the purple or yellow fruits that are generally known as "passion fruit."

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Microscopy:

Sreelakshmi et al. (2014) investigated the association between leaf area and the taxonomic relevance of foliar stomata in nine different plants. P. edulis Sims was among them. In Passiflora, anisocytic and paracytic stomata were randomly arranged. Sethi (2019) identified uniwall cells by examining leaf lamina trichomes with scanning electron microscopy.

Phytochemical, nutrient, and antioxidant studies

Ramaiya et al. (2019) studied the nutritional and organic acid contents of several Passiflora fruit juices and mesocarps. The investigation revealed that all species of fruit juice have nearly identical nutritional and organic acid values. While the mesocarp has a higher fibre content than the fruit juice, the most common organic acids in Passiflora fruit juice were citric and malic acid. Odewo et al. (2014) investigated the bromatological and spectroscopic properties of P. foetida L. leaves. Passiflora leaves were high in essential nutrients such protein, lipids, carbs, ash, moisture, and fibre.In phytochemical study, ethanol extracts of leaves revealed saponins, tannins, cardiac glycosides, alkaloids, anthraquinones, steroids, and flavonoids. The authors also performed an infrared spectroscopy examination to determine the molecular structure of the sample. They discovered that the acid functional group (C=ON) is responsible for the formation of unsaturated oil. Shanmugam et al. (2018) investigated the phytochemical, carbohydrate, and antioxidant profiles of P. subpeltata fruit pulps.The UHPLC-QqQ-MS/MS study revealed fifteen polyphenolic chemicals, including protocatechuic acid, ferulic acid, vanillic acid, epicatechin, p-coumaric acid, cinnamic acid, eriodictyol, and quercetin-3-glucoside.. The fruit also inhibited α-amylase and α-glucosidase. Saravanan and Parimelazhagan (2014) studied the antioxidant, antibacterial, and anti-diabetic properties of several solvent extracts of P. ligularis Juss. fruit pulp. Acetone extract yielded the highest total phenolics, tannins, and flavonoids concentration of any solvent employed. Acetone extract, on the other hand, exhibited strong DPPH, ABTS, superoxide, and nitric oxide radical scavenging activity, ferric reducing antioxidant capacity, and metal chelating properties. The acetone extract of P. ligularis fruits effectively inhibited α-amylase and α-glucosidase enzymes. Additionally, the fruits contain antibacterial and antifungal properties. HPLC examination confirmed the presence of ellagic acid, gallic acid, and rutin in the quantification study. Zeraik et al. (2012) employed HPTLC to demonstrate the isoorientin content of passion fruit rinds. isoorientin was therefore higher in healthy P. edulis rinds than in rinds showing typical signs of passion fruit woodiness virus infection. Using HPTLC, it was determined that P. edulis rinds acted as a natural supply of flavonoids and had the ability to scavenge radicals. According to Guimaraes et al. (2020), P. edulis leaves in the reproductive stage had the highest concentration of phenolic and flavonoid content. Passion fruit flour inhibited Staphylococcus aureus more successfully and lowered DPPH levels, according to research by Lima et al. (2018). Lima-Neto et al. (2017) looked at the physicochemical characteristics and antioxidant activity of P.glandulosa Cav. pulp from the Cariri region. They found that the caloric value and proximate constituent of this passion fruit are

comparable to those of other species. The pulp of P. glandulosa has lower levels of polyphenolic compounds and higher levels of ascorbic acid when compared to other fruits. In contrast, pulp has a higher total soluble solids and titratable acidity. Saptarini et al. (2013) assessed the antioxidant potential of yellow passion fruit (P. flavescens) leaf extract and fraction. In comparison to the ethanolic extract, n-hexane fraction, ethyl acetate fraction, and water fraction, the ethyl acetate fraction exhibited the highest level of antioxidant activity. P. foetida Linn. The researchers found that fruit includes a wide range of phytochemicals, including carbohydrates, fat, protein, reducing sugar, ascorbic acid, flavonoids, alkaloids, phosphorus, magnesium, calcium, amino acids, cholesterol, and phenolic compounds. Silva et al. examined the phytochemical composition of P. edulis f. flavicarpa, and seed oil was analyzed by Silva et al. (2015) According to the study, passion fruit seeds and oil can be used to make nourishment for humans and can also help the fruit sector by reducing organic waste. Moisture, lipids, proteins, ash, fibres, titratable acidity, pH, soluble solids, and antioxidant activity are all present in passion fruit seeds. Ramaiya et al. (2014) looked at the total phenolic content, antioxidant capacity, and antibacterial activity of the leaves and stems of P. quadrangularis, P. maliformis, and P. edulis. Using a combination of solvents (petroleum ether, acetone, and methanol), the highest antioxidant components were isolated from the methanol extracts of P. edulis leaves and stems (24.28 percent) and P. quadrangularis leaves and stems (24.28% and 9.76% resp.). The maximum TPC concentration and antioxidant potential were found in P. maliformis leaf methanol extract, whereas P. quadrangularis stem methanol extract had the higest antioxidant activity and highest phenolic content The P. maliformis methanol extract exhibited the strongest inhibitory zone against B. subtilis in antibacterial investigation. The plant P. foetida contains phytochemicals such as triterpenoids, glycosides, alkaloids, saponins, phenolic compounds, carbohydrates, tannins, proteins, and amino acids (Biruduet al. 2019). Even though P. edulis Sims. has a wide range of phytochemicals, the ethanol extract of the plant showed excellent antioxidant potential (Sunitha and Devaki 2009). Sasikala et al. (2011) evaluated the antioxidant capacity of P. foetida's root, leaves, flower, and seed. Ethanol and petroleum ether were utilized to extract the different plant sections. The fruit dry fruit powder exhibited the most antioxidant and antihemolytic properties among all the extracts from all the components. It also had a carotene in high amount Giambanelli et al. (2020) employed high performance liquid chromatography (HPLC-ESI-TOFMS) in conjunction with a high-resolution mass spectrometry detector to investigate the phenolic components of P. tripartite. They found 82 polar compounds in total in the extracts, including organic acids, phenolic acid derivatives, benzophenones, flavan-3-ols, flavonols, and flavones. Isomerin is the main flavone found in the pulp of passion fruit, P. edulis f. flavicarpa O. Deg. (ZeraikandYariwake, 2010). Monoterpenoids were extracted from P. edulis f. flavicarpa O. Deg. fruit pulp (Osorio et al., 2000). Sakalem et al. (2012) looked at the different Passiflora species' phenolic makeup. Using HPLC-DAD-ESIMS/MS, flavones C-glycosides were identified in all extracts, although P. vitifolia, P. coccinea, P. bahiensis, and P. sidifolia primarily contained flavones C-

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glycosides. All species include apigenin-6-C-rhamnosyl-8-Carabinoside in addition to flavone-6,8-di-C-glycoside. P. quadrangularis has cyclopassiflosides with cyanogenic glycosides, while P. coccinea has flavones-C glycosides and procyanidins. The juices obtained from the pulps of P. edulis, P. maliformis, and P. quadrangularis were high in fibre, protein, and carbohydrates, as well as minerals such as K, Mg, P, and Fe. Aside from the juice, the edible mesocarp of P. quadrangularis is a nutrientdense food (Ramaiya et al., 2019).

Bioactivity of Passiflora

Colomeu et al. (2017) coexamined the antiproliferative and antioxidant properties of four Passiflora species. The aqueous extract of P.edulis (yellow) showed stronger phenols and antioxidant activity than the other four Passion fruit species, as well as inhibiting T lymphocytes. The phytochemical and antibacterial activities of P. edulis var. flavicarpa seed extract were investigated by Kanu et al. (2017). It has been discovered through preliminary phytochemical analysis that flavonoids, alkaloids, steroids, and saponins exist. At different extract concentrations, the growth of Escherichia coli, Candida albicans, and Staphylococcus aureus is suppressed. On the other hand, P. edulis extract was found to have antibacterial activity against Salmonella typhi, Bacillus subtilis, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, and Shigella spp. by Razia et al. (2014) and Aernan et al. (2016). Mohanasundari et al. (2007) investigated P. foetida in a comparable manner. The ethanolic leaf and fruit extracts shown varying levels of antibacterial effectiveness against P. putida, V. cholera, S. flexneri, and S. pyogenes. Johnson et al. (2008) found preliminary phytochemical and antibacterial activity of P. edulis leaf and callus. Out of all the investigated solvents, the leaf and callus chloroform extract exhibited the highest solubility and antibacterial activity. On the other hand, the phytochemicals in the extracts of ethanol and chloroform were verified. Wasagu et al. (2016) found antibacterial activity and comparative phytochemical studies of P. edulis fruit rinds, seeds, and juice extract on Salmonella typhi, Escherichia coli, Staphylococcus aureus, and Aspergillus niger using the agar method. Compared to the other fruit sections, the rind and seed had a noticeably higher level of antibacterial activity. In addition to being used as a sedative, the Passiflora species is frequently used to treat skin irritation and sporadic fevers (Zucolotto et al., 2009). According to Ananet et al. (2016), P. incarnata may be helpful in the treatment of neuropathic painThe leaf and callus chloroform extract demonstrated the highest solubility and antibacterial activity of all the tested solvents. The phytochemicals found in extracts of ethanol and chloroform, however, were verified. Wasagu et al. (2016) found that P. edulis fruit rinds, seeds, and juice extract had antibacterial activity against Salmonella typhi, Escherichia coli, Staphylococcus aureus, and Aspergillus niger, as well as comparative phytochemical analyses. This was achieved by using the agar method. The rind and seed exhibited notably greater antibacterial activity in comparison to the remaining fruit sections. According to Zucolotto et al. (2009), the Passiflora species is frequently used as a sedative and a treatment for inflammatory skin conditions and sporadic fevers.

According to Ananet et al. (2016), P. incarnata may be helpful in the treatment of neuropathic pain

Neuropathic pain may benefit from the use of P. incarnata (Amanet et al., 2016). The flavonoids were extracted from healthy and diseased passion fruit pulp and rinds with the virus that causes passion fruit woodiness (PWV). Both the pulp and the rind of the fruit play important roles in inflammation. The analgesic and anti-inflammatory properties of P. foetida leaves ethanol extract were discovered by Sasikala et al. (2011). Analgesic and anti-inflammatory activities were found in P. foetida leaf extract. Silva et al. (2013) investigated the antioxidant activity of P. edulis leaf aqueous extract. They discovered that P. edulis leaves are a rich source of bioactive chemicals such as polyphenols using HPLC-PDA and ESI-MS/MS analyses. The flavonoids were obtained from healthy and infected passion fruit pulp and peels with the virus resulting in passion fruit woodiness. Both the pulp and the rind of the fruit play important roles in inflammation. The analgesic and anti-inflammatory properties of P. foetida leaves ethanol extract were discovered by Sasikala et al. (2011). P. foetida leaf extract exhibited analgesic and anti-inflammatory properties. Silva et al. (2013) investigated the antioxidant activity of P. edulis leaf aqueous extract. They discovered that P. edulis leaves are a rich source of bioactive chemicals such as polyphenols using HPLC-PDA and ESI-MS/MS analyses. The antioxidant activity of aqueous extracts of leaves, as well as SOD, GR, GPx, ORAC, GSH in the kidneys, and thiobarbituric acid reactive compounds in the liver, brain, and kidneys, is high. The presence of asvitexin, isovitexin, and isoorientin in the leaves of P. edulis was investigated. Osma et al. (2013) found antioxidant and antiproliferative properties in P. edulis checked leaf extracts and fruit juice. Cardiotonic glycosides, flavonoids, and tannins were discovered by phytochemical analysis. The leaves had a lot of DPPH activity, while the juice had a lot of hydroxyl free radical-scavenging activity. H2O2-induced hemolysis was reduced by 98 percent in both extracts. Aqueous extracts of leaves had the best cytotoxic activity against SW480 and SW620 cells. Based on this study, it appears that P. edulis could be a useful source of antioxidants.

Conclusion

The plant Passiflora is classified into numerous species. Each species has unique qualities, which may be medicinal, nutritional, or bioactive. The plant has a traditional value. Data analysis indicates the need for precise chemical constituents from each plant species, as well as Bioprospecting of important medicinal plant Passiflora.

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Blue Green Algal Approach in Sustainable Agricultural Development

Sharada J. Ghadage
Manasi S. Patil
Ahilya V. Waghmode
Poonam S. Panaskar
Department of Botany and Plant protection,
Sadguru Gadage Maharaj College, Karad.
Email: ssharada1980@gmail.com

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Abstract:

Nitrogen is one of the most integral elements required by plants for their proper growth. Although nitrogen is plentiful in the earth's atmosphere, very few plants are able to incorporate nitrogen directly from the atmosphere and most of the plant groups obtain nitrogen from complex compounds in the soil. Fertilizers fulfill the demands of plants nutrients in organic, inorganic or chemical form, but they are expensive, besides this the residual effect of chemical fertilizers become troublesome problem in accordance to environmental health.

Awareness of biofertilizers is increasing frequently. Blue green algae or cyanobacteria have occupied a key position among the organisms being utilized in the production of biofertilizers. Agriculturally blue green algae are used as soil conditioner, plant growth regulators and ameliorators of soil health. Besides this they increase fertility, change physical, chemical and biological properties of soil. Algalization or use of BGA as a fertilizer is a locally used and low-cost technology. Blue green algae are the important members of paddy field soils expressively furnish to its fertilization, so that rapidly growing N_2 fixing strains need to segregate from their community. Using blue green algae as a biofertilizer is ecologically and economically beneficial technique for sustainable agriculture.

Key words: *BGA, fertility, paddy fields, Algalization, sustainable*.

Introduction:

Besides contribution of Nitrogen economy, BGA play a very important role in sustain crop yield by liberating growth promoting substances in soil. A number of growths promoting substances have been documented (polysaccharides, amino acids, sugars, various vitamins viz. vitamin B12, folic acid, pantothenic acid, nicotinic acid and growth hormones) [1,2].

Blue green algal potential as soil conditioner was known worldwide. Organic alteration not only by improve soil structure, but also strongly impact soil microflora [3]. A significant amount of biomass is a result of continuous gelatinous mass uniformly covered by colonies of blue green algae on soil. Blue green algal biomass of some species

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decomposes quickly while some forms last longer [4]. For quickly regeneration and enhancing the soil structure best solution is inoculation of rice fields with BGA. Extracellular excretion of number of compounds was noted during blue green algal growth (polysaccharides, peptides, lipids etc.) [5-7]. these compounds act as glue which holds the soil particles in clusters.

Due to algal inoculation polysaccharide content of soil increases [8,9]. BGA also mobilize and solubilize phosphate and make it available to plants. Some of the nitrogen fixing BGA viz. *Tolypothrix tenuis* as well as *Hapalosiphon fontinalis* have prospective, to solubilize Mussourie rock phosphate (MRP), a origin of P2O5. Similarly in presence of mineral phosphate sources; *Westeillopsis prolifica* and *Anabaena variabilis* showed good growth and N fixing ability [10,11] (Fig. a-b, c-d). For that purpose, such forms can be exploited for sustainable utilization of ecofriendly and low cost biofertilizers.

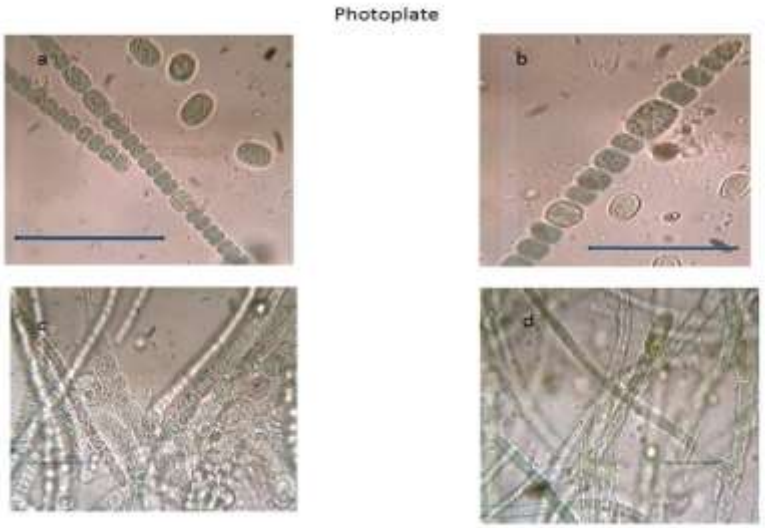

Fig: a-b) *Anabaena variabilis* var *ellipsospora* c-d) *Westiellopsis prolifica*

Importance of Bio-fertilizers for crop growth:

- Biofertilizers are the natural fertilizers that are algae, fungi or bacterial inoculants.
- Soil micro-biota gets disturbed by regular use of chemical fertilizers in agriculture; the best remedy to get rid from this problem is use of Biofertilizers.
- Biofertilizers help to build up soil micro-biota and improve soil texture so its eco-friendly application was also suggested [12].
- Application of only blue green algal fertilizer in rice 5-24% increased yield was also recorded [13,14].
- High application of nitrogenous fertilizers in rice fields responsible for absence of N2 fixing blue green algae [15].
- Blue green algae able to tolerate nitrogenous fertilizers at low concentration and its positive impact on heterocyst differentiation was also documented [16].

Importance of algal biofertilizer:

- Cyanobacteria are also know as blue-green algae, invented oxygenic photosynthetic and able to oxygenation of the Earth's atmosphere [17].
- By using solar energy blue green algae able to fix atmospheric carbon and nitrogen. Therefore, they have great potential as biofertilizers [18, 19]. Cyanobacterial biofertilizers are low cost, very simple to use and manufacture and have no problem of environmental pollution.
- Rice/Paddy fields are the best studied aquatic ecosystems on the earth. They provide light, water, high temperature and availability of nutrients; which is the basic need for blue green algal existence. This could be the main reason for luxuriant growth of blue green algae in paddy field soils than upland soils [24].
- The beneficial role of blue green algae in agriculture viz. synthesis of osmoprotective compound, synthesis of internal inorganic ion concentration and salt stress protein expression was also well documented [12].
- Large number of occurrence of green and blue green algae in the upper layer of soil which is responsible to perform valuable services for the soil ecosystem [25].
- Symbionts such a blue green algae increase the efficiency of nutrient acquisition by plants. By the biological process; mobilization of nutritionally important element like phosphorous was done by the application of blue green algal fertilizer [20].
- Blue green algae also involved in sustainable agriculture by the process of bioremediation i. e. removing soil heavy metal [21].
- More than hundred of blue green algal species able to fix atmospheric free nitrogen through their specialized cell called heterocyst [22]. From India nitrogen fixing blue green algal species have been reported from paddy fields [26,27].
- Nitrogen deficiency is the common problem in paddy fields. Thousands of species of BGA having nitrogen fixing capacity are used as biofertilizers in different parts of the world. The BGA contain nitrogenase and fix atmospheric nitrogen for which these are used as biofertilizers to maintain as well as to improve fertility of rice field soils [28].
- Besides addition of nitrogen to the soil and increase in yield of rice, blue green algae also produce significant physical, chemical and biological changes in rice field soils [29,30]. Blue green algal biofertilizer increase the soil fertility by fixing atmospheric nitrogen and mobilizing macro and micronutrients, as a result of this insoluble phosphorous conversion takes place which increase phosphorous level in soil. Blue green algae are the enhancers of soil nitrogen and phosphorous [31].
- Blue green algae used as biofertilizers are inexpensive, easy to create, very simple to use and have no hazardous impact on environment. Blue green algae can be potential natural resource positively ensure the sustainable development of agriculture and environment [23].

Conclusion:

Role of Blue green algae in agriculture has both assurance and potential. Mostly

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blue green algae recorded in paddy fields from different parts of the world. The simple reason behind this is the favorable environment provided by the paddy fields for luxuriant growth of BGA, although their effect on different other crops viz. wheat, maize, sugarcane, cotton and other vegetable crops also require experimentation and will further uplift their role in agriculture. Bioregional utilization of blue green algal biofertilizers will not only provide economic satisfaction but also improve and maintain soil fertility, texture, physico-chemical characteristics and sustainability in natural ecosystem. Nevertheless, BGA have great potential and their use will expand to new domain in near future.

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Nutritional security and Health Promoting Potential of Millets

Asha B. Kadam
Suvarna V. Gaikwad
Dadasaheb S. Wadavkar
Rayat Shikshan Sanstha's, Dada Patil Mahavidyalaya, Karjat,
Dist. Ahmednagar, Maharashtra, India- 414402
Email: *ashakadam16@gmail.com*

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Abstract:

The maintenance of human physical well-being is heavily dependent on the nutritional quality of food, as it is a sustainable factor that promotes health, development, and the full potential of human genetics. Climate change and biodiversity loss will need us to rethink and rebuild our current food systems in order to feed everyone on the planet and offer sustainable nourishment. Cultivating substitute crops, such as millets, is an excellent method to enhance food security and diversify our diet. Millets are a group of small seeds derived from annual plants that are commonly grown in dry, semi-arid land parts of the world. These millets are a superior source of nutrients since they are high in essential amino acids, dietary fibers, iron, zinc, calcium, phosphorus, and potassium. Additionally, millets are also valued due to it's significant biological activities namely, anti-diabetic, anti-hypertensive, anti-inflammatory, hepatoprotective, anti-oxidant, to manage obesity and boosting immunity. The current chapter provides the nutritional and health promoting potential of millets which can be used by industry, consumers, researchers, and nutritionists as a set of recommendations.

Keywords: Millets, Cereals, Nutritional security, Health promoting potential, Biological activities**.**

1. Introduction:

In the twenty-first century, achieving global food and nutritional security is difficult owing to economic weaknesses and climatic change (Chaturvedi et al., 2023). A number of factors lead to these challenges, including a lack of micro- and macronutrients, shortfalls in food production that result in supply-demand imbalances, and conflicts that destabilize various parts of the world (Naresh et al., 2023). In order to feed the world's population and provide sustainable nutrition, climate change and biodiversity loss will force us to reinvent and restructure our current food systems. A good way to vary our diet and improve food security is by growing alternative crops like millets (Narciso and Nystr¨om, 2023**).** According to estimates, over 2 billion would be needed globally by 2050 to provide food security, with millet grains being the primary source of production due to their climate-resilient nature (FAO, 2021).

Millets are a group of small seeds derived from annual plants that are commonly grown in dry, semi-arid land parts of the world (Shah et al., 2023). Millets are frequently grouped together under the term "coarse cereals," which refers to any warmed up

seasoned cereal seeds (wheat and rice excluded) that were formerly used to feed birds and animals but are currently becoming more and more important as cutting-edge human therapeutic meals (Fu et al.,2020). Different types of millets along with their scientific names, common names and family are described in table 1. In temperate, subtropical, and tropical locations, millets are typically grown in arid conditions. Finger millet, pearl millet, fonio, and teff are millets that originated in Africa, whereas foxtail, proso millet, little milet, barnyard, and kodo millets originated in Asia (Narciso and Nystr¨om, 2023**)**. In the Indian cereal production sector, millet is experiencing a significant revival following decades of negligence. With an expected total share of 40.62% and a projected production of 10.91 million tonnes in 2018–2019, India leads the world in millets production (Ashoka et al., 2020).

Sr. No.	Scientific name	Common Name	References
1.	*Panicum miliaceum L.*	Proso millet	Sachdev et al.,2023
2.	*Setaria italica L.*	Foxtail millet	Sachdev et al.,2023
3.	*Sorghum vulgare*	Sorghum	Sachdev et al.,2023
4.	*Pennisetum glaucam L.R. Br.*	Pearl millet	Sachdev et al.,2023
5.	*Eleusine coracana L.*	Finger millet	Sachdev et al.,2023
6.	*Setaria italica (L.) P. Beauvois*	Foxtail millet	Rao, 2017
7.	*Panicum sumantrense*	Little millet	Sachdev et al.,2023
8.	*Echinochloa crusgalli (L.) P. Beauvois*	Barnyard millet	Rao, 2017
9.	*Paspalum scrobiculatum L*	Kodo millet	Rao, 2017
10.	*Digitaria iburua*	Fonio	Narciso and Nystr¨om,2023
11.	*Eragrostis tef*	Teff	Narciso and Nystr¨om,2023

Table 1. Scientific names and common names of different Millets

2. Millets for nutritional security:

Nutritional insecurity and malnutrition affect billions of people worldwide. We are a long way from meeting the 2030 worldwide target set by the United Nations to eradicate hunger. Consequently, in order to achieve food and nutrition security, the food system must change. Millets could be a vital weapon in the fight against hunger and food insecurity (Gowda et al., 2022). Since millets are rich in proteins, dietary fibres, iron, zinc, calcium, phosphorus, potassium, vitamin B, and vital amino acids, they are a better source of nutrients than wheat and rice. Approximately eighty percent of millet grains are used for human consumption; the remaining 20 percent is used in the brewing sector to make alcoholic beverages and as animal feed (Vinoth and Ravindhran, 2017). Millets are rich in dietary fibre, vitamins, minerals, fatty acids, carbohydrates, and polyphenols. The nutrient composition of different types of millets have shown in Table 2.

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2.1 Carbohydrates:

According to estimates, soluble and dietary fiber makes up the majority of the carbs that make up almost 70% of grains. In millets, amylopectin and amylose make up 70–80% of the polysaccharides (Sabuz et al., 2023). Abah et al. (2020) reported Sorghum grain is a great source of energy (349 kcal) due to its high carbohydrate content of 73%. Sorghum also contains cellulose and hemicellulose as additional carbohydrates.

Source	Carbohydrates (g)	Crude Protein (g)	Fat(g)	Crude Fiber (g)	Ash(g)	Energy (Kcal)
Pearl millet	60.0-76.0	12.0-14.0	4.8-5.7	2-2.5	2.0-2.2	363-412
Finger millet	60.0-80.0	7.0-10.0	1.3-1.8	3.6-4.2	2.6-3.0	328-336
Foxtail millet	59.0-70.0	11.2-15.0	4.0-7.0	4.5-7.0	2.0-3.5	330-350
Kodo millet	66.0-72.0	8.0-10.0	1.4-3.6	5.0-9.0	4.0-5.0	309-353
Little millet	60.0-75.0	10.0-15.0	5.0-6.0	4.0-8.0	2.5-5.0	329-341
Barnyard millet	55.0-65.0	6.0-13.0	2.0-4.0	9.5-14.0	4.0-4.5	300-310
Proso millet	55.0-70.0	10.0-13.0	1-3.5	2.0-9.0	2.0-4.0	330-340
Teff	70.0-73.0	10.0-11.0	2.0-4.0	1.0-2.0	2.8-3.1	330-340
Fonio	75.0-82.0	7.0-9.0	0.5-2.0	2.0-3.5	1.0-4.0	360-370

Table: - 2. Nutrient Composition of Millets (Per 100 g)

Source: Chauhan, M., Sonawane, S. K., & Arya, S. S. (2018). Nutritional and Nutraceutical Properties of Millets: A Review.

2.2 Protein:

In millets, protein makes up roughly 10% of the total weight and is the second most prevalent ingredient after starch. Several millet seed species have total protein contents ranging from 7.52% to 12.1%, which is similar to that of wheat and rice. In a recent study, the present state and possible uses of millet proteins in the pharmaceutical, food, dietary supplement, and bio-based industries have been reported (Sachdev et al., 2023).

2.3 Fat and Fiber:

It has been found that little millet and kodo millet contain the highest levels of dietary fiber which ranges between 38% and 37% respectively. In addition, they contain highest levels of polyunsaturated fatty acids. Additionally, Resistant starch, soluble and insoluble dietary fibres, minerals, and antioxidants were all shown to be significantly abundant in pearl millet (Saleh et al.,2013).

2.4 Lipids:

Millets vary in their fat content; finger and kodo millet have the lowest fat level (1%), while proso, foxtail, and pearl millets have the highest fat content (5%). Usually, the fat contains more than 60% unsaturated fatty acids, including linolenic acid (Ushakumari et al., 2007).

2.5 Others:

Niacin (B3), thiamine, riboflavin, and folic acid are the vitamins that are abundant in millet grains. The majority of the antioxidant activity found in millets is derived from their phytates, tannins, and polyphenols; these compounds also play a part

in anti-aging. With the highest calcium content (344 mg/100 g), finger millet is superior to other grains (Tripathi et al., 2021).

3. Health Benefits of Millets:

Beyond their nutritional value, millet has other health benefits, such as decreasing blood pressure, preventing heart disease, lowering cholesterol, and improving fat absorption. Millets have been shown to improve human health by supporting the growth and repair of body tissue, enhancing the digestive system, cleansing the body, boosting immunity in the respiratory system, boosting vitality, and defending against degenerative diseases (Makuvara, 2022).

3.1 Boosting immunity:

Globalization and industrialization have drastically changed people's diets and lives, which has lowered immunity and thus contributed to the rise of non-communicable diseases (Arora et al., 2023). Millets have a high nutritional content, which can be quite beneficial for boosting immunity. Antioxidants, such as phenolic chemicals, which are abundant in millets, can strengthen immunity by shielding immune cells from oxidative damage (Srivastava et al., 2023). In people who are genetically predisposed, gluten consumption causes celiac disease (an immune-mediated enteropathy). Sarita and Singh (2016) reported millets are a great choice for individuals with gluten sensitivity and those with celiac disease.

3.2 Anti-diabetic activity:

It has been claimed that grains including barley, quinoa, oats, can reduce inflammation, hyperglycemia, and hyperlipidemia in both humans and rats. Furthermore, rats treated with whole pearl millet grain powder and its ethanol extract demonstrated hypoglycemic potential (Alzahrani et al., 2022). Research was done on foxtail millet's ability to reduce blood sugar levels in free-living subjects who had difficulty absorbing glucose. The findings confirmed that increased foxtail millet diet may be advantageous for those with type 2 Diabetes mellitus as it has been shown to improve glycemic control in free-living subjects with impaired glucose tolerance (Ren et al., 2018).

3.3 Anti-hypertensive activity:

In a study of individuals with moderate hypertension, Hou et al., (2018) examined the possible anti-hypertensive impact of whole foxtail millet and shed light on the potential cause. The findings demonstrated that following a 12-week whole foxtail millet diet intervention, there were notable drops in the participants' blood pressure. Furthermore, a considerable decrease was observed in the body mass index, body fat percentage, and fat mass. All things considered, whole foxtail millet has the potential to lower blood pressure and relieve associated cardiovascular disorders.

3.4 Hyperlipidemia and obesity:

According to World Health Organization (WHO) data, cardiovascular disease is the primary cause of morbidity and mortality globally, responsible for around 30% of all fatalities. WHO estimated that the death toll from cardiovascular disease was 17.3 million in 2016 and might reach 23.3 million by 2030(Zhao et al., 2021). Previous research reported that consuming millets has been shown to lower hyperlipidemia, which

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in turn lowers blood pressure, and to increase HDL-C, or good cholesterol. These effects may help control the related risk of hypertension and atherosclerotic cardiovascular illnesses in the future (Anitha et al., 2021).

3.5 Hepatoprotective and anti-inflammatory activity:

By giving rats, a high-fat diet, it was investigated the hepatoprotective and anti-inflammatory properties of whole pearl millet grain powder and its ethanol extract. In high-fat diet-fed rats, the results indicated that pearl millet's raw powder and ethanolic extract had comparable dose-dependent anti-inflammatory and anti-steatotic properties. The food industry and dietitians may be prompted by these findings to incorporate specific grains into their plans and pay more attention to them (Alzahrani et al., 2022).

3.6 Antioxidant:

Antioxidant efficacy of different aqueous and organic solvents of foxtail millet flour (*Cetaria italic*) was evaluated by Abedin et al., (2022). Furthermore, it's functional and physical attributes, as well as nutritional value, were examined. The current findings demonstrated the value and usability of foxtail millet, a food item with exceptional nutritional and antioxidant levels. The present investigation delved into the possible application of foxtail millet grains in food product formulations, particularly as a functional element that may aid in the advancement of health status and consumption patterns.

Conclusion:

Millets are a family of small seeds that are often grown in arid and semi-arid regions of the world. In addition to rich in dietary fiber, vitamins, minerals, fatty acids, carbohydrates, and polyphenols, these nutricereals are also valued for their diverse biological properties. It is confirmed by our research that these millets hold great promise for managing diet and management of several diseases. Additionally, by cultivating millets, we can increase food security and provide sustainable nutrition to the world's increasing population. Nevertheless, in order to raise the millet diet's quality and increase the micronutrients' bioavailability, new processing and preparation techniques are required.

Acknowledgment:

Authors are thankful to their respective Head of the Institutions.

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Hypervalent Iodine: Introduction, Synthesis and its Applications

Dr. K. A. Sasane
Department of Chemistry, Abasaheb Marathe Arts & New Commerce, Science College, Rajapur, Ratnagiri 416702, Maharashtra, India
E-mail: kulsasane007@gmail.com

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Abstract:

Hyper iodine reagents are readily available, easy preparative procedures, and mild reactivity with good stability. The hypervalent iodine reagents have become regents of interest to organic chemists. They can be used for many transformations like ring expansion reaction, ring closure reaction, single electron transfer reaction, oxidation etc. in this chapter study literature on hypervalent iodine compounds, their synthesis and applications are listed.

Keywords: Hypervalent iodine, DIB, IBX, Cyclisation, Synthesis

Introduction:

1.1 Hypervalent Iodine Reagents:

French chemist Bernard Courtois was discovered Iodine in 1811 and it was named by J. L. Gay Lussac in 1813. Its name derives from the Greek word iodes, sense "violet-colored," reflecting both the characteristic lustrous, deep purple colour of resublimed crystalline iodine as well as the colour of its vapours. It can be found in seaweed and brine wells.

Iodine

Element number 53
Atomic weight 126.9
Oxidation state
Main I-1
Others I0, I+3, I+5, I+7
Electronic Configuration $1s^2$, $2s^2$, $2\ p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^6$, $4d^{10}$, $5s^2$, $5p^5$

Hypervalency

In numerous compounds, the elements belonging to the 15–18 groups exhibit greater oxidation states than normal valency (Musher, 1969). "Hypervalency" refers to an atom's ability to expand its valence shell outside of the bounds of the Lewis octet rule within a molecular entity. The relocation of electrons from the core, hypervalent atom to the nonbonding molecular orbitals it creates with (more electronegative) ligands is implied by an explanation of hypervalency.

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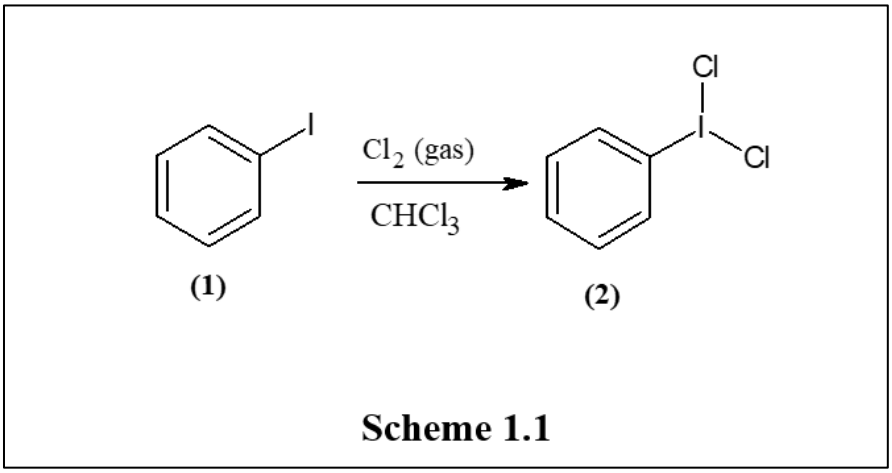

Scheme 1.1

1.1.2 Nomenclature of hypervalent iodine compounds:

The nomenclature of hypervalent iodine compounds is based on the oxidation states of the core iodine atom. Numerous compounds with valences ranging from 1 to 5 are known to exist. These compounds are typically coordinated with 2-4 different ligands (Varvoglis, 1992). Figures 1.1 illustrate four major structural kinds of hypervalent iodine reagents together with general notations for each iodine reagent.

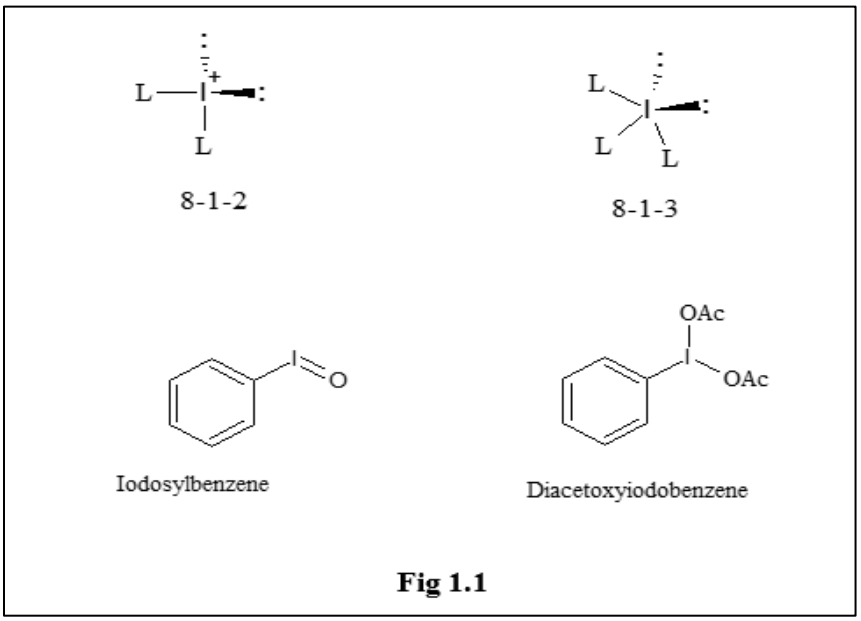

Fig 1.1

1.1.3 Iodine (V) compounds: Also named λ5-iodanes. Represented C in Fig. 1.2

1.1.4 Iodine (III) compounds: Also named λ3-iodanes according to IUPAC

Recommendations

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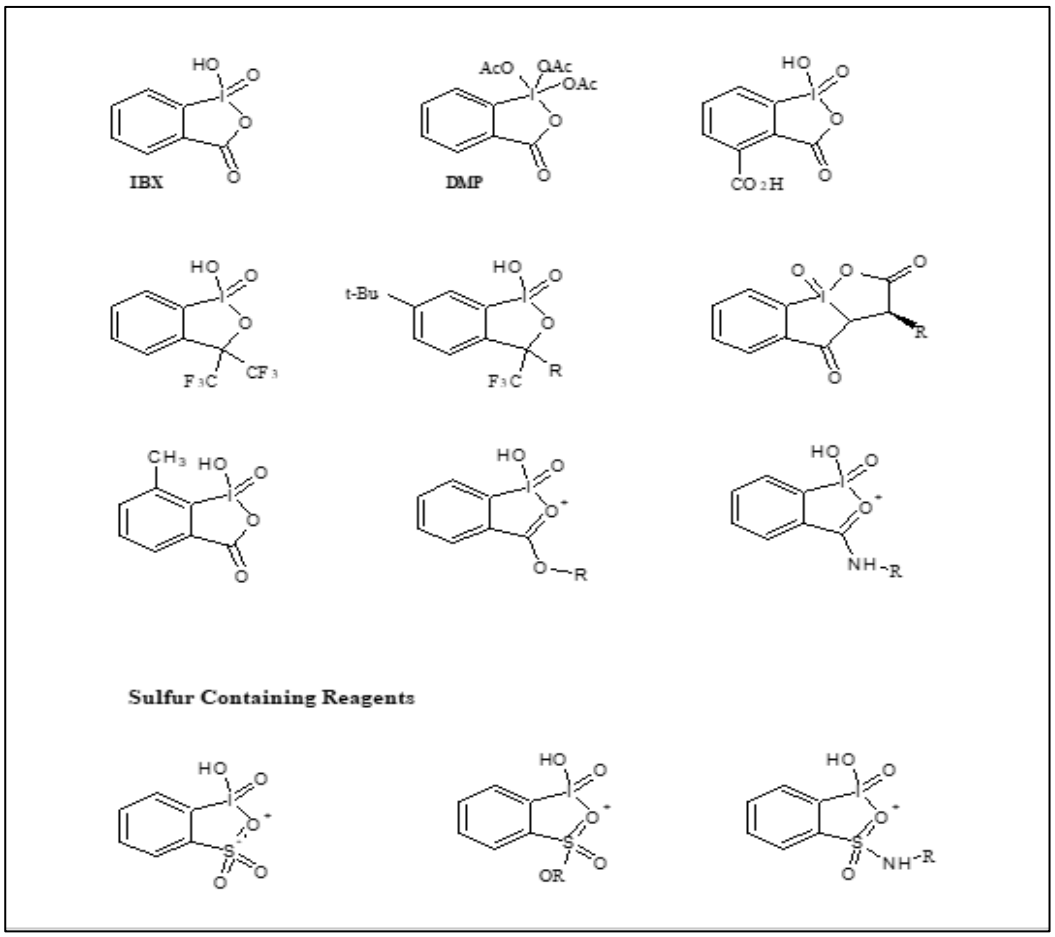
(A) (B)

where R = Carbon ligand

X = O or N Ligand

Fig 1.2

Some of the Examples of hypervalent iodine (IV) regents, derivatives of IBX and other cyclic pentavalent reagents are shown below (Fig 1.3)



These reagents are employed in a variety of transformations as oxidizing agents for amino alcohols protected by carbamate, as well as primary, secondary, benzylic, allylic, and terpene alcohols, resulting in the corresponding aldehydes or ketones in

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remarkable yields and purities.

d) Polymer supported Hypervalent (IV) reagents:

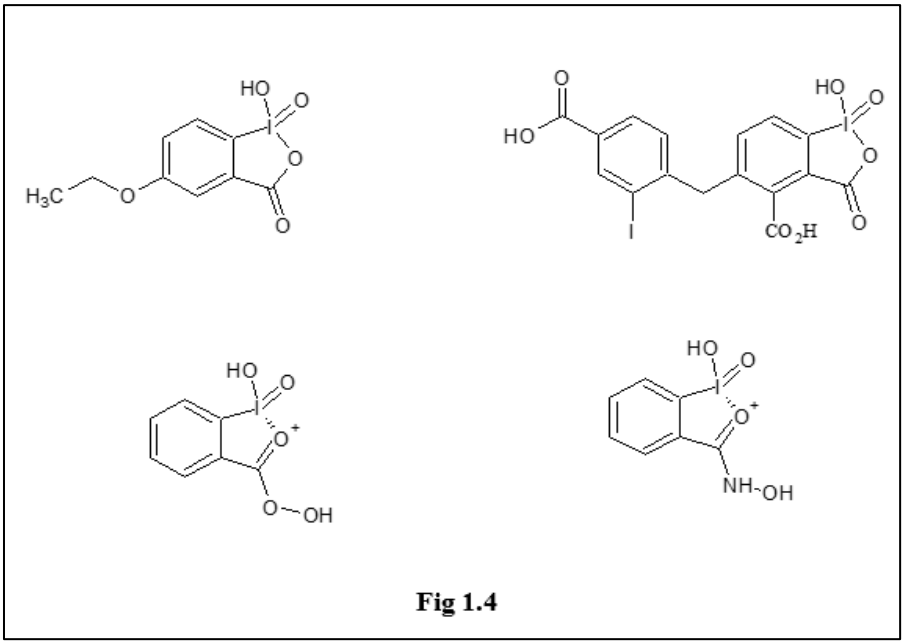

Fig 1.4

1.2Applications of IBX:

- Oxidative cleavage of vicinal 1, 2-diols.
- The oxidative transformation of threonines involved the a-hydroxylation and oxidation of a secondary alcohol to a ketone (Harding, 2009).
- Dehydrogenation of tetrahydro-carbolines to their aromatic forms.
- Primary Carboxamides Oxidatively Transform into One-Carbon Dehomologated Nitriles
- Synthesis of α-β Unsaturated Systems from Alcohols and Ketones
- Oxidation of primary alcohol to carboxylic acid
- Oxidation of secondary alcohol to ketone.
- α-Hydroxylation of Alkynyl Carbonyl Systems
- Oxidation of various phenols to *o*-quinones.
- Key step of the total synthesis of the streptomycin maritimus metabolite, wailupemycin B.
- Oxidation of primary alcohols or aldehydes to N-hydroxysuccinimide esters.
- Oxidation of alcohols, ketones, and aldehydes to the corresponding α-β unsaturated species.
- Oxidation of alkyl-substituted aromatic compounds at the benzylic position to the corresponding carbonyl derivatives.
- Oxidation of alcohols, secondary amines can be oxidized with IBX in DMSO to yield the corresponding imines.

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1.2.1 Applications of DMP:

The utilization of DMP in the complete synthesis of CP-molecules, lead structures for cardiovascular and anticancer medications disclosed by Nikolaou and colleagues, is the greatest example of the compound's special oxidizing capabilities.

- The allylic aldehydes and alkyl acetylates' Baylis-Hillman adducts can be effectively oxidized to get the appropriate α-methylene-β-keto esters.
- Synthesis of Cyclic enecarbamates from oxidation of α-hydroxy carbamates.
- Synthesis of cyclic acetoxy acetals from 1, 4 diols.
- Polyfluorinated alcohols can be oxidised to respective aldehydes.
- Primary alcohol can be oxidised to α, β unsaturated esters in presence of witting ylide.
- Deoximation of aldoximes as well as ketoximes to respective ketones.
- Conversion of matching aldehydes and thioles into thioesters under mild circumstances.
- *α*- bromination of α-β unsaturated ketones.
- α- tosylation of secondary alcohol.
- *α*- bromination of 1, 3 diketones.

1.3 Preparation of trivalent reagents:

a) (Difluoroiodo) arenes

This is an extremely potent fluorinating reagent that can be made by fluorinating iodoarenes with strong reagents like XeF2, F2, ClF, and BrF5. Mercuric oxide and aqueous HF were previously used in a process where they reacted with (Dichloroiodo) arenes in MDC. This method's drawback is the significant amount of hazardous HgO required to remove the chloride ion from the reaction mixture. Iodosylarenes are treated with 40–46% aqueous hydrofluoric acid, and the resultant (Dichloroiodo) arenes are then crystallized from hexane in a convenient modified process that does not require the use of HgO (Hara et al., 2002; Wirt et al., 2005; DiMagno et al., 2008). It is crucial that the Iodosylarenes be utilized in this technique freshly manufactured.

b) Koser's reagent

Typically, a ligand exchange reaction between (diacetoxyiodo) arenes and p-toluenesulfonic acid monohydrate in acetonitrile is used to prepare [hydroxy (tosyloxy) iodo] arenes (Scheme 1.1). Katzenellenbogen et al., 2007; Togo et al., 2002; 2005; 2001; Kita et al., 2004; 2005; Zhdankin et al., 2008; Zhang et al., 2005; Wirth et al., 2001; 2005).

Iodoarenes and mCPBA react in one pot at room temperature with sulfonic acids and a tiny amount of chloroform, providing a straightforward modified method for preparing several [hydroxy (sulfonyloxy) iodo] arenes. Recently, novel reusable organic trivalent iodine reagents based on biphenyl and terphenyl were prepared using this modified process.

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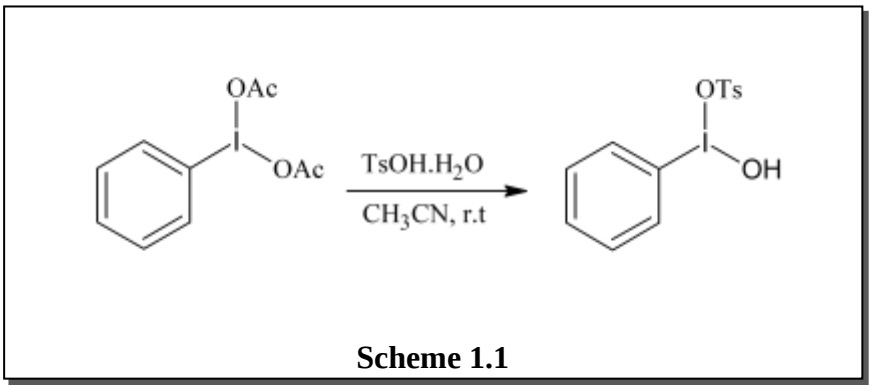


Scheme 1.1

1.3.1 (Diacetoxyiodo) benzene preparations:

(DIB) is a synthetic precursor to several related compounds and one of the first reagents in this family to be studied. Of these derivatives, [Bis (trifluoroacetoxy) iodo] benzene (BTI) is important since it has various intriguing uses in contemporary chemical synthesis. It has been noted that the synthetic characteristics of trivalent iodine compounds are often comparable to those of derivatives of lead and thallium, albeit with better yields and improved toxicity, making them more suitable for use in pharmaceutical production settings.

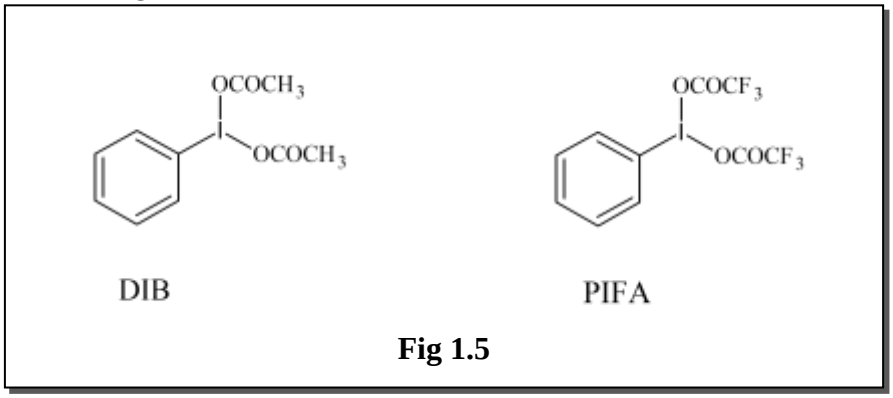
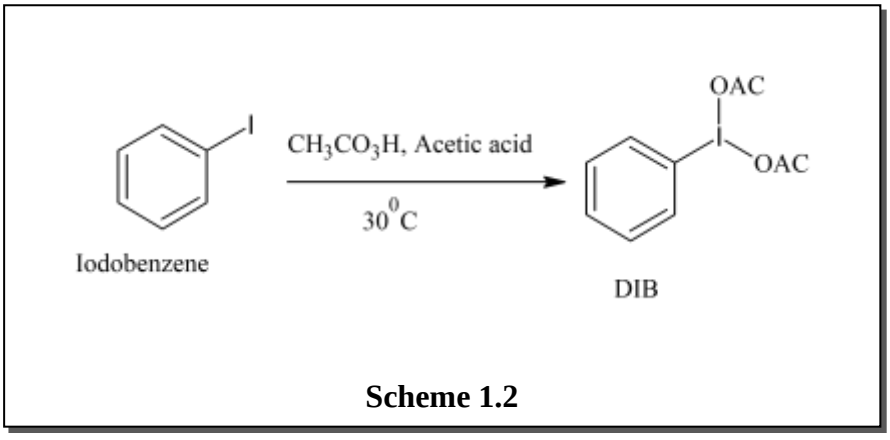


Fig 1.5

a) From Iodoarenes:

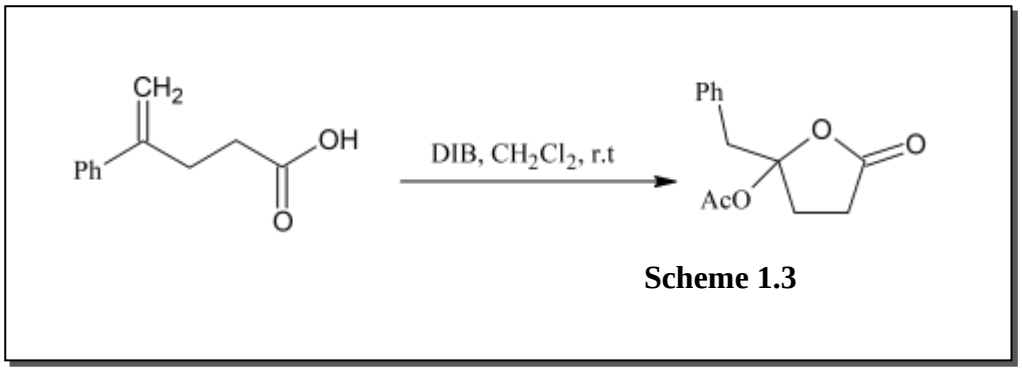


Scheme 1.2

The easiest and most often used method for preparing a variety of (diacetoxyiodo)-substituted arenes and hetarenes on a small scale is the oxidation of iodoarenes with sodium perborate in acetic acid at 40 ºC.

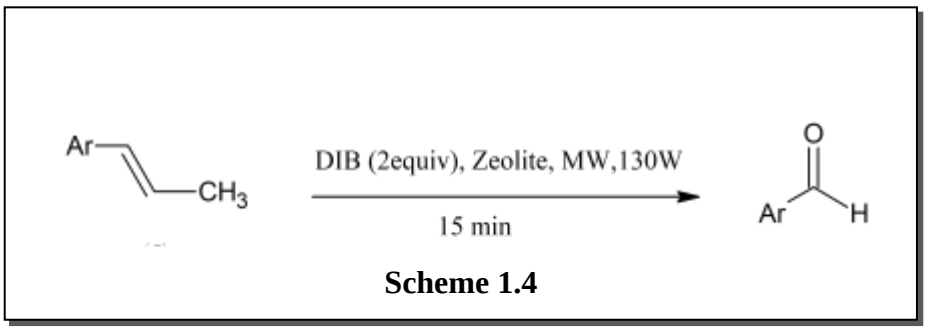
1.4 Applications of hypervalent iodine (III) reagent:

I. Lactonization:



Scheme 1.3

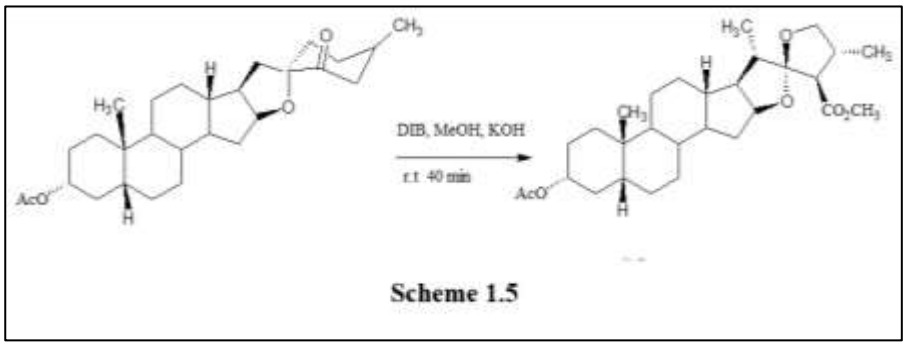
A multicomponent reaction of allenes, diaryl diselenides, DIB and alcohols or acids formed substituted allyl derivatives in moderate yields (Huang et al., 2007).



Scheme 1.4

V. Oxidative transformations of steroidal substrates:

An axial acetoxy group was introduced at position C-23 of the side chain in the instance of steroidal substrate with DIB and boron trifluoride etherate in acetic acid (Iglesias-Arteaga et al., 2006; 2007).



Scheme 1.5

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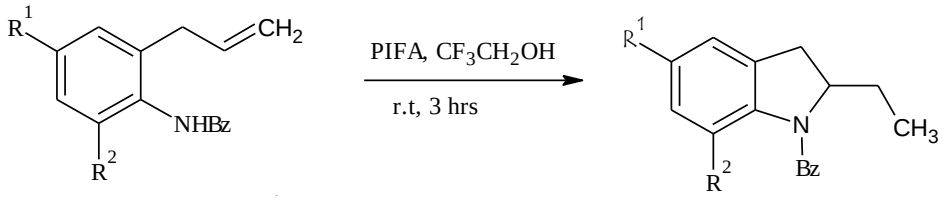
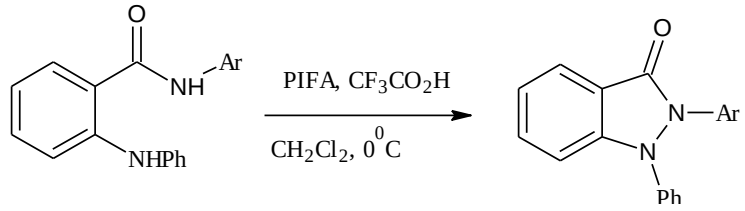
VII. Oxidative Cationic Cyclization, Rearrangements, and Fragmentations:

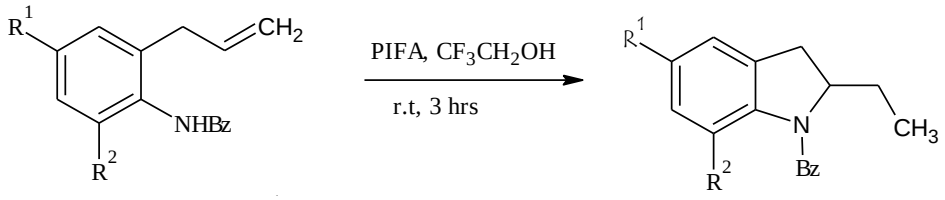
The synthesis of indoline derivatives from anilides and indazol-3-ones from anthranilamides (Scheme 1.6; Dominguez et al., 2005, 2006, 2007) are two recent exemplary instances. Pyrrolidinones have been synthesized from alkynylamides with the assistance of PIFA.



Scheme 1.6



Scheme 1.7



Scheme 1.8

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ABOUT THE EDITORS

Prin. Dr. Vilas V. Patil

He is currently working as Incharge Principal and Professor at Akhil Bhartiya Maratha Shikshan Parishad's Shri Shahu Mandir Mahavidyalaya in Parvati, Pune-411009 (MH). He received his Ph.D. from Savitribai Phule Pune University, Pune. His scientific interests area is geomorphology, population and settlement, and GIS. He has published 38 research papers in UGC-CARE and peer-reviewed international publications. He was published five books and Six book chapters. He is a recognized PG teacher and Ph.D. Guide at SPPU in Pune. He Supervised four Ph.D. students. He has given 20 expert addresses as invited lecturers and resource individuals. He has presented over 28 research articles at international and national conferences, seminars, and symposia in India. He was completed one Minor Research Project which is funded by UGC.

Dr. Digvijay S. Kumbhar

He is presently working as Asst. Professor and Head, Department of Zoology at Rayat Shikshan Sanstha's D.P.Mahavidyalaya, Karjat, Dist. Ahmednagar. He has qualified SET and GATE examinations and awarded Ph.D. from Savitribai Phule Pune University, Pune. His area of research is Hydrobiology, Wetland Avifauna, Heronries and Biodiversity. He has published 18 research papers in UGC-CARE and Peer-reviewed international journals, 04 conference proceedings and 05 book chapters. He has delivered 16 expert talks as invited lectures and as resource persons. He is recognized PG teacher of SPPU, Pune. He has presented more than 40 research papers through various international and national conferences, seminars and symposia. In addition to this, Dr. Kumbhar has completed 08 induction and faculty development programmes. He has guided 10 students for their PG dissertations. He is working as life member of Academic and Research conclave, Tamilnadu, India.

Dr. Pratishtha N. Nagane

Presently she is working as an Assistant Professor, in the Rayat Shikshan Sanstha's, PG & Research Center, Department of Botany, Dada Patil Mahavidyalaya, Karjat, District Ahmednagar (MH.). She was completed her B. Sc. in Botany from The New College, Kolhapur, M.Sc. M. Phil. and Ph.D. from Department of Botany, Shivaji University Kolhapur. She has a teaching experience of 21 years at under graduation & post graduation. Dr. Nagane contributed a lot to the research field also, she published more than 15 Research Papers with impact factors, h-index 3, and more than 23 citations. Her area of research specialization is Mycology, Plant Pathology, Plant Physiology, Biotechnology, Cytology, Plant Breeding, etc. She published 9 book chapters so far and has been granted one patent by the Australian Government. She is recognized as a PG Teacher & Ph. D. guide by Savitribai Phule Pune University, Pune.

Mr. Agastirishi B. Toradmal

He is presently Research Scholar at Prof. Ramkrishna More Mahavidyalaya, Akurdi, Pune- 411044 affiliated to Savitribai Phule Pune University, Pune. He have 10 year experience as Assistant. Professor, Department of Geography at Rayat Shikshan Sanstha's Dada Patil Mahavidyalaya, Karjat, Dist. Ahmednagar. He has qualified SET examinations. His area of research is Groundwater Hydrology, Geomorphology and GIS. He has published 15 research papers in UGC-CARE and Peer-reviewed international journals, 04 Books and 04 book chapters. He has delivered 04 expert talks as invited lectures and as resource persons. He is recognized Co-ordinattor of IIRS- ISRO outreach Programme. He has presented more than 10 research papers through various international and national conferences, seminars and symposia.

Dr. Sunita Arya

She is working as Professor, Department of Zoology, Dayanand Girls P.G. College, Civil Lines, Kanpur - 208001. She has published 54 research articles/ review articles/ 09 book chapters and 01 books/edited books. She supervised 05 Ph.D. student. and successfully organized 32 national/International conference/seminars/Webinars and actively participated in more than 100 conferences. Dr. Arya has been Member, Board of Studies (BoS), CSJM University, Kanpur and Coordinator, Star College Scheme of DBT, Ministry of Science and Technology. She is Assistant Editor in Kamdhenu Kripa monthly magazines. She has received about 29 most prestigious awards of Regional, National and International repute.

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