EMERGING RESEARCH PARADIGM

FOR SUSTAINABLE DEVELOPMENT

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Emerging Research Paradigm for Sustainable Development

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First Impression: August 2023

Emerging Research Paradigm for Sustainable Development

ISBN: 978-81-19481-23-1

Rs. 1000/- ($80)

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Published by:
IARA Publication

Preface

Emerging research paradigm for sustainable development refers to the method of development which may, on the one hand, bring about better standard of living and life chances and, on the other, the possibility of negative impact of the process of development may be minimal. Sustainability is a paradigm for thinking about a future in which environmental, social and economic considerations are balanced in the pursuit of development and an improved quality of life. This edited book focusses on emerging research paradigm for sustainable development. *The contributions by the authors includes Documentation of medicinal plants of Jharkhand with antiulcer activity* in this the authors has investigated the different types of medicinal plant for the treatment of many diseases.

In the chapter *Role of Medicinal Plants and Yoga on Human Health* authors promoted the traditional practices such as pranayama and the use of medicinal plant to improve overall health and wellbeing.

In another chapter *GC-MS analysis and Medicinal Values of Leaves Extract of Shorea robusta Gaertn in Jharkhand* authors highlights about the medicinal values of leaves extract of Shorea robusta Gaertn in Jharkhand and its multiple uses in anti-microbial, anti-inflammatory, anti-cancer, anti-aging etc.

The chapter titled *"Effects of ethanol and chloroform extracts of some medicinal plants against Sclerotium rolfsii"* the authors evaluate the effect of ethanol and chloroform extracts of some medicinal plants.

In the chapter *Study on traditional knowledge of some medicinal plants used to cure various ailments by ethnic people of Ranchi district, Jharkhand,* different plants with medicinal properties have been explored in different villages of Ranchi district of Jharkhand for the treatment of different diseases.

Global action toward food security is needed in the present scenario to ensure and sustain food production. This is to provide adequate food for everyone in the world. To prevent global hunger and malnutrition, effective international policies must be implemented that address the diverse needs of different countries. In the chapter *Sustainable Agriculture and Food Security* authors focused on insights of sustainability in agricultural toward food security.

In another chapter *Post-Harvest Management, Value Addition and Marketing of tomato* the authors highlights about the proper handling practices and preservation measures so to the improved the post-harvest quality of tomatoes.

Few chapters include "A *Comprehensive investigation for Water Resources and Water Borne Disease in Banka", "Studies on In Vitro Antifungal activity of Solvent extracts of Neem (Azadirachta indica) against Fusarium* mangiferae causing Mango Malformation" and "*Leea macrophylla Roxb. ex Hornem. as a wild edible ethnomedicinal plant".* In another chapter the authors highlights *Antioxidant properties of solvent extracts of mulberry.*

This edited book highlights the emerging research basically in agriculture science. I hope this book would be helpful for students, researchers and academicians in the field of life science and agriculture science.

Acknowledgement

We gratefully acknowledge all the authors for contributing paper which provides richness of content to this book. We would like to offer my sincere thanks to all the authors.

We extremely indebted to Prof. (Dr.) Savita Sengar (Vice Chancellor, Jharkhand Rai University, Ranchi), Prof. (Dr.) Piyush Ranjan (Registrar, Jharkhand Rai University, Ranchi), as a source of inspiration for us in our academic growth.

We are thankful to IARA Publication for publishing this edited book.

Dr. Shraddha Prasad

Dr. Harmeet Kaur

Table of Contents

DOCUMENTATION OF MEDICINAL PLANTS OF JHARKHAND WITH ANTIULCER ACTIVITY

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[1]Research Scholar and [2]Associate Professor, Department of Botany, Ranchi University, Ranchi

ABSTRACT

Medicinal plants are known to be the most attractive sources of new drugs and have shown promising results in the treatment of many diseases including peptic ulcer. Large number of synthetic drugs are available to treat ulcer but these drugs are expensive and produce several side effects when compared to herbal medicines.

Peptic ulcer is erosion in a segment of the gastro-intestinal mucosal layer affecting upto 10% of the world population. Presence of acid HCl and gastric juice pH are found to be main reasons of ulcer formation. But certain other factors are also responsible for ulcer formation like stressful lifestyle, emotional disturbance, consumption of alcohol, chewing tobacco, H. pylori infection etc.

Therefore herbal plants stand out as being exceptional for its ethnic, ethonobotanical and ethnopharmaceutical use.Various plants like Butea frondosa, Ficus religiosa, Acacia arabia, Emblica offinicinals, Aegle marmelos, Madhua longifolia ,Annona squamosa, Carica papaya, Psidium guajava, Ocimum sanctum ,Moringa oleifera, Glycyrrhiza glabra, etc. proved active in antiulcer therapy.The secondary metabolites present in the plants like alkaloid, flavonoids, terpenoids, tannins have an important role in reliving pain, healing ulcer and delaying ulcer recurrence.

Keywords: Ulcer, H.pylori, ethnobotany, HCl, Flavonoid

INTRODUCTION

Plants have been major source of drugs in Indian System of Medicine and other ancient system in the world.

WHO reported that 80% of the world population in developing countries depends on botanical medicines.

Peptic ulcer is erosion in a segment of the gastro-intestinal mucosal layer affecting upto 10% of the world population.

It is estimated that 15000 deaths occur each year as a consequence of peptic ulcer.

Excessive secretion of gastric acid is the main factor in the pathogenesis of peptic ulcer disease.

The two most common types of peptic ulcer are gastric ulcer and duodenal ulcer.

Causes:

- stressful lifestyle
- Alcohol consumption
- Irregular and spicy food habits
- Severe illness
- Tobacco smoking
- Non – steroids anti – inflammatory drugs (NSAIDs)
- Some hereditary conditions
- H. pylori bacterium infection

Symptoms - The common symptoms include:

- Waking at night with severe upper abdominal pain
- Bloating
- Nausea
- Heart Burn
- Abdominal fullness
- Weight gain or loss
- Dark or black stool
- Vomiting

General Treatment

Treatment is planned after analysing the cause of peptic ulcer. Antacids may be provided for temporary relief.

MATERIALS AND METHODS

This paper is based on extensive study of ethnic medicinal plants found in Jharkhand.Various plants were studied during a period of time to identify the plant and their usage. Collected plants were compared with previous data available in different books and were identified using the book "The Botany of Bihar and Orissa" by H. H. Haines.

RESULTS AND DISCUSSION

Documentation of plants is based on the information obtained from local people, vaidyas, faith healer etc.

Some of the important plants used to treat Peptic ulcer are as follows :

Carica Papaya

- Family – Caricaceae
- Local name – papita
- English name – papaya
- Part used – seeds

It is a fast growing, semi woody, tropical herb. Papaya contain many biologically active compounds. Chymopapain and papain are two important compounds which arewidely used for digestive disordersand problems of the gastro-intestinal tract.

Psidium Guajava

- Family – Myrtacea
- Local name- amrood
- English name- guava
- Parts used- roots, barks and leaves

This tree is cultivated all over India. It is used ethno botanically for the remedy of several stomach diseases including peptic ulcer.

Curcuma Longa

- Family- Zingiberaeae
- Local name- haldi
- English name- turmeric
- Parts used- rhizome

It is perennial herb erect, leafy upto 1m high with short stem. It is anti-inflammatory, antioxidant and can inhibit ulcer formation caused by stress and alcohol consumption.

Glycyrrhiza Glabra

- Family- Fabaceae
- Local name- mulethi
- English name- liquorice
- Parts used- root and rhizome

It reduces stomach secretion and therefore protects from peptic ulcer imflammatory disease.

Mangifera indica

- Family- Anacardiaceae
- Local name- aam
- English name- mango
- Parts used- leaves

It provides gastroprotection againt gastriv ulcer due to its cytoprotection, antioxidant and antisecretory effects.

Annona Reticulate

- Family- Annonaceae
- Local name- sharifa, sitaphal
- English name- custard apple
- Parts used- leaves

It is antimicrobial, anti – inflammatory, antiulcer, wound healing and hepato- protective.

Butea Frondosa

- Family- Fabaecae
- Local name- plash
- English name-
- Parts used- leaves

It is a medicinal Indian herb and is used as as external as well as an internal remedy for the management of various ailments.

Aegle Marmelos

- Family- Rutaceae
- Local name- bael
- English name- wood apple
- Parts used- leaves

It is used to treat peptic ulcer, chronic diarrhea, dysentery and respiratory ailments.

Aloe Vera

- Family- Asphodelaceae
- Local name- aloevera
- English name- aloevera
- Parts used- whole plants

It is effective in non- steroidal anti-inflammmatory drugs induced peptic ulcer.

Moringa Oleifera

- Family- Moringaceae
- Local name-sahjan
- English name-drumstick tree
- Parts used- leaves

It increases healing of gastric ulcer and is cytoprotective and antisecretory.

Table 1. List of Indian medicinal plants having antiulcer activity

S.no	Plant	Family	Part used
1.	*Carica papaya*	Caricaceae	Seed
2.	*Psidium guajava*	Myrtacea	Roots, bark & leaves
3.	*Curcuma longa*	Zingiberaceae	Rhizome
4.	*Glycyrrhiza glabra*	Liquoricae	Stem & root
5.	*Mangifera indica*	Amacardiaceae	Leaves
6.	*Annona reticulata*	Annonaceae	Leaves
7.	*Butea frondosa*	Fabaceae	Leaves, seeds &fruits
8.	*Aegle marmelos*	Rutaceae	Leaves & fruits
9.	*Aloevera*	Asphodelaceae	Whole plant
10.	*Moringa oleifera*	Moringaceae	Leaves

CONCLUSION

Peptic ulcer is a gastro-intestinal disorder occurred due to the imbalance between aggressive factors such as acid, pepsin, H. Pylori and defensive factors.in the present investigation, attempts have been made to document ethno-medicinally important plants so that its utilisation could take place to produce better drugs for the treatment of peptic ulcer disease with fewer side effects.Plants sources can result in novel and effective pattern of treatment.

Acknowledgement- I would like to thank Dr. Anil Kumar, Associate Professor of Department of Botany, Ranchi University, Ranchi for his encouragement and support.

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ROLE OF MEDICINAL PLANTS AND YOGA IN PANDEMIC ON HUMAN HEALTH

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ABSTRACT

The COVID-19 pandemic has made us realize the significance of traditional medicine and practices like yoga in boosting our immune system and overall health. This paper is an insight to the role of medicinal plants and the practice of yoga in pandemic and human health. The first part of the paper focuses on the medicinal plants. It highlights the traditional uses of plants like Tulsi, Giloy and Neem and their medicinal properties. The paper also discusses their potential role in preventing and treating viral diseases like COVID-19. The antiviral and immunomodulatory effects of these plants are examined in detail, and the paper stresses the importance of scientific validation of traditional medicine. The second part of the paper explores the role of yoga in pandemic and human health. It highlights the benefits of yoga in managing stress, anxiety, and depression, which have become increasingly prevalent during the pandemic. The paper also discusses the immune-boosting effects of yoga and its potential role in preventing and managing viral infections. It emphasizes the need for further research in this area and the integration of traditional practices with modern medicine. The paper also discusses the importance of sustainable harvesting and conservation of medicinal plants. It stresses the need to preserve these plants and use them in a responsible manner to ensure their availability for future generations. In conclusion, this paper highlights the potential of medicinal plants and yoga in boosting our immune system and overall health during the pandemic. It emphasizes the need for scientific validation of traditional practices and the integration of these practices with modern medicine to mitigate the impact of pandemics on human health.

***Keywords**: Pandemic, Covid-19, Sustainability, Yoga, Immune System, Natural Remedies, Medicinal Plants.*

INTRODUCTION

The COVID-19 pandemic has brought the world to a standstill, causing millions of deaths, and affecting the physical, mental, and social well-being of people globally. The search for a cure and effective treatment for the disease has spurred research and development efforts worldwide. While pharmaceuticals and vaccines remain the primary focus of these efforts, there is growing interest in traditional systems of medicine, such as Ayurveda, and complementary approaches, such as medicinal plants and yoga, in the prevention and management of COVID-19.

Medicinal plants have been used for centuries in traditional medicine for their therapeutic properties. Recent research has shown that many of these plants possess antiviral and immunomodulatory activities, which can potentially benefit the prevention and treatment of COVID-19. For instance, curcumin in turmeric, gingerol in ginger, and eugenol in holy basil have been shown to inhibit viral replication and enhance the immune response against viruses. Thus, exploring the role of medicinal plants in COVID-19 prevention and management, is of great interest to the scientific community.

Yoga, an ancient practice of physical postures, breathing exercises, and meditation, has gained worldwide popularity as a holistic approach to health and well-being. Research has shown that regular practice of yoga can reduce stress, anxiety, and depression, and improve respiratory function and immune response. As COVID-19 has been known to affect the respiratory system and cause mental health issues, the potential role of yoga in the pandemic and human health has become increasingly relevant.

The main objective of this study is to explore the use of medicinal plants and yoga practices among people in the Jharkhand region during the COVID-19 pandemic. We aim to gather data on the most used natural remedies, including tulsi, ginger, and garlic, as well as the use of pranayama, a type of yoga that focuses on controlled breathing exercises. Additionally, we hope to investigate how individuals in the region perceive these natural remedies and yoga practices, including their perceived effectiveness in boosting immunity and improving overall health.

This research paper aims to explore and discusses the potential efficacy and safety of selected medicinal plants and the benefits of yoga in improving physical and mental health. The findings of this paper can inform healthcare professionals and policymakers in developing effective strategies to improve human health and well-being in the pandemic and beyond.

HYPOTHESIS

1. The use of medicinal plants and yoga practices, such as Tulsi, ginger, garlic, and Pranayama, will be common among people in the Jharkhand region during the COVID-19 pandemic.

2. These natural remedies and yoga practices will be perceived as effective in boosting immunity and improving overall health among individuals in the Jharkhand region.

METHODOLOGY

The following method was used to study the use of Tulsi, ginger, garlic, and Pranayama by people for COVID-19 prevention and management:

1. Participant Selection: Participants were selected randomly from different age groups and backgrounds in the Jharkhand region who have used or were currently using Tulsi, ginger, garlic, and Pranayama for COVID-19 prevention and management.

2. Data Collection: The data was collected through one-to-one interviews with the selected participants. The interviews was conducted in a safe and socially distanced manner. The participants were asked about their use of Tulsi, ginger, garlic, and Pranayama for COVID-19 prevention and management, including the frequency and quantity of use, the method of use, and their perceived efficacy.

3. Tulsi, ginger, and garlic use: The participants were asked to describe the method of use of Tulsi, ginger, and garlic, such as whether they were used in cooking, as herbal teas, or as supplements. The participants will also be asked about any side effects they may have experienced and whether they have consulted with a healthcare professional before using these herbs.

4. Pranayama Practice: The participants were asked about their Pranayama practice, including the frequency, duration, and type of Pranayama they perform. They were asked about any perceived benefits or changes in their respiratory function and overall health. The data collected from the interviews were analysed using statistical software.

5. Ethical Considerations: The study was conducted in accordance with ethical principles and guidelines. Informed consent was obtained from each participant before the interview. The participants' privacy and confidentiality were ensured, and the data was used only for research purposes.

RESULT AND DISCUSSION

Based on the survey conducted on the use of Yogasana and medicinal plants for COVID-19 prevention and management in the Jharkhand region, it was found that participants commonly used Pranayama, Tulsi, ginger, and garlic.

Pranayama, a breathing technique that involves controlled and rhythmic breathing, was found to be the most used Yogasana for COVID-19 prevention and management among the participants. The participants reported practicing Pranayama daily, usually for 15-20 minutes, and found it helpful in improving their respiratory function and overall health.

Tulsi, ginger, and garlic were the most used medicinal plants for COVID-19 prevention and management. The participants reported using these herbs in various forms, such as herbal teas, supplements, and as ingredients in cooking. They reported experiencing various health benefits, such as improved immunity, reduced symptoms of cough and cold, and improved digestion.

SIGNIFICANCE

The study on the role of medicinal plants and yoga in pandemic and human health is significant as it explores traditional practices that can complement conventional treatments for COVID-19 prevention and management. This study is relevant to the current global health crisis and can provide insights into cost-effective and accessible healthcare options for populations with limited resources. Additionally, this study highlights the importance of incorporating traditional practices into public health initiatives, which can lead to improved health outcomes and overall wellbeing.

LIMITATION

There are several limitations to this study. One limitation is the sample size and geographic scope of the survey conducted. The survey was limited to participants in the Jharkhand region, which may not be representative of the broader population. Additionally, the survey was conducted through one-to-one interviews, which may introduce bias and limit the generalizability of the findings.

Another limitation is the lack of scientific evidence on the efficacy of some of the traditional practices explored in this study. While there is some research supporting the use of medicinal plants and yoga for COVID-19 prevention and management, further studies are needed to validate these practices and determine appropriate dosages and methods of use.

Overall, while this study provides insights into the potential benefits of traditional practices for COVID-19 prevention and management, further research is needed to validate these practices and determine their appropriate use in healthcare settings.

CONCLUSION

The findings of this study suggest that traditional practices such as Pranayama and the use of Tulsi, ginger, and garlic can play a role in COVID-19 prevention and management. These practices can be promoted as complementary therapies to conventional treatments and can be incorporated into public health programs and COVID-19 prevention and management to improve overall health and wellbeing.

However, further research is needed to validate the efficacy of these traditional practices and to determine the appropriate dosages and methods of use. Additionally, it is important to promote the safe and responsible use of these practices and to educate the public on potential side effects and interactions with other medications.

In conclusion, the use of Pranayama, Tulsi, ginger, and garlic for COVID-19 prevention and management is a promising approach that warrants further investigation and promotion in public health initiatives.

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GC-MS ANALYSIS AND MEDICINAL VALUES OF LEAVES EXTRACT OF *SHOREA ROBUSTA* GAERTN IN JHARKHAND

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ABSTRACT

Ethomedicinal plant Shorea robusta Gaertn is an edible plant traditionally used by the local people since ancient period which is abundant in Jharkhand. The use of Shorea robusta Gaertn as medicine exhibits multiple roles such as anti-microbial, anti-inflammatory, anti-cancer, anti-aging etc. enhances the immunity as well. To authenticate the medicinal properties of the plant Gas Chromatography-Mass Spectroscopy has been done to identify the biomolecules responsible for the drug behavior. Few major identification of biomolecules of medicinal values are Mome Inositol, Neophytadiene, Squalene, Vitamin E, Lanosterol, Lup-20(29)-en-3-one, beta.-Amyrin, Lup-20(29)-en-3-one.

***Keywords**: Shorea robusta Gaertn, Medicinal values, GC-MS, Biomolecules*

INTRODUCTION

Nature comprises incredible phenomena with enormous biodiversity which is still incomplete by the human knowledge. The medicinal plants have been used for centuries as remedies for human diseases, because, they contain components of therapeutic value.[1] It is estimated that there are about 250000 species of higher plants and majority of them have not been examined for their pharmacological activities. Medicinal plants frequently used as raw materials for the extraction of active ingredients which used in the synthesis of different drugs.[2] The plant is well reputed in traditional system of medicine and used by the tribal people to treat various diseases.[3] Almost eighty percent of the population of developing countries relies on traditional medicines, mostly plant drugs, for their primary health care needs.[4][5][6] Sal with the botanical name *Shorea robusta* Gaertn, is the State Tree of Jharkhand and encounter lots of medicinal values in the entire different parts. The leaves are edible as well as commercially involved in local tribes in the form of *dona* and *patal*. Active biomolecules present in the leaves enhance the medicinal values though the locals use them without scientific exposure.

The study reveals with the bioactive molecules present in the leaves of *Shorea robusta* Gaertn knocks the opportunities inviting the pharmacology sector.

MATERIALS AND METHOD

Collection of Plant Material

The leaves of *Shorea robusta* Gaertn was collected from the Gopalpur Jungle at Panchyat Hulsu of Block Lapung in Ranchi District of Jharkhand.

Preparation of extract

The Leaves were dried in a dark place at room temperature and processed for fine powder mixture-grinder followed by sieving and stored in an air tight container. Then, the fine powder of barks was subjected to methanol as organic solvent. The extract was collected using the soxhlet apparatus.

GC-MS Analysis

1.5 ml of extract in a GC vial was subjected to the GC-MS equipment. The biomolecules investigation of organic extract was performed by GC-MS equipment (GCMS-QP2010 Ultra) followed by Gas Chromatography through Column Oven Temp. :100.0 °C, Injection Temp. : 260.00 °C, Injection Mode :Split, Flow Control Mode :Linear Velocity, Pressure :90.5 kPa, Total Flow :16.3 mL/min, Column Flow :1.21 mL/min, Linear Velocity :40.9 cm/sec, Purge Flow :3.0 mL/min, Split Ratio :10.0, Gas : Helium(He) and Mass Spectroscopy through Start Time :4.00min, End Time :39.98min, ACQ Mode :Scan, Event Time :0.20sec,Scan Speed :3333, Start m/z : 40.00 and End m/z :650.00. A mass spectrum observed.

RESULTS AND DISCUSSION

Interpretation of mass spectrum was done using database of NIST and WILEY Library. The mass spectrum of unknown compound was compared with the spectrum of known compound stored in the WILEY's Library. Compounds were identified by with authentic standards and by with recorded from computerized libraries.

There were 39 biomolecules detected referring the Wiley and NIST Library in the leaves of *Shorea robusta* Gaertn. The biomolecules are mentioned below (Table i) with name of the compound:

Bicyclo[7.2.0]undec-4-ene, 4,11,11-trimethyl-8-methylene, 2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R), 1,5-Dimethyl-2,3-divinylcyclohexane,11,11-Dimethyl-4,8-dimethylenebicyclo [7.2.0]undecan-3-ol, Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.), Spiro[androst-5-ene-17,1'-cyclobutan]-2'-one, 3-hydroxy-, (3.beta.,17.beta.), Mome Inositol, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, Neophytadiene, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, (3S,3aS,6R,7R,9aS)-1,1,7-Trimethyldecahydro-3a,7-methan-ocyclopenta[8] annulene-3,6-diol, n-Hexadecanoic acid, 2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [r-[r*,r*-(e)]], 9-Octadecen-1-ol, (Z), Squalene, .alpha.-Tocospiro A, .alpha.-Tocospiro B, 16,23-Cyclocholesta-5,16(23)-dien-22-one, 3,26-dihydroxy-, (3.beta.), (R)-6-Methoxy-2,8-dimethyl-2-((4R,8R)-4,8,12-trimethyltrid-ecyl)chroman, .gamma.-Tocopherol, Stigmasta-5,22-dien-3-ol, acetate, (3.beta.), 03027205002 Flavone 4'-oh,5-oh,7-di-o-glucoside, Stigmast-5-en-3-ol, oleat, ,

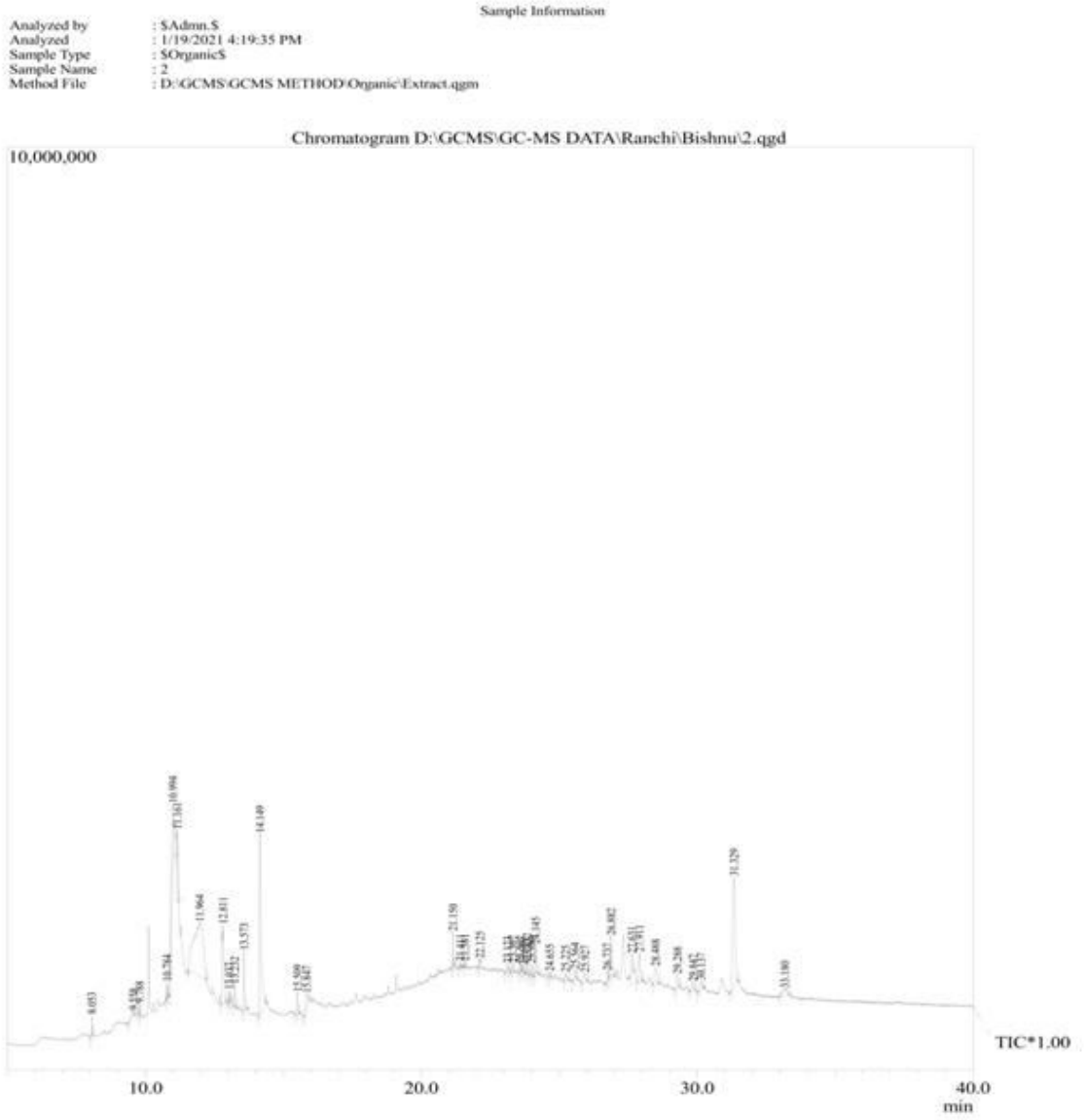

Figure (i): Chromatogram of leaves extract of *Shorea robusta* Gaertn by GCMS

17-(1,5-dimethyl-3-phenylsulfanyl-hex-4-enyl)-4,4,10,13,14-pentamethy l,3,4,5,6,7, 10, 11,12,13,14,15,16,17-tet, Radecahydro-1h-cyclope Vitamin E, Lanosterol, A'-Neogammacer-22(29)-en-3-one, Ergost-5-en-3-ol, (3.beta.,24r), Stigmasterol, Lup-20(29)-en-3-one, .gamma.-Sitosterol, .beta.-Amyrin, Lup-20(29)-en-3-one, 24-Norursa-3,12-diene, .gamma.-Sitostenone, 10,10-Dimethyl-4-acetyl-tricyclo[5.2.1.0(1,5)]decane, D-Homo-androstane, 5.alpha.,13.alpha.), 4,4A,6B,8A,11,11,12B,14A-octamethyl-eicosahydro-picen-3-one, Stigmastane-3,6-dione, (5.alpha.).

Table (i): Name of the Compound, Molecular Formula, Molecular weight, Peak area(%) and Molecular structure expressed in leaves extract of *Shorea robusta* Gaertn .

Sl. No.	Name of the Compound	Molecular Formula	Molecular Weight	Peak Area %
1	Bicyclo [7.2.0]undec-4-ene, 4,11,11-trimethyl-8-methylene-	$C_{15}H_{24}$	204	0.68
2	2(4H)-Benzofuranone, 5,6,7,7a-tetrahydro-4,4,7a-trimethyl-, (R)-	$C_{11}H_{16}O_2$	180	0.83
3	1,5-dimethyl-2,3-divinylcyclohexane	$C_{12}H_{20}$	164	0.40
4	11,11-Dimethyl-4,8-dimethylenebicyclo [7.2.0] undecan-3-ol	$C_{15}H_{24}O$	220	0.45
5	Androstan-17-one, 3-ethyl-3-hydroxy-, (5.alpha.)-	$C_{21}H_{34}O_2$	318	8.16
6	Spiro[androst-5-ene-17,1'-cyclobutan]-2'-one, 3-hydroxy-, (3.beta.,17.beta.)-	$C_{22}H_{32}O_2$	328	1.45
7	Mome inositol	$C_7H_{14}O_6$	194	24.14
8	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	6.20
9	Neophytadiene	$C_{20}H_{38}$	278	0.48
10	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	1.04
11	Compname:(3S,3as,6R,7R,9as)-1,1,7-Trimethyldecahydro-3a,7-methanocyclopenta [8] annulene-3,6-diol	$C_{15}H_{26}O_2$	238	3.06
12	N-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	12.57
13	2-hexadecen-1-ol, 3,7,11,15-tetramethyl-, [r-[r*,r*-(e)]]-	$C_{20}H_{40}O$	296	1.00
14	9-Octadecen-1-ol, (Z)-	$C_{18}H_{36}O$	268	1.65
15	Squalene	$C_{30}H_{50}$	410	1.10
16	.Alpha.-tocospiro a	$C_{29}H_{50}O_4$	462	0.17
17	.Alpha.-tocospiro b	$C_{29}H_{50}O_4$	462	0.16
18	16,23-Cyclocholesta-5,16(23)-dien-22-one, 3,26-dihydroxy-, (3.beta.)-	$C_{27}H_{40}O_3$	412	0.12
19	(R)-6-Methoxy-2,8-dimethyl-2-((4R,8R)-4,8,12-trimethyltridecyl) chroman	$C_{28}H_{48}O_2$	416	0.45
20	.Gamma.-tocopherol	$C_{28}H_{48}O_2$	416	0.66
21	Stigmasta-5,22-dien-3-ol, acetate, (3.beta.)-	$C_{31}H_{50}O_2$	454	0.30
22	03027205002 flavone 4'-oh,5-oh,7-di-o-glucoside	$C_{27}H_{30}O_{15}$	594	0.25
23	Stigmast-5-en-3-ol, oleat	$C_{47}H_{82}O_2$	678	0.75
24	17-(1,5-dimethyl-3-phenylsulfanyl-hex-4-enyl)-4,4,10,13,14-pentamethyl-2,3,4,5,6,7,10 ,11, 12, 13,14,15,16,17-tet Radecahydro-1h-cyclope	$C_{36}H_{54}OS$	534	0.64

25	Vitamin E	$C_{29}H_{50}O_2$	430	1.87
26	Lanosterol	$C_{30}H_{50}O$	426	0.34
27	A'-Neogammacer-22(29)-en-3-one	$C_{30}H_{48}O$	424	0.61
28	Ergost-5-en-3-ol, (3.beta.,24r)-	$C_{28}H_{48}O$	400	0.86
29	Stigmasterol	$C_{29}H_{48}O$	412	0.94
30	Lup-20(29)-en-3-one	$C_{30}H_{48}O$	424	0.74
31	Gamma.-sitosterol	$C_{29}H_{50}O$	414	3.93
32	Beta.-amyrin	$C_{30}H_{50}O$	426	1.56
33	Lup-20(29)-en-3-one	$C_{30}H_{48}O$	424	2.56
34	24-Norursa-3,12-diene	$C_{29}H_{46}$	394	1.94
35	Gamma.-sitostenone	$C_{29}H_{48}O$	412	1.41
36	10,10-Dimethyl-4-acetyl-tricyclo [5.2.1.0 (1,5)] decane	$C_{14}H_{22}O$	206	0.80
37	D-Homoandrostane, (5.alpha.,13.alpha.)-	$C_{20}H_{34}$	274	0.89
38	4,4a,6b,8a,11,11,12b,14a-octamethyl-eicosahydro-picen-3-one	$C_{30}H_{50}O$	426	12.89
39	Stigmastane-3,6-dione, (5.alpha.)-	$C_{29}H_{48}O_2$	428	1.51

Biocompounds that exhibits medicinal values found in the extract are Mome Inositol may aid people with mental health and metabolic conditions, such as panic disorder, depression, bipolar disorder, polycystic ovary syndrome, metabolic syndrome and diabetes.[20] Neophytadiene is a diterpene that is 3-methylidenehexadec-1-ene substituted at positions 7, 11 and 15 by a methyl group. It has a role as an anti-inflammatory agent, an antimicrobial agent, a plant metabolite and an algal metabolite. It is an alkene and a diterpene [21], n-Hexadecanoic acid, may help in designing of specific inhibitors of phospholipase A (2) as anti-inflammatory agents [22]. The enzyme kinetics study proved that n-hexadecanoic acid inhibits phospholipase A (2) in a competitive manner. Squalene exhibits anticancer, antioxidant, anti-aging, drug carrier, detoxifier, skin hydrating, and emollient activities[23], .gamma.-Tocopherol has been shown to have anti-inflammatory and anti-aging properties, as well as protecting against cancer, heart disease and degenerative brain disorders such as Alzheimer's disease.[24], Vitamin E helps maintain healthy skin and eyes, and strengthen the body's natural defense against illness and infection (the immune system).[25] Lanosterol has been identified as a key component in maintaining eye lens clarity.[26], Stigmasterol is potent pharmacological effects such as anticancer, anti-osteoarthritis, anti-inflammatory, anti-diabetic, immunomodulatory, antiparasitic, antifungal, antibacterial, antioxidant, and neuroprotective properties.[27] .beta.-Amyrin exhibits long-lasting antinociceptive and anti-inflammatory properties[28], Lup-20(29)-en-3-one inhibits the progression of rheumatoid arthritis.[29]

CONCLUSION

It has been evident that there is an apparent scope of medicinal values of leaves of *Shorea robusta* Gaertn as their utility, application and implementation had been since

ancient era. The study authenticates the plant leaves to be exploitage in pharmacology sector, though used by the local people traditionally.

CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

ACKNOWLEDGEMENT

This study was supported by Dr. Ajai Kumar, Faculty of Advanced Instrumentation Research Facility, Jawaharlal Nehru University, New Delhi-110067, India

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EFFECTS OF ETHANOL AND CHLOROFORM EXTRACTS OF SOME MEDICINAL PLANTS AGAINST *SCLEROTI*UM *ROLFSII*

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ABSTRACT

Effects of ethanol and chloroform extracts of some medicinal plants such as Cassia tora L., Cymbopogon citrates Stapf. and Moringa oleifera Lam. against Sclerotium rolfsii ITCC No. 4737 were evaluated. Diameter of mycelial growth and inhibition zone of test pathogen Sclerotium rolfsii was recorded. Maximum inhibition of test pathogen Sclerotium rolfsii was found in seed extracts of Cassia tora L. with 63.7 mm, using chloroform solvent. Significant inhibition was recorded in bark extract of Moringa oleifera in chloroform with 59.3 mm. Ethanol extracts were also effective to control Sclerotium rolfsii. In ethanol solvent, maximum inhibition of test pathogen was found in seed extracts of Cassia tora L. with 56 mm .

Keywords: *Ethanol, choloroform, Cassia tora L., Cymbopogon citrates Stapf., Moringa oleifera Lam. and Sclerotium rolfsii.*

INTRODUCTION

Sclerotium rolfsii Curzi is a fungal pathogen, causes Southern Blight on tomato, peanut, watermelon, rice and wheat. The symptoms of disease are lesions, wilting and yellowing of the plants. It can cause severe damage and destroy affected crops. In severe condition, it can cause significant yield reductions. The *Sclerotium rolfsii* causes severe damage to more than 500 crops (Aycock, 1966).

*Some of the chemical fungicides are used to control are hexaconazole, propiconazole, difenconazole, Avatar, Nativo and Vitavax power (*Johnson et al., 2000; Sheoraj et al., 2005; Kulkarni et al.,2007; Basamma, 2008; Bhatt et al.,2015). *Fungicides cause pollution in environment and also harmful for human health and all living organism.*

Some researcher has been worked on the bio-control of Blight disease caused by *Sclerotium rolfsii* Curzi through plant extracts in different solvents (Ram et al., 1994; Eksteen et al., 2001; Hanthegowda et al., 2001; Virupaksha et al., 2003; Blum et al., 2004; Gautam et al., 2004; Okereke et al., 2006)

Plant extracts is used for controlling the plant pathogen due to presence of some alkaloids, phenols, tannins, and flavonoids (Romanazzi et al. 2012).

In present study, the effects of ethanol and chloroform of selected plants -*Cassia tora* L., *Cymbopogon citrates* Stapf. and *Moringa oleifera* Lam against *Sclerotium rolfsii* ITCC No. 4737 were studied.

Cassia tora L. belongs to family of Fabaceae which are distributed in different places of South-East Asia including India, Northern Australia and America. It is also known as coffee pod, chakvad and thakara. It is commonly used for the treatment of piles, wound healing, head pains, skin diseases, leprosy, rheumatic arthritis and liver pain. It is used as analgesic, antibacterial, antifungal and antihelmintic. *Cassia tora*L.contains fatty acid esters like palmitate, linoleate, emodin, stearate, oleate, tricontan-1-ol, stigmasterol, succinic acid, uridine, quercitrin and isoquercitrin.

Cymbopogon citrates Stapf. also known as lemon grass or oil grass, belongs to family of Poaceae. It is found in tropical countries, especially in Southeast Asia. Lemon grass contains essential oil which is mostly used in aromatherapy. *Cymbopogon citrates* Stapf. contains mainly alcohols, ketones, terpenes, aldehyde and esters. Lemon grass oil and extract has antiamoebic, antidiarrheal , antimicrobial, anticancer, , antifilarial, analgesic, aesthetic, anti-inflammatory and antioxidant properties. Essential oils contain Citral α, Citral β, Nerol Geraniol, Citronellal, Terpinolene, Geranyl acetate, Myrecene , flavonoids and phenolic compounds.

Moringa oleifera Lam. belongs to the family Moringaceae . It is widely found in the tropical and subtropical regions of world. Drumstick or horseradish tree is common name of *Moringa oleifera* Lam. Moringa oleifera possesses many pharmacological activities such as analgesic, anti-inflammatory, diuretic, antihypertensive, antioxidant and anti-tumor activities. The *Moringa* is rich source of phytochemicals such as zeatin, quercetin, β-sitosterol, kaempferol, kaempferitrin, Isoquercitrin, rhamnose and isothiocyanates (Fahey, 2005).

Some plants are known to have antifungal properties against *Sclerotium rolfsii* Curzi (Meena et al., 2002; Anand et al., 2003; Tripathi et al., 2006; Singh et al., 2007; Mundhe et al., 2009; Venkateswarlu et al., 2013; Sahana et al.,2017)

MATERIALS AND METHODS

Collection of Test Pathogen

The test pathogen *Sclerotium rolfsii* ITCC No. 4737 was collected from Department of Mycology and Plant Pathology, ICAR-Indian Agricultural Research Institute, New Delhi. The test pathogen was maintained and cultured on Potato dextrose agar medium (PDA).

Preparation of Plant Extract

Fresh plant parts- leaf, stem, bark, seed and root of selected plants - *Cassia tora* L., *Cymbopogon citratus* Stapf. *and Moringa oleifera* Lam. were collected, washed with tap water followed by sterile distilled water, dried under shade condition at room temperature. Fine powder stored in airtight container at room temperature till extraction (Nostro et al. 2000). Extracts of different parts of selected plants were prepared by dissolving 10 g dried materials in 100 ml of different solvents. The extract was finally filtered through Whatman No.1 filter paper. Filtrates was considered as a standard solution.

Antifungal Activity

Selected plants extracts such as leaf, stem, bark, seed and root part of *Cassia tora* L., *Cymbopogon citratus* Stapf. and *Moringa oleifera* Lam. at different 1.0 %. 2.5 %, 5.0% and 10.0% concentrations were evaluated against *Sclerotium rolfsii* using different solvents - ethanol and chloroform by poison food technique on potato dextrose agar for their antifungal activity against *S. rolfsii* (Nene et al.2000,Das et al. 2010). Inhibition zone and Percentage of inhibition of mycelial growth of *Sclerotium rolfsii* was calculated using the following formula of Vincent (1947).

$$\% \text{ of inhibition} = \frac{\text{Radial growth in check - Radial growth in treatment}}{\text{Radial growth in check}} \times 100$$

RESULT AND OBSERVATION

Effects of ethanol and chloroform extracts of some selected plants such as *Cassia tora*L.**,** *Cymbopogon citrates* Stapf.and *Moringa oleifera* Lam. were given in Table 1 **and** Table 2.Ethanol and chloroform extracts of selected plants controlled the mycelial growth of test pathogen *Sclerotium rolfsii* Curzi .

Table 1 shows the effect of ethanol extracts of different parts of selected plants. Seed extract of *Cassia tora* L. in ethanol solvent showed maximum inhibition zone against *Sclerotium rolfsii* Curzi which was 56 mm. Bark extract of *Moringa oleifera* Lam. and leaf extract of *Cymbopogon citratus* inhibited the test pathogen at 10% concentration with 53.7 mm and 53.3 mm inhibition zone respectively . Bark extracts of *Cassia tora* L. controlled the mycelial growth of *Sclerotium rolfsii* with 50.7 mm inhibition zone. Significant inhibition was also observed in leaf or root extract of *Cymbopogon citratus* , leaf or stem extract of *Cassia tora* L. and leaf or stem extracts of *Moringa oleifera* Lam. using ethanol.

Effects of chloroform extracts of selected plants are summarized in Table 2. Maximum inhibition zone of test plant pathogen was recorded in chloroform extract of *Cassia tora* seed with 63.7 mm. Bark extract of *Moringa oleifera* Lam. or *Cassia tora* L. showed 59.3 mm or 58 mm inhibition zone respectively. Also 54.3 mm inhibition zone was recorded in leaf extract of *Moringa oleifera* Lam.at 10% Concentration. Significant inhibition was also observed in leaf or stem extract of *Cassia tora* L.., stem extract of *Moringa oleifera* Lam. and in leaf or root extract of *Cymbopogon citratus* using chloroform solvent.

Table 1. Effect of ethanol extracts of *Cassia tora* L., *Cymbopogon citrates* Stapf. and *Moringa oleifera* Lam. against *Sclerotium rolfsii* Curzi

Plant Extracts	**1%**	**2.5%**	**5%**	**10%**
Cassia tora L.	Inhibition Zone (mm)	Inhibition Zone (mm)	Inhibition Zone (mm)	Inhibition Zone (mm)
a) Seed	44	45.3	52	56
b) Bark	39	42.3	48.7	50.7
c)Leaf	20.3	32.7	47.3	48
d)Stem	18.7	26.3	41.3	46.3
Cymbopogon citratus				
a) Leaf	21.7	34.7	42	53.3
b) Root	13	23	40	35.3
Moringa oleifera Lam.				
a) Bark	36.7	42.3	50	53.7
b) Leaf	26.3	33.7	42	49.3
c)Stem	17.3	26	37.7	45.7
Check	0	0	0	0

Table 2. Effect of chloroform extracts of *Cassia tora* L., *Cymbopogon citrates* Stapf. and *Moringa oleifera* Lam. against *Sclerotium rolfsii* Curzi

Plant Extracts	**1%**	**2.5%**	**5%**	**10%**
Cassia tora L.	Inhibition Zone (mm)	Inhibition Zone (mm)	Inhibition Zone (mm)	Inhibition Zone (mm)
a)Seed	26.7	34.7	50.3	63.7
b)Bark	20	32	40.7	58
c)Leaf	18	23.7	36.3	51.7
d)Stem	16	16.7	29.3	41.3
Cymbopogon citratus				
a)Leaf	19.3	26.3	35.7	38.7
b)Root	12.7	22.7	30	35
Moringa oleifera Lam.				
a)Bark	35.3	42	54.7	59.3
b)Leaf	25.7	34.3	44.3	54.3
c)Stem	18	26.7	29.7	43
Check	0	0	0	0

CONCLUSION

Plant extracts are effective fungicides for controlling a wide range of harmful fungal species. Ethanol and chloroform extracts of *Cassia tora* L., *Cymbopogon citrates* Stapf. and *Moringa oleifera* Lam. was effective against *Sclerotium rolfsii* Curzi. Chloroform

extracts of selected plants were more effective than ethanol extracts against *Sclerotium rolfsii. Cassia tora* was found to be excellent in inhibiting the mycelial growth of test plant pathogen at 10 % concentration . Other plant extracts also showed moderate effect on growth of test pathogen .It may be due to presence of secondary metabolites such asflavonoids, alkaloids, flavones ,terpenoids, tannis and pyrons etc. Plant extract of selected plants could decrease the environment pollution and enhance the human health . It also minimize the cost of cultivation.

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STUDY ON TRADITIONAL KNOWLEDGE OF SOME MEDICINAL PLANTS USED TO CURE VARIOUS AILMENTS BY ETHNIC PEOPLE OF RANCHI DISTRICT, JHARKHAND

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ABSTRACT

Plants have been the major source of drugs in Indian system of medicine and other ancient systems in the world. The present study is based on extensive and intensive field survey that was made during 2019 to 2023. The survey work was conducted by preparing a questionnaire that was having questions related to ethno medicinal plants and their properties. After the conduction of interview it was concluded that many of the plants have been used by local people to cure various ailments. Some of the plants include Eclipta alba, Carica papaya, Terminalia arjuna, Cajanus cajan , ,Saraca asoca, Pongamia pinnata Linn., Acacia arabica, Madhuca indica, Moringa oleifera, Citrus medica Linn.,Psidium guajava, Moringa oleifera, Aloe vera, Brassica oleracea etc. These people pass this traditional knowledge orally to the next generation and hence this knowledge is needed to be preserved so the survey work was conducted. A large number of plants have been documented. Many of the plants contain bio active compounds like alkaloids, glycosides, tannin, terpenoids etc. and these plant extracts possess medicinal properties and hence they are highly useful and used by ethnic people of Jharkhand.

Keywords*: Ethno medicinal plants, diseases, cure, phytochemical , survey*

INTRODUCTION

Plants have an important place in both traditional and modern medicine. Charak samhita and sushruta samhita gave extensive description on various medicinal herbs[1]. According to WHO at least 80% people in developing countries depend on herbal plants[2].Tribal system of medicine(hodopathy) cover many health-related problems including cough, cold, diarrhoea, dysentry, hypertension, diabetes, gynaecological problems etc.

Ranchi is one of the most privileged places on earth that enjoys nature's generosity in its fullness. The Ranchi district of Jharkhand state is highly rich in biodiversity .The utility of plant by the aboriginal people of Ranchi district of Jharkhand for different purposes have been mentioned by Sahu et.al. in their project report on ethnobotanical studies of Ranchi district of Jharkhand conducted during 2001 in 2004[3].

Ethnobotany deals with the studies among tribals and rural indigenous people for recording their unique knowledge about plant wealth and search of new resources of edible plants, herbal plants and other aspects of plants including conservation . It has been recognized as a multidisciplinary study comprising many interesting and useful

aspects of plant science, history, anthropology, culture and literature. The interest in medicinal plants has been grown possibly due to their availability, accessibility and the general belief that they demonstrate minimum side effects[4-6].

The objectives of the of the present research work was that ethno medicinal survey provides the rational for selection and scientific investigation of medicinal plants. Some remedies have been used successfully by number of people over long period of time[7]. Herbal medicines can be characterized as completed level therapeutic products that contain ingredients from aerial or underground parts of plant parts or other plant material or combination in the crude state or as plant arrangements.Therapeutic herbal medicines are naturally occurring plant derivatives with nominal or no industrial preparing used to treated disease within local remedial practices.

MATERIALS AND METHODS

This study is based on extensive an intensive ethno medicinal survey that was conducted in villages of Ranchi district of Jharkhand during 2019 to 2023 . The work was started by visiting neighbouring villages of Ranchi and interacting with local people. The physical , geographical and climatic study of the area was done . Information was collected concerning the use of plant as medicine in terms of part used , mode of preparation of drug, mode of administration, storage, doses etc. Tools that were used for routine visit to different villages were notebook, questionnaire, map of the study area, camera, magnifying glasses, plastic bags etc. The interview technique was applied to get the information from knowledgeable persons, local healers , vaidyas etc. And this was also confirmed with patients and through visits to different localities and also from books of plant taxonomy like floras botany of Bihar and Orissa . Photographs of the knowledgeable persons were taken and the plants were collected and herbaria was prepared in the University Department of Botany , Ranchi University, Ranchi for reference.

RESULT AND DISCUSSION

In the present investigation, more than 30 plant species have been found to be used by local people of different villages of Ranchi district of Jharkhand and used for treatment of various ailments. These plants have been arranged with their botanical name, common name , family , parts used etc. in the table. Ethnic people of the region believe in natural treatment of different diseases by some special herbal plant species.

Figure 1: District of Jharkhand State and Jharkhand state in India.

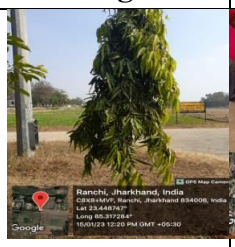
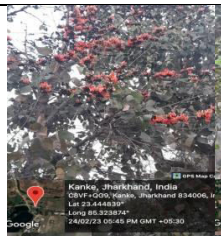
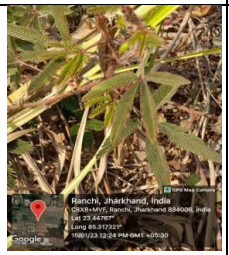
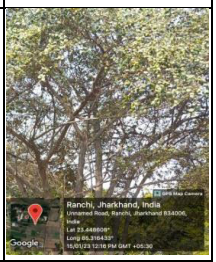
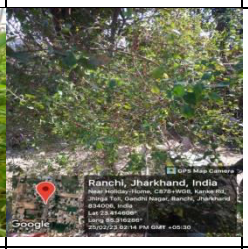
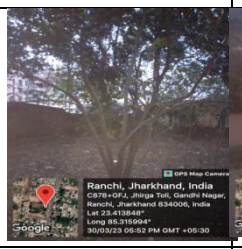
Figure 2: Blocks of Ranchi district of Jharkhand, India

Table 1: list of plants used by vaidyas/ hakims/ knowledgeable persons of Ranchi district of Jharkhand

S.No.	Common name	Scientific name	Family	Habit	Parts used	Diseases
1.	Aam	*Mangifera indica*	Anacardiaceae	Tree	Dried flower bark	Astringent, diarrhea, chronic dysentery, spermatorrhoea
2.	Arjun	*Terminalia arjuna*	Combretaceae	Tree	Bark	Ulcer, diabetes
3.	Ashok	*Saraca asoca*	Caesalpiniaceae	Tree	Leaf	Malaria
4.	Arhar	*Cajanus cajan*	Fabaceae	Woody shrub	Leaf	Treat jaundice
5.	Babool	*Acacia arabica*	Mimosaceae	Tree	Leaf, flower, bark	Jaundice, diarrhoea
6.	Karanj	*Pongamia pinnata* Linn.	Leguminosae	Tree	Oil Leaf	Itch, skin disease
7.	Mahua	*Madhuca indica*	Sapotaceae	Tree	Bark, seed	Cough, spermatorrhoea
8.	Munga	*Moringa oleifera*	Moringaceae	Tree	Bark	Headache
9.	Nimbu	*Citrus medica* Linn	Rutaceae	Tree	Fruit, leaf	Bile, Malaria
10.	Papita	*Carica papaya* Linn.	Caricaceae	Tree	Milk, mature leaf	Malaria, Teeth pain
11.	Peepal	*Ficus religiosa* Linn.	Moraceae	Tree	Stem, leaf, wood	Spermatorrhoea, malaria
12.	Palash	*Butea monosperma*	Fabaceae	Tree	Bark, root	Night blindness, skin disease
13.	Neem	*Azadirachta indica*	Meliaceae	Tree	Leaf	Acidity, fever
14.	Amrud	*Psidium guajava*	Myrtaceae	Tree	Leaf	Malaria
15.	Tejpatta	*Cinnamomum tomala*	Lauraceae	Tree	Leaf	arthritis
16.	Tulsi	*Ocimum indicum*	Lamiaceae	Hairy herb	Leaf	Skin disorder, wound fever
17.	Mehndi	*Lawsonia inermis*	Lythraceae	Glabrous shrub	Leaf	Antipyretic, infusion of leaf in malaria
18.	Karripatta	*Murraya koenigi*	Rutaceae	Small tree	Leaf	Cooling, antibacterial, diarrhoea
19.	Lajwanti	*Mimosa pudica* L.	Mimosaceae	Shrub	Shoot	Malaria, jaundice, asthma, diuretic
20.	Pudina	*Mentha piperita*	Lamiaceae	Herb	Leaf	Anaemia, skin disease
21.	Palak	*Spinacea*	Amaranthaceae	Herb	Leaves	Anaemia,

		oleraceae				constipation, kidney stone, blood pressure
22.	Lal saag	*Amaranthus dubius*	Amaranthaceae	Herb	Leaves	Anaemia, arthritis, blood pressure, constipation
23.	Broccoli	*Brassica oleraceae*	Brassicaceae	Plant	Flowers, Leaves, stalk	Hormonal imbalance, arthritis, anaemia, asthma
24.	Beet	*Beta vulgaris*	Amaranthaceae	Plant	Root, fruit	Anaemia, blood pressure, heart disease, fever, diarrhoea
25.	Ber	*Zizyphus mauritiana*	Rhamnaceae	Tree	Fruit, Leaf	Anaemia, cold cough, insomnia, anxiety
26.	Tomato	*Solanum lycopersicum*	Solanaceae	Herb	Fruits	Anaemia, skin problem, eye problem, skin problems
27.	Datura	*Datura anoxia*	Solanaceae	Small shrub	Root	Paralysis, gastrointestinal disorders, anti-cough
28.	Carrot	*Daucus carota*	Apiaceae	Herb	Root	Eye disorder, anaemia, digestive disorders
29.	Aloevera	*Aloe vera*	Asphodelaceae /liliaceae	Herb	Leaf	Skin, burn, ulcer, diabetes
30.	Haldi	*Curcuma longa*	Zingiberaceae	Herb	Leaf	Anaemia, inflammation, diabetes
31.	Lahsun	*Allium sativum*	Amaryllidaceae	Herb	Cloves	Anaemia, arthritis, skin
32.	Dhaniya	*Coriandrum sativum*	Apiaceae	Herb	Leaf, seed powder	Arthritis, anaemia
33.	Anar	*Punica granatum*	Puniaceae	Small tree	Peel, seed, fruit	Anaemia, Hair
34.	Sharifa	*Annona squamosa/ reticulata*	Annonaceae	Tree	Leaf, seed	Anaemia, dysentery, fever, diarrhea, contraceptive

 ISBN: 978-81-19481-23-1

				
Brassica oleracea	**Aloevera**	**Beta vulgaris**	**Psidium guajava**	**Azadirachta indica**
				
Carica papaya	**Curcuma longa**	**Moringa oleifera**	**Murraya koeinigii**	**Pongamia pinnata**
				
Ocimum tenuflorum	**Saraca asoca**	**Daucus carota**	**Butea monosperma**	**Citrus lemon**
				
Terminalia arjuna	**Cajanus cajan**	**Cinnamomum tamala**	**Mimosa pudica**	**Ziziphus mauritiana**
				
Solanum lycopersicum	**Lawsonia inermis**	**Annona squamosa**	**Punica granatum**	

CONCLUSION

Different plants with medicinal properties have been explored in different villages of Ranchi district of Jharkhand for the treatment of different diseases. In this investigation attempts have been made to document and compile different ethno medicinally important indigenous plants so that maximum utilization of these plants in the cure of various ailments and in preparation of drugs could take place. The plants identified in the area are found to be very useful for future experimental clinical studies and development of drugs for different diseases.

ACKNOWLEDGEMENT

We would like to extend our sincere gratitude to Dr. Kunul Kandir, Professor and Head Department of Botany, Ranchi University, Ranchi, Jharkhand, India for her encouragement and valuable suggestions for the improvement of the article.

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SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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ABSTRACT

There are a lot of risks involved in food security. It can affect the production of agriculture, food access, and stability directly. According to the U.N., there are more than 800 million people living in extreme poverty and the World Bank says 719 million people live in extreme poverty, living on less than $2.15 a day. Hunger is being fought, but an unacceptably large number of people still don't have food, and they need to be active, healthy, and wealthy. There will be 702 to 828 million hungry people in 2022. The prevalence of undernourishment in India was 21.6% in 2004-06 and 16.3% in 2019-21. Changes in large populous countries, notably India, play a large part in explaining overall hunger reduction trends in developing regions. To meet global population demand, sustainable agriculture is the immediate remedy to increase productivity. In this paper, perspectives of various agricultural practices focused on insights of sustainability in agricultural toward food security were discussed.

Keywords: Food security, poverty, hunger, sustainable agriculture, India.

1. INTRODUCTION

The state of food security is when everyone has access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for a healthy and active lifestyle. Ensuring food security is essential to promote healthy and active lifestyles for all. Availability, stability, access, and utilization are the four key dimensions of food supplies. First, there's the availability of enough food, which refers to the agricultural system's capacity to meet food demand. Among its sub dimensions are agro climatic fundamentals.

It's a broad concept, and traditional concepts of food security included things like national food production, grain storage, food self-sufficiency, and food aid. They were mainly macro indicators of food supply, and were used to develop famine early warning systems. These systems were designed with the idea of predicting acute food insecurity so that the relevant authorities could respond appropriately by centralizing food aid or national food reserves. Growing food consumption presents a lot of challenges for agriculture, which are exacerbated by climate change, land degradation, and diminishing resources like freshwater, phosphates, fossil fuels, and fertile soil. Over the next decades, annual crop yield is projected to grow very slowly, and there is very limited space for arable land expansion.

Overall demand for food is affected by population growth. As populations grow, the demand for food will increase accordingly. India wants to be food self-sufficient and

"food secure". Therefore, it is imperative for national food security to grow sufficient food within the country. At the same time, for domestic food security, we need to sustain economic growth to raise the income levels and purchasing power of the poor people. This, in turn, will increase their access to a variety of nutritious food and help ensure a healthy, hunger-free society.

2. FOOD DEMAND

Global food demand for agricultural crops is increasing and may continue for decades. This is propelled by a billion person increase in global population and rising per capita incomes anticipated through midcentury. Agriculture already has major global environmental impacts: land clearing and habitat fragmentation threaten biodiversity. For instance, the conversion of natural habitat to agricultural land is estimated to be the primary cause of species extinctions, with the loss of wild pollinators being particularly concerning. About 25% of global greenhouse gas (GHG) emissions result from land clearing, crop production, and fertilization and fertilizer can harm marine, freshwater, and terrestrial ecosystems. For instance, nitrogen pollution from fertilizer runoff can contribute to ocean dead zones, where oxygen is depleted and aquatic life cannot survive.

A threefold challenge now faces the world: match the rapidly changing demand for food from a larger and more affluent population to its supply; do so in ways that are environmentally and socially sustainable; and ensure that the world's poorest people are no longer hungry. To do this, we must find ways to feed more people with fewer resources, while respecting the planet and treating people with dignity and respect. This challenge requires changes in the way food is produced, stored, processed, distributed, and accessed that are as radical as those that have occurred. To achieve this, the food system must be completely overhauled and remained.

3. CAUSES FOR FOOD PRODUCTION

3.1. Climate Change

Agriculture is inherently sensitive to climate variability and change, whether due to human activities. This means that even slight changes in temperature and precipitation can have serious impacts on global crop yields. Climate change could have direct and indirect effects on all four dimensions of food security. Global climate change is an additional constraint to agricultural production in the second half of the twenty-first century. This is expected to have a significant effect on food security, leading to increased hunger and malnutrition.

Impact of climate change on agricultural productivity will reduce food crops and thus land scarcity in 2050. The simulation also looks at the effects of climate change with and without adaptation (induced technological progress, domestic policy changes, international trade liberalization, etc.) and mitigation, such as stabilizing CO2, changing temperatures, rain patterns, etc.

Jharkhand has 24 districts and 32,620 villages. The state's total population is 26.9 million, including tribal. There are three agro-climatic zones in the state.

Table 1: Agro Climatic Division with Broad Characteristics

Zones	Agro- Climatic Regions	Districts	Cropped area (ooo heactares)	% Irrigated area	Characteristics
Zones - I	Central North Eastern Plateau	Chatra, Koderma, Hazaribag, Bokaro, Dhanbad, Giridih, Deoghar, Dumka, Pakur, Godda, Sahebjunj.	1042.0	6.58	Erratic and uneven distribution of rainfall Coarse textured soils. Crust formation on the soil surface Low water retention capacity of the soil Lack of safe disposal runoff and drying of the tanks
Zones - II	Western Plateau	Garhwa, Palamau, Lohardaga, Gumla and Ranchi	771.8	9.65	Erratic and uneven distribution of rainfall Low water retention capacity of the soil
Zones - III	South Eastern Plateau	Purbi Singhbhum and Paschimi Singhbhum	389.1	4.54	Uneven distribution of rainfall Low water holding capacity, eroded soils Shallow soil depth Poor soil fertility

Source: Economic Survey 2007-08. Government of Jharkhand.

Sub-zones of the state (Table 1) all have undulating terrain, no perennial rivers, erratic rainfall, low groundwater levels, high soil erosion, and no soil or water conservation practices. Thus, all the sub-zones have insufficient dairy and fishery activities, single-cropping, low agricultural productivity, and pockets that are chronically dry. Agriculture seasonal unemployment and acute poverty are rampant in all three sub-zones. When climate change is at such a critical point, sustainable agriculture and food security will be at risk.

3.2. Land Acquisition and Agriculture

Land is a farmer's most important asset and plays a crucial role in increasing and sustaining agriculture. Land for agriculture will also be increasingly constrained by land requirements for other purposes, like infrastructure development, urbanization, bio energy production, and biodiversity protection. Land prices determine how much demand there is for agricultural land. Low agricultural land prices will lead to more demand, and high agricultural land prices will lead to less demand. As a result, demand for and price of agricultural land are inversely related.

3.3. Population

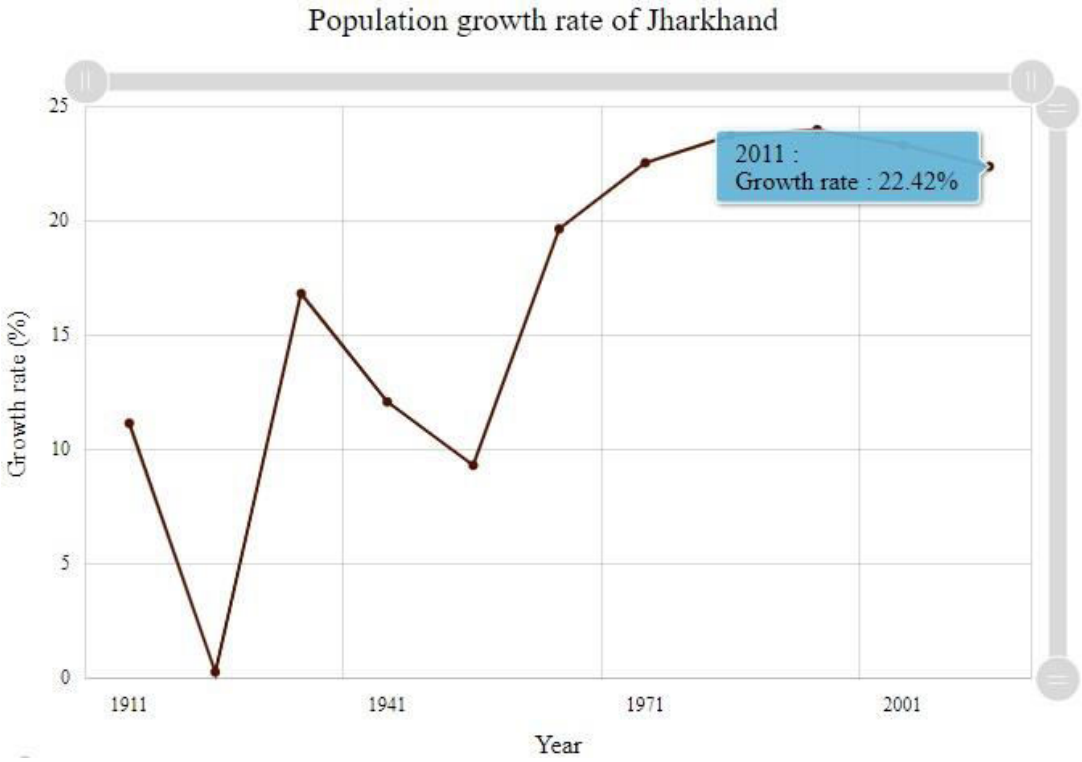
Population growth and food demand are the main factors driving the food crisis. Due to population density, urbanization is one of the key factors for fragmenting agricultural lands. However, most of the countries with the highest numbers of food insecure people also have high fertility rates and rapid population growth, which makes meeting nutritional needs harder.

India's population is pegged to reach 142.86 crore against China's 142.57 crore by July 2023. However, population growth is still relatively low in other countries. There's also a high percentage of food insecurity, with one in four people undernourished. Food production depends on croplands and water supplies, which are stressed as human populations increase. Pressure due to limited land resources, driven in part by population growth, can mean crop expansion.

According to the Census of India 2011, Jharkhand has 33 million people, 76% of whom live in rural areas and 24% in urban areas. It's the 13th most populous state in the country.

Jharkhand Population (1901-2011)

Year	Population	Growth		Share (%)
		Net Change	rate (%)	to India
2011	32,988,134	6,042,305	22.42	inf
2001	26,945,829	5,101,918	23.36	inf
1991	21,843,911	4,231,842	24.03	inf
1981	17,612,069	3,384,936	23.79	inf
1971	14,227,133	2,620,644	22.58	inf
1961	11,606,489	1,909,235	19.69	inf
1951	9,697,254	829,185	9.35	inf
1941	8,868,069	959,332	12.13	inf
1931	7,908,737	1,140,967	16.86	inf
1921	6,767,770	20,648	0.31	inf
1911	6,747,122	678,889	11.19	inf
1901	6,068,233	-	-	inf



According to this data, Jharkhand's population has grown a lot. Food security has become a bigger problem because of that. This increase in population has not been accompanied by an increase in agricultural production, resulting in a shortage of food resources and an overall increase in food insecurity.

4. EFFECT OF CLIMATE CHANGE ON FOOD UTILIZATION

Climate change affects individuals' ability to use food effectively by altering food safety conditions. Essentially, all manifestations of climate change, such as drought, higher temperatures, or heavy rain falls, have an impact on disease pressure. There is growing evidence that these changes affect food safety and food security.

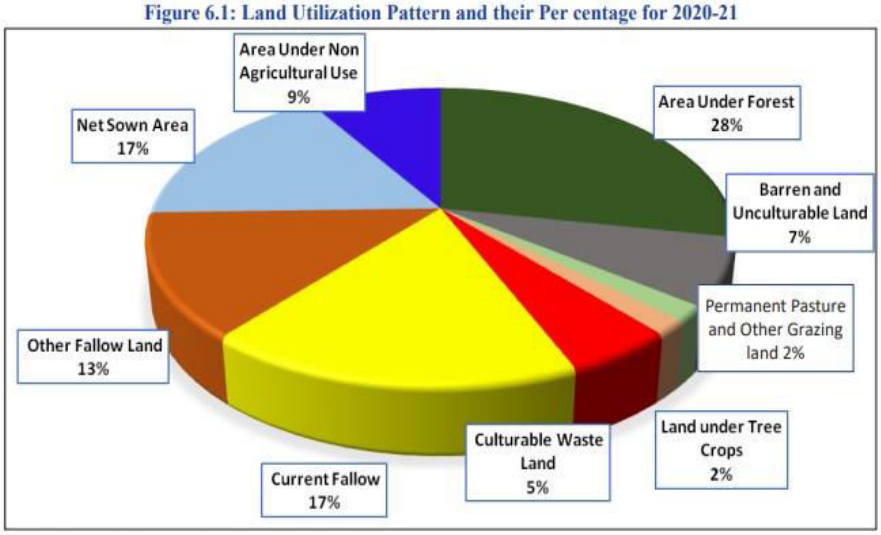
5. EFFECT OF CLIMATE CHANGE ON FOOD PRODUCTION AND AVAILABILITY

Climate change impacts on agriculture and food production can be complex. Changes in temperature and precipitation associated with continued emissions of greenhouse gases will bring changes in land suitability and crop yields.

6. MANAGEMENT OF LAND FOR SUSTAINABLE AGRICULTURE

By 2050, the human population will hit nine billion, and we have to conserve the environment at the same time. Agriculture can be grown sustainably by using agricultural practices that are both economically and environmentally sustainable, which could be a useful strategy for tackling food insecurity, which is caused by population growth and environmental degradation, both of which have long-term effects on agriculture.

Figure 6.1: Land Utilization Pattern and their Per centage for 2020-21



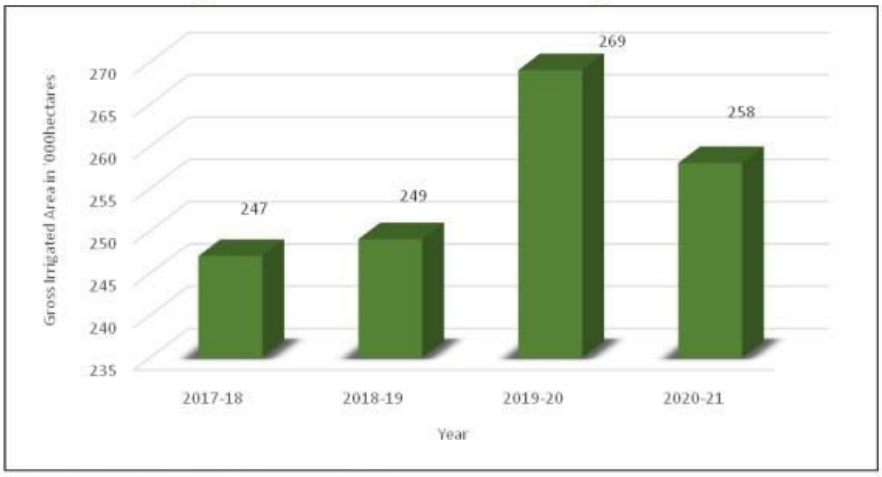
Source: https://aps.dac.gov.in/LUS/Public/Reports.aspx

The total cultivable area of the state is 38 lakh ha, but the net sown area is only 22.38 lakh ha. Current fallow, other fallow and cultivated land totals 18.35 lakh ha. The state has varied climatic regions: highlands, lowlands, and plains. In which the area of cultivable land can be increased by managing the land. This will eliminate the problem of food security in the coming days and benefit sustainable agriculture. To further increase cultivable land, the state needs to focus on managing land efficiently, in order to reduce fallow and other cultivated land, and improve food security. This will increase the benefits of sustainable agriculture for the state in the long run.

7. INCREASING WATER DEMAND

Population growth and economic development are driving significant increases in agricultural water demand. Water is needed to irrigate agriculture with the increase in crops. Without a sufficient water supply, farmers won't be able to maximize the yield from their crops.

Figure Year-Wise Status of Gross Irrigated Area



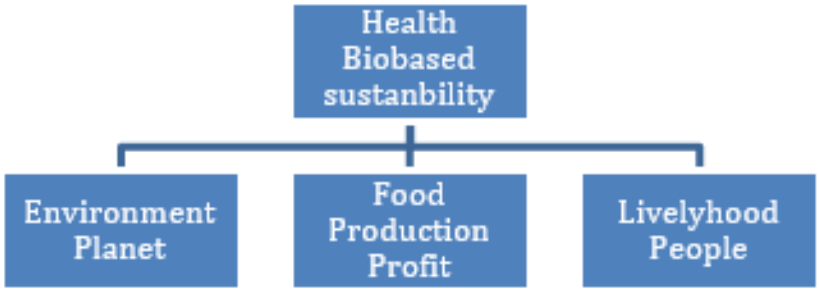
Source: RBI Handbook of Statistics on Indian States 2021-22

It's the total area under crops that's irrigated. It's irrigated once a year or more. Therefore, if a crop is grown more than once in an agricultural year, the gross irrigated area counts it twice. Over the years, the state's gross irrigated area has grown. In 2019-20, it's 269 thousand hectares up from 247 thousand in 2017-18. Gross irrigated area in the state decreased to 258 thousand hectares in 2020-21(Figure 7.1).

8. FARMING OF SUSTAINABLE AGRICULTURE

Sustainable agriculture has three main goals: economic profitability, environmental health, and ethical integrity. People-Planet-Profit is often presented as a three Ps framework. Agriculture has changed from a purely profit-oriented activity into a three P-based production sector, trying to achieve productivity, efficiency, and efficacy.

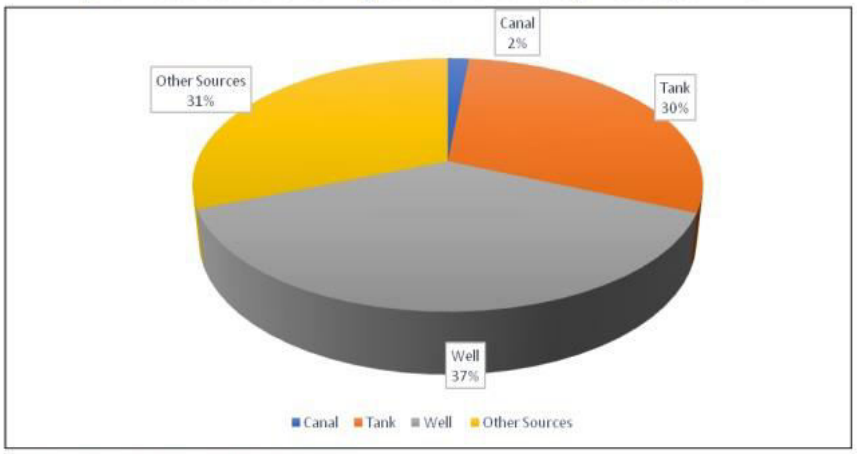
The demand for resources such as water, land, and biomass and the rate of environmental degradation in a cumulative sense are increasing manifested by land salinization, groundwater pollution due to excessive leaching of fertilizer residues, and the pollution of surface water due to the poor or lack of treatment of trade effluents disposed into natural water resources.



9. WATER SCARCITY AND ITS IMPLICATIONS FOR AGRICULTURE

Global food security would be tougher if there was a water shortage. For the year 2025, water will be needed by all four sectors: agricultural, industrial, domestic, and livestock drinking.

Figure : Source-Wise Gross Irrigated Area in Jharkhand (in hectares) as in 2020-21



Source: https://aps.dac.gov.in/LUS/Public/Reports.aspx

Wells are the most popular source of irrigation in Jharkhand, followed by tanks and canals. State land use statistics show there are 97,062 wells, 77,060 tanks, and 4,150 canals used for irrigation (Figure 9.1). Jharkhand is a plateau area, so wells are the main method of irrigation here, so by increasing the number of wells, irrigation problems can be solved. So that food security can be avoided and sustainable agriculture achieved.

The future of sustainable agriculture lies in micro irrigation. Micro-irrigation can not only enhance agricultural productivity but also lower irrigation water, fertilizer and labor requirements in an era of climate change and water scarcity.

10. MIXED FARMING SYSTEMS IN AGRICULTURE

Beyond crop rotation, integrating crop and animal production can increase eco-efficiency. Nutrient management has traditionally been about optimizing crop yields with nutrients. There was a lot of focus on how adding nutrients to the soil would affect the crop.

11. TECHNOLOGIES FOR INCREASING SUSTAINABLE AGRICULTURAL

Technology, in the classical sense, includes the development and use of nutrients, pest control products, crop cultivars, and farm equipment, but it also includes the vision of genetically modified crops providing greater nutritional efficiency (more calories per yield or more yield), manipulation of natural pest control agents, and use of farm management techniques that focus on whole farm productivity over time, not just annual production per hectare.

Several on-farm management practices Indian farmers can adopt in agriculture. Such practices, if carried out consistently, reduce the water requirement of existing crops and improve the primary productivity of cultivated land. For alteration and gradual reduction of chemical fertilizers, Indian farmers are increasingly using organic manure, vermin-culture technologies, and agronomic practices such as mulching, crop rotation, and bio-pest control measures. Organic manure can help regain the structure and texture of soils and enhance their moisture retention capacity along with improving soil nutrients. Farm management practices such as mulching can reduce soil evaporation, thereby increasing irrigation water utilization efficiency practiced by Indian farmers.

12. CONCLUSION

Global action toward food security is needed in the present scenario to ensure and sustain food production. This is to provide adequate food for everyone in the world. To prevent global hunger and malnutrition, effective international policies must be implemented that address the diverse needs of different countries. Although many conventional techniques have existed since antiquity to produce food, other effective development strategies are also needed for sustainable agricultural practices. To ensure a successful and sustainable agricultural system, it is essential to employ and explore both traditional and modern techniques. Consequently, in order to combat hunger and sustain food security in the future, active and sustainable agricultural research is required. An investment in agricultural research now could ensure a more secure and nourishing future for all.

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POST-HARVEST MANAGEMENT, VALUE ADDITION AND MARKETING OF TOMATO

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ABSTRACT

*Tomato (*Solanum lycopersicum *L.) is one of the most cultivated and consumed horticultural crop. It is cultivated and processed in India during two seasons:* Kharif *and Rabi. Tomato is also cultivated in the off-season, under protected cultivation. It can be eaten as a salad or used in a variety of foods and drinks as an extract or sauce. Tomatoes and tomato-based foods provide a wide range of nutrients as well as other health advantages. Because of the crop's economic and nutritional value, tomato production has wavered in recent years. In recent years, many tomato growers have found that a high yield does not translate into profit because majority of the crop is lost after harvest. Tomatoes are perishable in nature, with a limited shelf life of roughly 48 hours in tropical environments due to their high moisture content. To extend the shelf life of the crop after harvest, specialised postharvest handling practices and treatment technologies are required. Value addition is done to generate more profits. Furthermore, it provides employment, which ultimately generates income. Currently, ketchup is in demand all over the world. Several small and medium-sized enterprises are involved in the production of its processed products. The value addition of tomatoes into various forms includes tomato ketchup, tomato sauce, tomato juice, tomato soup, tomato pulp, tomato paste etc. On the other hand, the marketing pattern of processed tomatoes plays an important role; it varies from region to region in India. In the market, there is a high demand for it because it is considered the most important canned or processed vegetable. Constraints faced by the farmers need to be effectively addressed. Adequate training of farmers on post-harvest crop handling procedures and proper storage facilities will reduce the chances of crop losses at the farm level. Concerning the economic upliftment of farmers, the reduction of post-harvest losses will lead to an increase in the per capita income of farmers as well as increased food availability and ultimately nutritional security of the*

Keywords: *Marketing, Post-harvest management, Tomato, Value addition*

INTRODUCTION

The vegetable sector plays a very important role in farm income enhancement and the mitigation of poverty in most developing countries. Preferences in food and the agricultural sector in developing countries are being transformed from grains and staple foods to high-value agriculture, including vegetables. (Birthal *et al*., 2005; Gulati *et al*., 2007). Tomatoes are one of the most produced horticultural crops in India, just after potatoes. A great demand for fresh vegetable crops is created by the customers, but the main challenge in fulfilling this demand for fresh vegetables is post-harvest losses, which account for about 30 percent in India (FAO 2019).

Newly harvested tomatoes normally need proper post-harvest management to reduce losses and maintain greater quality for better returns from the market. The worldwide tomato processing in the year 2020 was around 38.77 million tons, whereas India recorded 130 million tonnes of tomato processing. In India, the total production of tomatoes was 205.72 lakh tonnes from 7.96 lakh hectares (FAOSTAT, 2019-20), which is 8 per cent higher than last year's production. Postharvest losses in the crop tomatoes are a matter of concern and their management plays a key role in loss lessening, value addition, food security, employment and income generation. While the accessibility of better marketing facilities helps in stimulating production and consumption of produce as it acts as a critical link between the farming sector and non-farm sectors. The adoption of scientific practices in the farming system depends on the knowledge of the farmers (Nain and Chandel, 2013). Lack of a well-organized marketing system, more distance to the mandis, manipulation of weight machines, lack of proper grading facilities, and the presence of middlemen who charge huge commissions and force farmers to sell their products at unregulated markets. Therefore, there is an urgent need for adequate infrastructure facilities for post-harvest management, value addition, as well as a competitive marketing system. Furthermore, this paper is all about a clear understanding of post-harvest losses, quality parameters of tomatoes, and adopting suitable approaches to minimize the losses.

Factors Affecting the Post-Harvest Quality of Tomatoes

Postharvest technology includes grading, packaging, and storage. These are very important to overall food safety and the quality of the product. Following harvest, there are some major factors that may affect the quality of tomatoes.

Temperature

Temperature plays a very important role in increasing the shelf-life of vegetable crops. Storage of tomatoes at a low temperature of nearly 20 ^{o}C to delay ripening and post-harvest loss. However, below this temperature, it may also cause chilling injury, which is characterized by surface pitting, premature softening, etc. Delaying the time of storage after harvesting has a huge effect on shelf life.

Relative Humidity

Tomatoes contain a very high amount of moisture; hence they don't shrink or dry up after being harvested. Relative humidity can have an influence on water loss and the decay of the fruit. The best relative humidity for harvested green tomatoes is 85-95 (v/v) and for ripped tomatoes is 90-95 (v/v).

Physical Handling

It has a significant impact on tomato quality and shelf life. It includes cleaning, sorting, grading, etc. To maintain a high degree of hygiene and to fulfil market demand, we can clean tomatoes by whipping or washing them to remove dust particles from the fruits. Before going to market, sodium hypochlorite can also be added to water as a disinfectant agent. Sorting and grading are mainly done for quality enhancement. It can be done both manually and mechanically. Based on the size of fruits and weight of fruits, according to size, weight, and colour of fruits, the fruits will be separated and packed accordingly.

Post Harvest Losses in Tomato

In developing countries, post-harvest losses take place mainly due to inappropriate storage facilities. Tomato losses appear due to improper method and time of harvesting, mechanical damage, poor packaging material, and poor transportation facilities. All effort must, therefore, be made to curtail these losses. There are various execution proposals to improve this phenomenon. Maintain the right temperature during storage (ripe: 7.2^{o} C; unripe: 8.9^{o} -10^{o} C). It is a climacteric type of fruit, so it has a high respiration rate and maintains a relative humidity of 85-90%.

Packing Material

Packaging is an important parameter to maintain quality for the commercialization of tomatoes and in the distribution chain. The package must protect the product against damage, have adequate holes to facilitate aeration and fast cooling, and be impervious to climatic adversities. It must also be attractive to consumers. For the protection of tomatoes from damage, plastic boxes are highly recommended. Moreover, poly bags and mesh bags do not provide sufficient protection; if fruit gets damaged, it will rot inside it.

Zero Energy Cool Chamber (ZECC) for short term storage of tomatoes

The Zero-energy cool chamber is an environmentally friendly new storage idea that doesn't require any electricity. The low inside temperature and high relative humidity of it are maintained based on the principles of a passive evaporative cooling mechanism. As liquid water particles of the brick partition cooler consist of bricks with a mixture of zeolite and sand produce gas under the effect of open-air through a procedure that uses energy (Parvez and Morimoto, 2012). The actual benefits of this on-farm low-cost cooling technology are that it does not need any electrical power to operate and the materials required like sand, bricks, bamboo, etc. are simply available on their farm.

Within the Zero-energy cool chamber, the average temperature during its operation is reduced to 10-15 °C and relative humidity will be maintained from 85 to 95% when water is applied over the sand filled in between the walls of the chamber. (Singh and Satapathy, 2006).

Post-Harvest Treatments Prior to Storage

Application of slight heat shock to tomatoes before introduction to low degree temperature increases their resistance to frightening injury (Saltveit, 2001). Based on the ion outflow method from tissue discs for the valuation of frightening injury, it was seen that a little heat treatment (10 minutes at 45^{o}C) and subsequent introduction of the fruit to little temperatures would decrease the succeeding development of chilling indications. Soto-Zamora *et al.* (2005a) showed developed green tomatoes to heat treatments (34^{o}C to 38°C with 95% RH for 24 hours) before storage at 4^{o}C to 20°C for 4 weeks is a challenge to decrease frightening injury at 4°C. Though over degree temperature produced serious injury, treatment at 34°C was to some extent injurious. At storing temperature of 20^{o}C, fruit that had been exposed to 34°C matured similarly to control, but frightening injuries occurred at 4°C in both the control and the treated fruit, however, the production of lycopene was greater in the last. In the same trials (Soto-Zamora *et al.* 2005b), fruits were exposed at a higher degree temperature (38°C), but to a low level of oxygen concentration (5%) to prevent the action of oxidative enzymes concerned in the introduction of warm injury. Meanwhile, neither the warm air damage tempted at this treatment temperature nor frightening damage at the time of storage was reduced. In contradiction, Fallik *et al.* (2002), also in an effort to postponement ripening and decrease frightening wounds, found that short-lived exposure of tomatoes at the pink phase of maturity to a higher degree temperature (brushing and washing at 52^{o}C for 15 seconds or absorption of fruit for 1 minute) prohibited the appearance of frightening damage symptoms at 5°C for 15 days and in case of washing briefly improved fruit confrontation to Botrytis. High-temperature treatment has also been projected as a means of preventing microbial action besides fruit cracking under high humidity conditions in altered atmosphere packaging (Suparlan and Itoh 2003), along with postponing the change of colour in cherry tomatoes (Ali *et al.* 2004).

Value Addition

Value addition is another important part through which tomatoes can be processed into several value-added products during surplus. Value addition is done to produce more revenues. Furthermore, it provides employment, which ultimately generates income. Currently, ketchup is in demand all over the world. Several small and medium-sized enterprises are involved in the production of their processed products. The value addition of tomatoes in various industries includes tomato ketchup, tomato sauce, tomato juice, tomato soup, tomato pulp, tomato paste, etc. Furthermore, post-harvest value addition technologies at the adoption level indicated by the majority were as follows: sun-dried and peeled tomato preserves, fresh refrigerated, pureed and sealed

with oil in jars, boiled, sealed and packed sealed, cold-water bath, evaluated pickling, trialed irradiation, and trialed pulping.

The followings are some of the industrial uses of tomatoes

1. Pharmaceutical Industry

Over the years, the tendency has been the merging of the food and pharmaceutical industries, and now, the cosmetic industry. Many researchers have focused on the possible application of natural elements, especially those that are extracted from foods, and their physiological and pharmacological effects. The application of tomato pomace in the beautifying industry is a new concept. In the past, skincare was wholly associated with the application of topical formulations, whereas recent reports have claimed the importance of skin care from an inside-out point of view. Tomatoes are used in numerous categories of medicine in the medicinal community. It contains lycopene, which is a powerful antioxidant, as well as beta-carotenoid, vitamin C, particularly flavanols and flavones, known to fight inflammation and cancer. It has many advantages as it is rich in chromium, it is good for diabetic patients; it reduces blood pressure and cholesterol levels, which is ultimately good for the heart.

2. Textile Industry

In forthcoming years, tomatoes could become commercially important as a natural source of carotene (a pigment of red-orange colour). The natural dyes (carotenoids) present in tomato peels and pulp are extracted through several methods and used as natural dyes in various fabrics (silk, wool, and polyamide). The calm nature and bright shades of natural dyes make the textile materials attractive and eye-catching to consumers. Natural dyes are more eco-friendly and can eliminate pollution in the environment if the waste is used in such a way.

Marketing Strategy for Tomato

Marketing is a vital activity in any business which can be approached systematically. For better yield profit it should be well planned. It may lead to heavy losses if it is not properly done.

Marketing pattern varies from area to area in India because of agro-climatic conditions. In Punjab, vegetable production is not common at the commercial level as it is known for cereal production as farmers are interested in the MSP on the other hand Karnataka and Maharashtra are producing tomatoes for export. Sometimes farmers can tie together, to form informal associations like cooperatives, for example, production groups or marketing groups. Combining resources together can have a big advantage for small or marginal farmers. The size of the cooperative may encourage banks to lend a larger amount of money. Associations or cooperatives can also get advantages during buying raw materials. More raw materials can be bought at one time, for example, farm implements, hence prices may be lower. Also, a group of farmers may have better

negotiation power with rural traders, retailers, wholesalers and processors. Moreover, cooperatives can often help the farmers with market research.

Tomato is used for producing sauce, ketchup, soup, puree, etc. In the market, there is a high demand for it because it is considered as number one canned vegetable or processing vegetable crop in the world. In local markets, tomatoes are bagged in plastic bags and carried by people. In India as vegetable 80% of production is consumed and for processing purposes, 20% of it is used. Transportation plays a major role in marketing carrying tomatoes. It is essential to address the limitations in tomato cultivation at the earliest to bear the momentum of production.

CONCLUSION

Tomatoes can be grown in various types of soils, from heavy clay to sandy. However, red loam or well-drain sandy soils with a pH range of 6–7 and rich in organic matter are considered perfect. Tomatoes are a summer-season crop. The best fruit colour and quality are obtained at a temperature range of 21^0–24^0 Celsius. The yield was about 96.2 tonnes per ha with a crop duration of 140-145 days. The tomato plants are semi-deciduous in nature, about 90–95 cm long. The shelf life of the tomato can also be extended when proper post-harvest handling practices and treatment methods are employed. Post-harvest management practices like harvesting, pre-cooling, cleaning, sorting, grading, packaging, storage, and transporting played an important role in maintaining the quality and extending the shelf life of the tomato fruits after harvest. Improving the post-harvest properties of tomatoes can enhance their marketing efficiency and bring more income to the marketer. From the above-cited results, it can be concluded that if farmers get need-based training and are equipped with knowledge regarding better marketing facilities, and are provided with well-developed infrastructure at marketplaces, it results in a positive impact on their livelihood and will enhance their income. Thus, to provide training regarding marketing systems, government organizations like SAUs, extension education institutes, and ICAR institutes should impart training from time to time to educate and make farmers aware of marketing strategies and prevailing market prices so as to overcome the ill effects of post-harvest losses. By combining proper handling practices and preservation measures, the post-harvest quality of tomatoes will be improved, and traders may efficiently market tomatoes and get more profit.

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A COMPREHENSIVE INVESTIGATION FOR WATER RESOURCES AND WATER BORNE DISEASE IN BANKA

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ABSTRACT

Water resources and waterborne diseases are major issues facing the district of Banka, located in the eastern Indian state of Bihar. The district is located in a semi-arid region and relies heavily on the polluted Ganges River for its water supply. Other sources of water in the district, such as open wells, hand pumps, ponds, and canals, are often contaminated with pollutants and bacteria, leading to waterborne diseases. The high levels of fluoride in some sources of water also pose a serious health risk to the local population. Water is one of the most vital elements on Earth, required by every living thing. Climate change, pollution, population increase, and poor management are only some of the threats to the world's water supplies. These problems offer serious dangers to the quantity and quality of water supplies, which in turn may cause water-borne illnesses. Particularly in underdeveloped regions where sanitation is inadequate and access to clean water is restricted, water-borne infections pose a serious threat to public health. These illnesses have the potential to inflict serious harm, and even death, and they have a major effect on the economic growth of places where they are prevalent. The significance of water, the forces that alter it, and the connection between water and water-borne illnesses are all explored in this in-depth analysis. Sustainable water management techniques and methods for combating water-related illness are also covered. Sustainable development relies heavily on the availability of fresh water for human use. However, natural and anthropogenic forces often endanger the availability and quality of water supplies. In poorer nations where sanitation is poor and access to clean water is limited, water-borne infections are also a serious problem. In this extensive study, we delve into the following issues concerning water supplies and water-related illnesses: Contamination can occur in several ways, including from industrial pollution, agricultural runoff, and human waste. This paper explored the Water resources and waterborne diseases and water contamination in Banka District.

Keyword: Water Resources, Waterborne Diseases, Banka (Bihar), Water contamination

INTRODUCTION

Water is one of the most vital elements on Earth, required by every living thing. Climate change, pollution, population increase, and poor management are only some of the threats to the world's water supplies. These problems offer serious dangers to the quantity and quality of water supplies, which in turn may cause water-borne illnesses. Particularly in underdeveloped regions where sanitation is inadequate and access to clean water is restricted, water-borne infections pose a serious threat to public health.

These illnesses have the potential to inflict serious harm, and even death, and they have a major effect on the economic growth of places where they are prevalent. The significance of water, the forces that alter it, and the connection between water and water-borne illnesses are all explored in this in-depth analysis. Sustainable water management techniques and methods for combating water-related illness are also covered. Sustainable development relies heavily on the availability of fresh water for human use. However, natural and anthropogenic forces often endanger the availability and quality of water supplies. In poorer nations where sanitation is poor and access to clean water is limited, water-borne infections are also a serious problem. In this extensive study, they delve into the following issues concerning water supplies and water-related illnesses (Prüss-Ustün et al., 2019; Hutton& Haller,2004)

1.1 Water resources and their importance:

Water resources are natural sources of water that are essential for human life and the environment. Both surface water (rivers, lakes, and seas) and groundwater (aquifers) are considered part of this category. These resources are crucial for agriculture, industry, energy production, and human consumption (Pimentel et al., 2004).

1.2 Factors Affecting Water Resources:

Several factors can affect water resources, such as climate change, pollution, deforestation, over-extraction, and population growth. The quantity and quality of water supplies may be impacted by changes in precipitation patterns brought on by climate change (Chaudhry& Malik,2017).

1.3 Water-borne diseases:

Microorganisms that can survive in water or are spread via water are the root cause of water-borne illnesses. Cholera, typhoid, hepatitis A, and diarrhea are only some of them. These illnesses are widespread in third world nations due to a lack of access to clean water and sanitation (El-Fadel et al., 2012)

1.4 Prevention and treatment of water-borne diseases:

Preventing water-borne diseases requires a multi-faceted approach, including providing entree to nonviolent drinking water, improving sanitation, promoting hygiene, and treating contaminated water. Vaccines are also available for some water-borne diseases, such as cholera and hepatitis A (Misra& Singh2012).

1.5 Water Resource and its Sustainable Management

This method requires the use of integrated approaches that consider the ecological, social, and economic aspects of water use. It includes measures such as water conservation, watershed management, and water reuse.So, the water resources are essential for human life and sustainable development, but their availability and quality are threatened by natural and human-made factors. In poorer nations where sanitation is poor and access to clean water is limited, water-borne infections are also a serious

problem. Preventing water-borne diseases and managing water resources sustainably require a multi-faceted approach that considers ecological, social, and economic aspects (Flint, 2004).

II. LITERATURE REVIEWS

Ford et.al., (2018) Diseases spread by contaminated water continue to be a major cause of death and disability across the world, with the greatest impact being seen in underdeveloped countries and among children. Beginning with some background on the problem's origins, this article delves into the factors that have allowed it to persist despite public health improvements over the last century. Although molecular biology has greatly improved their capacity to characterize the habitats and etiologies of aquatic diseases, effective management has yet to be achieved.

Abdulkadir et.al., (2019) There has been a rise in the number of instances of waterborne infections worldwide, particularly in rural regions of developing nations. They looked on the bacteriological quality of water and the geographical spread of waterborne illnesses in Bodinga, Sokoto, Nigeria. Selected waterborne illness prevalence and sanitary inspection rates were assessed using a retrospective research approach. Bacterial contamination of some water supplies was measured using an experimental setup. The research took place over the course of a year at Bodinga General Hospital and the Department of Microbiology at Sokoto State University. All of the patients who visited the outpatient clinic at Bodinga General Hospital between the months of January and December during the course of three years (2015-2017) had their medical records reviewed retrospectively. This research provides more evidence that the poor water quality in the study region may have contributed to the development of waterborne illnesses.

Grabow et.al., (1996) The most pressing issue with water quality is the spread of water-borne illnesses. Many different kinds of viruses, bacteria, and protozoan parasites are the culprits here. The frequency with which they appear and the ways in which they behave in aquatic ecosystems are affected by factors like as size, structure, composition, and excretion. This presents significant difficulties in evaluating the quality of water and the efficacy of treatment methods. Many water-borne infections, including the vast majority of viruses and protozoan cysts and oocysts, are not easily detected, adding further complexity. The incidence of many water-borne diseases also shifts in response to variations in selection forces. The techniques and tactics for quality monitoring and control of waterborne illnesses are constantly being improved and updated in light of shifting priorities, updated epidemiological data, and advances in technology and knowledge. Indicators of human and animal feculent contamination and novel technologies for the detection of viruses are discussed as they pertain to the most up-to-date approaches to water quality monitoring. The need for easy, cheap, and quick techniques to monitor water quality and the efficacy of treatment systems at a high

frequency is emphasized. The critical role that microbiological quality data plays in the administration of national and regional water supplies is emphasized.

Ali et.al., (2020) various infections may cause various water-related illnesses, and different vectors can disseminate them. When the water supply is contaminated from the outside, the disease is more likely to spread. The main purpose of this research was to show that different ground water parameters, the water quality index, and the prevalence of reported water-borne diseases can be used to determine a region's susceptibility to water-borne diseases using a geographical information system-based Geostatistical technique. Setting appropriate goals and choosing relevant research criteria with spatial rationale, as suggested by the study's findings, may also be useful when doing susceptibility analysis for other kinds of illnesses.

Nusrat et.al., (2022) Repairing infrastructure following natural catastrophes may be very difficult on a global, national, and even local scale. Social facilities like schools and hospitals, as well as essential infrastructures like clean water supplies, sewage systems, and transportation, have all been damaged. The potential for an epidemic of waterborne diseases increases in areas hit by catastrophe because clean water supplies are either destroyed or combined with polluted water. A nation like Haiti, where many people lack access to clean water and basic sanitary infrastructure, would be hit worse in the aftermath of a natural catastrophe. Humanitarian assistance and the control of disease outbreaks would benefit greatly from early warning of watery illnesses like cholera. Finding the right factors to better anticipate an epidemic is a difficult challenge in disease forecasting. on this research, they created five (5) models, one of which is based on machine learning, to detect and assess the influence of environmental and societal factors on cholera epidemics after natural disasters. Following Hurricane Matthew's October 2016 landfall in Haiti, they used that country's cholera epidemic data to build the model. Their findings show that improved cholera forecasting in the aftermath of a catastrophe may be achieved by including high-resolution data with relevant social and environmental factors. In addition, the limitations of current techniques may be addressed by combining a machine learning approach with pre-existing statistical or mechanical models to get valuable insights into the selection of variables and identification of cholera risk hotspots.

Chalmers et.al., (2012) In the vast majority of documented cases of Cryptosporidium outbreaks, water is the suspected vector. The use of molecular typing data to connect isolates from patients to each other and to probable sources is a new development that has greatly aided epidemiological examinations of outbreaks by providing additional microbiological evidence. Recent developments in the detection and investigation of these outbreaks and their spread, particularly the application of molecular typing assays, are detailed in this article, along with how waterborne Cryptosporidium outbreaks are identified and reported.

Levy et.al., (1998) Time Frame for the Reporting: Previously unreported occurrences from 1994 are also included in this review, which covers the period from January 1995 through December 1996. The System, Defined: Outbreak information related to both potable and recreational water sources is collected and analyzed by the monitoring system.

Morua et.al., (2011) About 10% of all infections are thought to be spread by water. However, the ways in which people in impoverished countries see the risks associated with drinking contaminated water are little known. They zero down on a location in northern Mexico to better comprehend people's sense of danger in relation to these concerns. Their research reveals how eight tiny towns along a severely polluted river system perceive the causes and treatments of waterborne diseases. There were substantial disparities in risk perception amongst medical experts, government officials, and the general public. Health experts were of the opinion that there was a significant threat from human waste in the area. Not many public servants or regular folks had this view. Disease outbreaks and water pollution due to improper wastewater management were also largely unknown to both government authorities and the general public. Few respondents, however, grasped the significance of basic hygiene and water treatment procedures in preventing illness, and this was not limited to health professionals. Their findings contribute to what is already known about how people in poorer regions of the globe see risks associated with the natural world. They conclude with some suggestions for how the area should strengthen its risk communication in the future as it relates to human wastewater.

Waters et.al., (2016) Diarrheal illnesses caused by waterborne parasites affecting both people and animals are prevalent, but the relative relevance of human-to-animal and animal-to-human transmission is poorly known. Attention has been drawn to the possibility of endemic and epidemic infections resulting from transmission of infection from animals to humans via environmental reservoirs, such as water sources. Within and between animal and human populations, this research creates a mathematical model that describes the spread of aquatic parasites. It's an improvement above prior models because to how it explicitly accounts for the pollution of water supplies by animals.

III. AUTHORS REVIEWS AND FINDINGS

Author	Year	Methodology	Finding
Prüss-Ustün et al.	2019	Systematic Review	Improved water, sanitation, and hygiene (WASH) reduces diarrheal diseases by 26%.
MacDonald et al.	2016	Literature Review	Climate change can exacerbate water scarcity and growth the danger of water-borne bugs.

Hunter et al.	2014	Systematic Review	Inadequate water stock and health increase the danger of diarrheal diseases in low- and middle-income countries.
Gundry et al.	2004	Meta-Analysis	Household water treatment reduces diarrheal diseases by up to 39%.
Hutton and Haller	2004	Systematic Review	The monetary benefits of improved water and sanitation outweigh the costs by a factor of 5 to 28.
Howard et al.	2013	Literature Review	Inadequate water supply and sanitation disproportionately affect women and girls, leading to gender inequalities.
Gleick	2000	Literature Review	Conflicts over water resources are increasing, posing a threat to international security.
Bartram et al.	2005	Systematic Review	POU (Point of Use) water treatment improves water quality and reduces the risk of water related diseases.
Cairncross et al.	2010	Systematic Review	Handwashing with soap reduces the risk of diarrheal diseases by 30%.
Wolf et al.	2003	Literature Review	Water scarcity can lead to conflicts and displacement of populations, particularly in arid and semi-arid regions.

IV. FACTORS IMPACTING WATER-BORNE DISEASES

Several factors can impact water resources and increase the risk of water-borne diseases. Here are some of the significant factors:

a) **Climate Change:** The quantity and quality of water supplies may be impacted by changes in precipitation patterns brought on by climate change. Changes in temperature and weather patterns can also impact the water cycle and cause droughts and floods.

b) **Pollution:** Industrial, agricultural, and domestic activities can contribute to the pollution of water resources, including surface water and groundwater. Pollutants can

include nutrients, chemicals, and microorganisms, which can harm human health and the environment.

c) **Over-extraction:** The over-extraction of groundwater or surface water can lead to a decrease in the availability of water resources. This can cause conflicts over water use and can lead to the degradation of ecosystems that depend on water.

d) **Deforestation:** Deforestation can lead to changes in the water cycle, such as reducing the amount of water that infiltrates into the soil and increasing surface runoff. This can lead to soil erosion, decreased water quality, and changes in the ecosystem.

e) **Population Growth:** The increase in the global population can increase the demand for water resources. This can lead to conflicts over water use and can put pressure on existing water resources.

f) **Poor Sanitation:** Poor sanitation practices, such as open defecation and improper wastewater disposal, tin main to the contamination of water resources. This can increase the risk of water-borne diseases.

g) **Inadequate availability of Safe Drinking Water in proposed area:** In poor nations particularly, the lack of access to clean water is a major problem. This has the potential to affect human health by raising the frequency of water-borne poisons.

Understanding the influences that move water resources and increase the risk of water-borne diseases is crucial to developing strategies for sustainable management and disease prevention.

V. CAUSES OF WATER-BORNE DISEASES

Microorganisms that can either survive in water or be spread via water are the root cause of water-borne illnesses. Some of the most common reasons people become sick from water:

a) **Bacteria:** Most water-related illnesses are caused by bacteria. Disease-causing organisms including cholera, typhoid, and E. coli may infiltrate water supplies through human and animal waste.

b) **Viruses:** Viruses can enter water resources through human or animal waste and can cause illnesses such as hepatitis A, polio, and Norovirus.

c) **Parasites:** Parasites such as Cryptosporidium and Giardia can enter water resources through animal or human feces and can cause illnesses such as diarrhoea.

d) **Chemical Contaminants:** Water resources can also be contaminated with chemical substances such as heavy metals, pesticides, and industrial chemicals. Exposure to these substances can cause various health problems, including cancer.

e) **Climate Change:** Climate change can impact water quality and availability, which can increase the risk of water-borne diseases. For example, changes in precipitation patterns and extreme weather events can lead to flooding and contamination of water resources.

f) **Poor Sanitation:** Poor sanitation practices may contribute to the pollution of water resources and an increase in the risk of water-borne infections. Some examples of these behaviors include defecating in the open and treating sewage in an inappropriate manner.

g) **Inadequate Access to Safe Drinking Water:** Lack of access to safe drinking water is a significant cause of water-borne diseases, particularly in developing countries. This can increase the risk of water-borne diseases and impact human health.

Understanding the causes of water-borne diseases is essential for developing strategies for prevention and treatment. Preventing water-borne diseases requires a multi-faceted approach, including providing access to safe drinking water, improving sanitation, promoting hygiene, and treating contaminated water (Cairncross et al., 2010).

VI. RESEARCH SIGNIFICANCE

Water resources and water-borne diseases have momentous impacts on human health, social and economic development, and the environment. Here are some of the significant implications:

a) **Human Health:** Water-borne diseases cause significant illness and death worldwide, particularly in developing countries. Children, pregnant women, and people with weakened immune systems are the most vulnerable to these diseases. Access to safe and clean water is crucial to reducing the burden of water-borne diseases and improving public health.

b) **Social and Economic Development:** Water resources are essential for agriculture, industry, and domestic use. Access to safe and clean water can improve living standards, reduce poverty, and promote economic development. However, water scarcity, poor water quality, and water-borne diseases can hinder social and economic development.

c) **Environmental Impacts:** Water resources support diverse ecosystems and provide habitat for numerous species. Pollution, over-extraction, and poor water management can degrade ecosystems and harm wildlife. Climate change can also impact water resources and biodiversity.

d) **International Security:** Water resources are increasingly becoming a source of conflict between nations, especially in regions where water is scarce. Conflicts over water can lead to tension, displacement, and even violence. Therefore, sustainable management and cooperation over water resources are crucial for maintaining international peace and security.

e) **Sustainability:** The supply and quality of water are under jeopardy due to climate change, pollution, population increase, and poor management. The availability and quality of water resources for future generations depend on the implementation of sustainable water management methods.

So, the water resources and water-borne diseases have significant implications for human health, social and economic development, environmental sustainability, and international security. Therefore, it is essential to develop strategies for sustainable management, prevention, and treatment of water-borne diseases to ensure the availability and quality of water resources for future generations.

VII. CONCLUSION

In conclusion, water resources and water-borne diseases are interconnected and have significant implications for human health, social and economic development, environmental sustainability, and international security. Some of the variables that affect water resources and raise the risk of water-borne illnesses include climate change, pollution, over-extraction, poor sanitation, and insufficient access to clean drinking water. Preventing water-borne diseases requires a multi-faceted approach that includes providing access to safe and clean water, improving sanitation practices, promoting hygiene, and treating contaminated water. Sustainable water management practices are essential for ensuring the availability and quality of water resources for future generations. To address the challenges related to water resources and water-borne diseases, stakeholders must work collaboratively to develop and implement effective strategies that prioritize public health, social and economic development, and environmental sustainability. Some of the variables that affect water resources and raise the risk of water-borne illnesses include climate change, pollution, over-extraction, poor sanitation, and insufficient access to clean drinking water. With collective efforts and political, we can ensure that water resources are managed sustainably and equitably for present and future generations.

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STUDIES ON IN VITRO ANTIFUNGAL ACTIVITY OF SOLVENT EXTRACTS OF NEEM (*AZADIRACHTA INDICA*) AGAINST *FUSARIUM MANGIFERAE* CAUSING MANGO MALFORMATION

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ABSTRACT

Fusarium mangiferae is a fungus which causes mango malformation disease which affects both vegetative and reproductive structures of the plant. Neem (Azadirachta indica) tree has attracted worldwide prominence owing to its wide range of medicinal properties. Neem leaf and its constituents have been demonstrated to exhibit immunomodulatory, anti-inflammatory, antihyperglycemic, antiulcer, antimalarial, antifungal, antibacterial, antioxidant, antimutagenic and anticarcinogenic properties.

The objective of the study is to check the antifungal efficacy of three different solvent extracts of Neem leaves (Azadirachta indica) on F.mangiferae. Poisoned food technique was used to check the efficacy of antifungal compound present in Neem. The extracts were prepared in aqueous, ethanol and hexane solvent. These extracts were screened for their antifungal activity against F.mangiferae at different concentration of aqueous, ethanol and hexane extract. Neem leaves extracts showed promising antifungal activity against F.mangiferae at 20% concentration of aqueous ,ethanol and hexane extract. So, Neem leaves might be applicable as biofungicide against fungal plant disease Mango malformation.

Keywords: *Antifungal, bio fungicide, mango malformation, ethanol, hexane.*

INTRODUCTION

Mango malformation disease (MMD) is a serious disease caused by a fungus *F. mangiferae* occurring in mango plants, which is big concern in the mango industry and it is needed to be restricted. India, is a major producer of mango which is 41%, share of total world production (FAO, 2009). Due to this disease, there is huge reduction in the mango yield resulting to economic loss to the mango processing industry and mango export trade.

Chemical fungicides are being used to control this disease but due to the endophytic nature of *F. mangiferae,* exogenous application of few chemical fungicides is not enough to control mango malformation. As some plant extracts / botanicals have shown significant antifungal activity towards the mentioned fungus, therefore the aim of this investigation was to study the in vitro antifungal efficacy of Neem leaves extracts.

Traditional medicines have gained its importance in use in day today life due to the presence of bioactive compounds known as secondary metabolites. Impact of different

solvents has been studied and analysis have been made by researchers about solvent which includes hexane, water, chloroform as well as ethyl alcohol in the antioxidant extract of seeds, leaves and fruits etc. Different polarities of solvents are used to get bioactive compounds for more accuracy from plant parts. Multiple solvents have been usually used to obtain phytochemicals, dried powder from plant parts were usually used by scientists to obtain bioactive compounds and remove the presence of water as well.

In spite of the recent development in the field of agrochemicals, herbal fungicides and pesticides has got its widespread acceptance worldwide due to their lesser side effects. It has been realized that use of chemicals is unsafe and unfriendly. Continuous, indiscriminate, and haphazard use of pesticides has created many problems. One of the main implications is that the pesticides deteriorate the environment, disturb natural process and ecosystem, contaminate food and feed and affect human and animal health. The phytochemical contents and composition of the medicinal plants are urgently needed to be explored for the betterment of an alternative form of natural pesticide.

MATERIALS AND METHODS

In vitro tests were conducted using one strain of *F. subglutinans* obtained from IMTECH, Chandigarh. The pure lyophilized strain (MTCC 8782) was activated on PDA medium (potato infusion 200g/lt., dextrose 20g/lt., Agar 15g/lt., pH-5.6+0.2 at 25 °C) autoclaved at 121 °C for 15 lb pressure for 15 min.

Aqueous, Ethanol and Hexane extract of Neem leaves was prepared by using dried leaf powder Salie et al., (1996) in Aqueous, ethanol and Hexane, while the biological action of these plant extracts were concluded by following "Poisoned food techniques" Grover *et al* (1962). Aliquots of stock solutions were incorporated to PDA medium to provide final concentrations of 5%, 10%, and 20%. Mycelial disks having pathogens (5mm in dia.) were taken from corner of culture having seven days were added to said media incorporated with tested concentrations of plant extracts. Experiments were done in triplicates for each concentration. Restriction of vegetative growth of the said fungus was for each plant extract concentration, inhibition of radial growth was equated with control i.e., without any treatment. Calculation was made to evaluate efficacy after seven days incubated at 24°C, in dark. "Fungal radial growth was measured by averaging the two diameters taken from each colony. Percentage growth inhibition of the fungal colonies was calculated by applying the following formula" (Khanh *et al*, 2005).

$$\text{Growth/inhibition (\%)} = \frac{[(\text{Growth in Control} - \text{Growth in treatment})]}{\text{Growth in Control}} \times 100$$

RESULTS AND DISCUSSION

Aqueous, Ethanol and Hexane extracts of *Azadirachta indica* leaves was checked for their capability in restriction of vegetative growth in *F. mangiferae*.

The radial growth of the tested isolate has been influenced differently by different concentration of aqueous, ethanol and hexane extracts.

The highest restriction of growth of mycelia (85.11% efficacy) was observed from *Azadirachta indica* at 20% aqueous and ethanol extract.

At 20% concentration of Hexane extracts 82.86% inhibition of radial growth was observed.

Table :1 Biological action of *A. indica* leaves extracts on the growth of mycelia of *F. mangiferae.*

Plant extracts in solvents	Concentration (%)	Colony diameter (mm)	Efficacy (%)
Distilled water	Control (0%)	70	0.00%
	5%	55	21.43%
	10%	22	68.57%
	20%	10	85.11%
Ethanol	Control (0%)	70	0.00%
	5%	45	35.71%
	10%	14	80.00%
	20%	10	85.11%
Hexane	Control (0%)	70	0.00%
	5%	48	31.43%
	10%	19	72.86%
	20%	12	82.86%

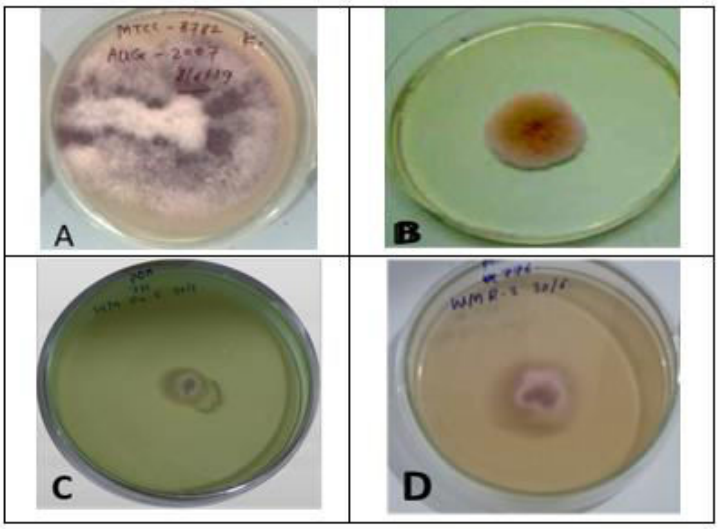

Fig. 1: In vitro biological activity of Neem leaves extracts (20%) in Aqueous, Ethanol and Hexane extracts against development of *F. mangiferae*. **A** – Control; **B** – 20% Neem aqueous extract; **C** –20% Neem Ethanol extract; **D** –20% Neem Hexane extract

The observation showed that of *Azadirachta indica extracts* inhibits the growth of test organism. The capability of aqueous, ethanol and hexane extracts to restrict the growth of phytopathogenic fungi is clearly evident.

Biocontrol is the safest and most economical method of plant pathogen by using botanicals.

The main bioactive components in medicinal plants are considered to be combinations of secondary metabolites. Singh *et al.*, (2016), Wu *et al*, (2011). Plant extracts and their secondary metabolites are rich sources of antimicrobial substances, including polyphenols flavonoids and nonflavonoids.

CONCLUSION

According to present investigation it can be concluded that the bioactive compounds of Neem leaves exhibited different degrees of antifungal activity in different concentrations of Aqueous, ethanol and Hexane extracts against plant pathogenic fungus *F.mangiferae*.

It is concluded from our study that Aqueous, ethanol and Hexane extract of *Azadirachta indica may* be developed as biofungicides against *F.mangiferae* as Neem extract has shown remarkable antifungal property towards the tested fungus .The advantages and benefits with the use of this plant is the cost effectiveness and global availability. It is safe to grow, use, harvest and lack of any side effects are the other advantages associated with it. Hence the botanicals might be used as natural antifungal agents in place of synthetic fungicides against the tested fungus.

FUTURE SCOPE OF THE STUDY

Similar types of studies may be done with other herbs to find the possibilities of presence of antifungal activity in other medicinal plants to exploit them in controlling plant diseases.

Soil drenching*: F.mangiferae* is a soil borne pathogen . It enters into the plant through root, and moves in the plant through xylem. Then it produces ethylene which plays a crucial role in mango malformation. So, soil drenching with botanicals will help in controlling the pathogen to enter into the plants.

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Leea Macrophylla Roxb. Ex Hornem. AS A WILD EDIBLE ETHNOMEDICINAL PLANT

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ABSTRACT

Medicinal plants being an herbal remedy in both developing and developed countries in the management of health care, globally 80% of the population relies on traditional medicine, since ancient times as major source of medicine in treating many diseases, ayurveda, hodopathy, homeopathy, naturopathy. Natural products nascent from plants on a large scale and draw by many researchers due to less or almost no side effects. Classical medicinal plants of Ayurveda, based upon their synonyms, were assigned botanical equivalents by the experts. The botanical sources of some plants are still in a state of controversy, and the cause of the controversy is as India is a country which have a diversity of localism and plantation dependent on diverse tribal and folklore medicine. The transformation in the language sometimes is liable for confusion in the nomenclature of several plants having tantamount name.

Attempt has been made to gather the information of Leea macrophylla Roxb. ex Hornem. of family Vitaceae. Leea macrophylla Roxb. ex Hornem. commonly known as Hastikarnapalasa, is known to have several therapeutic properties. These are due to the presence of numerous chemical compounds. The physicochemical analysis evolved in the study will give referential knowledge for identification of the crude drugs. The pharmacological activity of a plant can be predicted by the identification of the phytochemicals. Phytochemicals are beneficial to boost up immunomodulatory responses and also provide immunity against many diseases. Phytochemicals are chemical compounds produced by plants, generally to help them resist fungi, bacteria and plant virus infections, and also consumption by insects and by other animals. These chemical compounds naturally present in the plants attributing to positive or negative health effects and giving organoleptic properties and colour to the plant. Plants contain many chemical constituents which are therapeutically active or inactive. Nutrition is the provision for the cells of organism to support life. Leea macrophylla plant is rich in secondary & primary metabolites, vitamins & minerals.

Keywords: *Botanical equivalents, Tantamount name, Hastikarnapalasa, Vitaceae.*

INTRODUCTION

India is large-handed in diversity of plants and furthermore well known for its rich heritage and known repository for medicinal plants since ancient times.

India is well known for its rich heritage and known repository for medicinal plants since ancient times. The plant wealth for medicine was collected from various biodiversity

rich regions. Medicinal plants could also be used as nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates, chemical entities for synthetic drugs. Traditionally used plants and their products have been widely evaluated for pharmacological properties have been increased throughout the world now a day's. It is believed that the drug of natural origin plays a vital role in healthcare without any side effects. Medicinal plants typically contain mixtures of different chemical compounds that may act individually, additively or in synergy to improve health. As per W.H.O. report, about 60% peoples from developing countries relies on herbal medicines for better health and because of these medicinal plants are growing worldwide. Hereof, it is constitutive to study the uses of plants and other associated knowledge should develop for researchers for introducing new phytoproducts as well as the mechanisms in understanding the traditional knowledge for scientific validation.

Heading up the investigation deals with the standardization of plant resource, *Leea macrophylla* Roxb. ex Hornem. (Fig.1). The plant is commonly found distributed within the hotter parts of the Indian peninsula. It is found growing in Assam, Bengal, Jharkhand, South India, Eastern Himalayas and Western-ghats of Maharashtra etc. It is also known as Hatstikarna, Hathikana, Hastikarnapalasa, etc in vernacular language. According to Indian Mythology, Hathi/ Hasti means the animal Elephant, Karna means Ears, and Palasa means the leaves. The leaves of the plant are as long as the ears of Elephant. Hence, it is traditionally named as Hathikana, Hastikarnapalasa, Hastikarna. This traditional name of this plant might be come from the morphological structures of leaf which looks like an Elephant's ear.

Fig.1: *Leea macrophylla* Roxb. ex Hornem.

TAXONOMICAL CLASSIFICATION:

Kingdom: Plantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Vitales

Family: Vitaceae

Genus: *Leea*

Species: *L. macrophylla* Roxb. ex Hornem.

Synonyms: *L. macrophylla* var. oxyphylla Kurz.

COMMON NAMES OF THE PLANT

Sanskrit: Dhola, Jino, Morata, Hasthikanda, Samudrika, Hastiparni, Hastikarna, Hastikarnapalasa

Hindi: Hathikana, Hatikana, Dholsamudra, Samoodraka

Marathi: Gajakarni, Dinda

Bengali: Dholsamudra

Rajasthani: Dalavad, Lalpatta

Kannada: Mandala gadde

Telugu: Peddapayagillaaku

Malayalam: Njallu

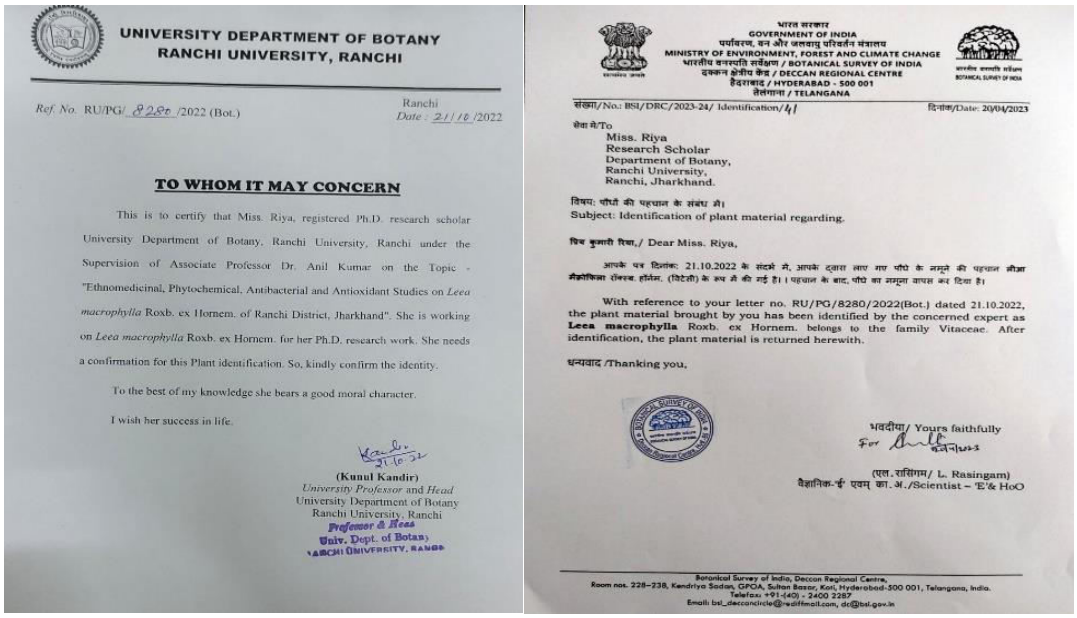
Assamese: Kath tenga

Nepali: Ekle galeni

METHODS AND MATERIALS

A thorough literature review survey of the plant *Leea macrophylla* with focus on Indian species were executed, and information was assembled. The whole plant was collected in between the month of July – September 2022 from, ICAR-RCER, Plandu, and ICAR-IIAB, Ring Road, Ranchi.

The plant was authenticated by Professor Dr. Kunul Kandir, Dean Faculty of Science and Head of University Department of Botany, Ranchi University, Ranchi, Jharkhand and with the help of flora book "The Botany of Bihar and Orissa" vol I-II. Also, from Botanical Survey of India, Deccan Regional Office, Hyderabad, Telangana with letter number RU/PG/8280/2022(Bot.), voucher number BSI/DRC/2023-24/Identification/41 (Fig.2).



UNIVERSITY DEPARTMENT OF BOTANY
RANCHI UNIVERSITY, RANCHI

Ref. No. RU/PG/ 8280 /2022 (Bot.) Ranchi Date : 21/10/2022

TO WHOM IT MAY CONCERN

This is to certify that Miss. Riya, registered Ph.D. research scholar University Department of Botany, Ranchi University, Ranchi under the Supervision of Associate Professor Dr. Anil Kumar on the Topic - "Ethnomedicinal, Phytochemical, Antibacterial and Antioxidant Studies on *Leea macrophylla* Roxb. ex Hornem. of Ranchi District, Jharkhand". She is working on *Leea macrophylla* Roxb. ex Hornem. for her Ph.D. research work. She needs a confirmation for this Plant identification. So, kindly confirm the identity.

To the best of my knowledge she bears a good moral character.

I wish her success in life.

(Kunul Kandir)
University Professor and *Head*
University Department of Botany
Ranchi University, Ranchi
Professor & Head
Univ. Dept. of Botany
RANCHI UNIVERSITY, RANCHI

भारत सरकार
GOVERNMENT OF INDIA
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
भारतीय वनस्पति सर्वेक्षण / BOTANICAL SURVEY OF INDIA
दक्कन क्षेत्रीय केंद्र / DECCAN REGIONAL CENTRE
हैदराबाद / HYDERABAD - 500 001
तेलंगाना / TELANGANA

संख्या/No.: BSI/DRC/2023-24/ Identification/41 दिनांक/Date: 20/04/2023

सेवा में/To
Miss. Riya
Research Scholar
Department of Botany,
Ranchi University,
Ranchi, Jharkhand.

विषय: पौधों की पहचान के संबंध में।
Subject: Identification of plant material regarding.

प्रिय कुमारी रिया,/ Dear Miss. Riya,

आपके पत्र दिनांक: 21.10.2022 के संदर्भ में, आपके द्वारा लाए गए पौधे के नमूने की पहचान सीजा मैक्रोफिला रोक्सब. हॉर्नेम. (विटेसी) के रूप में की गई है। । पहचान के बाद, पौधे का नमूना वापस कर दिया है।

With reference to your letter no. RU/PG/8280/2022(Bot.) dated 21.10.2022, the plant material brought by you has been identified by the concerned expert as **Leea macrophylla** Roxb. ex Hornem. belongs to the family Vitaceae. After identification, the plant material is returned herewith.

धन्यवाद /Thanking you,

भवदीया/ Yours faithfully
For
(एल. रासिंगम/ L. Rasingam)
वैज्ञानिक-'ई' एवम् का. अ./Scientist – 'E'& HoO

Botanical Survey of India, Deccan Regional Centre,
Room nos. 228–238, Kendriya Sadan, CPOA, Sultan Bazar, Koti, Hyderabad-500 001, Telangana, India.
Telefax: +91-(40) - 2400 2287
Email: bsi_deccancircle@rediffmail.com, dir@bsi.gov.in

Fig.2: Identification of *Leea macrophylla* Roxb. ex Hornem.

ETHNOMEDICINAL, TRADITIONAL, THERAPEUTIC USES:

The wild edible ethnomedicinal plant has various ethnopharmacological uses and almost all parts of the plant possess potential curative properties. Decoction of leaf juice is administering as local anti-inflammatory agent to cure of a number of pain disorders like boils, arthritis, gout, and rheumatism. Like leaves, roots are used in a number of disorders like fracture and cut injury. Roots also possess anthelmintic, astringent, styptic and anti-septic properties. This plant showed therapeutic uses in the treatment of cancer, dysentery, body-ache. It can be used in cuts and wounds remedy.

During survey in Ranchi District, it was reported that the Tribal people used the plant parts in cold, cough, headache, body pain and a number of ailments. Tribal people also use the leaves as vegetables in their food menu. Traditional practitioners used leaves, seeds and root in ayurvedic preparations since ancient times in the preparation of seasonal tonic known as 'Modaka' preparation. The leaves are used in gastric tumor, goiter, lipoma, tetanus also in urinary disturbances. The tuberous root are alexipharmic & astringents; used traditionally to kill guinea worm and pounded is applied to obstinate sores to promote cicatrisation. Plant is also used to heal pain and to stop bleeding. The leaves are traditionally used in snake bites, arthritis, tonsilitis, tetanus, rheumatism, nephrolithiasis, pain, sore and blood effusion.

The plant parts of the *Leea macrophylla* have traditional importance worldwide and these plants are predominantly used in the treatment of many life-threatening diseases. Many studies reported that various parts (tuberous root, stem, leaf, bark, inflorescence and flower) of this plant in certain formulations such as paste and decoction have been used in the treatment of several ailments such as joint pain, sore, leprosy, eczema, itching, bone fracture, rheumatism, sexual debility, piles, paralysis, throbbing pain,

typhoid, cancer, diabetes, dysentery, tetanus, tonsillitis, body ache, healing cut injury, nephrolithiasis, arthritis, snake bites, blood effusion, tumour, etc. which ensure the usefulness of *Leea macrophylla* for the betterment of peoples health. Leaves have hepatoprotective, anti-amnesic, and neuroprotective properties. The dry powdered root is often mixed with clarified butter to get anti-aging properties. Tribal people also use the leaves as vegetables in their food menu. Several chemical constituents like phenolics, amino acids, alkaloids, cardiac glycoside, glycoside, carbohydrate, reducing sugar, steroids, flavonoids and proteins along with others were obtained in the phytochemical studies with the different extracts of tuberous root, stem, leaves of *Leea macrophylla* Roxb. ex Hornem. These phytoconstituents are well known to produce many pharmacological activities, which is the evidence of the importance of this plant. *Leea macrophylla* contains vitamin B1, B2, B12, and vitamin C. Also, this wild ethnomedicinal plant contains minerals like Iron, sodium, calcium, sulphur, boron, potassium.

AN ETHNIC FOOD AND ECONOMICAL USES:

Leea macrophylla Roxb. ex Hornem. is a non-wood forest product used as ethnic food in tribal area of India. The leaves of this plant are eaten as vegetable and roots are also cooked as vegetable. The fruit edible and fruit juice are taken orally as nutritive.

Economically *Leea macrophylla* stems are used in making small flute. Its leaves are also used as platters. The tuberous root is used for yield a dye.

PHARMACOLOGICAL ACTIVITY

Pharmacological activity is the capacity of a specific molecular entity drug to achieve a defined biological effect (beneficial or adverse effect) on living beings. Plants are the most vital source of drugs. Almost around 40% of the prescribed drugs all over the world are derived from plants, which revealed the pharmacological importance of plant compounds. The botanical family Vitaceae is very rich in medicinal plants having a folkloric reputation to cure different ailments. *Leea macrophylla* has various ethno-pharmacological uses and almost all the plant parts possess potential curative properties. *Leea macrophylla* has antidiabetic, gastroprotective, neuroprotective, anti-urolithiasis effect, hepatoprotective, anti-thrombotic, cytotoxic, antimicrobial, cardiotonic, anticancer, antioxidant, anti-inflammatory, antinociceptive, wound healing properties.

PHYTOCHEMICAL PROFILING (In-vitro)

The extracts were subjected to qualitative phytochemical profiling (in-vitro) to detect for the presence of different bioactive compounds present in the plant *Leea macrophylla* Roxb. ex Hornem. Air-dried powdered plant materials were screened for the presence of alkaloids, amino acids, tannins, flavonoids, glucose, steroids, phenols, glycosides, proteins, gums, carbohydrates, etc.

Table 1: Phytochemical profiling (In-vitro) of *Leea macrophylla* Roxb. ex Hornem.

Sr. No.	Name of test examine	Test performed	Observation	Result
1	**Alkaloid**	• Wagner's reagent • Drangendorff's reagent	• Reddish brown • Orange red precipitation	• + • +
2	**Amino acid**	• Ninhydrin solution	• Pink, Purple, Bluish purple colour	• +
3	**Tannins**	• Ferric chloride	• Dark green colour	• +
4	**Flavonoids**	• Shinoda test	• Orange, red, pink or purple colour	• +
5	**Glucose**	• Benedict reagent	• Colour changes blue to: green, yellow, orange, red, brick red	• +
6	**Steroids**	• Salkowski test	• Red, yellow, green precipitation	• +
7	**Saponins**	• Frothing test	• Formation of Foam	• +
8	**Phenol**	• Ferric chloride test	• Reddish black or blackish blue	• +
9	**Glycoside**	• Salkowski test	• Yellow coloured ring turns to red colour	• +
10	**Proteins**	• Ninhydrin test	• Pink or purple precipitation	• +
11	**Gums**	• Molisch's test	• Red violet ring	• +
12	**Carbohydrates**	• Barfoed's test	• Red colour precipitation	• +
13	**Resins**	• Ferric chloride	• Dark green colour	• +
14	**Mucilage**	• Alcohol test	• White or cloudy precipitation	• +
15	**Starch**	• Iodine solution	• Blue-purplish or black colour precipitation	• +

RESULT AND CONCLUSION

In this study, it is of prime importance to exhibit the use of drug *Leea macrophylla* Roxb. ex Hornem. in front of the society. A general view of the previous research on the *Leea macrophylla* has been summarized and focused to outline the information regarding the botanical standardization, pharmacological activities, traditional uses, and qualitative phytochemical profiling (in-vitro) of *Leea macrophylla* Roxb. ex Hornem. This plant shows multifaceted uses including its use as an ethnic food, economical

usage, thus implying its significance. It is ethnomedicinal wild edible plant. Traditionally the plant parts are widely used due to its therapeutic potentials in various ailments or disorders and to cure a number of ailments such as joint pain, cough, common cold, goiter, lipoma, headache, sore, leprosy, eczema, itching, bone fracture, rheumatism, sexual debility, piles, paralysis, throbbing pain, typhoid, cancer, cardio tonic, diabetes, dysentery, tetanus, tonsillitis, body ache, healing cut injury, nephrolithiasis, arthritis, snake bites, blood effusion, tumour, and so forth maximum ethnomedicinal claims are in the management of bone fracture, diabetes, cancer, cardio tonic, nutritional tonic, followed by body aches, rheumatism and impotency. On the basis of these traditional uses, a number of scientific studies were performed and they all revealed potential activities of the plant species like anti-oxidant, antimicrobials, analgesic, antidiabetics, neuropharmacological, anticancer and so on. *Leea macrophylla* is highly helpful in nutritional point of view.

Moreover, many phytochemicals acting as primary & secondary metabolites, vitamins & minerals which is present in this plant are shown to exhibit pharmacological activities justify the use of this plant as traditional medicine. The data available in the present research work may help to check potency as well as efficacy of the drug. This research will be helpful for further studies on this plant. Hence, there are enormous scopes for further scientific investigation to establish *Leea macrophylla* Roxb. ex Hornem. as a potential source of novel drugs. Further research is required for the beneficial for commerce and trade of the drug *Leea macrophylla* Roxb. ex Hornem.

ACKNOWLEDGMENT

Author is Thankful to the Head, University Department of Botany, Prof. Dr. Kunul Kandir, Dean of Science Faculty, Ranchi University, Ranchi, Jharkhand, India for providing necessary facilities. Author also express gratitude towards her Supervisor University Associate Professor Dr. Anil Kumar, University Department of Botany, Ranchi University, Ranchi, Jharkhand, India for providing encouragement during the research work as well as Family & Friends who always supports, encouraged and helped during survey and completing this research work.

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ANTIOXIDANT PROPERTIES OF SOLVENT EXTRACTS OF MULBERRY

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ABSTRACT
Mulberry plants are enriched with secondary metabolites such as polyphenols and flavonoids that are associated with antioxidant and anti-inflammatory activities. The primary flavonoids found in mulberries are rutin, morin, quercetin, and myricetin all of which have been shown to be powerful antioxidants. Antioxidants obtained from natural sources play an important role in preventing several diseases thereby improving health. In the present studies, diethyl ether, ethyl acetate, ethanol and methanolic leaf extracts of Mulberry indica L. variety, vishala was screened for antioxidant activity by reducing power assay. The results showed that extracts as above possessed antioxidant properties. The ethyl acetate and ethanol extracts showed reducing power activity of 2.342 and 2.350 µg/ml, respectively. In reducing power assay, the methanolic extract showed the highest reducing capacity of 2.535 µg/ml. The results indicated that mulberry variety, Vishala could be important in the acquisition of a noticeable source of phytochemical compounds with health protective potential.

Keywords: *Mulberry, Antioxidants, Reducing Power assay, Flavonoids*

INTRODUCTION
Mulberry, belonging to the *Morus* genus is rich in fibers, sugars, carbohydrates, proteins, lipids, minerals and vitamins, making it the powerhouse of nutrients (Orhan and Ercisli, 2010). The leaves are known to have a high source of flavonoids such as quercetin 3-(6"-malonyl-glucoside), rutin, isoquercetin, cyanidin 3-rutinoside and cyanidin 3-glucoside and astragalin (Chen et al., 2006; Wang et al., 2021). The extracts of mulberry leaves exhibited a significant range of hypoglycemic, hypolipidemic and anti-atherogenic effects on both humans and on certain animal models (Chung et al., 2013). They contain high amounts of alkaloids, including 1-deoxynojirimycin (DNJ), the most active glycosidase inhibitor (Samuel *et al*., 2016). Mulberry is cultivated in most parts of the country in widely varied agro-climatic conditions.

In addition to reducing the nutritional value of food (Farag et al., 1989), autoxidation of polyunsaturated fatty acids also generates free radicals or reactive oxygen species, such as hydroxyl or peroxyl radicals, which have been associated to cancer, heart disease, ageing, and membrane damage (Cosgrove et al., 1987). The human body has several antioxidant defense systems to protect healthy cell membranes from active oxygen species and free radicals (Halliwell, 1994; Fridowich, 1995; Kaur and Kapoor, 2001). The innate defense systems may be supported by antioxidative compounds taken as

foods, cosmetics and medicine. Therefore, the antioxidative compounds provided by the diet enriched the antioxidative status of living cells and thus reduces the damage, particularly in the aged person (Shukla et al., 1997). Finding novel, secure antioxidants derived from natural sources is therefore of tremendous interest (Namiki, 1990; Gazzani et al., 1998).

Now-a-days, natural plants have received much attention as sources of biologically active substances including antioxidants, antimutagens and anticarcinogens (Dillard and German, 2000). However, scientific information on antioxidant properties of various plants, particularly those that are less widely used in culinary and medicine is still scarce. Therefore, the assessment of such properties remains an interesting and useful task, particularly for finding new sources for natural antioxidants, functional foods and nutraceuticals (Miliauskas et al., 2004). Mulberries, in addition to their antioxidant characteristics, also improves the functioning of digestive health, blood circulation and immunity. Due to its chemical novelty and pharmacological functions, it is one of the herbs which are used in medicine since ancient times (Zhang *et al*., 2015).

The mulberry variety Vishala is a triploid, selected clonally, fast-growing variety with early leaf maturation. Its unlobed, roughly elliptical, cordate and dentate leaves have a slightly rough texture and a dark green tint. The average leaf yield in the southern test centres varied from 26,000 kg/ha/year in Krishnagiri to 80,960 kg/ha/year in Thalaghattapura under irrigated conditions; and under rainfed condition in Chamrajanagar, it yielded 11,240 kg/ha/yr. In northern India, the leaf yield ranged from 5,000 kg/ha/year in Mirgund (Jammu & Kashmir)to 18,700 kg/ha/year at Pampore (Jammu& Kashmir) under two crop schedules in rain-fed system and in eastern India, it ranged from 8,901 kg/ha/year in Ranchi (Jharkhand) to 28,700 kg/ha/year in Berhampore,West Bengal (Saratchandra et al., 2016).

It is important to identify the solvents in which the variety, Vishala has the maximum antioxidant action. This study was undertaken to determine the antioxidant activity of the leaves of mulberry variety, Vishala by standard reducing power assay procedure.

MATERIALS AND METHODS

Fresh leaves of mulberry variety, Vishala was collected from Research Extension Centre, Lohardaga district of Jharkhand State. The collected leaf samples were packed in clean zip lock covers and transported to the Sangene Biotech Laboratory, Bengaluru. The leaves were washed thoroughly with tap water and then by distilled water, wiped with clean cloth and shade dried at room temperature for 30 days. The dried leaves were grounded into powders using a high-speed pulverizer and stored in airtight containers at room temperature. Chemicals and reagents used included, potassium ferricyanide, trichloroacetic acid, ferric chloride, diethyl ether, ethyl acetate, methanol and ethanol. About 50 g of powdered leaves of the above variety was taken for the Soxhlet extraction with 500 ml of four different solvents diethyl ether, ethyl acetate, ethanol, and

methanol. The extraction was run at the temperature corresponding to the boiling point of the solvent. The extracts were dried and stored at 4°C for further analysis.

The presence of reductants in antioxidant samples is generally associated with reduced capacities (Duh, 1998). Reductants cause the Fe3+ ferricyanide complex to be reduced to ferrous form. The amount of ferrous complex was recorded at 700 nm by measuring the formation of Perl's Prussian blue.

The reducing power of samples of mulberry leaf extract was determined using the method described by Aliakbarlu et al. (2013). Solvent extracts of the sample were taken in each test tube at the following concentrations (100, 200, 400, 600, 800, 1000 µl) and made up to one ml with the solvent.

One ml of 10%v/v sample solution was mixed with 2.5 ml of 1% potassium ferricyanide. After 20 minutes at 50°C, then 2.5 ml of 10% trichloroacetic acid was added to the mixture to stop the reaction, which was then centrifuged at 5000 rpm for 10 minutes. Finally, 2.5 ml of the upper layer was combined with 2.5 ml of distilled water and 0.5 ml of ferric chloride (0.1%). After 10 minutes, the absorbance at 700 nm was measured against blank containing all reagents except the sample extracts. All samples were prepared in triplicate and the final absorbance was determined by taking the average of the three readings obtained. A higher absorbance corresponds to a higher reducing power. Ascorbic acid was used as Standard for comparison.

RESULTS AND DISCUSSION

The reducing activity results of various extracts have been given in Table 1 and diagrammatically represented Fig. 1 below:

Table 1. Reducing Power Assay for Vishala in different solvents

Concentration (µg/ml)	Standard	Diethyl Ether	Ethyl Acetate	Ethanol	Methanol
100	0.177	1.093	1.112	0.995	1.015
200	0.223	1.24	1.487	1.235	1.238
400	0.45	1.571	1.763	1.542	1.549
600	0.647	2.035	1.982	1.766	1.876
800	0.763	2.058	2.123	1.986	2.232
1000	0.907	2.17	2.342	2.35	2.535

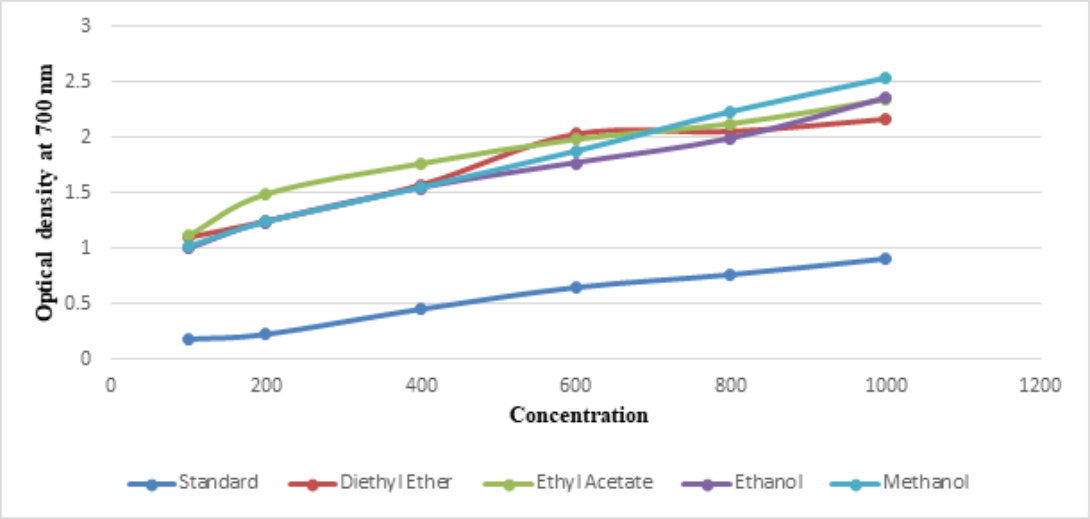

Fig.1. Reducing power of mulberry variety, Vishala in different solvents

Various solvent extracts from mulberry leaves showed varying degrees of antioxidant activity in different test systems in a dose-dependent manner. From our results, despite the difference in their solvents, each sample of leaf extract presented the highest antioxidant activity compared with reference antioxidant ascorbic acid for reducing activity. Methanol proved to be the most efficient solvent for extraction of antioxidant from mulberry leaves. However, its activity varied with pH, temperature and duration of storage. Therefore, it is important to consider the optimum technological conditions and processing factors influencing activity and bioavailability of plant antioxidants for utilizations in food and biological system. Although, further studies are needed to understand the concept of antioxidants.

The reducing power increased with the increase in concentration of the extract. Maximum reducing activity of 2.535 µg/ml was observed in the methanolic extract followed by ethanolic extracts with 2.350 µg/ml and ethyl acetate, 2.342 µg/ml. The minimum reducing activity of 2.170 µg/ml was found in diethyl extract.

Antioxidants are the molecules that fight free radicals in our body that cause harm if their concentrations are too high. Thus, antioxidants protect our body from multiple illness including cancer, diabetics and heart diseases (Lobo et al., 2010; Arabshahi-Delouee and Urooj, (2007)). The reducing power of a compound may serve as a significant indicator of its potential antioxidant activity (Meir et al., 1995). In this assay, the yellow colour of the test solution changed to various shades of green and blue, depending on the reducing power of test specimen. The presence of reductones, which have been shown to be an impart antioxidant action by breaking the free radical chain by donating a hydrogen atom. The presence of reductones (i.e. antioxidants) in the sample extracts might cause the reduction of Fe3+/Ferric cyanide complex to ferrous form which can be monitored spectrophotometrically at 700 nm (Nair et al.,2012). Solvent selection is crucial for extraction as different components get extracted in

different solvents based on the polarity value of solvent and the component (Zhang et al., 2018).

Researchers have established that mulberry leaves can be used as a therapeutic cure for the prevention and treatment of cardiometabolic risks (Thaipitakwong et al., 2018). Hence, mulberry leaves are promising sources of pharmacologically important compounds including antibiotics.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the help and support received from Sangene Biotech Laboratory, Bengaluru.

CONFLICT OF INTEREST

Authors declare that there are no conflict of interest.

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ISBN 978-81-19481-23-1

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