

46TH ANNUAL CONFERENCE **of Orissa Botanical Society** **&** **NATIONAL SEMINAR** **on Medicinal and Aromatic Plants:** **Traditional Knowledge and Current Research**

17th and 18th December 2023

SOUVENIR CUM ABSTRACT



Organised by



P.G. DEPARTMENT OF BOTANY
DHENKANAL AUTONOMOUS COLLEGE
Dhenkanal-759001



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SOUVENIR
CUM
BOOK OF ABSTRACTS

P.G. DEPARTMENT OF BOTANY
DHENKANAL AUTONOMOUS COLLEGE, DHENKANAL
Odisha – 759001

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BHUBANESWAR

Date 13. 12. 2023

Message

I am glad to know that P.G. Department of Botany, Dhenkanal Autonomous College, Dhenkanal is organising 46th Annual conference of Orissa Botanical Society and National Seminar on **"Medicinal & Aromatic Plants: Traditional Knowledge and Current Research"** and Souvenir cum abstract volume is being brought to commemorate this occasion.

Dhenkanal Autonomous College, Dhenkanal generates scientific temper and strive to solve many society and social problems through scientific education, research and skill development.

I appreciate the efforts of P.G. Department of Botany to organize this seminar worth the objective of bringing together scientists, academicians, research scholars and students to introspect and deliberate in the need of research for national developments. I hope the seminar will provide a spring board to upcoming experts and give a chance to know about the latest development in the field of research and knowledge.

I extend my best wishes for the grand success of the seminar and to all those involved in the effort.

(Atanu Sabyasachi Nayak)



वै.औ.अ.प. - राष्ट्रीय वनस्पति अनुसंधान संस्थान
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डॉ. अजित कुमार शासनी
निदेशक
Dr. Ajit Kumar Shasany
Director



MESSAGE

It gives me immense pleasure to write a message on the occasion of 46th Annual Conference of Orissa Botanical Society (OBS) and National Seminar on "Medicinal and Aromatic Plants: Traditional Knowledge and Current Research" organized by Dhenkanal Autonomous College, Dhenkanal, Odisha on 17th to 18th December, 2023.

Medicinal and aromatic plants (MAPs) are diverse category of plants exhibiting wide range of therapeutic and scent qualities. MAPs are capable of producing a vast array of secondary metabolites by diverting their primary metabolic flux. These secondary metabolites have multifarious activities, being potent antioxidants, antibiotic, antifungal, anti-herbivory agents. Research in this area has been ongoing for centuries, with new discoveries being made about the potential health benefits of these plants. Traditional knowledge systems have been recognized for their healing potential, employing in remedies for various ailments. However, contemporary scientific research with metabolomics and genetic engineering approaches has augmented this ancient wisdom, unraveling deeper insights into the biochemical and pharmacological mechanisms. Current studies focus not only on validating the efficacy of these plants but also on harnessing advanced technologies to extract, purify, and synthesize their bioactive compounds for pharmaceutical and industrial applications. This dynamic synergy is absolutely necessary between traditional wisdom and modern research for utilization of medicinal and aromatic plants, offering potential breakthroughs in healthcare and other sectors. Hence, we should honor tradition while embracing innovation, to unlock the immense potential of these plants for amelioration of human ailments.

I extend my heartfelt wishes for a resounding success of the conference, envisaging a vibrant gathering adorned by the enthusiastic presence of numerous students, researchers, scientists, and esteemed academicians converging from every corner of nation. This assembly will be a meeting point for diverse ideas, fostering rich discussions, and igniting innovative collaborations.

Date: 13th December, 2023


(Ajit Kumar Shasany)



Sri Sudeep Nayak, IFS
Chief Executive,
State Medicinal Plants Board, Odisha

MESSAGE

State Medicinal Plants Board, Odisha is very glad to know that PG Department of Botany, Dhenkanal Autonomous College is going to organize a National Seminar on Medicinal & Aromatic Plants; Traditional knowledge and Current Research in collaboration with Orissa Botanical Society on 17th & 18th December, 2023.

We all are very much concern about the conservation and sustainable use of Medicinal and Aromatic plants for our day to day herbal medicine. Due to heavy demand on these plants for production of herbal medicine the entire family of medicinal plants is under tremendous pressure, which resulted extinction of many species.

This seminar with participation of many eminent academicians, scholars & researchers will enlighten all on the issue. I wish all success for the seminar.

Sudeep Nayak, IFS
Chief Executive,
State Medicinal Plants Board, Odisha



PROF. SANTILATA SAHOO

President, OBS

MESSAGE

It is a matter of pride that Dhenkanal Autonomous college, Dhenkanal is organizing a National the 46th Annual conference of Orissa Botanical Society along with a National seminar on the topic "Medicinal and Aromatic plants: Traditional knowledge and current research " during December 17-18th, 2023 in the college campus.

This occasion brings out a souvenir-cum abstract volume released by the chief guest Dr. Ajit Kumar Sashany along with other dignitaries, Principal and Professor R.C. Mohanty, former president of Orissa Botanical Society.

Dhenkanal Autonomous college is fortified with a long history from 1959 with P.G. botany having 33 years of experience since 1991. All the faculty members are sincere, diligent and very co-operative.

This event is glorified by opening of a floriculture garden funded by National Botanical research Institute, Lucknow.

I wish all success of the conference with good number of participants.

Thank you.

Prof. Santilata Sahoo

President, OBS



Dr. Purna Chandra Baral

Dhenkanal Autonomous College, Dhenkanal,
Odisha – 759001

MESSAGE

My joy knows no bounds while I set writing a word of message from my desk on the occasion of the National Seminar and 46th Annual Conference of OBC on 17th and 18th December, 2023 on “Medicinal and Aromatic Plants: Traditional Knowledge and Current Research” under the able guidance of Convener Dr. Aniruddha Khillar and Organizing Secretary Dr. Debaraj Parida, PG Department of Botany of the college, their associates and Local Organizing Committee. It is high time we, as mentors, inculcated in the learners comprehensive and critical thinking so as to enable them to generate ever new ideas in their respective domains. It is needless reiterating that medicinal and aromatic plants sharing space humbly with us in the environment have extensive and effective usage in therapeutic, cosmetic and culinary sphere as well as in the preparation of life saving medicines and nutritious health foods, Putting behind all prejudices let us explore into the vistas unseen and tread the paths untrodden in this field.

I extend my warm and heartfelt greetings to all the students, organizers, staff members, participating teachers, delegates and resource persons from different parts of the country and wish, on the occasion of such a grand intellectual congregation, a grand success to the enterprise.

Dr. Purna Chandra Baral

Principal

Dhenkanal Autonomous College,
Dhenkanal, Odisha – 759001

ABOUT DHENKANAL AUTONOMOUS COLLEGE, DHENKANAL



Established in the year 1959 at the backdrop of a picturesque landscape, Dhenkanal Autonomous, Dhenkanal has carved a niche for itself in academic excellence not only in the state, but in the country as well. Last year it is proved when the college has secured 3rd rank among the Autonomous Colleges of the State and 33rd rank in all India basis. The results of the students testify to this honour. However, an endless pursuit of excellence being the motto, the College is forever making an endeavor to excel itself. To achieve this, it lays emphasis on a strategic planning that makes an assessment of its current functioning and the modus operandi of executing a higher mission that includes such crucial aspects like financial planning, budgeting, staffing and academic programming, which, in turn, would essentially relate to matching institutional commitments and the real, concrete benefits to the students.

In addition to many a plan, the College intends to materialize, its primary mission that is to lay utmost emphasis on academic excellence and to reach the pinnacle of glory. It aims at effecting radical changes in the syllabi of all the programmes and in pedagogy. But it intends to develop the plant science programme to the maximum possible extent. And there are reasons. The College provides Undergraduate and Postgraduate programmes in Botany. The performance of the students continues to be excellent. The rationale for this thrust on Botany has to do with the dense forest environment of the district. There are top quality Sal & Teak plants in the district. This forest area provides employment opportunities and researches to the students. Considering the bio-diversity of the district the botany students are much in demand. Apart from this consideration, the College intends to upgrade the research facility to a center of excellence for which the college has opened bio-technology UG courses last year.

The Institutional Development Proposal (IDP) envisages such future plans like building separate toilet galleries for boys and girls, modernization and upgradation of the existing library, building well-furnished hostels for ST and SC students, building e-classrooms, computer cells and Assistance Cells for redressing students' problems. As regards improvement of academic excellence of teachers, greater focus would be given to research and innovation.

This pantheon of wisdom and coliseum of learning, situated in the sylvan setting of forests, hills and mango groves has promised to achieve the goals and objectives in every aspect / field with the untiring efforts of its teaching and supporting staffs. The mission and vision of this premier institute are embedded in the crest of the college.

Affiliation: The College being conferred with academic autonomy by the State Government, University Grants Commission and Utkal University, all undergraduate and post graduate courses conducted by the college are affiliated to the Utkal University. The Academic Council of the College frames regulation and course syllabi for all courses, and are approved by the Executive Committee as per the Autonomous Scheme of the UGC.

PROGRAMME

17.12.2023

8.00-9.30 AM	:	Registration and Breakfast
9.30 AM	:	Opening of NBRI funded Floriculture garden of Dhenkanal Autonomous college by Dr. Ajit Kumar Shasany, Director, NBRI, Lucknow
10.00-11.45 AM	:	Inaugural session
10.00-10.10AM	:	Presentation of bouquets to dignitaries on the dais followed by Invocation
10.10-10.15AM	:	Inauguration by lighting the Holy lamp by the Dignitaries on dais followed by welcome song
10.15-10.20AM	:	Welcome Address by Dr. Purna Chandra Baral , Principal & Chairman, Organizing Committee.
10.20-10.25 AM	:	Presidential note by Prof. Santilata Sahoo, President, OBS
10.25-10.30 AM	:	Annual OBS report by Dr. Sujata Mohanty, Secretary, OBS
10.30-10.40AM	:	Introduction of the Guests by Dr. A.K. Khillar , <i>Convener, Organizing Committee</i>
10.40-10.45AM	:	Address by Dr. Chittaranjan Sahu , Co-Patron, Organizing Committee
10.45-10.50AM	:	Release of the "Souvenir-cum-Abstract of Papers" by the Chief Guest Dr. Ajit Kumar Shasany , Director, CSIR- National Botanical Research Institute, Lucknow, U.P.
10.50-11.00AM	:	Presentation of awards and felicitations.
11.00-11.10AM	:	Address by the Guest of Honour, Prof. Ranjit Kumar Pradhan , Deputy Director, Regional Directorate, Bhubaneswar
11.10-11.20AM	:	Address by the Guest of Honour Sri Sudeep Nayak , IFS, Chief Executive, State Medicinal Plant Board, Odisha.
11.20-11.30 AM	:	Address by the Chief Guest Dr. Ajit Kumar Shasany .
11.35-11.45 AM	:	Vote of thanks by Dr. Debaraj Parida , Organizing Secretary
11.45-12.00 Noon	:	Tea Break
12.00 - 12.15 pm	:	Presidential Address: Prof. (Mrs.) Santilata Sahoo
12.15 - 12.45 pm	:	Key note address by : Dr. Ajit Kumar Shasany, Director, NBRI, Lucknow, UP
12.45 - 2.00 pm	:	Plenary Session (Auditorium)
	Chairman :	Prof. Rama Chandra Mohanty, <i>Former CSIR - Emeritus Professor, Utkal University, Bhubaneswar</i>
	Rapporteur :	Dr. Ranindra Kumar Nayak, <i>Associate Professor, F.M. University, Balasore</i>

Invited Speakers:

1. Prof. Choudhury Habibur Rehman, Dept. of Botany, Visva Bharati, Santiniketan
Topic: Role of traditional botanical knowledge in bio-prospecting and conservation of medicinal plant resources.
2. Dr. Soumit Kumar Behera, Principal Scientist, *CSIR-National Botanical Research Institute, Lucknow.*
Topic: Conservation strategy of *Rauwolfia serpentina*.
3. Prof. Partha Pratim Baruah, Former Head, Botany, Gauhati University
Topic: Ethnomedicinal plants of eastern India: Prospects and Challenges
4. Dr. Prasanjit Mukharjee, D.SC., Head, Dept. of Botany, K.O. College, Gumla, Jharkhand.
Topic: Ethno-Botanical investigation of aquatic and semi-aquatic plants of Jharkhand.

2:00 - 3.00 pm : **Lunch and Poster session**

3:00 - 3.45 pm : **Technical Session – I Hall 1 (New Reading Room)**

- Chairman : Prof. K.B. Satpathy, Former Head, Department of Botany Utkal University
- Co-Chairman : Dr. Ashirbada Mahapatra, Reader & Head, Dept. of Botany, Sri Jayadev, College of Education & Technology

Invited Speakers:

1. Dr. Akhaya Kumar Mishra, *Former Professor, Dr. A.C. Homeopathic Medical College and Hospital, Bhubaneswar*
Topic: *An effective plant based approach to the management of hyper-cholesteromia.*
2. Dr. Sagar Kumar Mishra, *Head, University Department of Pharmaceutical Science, Utkal University, Bhubaneswar*
Screening of Indian medicinal plants for antimicrobial activity
3. Dr. Nabin Kumar Dhal, Chief Scientist & Head E & S Dept. CSIR-IMMT, BBSR
Topic: *Traditional knowledge for bioprospecting*

3.00-3.35 PM : **Parallel Session : Hall II (Smart Class Room, Room No. 009)**

Sarojini G. Panigrahi Young Scientist Competition (Prof. Barada Kanta Mishra, Prof. Janyan Ranjan Mishra)

1. Suraj Kumar Padhy, Dept. of Biodiversity and Conservation of Natural Resources, Central University of Koraput.

Topic: Traditional Niger Accession from Koraput: Nutritional and Climate resilient trait

2. Swagat Mohanty, Centre for Biotechnology, S'O'A University, BBSR

Topic: Chemometric analysis and anti-inflammatory activity of essential oil of four under -explored Curcuma species.

3.45-4.30 PM : **Technical Session II : Hall I**

Chairman : Prof. P.K. Chand, Former Head, Dept. of Botany, Utkal University

Co-Chairman: Prof. P.C. Panda, Dept. of Biotechnology, S 'O' A University, BBSR

Rapporteur :

1. Dr. Anil Kumar Biswal, Adjunct Professor, PG Dept. of Botany, FM University, Balasore

Topic: Indigenous knowledge in drug discovery

2. Sitaram Panda, Scientist D, BSI, Kolkata

Topic: Therapeutic importance of some orchids of Odisha and their conservation.

3. Dr. Ranindra Kumar Nayak, Asso. Professor, Dept. of Environmental Science, FM University, Balasore

Topic: Conservation and restoration of mangroves in coastal regions of Bhadrak District, Odisha

Parallel Session : Hall II

3.35-4.30 PM : Dr. B.P. Chowdhury Memorial Competition

4:30-4.45 PM : Tea Break

Technical Session III : Hall I

4.45-5.45 PM : Chairman : Dr. B.C. Patra, CSIR-NRRI, Cuttack

Rapporteur:

Oral Presentation:

1. Dr. Sujit Kumar Bhutia, Professor, Dept. of Life Science, NIT, Rourkela
Topic: Bacopaside -I, an active component from *Bacopa monnieri*, induces PPA-mediated mitochondrial fission and mitophagy for targeting NLRP3 inflammasome activation in oral Cancer.
2. Dr. Binod Kumar Sahu, Asso. Prof., Dept. of Life Science, NIT, Rourkela
Topic: IMPORTIN ALPHA-2 Provides Immunity Against Rice Sheath Blight Pathogen

Parallel Session : Hall II

4.45 – 6.00 PM : Smt. Priyambada Mishra Memorial Award Competition
6.00 PM – 8.00 PM : Cultural Programme
8.00 – 9.00 PM : Dinner



10.00-12.30 pm : **Technical Session - IV**

Chairman : Prof. Bibhuti Bhusan Mishra, Former Prof. Dept of Botany, OUAT, BBSR

Rapporteur :

Oral Presentation of OBS

12.30-1.30 pm : **Business Session**
01.30-2.30 pm : **Lunch and Poster Session**
02.30 pm : **Valedictory function**

(This being a tentative schedule of events this is subject to change if necessary)

1. Presentation of Bouquet to dignitaries on Dias.
2. Welcome address by Principal, Govt. College, Dhenkanal.
3. Introduction of Guests by the Convenor, A.K Khillar.
4. Felicitation to Guests. (Principal + President OBC + Chief Guest)
5. Presenting awards to the winners of Competition. (Oral + Poster)
6. Address by the Chief Guest.
7. Vote of Thanks by the Organising Secretary.

● **HIGH TEA**

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SOUVENIR



MY REMINISCENCES OF THE ORISSA BOTANICAL SOCIETY

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Budding of Orissa Botanical Society (OBS) in a compatible environment clubbing fore-running-minds of a few geniuses to bring botanical togetherness in one platform originated in the year 1979. The purpose was to spread the knowledge of Botany and its research activities all over Orissa. Before this idea of forming a society of Plant Scientists mooted late Professor Mahendra Kumar Rout who was a renowned scholar in Chemistry and Principal, Ravenshaw College (Later Vice-Chancellor of Utkal University) organised a group of scientists' activity in Ravenshaw College every year and published an abstract volume namely "Proceedings of Science in Orissa" inviting researchers of the State from all branches of science for presentation and discussion.

Founder members of OBS were reputed botanists championed by none-other than late lamented Professor Prana Krishna Parija, the first Vice-Chancellor of Utkal University. He was associated by Professor Parsuram Mishra, Former Vice-Chancellor, Sambalpur University, Professor Banshidhar Samantaray, who occupied the chair of Vice-Chancellor, OUAT, Professor Gadadhar Mishra, Professor Harihar Pattnaik, former VC Berhampur University, Professor Tapas Kabi, Dr. Gopinath Panigrahi (former Joint Director, BSI), Professor Bidyadhar Padhi, Utkal University, who was a reputed scholar in Plant Pathology and Microbiology and first Head of the P.G. Department of Botany, Utkal University. Professor Satya Narayan Patnaik, Professor Dinabandhu Mishra, Professor Basanta Kumar Nanda and a few others.

They all assembled in few meetings in P.G. Botany Dept., Utkal University to form the society with office bearers as follows:

1. Professor Bidyadhar Padhi - President
2. Professor Dinabandhu Mishra - Vice-President
3. Professor Satya Narayan Patnaik - Secretary
4. Professor Aruna Kumari Mishra - Treasurer

Professor Parija remained as Patron and Mentor to guide Professor Padhi in all aspects to form the society and P.G. Department of Botany, Utkal University remained as its official address.

Finally the society was registered with the above office bearers and 10 Executive Members in the name of “The Orissa Botanical Society” on December 26, 1979 (Regd. No. 16671/1506). Thus it bloomed and opened its numerous petals gradually tentacling all over the State. Now not only the botanists but also scientists of allied subjects of Botany like biotechnology, environmental science, microbiology, agriculture, forestry, zoology etc. are eligible to become members of the society. The major objectives of the society are

- (i) to cultivate and promote interests among members of the society in the state of Orissa.
- (ii) to bring about union of all in Orissa and outside interested in teaching, research and extension of Botany.
- (iii) to organise seminars / conferences of regional / national / international nature.
- (iv) to work in association with other similar societies
- (v) to publish journals / proceedings/bulletins, etc.
- (vi) to felicitate eminent members and other reputed workers in Botany giving awards annually.
- (vii) to encourage student interest in Botany.

Privileges of the members are extended to become patrons, founder members, invited members, life members, annual members and for students as sessional members.

In course of time the activities of the society increased many folds apart from organising annual meetings. Of them, notable are: introduction of various awards to honour and recognise the contribution of senior / junior botanists of the state, young scientists award, seminar awards for students with donations received from members / family members. Dr. Gopinath Panigrahi, the then joint Director, Botanical Survey of India (BSI) donated for two awards viz. Dr. Gopinath Panigrahi award in Plant Taxonomy and Sarojin G. Panigrahi young scientists award in 1983 and 1985, respectively. Professor Gadadhar Misra Plant Physiology & Biochemistry award was introduced by Professor Misra in 2007. Plant Diversity and Conservation award was instituted by the family members of late Dr. Moukeri Brahmam in 2011. In 1986 Professor Dinabandhu Mishra introduced the Priyambada Misra award for students excelling in student seminar in the name of his wife. The Prof. Harihar Pattnaik Memorial Award was instituted in 2011 by Dr. Uttara Pattnaik to be given alternately for Algology, Microbiology and Environmental Science.

In the year 1995 four awards were instituted at Basic Science College, OUAT by late Professor Rabindra Kumar Mishra and his team. These are the following:

Name of the Award

Donator

- | | |
|--|--|
| 1. College of Basic Science Award | Basic Science College, OUAT |
| 2. Bhagbati Misra Memorial Award | late Prof. Rabindra Kumar Misra |
| 3. Mahesh Prasad Purohit Memorial Award | Mrs. Paramita Purohit |
| 4. Prof. Basanta Kumar Nanda Memorial Award for best Poster presentation in OBS Annual Meeting | Dr. Diptirani Nanda, Prof. Bibhuti Bhusan Misra and family members |

In the memory of late Professor Tapas Kabi, who was first Chairman, +2 Council, Odisha his son Sri Ashesh Kabi and the family instituted an award in 2004, for the student who secures highest marks in Biology in +2 examination conducted by Odisha Higher Secondary Board every year. The family members of late Prof. Bhabani Prasad Chaudhury introduced the OBS Annual Seminar Presentation Award in his name in the year 2010.

Each year eminent researchers based on seniority are selected for the post of President and Vice-President for a period of one year only. Past Presidents of the Society nominate them in a specially convened meeting to be further ratified by a joint meeting of past Presidents and Members of the Executive Committee. In the above-said joint meeting awards of the society are also finalised excepting some special awards (Taxonomy, Physiology, Diversity and Algology/Microbiology/Environmental Science), student and seminar presentation award, poster presentation award and young scientist award.

In the year 1983 with a great initiative by late Professor S.N. Patnaik for the first time a journal named “Journal of Orissa Botanical Society” was published by the society. It was renamed as “Plant Science Research” in subsequent years. Now the journal is regularly surfaced every year in annual meetings. It has good NAAS rating and is now included in the abstract volume of Asian Journal of Science since 2023. All the articles are before publication reviewed by experts in respective fields.

The Chief Editor, Managing Editor, Members of the Editorial Board are elected along with all other office bearers and Executive Committee Members in the Annual General Body meeting for a period of three years. The President, Vice-President, Chief Editor, Managing Editor and Secretary remain as Ex-Officio Members in the Executive Committee for the same period of three years.

Our journal is now upgraded with open access online. It is featured in the Society website and invites articles from members every year.

We are growing year after year with inclusion of new members from colleges, Universities, Institutes and Plant Lovers from different fields. Now our life members are around 500. Besides hundreds of sessional and annual members increase our strength.

The bye-law of the society was amended by a committee headed by Professor R.C. Mohanty in 2018. The other two members were Professor A.B. Das and Prof. Pradipta Kumar Mohapatra. All the amendments suggested in different General Body (GB) meetings of the society have been incorporated in the bye-law and circulated among all life members. The G.B. has unanimously approved the bye-law of the society same year.

Office bearers of Orissa Botanical Society for the current year i.e. 2023 are:

1. Prof. Santilata Sahoo - President
2. Prof. A.B. Das - Vice President
3. Dr. Sujata Mohanty - Secretary
4. Dr. K.B. Satapathy - Treasurer
5. Prof. Bibhuti Bhusan Misra - Chief Editor, Journal (Plant Science Research)
6. Prof. Chandi Charan Rath - Managing Editor, Journal (Plant Science Research)

We have a noble mission of spreading the advanced knowledge of Botany derived from research activities to all places and more so to encourage and recognize botanists of the State including students. We expect more and more enthusiastic endeavour and cooperation from one and all.

HEALTH BENEFITS OF ASWAGANDHA PLANT

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ABSTRACT

The majority of people on Earth, who live mostly in developing and impoverished nations, lack access to modern medical care and instead rely on tried-and-true complementary, alternative, and traditional medical systems, many of which are far older than allopathic medicine. The risk of disease is increased in the twenty-first century by environmental toxins, unhealthy lifestyle choices, and pollution. Therefore, in order to prevent such issues and offer universal access to basic healthcare, the globe is searching for more affordable, readily available, physiologically compatible traditional medical systems, as well as holistic approaches. For primary healthcare, between 75 and 80 percent of the world's population still turns to herbal medicine, mostly in developing nations. Herbal medicines are becoming more and more popular because of their efficiency, minimal toxicity, and absence of negative effects. The world's flora is a renewable, non-exhaustive source of bioactive chemicals. As a Rasayana (tonic), *Withaniasomnifera*, also known as Ashwagandha, is highly valued in the Indian Ayurvedic medical system. It is used as a nervine tonic in particular and for a variety of disease processes. Numerous additional health benefits of ashwagandha's multipurpose use are noteworthy from a pharmaceutical standpoint. The scientific evidences supporting the effectiveness of Ashwagandha have been explored from various national and international publications.

Introduction

For many years, a natural plant called ashwagandha (*Withaniasomnifera*) has been used in Indian medicine. It is also known as 'winter cherry' or 'Indian ginseng'. It belongs to the family Solanaceae. There has been a lot of research on ashwagandha lately to find out what it can do for our health. Substances in ashwagandha could reduce high blood pressure, calm the brain, reduce swelling, and change the immune system. The health benefits of Ashwagandha are multifaceted and compelling. Because ashwagandha has been used for a long time as an adaptogen. Adaptogens are natural plants and fungi that help your body handle stress, anxiety, tiredness, and overall health better.

Traditionally known as "ashwagandha," was derived from the Sanskrit terms "ashva,"

which means “horse,” and “gandha,” which means “smell,” and denotes the root’s aroma, which is similar to that of a horse. Sleep inducer is the species name “*somnifera*,” which emphasises its critical role in stress relief. The plant is an upright, greyish, evergreen shrub with long tuberous roots, short stems, oblong, petiolate leaves, and greenish, bisexual flowers borne in the axils. Along with the drier regions of India, it can grow at high altitudes of 1700 m in the Himalayan region (mainly Himachal Pradesh, Uttarakhand, and Jammu and Kashmir)

More than two hundred Ayurvedic formulas contain roots of *W. somnifera*. Ashwagandha, the powdered root of the *W. somnifera* plant, is widely used as a remedy for a number of ailments. It is also mixed with different substances. *W. somnifera* is the primary ingredient in Saraswati churna, a herbal powder mixture used to treat neurological conditions. Ashwagandhadhilehyam is another product that contains *W. somnifera*; it is typically used as a supplement for general rejuvenation, as a male impotence remedy, and as an energy booster (Rasheed et al., 2013).

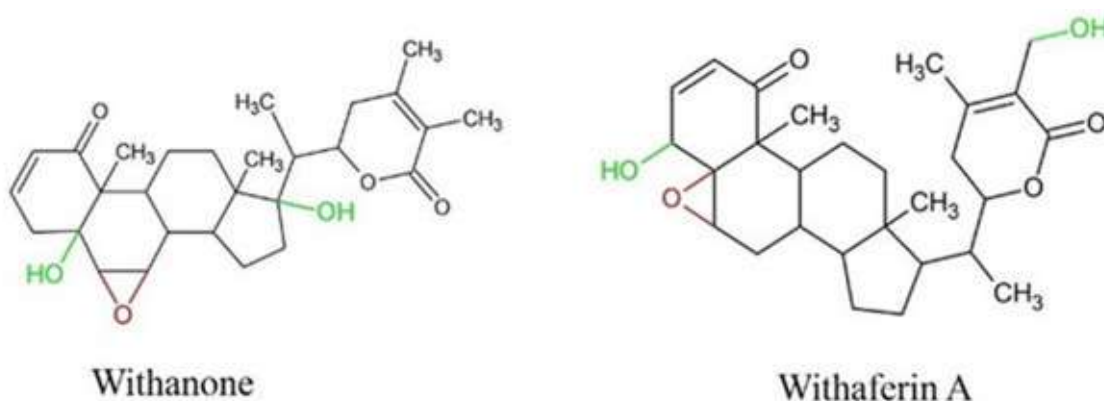
This work offers a brief account of the many applications of ashwagandha and its active ingredients, highlighting the herb’s potential for treating a range of ailments.



Pic: Aswagandha Plant with its roots

Composition

The major active ingredients of *Withaniasomnifera* includes withaferin-A, withanolide-D, withanosides, withanones, sitoindosides, anaferine, isopelletierine, and includes various other alkaloids, steroidal lactones and saponins that have a therapeutic function as an anti-stress agent or a tonic for rejuvenation. It also contains mineral iron, which is necessary for the formation of red blood cells (RBCs) to carry more oxygen to different organs, thus changing the energy levels in the body. The structure of the withanolides are ergostane-tri-terpene-based, with a steroidal nucleus (C28), a C9 side-chain, and a 6-member lactone ring (Kulkarni S.K. *et al*, 2007).



Pic: Structure of Withanone and Withaferin A

In traditional Indian medicine, this plant is grouped under the name Rasayana (longevity) in Ayurveda. Daily consumption powder from the roots of this plant is said to have a delaying effect aging, muscle rejuvenation and reproduction organs and increase fertility (Durg *et al.*, 2018). The root extracts of the plant exposed to be efficiently improved cerebral health, brain ageing and locomotive syndrome (Singh *et al.*, 2008).

The nutrient composition of Ashwagandha root powder (Per 100 g) obtained by chemical analysis is as given in the table (Kumari and Gupta, 2016; Gulati *et al.*, 2017)

Table : Nutritional constituents of Ashwagandha root powder *per* 100 g

Nutritional composition	Root powder of Ashwagandha
Protein (g)	3.9
Iron (mg)	3.3
Calcium (mg)	23

Total carotene (µg)	75.7
Carbohydrate (g)	49.9
Fibre (g)	32.3
Vitamin C (mg)	5.8
Moisture (%)	7.45
Oil (%)	0.3
Ash (g)	4.41
Energy (Kcal)	245
Total alkaloids (%)	0.26-0.31
Tannins (mg/g)	0.39-0.82

Pharmacological effects of *W.somnifera*

Anti-stress activity:

Aswagandha has been shown to reduce anxiety and stress in clinical trials in humans. (Pratte et al., 2014). Aswagandha has antistress effects in rats. The rats were treated with Aswagandha and showed better tolerance to stress. A withanolide-free aqueous fraction of ashwagandha obtained from the root of the *W.somnifera* showed dose-dependent anti-depressant activity in mice (Khare, 2007). Antistressor effects of Aswagandha were investigated in rats using a cold water swimming stress test. The treated animals showed better stress tolerance (Archana and Namasivayam, 1999). When Aswagandha was administered with other drugs to experimental animals that had been exposed to various biological, physical and chemical stresses, it was found to provide protection against those stressors. (Bhattacharya, 1992; Rege et al., 1999).

Anti-microbial activity

Studies have found that Ashwagandha is a pleasant and potential source in the treatment of infectious diseases due to its antibacterial and antimicrobial effects. A strong antibacterial effect was found against *Salmonella typhimurium*, *Escherichia coli* and *Staphylococcus aureus*. Ashwagandha was also found not to induce lysis of human erythrocytes during incubation,

supporting the safety of live cells, unlike synthetic antibiotics (such as chloramphenicol) (Owais et al., 2005). Other studies indicated the potential antibacterial activity of Ashwagandha against multidrug-resistant strains (Muddukrishnaiah and Singh, 2015).

Anti-Parkinson effect

Many research publications have reported the key role of *W. somnifera* in the treatment of Parkinson's disease. The development of Parkinson's disease is caused by decreased dopamine levels in brain areas that control motor activity (Mazzoni et al., 2012). PD is associated with impaired antioxidant defense mechanisms and increased production of oxidative free radicals. Dysregulation of glutathione peroxidase (GPX), catalase and superoxide dismutase (SOD) increases the accumulation of harmful free radicals and the disease progresses in a degenerative fashion (Maxwell, 1995). Ashwagandha demonstrated neuroprotective effects in 6-hydroxydopamine-induced Parkinson's disease in mice, where treatment reversed impaired behavioral deficits through an unknown mechanism. Ashwagandha was reported to increase dopamine content in the striatum, reducing the effects of Parkinson's disease in rats (Ahmad et al., 2005; Bhatnagar et al., 2017).

Anti-Alzheimer's activity

Alzheimer's disease involves disruption of Ca^{2+} homeostasis, extracellular deposition of amyloid alpha, generation of free radicals, intracellular deposition of neurofibrillary tangles (NFT) which are aggregates of hyperphosphorylated tau protein, known as a primary marker of Alzheimer's disease. Withanoloids are also known to exhibit dose-dependent inhibition of butylcholinesterase and acetylcholinesterase. *W. somnifera* is an attractive pharmacological candidate for the treatment of Alzheimer's disease and related conditions due to its cholinesterase inhibitory potential and calcium homeostasis ability. The synthesis, release, excitability, and phosphorylation of neurotransmitters are just a few of the neuronal processes that are attributed to the elevation of Ca^{2+} levels in *Withania* extracts. Ca^{2+} triggers and controls the central nervous system's reactions to prevent damage and injury to brain tissue. Ca^{2+} homeostasis therefore promotes brain physiology and preserves neural integrity (Zahiruddin S., 2020). Treating healthy people with an aqueous extract of *W. somnifera* improved cognitive and psychomotor activity (Pingali et al. 2014).

Cerebral ischemia

For millions of people worldwide, stroke is one of the main causes of brain damage. Ischemic strokes account for about 87% of all strokes (Go et al., 2014). In a rat model of bilateral common carotid artery blockage, *W. somnifera* pre-supplementation (50 mg/kg) decreased the biochemical and histological alterations brought on by reperfusion injury. In a different study, the middle

cerebral artery occlusion (MCAO) stroke model showed that pre-supplementing with *W. somnifera* decreased oxidative stress, lesion volume, and restored neurological impairments (Choudhary et al., 2013).

Memory and cognitive function

When ashwagandha is tested to help adults with mild cognitive impairment (MCI) improve their memory and cognitive functioning, the results show that it helps MCI patients with immediate and general memory, executive function, attention, and information processing speed (Choudhary et al., 2017).

Anti-cancer effect

Many studies that have been published in the past 20 years have shown that *W. somnifera* and its chemical constituents have anti-cancer properties. Ashwagandha has been shown to have anti-cancer properties against a range of cancer types, including skin and stomach cancer cells in mice (Padmavathi et al. 2005), colon, prostate, leukaemia, lung, breast, pancreatic, renal, and head and neck cancer of human cells (Yadav et al. 2010; Singh et al. 2011; Nema et al. 2013; Patel et al. 2013). According to Mohan et al. (2004), withaferin A inhibits the proliferation of human umbilical vein endothelial cells (HUVECs) by modifying the defects in the proteasome pathway and cyclin D1 expression.

Anti-arthritic effect

Research has indicated that the anti-inflammatory properties of ashwagandha may help lessen the arthritic effects in rats with collagen-induced arthritis. As such, it may play a part in the management of rheumatoid arthritis and be applied as a therapeutic approach (Gupta and Singh, 2014). By assessing the amount of bone collagen, *W. somnifera* root powder reduced the cartilage degradation in an adjuvant-induced arthritis rat model (Rasool and Varalakshmi 2007). *W. somnifera* root powder aqueous extracts have been shown to have cartilage-protective effects on human osteoarthritic cartilage through notable reduction of NO release and significant in-vitro inhibition of gelatinase enzyme activity (collagenase type-2) (Sumantran et al. 2008).

Anti-diabetic effect

One of the key herbs in Indian medical systems with anti-diabetic properties is *W. somnifera*. Through both enzymatic and non-enzymatic antioxidant mechanisms, the administration of *W. somnifera* root and leaf extracts to rats induced with alloxan resulted in a significant restoration of tissue glycogen, blood glucose, urine glucose, and glucose-6-phosphatase levels (Udayakumar et al. 2009, 2010). Additionally, when cytokines cause damage to pancreatic islets in vitro and through subsequent transplantation, withaferin-A blocks the inflammatory response (SoRelle et al. 2013). *W. somnifera* leaf and root extracts improved skeletal myotubes' and adipocytes'

glucose uptake, demonstrating anti-diabetic action in a dose-dependent manner. The leaf extract of *W. somnifera* had stronger effects than the root extract (Gorelick et al. 2015). Numerous Ayurvedic polyherbal formulations, including Dianix and Trasina, have been shown in human studies to reduce blood sugar levels (Bhattacharya et al. 1997; Mutalik et al. 2005; Gauttam and Kalia 2013).

COVID-19

Numerous investigations have demonstrated that withaferin-A may be able to help combat the coronavirus. In particular, four AYUSH formulations were the subject of tests against the novel coronavirus infection. In order to determine whether ashwagandha can effectively prevent COVID-19 infections in the same manner as the anti-malarial drug hydroxychloroquine, the Indian government initiated a fairly large-scale trial. The clinical trials were actually conducted, or so the scientists and researchers thought, by a team from the Indian Council of Medical Research (ICMR), University Grants Commission (UGC), Ministry of Health and Family Welfare, and Ministry of AYUSH (Jain and Mathur, 2020). The fact is that withaferin-A specifically has no impact on ACE2 expression in the lungs and essentially hinders the ability of the viral S protein to bind to host receptors, for all intents and purposes, can be used as a real augment therapeutic agents to treat or prevent the spread of COVID-19 (Alex R. et al, 2020).

Conclusion

Withaniasomnifera is an important medicinal plant and it has been used from ancient times in traditional Indian medicines (TIM). In Indian Ayurveda, this plant has grouped as Rasayana (which means lengthening lifespan). To sum up, Ashwagandha is a multipurpose herb that may offer a wide range of health advantages. While Ayurvedic traditional uses established the groundwork, contemporary scientific research on Ashwagandha's therapeutic potential is still uncovering new information, making it a topic of interest in the fields of wellness, nutrition, and medicine. Because *W. somnifera* toxicity studies have not yet revealed any toxicity or adverse effects, it is safe to use in humans to treat both acute and chronic medical conditions. *W. somnifera* is a good drug candidate for the treatment of a number of diseases because of its many bioactive constituents, low toxicity, and distinct mechanism of action. For the purpose of determining its place in conventional medical practises, more research is necessary to examine its modes of action, ideal dosages, and possible adverse effects.

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HERBS FOR HEALTH

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Since the beginning of time, people have turned to plants for healing help. It is rather ironic that this form of medicine, the oldest and still the most important in many parts of the world, should in some way be considered alternative, while the relatively new science of synthetic drugs in Western medicine should be called orthodox. What is important is that the best in every system should be valued and that proper attention should be paid to the dangers of any method. For emergencies, disasters and rapid infections, antibiotics, surgery and powerful drugs are vital to save lives; for minor or chronic ailments other form of healing may have better results. In 1975 a Chief Medical Officer in Britain commented that "the number of admissions to hospital for treatment of adverse reactions of [medical] drugs now exceeds 100,000 a year".

But must be recognized that plants too are potent drugs, Indeed, their active principles, isolated and synthesized, form the basis of many of today's drugs, from aspirin to morphine. Consequently, accurate dosage is vital; herbs should never be taken in excessive amounts.

Whenever you are in doubt or have a serious or recurring complaint, you should consult a trained herbalist. Most herbal practitioners follow the holistic approach to medicine. Holistic thinking has a way of spreading outward – like waves from a pebble dropped in water. Just as a whole plant is considered as being greater than the sum of its parts, a person's whole lifestyle and physical, mental and spiritual existence are examined before any treatment takes place. A

herbalist will consider your diet, your work, general exercise, home-life and environment as well as the overall balance of your body's systems. Therefore what is prescribed for one patient may well differ from what is prescribed for another with the same symptoms.

Common ailments can be treated at home with a range of simple herbal remedies; follow the preparation instructions and advice in this chapter. You can also assist your health by including herbs in your daily diet. In times past it was the tradition to take herbal tonics in the spring to restore the body's vitality after a winter diet lacking in fresh green vegetables. Among the herbs used as tonics were yarrow, dandelion, sage, peppermint and rose hips, which helped to cleanse the system, and other herbs which

were thought to strengthen the whole body, toning and invigorating its systems. Mint, for example, was taken for the digestive tract, and hawthorn berries were taken to improve the circulation system.

As research into the active constituents of herbs continues, increasing numbers of ancient treatments and tonics are becoming validated, revalued, and brought back into common use.

A history of herbal healing

For thousands of years early tribes accumulated a useful body of herbal knowledge through a process of trial and error. Women, with the restricted mobility of the child-bearer, assumed the task of collecting and administering herbs, so that medicine was almost universally a female vocation in pre-scientific cultures. Early peoples also saw a link between health renewal and a women's ability to create new life. The healing craft and plant knowledge were handed down from mother to daughter, and the efficiency of this system depended on both the accuracy of their observation and the nurturing qualities of the healer involved. To help their memories, nomadic tribes would select a visual attribute of each herb to remind them of its usage.

Difficulties in describing and remembering plants lessened with the advent of written language and by 3000 BC, parallel cultures in China, Babylon, Egypt and India had begun to record their knowledge of medicinal plants.

Chinese Herbalism

The country with the longest unbroken tradition in herbal medicine in China. By the time he died in 2698 BC, the legendary Emperor Shen Nung had "tested on hundred herbs". His Canon of Herbs deals with 252 plants, describing how to preserve and administer them and many are still in use.

A hundred years later the Yellow Emperor, Huang Ti, formalized medical theory in the Nei Ching and displayed a sophisticated understanding of human disease for the time : "In treating illness, it is necessary to examine the entire context, scrutinize the symptoms, observe the emotions and attitudes. If one insists on the presence of ghosts and spirits, one cannot speak of therapeutics". It was an optimistic book, stating that, with the growth of knowledge, all kinds of disease would eventually be curable.

The Nei Ching was updated in the sixth century AD and again in the seventh century, when a certain Su Jing had a vision of a more complete herbal, and approached the Tang dynasty for sponsorship. The court responded with the provision of 20 experts and a command to each province to submit records and illustration of the useful herbs in their area. After two years A Revised Canon of Herbs was published, described the

source, collection methods, flavor and therapeutic properties of 844 herbs. More than 800 years before the Western printing press was invented, the Tang government printed and distributed the revised herbal throughout China.

During the Ming dynasty, a world-famous Compendium of Materia Medica was compiled by Li Shizhen (1518-1593). From Childhood he had always followed his father, collection herbs and copying prescriptions, and he became aware of the real need for an accurate and comprehensive manual. His Materia Medica was completed in 1578 after 27 years of research: a thoroughly practical and scientific manual, listing 1,800 healing substances, mainly herbs, and 11,000 recipes or compounds. This process of updating and revising information has continued to the present day.

From the Far East to the Middle East

Clay tablets from 3000 BC record herbal imports into Babylon, and there is evidence of trade in ginseng between China and Babylon around 2000 BC. The Babylonians had an enormous pharmacopoeia with 1,400 plants; they used poppy as an anaesthetic and fennel as a digestive. The Greek historian, Herodotus, noted that every Babylonian was an amateur physician since it was the custom to lay the sick in the street and solicit advice from anyone passing by.

The first known Egyptian physician was Imhotep (2980-2900 BC), a priest healer who also designed one of the earliest pyramids. He was greatly respected as a skilled and compassionate healer and was eventually deified.

The Ebers papyri of 1550 BC list many herbal remedies and accompanying incantations, and around this time a form of astrology was incorporated into Egyptian medicine. Egyptian physicians worked with around 900 herbs, and through their embalming skills, had a superior understanding of the human organisms.

At about the same time, Indian physicians were developing advanced surgical and diagnostic skills and used hundreds of herbs in their treatments. Like the Chinese, they used all five senses when diagnosing, and developing a keen sensitivity to assessing breathing, pulse and skin odours.

Herbalism in the Ancient World

The Ancient Greeks acquired their knowledge of herbalism from India, Babylon, Egypt and even China. In the thirteenth century BC there lived in Greece a healer named Asclepius, skilled in the use of herbs. He designed a healing system, whereby people would live through a series of experiences intended to transform them by changing old thinking patterns. Many miracles of healing were attributed to Asclepius and his daughter Hygieia. Eventually he was deified and healing temples sprang up

across Greece. His system was practiced in Greece for several hundred years, and some of his ideas are still relevant in today's health centres.

In the sixth century BC, the philosopher and mathematician, Pythagoras, set up a university to teach advanced knowledge. Herbs particularly aromatic gardens, played an important part in the healing and restorative regime which preceded higher learning. Herbs were also used in the special high-energy food mixtures created for Pythagoras's long sojourns for contemplation.

Hippocrates (460-377 BC) brought Western medicine into a scientific framework of diagnosis and treatment. He dismissed the idea of disease being punishment from the gods and considered food, occupation and climate important factors in disease. He believed that it was the individual's responsibility to aid self-healing through diet and plant medicines. He gave the medical profession a code of conduct that is still respected by doctors throughout the world.

Around 300 BC in the new cultural centre of Alexandria a famous medical school was established where herbal research was conducted. By 60 AD herbal knowledge had increased to such an extent that the physician Dioscorides was able to assemble a *Materia Medica* of 600 herbs, with their description, preparation and effect, and a new emphasis on botany. This became the standard herbal reference book for 1500 years.

Soon afterwards, in 77 AD, Pliny the Elder, the most quoted writer from Ancient Rome, completed a listing of over 1,000 plants in his *Historia Naturalis*. Throughful of curious information, it is not considered accurate.

More accurate was the herbal written by Galen (131-201 AD), a great physician and philosopher who travelled widely making detailed plant observations. His enthusiasm for drugs and exotic compounds marks the beginning of several hundred years of a fashionable leaning towards complex drugs concocted mainly for the wealthy.

The Dark Ages

During the Dark Ages, Persia became the centre of excellence. There the Nestorian Christians (an Eastern Church not affiliated with Rome) established a famous school and hospital where Greek medical manuscripts were translated into Arabic. At about this time Avicenna (980-1037 AD), a gifted physician and scientist credited with inventing the process of distilling essential oils, wrote his *Canon Medidinae*, full of information on disease, remedies and medical philosophies.

In contemporary Europe medical progress was hampered by the authorities of the Christian church : scientific learning was not highly regarded, experiment was discouraged and originality considered a dangerous asset. Most significantly, the

Church viewed disease as punishment for sin. However, plant medicine continued to be practiced by monks in the monasteries and by “herb women” in the villages.

The Renaissance

With the development in the fifteenth century of the Western printing press began a golden age of herbals. This was the beginning of the Renaissance, a time for re-examining old ideas, attempting to escape the limitations of old dogmas and giving rein to an eagerness for discovery. A new scientific attitude spread through medicine. The result of herbal remedies were observed more accurately, and the more bizarre drugs were dropped. Rather oddly, in this environment of growing reason, there occurred the cruelest witch-hunts in history. Women were forbidden to study, while non-professional healers were pronounced heretics. Because of this, even today some people equate herbalism with superstition, quackery and magic.

Herbalism today

With the ascendancy of science in the nineteenth century came the ability to synthesize plant parts and concentrated doses. Herb usage probably reached an all-time low in the midtwentieth

century. But now, because of a greater concern about the side-effects of drugs; and understanding of ecology and people’s desire to take greater responsibility for their own health, herbal medicine is experiencing a remarkable revival. Research into plants such as feverfew, used to treat migraines, rosy periwinkle, which can control leukaemia, and Rauvolfia serpentine, which was used in tranquillizers, has highlighted the potential of herbal materials.

Pharmaceutical companies on the one hand recognize the value of herbs and are busy investigating worldwide herbal lore with unprecedented zeal, while on the other hand they wish to maintain their lucrative near-monopoly over medicinal products. Some drug companies have tried to have herbs removed from the healing area. One tactic has been to concentrate on finding and isolating a single, toxic constituent in a herb. This happened in the case of sage some year ago, but attempts to quash its usage failed after further research found that the other constituents in sage nullified any toxic element.

In order to use herbs safely, we need to find a sensible middle ground. One solution is a proposal on the statute book of Canada. This is to create a new class of “Folk Medicines”. Each product would be labeled with botanical names, the plant parts used and the type of preparation. Ingredients would have to meet set standards of purity and concentration, and advertising would not make extravagant claims. Such a system would guarantee the safety of herbal medicines on the market and allow people to continue using these benevolent plants.

IN SILICO ALLERGENICITY ASSESSMENT OF CRY PROTEINS OF BACILLUS THURINGIENSIS EXPRESSED IN INSECT RESISTANT GENETICALLY MODIFIED-RICE (*ORYZA SATIVA* L.)

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ABSTRACT

Rice (*Oryza sativa* L) is one of the main crops farmed as a staple food in more than 120 nations. Pest insects account about million tons of annual losses. Genetically modified (GM) rice with insect resistance is developed as a result of this problem. *Bacillus thuringiensis* (Bt) produces endotoxins that are unique to insects. The insecticidal crystal proteins Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A, and CryAb/Ac fusion are expressed in GM rice. When used against stem borers, these cry toxins have great species-specific toxicity. Novel rice cultivars developed by these bacteria may induce allergies like asthma, atopic dermatitis, and rhinitis which can be fatal. It may be possible to determine whether the novel proteins in genetically modified plants (GMPs) are more allergenic than those from conventionally bred crops by bioinformatics analysis. One of the most important considerations for assessing the biosafety of GMPs is the assessment of allergenicity. A number of databases, including FARRP, SDAP, ADFS, PSD, Allergome, and AlgPred, have been proposed for *in silico* identification of allergens. Using sequence alignment searches and bioinformatics tools and techniques these cry proteins expressed in Bt-Rice were examined for their probable allergenic cross-reactivity. BLASTX program, FASTA, and online databases (AllergenOnline version 21.0, AlgPred, and SDAP) were used for *in silico* assessment, or similarity searches of these recombinant proteins expressed in Bt-Rice. The cry proteins

were examined for the existence of domains that matched those of the allergen proteins to determine whether allergen cross-reactivity was likely even in the absence of sequence homology.

Key Words: *in silico*, *Bacillus thuringiensis*, Allergen, Bt-rice, GM rice Bioinformatics, Genetically modified plants, Nihar Singh

INTRODUCTION:

Rice (*Oryza sativa* L.), a major staple food crop, is farmed in more than 120 countries¹. Over 3 billion individuals around the world consume about 21% of all calories in this way². Insects have the biggest impact on this grain crop. The entire rice plant starting from root to panicle, are susceptible to invasion by different insects³ and insect pests cause annual losses of 10 million tons. Due to this problem, genetic technology presents a novel strategy for minimising insect injury. For the successful production of genetically modified (GM) rice, insect resistance phenotypes have been sufficiently established over the previous 20 years. These GM crops can be utilised to increase farm profitability and might potentially result in a considerable reduction in losses⁴.

Insect-specific-endotoxins are produced by the soil bacteria *Bacillus thuringiensis* (Bt)⁵. The insecticidal crystal proteins are expressed in GM rice through a variety of cry genes, including Cry1Ab⁶, Cry1Ac⁷, Cry1B⁸, Cry1Aa⁸, Cry2A⁹, and CryAb/Ac fusion¹⁰. When used against stem borers, these cry toxins have great species-specific toxicity (*Chilo suppressalis*). These Bt proteins operate as incredibly selective insecticides by attaching to receptors, which leads to the formation of pores and the death of the insect¹¹. These Bt proteins have not been shown to be hazardous to mammals, most likely because human gut epithelial cells lack the necessary receptors¹².

By employing the soil bacteria *Bacillus thuringiensis* (Bt), which produces insect-specific-endotoxins, to create novel rice cultivars, agricultural biotechnology has pioneered the path for crops with improved nutritional qualities and the ability to adapt to adverse environmental conditions. These, however, may alter the characteristics of food proteins, hence raising the likelihood that it will cause allergies. Allergens are large protein molecules that frequently cause an allergic reaction. Several intrinsic and extrinsic reactions are involved, which help to cause the symptoms¹³. Common homologous allergens from multiple sources might cause particular IgE antibodies, which in turn cause a typical allergy (Type I hypersensitivity reaction). Asthma, atopic dermatitis, and rhinitis are some of the allergy symptoms, but more serious reactions, including anaphylactic shock, can also happen and can be fatal. According to the Codex Alimentarius Commission, investigations into potential inclinations to trigger allergies as a result of gene insertion must be part of safety assessments of genetically modified (GM) foods¹⁴. A

thorough examination, like bioinformatics, may be helpful in determining whether newly produced proteins in GMOs are more allergenic than those from conventionally bred crops.

Allergenicity assessment is one of the most crucial factors when evaluating the biosafety of genetically modified plants (GMPs). Digestibility, bioinformatics analysis, and animal models are some of various methods of allergenicity assessment suggested by the Codex Alimentarius recommendations for allergenicity assessment of GM plants¹⁵. Bioinformatics analysis is considered an important method for analyzing the safety evaluation of genetically modified plants using a database search. To ascertain whether new proteins are allergenic, The World Health Organization (WHO), The European Food Safety Authority (EFSA), and The United States Environmental Protection Agency encourage database searches^{16, 17}. More than 2000 allergens have been found and are listed in various allergen databases as of now. Using similarity search techniques, these databases have been extensively used to find sequence similarities with the probable allergens that are available in the database¹⁸. For determining whether recombinant proteins synthesized from transgenes of genetically modified plants are allergenic, several allergy databases and computational methods are becoming more and more crucial¹⁹. A number of databases, including FARRP, SDAP, ADFS, PSD, Allergome, and Algpred, have been proposed for *in silico* identification of allergens. The application of bioinformatics tools and techniques for the assessment of potential allergenicity of genetically engineered novel proteins has significantly risen in the last few decades²⁰. Using sequence alignment searches and bioinformatics tools and techniques, the Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac fusion proteins expressed in Bt-Rice were examined for their probable allergenic cross-reactivity. The National Centre for Biotechnology Information's (NCBI) BLASTX program, FASTA, and online databases (Allergen Online version 21.0, AlgPred, and SDAP) were used for *in silico* assessment, or similarity searches of these recombinant proteins expressed in Bt-Rice. The cry proteins were examined for the existence of domains that matched those of the allergen proteins to determine whether allergen cross-reactivity was likely even in the absence of sequence homology.

MATERIAL AND METHODS:

Query protein sequences taken for the study

For this investigation, the Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac fusion genes of *Bacillus thuringiensis* were employed. The translated protein sequences of these cry genes Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac fusion genes (GenBank accession numbers: X54939, Y09787, EF102874, AY197341, MN547963 and EU816953 respectively), were deposited in FASTA format for future research. The nucleotide sequences of these genes were retrieved from the NCBI GenBank database.

***In silico* assessment of the genetically modified proteins expressed in Bt-Rice using online databases**

Numerous databases are available for *in silico* assessment of genetically modified proteins expressed in Bt-Rice. Three databases were used for this study, namely AllergenOnline version 21.0 (<http://www.allergenonline.com>), Algpred (<http://crdd.osdd.net/raghava/algpred/>), SDAP (<https://fermi.utmb.edu/SDAP/>).

The AllergenOnline Version 21.0 database

This database, which can be accessed at <<http://www.allergenonline.org>> is a useful resource for pinpointing the primary potential allergenic issues for GMOs (genetically modified organisms) and novel foods in accordance with the guidelines set forth by the Codex Alimentarius Commission (2003). The Allergen Online database contains 2233 sequence entries of allergenic proteins derived from a variety of sources, including food, respiratory, contact, and toxic allergens. A protein sequence is compared with entries in the allergy database using FASTA on this website²¹. The protein sequence is searched in this database using three distinct approaches, including checking for full-length alignments using FASTA, which shows high identity score alignments and hint to the probability of allergic cross-reactivity. FASTA results confirm that when a protein shares more than 70% of its entire length with an allergenic protein, it is more probable to be cross-reactive. When it shows less than 50%, it has a chance to be less likely cross-reactive and unlikely to be cross-reactive. Search with 80-mer sliding window, each query protein having each feasible adjacent 80-amino acid sequence were looked up, starting with first amino acid position 1-80, moving on to 2-81, 3-82, and so forth until each protein's final amino acid section was evaluated²². A search for an exact match of 8 amino acids should be conducted, with a search for 8-amino acid short sequence identity intended for an extremely cautious search, and alignments showing > 35% identity across segments of up to 80 amino acids should be screened for a protein to know probable cross-reactivity²³. As of now scientific community has found no evidence that a protein that matches an 8-amino acid sequence is more probable to be cross-reactive and might be unnoticed by the conservative 80-amino acid match (35%).

Algpred

AlgPred is available at <<http://crdd.osdd.net/raghava/algpred/>>. AlgPred is a web server created to anticipate allergenic proteins and allergenic areas in a protein. To reliably predict allergenic proteins, a deliberate effort has been made in AlgPred to integrate a variety of approaches²⁴.

Structural Database of Allergenic Proteins (SDAP)

Access to SDAP is available free of charge from <<https://fermi.utmb.edu/SDAP>>. This database combines allergenic proteins with different computational tools and techniques to support studies on the structural biology of different allergens. SDAP is a crucial tool for investigating the probable cross-reactivity between identified allergens including cross-checking of novel proteins for conformity with the FAO/WHO allergenicity recommendations and forecasting the IgE-binding capability of genetically engineered food proteins. With help of this browser-based Internet service, it is possible to locate an allergen's sequence as well as structural neighbours, search for an epitope presence, as well as retrieve information about an allergy from SwissProt, PIR, NCBI, PDB databases. The FASTA 3.45 tool is used in SDAP to perform alignments between the query protein sequence and all SDAP allergens. E values > 0.01 signify that there is no homology between the query protein sequence and the database sequences, while alignments with E values < 0.01 usually invariably show homology.

***In silico* evaluation of genetically engineered proteins expressed in Bt-Rice using NCBI's BLASTX tool**

The genetically modified proteins synthesized in Bt-Rice were examined for allergenic cross-reactivity using the BLASTX tool, which is run by NCBI (National Centre for Biotechnology Information). To find homologous sequences of the allergen protein, the BLASTX tool was used with the Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac fusion genes of *Bacillus thuringiensis*.

Comparison of the allergen and cry protein domains

The domains in Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac fusion proteins were searched using InterProScan, which is available at The European Bioinformatics Institute web server. The cry protein domains were matched to those in the AllergenOnline database for domain-level similarity testing.

Bioinformatics evaluation of genetically modified proteins expressed in Bt-Rice using FASTA program

The FASTA software package allows users to search nucleotide or protein databases using a query sequence. It is available at The European Bioinformatics Institute web server. For a query of the same kind, FASTA itself conducts a local heuristic search of a protein or nucleotide database. The comparison seeks to ascertain whether the protein sequence in question is homologous or identical to any known or suspected allergens.

RESULTS:

In the current study the translated protein sequences of Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac from *Bacillus thuringiensis* were examined to see whether they would be allergenic in Bt rice (Table 1).

***In silico* assessment of the genetically modified proteins expressed in Bt-Rice using online databases**

To assess for a potential allergic match, *in silico* test was performed to find the homology between genetically engineered proteins and known allergens. Searches were performed using various allergen databases on the complete/partial (80mer/8mer/6mer) sequences of Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Acsynthesized in Bt-Rice. None of the known allergens showed a significant match of more than 35% according to Allergen Online version 21.0, AlgPred, or SDAP. For all questioned Cry protein sequences, a maximum percent identity of less than 50% was determined (Table 2).

It is assumed that a protein having greater potential for cross-reactive or IgE-binding provided that it shares more than 70 percent of its length with an allergen, compared to proteins that share less than 50 percent²². The Codex, 2003 criteria which stipulate that minimum 35 percent identity across an 80-amino acid match suspect probable allergenic cross-reactivity of genetically modified proteins that are inserted into a GM crop was not met by these results.

***In silico* evaluation of genetically engineered proteins expressed in Bt-Rice using NCBI's BLASTX tool**

According to the NCBI BLASTX search results, the proteins encoded by Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Achad homology with a number of insecticidal crystal proteins from *Bacillus thuringiensis*, but no homology found with the allergenic proteins (Table 3).

Comparison of the allergen and cry protein domains

Using Interproscan, the domains of the novel cry proteins were generated. When the domains of the novel cry protein and the AllergenOnline database domains were evaluated, they did not match, eliminating the potential for allergen cross-reactivity even when there is no sequence resemblance.

Bioinformatics evaluation of genetically modified proteins expressed in Bt-Rice using FASTA program

Using Pearson's standard search and scoring matrix, a complete FASTA protein similarity search was carried out²⁵. Finding out whether the protein sequence of Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac, is homologous to any known allergens in the database is the goal of the comparison. Table 4 displays the alignment's outcomes. A low degree of homology between the database and query protein is indicated by a high E score.

DISCUSSION:

Rice (*Oryza sativa* L) is one of the main crops farmed as a staple food in more than 120 nations. Pest insects cause annual losses of about one million tons. Due to this problem, insect resistant GM-rice has been developed. *Bacillus thuringiensis*, a soil bacterium, produces endotoxins that act only on insects (Bt). Through a variety of Cry genes, including Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A, and CryAb/Ac fusion, the insecticidal crystal proteins are expressed in GM rice. When used against stem borer, these Cry toxins have high species-specific toxicity. The use of these soil bacteria, which produce insect-specific endotoxins, to develop new rice varieties may alter the properties of dietary proteins, increasing the risk of triggering allergies. Asthma, atopic dermatitis, and rhinitis are only a few of the allergy symptoms, but more serious reactions, such as anaphylactic shock, can also happen and be fatal. The study of the safety of new proteins produced through genetic engineering in rice is one aspect of the safety assessment of agricultural commodities. Based on the information of proteins' organic and inorganic characteristics and different test techniques for assessing the inherent risks of chemicals, two-stage system has developed by International Life Science Institute (ILSI) for safety evaluation of genetically modified proteins used in agricultural biotechnology. Tier I considerations include the evaluation of protein's biological function or method of operation and anticipated use, prior safe usage, comparison of genetically engineered protein's amino acid sequence with other proteins, and biochemical and physicochemical qualities (identification of potential hazards). When Tier I data are insufficient to determine an individual's safety (reasonable certainty that no harm will come to them), Tier II (hazard characterization) is used.

An increasing number of Bt plants are being introduced for commercial cultivation globally that express single, stacked, or pyramidal Cry proteins. According to the results of the in vitro investigation, Cry1, Cry2, and Cry3 degrade quickly, typically in less than 30 seconds²⁶. These in vitro tests show that consuming Cry proteins causes rapid and extensive protein degradation. Since there is a much lower chance of absorption, the risk for an allergic reaction is minimized by the rapid breakdown of the Cry1, Cry2, and Cry3 protein groups after eating. While unremarkable proteins from common foods of being allergic are swiftly destroyed in simulated gastric fluid, food allergens typically linger in the gastrointestinal model²⁷. Additionally, the diet's quite low concentration of these genetically modified Cry proteins significantly reduces the exposure and, hence, the chance of absorption. The likelihood that a novel gene will encode an allergen is very high. A recognized allergen being transferred from one source to another is one probable allergy concern associated with genetically engineered food crops. An immunological cross-reaction may happen as a result of the proteins' close structural resemblance. The newly introduced protein's degree of similarity to a recognized allergen must therefore be

ascertained. To determine whether a protein is safe, its primary amino acid sequence and general structure must be compared to those of known allergens.

Various bioinformatics tools are available for the evaluation of potential allergenicity, and authenticated epitopes can be used in addition to various online databases to analyze each protein for allergenic potential. The current study describes how several bioinformatics tools and approaches were used to assess Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Acproteins produced in genetically modified insect resistant rice for probable allergic cross-reactivity. AlgPred, SDAP, and Allergen Online version 21.0 results showed no homology with identified allergens. None of the genetically modified proteins meet the requirements for possible allergic cross-reactivity, according to BLASTX, domain analysis, and FASTA searches.

CONCLUSION:

The Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac insecticidal toxin proteins, which are expressed in insect resistant Bt-Rice, were examined *in silico* to check for any probable allergic cross-reactivity. The genetically modified proteins of Bt-Rice were not identical to allergenic proteins in whole sequence, 80 amino acid matches, or 8 amino acid/6 amino acid match, according to several database searches and similarity searches. Since the potential cross-reactivity of these recombinant proteins with allergenic proteins was not reached, this result can help farmers, researchers and policy makers to promote the cultivation of insect resistant Bt-Rice as far as biosafety is concerned.

Table 1: Sequence information of Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac

Gene Name	Organism Name	GenBank Accession No	UniProtKB/ Genpept ID	Protein Name	Sequence Length (Protein)	InterPro Domain ID
Cry1Ab	<i>Bacillus thuringiensis</i> subsp. aizawai	X54939	P0A372	Pesticidal crystal protein Cry1Ab	1155	IPR041587 IPR005639 IPR001178 IPR005638
Cry1Ac	<i>Bacillus thuringiensis</i>	Y09787	O32306	Crystalline entomocidal protoxin	618	IPR001178 IPR005638 IPR005639
Cry1B	<i>Bacillus thuringiensis</i>	EF102874	ABL60921	delta endotoxin	1228	IPR005638 IPR041587 IPR001178 IPR005639

Cry1Aa	<i>Bacillus thuringiensis</i>	AY197341	AAP40639	delta endotoxin	1183	IPR005639 IPR041587 IPR001178 IPR005638
Cry2A	<i>Bacillus thuringiensis</i>	MN547963	QIN91189	delta endotoxin	633	IPR015214 IPR005639 IPR005638
Cry Ab/Ac	<i>Bacillus thuringiensis</i>	EU816953	ACF32736	delta endotoxin	609	IPR005639 IPR005638 IPR001178

Table 2: Sequence homology search of Cry1Ab, Cry1Ac, Cry1B, Cry1Aa, Cry2A and CryAb/Ac proteins in allergen databases

Protein Query		Allergen Online version 21.0	Algpred	SDAP
Cry1Ab	Full sequence	No identity matches >35% found	Does not contain experimentally proven IgE Epitope	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	NA	No match found with E-value<0.01
	8 amino acid	No identity matches >35% found	NA	No match found with E-value<0.01
	6 amino acid	NA		NA
Cry1Ac	Full sequence	No identity matches >35% found	Does not contain experimentally proven IgE Epitope	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	NA	No match found with E-value<0.01
	8 amino acid	No identity matches >35% found	NA	No match found with E-value<0.01
	6 amino acid	NA	NA	NA

Cry1B	Full sequence	No identity matches >35% found	Does not contain experimentally proven IgE Epitope	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	NA	No match found with E-value<0.01
	8 amino acid	No identity matches >35% found	NA	No match found with E-value<0.01
	6 amino acid	NA	NA	NA
Cry1Aa	Full sequence	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	8 amino acid	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	6 amino acid	NA	NA	NA
Cry2A	Full sequence	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	8 amino acid	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	6 amino acid	NA	NA	NA
CryAb/Ac	Full sequence	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	80 amino acids	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01

	8 amino acid	No identity matches >35% found	No identity matches >35% found	No match found with E-value<0.01
	6 amino acid	NA	NA	NA

*Not Applicable

Table 3: BLASTX results for cry genes

Query Protein sequence	Subject/Database sequence	Maximum score	Total score	E-value	Percent identity	Accession
Cry1Ab	insecticidal delta-endotoxin Cry8Ea1 family protein [<i>Bacillus cereus</i> group]	2378	2378	0.0	100.00%	WP_000369819.1
	Cry1A-like protein [<i>Bacillus thuringiensis</i>]	2144	2144	0.0	98.08%	AEH31438.2
	insecticidal delta-endotoxin Cry8Ea1 family protein, partial [<i>Bacillus thuringiensis</i>]	2151	2151	0.0	99.90%	WP_228221522.1
Cry1Ac	Cry1AcCry1I [<i>synthetic construct</i>]	1270	1622	0.0	100.00%	AGS47767.1
	cry1A type crystal protein [<i>Bacillus thuringiensis</i>]serovar kurstaki	1093	1093	0.0	88.73%	AAS93796.1
	delta-endotoxin Cry1A [<i>Bacillus thuringiensis</i>]	1081	1081	0.0	86.30%	AAQ14326.1
	insecticidal delta-endotoxin Cry8Ea1 family protein [<i>Bacillus cereus</i> group]	2488	2488	0.0	99.35%	WP_000203376.1

Cry1B	insecticidal crystal protein Cry1Bb [<i>Bacillus thuringiensis</i>]	2012	2012	0.0	82.23%	AJF40147.1
	Cry1Be-like protein [<i>Bacillus thuringiensis</i>]	1989	1989	0.0	83.04%	EH31415.1
Cry1Aa	insecticidal delta-endotoxin Cry8Ea1 family protein [<i>Bacillus thuringiensis</i>]	2430	2430	0.0	99.41%	WP_000369822.1
	Cry1A-like protein [<i>Bacillus thuringiensis</i>]	2358	2358	0.0	97.86%	AEH31438.2
	insecticidal delta-endotoxin Cry8Ea1 family protein, partial [<i>Bacillus thuringiensis</i>]	2239	2239	0.0	93.38%	WP_103595476.1
Cry2A	delta-endotoxin [<i>Bacillus thuringiensis</i>]	1153	1153	0.0	98.26%	AFK79797.1
	Cry2Ab protein [<i>Bacillus thuringiensis</i>]	1153	1153	0.0	98.42%	QBO24621.1
	insecticidal crystal protein B2 [<i>Bacillus thuringiensis</i>]	1149	1149	0.0	98.26%	AHM93475.1
CryAb/Ac	Cry1A like protein [<i>Bacillus thuringiensis</i>]	1243	1243	0.0	99.84%	AKJ79185.1
	Cry1AcCryII [synthetic construct]	1243	1593	0.0	99.34%	AGS47767.1
	delta-endotoxin [<i>Bacillus thuringiensis</i>]	1216	1216	0.0	97087%	AAA22338.1

Table 4. FASTA results for cry genes

Query Protein sequence	Database ID	Subject sequence	Length	Score (Bits)	Identities %	E-value
Cry1Ab	TR:J9Q6Q6	Crystalline entomocidal [<i>Bacillus thuringiensis</i>]	1155	1791.7	99.0%	0.0
	TR:Q9AM83	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>] serovar	1118	1606.2	98.7%	0.0
	TR:Q9AM82	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>] serovar	1118	1489.9	92.8%	0.0
Cry1Ac	TR:A0A5C0C9J2	Crystalline entomocidal protoxin (Fragment) [<i>Bacillus thuringiensis</i>]	653	945.8	99.0%	0.0
	TR:A0A346JEM5	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	1178	943.2	98.9%	0.0
	TR:D2CN95	Crystalline entomocidal protoxin (Fragment) [<i>Bacillus thuringiensis</i>]	620	938.9	98.4%	0.0
Cry1B	SP:P0A373	Pesticidal crystal protein Cry1Ba [<i>Bacillus thuringiensis</i>] kurstaki	1228	1894.4	99.0%	0.0
	SP:O85805	Pesticidal crystal protein Cry1Be [<i>Bacillus thuringiensis</i>]	1227	1560.8	83.1%	0.0
	SP:Q9ZAZ5	Pesticidal crystal protein Cry1Bd [<i>Bacillus thuringiensis</i>] subsp. wuhanensis	1231	1507.3	79.0%	0.0
	TR:J3QWA8	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>] serovar	1180	1794.2	99.4%	0.0

Cry1Aa	SP:P0A367	Pesticidal crystal protein Cry1Aa [<i>Bacillus thuringiensis</i>]subsp. aizawai	1176	1762.4	97.8%	0.0
	TR:D7PE48	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	1176	1761.1	97.7%	0.0
Cry2A	TR:A0A482F7A9	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	633	944.9	98.4%	0.0
	TR:J9Q669	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	632	942.4	98.0%	0.0
	TR:A0A7S6TD99	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	666	923.6	95.9%	0.0
CryAb/Ac	TR:A0A3G1C928	Crystalline entomocidal protoxin (Fragment) [<i>Bacillus thuringiensis</i>]	1173	937.1	99.8%	0.0
	SP:P05068	Pesticidal crystal protein Cry1Ac [<i>Bacillus thuringiensis</i>] subsp. kurstaki	1178	924.4	98.4%	0.0
	TR:Q9R826	Crystalline entomocidal protoxin [<i>Bacillus thuringiensis</i>]	1178	919.3	97.9%	0.0

DECLARATIONS:

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The authors declare that there is no conflict of interest.

Authors Contribution:

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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Not applicable.

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The datasets used and/or analyzed during the current study are available in the UniProtKB (The Universal Protein Resource Knowledgebase)

Abbreviations:

CRY proteins: Crystal proteins

Bt: *Bacillus thuringiensis*

GM: Genetic Modified

IgE: Immunoglobulin E

GMPs: Genetically Modified Plants

WHO: World Health Organization

BLASTX: (Basic Local Alignment Search Tool X)

ILSI: International Life Science Institute

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PLANT USED FOR TRADITIONAL MEDICINES DURING PREGNANCY, CHILDBIRTH, AND POSTPARTUM CARE BY CHUKTIA BHUNJIA TRIBE OF NUAPADA DISTRICT, ODISHA

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ABSTRACT

The use of medicinal plant species against a wide range of diseases has a long history in human civilization, which dates back to the time when people were seeking remedies in their surroundings to help them recover from illness. Activities and diet during the postpartum period are culturally dictated in many tribal cultures, and a period of confinement is observed. Plants play an important role in recovery during the postpartum period in diet and traditional medicine. Little is known of the Chuktia Bhunjia, a particularly vulnerable tribal group (PVTG), who live in Sunabeda village of Nuapada District. The primary objective is to identify the use of plants during pregnancy, parturition, postpartum recovery and infant healthcare.

Keywords: Chuktia Bhunjia, Medicinal Plant, Nuapada, Pregnancy, Traditional medicine.

1. Introduction:

Use of plant-based drugs and chemicals for curing various ailments and personal adornment is as old as human civilization. In India, the sacred Vedas dating back between 3500 B.C and 800 B.C give many references of medicinal plants. One of the most works in traditional herbal medicine is “Viriksha yurveda”, compiled even before the beginning of Christian era and formed the basis of medicinal studies in ancient India. “Rig Veda”, one of the oldest Indian literatures written around 2000 B.C. mentions the use of Cinnamon (*Cinnamomum verum* Presl.), Ginger (*Zingiber officinale* Rose.), Sandalwood (*Santalum album* L.) etc. not only in religious ceremonies but also in medical preparation (Bentley and Trimen, 1980). Plants and plant-based medicaments are the basis of many of the modern pharmaceuticals we use today for our various ailments (Abraham J. and Thomas, T.D., 2012; Kapoor, L.D., 2017). At one time, nearly all medicines were derived from biological resources. Even today they remain vital and as much as 67%-70% of modern medicines are derived from natural products (State of the Environment

Report, 2001). Nearly 80% of the world populations rely on traditional medicines for primary health care, most of which involve the use of plant extracts (Sandhya et al., 2006). WHO had earlier estimates that the usage of traditional medicine for primary healthcare in developing countries is 80% and most of which involve the use of plant extracts (WHO1991; WHO 2007). Herbal medicine and phytotherapy are still used in many regions of the world, despite the fact that allopathic medicine has produced a number of the therapeutic substances (Sandhya et al., 2006).

Medicinal plants have a significant role during pregnancy, birth and postpartum care in many rural areas of the world. Plants used in women's health related conditions such as female fertility, menorrhea, birth control, pregnancy, birth (parturition), postpartum (puerperium) and lactation, including infant care, have been documented for various ethnic groups (Liulan et al., 2003; Jain et al., 2004).

These cultural traditions, such as postpartum confinement, steam baths and food taboos, are common and widespread in Chukhtia Bhunjia community and form the core of primary maternity healthcare in many rural areas of Sunabeda. In the context of the introduction and modernization of primary healthcare systems in rural areas, and with training programs for traditional birth attendants focusing on the paradigms of Western medicine, this traditional knowledge has often been ignored (Jordan, B., 1992). Erosion and deterioration of traditional medical knowledge can be observed in many cultures and leads not only to a loss in biocultural diversity, but also diversity in alternatives for primary healthcare (Maffi, L., 2005). Documenting the use of plants and elements of traditional birth practices by ethnic minorities is not only an important aspect of understanding and analyzing these practices, but a way to perpetuate knowledge at risk of being lost.

2. Tribal Profile:

A lesser-known tribe, the Bhunjia are divided into two clans, the Chukhtia and Chinda Bhunjias. The tribe is believed to be formed from offshoot groups of the Halba, Gond and Baiga. The Chukhtia Bhunjias are culturally distinct in the construction of a sacred kitchen shed, separated from the main dwelling building. Cock fighting is a major sport and is held at weekly markets. The annual fairs of Dashera, seed sanctification and mahua collection are occasions for celebration. Apart from wet and shifting agriculture, they also engage in fishing and the collection of minor forest produce besides rearing cattle and wage earning. Animals are reared mainly for sacrificial purposes. Bamboo is also collected and woven into fishing baskets and grain bins for personal use.

As per 2007 Survey, population of the Chukhtia Bhunjia in the CBDA, Sunabeda Micro project area was 2269 (Male 1124 and Female 1145). The growth rate among them during

the period 2001-2007 was 3.96 percent. The sex ratio is 1018 females per 1000 males. The literacy among them was 18.77 percent (28.55 percent for males and 9.17 percent for females) (Ota, A.B. and Sahoo, T., 2020).

Chukatia Bhunjia everyday life involves ritual taboos to which people are also subject, notably the prohibition of visiting certain people, at certain times, in certain houses. For example, when a woman is menstruating, she is prohibited from going to the kitchen (Lal Bangla) At these times she sleeps in a separate hut. For example, no man is allowed to be in the house during child birth until his infection is resolved by a formal ritual.

The study provides a detailed overview of medicinal plant species used in women's healthcare; and describes the unique cultural traditions surrounding pregnancy, childbirth and post partum recovery observed by this group of people.



Fig.1. Pregnant women of Chuktia Bhunjia tribe



Fig.2. While giving medicinal plant juice to pregnant women

1. Study area:

Nuapada located in the western part of Odisha lies between 20° 0' N to 21° 5' N latitudes and between 82° 20' E to 82° 53' E longitudes. Its boundaries extend in the north, west and south to Raipur district in Chhatisgarh and in the east to Bargarh, Balangir and Kalahandi districts. This district is spread over in an area of 3852 Sq.kms (2.47% of the state) and has a forest cover of 1849.69 Sq.kms (48%) of the total area 3,852 Sq. kms (District statistical book Nuapada, 2005). The forest is of dry deciduous type and has rich phytodiversity and is abode to large number of medicinal plants. The population of the district is 5,30,690 as per the 2001 Census of India out of 184221 (34.71%) are schedule tribes.

The Prominent among the mare Gond (65.76%), Sabars (11.36%), Saora (4.92%),

Luhuras, Chinda Bhunjia, Binjhals, Kharia, Konmdha and Paharias (STSCRTI, 1990). Nuapada is considered as the homeland of the Bhunjias. 75 % of the total population of this tribe lives here. Chuktia Bhunjia is the only primitive group (PVTG) found in Nuapada district. Bhunjias, are an ethnic group found in India mainly reside in Sunabeda plateau in Odisha and Chhattisgarh. The tribal dominated villages located in isolated pockets in forest ecosystem of the district and have limited livelihood options and are mainly depend on forests for their earning and medicinal requirements (Kandi et al., 2013).

Table.1: Demographic data of Chuktia Bhunjia Tribes

Demographic Items	Frequency (N=200)	Percentage (%)
Age		
20-30	120	60
31-40	45	22.5
41-50	35	17.5
Marital Status		
Married	144	72
Widow	56	28
Education Qualification		
Illiterate	170	85
+2 or below	18	9
Graduate	12	6

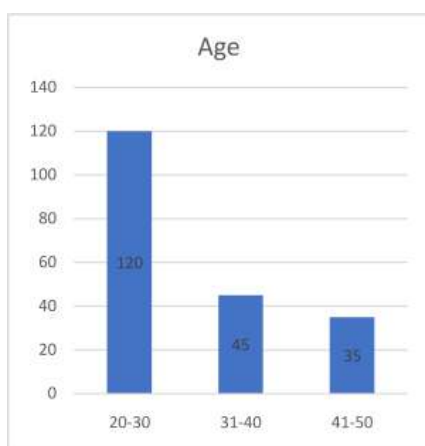


Fig.3. Age of tribal women

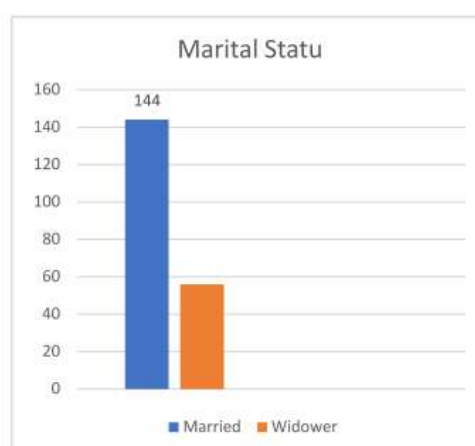


Fig.4. Marital status of tribal women



Fig.5. Educational Status of Chuktia Bhunjia tribe

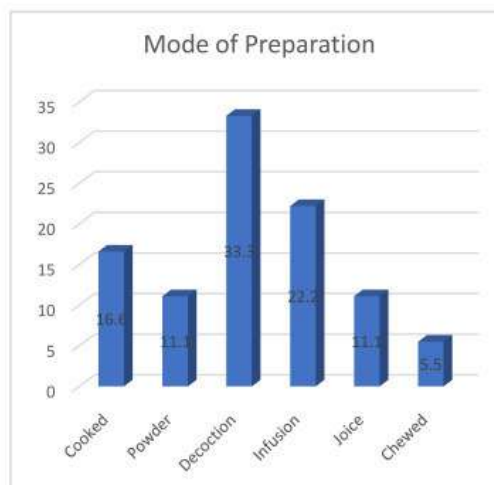


Fig.6. Mode of preparation

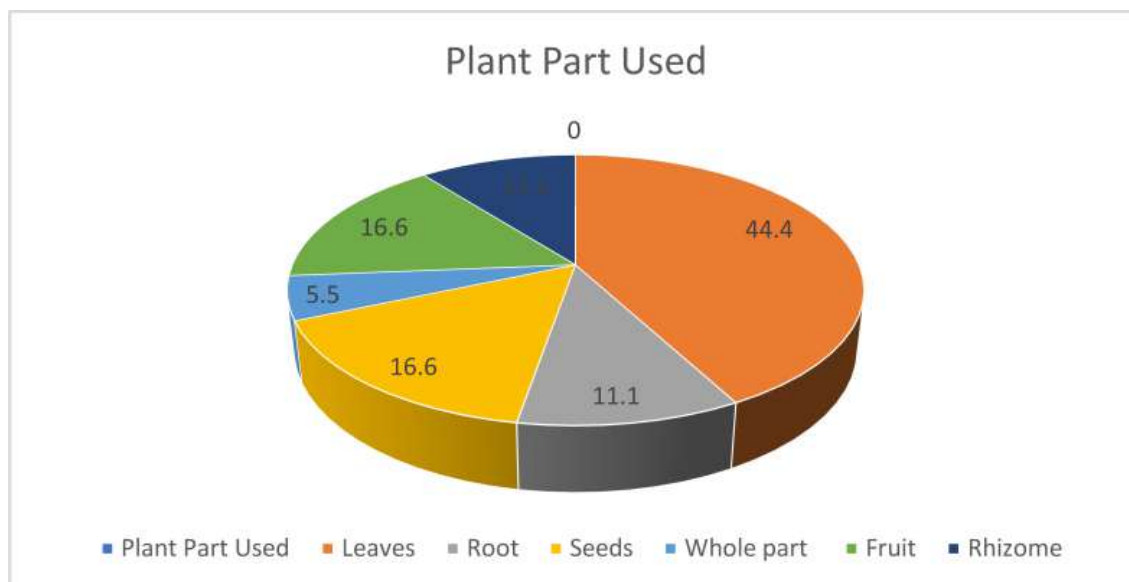


Fig.7. Plant part used by Chuktia Bhunjia tribe

4. Methodology:

Extensive surveys were done during the period of April to September 2023 to document the use of plants by local communities within the study area. Women interviews were conducted within individuals and groups, such as herbal practitioners and the elderly persons, traditional birth attendant known to possess knowledge about medicinal plants. The interviews were a relatively open framework that allowed and encouraged focused, conversational, two-way communication about medicinal plants and medicinal plant use among those being interviewed.

All interviews were performed in the local language. Throughout the interviews, information was collected on plant species, the usable plant part, and the medicinal preparation. The plant dealers, the elderly woman known as Kabiraj, and the herbalist “VAIDYAS.” Since these medications made it difficult to get at the truth directly, indirect means were used to learn about their most common illnesses and potential remedies.

Table2: List of medicinal plants used during pregnancy, Childbirth, And Postpartum

Scientific name/Family	Local Name	Habit	Part used	Preparation	Disease treated
Moringa oleifera /Moringaceae	Muguna	Tree	Leaves	Cooked	Consumption of Moringa leaf during pregnancy increases iron levels and prevent anemia during pregnancy.
Achyranthes aspera/Amaranthaceae	Kukurdatti	Herb	Root	Powder	Facilitate easy delivery
Amaranthus viridis /Amaranthaceae	Leutia	Herb	Seed	Cooked	Relieves labor pain
Chenopodium album /Amaranthaceae	Bathua	Herb	Leaves	Decoction	Weakness
Chenopodium botry /Amaranthaceae	Tikhodi	Herb	Whole part	Decoction	Relieves labor pain
Coriandrum sativum /Apiaceae	Dhania	Herb	Fruits	Decoction	Swelling of feet and ankle
Cocos nucifera/Arecaceae	Nadia	Tree	Fruits	water	Promote both maternal and fetal health
Zingiber officinale/Zingiberaceae	Ada	Herb	Rhizome	Decoction	Relieves vomiting
Macrotyloma uniflorum/Fabaceae	Kolatha	Herb	Seed	Cooked	Recovery of blood level
Butea monosperma/Fabaceae	Palsa	tree	Rhizome and leaves	Decoction	Healthy for both mother & child
Canavisa sativa /Cannabaceae	Ganji	Herb	Leaves	Infusion	Relieves labor pain
Mentha piperita /Lamiaceae	Pudina	Herb	Leaf	Infusion	Induce labor pain
Punica granatum /Lythraceae	Dalimba	Tree	Fruit	Juice	Cure Weakness
Oxalis corniculata /Oxalidaceae	Amliti	Herb	Leaf	chewed	Chewed Vomiting
Papaver somniferum /Papaveraceae	Khusi	Herb	Seed	Powder	Weakness during pregnancy
Rauvolfia serpentina /Apocynaceae	Bhuinkur uwa	Shrub	Root	Decoction	Facilitate early delivery
Eclipta prostrata/Asteraceae	Bhrungraj	Herb	Leaf	Juice	Induce abortion
Pergularia daemia/Asclepiadaceae	Utrudi	Climber	Leaf	Juice	For pregnancy

5. Dependency on Traditional Medical care:

The findings reveal that women with lower literacy levels and those opting for institutional deliveries tend to rely on a combination of modern and traditional medicines. Specifically, Chukiya Bhunjia women utilize medicinal plants such as kaya bark (*Terminalia arjuna*) and satavari (*Asparagus racemosus*) root for a safe delivery. Additionally, they incorporate horse gram (*Macrotyloma uniflorum*) to replenish blood and alleviate weakness. Dietary restrictions are prevalent during antenatal care (ANC), with the avoidance of bananas, raw fruits, and black pepper to prevent pregnancy. Coconut oil and indigenous jaggery are commonly consumed for both prenatal and postnatal care, and are also applied after cutting the umbilical cord of a newborn—a traditional practice believed to hasten recovery, acting as a preventive measure against tetanus.

Notably, approximately 80% of individuals, as reported by elders and traditional birth attendants, prefer seeking treatment from traditional healers for various ailments. In instances of family illness, tribal communities tend to turn to traditional healers as a first resort, foregoing visits to doctors in hospitals.

a) Application of Health Belief Model: Many families do not know the severity and seriousness of pneumonia, malaria or any delivery-related complications. They perceive any disease as an evil eye and go to traditional healers for treatment, as they trust them and have easy access. Also, it is a practice among tribals that if the person cannot be treated by traditional healers, they go to the hospital for further treatment. These tribal communities have good knowledge about traditional medicinal plants.

b) Dependent on knowledge and socio-cultural beliefs about illness: The analysis suggests that the majority of tribal families rely heavily on traditional healers for addressing various health concerns. In instances where a pregnant woman or a child falls ill, the family's initial course of action is to seek treatment from a traditional healer. For instance, if a child is experiencing a fever, the family is likely to take the child to a traditional healer, attributing the illness to a potential evil eye. The traditional healer, in response, would typically perform a treatment known as 'judafunka' on the child.

c) Belief in traditional healers: Tribal communities rely on socio-cultural beliefs. Thus Many families do not go to the hospital despite the condition of a pregnant woman or a sick child. In-depth interview conducted among Chukiya Bhunjia women expressed their distrust of health services and health workers. Displaced women lacked knowledge about the consequences of malaria, yellow fever or anemia during pregnancy.

d) Fear of institutional delivery: The Chuktia Bhunjia community holds firm convictions in

their traditional customs. Research indicates that tribal women from the Chukiya Bhunjia group express a preference for delivering babies at home instead of opting for hospital births. This preference stems from their belief in the safety of home births, facilitated by the expertise of mothers-in-law and traditional birth attendants. Some women in the community express a sense of deprivation as modern medical facilities become more prevalent, feeling that the traditional childbirth methods, relied upon for generations, are diminishing. Consequently, there is hesitancy among women to embrace modern medical services, driven by a fear of deviating from the traditional practices they hold dear.

e) Lack of knowledge on emergency referral: Pregnancy is considered a natural phenomenon among the Chukia Bhunjia community and the survival of the child is considered as the will of God. Most tribal people rely on traditional medicine for most ailments. They rely on socio-cultural beliefs on fertility. Moreover, non-use of contraceptives also leads to repeated pregnancies many women lack knowledge of emergency referrals and do not see a doctor despite two to three pregnancies or neonatal deaths. During the interviews, many women said that they did not like modern birth control methods such as sterilization or using a Copper-T (a small intrauterine device that comes in a T-shape and is inserted into the uterus to prevent pregnancy). Lateral reaction. For birth control they rely on the seeds of the traditional medicinal plant *Abrus* precautions.

f) Price restrictions: Financial and poor communication, distance barriers in visiting health facilities have been a major reason that tribal people do not get timely health services. These communities, irrespective of being relocated from the wild life sanctuary, are facing financial barriers for availing health care services. It was evident that the healthcare workers play tricks to take bribes from the tribal women. Many women expressed their apprehension about paying money to the healthcare workers in the villages. This has brought distrust between healthcare workers and women.

g) Receiving modern healthcare benefits: Disease severity, susceptibility to disease and lack of access to forests for medicinal plants have helped many women cope with displacement and access modern healthcare. Many tribal women in these communities find it difficult to accept modern medicinal methods and techniques for childbirth as they prefer traditional methods. Scarcity of forest resources makes it difficult for them to access medicinal plants

6. Result and discussion:

The research findings indicated that 18 angiosperms belonging to 14 families have significant importance in ethnomedicinal practices associated with pregnancy, labor, and delivery. Among these, the Amaranthaceous family stands out as the predominant group, featuring the highest count of plant species possessing medicinal attributes. Essentially, these plants are utilized in traditional medicine through the preparation of decoctions.

7. Conclusion:

Traditional belief systems among tribal communities often fall short in promoting overall health, contrasting with traditional medicinal practices that often prove more beneficial and upon which they heavily rely. However, a significant gap persists in integrating scientific knowledge into ethnomedicine, a step that could assist tribal communities in embracing modern healthcare. The displacement resulting from development projects has led to the disappearance of natural habitats surrounding many villages, once vital sources of medicinal resources. Despite this loss, there are instances where it brings about positive health outcomes, such as improved access to hospitals and healthcare professionals. The healthcare beliefs and practices of tribal communities, rooted in their forest-dwelling experiences abundant with medicinal plants, differ markedly from the modern scientific worldview. These traditional beliefs and healing systems profoundly shape healthcare practices, influencing the health-seeking behaviors and preferences of indigenous peoples.

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ROLE OF MEDICINAL PLANTS IN DISEASE PREVENTION

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Introduction:

The emphasis on the use of medicinal plants had so far been placed on the treatment rather than prevention of diseases. But, the literature in recent times suggest that progress of research is on for developing protocols in respect of use of medicinal plants and their constituents in disease prevention. More than 90% of traditional medicine recipes/remedies contain medicinal plants and such plants have been utilized in healthcare from time immemorial. A medicinal plant which contains substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs in either of its organs. This description makes it possible to distinguish between medicinal plants whose therapeutic properties and constituents have been established scientifically, and plants that are regarded as medicinal but which have not yet been subjected to a thorough scientific study. A number of plants have been used in traditional medicine for many years. Some do seem to work although there may not be sufficient scientific data (double-blind trials, for example) to confirm their efficacy. Such plants should qualify as medicinal plants.

The importance of medicinal plants is ever increasing can be appreciated from the economic stand point when the following facts are considered:

- Ø Global trade in herbs is over USD100 Billion per annum
- Ø India and China's medicinal plant trade is about two to five billion US dollars annually
- Ø In Germany, it is over one billion US dollars annually
- Ø Rose Periwinkle which is endemic to Madagascar fetches US \$ 100 million per annum
- Ø China trades in 7,000 species and 700,000 tons of medicinal plants per annum
- Ø India trades in 7,000 species of medicinal plants
- Ø Morocco exports 58.7 tons of medicinal plants annually

In the last 5 years, sales of medicinal plants doubled in China, tripled in India and grew by 25% in Europe.

Steps for prevention:

Health promotion and disease prevention strategies focus on keeping people well and preventing diseases from occurring. These strategies are referred to as primary prevention activities. Prevention is classified into three levels:

(a) Primary Prevention, which seeks to decrease the number of new cases of a disorder or illness. At this level of prevention we have:

- ✧ Health promotion/education, and
- ✧ Specific protective measures (such as immunisation)

(b) Secondary Prevention, which seeks to lower the rate of established cases of a disorder or illness in the population (prevalence). This level essentially involves measures that ensure early diagnosis (such as screening) and prompt management

(c) Tertiary Prevention, which seeks to decrease the amount of disability associated with an existing disorder. This level involves:

- ✧ Disability limitation and
- ✧ Rehabilitation

The secondary and tertiary prevention activities focus on maintaining the health of individuals with chronic conditions, delaying progression of their conditions, and preventing complications.

Disease prevention should focus on strategies that reduce the risk of disease, identify risk factors, or detect disease in its early, most treatable stages. Public health, diet, food production and the environment are deeply interrelated, and understanding these relationships is crucial in pursuing a livable future. Sometimes therefore, there is only a thin line between treatment and prevention of certain diseases.

Plan for development traditional medicine:

As per WHO guidelines, the main principles of the strategy for developing traditional medicine (TM) globally were as follows:

✧ **Policy** : Integrate TM with national health care systems, as appropriate, by developing and implementing national TM policies and programmes

✧ **Safety, efficacy and quality**: Promote the safety, efficacy and quality of TM by expanding the knowledge- base on TM, and by providing guidance on regulatory and quality assurance standards

✧ **Access**: Increase the availability and affordability of TM, with an emphasis on access for poor populations

✱ **Rationaluse** : Promote the rapeutically sound use of appropriateTM by providers and consumers.

Global Disease Burden:

Diseases have been further classified as communicable or non-communicable based on the involvement or otherwise of a transmissible biologic disease causing agent. Communicable diseases (CDs) were the major reason so fill-health and fatality in the developing (low and middle resource) countries while non-communicable diseases (NCDs) were prevalent in the developed (high resource) countries, where improvement in living conditions and widespread deployment of technology had brought the CDs under control. Globally, NCDs and CDs account for about equal quantities of morbidity and mortality, thus making all countries to currently face the double disease burden. The overall picture is, however, more difficult for low and middle income countries because of the health and socio-economic impacts.

Ethnobotanical Studies on Medicinal Plants used in Disease Prevention:

Many reports evident in India regarding the use of different medicinal plants for the use of treatment of ancient human and animal population (Tan *et al.*, 2010). Chinese system of medicine and Indian sytems (Ayurveda and Unani) have been well documented and are in practice currently for the treatment and prevention of diseases which are also available online. Many common plant species of different genera like *Azadirachta*, *Moringa*, *Piper*, *Commelina*, *Spilanthes*, *Saraca*, *Centella*, *Solanum*, *Gymnopetalum*, *Solena*, etc. were in frequent use by the then health practitioners. A number of survey were conducted in different parts of the globe where it was known that ancient people had only access to such plants in absence of a regulated healthcare system.

Use of Medicinal Plants for prevention of Diseases:

a. Cancer: Cancer is known to be a most dangerous killer disease having cosmopolitan occurrence. Chemopreventive activity is observed in natural sources, foods, supplements, crude drugs and Kampo medicines (traditional Japanese herbal prescriptions) for which cancer chemoprevention is currently one of the most urgent projects in public health. Cancer chemoprevention is defined as the use of specific natural and synthetic chemical agents to reverse or suppress carcinogenesis and prevent the development of invasive cancers. Epidemiological surveys have shown that the majority of human cancers are related to two factors, namely, diet and smoking (Banning, 2005). However, in the general population, daily consumption of certain foods have also been shown to have anticancer effects. This highlights the importance of environmental factors such as diet in cancer chemoprevention.

Animal studies reveal that prevention of tumour is important and induction of tumour can be made to reverse at early stage. It is expected that achieving control of tumour induction will be an excellent control over tumour cancer. Japanese scientists have found potential anti-tumour promoters (cancer chemopreventive agents) from edible plants and fungi and from crude drugs, that various triterpene alcohols and sterols and their oxygenated derivatives showed inhibitory effects on mouse ear inflammation induced by 12-O-tetradecanoylphorbol-13-acetate (TPA). The adult population bears tumour cells that cannot revert to normal cells and thus, effective strategies to prevent cancer include avoiding continuous contact between these cells and promoters and/or aggressively inhibiting the tumour promoter effects. Therefore, to prevent cancer, it is essential to find plants that contain effective compounds (anti-tumour promoters) that delay, inhibit or block tumour promotion. Some plants those contain the such capabilities are discussed below:

i. Prunus sp. (Rosaceae) African Prune: Prostate cancer is a very good example for chemo prevention because prostate cancer is typically slow growing and is usually diagnosed in elderly males. The extract of the bark of *Pygeum africanum* (*Prunus africana*) has been used in Europe as a prevention and treatment of prostate disorders including benign prostatic hypertrophy (BPH).

ii. Azadirachta indica : More than 60 various biochemicals including terpenoids and steroids have been purified from Neem plant and the anticancer properties of the plant is well known in terms of its preventive, protective, tumour-suppressive, immunomodulatory and apoptotic effects against various types of cancer and their molecular mechanisms. Triple-negative breast cancer (TNBC) having occurrence of around 20% of breast tumors which are known to be very aggressive and metastatic in nature and its treatment scope is very limited (Paul *et al*, 2011). An ideal compound, 2'-3'- dehydrosalannol (DHS) found in *A. indica* leaves could help in inhibiting growth and induced apoptosis in TNBC cell lines. Bharati *et al*. (2012) evaluated the anticarcinogenic potential of aqueous *A. indica* leaf extract against N-nitrosodiethylamine (NDEA)-induced hepatocarcinogenesis and found that significant reduction in tumour incidence (33%), tumour multiplicity (42%), and increase in survival (34%) upon administration of the aqueous extract to NDEA-abused mice.

iii. Rosemarinus officinalis (Lamiaceae) Rosemary: Rectal cancer is one of the dreaded and commonly occurring cancer in human has been known to have protective effects by Rosemary plant. Evidence from animal and cell culture studies demonstrates that the anticancer potential of rosemary extract as well as other constituents such as carnosol, carnosic acid, ursolic acid and rosmarinic acid proved potential healers.

iv. Vitis vinifera (Vitaceae) Grape : All food items full with antioxidants are known to be cancer protective. Grape skin and seed extracts exert strong free radical scavenging and chelating

activities and inhibit lipid oxidation in various food and cell models *in vitro*. The use of grape antioxidants are promising against a broad range of cancer cells by targeting epidermal growth factor receptor (EGFR) and its down stream pathways, inhibiting over-expression of COX-2 and prostaglandin in E2 receptors, or modifying oestrogen receptor pathways, resulting in cell cycle arrest and apoptosis (Zhou and Raffoul, 2012).

v. *Glycine max* (Fabaceae) *Soya milk*: Genistein, the most abundant phytoestrogen in soybeans, may bind to oestrogen receptors and perform anticancer activities. Choriocarcinoma is a malignant, trophoblastic and aggressive cancer of the placenta (Liu *et al.*, 2011). It has been investigated that the effect of genistein on the invasive potential of the choriocarcinoma cell line JAR and its underlying mechanism and found that genistein inhibited JAR cell invasion in a dose-dependent manner by a matrigel invasion assay. Soy beans are known to contain high amounts of isoflavonoids and saponins; isoflavonoids have been shown to have phytoestrogenic activity.

vi. *Zingiber officinale* (Zingiberaceae) *Ginger*: Dehydrozingerone, a pungent constituent of ginger, is a vanillyl ketone. Structurally, it is representative of half the chemical structure of curcumin which is a promising phytochemical for the inhibition of malignant tumours, including colon cancer. Yogosawa *et al.* (2012) evaluated the antiproliferative effects of dehydrozingerone against HT-29 human colon cancer cells, and it was found that it dose-dependently inhibited growth at the G₂/M phase with up-regulation of p21. Dehydrozingerone additionally led to the accumulation of intracellular ROS, although most radical scavengers could not clearly repress the cell-cycle arrest at the G₂/M phase. Their results suggest that analogues of dehydrozingerone may be potential chemotherapeutic agents for colon cancer (Škrovánková *et al.*, 2012). Kurapati *et al.* (2012) investigated the combinatorial cytotoxic effects of *Curcuma longa* and *Zingiber officinale* on the PC-3M prostate cancer cell line. The two extracts separately showed significant inhibitory effects on colony-forming ability. However, when both the agents were tested together at the same concentrations, the combined effects were much more significant than their individual ones, suggesting the role of multiple components and their synergistic mode of actions to elicit stronger beneficial effects.

Hexahydrocurcumin, extracted from *Zingiber officinale*, was shown to be cytotoxic to colorectal cancer cells by Chen *et al.* (2011). Treatment of SW480 cells with hexahydrocurcumin (100 µM) resulted in a massive accumulation of the cells in the G₁/G₀ phase of the cell cycle. This compound could prove useful in cancer prevention.

b. Heart Diseases: Coronary Heart Disease (CHD) is the primary contributor to morbidity and mortality worldwide. A great deal of research is now focused on identifying new therapeutic

alternatives to prevent and treat CHD. The most consistent recommendations from a Public Health perspective involve multiple changes in diet and exercise. Medicinal plants are also a viable option for its prevention and treatment. Clinical and preclinical data on some medicinal plants used as dietary supplements show that they may be useful in the strategies to reduce the prevalence and mortality of CHD either in the general population or in the subsets of individuals at high risk. Such plants include, artichoke (*Cynarascolumus*), garlic (*Allium sativum*), ginkgo (*Ginkgo biloba*), guggul (*Commiphoramukul*), hawthorn (*Crataegus* sp.) and tea (*Camellia sinensis*).

c. Oral Diseases: Oral health influences the general quality of life and poor oral health is linked to chronic conditions and systemic diseases. Although there are more than 750 species of bacteria that inhabit the oral cavity, most are normal commensals and only a few are implicated in oral diseases. The development of dental caries involves acidogenic and aciduric Gram-positive bacteria (mutans streptococci, lactobacilli and actinomyces). Periodontal diseases have been linked to anaerobic Gram-negative bacteria (*Porphyromonas gingivalis*, *Actinobacillus*, *Prevotella* and *Fusobacterium*). Given the incidence of oral disease, increased resistance by bacteria to antibiotics, adverse effects of some antibacterial agents currently used in dentistry and financial considerations in developing countries, there is a need for alternative prevention and treatment options that are safe, effective and economical. While several agents are commercially available, these chemicals can alter oral microbiota and have undesirable side-effects, including tooth staining. Hence, the search for alternative products continues and natural phytochemicals isolated from plants used as traditional medicines are considered as good alternatives. Palombo (2011) concluded that there is considerable evidence that plant extracts, essential oils and purified phytochemicals have the potential to be developed into agents that can be used as preventive or treatment therapies for oral diseases.

Conclusion: Since people now a days are afraid of the side effects of synthetic chemicals and chemotherapy, efforts are getting geared up towards the vivid use of phytochemicals that will enhance the effectiveness, efficacy and rational use of medicinal plants, especially through the integration into national, regional and local health policies and programmes.

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DYNAMICS OF SPATIO-TEMPORAL CHANGES OF URBAN LAND USE / LAND COVER PATTERN IN TEMPLE CITY OF BHUBANESWAR, ODISHA, INDIA

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ABSTRACT

The present study has been carried out in Bhubaneswar which has been declared as a smart city in the recent past by the Indian Government. The objective of the study is to understand the spatio-temporal dynamics of population growth and land use pattern in the perspectives of its future growth and development. The population has grown from 16,000 at the time of its inception to more than 10 lakhs presently with an annual growth of 9.148 percent. The fast growth of population has led to expansion of the geographical area of the city from 28.7 sq.km to 148 sq.km. Of 13 different land uses recognized, residential area has increased from 6.20 to 23.04% of the total area. With increase in residential and commercial areas, agriculture and forest land areas are shrinking at a rate of 0.717% and 0.449% per annum respectively. Water bodies in the city are declining in area and getting polluted. Promotion of vertical growth of the city, rejuvenation of water bodies, availability of open space, development of sewage network and drainage systems were realized in order to make the city green, resident friendly and sustainable.

Keywords: Land use, Population, Water bodies, Slum, Environment, Open space

Introduction

Land is one of our most precious assets and its use is multidimensional. It provides basis of the life to terrestrial and aquatic flora and fauna in one way or another. Globalisation and industrialization have brought rapid urbanization and fast growth of cities that are considered as engines of economic growth (Kumar and Chithra, 2012). Urbanization in India is no way different from the rest of the World. It is observed from the recent census that the number of urban centers in India has increased from 3769 to 9378 and around 285 million people are living in different

urban centers constituting 27.8% of the total population. The United Nations in 2001 has predicted that the number of people in Indian towns and cities will reach at 814 million by 2050 (Stanley, 2008). It is said that urban population presently almost contributes 60% of India's GDP and is likely to reach at 70% in coming 15-20 years. Such a huge population in urban areas is likely to pose various developmental problems urging India to stream like planning policies, setting growth pattern and master plans to guide development and above all regulating development to have better quality of life (Jain, R.K and Kumar Matindar , 2008). Realizing the need for transformation of the urban life, Government of India has launched the smart city mission in June 2015 for comprehensive development of physical, institutional, social and economic infrastructure and the quality of life of people in 100 selected cities in the country (Kulashrestha, 2016) at the first hand. Bhubaneswar ranks number one in the smart city pilot projects. As such it attracts the attention of policy makers, planners and researchers to make it a model city for others.

The capital city of Bhubaneswar that came into existence in 1948 with a total area of 510 ha has increased tremendously in recent times because of rapid growth of infrastructure such as housing complexes, educational institutions, policy sectors units, small manufacturing industries, IT hubs etc (Anonymous, 2017). Bhubaneswar, the capital city at the time of its design was planned to accommodate about a population of 20,000. But its population has reached at 4.11 lakhs in 1991 and presently stands at more than 10 lakhs. The original master plan of 1946 that was based on the neighbourhood concept of living is being replaced by Comprehensive Development Plan to address.

Though some study has been conducted by Geographers on the land use modeling and in the area of land use and vegetation of Bhubaneswar there is no comprehensive study that could throw light for the future planning and development of Bhubaneswar modern city (Smart City). Under this background the present study was conceptualized so as to study the land use changes in recent times. Apart from this, the disturbances caused due to capital city development in the previously existed dense vegetation in the large stretches of Bhubaneswar covered in the forest patches was also investigated.

The objectives of the present study are:

- a) to understand the spatio-temporal dynamic of Bhubaneswar city in terms of population and land use till time.
- b) to analyse the pattern and nature of land use.

Concept of Land cover and Land use:

Land Cover: Land cover is the biophysical state of the earth surface (Turner et al., 1995). In other words, land cover describes the observed physical state of the land surface as seen on the ground at a given location and time. This includes the soil surface, vegetation or forest, mountains etc.

Land use: Land use refers to the way human beings employ and exploit land cover for several purposes such as farming, mining, housing, logging or recreation (Gupta et al., 2015). Hence land use change is the exploitation of land cover through its conversion and/Urban sprawl refers to the aerial expansion of urban concentrations beyond what they have been. It refers to the continuous expansions around large cities, whereby there is always a zone of land that is in the process of being converted from rural to urban use or modification overtime primarily to serve human needs (Burley, T.M., 1961).

Materials and Methods

The study Area: Bhubaneswar is located in the Khurda district of Odisha, India between 20°12'N to 20°25'N latitude and 85°44'E to 85°55'E longitude on the Western fringe of the coastal plain across the main axis of the Eastern Ghats. It is situated on the South Eastern Railway line joining Howrah and Madras at a distance of 435 km South of Calcutta. The National Highway No.16 connecting Calcutta and Madras passes through Bhubaneswar. The city stands at the Western side of the "Mahanadi Delta" on the bank of river Kuakhai, a distributary of Mahanadi river, 30 km South-West of Cuttack city. The river Daya which has branched off from Kathojodi, flows along the South-eastern part of the city. The present study is confined to the Bhubaneswar city which is carried by Bhubaneswar Municipality Corporation (BMC) with an area of 146 Sq.km with 67 wards. However Bhubaneswar Development Plan (BDP) spreads over an area of 419 Sq. km that goes beyond the BMC jurisdiction.

The Study Design: The present study has been carried out on Bhubaneswar city and it is based on multi source data base/ Analysis of secondary and primary data, collected through survey method has been used in the current study. The Primary data includes informations collected from personal physical survey of localities and wards, study of satellite images. The secondary data involves analysis of published research papers, maps, census reports, Government documents, cadastral sheets, news paper, reports etc. The available satellite data has been visually interpreted and integrated with intensive field checks and land use maps available from BDA, BMC and revenue departments. Open source data available on internet was also used. Year 1974 has been considered as the base year for the present study and land maps was developed in 1974 first time.

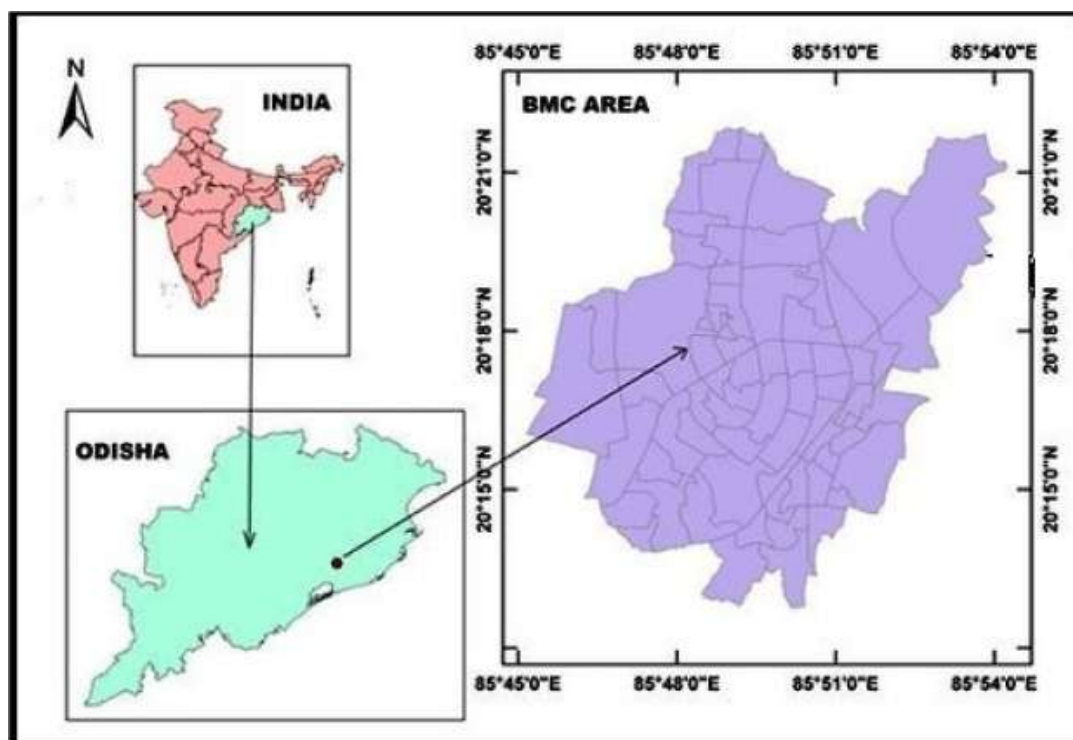


Fig.1 Location(GPS) of Bhubaneswar area

Field survey:

Field survey was broadly divided into two phases.

- i) The satellite data and ancillary data were collected prior to the start of the field survey.
- ii) The second phase of the field survey dealt with the collection of data through survey of the area(s) by the researcher(self) to understand the field scenario and collect information pertaining land uses (agriculture, housing, commercial, drainage, open space, recreation etc) .

For urban sprawl mapping and for temporal land use and land cover delineation, the following maps/ data base sets were used in the present study.

1. 1930: Survey of India maps in 1:63360 (in inch = 1 mile) (From SOI)
2. 1956: Directorate of Town Planning maps (From ORSAC)
3. 1968: Directorate of Town Planning maps (From ORSAC)
4. 1974: Aerial photographs of 1974 (Scale 1:25,000) (From ORSAC)
5. 1985: Thematic Mapper TM data of Oct. 1985, Land use map of BDA (From ORSAC)
6. 1977: IRS-ID-LISS-III and PAN (Panchromatic) BDA interim development plan maps. (From ORSAC)

7. 2000: IRS-ID PAN and LISS-III of Feb. 16, 2000(From ORSAC)
8. 2009: World view, CDP map of Directorate of Town Planning and BDA (From ORSAC)
9. 2011: Cartosat-II of March, 2011(From ORSAC)
10. Top sheet of BBSR and its surrounding area (From BDA)

The field data collected was matched with the field maps and satellite images to come out with conclusions.

RESULTS AND DISCUSSION

Development of Bhubaneswar city:

Bhubaneswar is one of the growing cities of the country. The overall special structure of the city is presented under the divergent stages of growth to reach at present day development of urban agglomeration through analysis of maps published by Government of Odisha from time to time (Das, B., 2016).

Dynamics of Bhubaneswar city:

Population in an urban area is very important as it determines the rate and pattern of growth of the city which in turn demands for various resources, facilities and services. The population of Bhubaneswar for last 90 years has been presented in Table 1. The population was only 8170 in the year 1921 and in touched a size of 16,512 just after declaration of the capital. The population reached at a number of 2.2 lakhs after 30 years in 1981. In 2011 the number touched at 8.81 lakhs(Fig.2). Presently (2016) the population about 971120 lakhs.

Table 1. Year, Population and its decadal growth in Bhubaneswar city (1921-2016)

Year	Population	Decadal growth (%)
1921	8170	
1931	9024	10.4
1941	9253	2.5
1951	16512	78.4
1961	38211	131.4
1971	105514	176.0
1981	219211	107.8
1991	411542	87.5
2001	658220	60.0
2011	881988	34.0
2016	971120*	

*Calculated Value

It is observed that the population grew at a rate of 9.148 percent units per year, as per the log logistic model (Fig.3) with a R^2 value of 0.779.

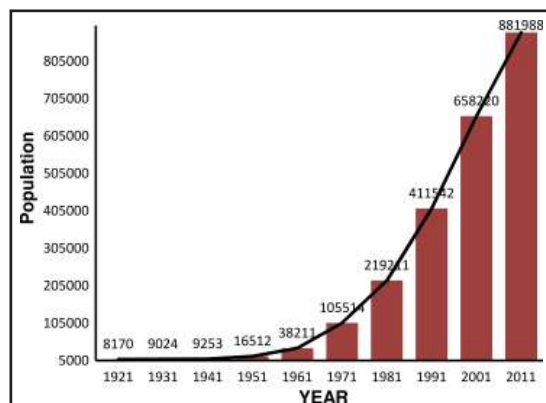


Fig.2 Population growth over the years thousands in Bhubaneswar city during 1931-2011

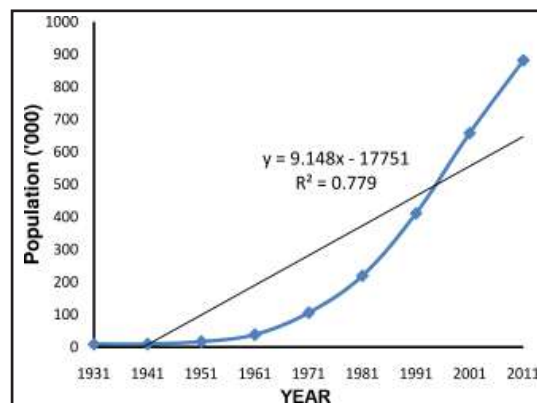


Fig.3 Increase of Population number in (1921- 2011) of Bhubaneswar city

As per the decadal growth of population, growth was minimum between 1931- 41 and the highest during 1961-71. Further there is increase in absolute number, the decadal growth in population has decreased after 1971 (Fig. 4) reaching at 34.0% between 2001- 11. As per the statistical calculations, the rate of decrease in decadal population is by 24.45 units per year ($R^2 = 0.807$) (Fig.5)

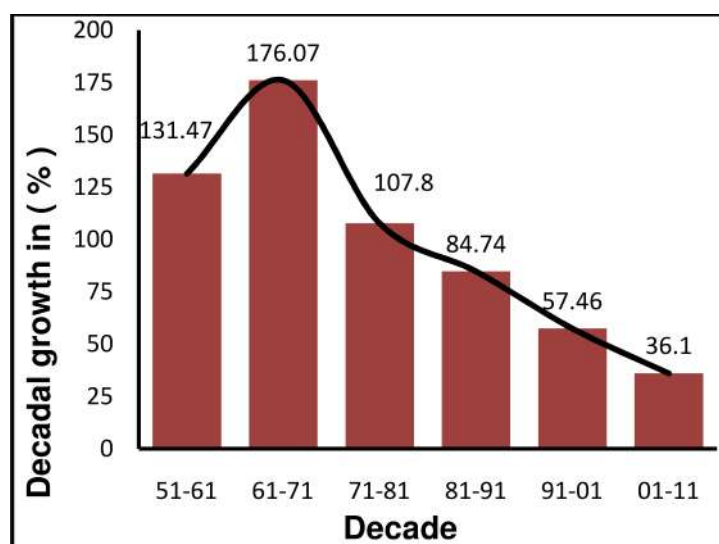


Fig. 4 Decadal growth in population of Bhubaneswar city

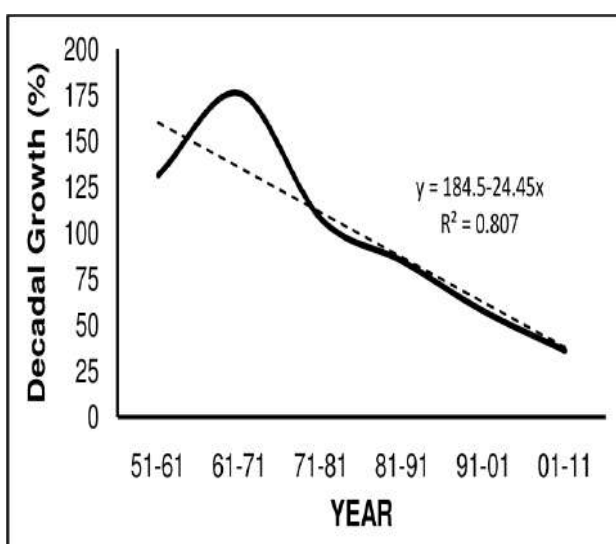


Fig.5 Decadal growth in population of Bhubaneswar city

As per 2001 census the population density of the city works out to about 4444 persons per sq.km in the municipality area. However in the present population projection, the present density stands at 7292 persons per sq.km. The three most populous wards are 53(Bapuji Nagar area), 59(Lingaraj Nagar area, Raushapatna area) and 43(Laxmi sagar area). The increase in population density showed that there is an annual increase of 110 persons per sq. km. as reflected from linear logistic model ($R^2 = 0.923$) Fig.6

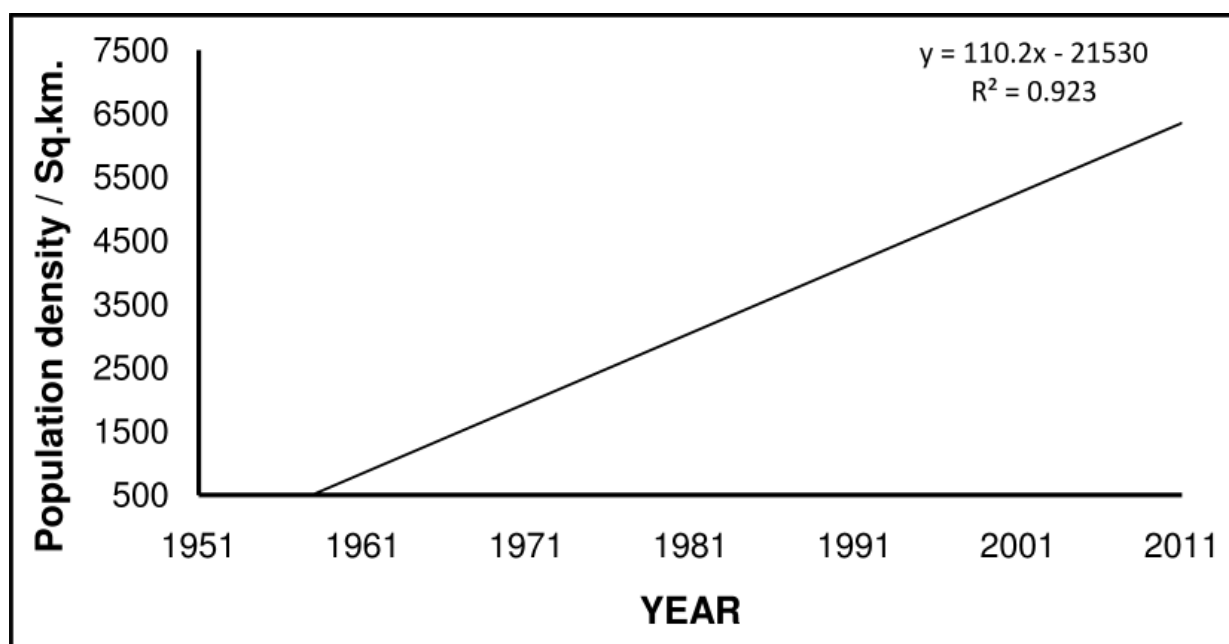


Fig.6 Increase in Population density (per Sq. Km.) in Bhubaneswar city over the years

Land use Pattern

Bhubaneswar started its master plan since 1968 and the city had only a geographical area of 9621 ha. Seven functional land use zones are identified keeping specific land uses in view. These zones are residential, commercial, industrial, public and semi-public, open space, green belt and transportation zones. During this period residential zone covered the maximum area (22.93%) followed by green belt zone (19.54%) and open space area (14.47%). Commercial zone covered only 2.72% of the total geographical area.

After 1968, the city expanded at a fast rate and new zones such as utility services, vacant land, recreation services, and waste land were created. Presently a total of 13 types of land uses have been recognized. The details of change in pattern of land use have been shown in Table 2 and Fig.7.

Table 2: Changes in land use pattern over the years from 1974-2016 in Bhubaneswar city*

Sl. No.	Land use type	1974		1990		2000		2010		2016	
		Area (Sq.km.)	Area (%)	Area (Sq.km)	Area (%)	Area (Sq.km.)	Area (%)	Area (Sq.km.)	Area (%)	Area (Sq.km.)	Area (%)
1.	Residential	4.30	6.2	13.41	10.74	23.97	17.59	31.61	21.85	32.29	23.04
2.	Commercial	0.131	0.19	0.957	0.77	1.472	1.08	2.474	1.71	----	----
3.	Industrial	0.159	0.23	1.928	1.55	3.14	2.31	3.47	2.4	3.69	2.48
4.	Traffic and Transportation	0.596	0.86	1.219	0.98	1.635	1.2	12.73	8.8	----	----
5.	Public /Semi Public, Institutional	1.422	2.05	3.893	3.13	5.82	4.27	10.79	7.46	12.2	8.2
6.	Utility services	0.131	0.19	0.335	0.27	0.517	0.38	0.781	0.54	----	----
7.	Recreational	0.242	0.35	1.094	0.88	1.690	1.24	2.691	1.86	----	----
8.	Vacant land	2.86	4.13	10.68	8.59	18.04	13.24	32.99	22.8	----	----
9.	Agricultural land	25.33	36.5	42.70	34.33	32.24	23.66	18.01	12.45	16.07	10.8
10.	Vegetation / Forest land	17.21	24.8	19.07	15.33	19.57	14.36	16.78	11.6	16.60	11.2
11.	Waste land	14.28	20.58	23.38	18.8	19.45	14.27	6.279	4.34	5.23	3.52
12.	Water bodies/ Wet land	2.22	3.2	4.366	3.51	3.70	2.72	3.646	2.52	3.60	2.42
13.	Others	0.499	0.72	1.39	1.12	5.01	3.68	2.416	1.67	----	----
Total		69.4	100	124.4	100	136.3	100	144.7	100	148.8	

* = Data from BMC and BDA reports

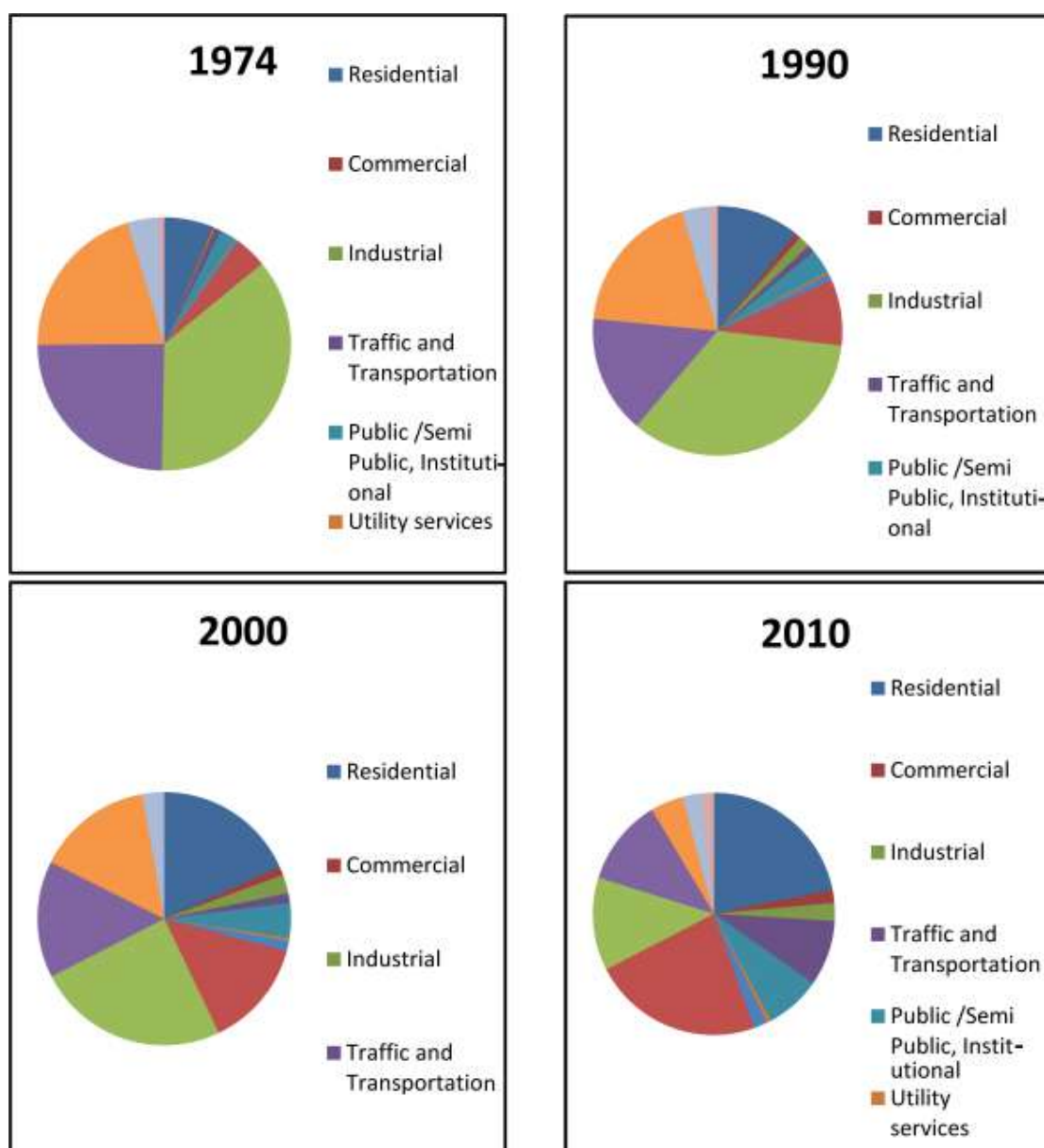


Fig. 7 Change in land use pattern over the city (%) in Bhubaneswar from 1974-2010

The overall land use of different types of residential, agricultural, vegetation, wasteland and water bodies in terms of area (in %) from 1974-2016 in Bhubaneswar city has been presented in Fig. 8 and Fig. 9.

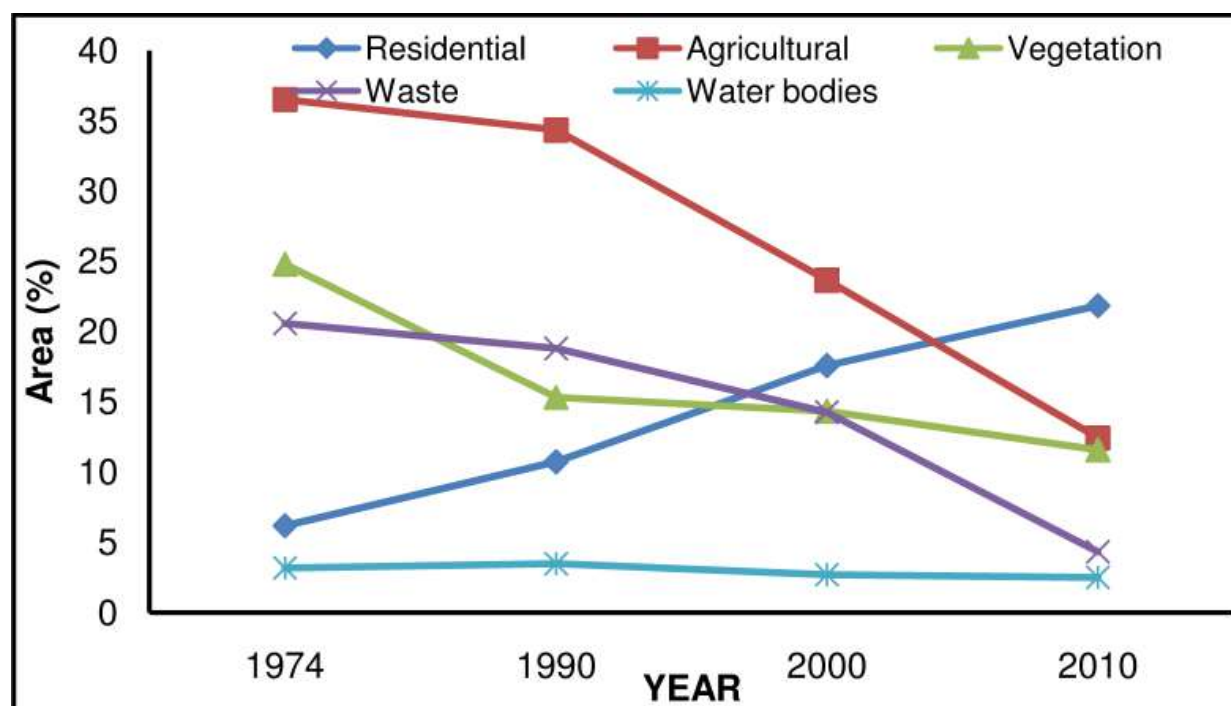


Fig.8 Change in land use area for residential, agriculture, vegetation, wasteland and water bodies over the years in Bhubaneswar city.

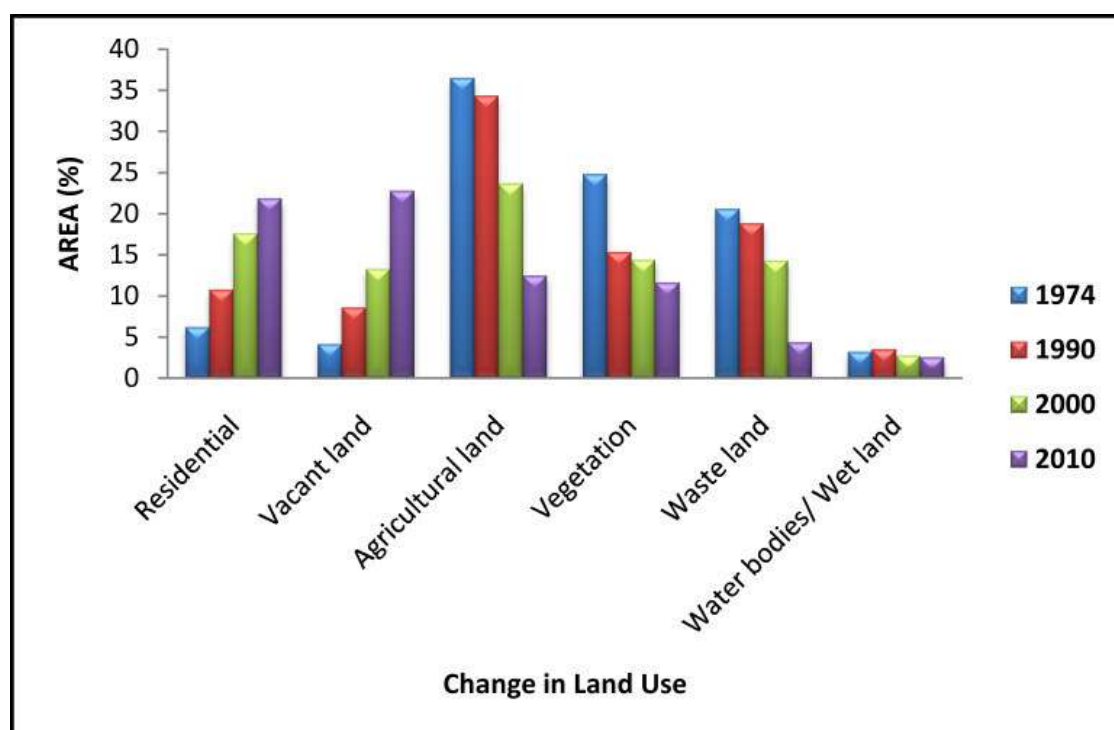


Fig. 9 Change in land use for residential, vacant land, agriculture, vegetation, and wasteland, water bodies over the years in Bhubaneswar city.

The CDP 2010 for BDPA 2030

The open space under CDP 2010 for BDPA 2030 included open space as recreational zone that involved i) Playground, stadium and sports complex, ii) Parks and gardens, iii) Special recreation zone (Archeological sites) and iv) multipurpose open space.(Perspective Plan – VISION , 2030)

Presently the existing number of parks and playground in the BDPA region are 161 and about 80 in the BMC area. It has been observed that there has been an increase in the developed parks in the city in terms of area from 180.30 ac. in 1993 to 356.54 ac. presently.

The overall increase in area of Bhubaneswar city (Fig.10) shows through linear logistic model ($R^2=0.963$) that there is an average increase of 2.032 sq.km. area per annum. Further a positive correlation was noted between population growth and expansion of city area (Fig. 11)

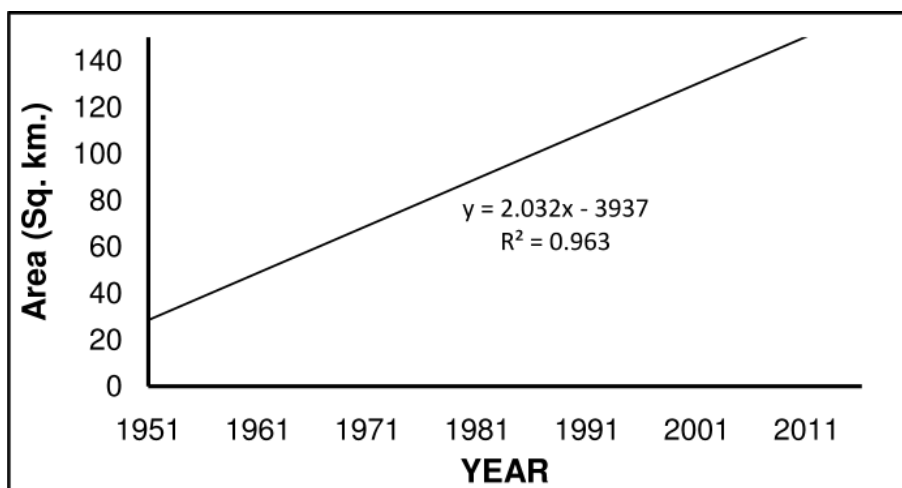


Fig.10 Increase in geographical area in Bhubaneswar city over the years

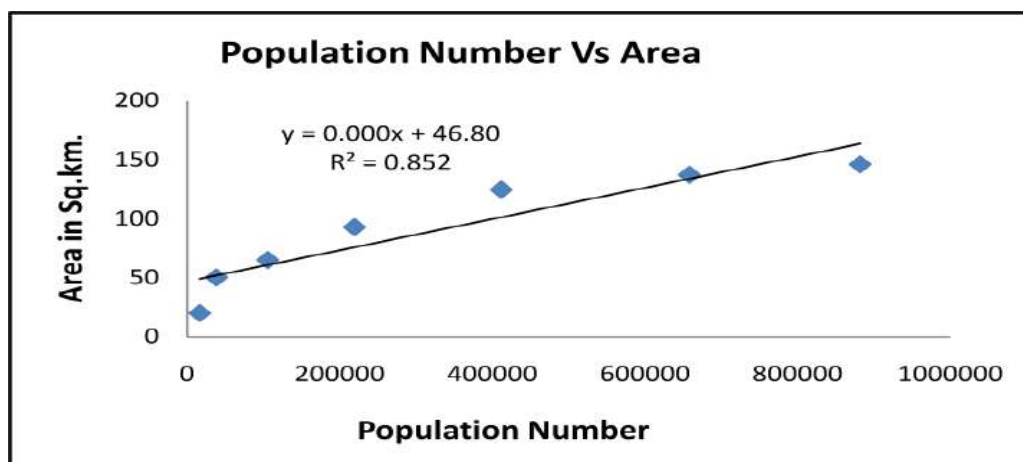


Fig.11 Correlation between Population number and Area (in Sq. Km.) in Bhubaneswar city

Conclusion

Global human population is growing and rural to urban migration is increasing. This urbanization trend will continue to happen left for another few decades. The United Nations estimates that 4.9 billion inhabitants out of 8.1 billion will be living in cities by 2030. Bhubaneswar is no exception. Its population is estimated to touch 15 lakhs in next 4-5 years. This continued urbanization pattern will increase land and resource consumption besides putting stress on the environment. So the state and local governments, planners and policy makers should acknowledge these problems immediately and put environment perspective(s) into land use planning and decision making process effectively and promptly to bring visible changes. Bhubaneswar is historically known as a Temple city and recently it has been declared as the Smart city. It is therefore most essential to ensure that utilization of available land is judicious while extending modern facilities and techniques to its people in terms of better mobility, waste management and citizen centric services. The tradition and heritage of the city is not compromised as Bhubaneswar has become a city of both tradition and modernity.

Recommendations

From the discussion and conclusion made on the piece of work in the previous pages, the following recommendations are made to promote proper urban planning and sustainable development leading to a people friendly city.

1. Instead of horizontal growth in North-South direction, vertical growth of the city needs to be promoted in order to reduce land area utilization (more people in less area) besides reducing stress on natural resources such as water, energy and also global warming.
2. Planning for development of satellite cities with all basic facilities close to capital city (Bhubaneswar) could help in reducing migration of people from other places.
3. Proper planning and segregation of residential and commercial areas will help in reducing traffic jam, noise pollution and unhygienic environment. Domestic animals with cattle sheds are to be kept away from the residential areas. Conservancy lands meant for utility services always be kept clean.
4. Sewerage disposal, sanitation and solid waste management need urgent attention. Sewerage treatment plants (STP) are to be constructed on priority basis. About 600 metric tons of solid wastes produced per day from the city needs to be converted into energy.
5. To promote communication and reduce traffic jam, ring road, service road, over bridge/ fly over and multi-level parking need to be constructed.

6. Desilting and renovation of water bodies and ponds are necessary to influence microclimate of the city. Funds for the purpose could to be arranged from Orissa Urban Improvement Development Fund, Water Resources, Orissa Environment Management Fund etc.

7. Cleaning of natural drainage and their maintenance will stop stagnation and water logging in the city areas.

8. To promote healthy life style, there is a need for increase provisions of public urinals, subways, foot paths, community toilets, park, gardens and playgrounds. Increase number of burial grounds, cremations ground and electric crematorium are need to be constructed. Open defecation needs to be stopped by creating awareness.

9. As water table is going down with reduction of rainy days, BMC should give stress on water conservation. Digging well along natural streams will not only help to store water but also will help to recharge ground water.

10. As green environment of Bhubaneswar has been lost, massive plantation programme is necessary to save the residents from heat waves during summer. Plantation of suitable broad leafed wind resistant fruit trees in the waste lands and along the road side is need of the hour. During construction and expansion of roads, translocation of trees to new localities is necessary for a better, cleaner and greener Bhubaneswar.

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EFFECT OF POLLUTION AND IMPACT ON MEDICINAL PLANTS AND ITS PROTECTION

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Introduction:

Medicinal plants are the gift of natural ecosystem and from the ancient times in “Ayurveda”. It is practiced for curing of health of mankind. The very commonly used plant products include Harida, Bahada and Anlawith extensive use in the traditional knowhow from long back. Many companies sell the products in various trade name and is quite acceptable in the public. The plant extracts of Ashoka (*Saracaashoka*), Tulsi (*Ocimum sanctum*), Ghee Kuanri (*Aloe vera*), Aswagandha (*Witheniasomnifera*), Dalchini (*Cinnamomum zeylanicum*), Bisalya Karani (*Tridax procumbens*), Neem (*Azadirachta indica*), Sarpagandha (*Rauvlfia serpentina*), Vringaraj (*Eclipta alba*), Haladi (*Curcuma longa*), Brahmi (*Bacopa monnieri*), Dalimba (*Punica granatum*), Jamu (*Syzigiumcumini*) is having extensive medicinal use among the people. The state of Odisha has ancient history of using medicinal plants in traditional method. The use of herbal products is increasing day by day with different trade names and became popular. The use of herbal medicines and herb-based nutrition has increased substantially in the last decades, so much so that 65-80 % of people globally use herbal medicines as treatment options for many diseases (Asmaa M Radwan & Ors. 2018). The use of clove oil used for temporary relief of dental pain is adhered to. The use of Chandan extracted from the sandal wood during worship creates a piece of mind in every body. The use of neem leaf during the “Sudhi Kriya” and also for the curing of chicken pox is well known. The conservation of the medicinal plants is essentially required for the transfer of knowledge from one generation to next. The anticancer drugs such as taxol is isolated long back (1997) from natural sources. The present topic is correlated with the increasing level of pollution as caused by the different sectors including industries and rapid urbanization. The medicinal plants have the value of therapeutic purposes, extracts of which is used as a raw material for preparation of medicine. The parts are used such as roots, stems, leaves or fruits which develops the defense mechanism in the human body for curing. The plant constituents are Chlorophylls, Proteins, Sugars, terpenoid, alkaloids, phenolic compounds, saponins, tannins etc. The anti-viral drugs are also derived from plants for combating potential epidemic viral diseases such as flu. Drugs to fight life-threatening diseases such as diabetes, HIV, and diarrhoea

are being developed from plants, microorganisms, amoebae, and other species in foreign countries (E. Roberson, 2008).

The State Govt. of Odisha has established the “State Medicinal Plant Board” at Bhubaneswar for effective management for protection of such plants with future research activities in this line and everybody will be benefitted. The Regional Plant Resource Centre (RPRC) and Odisha Biodiversity Board (OBB) are also functioning at Bhubaneswar. The Forest, Environment and Climate Change Department is the administrative organization at Govt. level. At the same time State Pollution Control Board is functioning with the objective for the protection of environment under the provisions of Water (PCP) Act, 1974 and Air (PCP) Act, 1981 and Rules framed thereunder.

Environmental issues: The word “**Environment**” is of significant importance now a days, keeping the level of pollution caused due to rapid modernization of the Country including the State of Odisha. The Dist. Dhenkanal have come up in recent years with many industries are operating. Earlier in undivided district the coal mines are operating at Talcher Coalfields area having underground and open cast mines. Later on industries like NALCO having Power Plant and Aluminum Smelter is established, NTPC having mega power Plant at Kaniha, Sugar Industry at Haripur, Asbestos factory at Korian, Sponge Iron Plants, Steel Plant, Ferro-Alloys Plant, nearby area is having Chromite Mine, many smallscale unit like Stone Crushers, Brick Kilns are operating in the district and nearby area. It can be assessed easily that prior to the establishment of these industries, the areas are covered with much more greenery, naturally grown trees, herbs and shrubs etc. providing free pollution free air. The control of fluoride emission generated from the Smelter units also requires proper treatment. Thus, it can be easily concluded that, there is impact of pollution with deterioration of air and water quality. The policy makers and framers of constitution have felt the importance of protection of environment and thus included specific provisions in 42nd Amendment Bill, 1976, at Part IV (A), under “Fundamental Duties” S.11 effective from 03.01.1977.

Article 48A: The Article under the Directive principle of the State policy says that the State shall endeavour to protect the environment and emphasizes on safeguarding the forests and wildlife of the country. It imposes the duty of State to protect the environment from pollution by adopting various measures.

Article 51A (g): The Article states that it shall be the duty of each and every citizen of India to protect and improve the natural environment that includes lakes, rivers, forests, and wildlife. This Article also focuses on showing compassion for living creatures. This article is similar to Article 48A, but the only difference is that it concentrates on fundamental duty of citizens whereas Article 48A instructs the state to perform their duties and protect environment. Hence, it is the duty

of every citizen to protect the environment from pollution with improving its quality.

Another provision is Article 51 (a) (h), which says to develop scientific temper, humanism and the spirit of enquiry and reform. In the Environment (Protection) Act, 1986 (effective from dt. 19.11.1986) the word environment is defined which “includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property”(Section 2 (a)). The environmental pollutant means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be, injurious to environment (Sec. 2 (c)).

The country faced the major tragedy and disaster i.e. “Bhopal Tragedy” on the night of 2nd December 1984 which was an eye opener and mostly known to every citizens due to emission of Methyl iso-Cyanate (MIC), the poisonous gas emitted to the atmosphere by the Union Carbide, a US based multinational company manufacturing pesticide known as “**Sevin**”. The tragedy occurred due to negligence of the plant authorities and is purely on human error. Prof. Dr. M.K. Rout, being an eminent Scientist, former Vice Chancellor of Utkal University and first Chairman of State Pollution Control Board has explained the “Bhopal Tragedy: Analysis of Related Issues in his book published on 01.01.1985. The book contains chapters on the formation of Methyl iso-Cyanate ($\text{CH}_3\text{-NCO}$). The impact of poisonous gas was so high that thousands of people died at the spot, public could not able to know what is happening. This has caused complete disturbance of natural ecosystem and harm to plants and animals which are still not addressed. The compensation paid whether adequate or not it requires due attention including steps to be taken for restoration of environment. A longtime adjudication of the matter took place on “Bhopal Tragedy” before different Court’s including High Court and Supreme Court and how far we are satisfied, the matter is also point of discussion till date. The compensation paid is the only consolation to the affected people. In the state of Kerala, significant mortality and morbidity have also been reported due to exposure of Endosulfan a toxic pesticide whose use continued for 15 years after the occurrence of Bhopal tragedy. Still there is apprehension in the mind of people staying near the industries that at any point of time they may face any accident or disaster which may cause damage to natural ecosystem and also taking lives. Always, the common man suffers due to lack of medical treatment facilities. Initially, the treatment facility is not available, it is costly and restoration of environment is not easily possible. Due to such reason, the risk assessment study is essential with disaster management plan for the industries handling hazardous materials to face for all emergency to face.

As per earlier practice, the importance of medicinal plants is of great significance, which is the immediate source of medicine which cures the persons. The establishment of industries causing air and water pollution has direct impact on the degradation of natural ecosystem. Due to large scale mining, the flora and fauna of the area is lost and the ecosystem is completely changed. The

trees which are existing during course of evolution were cut, many important species are in the verge of extinct including the medicinal plants. As regards to the mythological era, the “Hanuman” brought the complete forest for curing the “Lord Laxman” who was unconscious. When asked Hanuman replied that as he could not able to differentiate the medicinal quality of trees, thus he brought the total forest. This is the faith still existing over era’s in our mind. Thus, the natural ecosystem has provided everything to the benefit of mankind, which is to be protected at any cost and not to be exploited at any cost. Feeling the importance on preservation and protection of medicinal plants, the Odisha Botanical Society has organized the “National Seminar on Medicinal and Aromatic Plants: Traditions, Knowledge and Current Research” at Dhenkanal College, Dhenkanal on two days programme on 17th & 18th December, 2023. For the second time, the Odisha Botanical Society has decided the P.G. Dept. of Botany to hold the National level Seminar in Dhenkanal college. As a former I. Sc. & B. Sc. (Hons.) student of this Dept., I compiled an article of multi-disciplinary approach covering some aspects on the legal framework of the country.

The environmental degradation is assumed to include personal and property injury or damage by any activity related to environmental pollution, accident, or other damages as defined under the “National Green Tribunal, Act, 2010 (Charu Sharma, Published Book on 2017). In the matter of **Bhopal Gas Peedith Mahila Udyog Vrs. Union of India**, Writ Petition (C) No. 50/1998, adjudicated before Hon’ble Supreme Court of India in the bench headed by Hon’ble Chief Justice of India, Mr. Justice S.H. Kapadia and his companion Judges, Hon’ble Mr. Justice A.K. Patnaik and Hon’ble Mr. Justice Swatanter Kumar on 09.08.2012 directed at para 38 to transfer all pending cases pertaining to environment matters to the NGT for delivering expeditious and specialized justice in the field of environment. The constitutional under Section 323-B has specific provision for establishment of Tribunals for adjudication or trial of disputes, complaints or offences with respect to matters specified at Clause 2. Later on, the NGT was headed by Hon’ble Mr. Justice Shri Swatanter Kumar as Chairperson of NGT delivering many landmark/ watermark judgements in the environmental matters all over the Country from 2013-2018. The judgements include matters on Ganga, Yamuna water pollution, implementation of prohibition of 10 years Diesel and 15 years petrol vehicles at New Delhi, improvement of air quality, solid waste management, Plastic waste management, construction and demolition waste management, environmental clearances issues etc. The various legislations as specified in Schedule I of the NGT Act, 2010 covers adjudication of matters of Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, Water (Prevention and Control of Pollution) of Cess Act, 1977 (now not in force), Forest Conservation, Act, 1980, Public Liability Insurance Act, 1991, Biological Diversity Act, 2002 has been included for adjudication by National Green Tribunal (NGT). The NGT has jurisdiction to settle disputes over all civil

cases where a substantial question relating to environment (including enforcement of any legal right relating to environment), is involved and such question arises out of the implementation of the enactments specified in Schedule I as stated above (Section 14). The Tribunal shall hear the disputes and settle it and pass orders. There is a time limit of six months from the cause of action arises for such dispute. The Tribunal is empowered for directions for relief, compensation to the victims of pollution and environmental damages (section 15). The relief to be granted is in addition to the relief paid in addition to PLI Act, 1991. There is an Appellate provision under the NGT Act, 2010 (Section 16). Also, the environmental clearances granted by the MoEF& CC and also by SEIAA for the industries can be challenged under the provisions of NGT Act, 2010 within a period of 30 days. The polluter pay principle and Sustainable development approach is adopted in the NGT Act, 2010. The orders and decisions of NGT can be Appealed before Hon'ble Supreme Court of India (Section 22). The country has enacted the Biological Diversity Act, 2002 on 05.02.2022, which makes the provision for establishment of National Biodiversity Authority, State Biodiversity Board's. The biological diversity with associated traditional and complementary knowledge system are to be preserved for future which is an important legislation. The biological resources include, plants, animals, microorganisms, their genetic material and by-products etc. In view of the above, there is adequate provision in the Acts and Rules to protect the natural ecosystem and so also the medicinal plants. In the remote areas where the thick forest area exists, the human being staying with their own culture are completely dependent for food and medicine derived from the Plants. They know how to use and which plant is to be used for medicinal purpose generation wise. The rich forest area of Panchpatmali area, Nayagarh, Daspalla, Tikarpada, Deograh, Nrusinganath area contains many medicinal plants whose preservation is highly essential even though industrialization takes place. Once, the rich flora and fauna will be lost, it will not be easy to get the plants to grow and regenerate for many years. The Indian Forest Act, 1927 also covers the protection of trees and also now a days, the trees can be displaced from one area to another without cutting the same. The Forest Conservation Act, 1980 has got provision of afforestation for the area which is damaged along with deposit of funds to Govt. for forest regeneration and new tree plantation purpose. The vast mining activities are operating at Talcher, Ib Valley area at Brajaraj Nagar, Vasundhara area for Coal mines, Iron ore mines at Keonjhar, Bauxite mines at Damanjodi of Koraput, Chromite mines at Sukinda and Manganese mines has caused a lot of deforestation. The mining activities needs to be managed properly. The activities should be restricted to bare minimum and also capping of mines may be one aspect needs further considerations by the policy makers so as to preserve the resources for future generations. The sand mining in rivers are to be extracted as per the provisions of E.P. Act, 1986 after obtaining Environmental clearance.

Issues of Air Pollution:

As regards to specific issues which is very common is the “air Pollution” causing damage to the environment so also the plants. The recent issues on Delhi air pollution caused inconvenience to public as air quality deteriorated and the air quality index has exceeded the tolerance limit. The schools are closed, the construction activities are stopped. This indicates that the matter to be dealt cautiously for the protection of human beings. As an example, the major power plants can be considered for the emission of particulate matter, Sulphur dioxide and Nitrous Oxide. The tall chimney which is made for proper dispersion of pollutant which can travel in air to many areas and settle causing damages to both plants and animals. The installation of ESP and bag filters, including water sprinkling facility are required for effective control of air pollution. The water pollution part is covered by installation of Effluent Treatment Plants (ETP) and its reuse is always suggested. The discharge outside the plant is not required in case adequate provision is made. Sufficient power has been delegated to SPCB for the control of pollution. Now a days, waste management of Municipal solid waste, hazardous waste, E-Waste and plastic waste need proper management at each level. There should be public grievance mechanism to address all the issues of pollution including noise pollution occurred during major processions. The impact of Sponge Iron Plants on air pollution level is very high and thus impact on environment to be minimized up to maximum extent by installing ESP and bag filter for control. The solid wastes generated from the mines and industries requires proper disposal with storage of top soil which is fertile in nature so as proper Ob dump management. The use of bio degradable plastic to be encouraged for preservation of environment.

The Ministry of Forests Environment and Climate Change Department, Govt. of India, New Delhi has notified the National Ambient Air Quality Standard in Gazette Notification GSR 826 (E) dated 16.11.2009 for 12 parameters. The parameters are Sulphur Dioxide, Nitrogen dioxide, Particulate Matter 10 & 2.5, Ozone, Lead, Carbon Monoxide, Ammonia, Benzene, Benzopyrene, Arsenic and Nickel fixing the standards, which is to be monitored 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals. The 24 hourly or 08 hourly or 01 hourly monitored values as applicable shall be complied with 98 % of the time in a year, 2 % of time, they may exceed the limits but not on two consecutive days of monitoring. Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified for the respective category, it shall be considered adequate pollution reason to institute regular or continuous monitoring and further investigation. The plantation of sensitive plant species act as bio-indicators with variation in the level of pollution tolerance and the air pollution tolerance index (APTI) to air pollution is calculated by synthesizing the values of different biochemical parameters which includes leaf extracts, pH, Ascorbic Acid, total Chlorophyll

and relative water contents. The index value from 30 to 100 is Tolerant, 29 to 17 as Intermediate, 16 to 1 as Sensitive and less than 1 is very sensitive (Vandana Singh, 2013). Specific species are to be planted in the industrial area. The plantation of trees like Neem (*Azadirachta indica*) (12.98), Chirbilva (*Holoptelea integrifolia*) (55.8), Peepal (*Ficus religiosa*) (25.77), Sheesham (*Dalbergia sissoo*) (32.5), *Aegle marmelos* Corr. (10.12) and *Ficus bengalensis* (13.26) having different APTI are helpful for cleaning of environment (Jyoti Sharma & Rohit Johari, 2023).

The Indian Forest Act, 1927 provides adequate provision for the protection of trees and prohibited tree cutting. The role of plants for protecting the environment is discussed everywhere including provision of compensatory afforestation provision itself in the Forest Conservation Act, 1980. The said Act has been amended on 04.08.2023 as the importance of forest is realized so as to enable the achievement of National targets of Net Zero Emission by 2070 and maintain or enhance the forest carbon stocks through ecologically balanced sustainable developments.

The levels of heavy metals such as lead, cobalt, cadmium, chrome, nickel and zinc have been detected in this river which is a major supply of potable water which poses a potential health risk to the people living in the downstream (Edward Broughton, 2005). Land pollution due to uncontrolled disposal of industrial solid and hazardous waste is also a problem throughout India. With rapid industrialization, the generation of industrial solid and hazardous waste has increased appreciably and the environmental impact is significant. The fly ash disposal from power plants is a major challenge and the mine void filling is advised.

Conclusion: The preservation of medicinal plants is essentially required in view of the traditional use by the mankind with the control of air as well as water pollution. The tree cutting is to be restricted to bare minimum. For the protection of environment, the NGT Act, 2010 has got sufficient adjudicatory power at National level and also its Zonal Benches covering all States of the Country and any one can approach for redressal of grievance. The sustainable development concept is to be adhered to and the polluters pay principle is to be discouraged. The co-operation from all the persons only can preserve the natural ecosystem.

Surjya Sankar Mishra was Chief Environmental Scientist, State Pollution Control Board, Odisha, Bhubaneswar and former Senior Scientist (Pollution Control) in Forest & Env. Dept., Govt. of Odisha, Retired on May, 2023. I have served as Assistant Director in AICTE, New Delhi during (2013-14), as Assistant & Deputy Registrar at National Green Tribunal, Principal Bench, New Delhi (2014-2019) & Western Zone Bench, Pune from 2014-2019. I am thankful to the Dr. Purna Chandra Baral, Principal, Dhenkanal College, Dr. Anirudha Kumar Khillar, Ex-HOD PG Dept. of Botany also former HOD of Dhenkanal College, all Faculty Members and his colleague for their kind cooperation by extending invitation to attend the National Seminar. I am also grateful to my then teachers of Dhenkanal College, Botany Department, while I was

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COMPARATIVE ANALYSIS OF CHLOROPHYLL CONTENT IN SELECTED MEDICINAL PLANT SPECIES FROM FAKIR MOHAN UNIVERSITY, NEW CAMPUS, BALASORE, ODISHA

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ABSTRACT

Chlorophyll is the name given to the green pigment used by plants to produce food during the photosynthesis process. If bought over the counter as a supplement, it is referred to as chlorophyllin, which is a water-soluble version of chlorophyll containing copper and sodium. Health enthusiasts assert that chlorophyll has a wide range of benefits, including the ability to increase red blood cells, aid in weight reduction, mend damaged skin, remove toxins, reduce inflammation, and prevent cancer. In the present study, chlorophyll content from the leaves of forty medicinal plants available inside the campus of Fakir Mohan University was analysed. Methanolic extract of the plant samples showed presence of chlorophyll a in elevated amount as compared to chlorophyll b & total chlorophyll. All the 40 plants under study was categorized in 27 families. While comparing the chlorophyll content among the families Amaranthaceae showed highest chlorophyll concentration. Out of the 40 medicinal plants analysed maximum chlorophyll content was estimated in *Phyllanthus niruri*. The results obtained in the present study indicated that these 40 plant species studied for their chlorophyll profiling can be utilised as chlorophyll supplements. They can serve as relatively inexpensive and conveniently accessible source of chlorophyll for reaping the health benefits of chlorophyll component.

Introduction

Plants, in general, play an important role in medicinal properties for both preventive and curative purposes. Plant-derived substances known as phytochemicals have recently gained popularity due to their wide range of applications. Medicinal plants are the richest bioresource of drugs in traditional medicine, and they are also responsible for the various colours, flavours, and smells of plants⁶. Plants' medicinal values are found in chemically active substances that have a specific physiological action on the human body. There are thousands of medicinal plant species used around the world to treat various infections. These plants are used as antimicrobial agents, and several studies have been conducted (Kulkarni *et al.*, 2018). Photosynthetic pigments are the pigments that are utilised during the photosynthesis process. The coloured organic compounds known as pigments have the ability to absorb some light wavelengths while reflecting others. There are numerous varieties of chlorophyll found in plants. Chlorophyll production is a

physiological activity that only takes place in live cells. The existence of genetic elements is one of the prerequisites for the creation of chlorophyll. Higher plants' potential as a source of novel pharmaceuticals is yet largely untapped. As a result, research into plants as a source of novel biomolecules for the treatment of human diseases increased over the past ten years. Plants have historically been used extensively by man to heal human maladies (Kadam *et al.*, 2013)

Photosynthesis pigments Chlorophylls are essential for photosynthesis. Chlorophylls are found in pharmaceuticals, candles, soaps, tooth paste, and oil. The leaves are used to treat a variety of human ailments. The powdered leaves are beneficial for diphtheria. The leaves are diuretic, anthelmintic, and anti-worm. In some parts of Indo-China, the powdered leaves are used to treat diabetics (Shaikh *et al.*, 2023)

Chlorophyll is a green pigment found in plant and tree leaves and juvenile branches. Leaf chlorophyll concentration is an important measure for determining the quantity of chloroplast present in any sort of photosynthetic mechanism, which determines crop production and yield. Because chlorophyll is a crucial pigment for photosynthesis, photosynthesis is the most important source of energy for plant growth (Prashanti *et al.*, 2022).

The use of plants in healthcare is crucial. Most individuals in developing nations still exclusively use conventional medications made from natural plant sources. Medicinal plants can be used as dietary supplements or directly as part of the diet. People have been more aware recently of the benefits of using plant-based products in particular due to their high nutritional value and lack of harmful side effects. Greens are essential sources of protective food that are extremely helpful for maintaining excellent health and disease prevention. The leaf pigment of higher plants and green algae is known as chlorophyll. It gives them their green hue and allows photosynthesis to occur. There are four types of chlorophyll: a, b, c, and d. Chlorophyll has been shown to have several health benefits, including improved circulatory, digestive, immunological, and detoxification systems. Toxins are neutralised by chlorophyll, and cancer-causing substances are inhibited in their actions (Palvannan, 2016). Chlorophyll raises iron levels in the blood, which is particularly beneficial for pregnant or nursing mothers. Chlorophyll also aids in liver cleansing. Chlorophyll regulates blood sugar levels in the human body, which is beneficial to overall health and well-being. Chlorophyll has been reported to have antioxidant properties (Kumari *et al.*, 2016). Chlorophyllin (E141) is a green-colored chlorophyll pigment derivative used as a food additive and in alternative medicine (Ma *et al.*, 2020). Recent study indicates that chlorophyll provides medicinal and health benefits (Levent Inanç, 2011). Identification of local greens with high chlorophyll content will allow incorporate them into daily diet in their fresh state. These greens, in addition to their medical benefits, can be a low-cost source of this pigment. As a result, an attempt is made to estimate the amount of chlorophyll pigments in less commonly used edible greens, primarily to validate chlorophyll's nutritional and therapeutic properties.

Materials & Methods

Study area: Fakir Mohan University (new campus), Nuapadhi, Balasore, Odisha. Latitude 21.5442° N, longitude 86.8166° E.

Time of collection: January, 2023 to April, 2023

Method of plant collection: fresh plant samples were collected from the various sites of Fakir Mohan University. The collected plant parts were taken in paper bags and later identified using standardized procedure for plant identification at P G Department of Botany.

Plant material: a total 40 number of samples were collected for the analysis as given in the table below:

SL. NO	BOTANICAL NAME	FAMILY	COMMON NAME
1	<i>Lantanacamera</i>	Verbanaceae	Lantana
2	<i>Psidium guajava</i>	Myrtaceae	Guava
3	<i>Commelina benghalensis</i>	Commelinaceae	Tropical spiderwort
4	<i>Tridax procumbens</i>	Asteraceae	Coatbuttons
5	<i>Tamarindus indica</i>	Fabaceae	Tamarind
6	<i>Syzygium cumini</i>	Myrtaceae	Java Plum
7	<i>Ocimum tenuiflorum</i>	Lamiaceae	<i>Tulasi</i>
8	<i>Cynodon dactylon</i>	Poaceae	Bermuda grass
9	<i>Nyctanthes arbortristis</i>	Oleaceae	Night Blooming Jasmine
10	<i>Vinca rosea</i>	Apocynaceae	Madagascar Periwinkle
11	<i>Coriandrum sativum</i>	Apiaceae	Coriander
12	<i>Citrus medica</i>	Rutaceae	Fingered Citron
13	<i>Hibiscus rosasinensis</i>	Malvaceae	Chinese hibiscus
14	<i>Centella asiatica</i>	Apiaceae	Asiatic pennywort
15	<i>Phyllanthus emblica</i>	Euphorbiaceae	Indian gooseberry
16	<i>Moringa oleifera</i>	Moringaceae	Drumstick
17	<i>Ziziphus mauritiana</i>	Rhamnaceae	Indian jujube
18	<i>Mimosa pudica</i>	Fabaceae	Humble plant
19	<i>Alternanthera sessilis</i>	Amaranthaceae	Sissoo spinach
20	<i>Phyllanthus niruri</i>	Euphorbiaceae	Gale of the wind
21	<i>Mangifera indica</i>	Anacardiaceae	Mango
22	<i>Murraya konenigii</i>	Rutaceae	Curry Leaf
23	<i>Artocarpus heterophyllus</i>	Moraceae	Jackfruit

24	<i>Aegle marmelos</i>	Rutaceae	Bael
25	<i>Boerhavia diffusa</i>	Nyctaginaceae	Punarnava
26	<i>Amaranthus spinosus</i>	Amaranthaceae	spiny amaranth
27	<i>Amaranthus viridis</i>	Amaranthaceae	green amaranth
28	<i>Trigonella foenum graecum</i>	Fabaceae	fenugreek
29	<i>Ipomoea aquatica</i>	Convolvulaceae	Water Spinach
30	<i>Basella alba</i>	Basellaceae	Malabar spinach
31	<i>Allium sepa</i>	Liliaceae	shallots
32	<i>Bryophyllum pinnatum</i>	Crassulaceae	cathedral bells
33	<i>Momordica charantia</i>	Cucurbitaceae	Bitter-melon
34	<i>Euphorbia hirta</i>	Euphorbiaceae	Asthma plant
35	<i>Musa acuminata</i>	Musaceae	Cavendish banana
36	<i>Phyllanthus acidus</i>	Phyllanthaceae	Tahitian gooseberry
37	<i>Pongamia pinnata</i>	Fabaceae	karanja
38	<i>Glinus oppositifolius</i>	Molluginaceae	Bitter Cumin
39	<i>Azadirachta indica</i>	<u>Meliaceae</u>	Neem
40	<i>Marsilea minuta</i>	<u>Marsileaceae</u>	Water Clover

Experimental set up: The leaves were washed thoroughly under running tap water followed by rinsing with deionised distilled water. The leaves were then blotted dry with tissue paper. Mid rib of the leaves were removed and were cut into pieces of 5-19 mm² using aseptic scissors.

Extraction of chlorophyll: 1gm of fresh leaves of each plant was homogenized for 3 min in mortar and pestle with 5 ml cold 80% acetone under aseptic conditions. The homogenate was taken in a test tube and the volume was made up to 15ml using 80% acetone. The whole volume was then centrifuged at 5000 rpm for 5 minutes. The supernatant was transferred into a cuvette, and absorbance was measured spectrophotometrically using a UV-VIS spectrophotometer.

Chlorophyll measurement and calculation: The chlorophyll content of solution for each plant sample was measured by reading optical density (OD) on a spectrophotometer at 645 nm and 663 nm. The blank solution contained only acetone. The concentration of total chlorophyll, chlorophyll a, and chlorophyll b was estimated using the equations described by Arnon, 1949.

$$\text{Chl a (mg/g)} = \{ 12.7 * \text{OD}_{663} - 2.69 * \text{OD}_{645} \} * V / 1000 * W \dots\dots\dots(1)$$

$$\text{Chl b (mg/g)} = \{ 22.9 * \text{OD}_{645} - 4.68 * \text{OD}_{663} \} * V / 1000 * W \dots\dots\dots(2)$$

$$\text{Chl total (mg/g)} = \{ \text{Chl a} + \text{Chl b} = 20.2 * \text{OD}_{645} + 8.02 \text{OD}_{663} \} V / 1000 * W \dots\dots\dots(3)$$

Where,

V = final volume of chlorophyll extract in 80% acetone, and W = fresh weight of extracted tissue, which is 1 gm.

Results:

Chlorophyll a content in the selected samples ranged between 0.823 mg/g fresh tissue (*Musa acuminata*, Musaceae) to 0.189 mg/g fresh tissue (*Hibiscus rosasinensis*, Malvaceae). Chlorophyll b content ranged between 1.186 mg/g fresh tissue (*Artocarpusheterophyllus*, Moraceae) to 0.315 mg/g fresh tissue (*Bryophyllumpinnatum*, Crassulaceae). Total chlorophyll content was observed to be maximum in *Phyllanthus niruri* (1.951mg/g fresh tissue) and minimum in *Hibiscus rosa-sinensis* (0.332 mg/g fresh tissue). Among the 40 plants highest chlorophyll a containing plant was *Musa acuminata* belonging to Musaceae family and lowest was observed in *Hibiscus rosa-sinensis* belonging to Malvaceae. Highest chlorophyll b containing plant was *Artocarpus heterophyllus* belonging to Moraceae family and lowest was observed in *Bryophyllum pinnatum* belonging to Crassulaceae. Highest total chlorophyll containing plant was *Phyllanthus niruri* belonging to Euphorbiaceae family and lowest was observed in *Hibiscus rosa-sinensis* belonging to Malvaceae

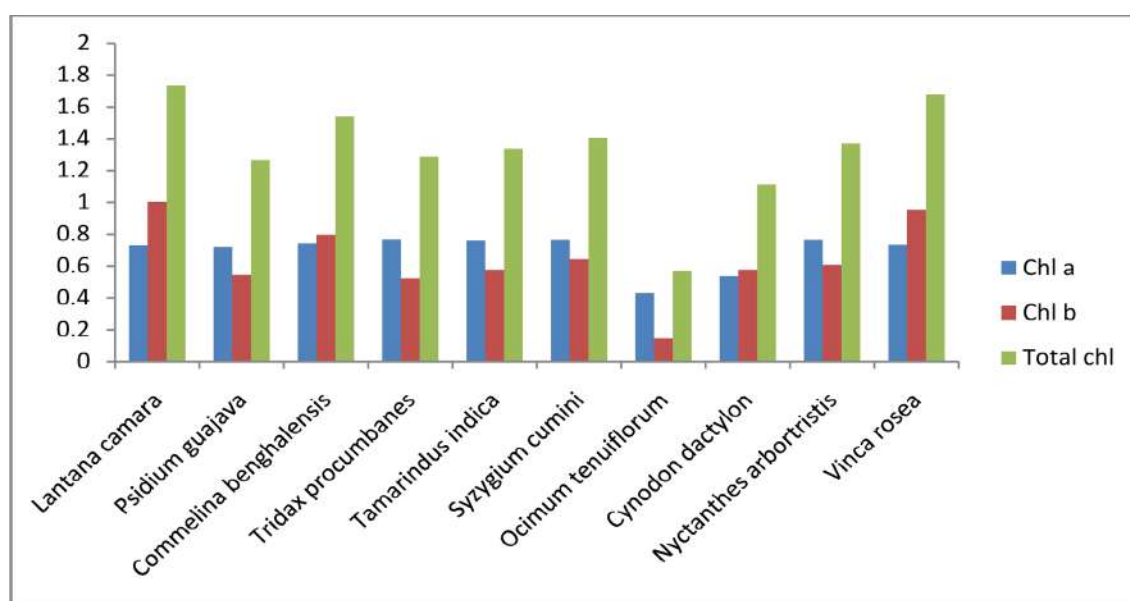


Fig 1: Chlorophyll concentrations of the selected plants using 80% acetone

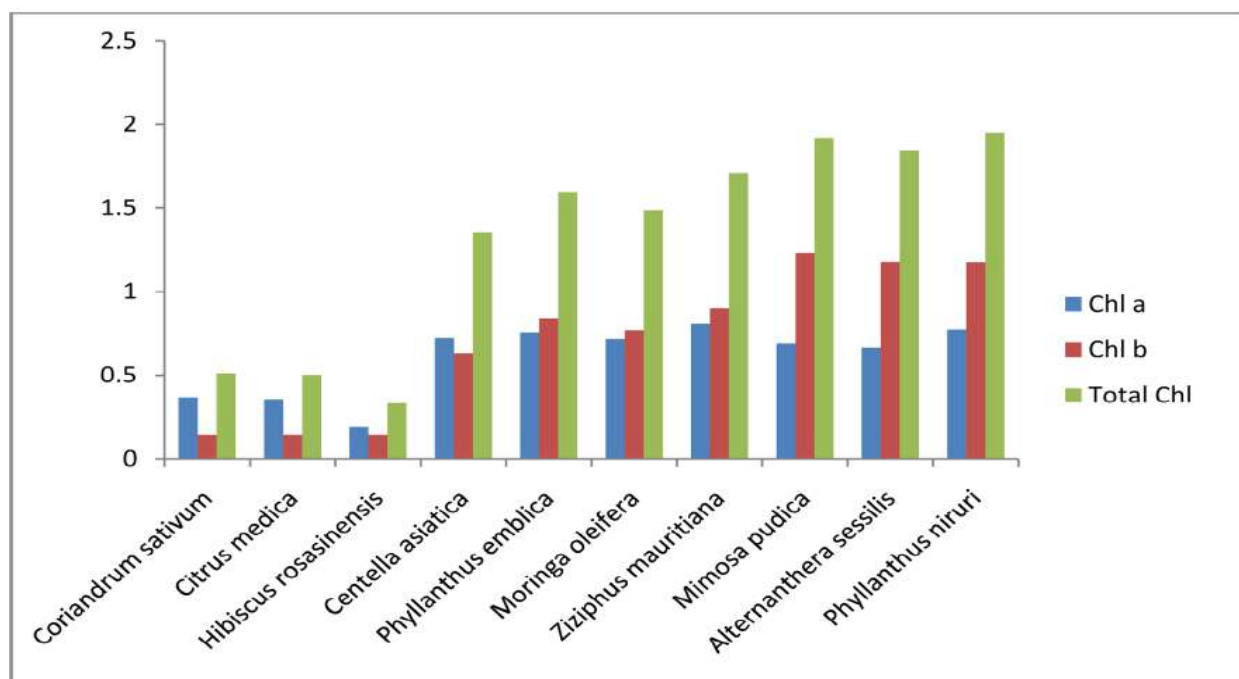


Fig 2: Chlorophyll concentrations of the selected plants using 80% acetone

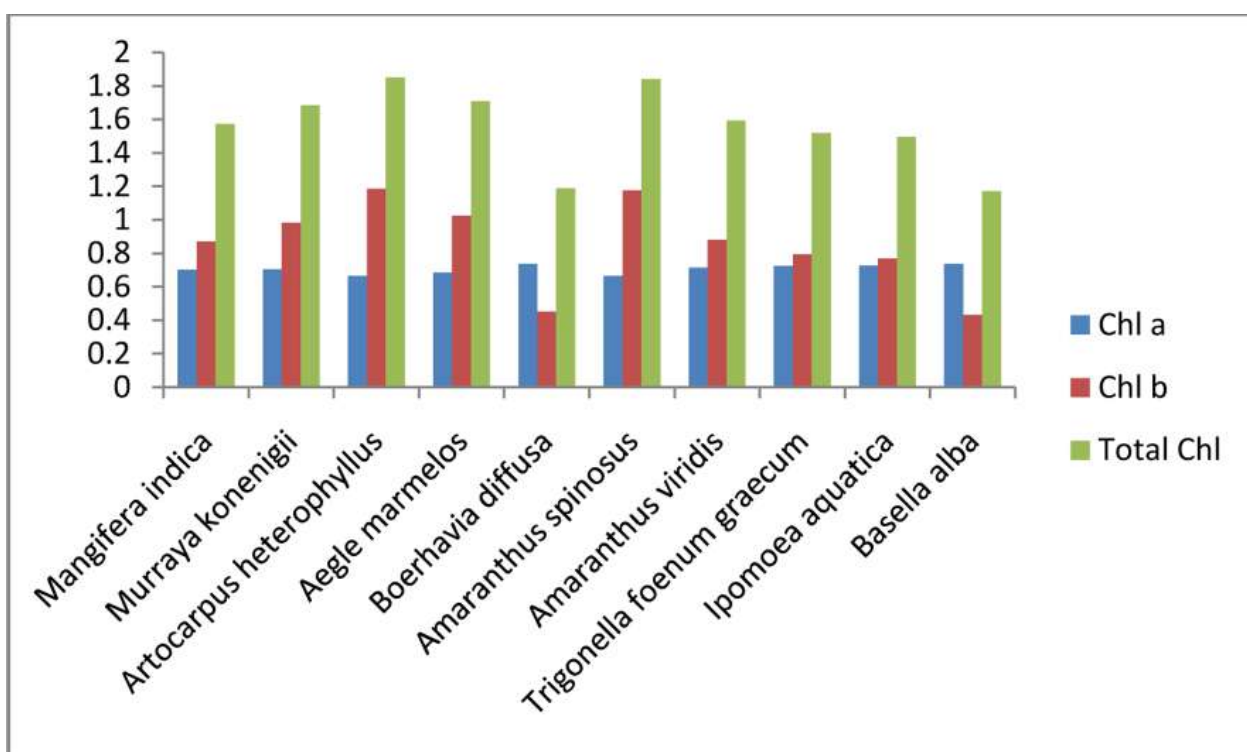


Fig 3: Chlorophyll concentrations of the selected plants using 80% acetone

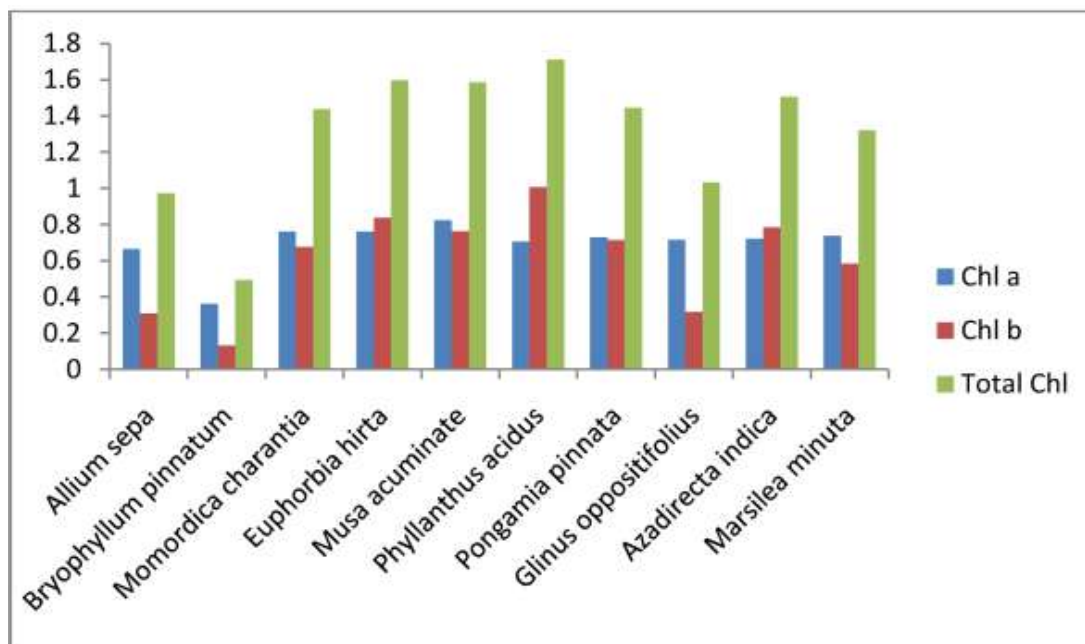


Fig 4: Chlorophyll concentrations of the selected plants using 80% acetone

Table 2 shows the comparison between the families and it was observed that Amaranthaceae showed highest content of chlorophyll.

Table 2- Comparative analysis of Chlorophyll a, Chlorophyll b and Total Chlorophyll between 6 Families

Family	Botanical name	Chl a (mg/g)	Chl b (mg/g)	Total Chl (mg/g)
Myrtaceae	<i>Psidium guajava</i>	0.719	0.542	1.261
Myrtaceae	<i>Syzygium cumini</i>	0.764	0.641	1.405
Rutaceae	<i>Citrus medica</i>	0.358	0.144	0.502
Rutaceae	<i>Murraya konenigii</i>	0.704	0.982	1.686
Fabaceae	<i>Trigonella foenum graecum</i>	0.724	0.794	1.518
Fabaceae	<i>Mimosa pudica</i>	0.689	1.230	1.919
Fabaceae	<i>Tamarindus indica</i>	0.756	0.578	1.334
Fabaceae	<i>Pongamia pinnata</i>	0.73	0.714	1.444
Euphorbiaceae	<i>Euphorbia hirta</i>	0.761	0.837	1.598
Euphorbiaceae	<i>Phyllanthus niruri</i>	0.774	1.177	1.951

Euphorbiaceae	<i>Phyllanthus emblica</i>	0.757	0.837	1.594
Amaranthaceae	<i>Amaranthus viridis</i>	0.714	0.880	1.594
Amaranthaceae	<i>Amaranthus spinosus</i>	0.665	1.176	1.841
Amaranthaceae	<i>Alternanthera sessilis</i>	0.665	1.179	1.844
Apiaceae	<i>Centella asiatica</i>	0.719	0.633	1.352
Apiaceae	<i>Coriandrum sativum</i>	0.368	0.143	0.511

Table 3. Comparitive analysis of Average Chlorophyll a, Chlorophyll b and Total Chlorophyll between 6 Families

Family	Average Total chlorophyll a (mg/g tissue)	Average Total chlorophyll b (mg/g tissue)	Average Total chlorophyll (mg/g tissue)
Myrtaceae	0.744	0.591	1.333
Rutaceae	0.531	0.563	1.094
Fabaceae	0.724	0.829	1.553
Euphorbiaceae	0.764	0.950	1.714
Amaranthaceae	0.681	1.078	1.759
Apiaceae	0.543	0.388	0.931

From Table 3, it was observed that the average chlorophyll a content was observed to be maximum in the family Euphorbiaceae (0.764mg/g tissue) and minimum in the family Rutaceae (0.531mg/g tissue). The maximum average chlorophyll b amount was observed in Amaranthaceae (1.078mg/g tissue) and minimum was observed in Apiaceae (0.388 mg/g tissue). In the current study it was observed that the maximum average total chlorophyll was estimated in the family Amaranthaceae (1.759mg/g tissue) and minimum was estimated in Apiaceae (0.931mg/g tissue).

Discussion:

The present study was aimed at elucidating the chlorophyll content of 40 different species collected from in and around F M University, new campus, Nuapadhi, Balasore, Odisha. The result obtained showed difference in the degree of chlorophyll content among the selected species. Chlorophyll plays a crucial role in the photosynthetic process. They absorb solar radiation and

convert it into chemical energy which is stored in plants in the form of sugars. Thus chlorophyll content in leaves gives an indirect method for determining the photosynthetic potential and primary production in plants. Recent research has shown a positive correlation between leaf chlorophyll content and photosynthetic capacity of the plants. The results obtained in the present study indicated that, out of the 40 plants total chlorophyll content was maximum in *Mimosa pudica* belonging to family Fabaceae (1.919 mg/g fresh tissue) and minimum in *Hibiscus rosa-sinensis* belonging to family Malvaceae (0.332 mg/g fresh tissue). However the plant with highest total chlorophyll content was found to be *Phyllanthus niruri*, followed by *Mimosa pudica*, *Artocarpus heterophyllus*, and *Alternanthera sessilis*. However the family with average highest total chlorophyll content was found to be Amaranthaceae followed by Euphorbiaceae, Fabaceae, Myrtaceae, Rutaceae and Apiaceae.

All of the plants mentioned in the study are common and have a variety of pharmacological properties. The observations of the current study helped to understand the photosynthetic growth potential of the medicinal plants. Chlorophyll shows structural similarities to human blood and therefore shows several health benefits. Thus plants act as relatively inexpensive and very easily accessible source of chlorophyll which can be used as chlorophyll supplements for reaping health benefits for humans. Primary metabolites like chlorophyll act as precursor for secondary metabolites like flavonoids, polyphenols, alkaloids, etc which play key role in formulation of drugs (Balakrishnan *et al.*, 2020). Thus the data from the current study signifies important area of research where the medicinal plants under study can be exploited for therapeutic purposes based on their chlorophyll content. Singh *et al.*, 2001 studied Chlorophyll Content of Some Selected Edible Plants Sourced from Ima Market, Manipur, India. He concluded that using 80% acetone as an extractant solvent, of the 19 plant samples investigated, *P. posumber* had the highest chlorophyll concentration and *H. cannabinus* has the lowest. It was also discovered that the appropriateness of solvents employed in extracting chlorophyll varied with plant type. It has been discovered that the extraction of chlorophyll by various solvents is dependent on the plant type as well as the chemical composition of biomolecules. However in the present work all estimations were done using 80% acetone and it revealed that all families showed comparable data.

The results obtained in the present study indicated that these 40 plant species studied for their chlorophyll profiling can be utilised as chlorophyll supplements. They can serve as relatively inexpensive and conveniently accessible source of chlorophyll for reaping the health benefits of chlorophyll component.

Conclusion:

All the 40 medicinal plants mentioned in the current study are habitual and possess many

other pharmacological properties. Moreover all the plants showed higher photosynthetic capacity and growth potential related to high concentrations of chlorophyll. The study focused on how these medicinal plants can be used as chlorophyll supplements along with their other therapeutic potential. The study presented a preliminary profiling of the chlorophyll content in various medicinal plants from F M University, new campus, which could be an innovative initiative for the benefit of students as well as local people and also serve as a trailblazing tool for practical work.

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QUALITATIVE PHYTOCHEMICAL ANALYSIS OF SELECTED MEDICINAL PLANT SPECIES IN FAKIR MOHAN UNIVERSITY, NEW CAMPUS, BALASORE, ODISHA

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ABSTRACT

Plants are the primary producers of various metabolites which provide crucial support to the living world for their sustenance. Medicinal plants contain secondary metabolites with therapeutic properties which can benefit humans in varied ways. Moreover, phytochemicals give colour and organoleptic quality to the plants. The present study, was undertaken to assess the presence of phytochemicals in 12 medicinal plants namely *Lantana camara*, *Rauwolfia tetraphylla*, *Psidium guajava*, *Nyactanthus arbortritis*, *Syzgium cumini*, *Azadirachta indica*, *Tamarindus indica*, *Phyllanthus emblica*, *Centella asiatica*, *Murraya koenigii*, *Chromolaena odorata* and *Vinca rose* collected from Fakir Mohan University, new campus, Balasore. Methanolic extract of the dried leaves was used to carry out all the phytochemical tests. All the plants showed presence of different types secondary metabolites indicating the curative role played by these plants in medicine as well as in traditional uses. Presence of flavonoids and phenols signify the antioxidative properties of these plants. Terpenoids and saponins play crucial role in assigning therapeutic potential to these plants. Highest concentration of flavonoids and phenol were found in *Centella asiatica* and *Rauwolfia tetraphylla* respectively. Tannins content was maximum in *Psidium guajava*. However, steroid was observed to be present only in *Syzgium cumini*.

Keywords: Medicinal plants, Phytochemicals, Secondary metabolites, Qualitative analysis

Introduction:

A medicinal plant is defined as any species that contain secondary metabolites that can be used for therapeutic treatment or can be used for synthesis of new drugs. Natural herbs have been said to possess a variety of therapeutic effects. According to (Octaviana *et al.*, 2015), medicinal plants are the primary source of innovative medications and healthcare goods. Plants have been utilized medicinally for at least as long as there has been humankind. The extraction and creation of numerous medications from these plants as well as conventionally used folk medicine have been linked to the usage of medicinal plants in industrialised civilizations. Some high activity profile medications have been created through the extraction and characterisation of various

active phyto-compounds from these green factories. India uses a lot of traditional medicine (Osabor *et al.*, 2015).

There is increasing evidence that secondary plant metabolites. Phytochemicals are the naturally occurring chemical substances in plants. They give the plant its colour and organoleptic qualities. Although they are easily accessible in many locations as a dietary supplement, phytochemicals' dormant health benefits can only be accessed by consuming the entire plant. Phytochemicals are useful for enhancing immune system responses and provide immunity to numerous diseases. Phenols, tannins, flavonoids, saponins, carbohydrates, alkaloids, phytosterols, and other phytochemicals are recognised to have therapeutic and physiological effects. Small researchers have always asserted that a plant's therapeutic or curative characteristics are medical. Recent studies have examined the occurrence of phytochemicals in therapeutic plants all around the world. *Azadirachta indica* is an anti-inflammatory and anti-nociceptive effects are important characteristics of traditional medicinal plants against numerous diseases. Therefore, medicinal plants exhibit these therapeutic characteristics as a result of the existence of bioactive ingredients (Madike *et al.*, 2017). Keeping in view the therapeutic potential of the medicinal plants, the present study was undertaken to qualitatively assess the phytochemical properties of commonly available medicinal plants in Fakir Mohan University campus.

Materials & Methods:

Area of collection: Fakir Mohan University (new campus), Nuapadhi, Balasore, Odisha latitude 21.5442° N, longitude 86.8166° E

Time of collection: January, 2023 to April, 2023

Plant collection method: fresh plant samples were collected from the various site of Fakir Mohan University. The collected plants were taken in paperbags and later identified using standardized procedure for plant identification at PG Department of Botany, FM University. The plants collected are tabulated below:

Figure1. List of plants with their respective scientific name, family and common name

SL.No.	BOTANICAL NAME	FAMILY	COMMON NAME
1	<i>Lantana camara</i>	Verbanaceae	Raimuniya
2	<i>Rauvolfia tetraphylla</i>	Apocyanaceae	Wild snake root
3	<i>Psidium guajava</i>	Myrtaceae	Guava
4	<i>Nyactanthus arbortritis</i>	Oleaceae	Night blooming jasmine
5	<i>Syzgium cumini</i>	Myrtaceae	Jambolan

6	<i>Azadirachta indica</i>	Meliaceae	Neem
7	<i>Tamarindus indica</i>	Fabaceae	Tamarind
8	<i>Phyllanthus emblica</i>	Euphorbiaceae	Amala
9	<i>Centella asiatica</i>	Apiaceae	Gotu kola
10	<i>Murraya keingii</i>	Rutaceae	Curry leaf
11	<i>Chroleana odorata</i>	Asteraceae	Jack in the bush
12	<i>Vinca rosea leaf</i>	Apocyanaceae	Sadabahar

Preparation of plant sample: The collected plant samples were washed under running tap water followed by rinsing in deionised distilled water. After washing the plant samples were dried for 5 to 7 days under shade condition until all the water molecules evaporated. After drying the plant sample were grounded into fine powder individually using mechanical blender. The powdered samples were transformed into sealed containers with proper labeling until further use.

Preparation of plant extract: 1 gram of finely powdered dried sample was taken in a beaker. To it 50 ml of 50% methanol was added after which the beaker was kept in an orbital shaker at 150 rpm for 48 hour. After 48 hour the ingredient of the beaker were filtered with Whatman's filter paper. The extracts were stored in dark coloured bottles for future use.

Phytochemical screening: The different qualitative tests were carried out using methanolic extract of the plant samples. The qualitative outcomes were expressed as presence of (+) or absence (-) of any phyto-constituent.

Test for phenol: Test for phenol was carried out the following method of Doss *et al.*, 2009. 5ml of extract is diluted with distilled water. To this few drops of 5% ferric chloride solution was added. A green colour indicates the presence of phenolic compound.

Test for flavonoids: Test for flavonoids was carried out the following method of Yadab & Agarwala 2011. Extract was mixed with 2ml of 2% solution of NaOH. An intense yellow colour was formed which turned colourless on addition of few drops of diluted acid which indicates the presence of flavonoids.

Test for tannins: Test for tannins was carried out the following method of Doss *et al.*, 2009. 5ml of extract is treated with few drops of ferric chloride solution. Development of blue green colour in the extract shows the presence of tannins.

Test for Saponins: Test for Saponin was carried out the following method of Bansal *et al.*, 2013. Each of the plant extract was diluted with distilled water and shaken in graduated cylinder

for 15 minutes. The formation of Layer of stable foam indicated the presence of saponins.

Test for Terpenoids: Test for terpenoids was carried out following the method of Farhan *et al.*, 2012. To each of the extract, 2ml of chloroform was added. To it 3ml of concentrated sulphuric acid was carefully added along the side of the test tube to form a layer. A reddish brown colour of the interface indicates the presence of terpenoids.

Test for steroids: Test for steroid was carried out following the method of Farhan *et al.*, 2012. Each of the extract was treated with chloroform and then to the chloroform layer Sulphuric acid was added slowly by the side of the test tube. Formation of red colour indicates the presence of steroids.

Test for carbohydrates: Test for carbohydrate was carried out following the methods of Bansal *et al.*, 2013. Crude extract when mixed with 2ml of benedicts reagent and boiled, a reddish brown precipitate was formed which indicates the presence of carbohydrates.

Result & Discussion

Leaves of 12 medicinal plants available in Fakir Mohan University, new campus, Balasore, namely *Lantana camara*, *Rauvolfia tetraphylla*, *Psidium guajava*, *Nyactanthus arbortritis*, *Syzgium cumini*, *Azadirecta indica*, *Tamarindus indica*, *Phyllanthus emblica*, *Centella asiatica*, *Murraya koeingii*, *Chromoleamna odorata*, *Vinca rosea* were analysed for the presence of phytochemicals employing various chemical tests. Methanolic extract of the Leaves of all the medicinal plants indicated the presence of varied types of metabolites in these plants. Phytochemical constituents of the 12 medicinal plants are shown in the Table 2.

Table 1. Phytochemical screening of different medicinal plants collected from Fakir Mohan University, new campus, Balasore, Odisha

Plants name	Phenol	Tannins	Flavonoids	Saponins	Terpinoids	Steroids	Carbohydrates
<i>Lantana camara</i>	+	–	–	–	–	–	–
<i>Rauvolfia tetraphylla</i>	++	–	–	++	–	–	+
<i>Psidium guajava</i>	–	++	–	+	++	–	++
<i>Nyactanthus arbortritis</i> (Leaf)	+	–	–	+	–	–	+
<i>Syzgium cumini</i>	–	+	+	+	+	+	++

<i>Azadirachta indica</i>	+	–	+	–	+	–	+
<i>Tamarindus indica</i>	+	–	+	+	–	–	–
<i>Phyllanthus emblica</i>	–	–	–	+	++	–	++
<i>Centella asiatica</i>	+	–	++	+	+	–	+
<i>Murraya koenigii</i>	+	–	–	–	+	–	+
<i>Chromolaena odorata</i>	+	–	–	+	++	–	+

In the present study qualitative analysis for phytochemical properties of medicinal plants collected from FM University, new campus, was carried out. All the plant samples showed presence of important phytochemicals which have medicinal implication in the drug discovery arena.

The presence of essential phytochemicals in the plant extract of the 12 medicinal plants collected from F M University campus ascertain the importance of these plants as rich resource of ingredients with therapeutic properties. However, the difference in the distribution of these essential phytochemicals across the selected plant samples may be due to the geographical location of the plants and/or due to the solvent system used in the extraction process.

From the present study it can be concluded that the methanolic extract of the medicinal plants collected from Fakir Mohan University act as reservoir of biologically important secondary metabolites. These secondary metabolites (phytochemicals) serve as natural significant antioxidants and provide protection against harmful oxidants. The wide diversity of phytochemicals reported in the samples studied under this current work is responsible for its copious medicinal and traditional uses. However, it can be suggested that further research can be taken up to assess the bioavailability of these secondary metabolites with other extraction solvents to maximize their efficiency. This report presents a preliminary template based on which novel therapeutic plant based agents with curative possibilities can be developed.

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PROSPECTS OF NUTRI-CEREALS IN ODISHA

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1. INTRODUCTION

Hidden hunger and micronutrient malnutrition are now the global matter of concern owing to daily death of 24,000 people (Fiaz *et al.*, 2019). Worldwide, the major staple foods like rice, wheat, or maize is consumed, mainly contributing to solve the problem of hunger, yet “hidden hunger” still prolongs in the world. Again, with increasing population the production of wheat and rice are facing loss of productivity because of indeterminate climatic changes, less availability of water for irrigation, uneven weather conditions and global warming. The present and anticipated global food demand hence necessitates switching for the climate resilient and smart alternate crops. Under this situation, millets are the critical plant genetic resources for the agriculture that extends food security. The name “Millet” has been derived from the word “mil or thousand” is referring to the large number of grains that can be produced from a single seed. Millets are the common small-seeded annual grasses or cereals belongs to the family *Poaceae* native to Ethiopia and successfully adopted by the India, China, Australia, Africa, and some regions of the United States of America (U.S.A.) (Saini *et al.*, 2021).

Due to its high nutritional qualities, these are considered as Nutri-cereals. Indian Council of Agricultural Research and Indian Institute of Millets Research (ICAR-IIMR) has described Nutri-cereals as highly nutritious grains that contain a comparable amount of nutrients to staple food (Saini *et al.*, 2021). These small-grained cereals are grown in warm-weather conditions. They are mostly rain-fed, hardy grains which have low requirements for water and fertility as compared to other popular cereals. These are resilient to drought, climate change other extreme weather conditions holding the suitability to address the issues of hidden hunger and climate change.

Globally, India is the largest producer and consumer of millets (APEDA, 2023). Odisha, one of the state of India that is historically rich and culturally diverse with several ethnic tribes, a place with immense tourism opportunity for exploring heritage of hidden gems tucked in different corners of the state.

Agriculture in Odisha faces problem due to small size land holdings, high land areas, unpredictable rain fall and frequent occurrence of natural calamities. The State has a cultivated

area of 61.80 lakh ha out of which 29.14 lakh ha is high land that are more prone to the risk of various stresses. Under these circumstances, the millets can be cultivated smoothly with least investment as the crop can flourish under a variety of harsh environmental conditions, may be grown on low fertility soils and above all is not reliant on the use of chemical fertilizers.

2. MAJOR TYPES OF NUTRI-CEREALS

The Nutri-cereals have been categorized in to 8 major different types. The scientific names and their vernacular names in Hindi and Odia are given in Table 1. Out of these, Foxtail Millet, Kodo Millet, Little Millet, Barnyard Millet and Proso millet are small millets.

Table-1: Nomenclature of Nutri-cereals

Sl no.	Common name	Scientific name	Vernacular name (Hindi)	Vernacular name (Odia)
1	Finger Millet	<i>Eleusine coracana</i> L.	Ragi/Mandu	Mandia
2	Pearl Millet	<i>Pennisetum glaucum</i> (L.) R.Br.	Bajra	Bajra
3	Sorghum	<i>Sorghum bicolor</i> (L.). Moench	Jowar	Juara
4	Foxtail Millet	<i>Setaria italica</i> L.	Kakun, Kangni, Rala	Kanghu, Kangam, Kora
5	Kodo Millet	<i>Paspalum scrobiculatum</i> L.	Kodo, Kodra, Koden	Kodua
6	Little Millet	<i>Panicum sumatrense</i> Roth. ex. Roem.&Schult	Kutki	Suan, Gurji, Koshala
7	BarnYard Millet	<i>Echinochloa frumentacea</i> Link	Sanwa, Jhangora	Khira
8	Proso millet	<i>Panicum miliaceum</i> L.	Cheena	Cheena

Finger Millet (Ragi): It is cultivated over 1.19 million hectares in India and accounts for around 85% all millets produced in India (Sakammaet *al.*, 2018).The unique potential of this crop is to tolerate high temperatures, requires less water, can cope up with climate vulnerability and suitable for farmers with marginal lands too.Finger millet is the richest source of calcium (300-350 mg/ 100 g). They have the essential amino acids like lysine and methionine.

Pearl Millet: Pearl millet is one of the most widely grown millet varieties. It is known for its

large, round grains. This millet is commonly cultivated in arid and semi-arid regions of Africa and India. It is often ground into flour and used to make unleavened bread, porridge, and traditional beverages. The presence of magnesium can aid the treatment of migraines and also can reduce the respiratory problems in asthmatic patients (Ambati and Sucharitha 2019).

Sorghum: Worldwide sorghum is the fifth highest produced crop and fourth in India (Saini *et al.*, 2021). The major portion of sorghum protein is prolamin that has a unique feature of lowering digestibility upon cooking. It is rich in protein, fibre, thiamine, riboflavin, folic acid, α -carotene, potassium, phosphorus and calcium with sufficient amounts of iron, zinc and sodium.

Foxtail Millet: The millet is known for its small, fox-tail-shaped grains. It is a drought tolerant crop and is cultivated in many parts of Asia. It gives a sweet nutty flavour and is considered to be one of the most digestible and non-allergic grains. It contains catechin, quercetin, apigenin, kempherol that helps in combating diabetes, cardiovascular disease, maintaining dyslipidemia. Due to the magnesium content it is known as healthy heart food. It is anti-microbial, anti-tumorigenic and help in body detoxification (Thakur and Tiwari 2019).

Kodo Millet: Kodo millet strengthens the nervous system as it has high lecithin. Due to lack of gluten, it is used by the gluten or wheat intolerance people (Saini *et al.*, 2021). Kodo millet is rich in B vitamins especially niacin, pyridoxin and folic acid as well as the minerals such as calcium, iron, potassium, magnesium and zinc.

Little Millet: Little millet, as the name suggests, has small grains as compared to others. It is high in iron content with high antioxidant activities. It contains about 38% of dietary fibre. Germinating little millets are the good sources of α -amylase with higher purity and specific yield (Usha *et al.*, 2011).

Barnyard Millet: Barnyard millet is known for its fast growth and short cultivation period (Singh *et al.*, 2019). It is the richest source of crude fibre and iron. Its grains possess other functional constituents i.e., Gamma amino butyric acid (GABA) and Beta-glucan, used as antioxidants. and in reducing blood lipid levels.

Proso Millet: It has small, round grains that can be white, yellow, or red. It is a cheaper source of manganese as compared to other conventional sources like spices and nuts. It contains high amounts of calcium which is essential for bone growth and maintenance. It reduces cholesterol levels and also reduces the risk of heart diseases (Rao *et al.*, 2018).

1. NUTRITIONAL VALUES OF MILLETS

Each type of millet offers distinct flavours and nutritional benefits. They are gluten-free, low in glycaemic index, and packed with essential nutrients, making them an excellent choice for those seeking alternative grains in their diet. The nutritional values of major types of millets

along with wheat and rice have given in Table-2 as per the data from National Institute of Nutrition (NIN), Hyderabad. Compared to rice and wheat, most of them have high amount of protein, fibre and minerals. Although the ragi has lesser amount of protein (7.3g), but it is exceptionally rich in mineral matter and calcium when compared to wheat and rice. Finger millet is the richest source of calcium (344 mg/100 g grains). The small millets like barnyard millet (14.7g), Kodo millet (9g) little millet (8.6g) and foxtail millet (8.0g) are the richest in fibre in comparison to wheat (1.2g) and rice (0.2 g/100 g grains) (Table 2).

Table-2: Nutritional proximate composition of millets as compared with major cereal crops (Per 100g)

Commodity	Protein (g)	Carbohydrates (g)	Fat (g)	Crude fibre (g)	Mineral matter (g)	Calcium (mg)	Phosphorus (mg)
Sorghum	10.4	72.6	1.9	1.6	1.6	25	222
Pearl millet	11.6	67.5	5.0	1.2	2.3	42	296
Finger millet	7.3	72.0	1.3	3.6	2.7	344	283
Proso millet	12.5	70.4	1.1	2.2	1.9	14	206
Foxtail millet	12.3	60.9	4.3	8.0	3.3	31	290
Kodo millet	8.3	65.9	1.4	9.0	2.6	27	188
Little millet	8.7	75.7	5.3	8.6	1.7	1.7	220
Barnyard millet	11.6	74.3	5.8	14.7	4.7	14	121
Barley	11.5	69.6	1.3	3.9	1.2	26	215
Maize	11.5	66.2	3.6	2.7	1.5	20	348
Wheat	11.8	71.2	1.5	1.2	1.5	41	306
Rice	6.8	78.2	0.5	0.2	0.6	10	160

Considering the nutritive value of Nutri-Cereals, in 2018 millets were officially declared as “Nutri-cereals” and were made part of the National Food Security Mission (NFSM). The same year, 2018 was declared as ‘national year of millets’ by Government of India (GoI) (NITI Aayog, 2018). Remarkably, FAO has considered this year i.e. 2023 as International Year of Millets. Due to higher nutritive value, Nutri-cereals have good prospects of penetrating the food baskets of a wider range of consumers, both rural & urban and poor & rich in the country.

1. CROP SCENARIO IN ODISHA

Out of these millets, finger millet (Mandia) and little millet (Suan) are mostly grown in Odisha. The major ragi growing districts are Koraput, Ganjam, Rayagada and Gajapati. The total millet growing area is 1.66 lakh ha with production of 1.59 lakh tones in the year 2020-21 of which finger millet occupies more than 70% of area (1.24 lakh ha) with a production of 1.37 lakh tones (Report: Odisha Millet Mission).

Production constraints in Odisha

Millet crops face several bio-physical and technological constraints in the state, which need to be addressed. Majority of millet area is cultivated in rain fed condition under traditional/indigenous landraces with low yield potential. Small millets cannot compete with remunerative crops like vegetables, cotton, groundnut, maize and cowpea. Inadequate awareness among general public about alternative uses and value added products of millets also reduces the demand of the crop. Non-adoption of scientific method of cultivation with poor nutrient management practices result in low yield of the crop. High labour requirements and the tedious work dissuade the farmers from taking up these crops.

State mission on millets

Special Programme for Promotion of Millets in Tribal Areas of Odisha (Odisha Millets Mission) was launched by **Department of Agriculture & Farmers Empowerment, Govt. of Odisha** in 2017 to revive millets in farms and on plates. It emerged from a consultation between directorate of agriculture and food production, Government of Odisha, Academia (Nabakrushna Choudhury Centre for Developmental Studies) and Civil Society (RRA Network, WASSAN Network and local NGOS). It was first agriculture programme with priority on increasing consumption in Odisha.

Major objectives of the mission:

- Promoting and increasing household level Consumption of millets
- Setting up decentralized Processing unit
- Improving Productivity of Millet Crops and make them profitable.
- Developing millet enterprises and establishing market linkages to rural/urban markets with focus on women entrepreneurs.
- Inclusion of millets in state nutrition programs like ICDS, and PDS

Other Key Initiatives taken by Government of Odisha for promotion of Nutri-cereals.

1. **Price Support Scheme (PSS):** Provides financial assistance to farmers for the cultivation of millets. Odisha became the first state to declare direct incentive to farmers for three years through DBT

- 2. Minimum Support Price:** Minimum Support Price for Millets introduced in Odisha. Procurement of Ragi is done at Minimum Support Price in Odisha
- 3. Development of Value-Added Products:** Encourages the production of value-added millet-based products to increase the demand and consumption of millets
- 4. Promoting Millets in PDS:** The government has introduced millets in the Public Distribution System to make it accessible and affordable to the masses
- 5. Improved Agronomy in Millet Crops:** Odisha became first state to develop standards/specifications for the minor millet machinery through recognised panel of experts from different scientific institutions.
- 6. Inclusion in supplementary nutrition Programme (SNP) - ICDS & Mid-Day Meal (MDM):** Odisha is the first state to include Ragi laddu in ICDS through support of District Mineral Foundation.
- 7. Promotion of Organic Farming:** The government is promoting organic farming of millets to increase the production and consumption of organic millets.

Association of tribes of Odisha with Nutri-cereals

Millets constitute one of the oldest forms of food, particularly in the tribal regions of Odisha. Specifically, millets have played a significant role in the dietary and cultural practices of tribal communities. The knowledge of how to grow, process, and cook millets is passed down through generations, forming an integral part of their traditional wisdom. This knowledge holds immense cultural and historical significance and connects the tribal communities to their land, their ancestors, and their identity. Preservation of this knowledge is essential for maintaining the unique cultural heritage of these tribes. Tribal communities predominantly cultivate local landraces of millets using traditional agronomic practices. The Kondh tribe, one of the largest tribal communities in Odisha, is well-known for cultivating millets, especially finger millet. Millets are a significant part of their diet, and they use ragi to make a variety of traditional dishes. The Saura tribe, primarily found in the Gajapati and Ganjam districts of Odisha, the Paraja tribe, found in the Koraput and Rayagada districts of Odisha and the Kutia Kondh tribe, primarily residing in the Kandhamal district of Odisha have a history of millet cultivation and are known for their millet cultivation practices.

2. FUTURE PROSPECTS

Adequate public support can make millet cultivation profitable. Small farmers in hilly regions and dryland plains who are among the poorest households in rural Odisha and other parts of the country will cultivate millets only if it gives them good returns. Lack of awareness about millets and their health benefits can be addressed through education and promotion. Improving the availability of millets in markets and making them more accessible to consumers can encourage consumption. The perception of millets as a poor man's food needs to be changed through marketing

and promotion. Without quality seed it is very difficult to achieve targeted yield or in other words we cannot think about crop production. The investment on other inputs like irrigation, weeding, plant protection, harvesting etc. is useful only if quality seed is used for sowing. The genotypes are sensitive to weather and soil conditions so only recommended varieties should be used for sowing. Popularization of high yielding bio-fortified varieties/hybrids resistant to biotic and abiotic stresses is again an important factor which should be taken care for higher productivity. Improving processing techniques and increasing the availability of value-added millet based products can make them more appealing to consumers. Collaboration between farmers, processors, and marketers can help increase the supply and demand of millets.

3. CONCLUSION

Strategic planning, technology development and timely action can enhance the area and productivity of millet crops in the state. Nutritional quality and drought-resistant properties of millets have drawn attention of various researchers all over the world and have increased focus to improve the millet varieties and to enhance their use in processed food products. Generation of location specific technology and development of suitable high yielding & disease-pest resistant varieties can ensure good yield of the crop. Adequate marketing infrastructure and ensuring minimum support price for products of millet crops will be very much helpful to encourage farmers for growing the crop.

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AN EFFECTIVE PLANT BASED APPROACH TO THE MANAGEMENT OF HYPERCHOLESTEROLEMIA

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HYPERCHOLESTEROLEMIA or Hyperlipidaemia refers to elevated levels of lipids (fats) in the blood. The condition is often characterized by high levels of cholesterol and/or triglycerides. Lipids are essential for various bodily functions, but an excess of these substances in the bloodstream can lead to health problems, particularly cardiovascular diseases.

Hyperlipidaemia can be caused by various factors, including genetics, diet, lifestyle, and certain medical conditions. Poor dietary habits, lack of physical activity, obesity, and diabetes are among the lifestyle factors that can contribute to elevated lipid levels.

PLANT BASED MANAGEMENT OF HYPERCHOLESTEROLEMIA:

As conventional medications such as statins commonly used to manage hyperlipidaemia, have many adverse health effects, there has been growing interest in the role of herbal medicine as complementary or alternative approaches, which are effective and do not have adverse effects.

EXAMPLES :

a) Artichoke (*Cynaracardunculusvar.scolymus*) leaf extract.

The researchers stated that using artichoke leaf extract supplements may work in combination with lipid-lowering therapy, specifically in those with hyperlipidemia.

b) Fenugreek seeds and leaves.

Studies show that fenugreek supplements may help lower blood cholesterol levels. According to a 2020 meta-analysis trusted Source, researchers found that evidence supports the use of fenugreek supplements to help lower cholesterol levels in people with diabetes.

c) Yarrow (*Achillea millefolium*)

Taking a yarrow supplement may help with cholesterol. However, studies specifically looking at it in humans are currently lacking.

d) Holy basil (*Ocimum tenuiflorum*)

A 2018 study looked at how holy basil affects adults 40 years and older with metabolic disorders. It found that a higher dose causes total and LDL cholesterol levels to drop. A person needs to consume at least 1 gram (g) per day to achieve this.

e) Ginger (*Gingiber officinale*) :

In a 2018 systematic review and meta-analysis Trusted Source, researchers looked at 12 trials. The studies suggested that low doses of ginger, less than 2 g per day, had a good effect on lowering both triglyceride and LDL cholesterol levels.

f)Turmeric (*Curcuma longa*) :

A 2017 study Trusted Source examined the effects of turmeric's active component, curcumin, on cardiovascular disease risk. The researchers found that turmeric and curcumin may protect patients at risk of cardiovascular disease by improving serum lipid levels.

g) Rosemary (*Rosmarinus officinalis*) :

Rosemary may also have some positive effects on a person's cholesterol levels.

ROLE OF HOMOEOPATHY :

COMMON HOMOEOPATHIC MEDICINES ARE :

- | | |
|------------------|----------------------|
| · ALFALFA | · CURCUMA LONGA |
| · ALLIUM SATIVA | · GAUTTERIA GAUMERI |
| · AVENA SATIVA | · GLYCERRHIZA GLABRA |
| · BERBERIS VULG | · STROPHANTHUS HISP |
| · CARDUS MAR | · SUMBUL |
| · CHRYSANTHEMIUM | · TERMINALIA ARJUNA |
| · CRATAEGUS OX | |

CONCLUSION :

It's important for all of us to :

a) Bring Lifestyle modifications, such as maintaining a healthy diet, exercising regularly, and avoiding smoking. These are crucial components of managing hyperlipidaemia and preventing associated complications.

b) Herbal Medicines : A total of 33 plant species distributed over 19 families were identified. The most represented families were Apiaceae, Fabaceae, Asteraceae and Lamiaceae. The most prescribed species were *Linum usitatissimum*(Flax seeds or Lin seeds), *Coriandrum sativum*(Coriander or Dhania), *Avena sativa*, *Olea europea*(EuropeanOlive), *Allium sativum*, *Juglans regia* (English Walnut), *Glycine max*(Soya bean), *Curcuma longa*, *Foeniculum vulgare*(Fennel)and *Rosmarinus officinalis*(Rose Mary). Flax and coriander had the highest Use Value.

c) To best utilize plant based management of Hypercholesterolemia, which is effective and don't have adverse effects on our health. Homoeopathic medicines are safe and can normalize cholesterol levels and do other benefits to other Systems of the body.



ABSTRACT



INTERNAL IMMUNITY OF PLANTS DOES IMPROVE OUR IMMUNITY?

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Present-day crops are evolved through a series of changes occurring in their DNA towards adopting a specific climate and to survive in an ecological niche. We also understand that the crops withstand to different stresses in different environmental conditions and hence their distribution in specific climate is unique. Also, it is assumed that the stresses they face in different environment is different and hence, we expect dominance of different pathogens and insects in different climates.

It is also observed that the genome synteny exists in floristic diversity. The secondary metabolites produced in a plant growing in a specific environment will be different compared to other. When we analyse the QTLs for stress resistance often, we end up with genes and TFs regulating the production of secondary metabolites. The immune system of plants differs from animal. We take help from plant secondary metabolites to improve our immunity. So as the *Vata*, *Pitta* and *Kapha* Samanam plants are being designated to subside the diseased forms. But question arises how these plants from different taxa reduces the common diseased form. The commonness of different plants, producing similar secondary metabolite can withstand similar stresses. Whether these secondary metabolites from plants can be scientifically exploited and validated in bigger way in traditional system of medicine and whether these can be extrapolated for plants' own immunity helping in climate resilient Agriculture in the future. All these will be discussed in detail.

SIGNIFICANCE OF FINGER MILLET IN NUTRITION, HEALTH AND VALUE-ADDED PRODUCTS

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ABSTRACT

Millets are a group of small spherical whole grains in India, Nigeria along with other Asian and African Countries. They were having multimer for human consumption, livestock and bird feed. Although all millet variety belongs to Poaceae family, they differ in colour, appearance and grain size, Finger millet (*Eleusine coracana* Gaertn.) is also known as ragi or mandia in local language, is an important millet grown extensively in various regions of India and Africa. It ranks 6th in production after wheat, rice, maize, sorghum and bajra in India. Finger millet is considered as one of the nutritious cereals. It contains about 5-8% protein, 1-2% ether constituents, 65-75% carbohydrates, 15-20% dietary fibre & 2.5-3.5% minerals of all the cereals and millets. Finger millet has the highest amount of calcium (344mg %) and potassium (408mg%). The cereal has low fat content (1.3%) and contains mostly unsaturated fat. 100gms of finger millet have 336Kcal of energy in them. The millets also contain phytates (0.48%), polyphenols, tannins (0.61%), trypsin inhibitory factors and dietary fibre. Millets are rich in nutrients and plant compounds. Therefore, they may offer multiple health benefits. Finger millet consumption helps in gut retardation. Dietary fibre has major effects on the rate of gastrointestinal absorption, sterol metabolism, ceacal fermentation and stool weight. It also helps in repairing body tissues, blood formation, bone formation and maintaining skin health. Millets are nutritious and useful for several edible products like chapati, papad, puffing, noodles, soup, cakes etc. It is also used by local people to make traditional dishes like pudding, idli, vada, dosa, mudde and traditional cakes. The harvested materials were also used as biofertilizer.

Keywords: Finger millet, Ceacalfermentation, Edible products, Biofertilizer.

***Entry for Sarojini G. Panigrahi Young Scientist Award**

CHEMOMETRIC ANALYSIS AND ANTI-INFLAMMATORY ACTIVITY OF ESSENTIAL OIL OF FOUR UNDER-EXPLORED CURCUMA SPECIES

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The genus *Curcuma* of family Zingiberaceae is widely used in traditional folk medicine to treat diseases caused by inflammation. The current study aimed to investigate the chemometric analysis of chemical composition and anti-inflammatory activities of rhizome essential oil of *C. alismatifolia* (C₁), *C. aromatica* (C₂), *C. raktakanta* (C₃) and *C. xanthorrhiza* (C₄). The essential oils were extracted using a solvent-free microwave extraction unit having a yield of 0.4-0.8%. GC-MS analysis identified curzerenone as the major compound in C₁ and C₄, germacrone and *ar*-curcumene in C₂ and C₃, respectively. The cytotoxicity of the essential oils on RAW 264.7 cells at different concentrations was checked to examine the anti-inflammatory activity. At 100 µg/mL, the production of nitric oxide (87%), prostaglandin E2 (91.2%) and pro-inflammatory cytokines viz., TNF-α (95.4%), IL-6 (92%) and IL-1β (88%) were significantly lowered compared to the LPS treated group. A multivariate analysis was used on the principal components (PC) to assess the relationship between the essential oil constituents and the results of anti-inflammatory assays.

Keywords: *Curcuma*, essential oil, GC-MS, multivariate analysis, anti-inflammatory

*Entry for Sarojini G. Panigrahi Young Scientist Award

ETHNO-MEDICINAL AND PHENOLIC ASSESSMENT OF MANGROVES AT BARUNEI MOUTH OF BHITARAKANIKA WILDLIFE SANCTUARY

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ABSTRACT

Bhitarakanika mangrove wetland is one of the important mangrove genetic resources of the world, located in the estuarine environment which is created by Brahmani-Baitarani River systems. The ecosystem has quite a large potential for natural products that can be used for medicinal purposes, the parts of the mangrove plants are used as medicine for curing different disease by the local people. An ethno-botanical exploration was made to find out the phyto-chemical and medicinal values of Mangroves present in Barunei mouth of Bhitarakanika wildlife sanctuary. During the survey, a total of 12 mangrove plants species belonging to 9 genera and 9 families were identified as being used for treatment of different ailments or therapeutic indication including wound, tooth-ache and skin disorders, etc. The total phenol contents found to be more in *Rhizophora mucronate* (26.16 mg g⁻¹) followed by *Caesalpinia crista* (23.36 mg g⁻¹) and *Excoecaria agallocha* (23.12 mg g⁻¹). This knowledge forms the basis for innovations of novel drugs for the benefit of the human beings.

Keywords: Mangroves, Medicinal uses, Phenolic assessment.

PHYTOREMEDIATION POTENTIAL OF *ZINNIA ELEGANS* (L.) SEEDLINGS GROWN *IN VIVO* UNDER CR ENRICHED OVER BURDEN SOIL OF SUKINDA CHROMITE ORE MINES, ODISHA

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ABSTRACT

Many mines, including the Sukinda Chromite Mines, regrettably have a major detrimental impact on the environment despite being a major contributor to India's economic prosperity. It is situated in the Jajpur (District) region of Odisha. Grown in the Cr-rich overburden soil of the Sukinda chromite mines, *Zinnia* plants produced reactive oxygen species and triggered an antioxidative defense system to counteract Cr toxicity and oxidative stress. The current *in vivo* pot investigations were conducted to investigate the cytological and biochemical modifications, as well as H₂O₂ accumulation in the root of *Zinnia elegans* (L.), using varied percentages of Cr rich over burden soil (OBS) of Sukinda. Following a 45-days duration of treatments, an analysis was conducted on biochemical parameters viz. total chlorophyll, carotenoid, protein, proline, starch and antioxidant enzymatic capabilities, specifically catalase (CAT), guaiacol peroxidase (GPX), and ascorbate peroxidase (APX). The metabolic characteristics deteriorated as the concentration of Cr⁺⁶ climbed. Cr⁺⁶ stress resulted in chromosomal abnormalities in mitosis and chromosome morphology. As the concentration of Cr-rich OBS grew, the mitotic index dropped. There aren't many studies on how heavy metals (HMs) affect the usage of decorative plants in phytoremediation. This study demonstrates how effectively Cr contaminated soils in mining areas may be phyto remediated using ornamental non-edible plants, minimizing the ion's effects on the food chain. Pollutants can be removed from the site and its appearance improved by the use of ornamental plants in HMs restoration.

MICRO-RNA REGULATION AND EXPRESSION ANALYSIS OF THEIR CLEAVED TARGETS CONTRIBUTING TO SHADE-TOLERANCE IN SWARNAPRABHA RICE

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ABSTRACT

Cloudy weather or low-light environment causes significant reduction in rice plant growth and yield. In response to incident light enriched with low R:FR ratio, the adaptations of rice plants compared to those in sun are collectively known as shade avoidance syndrome. Shade tolerance are responses when plants are subjected to prolonged shade. Present work bears importance due to the present unpredictable weather conditions, associated low-light, cloudy days and its impact on grain filling in rice. As rice is one of the major food crops and hence, any basic or applicability-based work on it bears importance not only for the society but also for the scientific community. This study integrates expression data of micro-RNA during prolonged-shade with their predicted targets through degradome study and ultimately correlating with the gene expression from the microarray data to reveals complex regulatory action of miRNA during low-light stress in Swarnaprabha rice. This study identifies interaction of 16 novel miRNAs with their 21 target pairs, whose actions can contribute significantly to the shade tolerance phenotype and sustainable yield of Swarnaprabha rice.

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AGROBIODIVERSITY OF KORAPUT FOR TRIBAL FOOD AND NUTRITION SECURITY

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Koraput district of Odisha is situated in Northern part of the Eastern Ghats of India and is a land of topographical and ecological diversity. It is one of the agro-biodiversity hot spots in India and recently declared by Food and Agriculture Organisation (FAO) as the global agricultural heritage site. This region is famous for secondary center for origin of Asian cultivated rice (*Oryza sativa* L.). The last five decades have witnessed a rapid decline in the genetic diversity of various crops and a depletion of forest species in the region. Though these are useful plant species for tribal communities but largely ignored by researchers, breeders and policy makers. Recently, our research groups collected more than 130 vital genetic resources of indigenous rice, 30 local finger millets, 30 local accessions of Niger and 08 different wild edible Yams from different tribal pockets of Koraput and taking initiative for conservation and commercialization to boost the local economy of tribal people. One high protein and low glycemic index rice “Kalajeera” a popular aromatic variety was identified for better consumption of diabetic patient and taken initiative for commercial production and GI tagging. Based on the introspection of yield and panicle traits, some finger millet genotypes like Bhalu, Ladu, Telgu and Bada are identified for better panicle traits and grain yield at par with the improved varieties. Further, enhanced level of nutritional compositions and energy was recorded in Telgu, Bada and Dushera. The identified genotypes with enhanced levels of nutritional and nutraceutical compositions could be used as functional foods. Further, some wild yam species were screened for mass consumption, commercialization and prepared value-added bakery products for ensuring tribal food and nutritional security and boost the local economy of tribal people.

STUDIES ON IN VITRO EVALUATION OF ANTIBACTERIAL ACTIVITIES OF LEMONGRASS (*CYBOPOGONCITRATUS*) LEAVES EXTRACT BY AGAR WELL METHOD

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Lemongrass is an herb scientifically called as *Cymbopogon citratus*. The prefix lemon owes to its typical lemon like odour, due to presence of citral a cyclic monoterpene. Lemongrass has phytoconstituents such as tannins, flavanoids, alkaloids, and various essential oils in this herb. Secondary active metabolites of several components have also been implicated in the varied pharmacological effects of this plant. Lemongrass possesses various antimicrobial properties. The objective of the present investigation was to evaluate the antibacterial potential of n-hexane and methanolic leaf extracts of *Cymbopogon citratus*. The antibacterial potential of the leaf extracts was tested against some human pathogenic bacteria causing several diseases such as *Staphylococcus aureus*, *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Shigella flexneri*, *Salmonella typhi*, *Klebsiella pneumoniae*, *Salmonella paratyphi*, *Bacillus subtilis*, *Micrococcus luteus*, *Salmonella typhimurium*, *Escherichia coli*, *Bacillus circulans*, *Streptococcus mitis*, *Enterococcus faecalis* by using agar well diffusion method. The concentration of test plant extracts was 10 mg/ml. The inhibitory activity of the leaf extracts was compared with streptomycin as reference antibiotic (RA). The concentration of (RA) was 0.5 mg/ml. The result of the study revealed that n-hexane extract of *Cymbopogon citratus* was highly effective against *Streptococcus mitis* (17.08 ± 0.86 mm) and least effective against *Pseudomonas aeruginosa* (11.36 ± 2.58 mm) whereas the methanolic extract had high inhibition effect against *Vibrio cholerae* (22.44 ± 2.46 mm) and least against *Pseudomonas aeruginosa* (10.24 ± 0.86 mm). The zone of inhibition of reference antibiotics ranged between 26.54 ± 1.04 mm (*Streptococcus mitis*) to 22.33 ± 2.64 mm (*Escherichia coli*). The extract may be useful as an alternative antimicrobial agent in natural medicine for the treatment of numerous infectious diseases.

Keywords: Agar well diffusion, Antibacterial activity, *Cymbopogon citratus*, n-Hexane, Methanol, Streptomycin

EXPLORING SEED DORMANCY AS A STRATEGIC TOOL FOR MANAGING VIVIPAROUS GERMINATION IN RICE CULTIVATION

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Seed dormancy is an agronomically important trait normally unsuitable for agriculture, but very much essential for preventing viviparous germination in rice when untimely rains frequent the crop fields. Under fluctuating climatic changes, seed dormancy might have been an essential trait that evolved as an adaptation to suboptimal conditions. Normally, the traditional and wild *Oryza* species are relatively dormant compared to the high-yield rice cultivars and the high-yielding genotypes usually lack dormancy to escape the erratic weather. An experiment was designed to test the hypothesis by taking rice seeds of different traditional and wild rice cultivars collected from different parts of Odisha and germination tests were conducted in three replicates in a growth chamber at 27^o C under 12h/12h light/dark cycle in Petri plates containing three layers of moist blotting paper. The experiment was conducted during the entire period of 2022 from January to December. Germination%, time of germination, seedling vigor index, total soluble sugars, starch concentration and α -amylase activities were measured in the soaked seeds and experiments were terminated after 50% of seed germination or 48h of soaking. Based on the initial screening, dormant, semi-dormant and non-dormant seeds were categorized and morpho-physiological parameters at different sampling occasions have been studied. The total soluble sugar concentration and α -amylase activity in the dormant seeds were relatively lower compared to semi-dormant and were highest in non-dormant seeds whereas the starch concentration followed an opposite trend during the entire experimental period. In non-dormant seeds, 100% germination occurred during the entire period of the experiment whereas, in semi-dormant seeds, germination was from January to June and reduced considerably thereafter and reached almost nil in November and December. On the other hand, dormant seeds attained a maximum value of germination in June-July and it ceased from August till December. Dormant seeds failed to germinate after August especially during the harvest seasons even if the environmental conditions are favorable for germination in our experiment. Hence, the dormancy trait of wild and traditional rice varieties may be used for its introgression in high-yielding rice cultivars for the prevention of viviparous germination. Manipulation of its gene may be of high significance for the cultivation of the crop, especially under inclement weather conditions.

EPIDERMAL LEAF PUBESCENCE AND FLAVONOID ACCUMULATION MEDIATE UV-B RESISTANCE IN RICE

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Increased UV-B radiation affects crop growth adversely because of significant decline in leaf photosynthesis due to damage of photosynthetic apparatus and poor biomass accumulation attributable to reduction in stomatal conductance in many crop plants including rice. High yielding rice genotypes are quite sensitive to diversified stress factors including UV-B radiation. In contrast, the traditional rice cultivars, exhibit high resistance against a multitude of extreme environmental conditions and also against UV-B radiation. Traditional rice cultivars with high amount of anthocyanin and flavonoids in their leaf epidermal layers and large numbers of pubescent hairs on their leaf surfaces are resistant against UV-B radiation. Western part of Odisha is endowed with rich diversity of traditional and wild rice cultivars and their resistance trait has not been exploited till now. Therefore, in the present study, attempts have been made to understand the actual mechanisms responsible for UV-B resistance in rice cultivars. Effective screening of two contrasting cultivars **Lalkain** and **Swarnaprabha** was carried out to evaluate the varietal specific differences to supplemental UV-B radiation that applied for 5h/day ($UVB_{BE} 14.4 \text{ KJm}^{-2}\text{d}^{-1}$) by UV-B emitting fluorescent tubes (TL20w/01). Morpho-physiological, biochemical and enzymatic parameters such as number of pubescent hairs (micro and macro) and concentrations of chlorophyll, carotenoids, anthocyanin, flavonoid, lipid peroxidation, Spad index, Pal activity and EDX were analysed during the experiment. In addition to quenching of absorbed UV-B radiations through fluorescence, many other yield parameters of panicles including grain sterility has been studied. Higher number of pubescent hairs (micro and macro hairs) in the adaxial surface of flag leaves in Lalkain cultivar than that of Swarnaprabha was observed. In response to supplemental UV-B radiation, Lalkain cultivar accumulated more amounts of flavonoids and anthocyanin compared to Swarnaprabha whereas the decline in chlorophyll and carotenoids due to UV-B treatment was quite higher in the later than the former. MDA contents in terms of lipid peroxidation after UV-B treatment was much more prominent in Swarnaprabha than that of Lalkain and these results were reflected in sterility percentage that was quite higher in Swarnaprabha compared to Lalkain. Hence high concentration of flavonoids and pubescence hairs on leaf epidermis might act as UV-B protective screen for providing UV-B resistance in Lalkain cultivars.

ETHNOBOTANICAL INVESTIGATION OF AQUATIC AND SEMI AQUATIC PLANTS OF JHARKHAND

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Since the time immemorial the plants are used for the benefit of the mankind, the plants are used to cure various ailments by the Kabiraj, Ojhas, Gunis, Horopaths and elderly people. During the recent days aquatic plants are proved as more productive than conventional terrestrial crop. This extremely productive crop does not require any tillage fertilizers seed and care. .

A study conducted from the year 2014 to 2019 reveals the presence of 58 plants which are used exclusively for medicinal purposes. These are revealed by the medicinal plant practitioners working for the cure of several ailments. The informations were gathered from the said people beside the patients. For this purpose semi slandered questioners were prepared and informations were gathered. In this chapter especially the aquatic and semi aquatic plants which are used to cure the diseases has been discussed in detail. The botanical name, local name, family parts used and specific uses of the concerned plants have been enumerated and discussed in the current communication.

Key Words: Ethnobotanical, Aquatic and semi aquatic plants , Jharkhand, Ailments.

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CANDIDATE MOLECULE OF AERIAL PLANT TARGET LIVING CELLS

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ABSTRACT

Lichen produce large number of secondary metabolites with many biological activities. Hydroxymellein a source from endolichenic fungus as bioactive substance isolated and assessed in vitro tests. The chemical profiles of the bioactive substance have been analysed by HPLC & TLC and involved in anti-biofilm and antioxidant activities. The chemical exerts important role in modulation of molecular mechanisms in the specific cells and protection against UV radiation. It is discerned that the biomolecule exhibited as candidate molecule in targeting specific cells of interest. The imaging technique validates the target abilities of the molecule during endocytosis.

TISSUE CULTURE MEDIATED SECONDARY METABOLITE(S) PRODUCTION IN *HYPERICUM PERFORATUM* L. (ST. JOHN'S WORT)- A REVIEW

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ABSTRACT

Hypericum perforatum L. (Hypericaceae) is an important medicinal plant which has been widely investigated and exploited. The plant possesses antibacterial, antiviral, anti-inflammatory, and anticancerous properties due to the presence of various bioactive compounds such as naphthodianthrone (hypericins and pseudohypericins) and prenylated acylphloroglucinols (hyperforin and adhyperforin). The conventional methods of propagation of *H. perforatum* are time consuming and unable to meet the commercial demand of secondary metabolites. Moreover, the field grown plants are exposed to biotic and abiotic stresses which affect its bioactive constituents. Therefore, in order to meet the growing raw material demand of *H. perforatum* in the pharmaceutical industries there is a need to develop efficient biotechnological methods (e.g. cell, tissue and organ culture, cell suspension culture, hairy root culture, elicitation, etc.) for improvement of target bioactive compounds. Bioreactors have been successfully used for *in vitro* biomass regeneration in short duration and enhancement of secondary metabolites, taking into consideration different parameters like-PGR(s), aeration volume, inoculum density, elicitors (biotic and abiotic) etc. OMICS approaches might be helpful in increasing the content of bioactive compounds in *H. perforatum*. By understanding and controlling the biosynthetic pathways of secondary metabolites production in *H. perforatum*, we could enhance the content of bioactive compounds.

MEDICINAL PLANTS AND CANCER CHEMOPREVENTION

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ABSTRACT

Cancer is the second leading cause of death worldwide. Although great advancement has been made in the treatment and control of cancer progression, significant deficiencies and room for improvement remain. A number of undesired side effect sometimes occur during chemotherapy, Natural therapies, such as the use of plant derived products in cancer treatment may reduce adverse effects. Currently a few plant products are being used to treat cancer However, a myriad of many plant products exists that have shown very promising anti-cancer properties in vitro but have yet to be evaluated in humans. This review will focus on the pivarom plant derived chemical compounds that have in recent years shown promise as anticancer agents and will outline their potential mechanism of action.

Keywords: Medicinal plants, Natural product, cancer, alternative Medicine

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DYNAMICS OF SPATIO-TEMPORAL CHANGES OF URBAN LAND USE / LAND COVER PATTERN IN TEMPLE CITY OF BHUBANESWAR, ODISHA, INDIA

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ABSTRACT

The present study has been carried out in Bhubaneswar which has been declared as a smart city in the recent past by the Indian Government. The objective of the study is to understand the spatio-temporal dynamics of population growth and land use pattern in the perspectives of its future growth and development. The population has grown from 16,000 at the time of its inception to more than 10 lakhs presently with an annual growth of 9.148 percent. The fast growth of population has led to expansion of the geographical area of the city from 28.7 sq.km to 148 sq.km. Of 13 different land uses recognized, residential area has increased from 6.20 to 23.04% of the total area. With increase in residential and commercial areas, agriculture and forest land areas are shrinking at a rate of 0.717% and 0.449% per annum respectively. Water bodies in the city are declining in area and getting polluted. Promotion of vertical growth of the city, rejuvenation of water bodies, availability of open space, development of sewage network and drainage systems were realized in order to make the city green, resident friendly and sustainable.

Keywords: Land use, Population, Water bodies, Slum, Environment, Open space

HERBAL MEDICINE: AN OVER VIEW

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ABSTRACT

Herbal medicines are popular. They are extensively used in the developing world, where in many places they offer a more widely available and more affordable alternative to pharmaceutical drugs. Increase in herbal medicines popularity brought concerns and fears over the professionalism of practitioners, and quality, efficacy and safety of their treatment methods and products from herbal and natural sources available in the market. Most research has focused on clinical and experimental medicine (safety, efficacy, and mechanism of action) and regulatory issues, to the general neglect of public health dimensions. Public health research must consider social, cultural, political, and economic contexts to maximize the contribution of herbal medicine to health care systems globally. The regulatory framework for herbal medicines and dietary supplements is currently under review. A new system for registration of traditional herbal medicines will ensure that marketed products meet standards for quality and safety. At present, the pharmaceutical quality of many complementary medicines is a cause for concern. Suggestions for herbal medicine standardization are outlined. The scenario and perception of herbal medicine are discussed. The public's belief that herbal and natural products are safer than synthetic medicines can only be ascertained by imposing regulatory standards on these products that should be manufactured using these Good Practices. Implementing standard operating procedures (SOP) leading to Good Agricultural Practice (GAP), Good Laboratory Practice (GLP), Good Supply Practice (GSP) and Good Manufacturing Practice (GMP) for producing these medicinal products from herbal or natural sources. This article presents a systematic review on herbal medicine including historical background, safety, efficacy, quality control, clinical trials, bioavailability, Herb-Drug interactions, Intellectual Property Rights, marketing, and regulatory aspects related to botanical therapeutics.

(Key Words: Herbal Medicines, Health, Safety, Clinical trials, Marketing)

PLANT BASED NANOPARTICLES AND THEIR APPLICATION IN THE MANAGEMENT OF CANCER

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ABSTRACT

Nanoparticles are tiny particles of various shapes such as spherical, cuboid and size ranges between 1 nm and 100 nm in diameter. Due to their small size, highly reactive nature and high surface area-to-volume ratio, these particles have a wide range of potential applications. Plant-based nanoparticles have been showing various activities such as catalytic activity, optical property, electronic property, and antimicrobial properties. The plant extract contains various types of phytochemicals like sugars, flavonoids, glycosides, terpenes, and terpenoids, which act as reducing and capping agents and help in the proper formation of the desired nanoparticles. The nanoparticles can specifically target tumor cells due to their specificity and effectiveness in cancer therapeutic applications, which may maximize patients' responses and survivals. Also, the plant-based nanoparticles have a great effect against various cancer cell lines such as MCF 7, Hep 2, HCT 116, and HeLa cell lines. Recently, many studies reported that plant-derived nanoparticles have the potential to control tumor cell growth while the free radical scavenging potential protects normal cells. The incorporation of nanotechnology with phytotherapy influences the pharmacological response and improves the clinical outcome of patients. Some reports showed that many more plant-based nanoparticles are used in various types of cancer treatments. Ag NPs synthesized from *Phyllanthus emblica* leaf extract showed anticancer activity against hepatocellular carcinoma. Similarly, *Moringa oleifera* and *Punica granatum* plant extracts were used to synthesize AgNPs reported to be cytotoxic against cancer cell lines. Again, AgNP synthesized from *Acalypha indica*, *Annona aquamosa*, and *Butea monosperma* showed cell proliferation activity against human breast cancer. CuO NPs synthesized by using *Azadirachta indica*, *Hibiscus rosa-sinensis*, *Murrayakoenigii*, *Moringa oleifera*, and *Tamarindus indica* plant extract showed different levels of cytotoxic effects against various cancer cells. ZnO NPs synthesized from *Nyctanthes arbor-tristis* flower extract showed anti-cancer activity and induced programmed cell death in cancer cells. NiO NPs, Au NPs synthesized from *Moringa oleifera*, and *Aloe barbadensis* (Aloevera) demonstrated anticancer activity against colon cancer.

Hence, an attempt has been taken to summarize the application of plant based nanomaterial and their efficacy in the management of different types of cancer.

DOCUMENTATION OF TRADITIONAL KNOWLEDGE ASSOCIATED WITH SOME COMMON WEEDS OF MEDICINAL IMPORTANCE IN ANGUL DISTRICT

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ABSTRACT

Weeds are plants which are undesirable, persistent, damaging and interfere with growth of other crop plants. They can also be referred as plants out of place. However, it is matter of interest that some of well-known weeds are source of drugs and traditional medicine. The weeds have certain biological phytochemicals viz. alkaloids, flavonoids, phenols, terpenes, and saponins etc. which are used to treat health disorders. Various *insilico* studies explored the binding affinities of phytochemicals of weeds with few important human receptors. These plant parts are highly valuable and have been frequently recommended by traditional healers for treatment of given ailments. On the basis of these facts, an investigation was carried out to document the presence of certain weed species in five Gram Panchayat level Biodiversity Management Committees (BMCs) of Angul district through the preparation of Peoples' Biodiversity Registers (PBRs). The Guidelines for the preparation of PBRs as issued by the National Biodiversity Authority contain 31 formats categorized into agrobiodiversity, domesticated biodiversity, wild biodiversity and urban biodiversity where Format 4 has provisions for the documentation of weeds. This format includes plant type, scientific name, local name, affected crop, impact, local status, uses if any, management options, other details like exotic and their associated traditional knowledge with Traditional Knowledge holder name.

The PBR work was carried out in 5 Gram Panchayats viz. Tubey, Kanaloi, Similipal in Angul Forest Division and Maimura, Sapaghara in Athamallik Forest Division of Angul District. The process involved PRA exercises, household survey, personal interaction with knowledgeable individuals, vaidyas. About twenty to thirty weeds were documented with medicinal uses for the management of various diseases facing in our daily life. For example *Cynodon dactylon* is used to cure dysentery, *Andrographis paniculata* helps to cure fever like malaria and typhoid, *Ageratum*

conyzoides used to treat any cuts/ wounds, *Argemone mexicana* is useful for skin infection, *Hygrophila auriculata* is taken as a blood purifier, *Ocimum basilicum* is taken to cure stomach disorder, *Paederia foetida* is used to treat arthritis, *Solanum surattense* is helpful for cough, asthma, *Jatropha gossypifolia* helps to cure piles and toothache, *Lantana camara* is used to cure wound, *Scoparia dulcis* is helpful in treatment of diabetes and many more which has been documented through interaction with key informants. The indigenous people who are dealing with the natural ecosystem of the locality are expected to possess essential knowledge about the natural resources. Hence, Peoples' Biodiversity Register can be a unique source of information which in turn may help to conserve these medicinal species.

Keyword: Biological Diversity, PBR, BMC, Natural Resources, Bioresources



MEDICATED AND EDIBLE HERBAL RECIPE PREPARED BY BODO TRIBE DURING RONGJALIBWISAGUFESTIVAL IN BODOLAND TERRITORIAL REGION OF ASSAM

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ABSTRACT

Herbal recipe prepared by Bodo tribe since immemorial time during RongjaliBwisaguFestival which is celebrated during the month of April. It is a festival of 15 days long in which the local tribal people used to collect approximately hundred medicinal plant species to prepare the herbal recipes. The local people believe that the ingredients present in these plant species can give them strength and have potent antimicrobial activities. They believe that these herbal recipes protect them from several diseases such as cancer, hypertension, diabetes, ulcer, skin diseases and inflammation. Amongst the plants used for preparation of these recipes, family Cucurbitaceae represents the highest number of plants with 8 species; Solanaceae with 5 species, Amaranthaceae, Lamiaceae, Rubiaceae&Verbenaceae with 4 species; Asteraceae, Euphorbiaceae, Liliaceae, Acanthaceae, Apiaceae, Clusiaceae, Lauraceae, Rosaceae, Polygonaceae, and Zingiberaceae with 3 species. Moraceae, Scrophulariaceae, Nyctaginaceae, Brassicaceae, Araceae, Urticaceae, Malvaceae, Rutaceae, Oxalidaceae&Piperaceae 2 species of each. Rest 30 families represent only 1 species of each. Most of the plant parts used for preparation of recipes are leaves, followed by fruits and stems.

Key words: Herbal recipe, Bwisagu, Bodo, anti-hypertensive

NEGLECTED WILD YAM SPECIES USED BY TRIBAL PEOPLE OF KORAPUT DISTRICT OF ODISHA TO ALLEVIATE HUNGER AND MALNUTRITION

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ABSTRACT

Wild Yam (*Dioscorea* spp.) plays a crucial role in supplying both food and medicinal benefits to millions of individuals globally, particularly in tropical and subtropical regions. Additionally, it holds a significant position in the dietary practices of small, marginalized rural families, as well as communities residing in forests. Based on the information collected from the different tribal communities, a total of nine different yam species such as *D. oppositifolia*, *D. hamiltonii*, *D. pubera*, *D. wallichii*, *D. pentaphylla*, *D. bulbifera*, *D. glabra* and *D. alata* were used both as food and medicine. Among the wild species, *D. pubera* was the most preferred species with highest use value (UV) of 1.76 followed by *D. pentaphylla* by the tribal communities. Further these two wild tubers were selected for making value-added products such as cookies and namkeen. From sensory evaluation, *D. pubera* cookies and namkeen showed better taste, crispiness, smell, colour and over all acceptability of a good score. In addition, these value-added products recorded higher protein, fiber, energy, antioxidants and nutritionally superior than conventional products. These functional foods from wild yam will helpful for mass consumption and will encourage the start ups for enhancing economic growth of tribal people of the locality.

PLANTS IN ETHNOVETERINARY PRACTICES IN DHENKANAL DISTRICT OF ODISHA, INDIA

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ABSTRACT

Ethnoveterinary medicine provides traditional medicines which are locally available and cheaper as compared to modern standard treatments. The present study was conducted to document the indigenous knowledge of ethnoveterinary practices in Dhenkanal district of Odisha. Farmers staying in remote areas of this district still depend upon native plants for curing various animal diseases. Plants of ethno-veterinary importance have been recognized by the rural folk by a process of experience over hundreds of years. The present communication deals with the indigenous knowledge of rural communities on medicinal plants used for curing various veterinary diseases in Dhenkanal district of Odisha. Information collected are based on interview with the herbal healers, tribal medicine men and knowledgeable persons of the locality, and cross-checked with other herbal practitioners. Shabar, Kolha, Munda, Khond, Santal, Bhumij, Dehuri and Lodha are the chief ethnic groups in this area. The uses of plant parts along with the mode of administration revealed that ——— plant species were used for curing — types of diseases. The plant parts used for livestock health treatment were mainly leaves and the preparations were administered mainly through oral. Ailments covered in the paper include anorexia, bronchitis, cold and cough, colic pain, conjunctivitis, constipation, cracks in palate, cracked nipples, diarrhoea, dysentery, dyspepsia, fever, filariasis, flatulence, foot and mouth disease, galactorrhoea, mastitis, mump, scabies, stomachache, throat infection, yoke wound, swellings, etc. Plants increasing the milching capacity as well as those adding to the strength and vigour of the animals have also been included.

Keywords: Indigenous knowledge, Medicinal plants, Veterinary diseases, Dhenkanal, Odisha
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BIO-HARDENING OF MICROPROPAGATED *MUSA ACUMINATE* (BANANA) VAR G9 PLANTLETS WITH AMF *CLAROIDEOGLOMUSCLAROIDEUM* INOCULATION

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ABSTRACT

Acclimatization or hardening is a critical stage in micropropagation where the transfer of *in vitro* raised plantlets to *ex vitro* field conditions is done. During hardening, the micropropagated plants are subjected to transplantation shock due to soft stem, excessive transpiration, non-functional stomata, poorly developed root system, susceptibility to pathogens etc. which may affect their survival. One of the strategies to reduce transplantation shock and to get well with the hardening process is microbial intervention, also known as bio-hardening. Among the symbiotic microbes, arbuscular mycorrhizal fungus (AMF) is a root symbiont of vascular plants. AMF association is known to improve water relation, nutrient uptake, increase the tolerance of the host plant to adverse conditions such as drought, salinity and protection from root pathogen attack. Several reports suggest the use of AMF for bio-hardening of micro-propagated plantlets. Hence, in the present study, AMF *Claroideoglomusclaroideum* inoculum developed in root organ culture was given to micro-propagated *M. acuminata* var G9 (banana) plantlets under *in vitro* conditions. The effect of AMF inoculation on morphology, biochemical parameters and acclimatization percentage of banana plantlets were estimated and compared with that of control. Although the difference in acclimatization percentage between AMF inoculated and non-inoculated plants were statistically not significant, however there was significant variations in morphology, biochemical parameters and photosynthetic efficiency. Hence, AMF inoculation can be given to micropropagated plants for improvement of overall health and performance of the plant.

ASSESSMENT OF EFFICACY OF INERT MATERIALS AGAINST ANGOUMOIS GRAIN MOTHSITOTROGA CEREALELLA OLIVIER ON STORED WHEAT

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ABSTRACT

Angoumois grain moth, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae), is one of the most destructive pests of stored wheat, which causes the damage both directly and indirectly in the preharvest and postharvest phases. The development of resistance in *S. cerealella* to various insecticides necessitates the development of alternative options to manage this pest. In the current study, we investigated the efficacy of inert materials against the *S. cerealella* on stored wheat, under laboratory condition at $30.25 \pm 0.25^\circ\text{C}$ temperature and $75.00 \pm 5.06\%$ relative humidity. The inert materials, such as, wood ash, saw dust, sand, cow dung ash, kaolinite clay, diatomaceous earth, and silica powder were tested. The corrected mortality of *S. cerealella* and the weight loss of wheat, were estimated using the formula given by Abbott (1925) and Adams and Schulten (1978). The results revealed that the corrected mortality was higher and the weight loss was lower in all treatments of inert materials as compared to control. All inert materials were efficient in reducing the population of *S. cerealella*. The corrected mortality was the highest, i.e., 81.67% and the weight loss was the lowest, i.e., 17.94%, when diatomaceous earth was used against *S. cerealella*. Diatomaceous earth was the most effective treatment in controlling the *S. cerealella*.

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EVALUATION OF BIO-EFFICACY OF VARIOUS SEED OILS AGAINST ANGOUMOIS GRAIN MOTH *SITOTROGA CEREALELLA* OLIVIER ON STORED WHEAT

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ABSTRACT

Angoumois grain moth, *Sitotroga cerealella* (Olivier) (Lepidoptera: Gelechiidae), is a major pest causing serious damage in different stored cereals, wheat, rice, barley, maize and sorghum. Although the infestation starts in the field, it causes both qualitative and quantitative losses under storage conditions. Various plant oils have been proved to be effective against various insect-pests. In the current study, we evaluated the bio-efficacy of various plant oils against the *S. cerealella* on stored wheat, under laboratory condition at $30.25 \pm 0.25^\circ\text{C}$ temperature and $75.00 \pm 5.06\%$ relative humidity. The single refined oils extracted from the seeds of *Brassica juncea* L., *Sesamum indicum* L., *Glycine max* L., *Cocos nucifera* L., *Arachis hypogea* L., *Ricinus communis* L., and *Azadirachta indica* (A. Juss), were tested. The corrected mortality of *S. cerealella* and the weight loss of infested wheat in each oil treatment, were estimated using the formula given by Abbott (1925) and Adams and Schulten (1978). The corrected mortality was the highest in the treatment of *A. indica* oil @ 7.5 ml/kg (86.67%) followed by *A. indica* oil @ 5 ml/kg (80.00%), *R. communis* oil @ 7.5 ml/kg (78.33%) and *Ricinus communis* oil @ 5 ml/kg (75.00%). Whereas, the significantly lowest mortality was noted in the treatment of *B. juncea* oil @ 5 ml/kg (55.00%). The results revealed that all the plant oils were effective in reducing the incidence of *S. cerealella*. *A. indica* oil @ 7.5 ml/kg was the most and *B. juncea* oil @ 5 ml/kg was the least effective in controlling the *S. cerealella*.

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MEDICINAL EFFICACY OF PLANTS IN THE TREATMENT OF DIABETES

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Medicinal plants and their active principles are used not only in native phytotherapy, but also find remarkable application to modern drug development programme. Many phytochemical constituents of native Indian plants have become chief ingredients of a number of pharmaceutical preparations used against variety of diseases. Folklore claims of tribes or ethnomedicine is a part of ethnobotany which deals with the study of medicinal use of flora present within the surrounding environment of man. The WHO has laid down the list of nearly 25,000 plant taxa possessing noted medicinal uses. Diabetes has been known to mankind for 3500 years when Egyptians first described the clinical features similar to the disease. It is believed that ayurveda also documented the control and cure for the disease at that time. Diabetes (Madhumeha) was known to Indian 'Ayurveda' since about 3000 years affecting the populace of both developed and developing countries since time immemorial. It was "Sushruta", the great Indian physician who diagnosed diabetes during 1000 B.C. Based on different medicinal systems such as 'Ayurveda', 'Unani' and 'Siddha' the knowledge of medicinal plants has been accumulated since many centuries. Many folklores indigenous Indian medicinal plants have been found to be effective in management of diabetes. It is advantageous to use herbal drugs as they are easily available and have very low side effects. The ethno-botanical survey reports about 800 plants that possess anti-diabetic potential. Plants have been an exemplary source of many currently available herbal drugs whose adequate herbal formulations form the modern-day cure for *Diabetes mellitus*. The antidiabetic or anti hyperglycaemic effects of these plants is dedicated to the ability of these plants to facilitate the metabolites in insulin dependent processes or to restore the function of the pancreatic tissue by increasing the insulin output. Hence, the treatment of *Diabetes mellitus* with herbal formulations/drugs aims on protecting β -cells and maintaining the glucose levels. Plants contain many secondary metabolites like glycosides, alkaloids, terpenoids, flavonoids, carotenoids etc. that frequently implies having anti-diabetic effect. *Aegle marmelos*, *Allium cepa*, *Asparagus racemosus*, *Boerhaavia diffusa*, *Catharanthus roseus*, *Clerodendrum philippinum*, *Cocculus hirsutus*, *Gymnema sylvestre*, *Hybanthus enneaspermus*, *Murraya koenigii*, *Naringi crenulata*, *Portulaca pilosa*, *Terminalia chebula*, *Toddalia asiatica*, *Vetiveria zizanioides* are some antidiabetic plants which have been proved effective in minimising sugar levels recorded by folklore claims.

Keywords: Ethnomedicine, *Diabetes mellitus*, herbal formulations.

AROMA AND PROXIMATE ANALYSIS OF AROMATIC RICE FROM DHENKANAL, ODISHA

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ABSTRACT

Background: Scented rice is a traditional food of the maximum population of the world belonging to major tropical, subtropical and temperate regions. The due demand is for its fragrance in whole grain and flavour in cooked form. Major countries like Pakistan, Thailand and India are the advanced Nations in the production and distribution of most of these varieties to other countries. Odisha a major state of India, is now cultivating more than 120 varieties of indigenous landraces short grain aromatic rice. The Dhenkanal district of Odisha also has diversity in indigenous aromatic short grain landraces. There are more than 100 aromatic volatile compounds present in different aromatic rice which adds flavour to them.

Methodology: The extraction and analysis of aromatic volatile compounds was done by GC-MS. The protein and crude fibre content of collected rice were analysed against control Gitanjali. Statistical evaluation was done by correlation analysis and ANOVA.

Results: The study indicated that the major aromatic component 2AP is most commonly found in all the varieties. Out of 9 collected accessions from the Dhenkanal district of Odisha, 2AP concentration was found maximum in Basumati-2 (0.287 mg/kg) and minimum in Kanika and Laxmibilas (0.256 mg/kg). The amount of aromatic compound showed a positive correlation with protein and crude fibre content. Basumati-2 also had a higher value of protein content (8.68%) and crude fibre (0.845%). All three parameters are significant at a 1% level.

Conclusion: Among all the collected rice accessions from the Dhenkanal district of Odisha, Basumati-2 can be selected for better fragrance and flavoured nutrient food. This variety can be used for breeding and genetic conservation.

Key Words: Aromatic, Indigenous, Landraces, 2AP.

UNVEILING THE THERAPEUTIC AND CULINARY ARTISTRY OF PROCESSED YOUNG BAMBOO SHOOTS

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ABSTRACT

Young bamboo shoots are not only a popular culinary ingredient in many Asian cuisines but also offer various nutritional benefits. Bamboo shoots are low in calories, making them a great addition to a low-calorie or weight loss diet because it contains a good source of dietary fiber, which promotes digestive health, helps prevent constipation, and may contribute to weight management. Bamboo shoots contain non-digestible fibers that promote the growth of beneficial gut bacteria. A healthy gut microbiome is associated with improved digestion and overall well-being. The shoots have a low glycemic index and saturated fat. Bamboo shoots contain vitamin A, C, E, and B-complex. They also provide minerals such as potassium, calcium, and phosphorus, which are essential for bone health. Young bamboo shoots contain antioxidants that help combat oxidative stress in the body. Antioxidants play a role in reducing inflammation and may contribute to overall health and disease prevention. Fresh bamboo shoots contain natural toxins and enzymes that need to be removed to make them safe and palatable. Bamboo shoots harvested during young and tender condition, usually before full maturity. Harvesting is often done during early morning. The outer layers of the bamboo shoot are tough and bitter. To make the shoots edible, the outer layers are peeled away, revealing the inner, softer part of the shoot. Bamboo shoots contain cyanogenic glycosides, which can be bitter and harmful if not properly removed. Boiling or blanching the peeled bamboo shoots in water helps leach out these toxins. This step is crucial for safety and taste. After boiling, the bamboo shoots are thoroughly rinsed with cold water to remove any remaining toxins and cooled down. Once processed, bamboo shoots are cut into desired shapes and sizes, and then added with desired quantity of salt, allowed to ferment for 3-4 days in an earthen pot and covered with lid. They are then ready to be used in various culinary preparations. It's important to note that some bamboo shoots may still require additional preparation before cooking, depending on the specific variety and processing method. It has a high cultural aspect during the celebration of festivals like *nuakhai*. Bamboo shoots can be incorporated into a variety of dishes, adding both flavor and nutritional value to meals.

NUTRITIONAL PROFILING OF EDIBLE FLOWERS OF BAUHINIA VARIEGATA

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ABSTRACT

Bauhinia Variegata commonly known as the orchid tree or camel's foot tree, is a plant that has been traditionally used in various systems of medicine for its potential therapeutic properties. It contains various phytochemicals, including flavonoids, alkaloids, saponins, tannins, and steroids. These compounds contribute to the plant's potential health benefits. *Bauhinia variegata* possesses antioxidant properties due to the presence of flavonoids. Antioxidants help neutralize free radicals in the body, which may contribute to the prevention of oxidative stress-related diseases. The extracts from *Bauhinia variegata* flower may have anti-inflammatory effects and antimicrobial activity against certain bacteria and fungi in laboratory studies. Extracts from the plant flowers have shown anti-diabetic, anti-cancer as well as hepato-protective effects. The flowers have a moisture content, carbohydrate, reducing sugar, protein, fat and ash content as 84.51%, 6.53, 2.35, 3.70, 2.33 and 4.13g per 100g. The fresh flower contains 2.19mg/100g vitamin C. The TSS and acidity of the flower is 6.33°Brix and 0.11% respectively. Phytochemicals i.e. phenolic compounds (6.386±0.077)mg, flavonoid (3.896±0.105) mg/g, tannin (0.277±0.005) mg/g, terpenoid (1.279±0.004) mg/g, tocopherol (10.161±0.465) µg/g and carotenoids(142.24±0.623) µg/g were found in *Bauhinia variegata* flowers. The IC₅₀ value of *Bauhinia variegata* was found to be 4.588 and 3.674 in ABST and DPPH assay respectively. From the study, it was revealed that the flower has good therapeutic aspects that need to be explored for its value addition and preservation.

Key words: antioxidant, flavonoids, phytochemical, therapeutic.

ANTIOXIDANT POTENTIAL EVALUATION OF EXTRACTS OF TRADITIONAL MEDICINAL TUBER *DIOSCOREABULBIFERA*

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Dioscorea bulbifera is a potent medicinal plant used in both Indian and Chinese traditional medicine owing to its rich phytochemical diversity. *Dioscorea bulbifera* has been proven as a pharmacopotent natural product as it is effective against several diseases including diabetics, malaria, inflammation and cancer. Further, it is reported to exhibit antimicrobial, antioxidant, analgesic, anti-inflammatory, antihyperglycemic, antihyperlipidemic, antidiabetic, antinociceptive, and antitumor activities. *Dioscorea bulbifera* is also reported to have good radical scavenging and singlet oxygen quenching ability hence could be useful for treatment against various diseases that occurred due to oxidative stress. Antioxidant activities of extracts were determined by DPPH scavenging activity and compared with standard ascorbic acid and BHT. Out of six solvents extracts, methanolic extracts possessed excellent DPPH inhibition potential. The relationship between DPPH inhibition potential of methanolic extract of *D. bulbifera* with its phenolic and flavonoid content was also verified. The IC₅₀ value (the concentration of the sample that reduced 50% of the absorbances of DPPH) of methanolic extract of tuber, ascorbic acid and BHT were found to be 46.11 µg/ml, 92.86 µg/ml and 54.35 µg/ml respectively. Total phenolics content (699.47 µgGAE/100mg) and total flavonoids content (705.43 µgQE/100mg) were found remarkably high in methanolic extracts compared to other solvents. The Lowest TPC (50.18 µgGAE/100mg) content was found in petroleum ether while the lowest TFC (20.53 µgQE/100mg) content was found in water extracts.

Key words: DPPH, Ascorbic acid, BHT, Antioxidant

ANTIOXIDANT POTENTIAL EVALUATION OF EXTRACTS OF TRADITIONAL MEDICINAL TUBER *DIOSCOREABULBIFERA*

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Key words: DPPH, Ascorbic acid, BHT, Antioxidant

ETHNO-MEDICINAL KNOWLEDGE AMONG TRIBAL COMMUNITIES INHABITING IN BAISIPALLI WILDLIFE SANCTUARY, ODISHA, INDIA

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ABSTRACT

Baisipalli wildlife sanctuary (BSW) is present in Nayagarh district of Odisha. In terms of floristic composition, it is one of the important protected areas of Odisha. Local tribal communities reside in the sanctuary area are rich source of ethno-medicinal knowledge. A survey was conducted in the sanctuary area and information was collected from local tribal communities through discussions and interviews. The study has recorded 51 plant species that are used for various medicinal purposes. Out of the total medicinal species recorded, 43% are tree species followed by herb (29%), shrub (20%) and climber (8%). *Andrographis paniculata*, *Azadirachta indica*, *Careya arborea*, *Leucas aspera*, *Pongamia pinnata*, *Holarrhena pubescens* etc. are the commonly used medicinal plants species of that area. The different plant parts used for medicinal purpose are leaves, stem, tuber, rhizome, root, fruit, seed, bark etc. out of which 'leaves' are the most used plant part among all the medicinal plant species recorded. Among the different medicinal purposes, 'wound healing' and 'skin diseases' purpose maximum numbers of recorded plant species are used. Present survey can provide primary information for future extensive studies for bio-prospecting and conservation medicinal plant species.

DIFFERENTIAL DROUGHT-TOLERANCE RESPONSES IN INDIGENOUS FINGER MILLET GENOTYPES FROM KORAPUT, EASTERN GHATS OF INDIA

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Finger millet [*Eleusine coracana* (L.) Gaertn.] is one of the most neglected and underutilized food crops consumed by subsistence farmers in Asia and Africa. It is commonly cultivated in rainfed conditions and contributed about 12% of the global millet area. Its production was negatively affected by drought stress. Thus, the assessment of genotypic variability for drought tolerance is of great significance for the finger millet breeding program. A pot experiment was conducted to assess drought responses among 32 indigenous finger millets from various tribal regions in Koraput, along with five improved varieties, including a drought-tolerant check (GPU28). Variations in early morpho-physiological traits, such as seedling length, fresh and dry biomass, dry matter accumulation (DMA), relative growth index (RGI), relative water content (RWC), drought tolerance index (DTI), SPAD index, photosynthetic gas exchange parameters, and PSII activity, were evaluated under induced drought stress by withholding irrigation during the early vegetative stage. Based on drought tolerance ranking, six indigenous finger millet genotypes—Bati, Biri, Bhalu, Ladu, Lala, and Tumuka—displayed superior drought tolerance capacity compared to the tolerant check genotypes, making them suitable for cultivation in drought-prone areas and valuable for future finger millet breeding programs focused on drought tolerance.

ETHNOBOTANICAL STUDY OF UNDERGROUND MEDICINAL PLANTS USED BY TRIBALS OF KARANJIA BLOCK IN THE DISTRICT OF MAYURBHANJ, ODISHA

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ABSTRACT

Ethnobotany is the study and documentation of how peoples of a particular region depends upon the plants for their different requirements. Karanjia block is one of the tribal rich blocks of Mayurbhanj district of Odisha which is bounded by Jasipur, Thakurmunda, Sukruli, Shamakhuanta. This block covers total an area of 314.76 sq. km and separated from kenjhor district by river Baitarani. Karanjia block is one of the important block of the district on the vegetation point of view. Santala, Kolha, Ganda, Munda, Bhumija, Bathudi are the major tribal of the karanjia block who depends upon the plant for various purposes. This Ethnobotanical study was conducted during 2021-2022 to document the medicinal values of different underground plants. This study deals with the traditional uses of 24 plant species belongs to 18 genera under 9 families. Most of the plants belongs to the family Zingiberaceae followed by Araceae, Dioscoreaceae, Costaceae etc. This study also provides data regarding documentation of taxa along local names, correct botanical identification, Updated nomenclature, part used and mode of consumption to cure different diseases. These documented medicinal plants are mainly used for nutritional value followed by skin disorder, digestion, jaundice, piles.

Key Words: Ethnobotany, Mayurbhanj, vegetation, tribal, nutritional value.

PROTAGONIST OF *LYSINIBACILLUSMACROIDSON* GROWTH AND METABOLISM OF *CYANOBACTERIALYNGYBAHIERONYMUSSI*

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Bacteria and cyanobacteria are the two main co-existing organism of an ecosystem which play important role in recycling of nutrients. Many heterotrophic bacteria and oxygenic photosynthetic cyanobacteria interact in an association ranging from synergistic to antagonistic through various metabolic pathways. In our experiment, the test cyanobacteria and associated bacteria were isolated from the mangrove forest of Bhitarkanika, Odisha which were identified as *Lyngybahieronymussi* and *Lysinibacillusmacroids* respectively by 16s r RNA sequencing. To study their interactions, cyanobacteria and the associated bacteria were co-cultured in BG-11 media at a 1:1 ratio. The associated bacteria had a synergistic effect on the growth of the cyanobacteria and the maximum biomass was observed on the 9th day of incubation (241.65 g/L) as compared to its axenic culture (151.54 mg/L). When the biochemical parameters of axenic and co-cultured cyanobacteria were compared, it was observed that the co-cultured cyanobacteria had higher protein (48.49%), carbohydrate (8.6%), reducing sugar (14.58%), amino acid (112.66%), and lipid (12.38%) contents than the axenic culture. The presence of many growth-enhancing factors was detected in the culture broth of bacteria (grown in BG-11 medium) and cyanobacteria under co-cultured conditions in order to determine the synergistic role of bacteria on cyanobacteria. The findings depicted the presence of IAA, Siderophore, Vitamin B₁₂, and a few amino acids like Tryptophan and Lysine in the axenic bacterial as well as co-cultured broth. These growth-stimulating compounds were further confirmed by thin-layer chromatography and HPLC chromatograms. Besides these, some other allelochemicals were also detected by LC-MS from the cultured broth of axenic and co-cultured bacteria belonging to alkaloid and fatty acids. More research is needed to use these findings to generate cyanobacterial biomass that can be used in a variety of biotechnological processes to produce value-added products such as bioplastics, bioremediation, biorefining, wastewater management, crop improvement, biofertilizer research.

Key words: Synergistic, *Lyngybahieronymussi*, *Lysinibacillusmacroids*, IAA, siderophore, Vitamin B₁₂, LC-MS

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH PROMOTING RHIZOBACTERIA FROM ROOT NODULE OF *PISUM SATIVUM* COLLECTED FROM KORAPUT, ODISHA

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ABSTRACT

The soil can host a huge number of microorganisms including bacteria, fungus, algae, protozoa, actinomyces etc. Among these, bacteria are the most common microbes (approx. 95%) inhabiting in the rhizospheric zone of plant and improve plant growth through plant-microbe interaction, hence known as plant growth promoting rhizobacteria (PGPR). Such bacteria improve the plant growth by various mechanisms including biological nitrogen fixation, production of phytohormones, siderophore and volatile organic compounds, ACC deaminase activity, antagonistic effect, induction of systemic resistance etc. The present study was undertaken to isolate and characterize bacteria from root nodules of *Pisum sativum* collected from Bhejput village, near Panchmatipali Buxite mines of Koraput, Odisha. The bacterial strain was observed to be gram negative bacteria from gram staining test. Among the biochemical tests the strain showed positive result for fermentation of carbohydrate (glucose and sucrose), MRVP (methyl red-Voges Proskauer test), indole production, siderophore production, TSI (Triple sugar iron) and negative results for lactose fermentation. Since the bacteria was isolated from the locality near Bauxite mines and exhibiting positive results for several plant growth promotion activity, it holds potential application for plants to be grown on mine spoil for re-vegetation and mine land restoration programme.

Key words: Rhizospheric zone, PGPR, *Pisum sativum*, Panchmatipali Buxite mines.

CONSERVATION AND RESTORATION OF MANGROVES IN COASTAL REGIONS OF BHADRAK DISTRICT, ODISHA

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Coastal regions of Bhadrak district of Odisha is endowed with mangroves and their associates, which have been depleted at an alarming rate due to the operation of various biotic as well as abiotic factors. As a result, the present vegetation is found in denuded condition and are at a great degree of threat due to various anthropogenic activities such as clearing mangrove forests for Pisciculture, human habitation and development of ports. Keeping the above facts in mind extensive as well as intensive floristic studies in these areas have been conducted in this area to get a comprehensive idea about the distributional pattern of mangroves, their socioeconomic importance, and impact of various biotic factors on the mangrove vegetation and to develop various strategies for its conservation.

During the present investigation, 21 species of mangroves and their associates have been reported from different locations of this area. It has been observed that these mangrove forests harbours quite a good number of potential medicinal plants and other plants of various socio-economic importance. The impacts of various biotic factors which are responsible for habitat destruction have been assessed and the present statuses of different medicinal plants have been evaluated. Qualitative estimations of phytochemicals of some potential mangrove plants and their associates reveals the presence of alkaloids, flavonoids, glycosides, phenol, tannin, saponin, protein, terpenoid, resin and reducing sugars which are responsible for their medicinal properties. It has been observed that mangroves of this area have been depleted at an alarming rate due to the operation of various types of anthropogenic activities cited earlier. This has intensified the rate of tropical cyclones and various environmental hazards. Conservation of the existing mangrove vegetation as well as restoration of mangroves in the degraded lands is much essential for the protection of coastal environment as well as conservation of biodiversity in this region.

Keywords: Mangroves, Ethnomedicine, Phytochemical analysis, Bhadrak District.

INDIGENOUS USES AND PHYTOCHEMICAL ANALYSIS OF MANGROVES AND THEIR ASSOCIATES OF SARTHA ESTUARY IN BALASORE DISTRICT, ODISHA

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Mangroves are peculiar group of salt tolerant plants, which are found in the coastal districts of Odisha. These are found in denuded conditions due to the operation of various biotic factors such as urbanization, industrialization, pisciculture and some other developmental activities. The present investigation has been conducted in different locations of Sartha estuary in Balasore district of Odisha to get a comprehensive idea about the distributional pattern of mangroves, their socioeconomic importance and impact of various biotic factors on the mangrove vegetation in this region.

During the present investigation, 20 species of mangroves and their associates have been reported from different locations of Sartha estuary. It has been observed that these mangrove forests harbour quite a good number of plants having Indigenous uses. Phytochemical analysis of seven species of mangroves and their associates shows the presence of various phytochemicals such as alkaloids, flavonoids, glycosides, phenols and tannins, saponin, protein, terpenoid, resin and reducing sugars etc. that are responsible for their medicinal properties.

It has been observed that mangroves of Sartha estuary have been depleted at an alarming rate due to the operation of various types of anthropogenic activities such as pisciculture, urbanisation and habitat settlements. Loss of mangroves in different locations of Sartha estuary has intensified the rate of tropical cyclones and various environmental hazards. Conservation of the existing mangrove vegetation as well as restoration of mangroves in the degraded lands should be done for the protection of coastal environment in this region.

Key Words: Indigenous uses, Mangroves, phytochemical analysis, Sartha estuary

ESTIMATION OF CARBOHYDRATE, PROTEIN AND SECONDARY METABOLITES OF SELECTED *CURCUMA* SPECIES FROM THE NORTHERN COASTAL REGION OF ODISHA, INDIA

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The presence of phytochemicals is responsible for the medicinal properties of different species belonging to the genus *Curcuma*. These are used since ancient times in a variety of Indian medications. Being edible, it also serves to supply the body with protein and carbohydrates besides other nutrients present in it. The study was undertaken to determine the composition of carbohydrate, protein and phytochemicals of some selected species of *Curcuma* viz., *C. longa*, *C. caesia*, *C. aromatica*, *C. amada* and *C. angustifolia* collected from the Northern coastal region of Odisha, India.

The objective of this work was to estimate the carbohydrate, protein, and phytochemical constituents of the selected *Curcuma* species and to raise consciousness about conservation and domestication of the species containing a decent amount of the above-mentioned macronutrients and phytochemicals.

During the present investigation it has been observed that, highest protein content was found in *Curcuma longa* (48.79%), followed by *C. caesia* (18.53%) and *C. amada* (13.19%). *C. aromatica* (10.29%) and *C. angustifolia* (9.18%) showed relatively lesser protein content. The carbohydrate content of the selected *Curcuma* species was found to be lying in the range of 19-31%. Highest protein content was found in *C. amada* (20.36%) followed by *C. caesia* (20.29%) and *C. aromatica* (19.93%). Comparatively lesser protein content was estimated in *C. longa* (19.91%) and *C. angustifolia* (19.51%). In the dried rhizome powder of *C. longa* and *C. angustifolia*, presence of alkaloids, glycosides, phenolics and tanin were found while in dried rhizome powder of *C. amada*, alkaloids, flavonoids, glycosides, phenolics and tannins were present. In the rhizome powder of *C. aromatica*, alkaloids, flavonoids, glycosides, phenolics and saponin was found and there was the presence of alkaloids, flavonoids, glycosides, phenolics, tannins and saponins in rhizome of *C. caesia*. The results implies that the *Curcuma* species are not only medicinally important but also nutritionally rich and should be domesticated in large scale to fulfil the demand of the common people.

Keywords: *Curcuma*, Carbohydrates, Proteins, Phytochemicals

ETHNOBOTANICAL STUDIES AND PHYTOCHEMICAL ANALYSIS OF POTENTIAL MEDICINAL PLANTS IN KEONJHAR DISTRICT OF ODISHA

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Keonjhar district in the state of Odisha has rich forest resources with large number of medicinal plants and plants of other socio importance. People of various ethnic groups in this district have rich traditional knowledge regarding the various uses of medicinal plants for the treatment of various diseases. Ethnobotanical surveys have been conducted in different regions of Keonjhar district of Odisha out during 2020 to 2022 to assess the medicinal uses of plants by the local tribe and other forest dwellers.

Ethnobotanical surveys have been undertaken in the forest dominated area of Anandpur, Sadar and Champua sub-division of the Keonjhar district. Ethnobotanical data have been collected through field assessment from traditional healers and elderly people of the tribe by means of personal interviews and semi-structured questionnaires. Herbarium specimens have been collected following standard methods and these are identified with the help of the regional flora books. The impacts of various biotic factors which are responsible for habitat destruction have been assessed and the present statuses of different medicinal plants have been evaluated. Phytochemical analysis of ten potential medicinal plants has been carried out for the authentication of the medicinal uses of plants for various purposes.

During the present investigation, 56 species of medicinal plants belonging to 18 families have been collected from various locations of the study areas. It has been observed that root parts are widely used for medicinal purposes. It is followed by the leaf, bark, seed and stem. Phytochemical analysis of 10 potential medicinal plants have been carried out which reveals the presence of various phytochemicals such as alkaloids, flavonoids, terpenoid glycosides, phenol, tanin and saponin.

It has been observed that the rich traditional knowledge of the people of various localities in the Keonjhar district regarding the various uses of plants for the treatment of various diseases

is on the verge of extinction due to the advancement of modern allopathic system of medicine. Proper documentation of this traditional knowledge is an urgent need of the hour for the conservation and sustainable utilization of medicinal plants in this region.

Keywords: Ethnobotanical studies, phytochemical analysis, Keonjhar district

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ECOLOGY AND DISTRIBUTION OF PLANTS OF CONSERVATION CONCERN IN ODISHA

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ABSTRACT

Section 38 of the Biological Diversity Act, 2002, mandate the State Biodiversity Boards (SBBs) and Union Territory Biodiversity Councils (UTBCs) to notify the threatened species at respective States and UTBCs. Further, Rule no. 12.8 and 17 (i) of the Odisha Biological Diversity Rules (OBDRs), 2012 says “the mandate of the board is to advice the state government in any matter related to conservation of biodiversity, its sustainable use and access and benefit sharing including restriction and regulation of access to threatened species”. National Biodiversity Authority, Chennai has notified 13 animals and only one plant species as species on the verge of extinction for Odisha state under Section 38 of the Biological Diversity Act, 2002 (18 of 2003) which need to be revised and updated. To identify the threatened plants of Odisha, a comprehensive survey and documentation of plants of conservation concern had been carried out from 2020 to 2023 in in Odisha using both primary and secondary methods. In total 165 plants species including 26 endemic species has been identified using review of published literature, herbarium consultation and primary survey from the state. The final list of threatened plants of Odisha shall be notified by the board using Conservation Assessment and Management Prioritization (CAMP) mode.

SOCIOBIOLOGY OF WETLAND PLANTS OF JAJPUR DISTRICT, ODISHA

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The present study deals with documentation and investigation of wetland plants available in Jajpur district of Odisha of eastern India, their socio economic value. An ethnobotanical survey have been conducted during 2018-2022 to document the wetland plants in Jajpur district of Odisha. Local elderly people were approached to collect the information regarding the use of these plants and their impact on society. Extensive and intensive floristic studies have been conducted during different season of the year in different location of the study area. Voucher specimens have been collected, identified and preserved in the form of herbaria following standard method. The result revealed that, 34 aquatic and wetland plants are used by local people as food, medicine, fodder, ethno veterinary practice, agriculture, bio-fertilizer, organic manure, fiber, fuel, food plate, ornamental, ritual works, packaging, thatching of house, preventing soil erosion, bio remediation and making of toy, boat, crown, basket, mat, handicrafts, rope. As these plants have a wide range of utilization, most of them have attained commercial status. These are cultivated and sold in the market. Now-a-days aquatic plants become rare in wild condition due to over exploitation, pollution load, mushrooming of industries, interference of invasive and alien species, anthropogenic pressure and other socioeconomic developmental activity in this area. Conservation of these plants is much essential for the maintenance of ecological balance in this region.

Key words: Sociobiology, Ethnobotany, Wetland plants, Conservation

INDIGENOUS KNOWLEDGE ON TRIBAL VEGETABLES OF NUAPADA DISTRICT, ODISHA

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The present work deals with the study of vegetables used by the tribals of Nuapada District of Odisha. The district is located between 20° 0' N and 21° 5' latitude and between 82° 20' E and 82° 4' E longitude. It covers an area of 3407.5 km². A survey was conducted during 2020-2022 in the tribal areas of the district. Major tribes of the district are Gond, Rajgond, Kandha, Mundari, Shabar, Lodha and Bhuiyan. Local tribal people are approached to collect data regarding the plants used by them as vegetables. From the investigation it is found that 25 species belonging to 22 families are used as vegetable by them. Out of these leaves of 17 plants, flowers of 2 plants, tuber of 5 plants and all the parts of 2 plants are consumed as vegetables. They are consumed in curry, fried, mashed, boiled and roasted forms. These vegetables not only fulfill the food demand but also are useful in the health care of the tribal people. Modern food habits have resulted in the decreasing use of indigenous tribal food, which is highly nutritious and a blessing of nature to human health. Proper documentation of the indigenous knowledge regarding the use of the vegetables by various tribal people and their conservation will be useful for future generation.

Key Words: Indigenous Knowledge, Vegetable, Conservation

MEDICINAL PLANT DIVERSITY IN MALYAGIRI HILL RANGES OF ODISHA

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Malayagiri Hill ranges located on the south of Pallahra town of Angul district in the state of Odisha is endowed with rich biodiversity including large number of flora and fauna. This area is rich with large number of medicinal plants and plants of other socio-economic importance. It consists of no. of small and large hills attaining height up to 1187 meters. It is the third highest mountain peak in Odisha. Malyagiri hills affiliated with Eastern ghats of India present within 85° 16' 58" E longitude and 21 ° 23' 30" N latitude, comes under Deogarh forest division and covers around 115 sq. k.m. From the past floristic studies conducted by earlier workers, it is evident that intensive floristic studies have not been conducted in this region. Large number of tribal people also inhabit around Malayagiri and its periphery. These people are utilizing various plants and plant products for medicinal and other purpose. Thus, this area is also much rich with indigenous knowledge which is on the verge of extinction due to the advent of modern Allopathic system of medicine. Keeping these facts in mind, intensive as well as extensive floristic studies have been undertaken in various locations of this region. Four hundred eighty six medicinal plants and plants of other socioeconomic importance have been collected and identified from different locations of this region.

During the present investigation, it has been observed that some species of medicinal plants are also on the verge of extinction in this region due to habitat loss. As such, conservation and sustainable utilization of medicinal plants and plants of other socioeconomic importance should be done on top priority for the conservation biodiversity and protection of environment in this region.

Key Words: Medicinal plant diversity, Conservation, Malyagiri hill ranges

ETHNOMEDICINAL USES AND PHYTOCHEMICAL ANALYSIS OF COMMON MEDICINAL PLANTS OF KULDIHA WILD LIFE SANCTUARY IN ODISHA

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Kuldiha wild life sanctuary in the Balasore district of Odisha has rich biodiversity including medicinal plants. These areas are having rich indigenous knowledge about the medicinal plants used by various ethnic groups. The present investigation has been carried out to conduct ethnobotanical studies in different locations of the study areas to assess medicinal plant diversity and to collect information about rare, endemic, endangered and plants of other socio-economic importance.

Regular field trips have been conducted in different seasons of the year to various locations of the study areas to know the distribution pattern and natural habitat of medicinal plants and plants of other socioeconomic importance. The plant species were identified with the help of regional flora books.

During the present investigation, 264 species belonging to 38 families have been collected during the present investigation. Phytochemical analysis of some selected plants has been carried out which are useful for the validation of the ethnomedicinal data for their application in herbal drug industry.

Key Words: Ethnomedicinal uses, Medicinal plant, Kuldiha Wildlife Sanctuary.

PHB ACCUMULATION OF PHOTO SYNTHETIC CYANO BACTERIA *LIMNOTHRIXPLANKTONICA* UNDER VARIOUS C:N RATIO CONDITIONS

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There is a rising problem about the impact of non-biodegradable plastic trash. Researchers are focused on finding out biodegradable plastics from microbes as an alternative to synthetic plastic. Photoautotrophic cyanobacteria are chosen as a potent source for the economical manufacture of this polymer. The biopolymer poly (3-hydroxybutyrate) (PHB) is hydrophobic, biocompatible and has thermal characteristics comparable to petroleum-based polymers. For this investigation, *Limnothrixplanktonica* was collected from the mangrove forest of Bhitarkanika, Odisha and it was explored for PHB accumulation. Experiments were designed by adding external commercial carbon sources and fruit waste-derived carbon sources (peels of banana, jackfruit, orange, pea) with or without nitrogen/ phosphate-starved cells to maximize the PHB accumulation alone and with combinations. The PHB accumulation was found to be 15.87 mg/L, 22.03 mg/L and 22.17 mg/L respectively, during NP-deficiency, acetate and banana peel supplementation. In the combinations of NP-starvation and banana peel supplementation, the organism exhibited the highest PHB accumulation (39.39 mg/L); followed by jackfruit peel supplementation (36.5 mg/L). In comparison to banana peel (C:N) alone, PHB accumulation increased by 77.76% when the banana peel combo was supplemented along with nutrient-deficient (C:N-0) conditions.

Keywords: Banana peel, Acetate, NP deficiency

SOME COMMON MEDICINAL PLANTS USED IN HOMOEOPATHY MEDICINE

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In the present study, an attempt has been made to document the common medicinal plants used in homoeopathy medicine to cure different diseases. The study reveals that 28 number of common medicinal plants belongs to 24 families are used in the preparation of homoeopathy drugs. The drugs are prepared according to homoeopathic pharmacopoeia approved by Central Council of Homoeopathy and German homoeopathic pharmacopoeia. Drugs are potentised by ethanol and pure lactose. Drugs derived from these plants are used in curing acute and chronic catarrhal condition, lungs disease, urinary tract infection, cardiac disease, eye disease, chronic headache, rheumatism, arthritis, worm disorder, gynecological disorder, skin disease, gastritis, liver disorder, neurological disorder etc. Some common plants used in homeopathic preparations include *Aconitum napellus*, *Allium cepa*, *Arnica montana*, *Atropa belladonna*, *Digitalis purpurea* and *Lycopodium clavatum*. Hence, these plants must be conserved for the preparation of this holistic system of medicine in future.

Key Words: Drugs, Homoeopathy, Medicine, pharmacopoeia

CULINARY ARTISTRY OF TURMERIC LEAVES IN INDIA

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ABSTRACT

Young turmeric leaves, like the rhizomes of the turmeric plant, offer several potential health benefits. Turmeric leaves are a good source of essential nutrients, including vitamin C and minerals (like iron and calcium), which are important for overall health. Turmeric, in general, is known for its anti-inflammatory properties, primarily attributed to curcumin, a bioactive compound found in both the rhizomes and leaves. This property may help reduce inflammation in the body. The leaves of the turmeric plant contain antioxidants that can help neutralize harmful free radicals in the body. Antioxidants play a role in protecting cells from damage and supporting overall health. Crushed turmeric leaves have been traditionally used for their potential wound-healing properties. Turmeric leaves also have some antimicrobial properties, which could be beneficial in inhibiting the growth of certain bacteria and fungi as well as molds. The essential oil of leaves also delays in spore germination. . The essential oil collected by steam distillation has a lot of terpene group of compounds responsible sweet aroma and used for several cuisines. In Bengali cuisine, fish or vegetables are often marinated with a paste of mustard and turmeric leaves and then wrapped in banana leaves before being steamed or grilled. This dish is known as “Paturi.” In Kerala, turmeric leaves are used to wrap and steam fish or meat preparations, imparting a distinct flavor. The use of turmeric leaves is particularly common in traditional dishes like “Karimeen Pollichathu,” where fish is marinated, wrapped in turmeric leaves, and then pan-fried or grilled. “Patrode” is a dish where a mixture of rice, lentils, and spices is smeared on turmeric leaves, rolled, and steamed. In Odisha, during festivals like Raja Sankranti, a dish called “Poda Pitha” is prepared. It involves marinating rice, black gram, and other ingredients, wrapping them in turmeric leaves, and then baking or roasting the bundle. Another festival named as “Prathamatami” *enduri pitha* has been made with fermented rice and black gram batter stuffed with jiggery and coconut. In Assam, turmeric leaves are used in making traditional sweets like “Til Pitha,” where a mixture of sesame seeds and jaggery is wrapped in turmeric leaves and steamed. In some North Indian recipes, especially biryanis, turmeric leaves may be

used to add aroma. The leaves are sometimes placed over the rice before covering the pot, allowing the steam to infuse the rice with the fragrance of turmeric leaves. While turmeric leaves are not as commonly used in every Indian cuisine, they are prized in specific regions for their unique flavor and aromatic qualities. The way turmeric leaves are utilized can vary from one state or community to another, contributing to the rich diversity of Indian culinary traditions. It's important to note that while these potential benefits are associated with turmeric leaves, more scientific research is needed to fully understand their specific properties and mechanisms of action.



VASCULAR PLANTS OF KOTAGARH WILDLIFE SANCTUARY, ODISHA, EASTERN GHATS, INDIA

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ABSTRACT

A comprehensive taxonomic inventory of higher plant of Kotagarh Wildlife sanctuary had been carried out for the period from 1st March, 2018 to 28th February, 2019. The floral diversity of the Sanctuary comprises 1372 higher plant species under 137 families and 707 genera including 1369 angiosperms and 3 species of Gymnosperms. Among angiosperms 732 species are herbs, 265 species are shrubs, 248 species are trees and 124 species are climbers. Fabaceae was found to be the the most dominant family represented by 162 species, followed by Poaceae (82 species) and Asteraceae (75 species). *Rauvolfia serpentina*, *Uvaria hamiltonii*, *Polyalthia simiarum*, *Oroxylum indicum*, *Pueraria tuberosa*, *Gardenia gummifera*, *Gloriosa superb*, *Operculina turpethum*, *Cycas spherica*, *Gnetum ula*, *Celastrus paniculatus*, *Symplocos racemosa*, *Garcinia xanthochymus*, *Smitinandia micrantha* and *Litsea glutinosa* were identified as regionally threatened species that require conservation action. All the plant species has been represented with updated nomenclature and their respective threat status has been assessed. Recommendations have been made to the Baliguda Forest Division towards protection and conservation of the plant diversity of the sanctuary.

IMPACT OF INDIVIDUAL AND COMBINED APPLICATION OF TETRACYCLINE AND STREPTOMYCIN ON RICE SEED GERMINATION PLANT PERFORMANCE

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Rice seeds are recommended to be pre-treated with antibiotics before sowing to eradicate bacterial diseases. A phytotoxicity test was conducted to evaluate the effects of tetracycline (TC) and streptomycin (STR) singly or in combination as Streptocycline (STC) at three different doses (half the recommended dose; 0.5RD, recommended dose; RD and double the recommended dose; 2RD) on rice seed germination and related parameters. The germination percentage, mean germination time (MGT), vigour index I, vigour index II and shoot length were significantly affected by types of antibiotics and their dosages. However, root length, fresh weight of roots and shoots of rice seedlings was not significantly affected by the antibiotics or their dosages. The germination parameters were significantly affected in combined application as compared to their single applications. In all cases higher doses (2RD) reduced the germination parameters in comparison to RD and 0.5RD treatments. Combined application of TC and STR at higher doses may inhibit the rice germination parameters and early vigour, thereby could pose serious issues in plant establishment in main rice field. The antibiotics did not cause any marked change in the OJIP fluorescence transients of the fully grown rice plants but there was a reduction of fluorescence at all levels. The primary photochemistry and the performance of plants for photosynthetic energy conversion decreased with the increase in the concentrations of antibiotics.

Key words: Streptocycline, Vigour, Phytotoxicity, Mean germination time, Fluorescence.

PEOPLES' BIODIVERSITY REGISTER AS A TOOL FOR THE CONSERVATION OF MEDICINAL PLANTS IN SIMILIPAL BIOSPHERE RESERVE, MAYURBHANJ, ODISHA

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ABSTRACT

As per the Biological Diversity (Amendment) Act, 2023 (Principal Act 2002), every local body shall constitute Biodiversity Management Committee (BMC) within its area of jurisdiction for promoting conservation, sustainable use and documentation of Biological Diversity. The main function of the BMCs is to prepare Peoples' Biodiversity Registers (PBRs) in consultation with local people. PBR is a comprehensive documentation of various aspects of Biodiversity present in a specific BMC area. The main objective of PBR is to ensure that the comprehensive knowledge on local biological resources and their medicinal and other uses as well as traditional knowledge are formally documented and maintained. PBR contains 31 formats categorized into agricultural biodiversity, domesticated, wild and urban biodiversity prescribed by the National Biodiversity Authority (NBA) where the Formats 12 and 22 pertaining to documentation of medicinal plants diversity. All the formats have provisions for documenting the local status and uses of species followed by associated Traditional Knowledge.

The State of Odisha is bestowed with the biodiversity paradise "Similipal Biosphere Reserve (SBR)" in Mayurbhanj District harbouring a wide diversity of medicinal plants. Odisha Biodiversity Board is carrying out preparation of Peoples' Biodiversity Registers in BMCs located in adjacent to the SBR to take actions for conservation of biodiversity of this pristine ecosystem. Particularly, the plants which have used traditionally for curing various ailments are being recorded with associated traditional knowledge being obtained from the local baidyas, hakims, disaris and other knowledgeable persons. As the PBR preparation involves PRA exercises, personal interviews, household surveys, etc., a wholesome awareness is being generated among the local people regarding the conservation and sustainable utilization of local bioresources. Further, PBR preparation will help the BMCs to prepare management plans, conservation strategies like building up of medicinal plant nurseries and Botanical gardens and also to gain financial benefits through the execution of Access and Benefit Sharing (ABS) by giving approval to private firms to access medicinal bioresources.

People of Mayurbhanj and particularly the tribal villages located to the periphery of SBR are highly dependent on this forest for livelihood particularly the local baidyas who collect number of medicinal herbs, shrubs and trees for preparing ayurvedic and herbal medicines. Now-a-days when

the ethnobotany has become increasingly valuable in the development of health care and conservation programmes in different parts of the world, flow of researchers is increasing to the SBR day by day. Through PBR preparation process, it has been revealed that the population and species status of medicinal plants have been declined drastically due to all these unregulated activities, forest fire and destructive harvest. Hence, activities under PBR preparation will also help the BMCs to regulate the access of bioresources by various entities and to conserve the medicinal plants in a long term basis.

Key words: Medicinal plants, Biodiversity Management Committee, Peoples' Biodiversity Registers, Traditional Knowledge, Similipal Biosphere Reserve



TRADITIONAL NIGER ACCESSIONS FROM KORAPUT: NUTRITIONAL AND CLIMATE RESILIENT TRAITS

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ABSTRACT

Niger [*Guizotia abyssinica* (L.f.) Cass.] is an economically important edible oilseed crop cultivated in different parts of India. These crops are being cultivated by tribal fraternity of India and considered as “lifeline of tribal agriculture and economy”. Present study evaluated the genetic variation in nutritional and climate resilience traits of 30 indigenous Niger accessions originating from Koraput, and compare them with three improved varieties of the locality (Deomali, Utkal Niger and JNC-28). Based on the results, some indigenous Niger accessions such as Mangardora, Ganjeipadar and Kolabnagar had exceptionally rich in fat, protein and energy contents and are nutritionally superior compared to improved variety of the locality. Further, exceptional rich in flavonoid, antioxidant capacity and vitamin-C was recorded in Manahar, Badapada and Mahadeiput accessions. Based on drought tolerance screening, three Niger accessions such as Dayanidhiguda, Manahar and Sungar recorded higher drought tolerant index than that of tolerant check variety Deomali and showed more adaptive response to drought. These nutrition rich and drought tolerant local accessions hold great potential for future crop improvement programs and global implications.

PHOTOSYNTHETIC PERFORMANCE OF *SYNECHOCYSTIS* SP. PCC 6803 ON EXPOSURE TO THIAMETHOXAM: A NEONICOTINOID

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Chemical pesticides are of critical importance in intensive farming systems' agricultural productivity. Neonicotinoids (NEOs) are the 4th generation pesticides that are being used widely replacing the traditional pesticides of organophosphates, organochlorines and carbamates group. Thiamethoxam (TMX) is a typical representative of the second-generation neonicotinoids with widespread use and having CAGR of 9.60% during 2020-2025. The wide use has increased the detection rate of TMX in global soil and surface water (81.3 %), with the values ranging from 0.002 to 4315 ng/L. In the work presented effect of TMX (0-150 μ M) on the cyanobacterium *Synechocystis* sp. PCC 6803. The response of the test organism to graded concentrations of TMX was measured with long term exposure (1-5 days). Growth and pigment content were negatively affected at concentrations > 10 μ M. There was enhanced production of fluorescing chlorophyll metabolites and a more intense lipid peroxidation at higher insecticide concentrations. With increasing concentration of pesticide, the chlorophyll fluorescence, PS II fluorescence, PBS fluorescence, PC fluorescence decreased on net value basis but increased on pigment basis. The PC/PBS and PBS/PS II ratio showed an increasing trend thus indicating a miscommunication in the efficient energy transfer at the bio-molecular level.

CHLORPYRIFOS ENRICHED *ANABAENA* SP. PCC 7119 STRAIN POTENTIALLY SUSTAINS DIMETHOATE TOXICITY

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Organophosphates (OPs) are a group of commonly used man-made chemicals formed by the esterification of phosphoric acid and alcohol and is used for on-field pest control. These constitute about 38% of the global pesticide consumption, more specifically rampant in the tropical agroecosystems. Various microorganisms, isolated from pesticide contaminated soil showing considerable tolerance and insecticide degrading abilities have been reported but few attentions were given to develop a tolerant strain of cyanobacterial species. The developed strain can potentially target other related pesticides to a greater extent with additional benefit to the crop field and environment. A chlorpyrifos tolerant strain of *Anabaena* sp. PCC 7119 was developed through continuous enrichment of the wild strain and its cross tolerance to the OP insecticide, dimethoate was evaluated through the measurement of photosynthetic performance, key enzyme activities and degradation potential. Enriched strain was comparatively more efficient in neutralizing the adverse effects of dimethoate, showing enhanced growth performance at elevated concentration. The photosynthetic pigment performance of the tolerance strain has been found to be significantly moderated than that of wild type. So biochemical and enzymatic basis of tolerance was properly established. Organism expedites the removal of insecticide at an efficient rate and protects its photosynthetic machinery from the adverse consequences and toxicity. The bioconcentration factors of both chlorpyrifos and dimethoate were low in the tolerant strain than in wild. The enriched strain showed promising results with regard to withstanding dimethoate toxicity. So it can emerge as a promising bioremediating organism for OP degradation.

Keywords: *Anabaena*, chlorpyrifos, dimethoate, photosystem performance, enzymes, degradation

ANTIOXIDANT ACTIVITY OF WATER CHESTNUT (*ELEOCHARIS DULCIS*) EXOCRAP OF AQUEOUS EXTRACT

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ABSTRACT

Eleocharis dulcis, an aquatic plant belonging to Cyperaceae family is indigenous to Asia, and also inhabits in tropical Africa and Australia. The present study was carried out to investigate antioxidant activity and estimation of total flavonoid content (TFC) and total phenolic content (TPC) of *E. dulcis* (Cyperaceae) exocrap of aqueous extract. Total flavonoids content was spectrophotometrically determined using aluminum chloride colorimetric assay while TPC by Folin Chiocalteu's reagent. Antioxidant activity was determined by DPPH free radical scavenging. The results showed high free radical scavenging activity as evidenced by the low IC₅₀ values in DPPH assay (23-45µg/ml). Furthermore, the TPC and TFC of the extract were found to be 21.25 mg gallic acid equivalent per gram of extract. The result of present comprehensive analysis demonstrated that *E. dulcis* exocrap possess high and potential antioxidant activity and could be used as a viable source of natural antioxidants.

Keywords: *Eleocharis dulcis*, TFC, TPC, antioxidant activity

ROLE OF TRADITIONAL BOTANICAL KNOWLEDGE IN BIOPROSPECTING AND CONSERVATION OF MEDICINAL PLANT RESOURCES

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ABSTRACT

Present discussion deals with the major aspects of research on bioprospecting and conservation of medicinal plant resources with a thorough illustration on importance of traditional botanical knowledge in the concerned areas of research. Ethnobotany embodies the traditional knowledge related to sustainable utilization, conservation and management of phytoresources. It is the study of age-old and natural relationship between people of a culture and plants in its environment. Present communication highlights the role of traditional knowledge in bioprospecting of medicinal plants in global as well as Indian perspective along with a precise discussion on application of statistical quantitative indices to identify the ethnobotanical leads prospective for discovery of novel drugs from the ethnomedicinal plant species. It is interesting to note that most of the clues or leads which are coming from folk herbal knowledge give a positive result in bioprospecting of natural products including medicine. Ethno-guided leads are most preferable to the bioprospecting scientists as their success or hit rate is very high than the success rate of information taken from other sources. Taking the information from ethnobotanical as well as other traditional herbal knowledge system many novel products including drugs have been developed worldwide by the coordinated efforts of ethnobotanists, phytochemists, pharmacologists and clinical persons. Over the last few decades, ethnobotanists have been using appropriate quantitative indices to analyze the collected data for more objectivity in their research carried out in the fields of conservation, management and sustainable utilization of plant resources at local as well as regional level. A good number of reports regarding bioprospecting of natural products have recently been published from different parts of the world where quantitative ethnobotanical approach played a positive role in selecting the ethnobotanical lead or clue.

Many international and national organizations are engaged in conservation and management of bioresources employing various *in situ* and *ex situ* strategies. Traditional conservation practices are also getting importance in framing the strategies for biodiversity conservation. A unique quantitative technique known as Local Conservation Priority Index (LCPI) has been devised using selective quantitative indices from ethnobotany and ecology for assessing the conservation

priorities of plant species used by the local folk communities. It has now been considered as an effective tool in the field of ethnoecology for successful management and conservation of local phytoresources including medicinal plants. All those aspects of ethnobotany, in relation to bioprospecting and conservation of medicinal plants including free prior informed consent, benefit sharing, IPR of the knowledge holders have been explained here in this paper at length. Finally, some recommendations have been made for future aspects of research on bioprospecting and conservation of ethnomedicinal plants in India.

Key words: Traditional knowledge, Bioprospecting, Conservation, Medicinal plants.



GENETIC CONTROL OF FLOWERING IN ANGIOSPERMS

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ABSTRACT

Flowering plants are the most highly evolved and complex organisms within the plant kingdom. The flower consists of several distinct organ systems that are responsible for higher plant reproduction. Flower development represents an excellent model for understanding the molecular and physiological processes that control organ differentiation in higher plants. Various models like ABC, ABCD, ABCDE, and Quartets Model of flowering have been established for explaining the genetic control of flowering. An external signal is required in order to trigger the differentiation of the meristem into flower meristem. ABC model proposes that the A gene, A+B, C, and B+C genes are responsible for development of sepal, petal, carpels, stamens respectively. In ABCDE model A+B, B+C, C, D and E genes control development of petals, stamens, carpels, ovule, and entire floral meristem respectively. These functions are exclusive and the absence of one of them means that the other will determine the identity of all the floral vertices.

Keywords: Flowering, ABC model, ABCDE model

INHIBITION OF THE CELL PARTITION AND GENERATION OF FILAMENT FORMS IN *SALMONELLA TYPHI* BY WMFEO OIL

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Inhibition of the cell partition leads to filament generation in gram negative bacteria. The partition wall is lost because of either non-functionality or distortion of cell division associated proteins. The phase of filamentation may be considered as a pro-killing phase. It is evident that the conventional antibiotics like fluoroquinolone compounds generate this filamentous form. However, the bacteria confer resistance being in filamentous form. Therefore, this study was initiated considering a plant *Mangifera indica* Linn (Anacardiaceae) which is widely grown in Western Odisha soil and its essential oil, Wild Mango Flower Essential Oil (WMFEO). WMFEO was extracted from *M. indica* flowers using Clevenger's apparatus as an alternative, cost effective natural and more so herbal bacterial growth inhibitory agent. Therefore, Wild Mango Flower was hand-picked up before fruiting stage and was subjected to hydro-distillation method, using Clevenger's apparatus, and the floral essential oil was extracted. This WMFEO was tested against a strain of *Salmonella typhi* and was observed with generation of filamentous form. Interestingly, there was total killing of all filamentous form in higher oil concentration of WMFEO. From this, it may be inferred that the said oil had bactericidal activity with generating filamentous intermediate forms. Hence, it is concluded that the oil had impact upon the protein involved in cell division of bacteria.

Acknowledgement: This study is a small part of a thesis work registered under Sambalpur University, Burla

SEAWEEDS AS NUTRACEUTICALS AND MEDICINAL AGENTS: EXPLORING ALTERNATIVE PHARMACOLOGICAL APPLICATIONS

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ABSTRACT

Pharmacologists are paying more and more attention to seaweeds, an aquatic flora that is well-known for its high nutritional content and rich biodiversity, as possible sources of novel compounds for alternative therapeutic interventions. These are rich sources of bioactive substances with a variety of pharmacological properties, such as polysaccharides, peptides, polyphenols, and essential fatty acids. Among other things, these substances have shown anti-inflammatory, antiviral, antibacterial, and anticancer effects. The investigation of compounds derived from seaweed as pharmacological agents creates new opportunities for the development of drugs. It can modulate immunity, especially through the presence of compounds like fucoidans and laminarins, which help to cure immune-related illnesses. Furthermore, the polyphenols especially derived from brown seaweed have antioxidant qualities that help to reduce oxidative stress, which is a major cause of many chronic illnesses. This summary also highlights the potential of algae in the treatment of metabolic disorders, cardiovascular diseases, and neurodegenerative diseases. Compounds such as phlorotannins and algal omega-3 fatty acids have been shown to have positive effects in preclinical studies, suggesting their utility in alternative pharmacological approaches. This abstract explores the need for extensive research on the pharmacodynamics, pharmacokinetics, and safety profiles of algal-derived compounds. Integrating algae into the pharmacological landscape can provide innovative and sustainable approaches to drug development, opening a step forward to alternative therapies.

Keywords: Seaweed, Therapeutic intervention, Nutraceuticals, pharmacodynamics, pharmacokinetics Alternative therapy

SIGNIFICANCE OF NON-TIMBER FOREST PRODUCTS (NTFPs) IN RURAL LIVELIHOOD OF BALASORE DISTRICT, ODISHA

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ABSTRACT

Non-timber forest products (NTFPs) play a significant role in the improvement of the forest-dependent people's livelihoods around the world, strengthening protection for the sustainable use of forests. The purpose of this research was to evaluate the influence of occupational category-wise (fuelwood collectors, farmers, small-scale businessmen, day labourers, and tribals) dependency on NTFPs. The study observed that these forest-dependent communities utilized resources for domestic energy supply, household income, and house construction. Results showed that income from NTFPs made a significant contribution to family income. The fuelwood collectors and farmers collected significantly greater amounts of NTFPs per trip than other occupational categories. Forest conservation is facilitated by increasing the value of NTFP earned by local people in addition that NTFPs harvesting is more sustainable than the timber harvesting. In contrast to timber extraction or agriculture, NTFP production has often been considered more harmonious with biodiversity conservation. So that the higher livelihood outcomes are associated with lower environmental outcomes and NTFP is likely to join the development and conservation of natural forest. However, the outcome depends on the production system used. NTFP extraction from a natural forest can have a low impact on the local ecology and biodiversity at the landscape and species levels. The sustainable development goals (SDGs) present an opportunity, according to the study, to increase emphasis on the livelihood benefits of NTFPs and make this invisible contribution. The research also discussed the consequences for the significance of NTFPs and usage type.

Keywords: NTFPs, local tribals, energy supply, natural forest, management, ethnomedicine

UNTARGETED METABOLOMICS STUDY WITH GC-MS TO REVEAL POSSIBLE METABOLITES AND BIOLOGICAL PATHWAYS INVOLVED IN INDUSTRIAL POLLUTION RESPONSE OF A MEDICINAL PLANT *HOLARRHENA PUBESCENS* WALL. EX G.DON

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ABSTRACT

Industrial pollution represents a major environmental threats to human, animal and plant health due to the accelerating industrial developments in recent decades. Among the non-nutrient heavy metals, are the most common and widespread contaminants release from industry, which absorbed by plants through contaminated soil and water. In plants, heavy metal toxicity could induce a number of morphological, physiological and biochemical abnormalities. In this study, the metabolite profiling analysis in the leaf of *Holarrhenapubescens* after the collection from Angul-Talcher industrial areas using GC-MS analysis. From the study, a broad range of pollution responsive metabolites were quantified, and the changes in several metabolic pathways were highlighted. In our study accumulation of most of the soluble sugar like D-allose, glucose, fructose, galactose, rhamnose, sucrose, D-xylose and mannose significantly decreased *H. pubescens* under polluted environment. In industrial areas the level of all three types of secondary metabolites decreased significantly ($P < 0.05$). Out of 17 alkaloids, two, i.e., kurchessine and hookerianamide were not detected in industrial areas, and highly decreased alkaloids were holarrhesine (67%), conarrhimin (64%), conessimine (61%), piperidine (60%), and conimin (59%). Additionally, to reveal the integrative biochemical networks of the species in response to pollution stress, the metabolomics data were integrated. This work comprehensively provides the framework for a better understanding of the mechanisms that govern plant cell response to pollution-induced stress in medicinal at a molecular level, and the resulting information would facilitate the effective management of pollution contamination by genetic manipulation.

Keywords: *Holarrhena pubescens*;untargeted metabolomics; GC-MS;industrial pollution; secondary metabolites.

PLASTIC FROM GRASS

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Nearly all the plastics sold today come from petroleum and aren't biodegradable. But researchers at Metabolix in Cambridge, Massachusetts, are genetically engineering switchgrass to produce a biodegradable polymer that can be extracted directly from the plant. That could transform the economics of making biodegradable polymers. Metabolic genes that allow bacteria found in soil to naturally produce a polymer known as PHA. (polyhydroxyalkanoates) are naturally occurring polymers. Metabolix plant scientists are working anew on inserting those genes, plus others that regulate growth, into plants including switchgrass, camelina, and sugarcane. In switchgrass, they're coaxing the plant to produce and store in its tissues a specific type of PHA, known as PHB, polyhydroxybutyrate is a biodegradable polymer that is produced by bacteria and archaea as carbon and energy reserves. Due to its rapid degradation in nature, it can be considered as a biodegradable plastic alternative. that can be used to make injection-molded products such as electronics housings. The company is also working on chemical production steps, including extraction of the PHB using solvents, and a thermal method of converting the PHB into a chemical called crotonic acid, which can be used as a feedstock for polymers. After the PHB is extracted or the crotonic acid produced, remnants of the grass could be burned as a biomass energy source that produces lower net carbon emissions than fossil fuels.

EVALUATION OF EFFECTIVE PLANT PRODUCTS FOR THE MANAGEMENT OF INSECTS INFESTING STORED GROUNDNUT

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ABSTARCT

The Groundnut beetle *Caryedon serratus* (Oliver), Coleoptera is a major pest known to infest groundnut in India and cause considerable damage every year. The efficacy of various botanicals was tested for one year against *Caryedon serratus* (Oliver), infestation in laboratory conditions. The various botanicals were extracted using Clevenger's oil extraction apparatus from the plant species namely "Til Oil" (*Sesamum indicum*), Karanja oil (*Pongamia glabra*), mustard oil (*Brassica Campestris*), Nilgiri oil (*Eucalyptus* sp), Palm oil (*Areca catechu*), Bel oil (*Aegle marmelos*), Castor oil (*Ricinus Communis*), Sunflower oil (*Helianthus annus*), Neem oil (*Azadirachta indica*), Citronella oil (*Cymbopogon nardus*), Crown oil (Resin of *Shorea robusta*), Rice bran oil (*Oryza sativa*), Sisso oil (*Dalbergia sisso*), Camphor oil (*Cinnamomum camphora*), Linseed oil (*Linum usitatissimum*), Mint oil (*Mentha spicata*) and ground nut oil (*Arachis hypogea*) were tested for their bio-efficacy. Out of all these products Nilgiri oil, Citronella oil, camphor oil and Crown oil (LD_{50} - 1% v/w) were found to have 100% pod protection for one complete year.

Keywords- *Caryedon serratus* (Oliver), Clevenger's oil extraction apparatus, LD_{50} .

EVOLUTION OF CYANOBACTERIA

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ABSTRACT

Earth was formed around 3.5 billion years ago, at that time the atmosphere of earth contains 0.1% of oxygen then after the evolution of cyanobacteria concentration of oxygen becomes increases in to 21%, Cyanobacteria played an important role in the evolution of Early Earth and the biosphere as it help in both nitrogen fixation and oxygenic photosynthesis. Hence it triggered the evolution of plants being ancestral to chloroplasts and enabled the evolution of complex life based on aerobic respiration. Having such a strong impact on early life, one might expected that the evolutionary success of this group may also have triggered further biosphere changes during early Earth history. However, very little is known about the early evolution of this phylum and ongoing debates about cyanobacterial fossils, cyanobacterial identity of only three fossil taxa is not debated: *Eoentophysalis*, *Eohyella* and *Polybessurus*. *Eoentophysalis belcherensis* is the oldest microfossil interpreted with certainty as a cyanobacterium. This microfossil has been described from 1.89–1.84 Ga silicified stromatolites of the Belcher Supergroup, Hudson Bay, Canada.

Among those, lipids such as 2-methyl-hopanes are produced by cyanobacteria oxygenic photosynthesis spread among some eukaryotic clades, giving rise to diverse types of algae and later to plants. They diversified from a last eukaryotic common ancestor (LECA), an aerobe protist with a mitochondrion. After this the periodic evolution was do occur.

KEY WORDS: cyanobacteria, LECA, nitrogen fixer and oxygenic photosynthesis.

GREEN HYDROGEN: ECONOMIC AND ENVIRONMENTAL FRIENDLY SOURCE OF ENERGY, PAVING THE WAY TO A SUSTAINABLE FUTURE

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ABSTRACT

To decarbonise the planet is one of the major goal that countries around the world have set for 2050. About 830 million tonnes of Carbon dioxide is emitted annually when hydrogen gas is produced using fossil fuels. A solution to this challenge is the generation of 'Green Hydrogen' - A universal, light and highly reactive fuel-through a process known as Electrolysis. This method uses electrical current to separate the hydrogen from the oxygen in water. This electricity is obtained from renewable sources like Wind energy and from Photovoltaic cells (Solar energy), without emitting carbon dioxide in atmosphere. It emits water vapour and leave no residues in air, unlike coal and oil. Then this Green Hydrogen can be used as in transport as fuel in cars, airships and spaceships. Hydrogen has a long-standing relationship with industry. It can be used in power generation in Industries like Refining Petrol, manufacturing Steel and in Fertilizers production. It will help to control pollution, to mitigate climate changes, reduce global warming and control ozone layer depletion. It will boost India's Economy along with play a vital role in Environmental Conservation.

Keywords: Green hydrogen, Renewable energy, decarbonise, electrolysis.

QUANTITATIVE PHYTOCHEMICAL SCREENING, NUTRITIONAL EVALUATION, AND ANALYSIS OF ANTIOXIDANT ENZYME ACTIVITY OF *BAUHINIA VARIEGATA* FLOWER PETALS

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ABSTRACT

Within the family, leguminosae lies the sub-family caesalpinioideae, to which *Bauhinia* belongs. It's a deciduous tree of medium size. The plants produce lovely, fragrant flowers. They are cultivated as decorative plants. Since ancient times, the petals of flowers have also been employed for culinary purposes and to make a variety of ayurvedic remedies. The current study used methanolic extract to determine the phytochemicals present and to evaluate the nutritional value of *Bauhinia variegata* flower petals. The antioxidant enzyme activity of the petals is also additionally observed here. The following phytochemicals are represented in descending order in the sample: carotenoid > tocopherol > phenol > flavonoid > terpenoid > tannin. From the nutritional analysis, we found that the petals have more carbohydrates than protein and far less crude fat when compared to both carbohydrates and protein. Also, when the different antioxidant enzyme activities like catalase, peroxidase, and superoxide dismutase were measured, it was found that the petals showed a high amount of peroxidase activities, a low amount of superoxide dismutase activities, and the catalase activities lie in between these two activities. The present study conclusively points out that the petals of the *Bauhinia variegata* flower petals are a good source of various pharmacologically active substances with potential antioxidant properties and other therapeutic uses.

Keywords: Bauhinia, Methanolic extract, Phytochemicals, Antioxidant Property

THE HOT FLOWER

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ABSTRACT

The AOX and uncoupling proteins participate in thermogenesis during flowering in few plants, mostly members of family Araceae. These plants which include skunk cabbage and voodoo lily, produce a club like structure on the developing floral apex. The outer layers of the appendix contain more mitochondrion than most plant tissues. During anthesis mitochondria in the appendix use the AOX and uncoupling proteins to respire at very high rates. The free energy released as heat raises tissue temperature 10c-25c above ambient conditions and volatilizes odorous compounds that attract pollinators. In some cases, this mechanism can mimic the scent rotting flesh and is used to deceive insects that lay their eggs. The sacred lotus is a thermogenic, that is it has the ability to regulate the temperature of its flowers. They found that lotus flowers maintained a temperature ranging from 30-35 degrees Celsius even the ambient temperature dropped to 10 degrees Celsius. The sacred lotus began heating as soon as the flower bloomed. As the night air cooled the petals, the flowers increased its metabolism to convert more carbohydrate to heat energy. Most scientist agreed that the lotus heats up to provide energy to its pollinators, especially beetles that must Shiver to generate enough heat before they can fly. Also imagine the happiness of the beetle trapped inside the warm lotus even as the chill of the night descends outside-and think how covered with pollen it will be when it flies away the next day, having crawled all over the head of the lotus while enclosed by the petals.

ISOLATION AND CHARACTERIZATION OF PLANT GROWTH PROMOTING RHIZO BACTERIA FROM ROOT NODULE OF *PISUM* *SATIVUM* COLLECTED FROM KORAPUT, ODISHA

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ABSTRACT

The soil can host a huge number of microorganisms including bacteria, fungus, algae, protozoa, actinomyces etc. Among these, bacteria are the most common microbes (approx. 95%) inhabiting in the rhizospheric zone of plant and improve plant growth through plant-microbe interaction, hence known as plant growth promoting rhizobacteria (PGPR). Such bacteria improve the plant growth by various mechanisms including biological nitrogen fixation, production of phytohormones, siderophore and volatile organic compounds, ACC deaminase activity, antagonistic effect, induction of systemic resistance etc. The present study was undertaken to isolate and characterize bacteria from root nodules of *Pisum sativum* collected from Bhejput village, near Panchmatipali Buxite mines of Koraput, Odisha. The bacterial strain was observed to be gram negative bacteria from gram staining test. Among the biochemical tests the strain showed positive result for fermentation of carbohydrate (glucose and sucrose), MRVP (methyl red-Voges Proskauer test), indole production, siderophore production, TSI (Triple sugar iron) and negative results for lactose fermentation. Since the bacteria was isolated from the locality near Bauxite mines and exhibiting positive results for several plant growth promotion activity, it holds potential application for plants to be grown on mine spoil for re-vegetation and mine land restoration programme.

Key words: Rhizospheric zone, PGPR, *Pisum sativum*, Panchmatipali Buxite mines

INDIGENOUS KNOWLEDGE ON HALLUCINOGENIC AND POTENT PLANTS USED AS APHRODISIACS BY CERTAIN TRIBAL COMMUNITIES IN EASTERN ODISHA

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Herbal medicine is a widespread and important form of traditional and complementary medicines that has been used since ancient times. Plants have been used for medicinal purposes since long. India has been known to be rich repository of medicinal plants. Over three quarters of the world population are using herbal medicines with an increasing trend globally herbal medicines may be beneficial but not so harmful (Bello and Isah,2015).In the present paper an attempt has been made to highlight the aphrodisiac plants available in Eastern Odisha that promote sexual behavior.

The healthy life has three main pillars a balanced diet, proper sleep and a healthy sexual and marital life (Charaka Samhita, Sutra Sthana 11/35). The importance and relevancy of the third pillar lies in the fact that an entire discipline has been mentioned among the eight specialized branches of Ayurveda known as Vajikarana Tantra. It has been described as a branch of Ashtang Ayurveda, which deals with the management of defective semen and spermatogenesis along with sexual potentiating (Sushruta Samhita Sutra Sthana 1/16). In the present era also, the importance of this branch has increased manifold, as more and more people are reporting to clinics with various disorders related to seminal parameters and sexual dysfunction. The term Aphrodisiacs has been derived from Aphrodite, symbol of love and beauty in Greek mythology. Aphrodisiacs are substances believed to enhance sexual pleasure and performance. Aphrodisiacs that contain hallucinogenic properties like Bufotenin have psychological effects on a person that can increase sexual desire and sexual pleasure. Over the years medicinal plants have been used to man age an array of diseases /ailments. Infertility is a biological ,clinical, personal and social problem and male factors contribute 50% to this subject. Men and women have since ages been curious to improve , revive and maintain their sexual efficiency and ancient literature is witness of use of natural aphrodisiacs for this purpose.

Key words: Aphrodisiac, Ayurveda, Herbal Medicine.

Objective:

- Science should follow the indigenous knowledge .

- To work for the conservation, propagation, research and development and other activities related to plants used for aphrodisiacs.
- There are many substances and chemicals which are carcinogenic ,apart from this there are number of allopathic medicine which causes malignant.
- Use of ethno medicine to avoid various disease

Study Area:

The Jajpur district located in between 20 degree 30 to 21 degree 10 north latitude and 85 degree 40 to 86 degree 44 east longitude. The district covering an area of 2887.69 square km is moderately populated having total population of 18,26,275 as per 2011 census.

Methodology:

- Collection and authentication of plant material.
- Preparation of extract
- Drugs, assay kits and other reagents
- Serum preparation
- Determination of serum testosterone.
- Determination of plasma cholesterol
- Acute toxicity test
- Data analysis

Discussion & Conclusion:

Jajpur district in Odisha is rich in medicinal plant and has great potential to be used by local people as well as tribes for primary health care. The plants for aphrodisiac use will be collected from wild or semi cultivated field to know the property and its analysis to treat sexual disorder as indigenous knowledge on hallucinogenic and potent plants .

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ETHNO-MEDICINAL PLANTS OF EASTERN INDIA: PROSPECTS AND CHALLENGES

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ABSTRACT

The entire Eastern India is the home to various ethnic communities with varied culture and tradition who are mostly dependent on the indigenous bioresources including medicinal and aromatic plants for their daily sustenance to health care at village level. These ethnic people have been living in the vicinity of forests and rivers since ages and have developed a kind of affinity with forest and river ecosystems. These people take shelter in the forest and utilize wild edible plants both raw and cooked. The flower and fruits are generally eaten raw where as tubers, leaves and seeds are sometimes cooked. They utilize forest produce, forest timber and fuel wood also. Recent advancement in ethno botanical research made documenting the plants utilized by the tribal communities in each state from Mizoram to Jharkhand and Odisha whereas management strategies are yet to be either explored or worked out for conserving the plants for future generation. Some of the tribal medicines from the region have been incorporated into the organised system of medicines like, Ayurveda, Unani and Sidha whereas some have still remain endemic to the small pockets of the region. Further, though the region represents a vast emporium of the ethno medicinal plant wealth, the entire area is recently under threat due to decline of the aboriginal tribes, changes in living subsistence and acculturation or total disintegration of primitive cultures. Urbanisation and climate changes are also the other issues to delineate the local people from the traditional believe. Whatever be the constrains, the highlighting entrepreneurial perspective of the ethno-medicinal plants, mainly the ‘wonder drugs’ is the need of the hour for uplifting the ethnic people as well as the society as a whole.

PHYTOREMEDIATION OF DHENKANAL LENTIC WATER BODY

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ABSTRACT

Background: Water is considered as vital renewable resource. All living organisms are mostly depending on fresh water body for their live hood. Out of all water bodies the local people of Dhenkanal mostly depend on lentic water body in their own geographic zone. Water pollution from various sources both natural and manmade, is now a days deplete the usable water to unusable and convert it to toxic ecosystem. So, it is high time to bioprocess the cleaning and purifying the water ecosystem and return the value to the environment.

Methodology: The study was carried out in lentic water body of Kunjakanta and Mallarsahi in the month of January-March of 2023. The Water parameters like PH, Conductivity, Chloride, Hardness, Nitrate-Nitrogen, inorganic phosphorus; soil parameters like PH, Conductivity, Organic carbon, Nitrate-Nitrogen, available phosphorus was analysed in laboratory. The macrophyte which were dominant in that particular lentic water body was *Nympha species* and *Nelumbo species* were grown in laboratory condition for near about 20-25 days from the date of collection. Again, all water and sediment parameters were analysed.

Result: The biochemical parameters of water and sediment PH was 7.4 ± 0.021 , 7.575 ± 0.496 and 7.025 ± 0.837 , 7.275 ± 0.913 ; Conductivity was $212.675 \pm 7.02 \mu\text{S}$, $236.355 \pm 8.14 \mu\text{S}$ and $207.462 \pm 0.634 \mu\text{S}$, 171.537 ± 0.352 ; Phosphate was $1.063 \pm 0.0335 \text{ mg/l}$, $1.292 \pm 0.0357 \text{ mg/l}$ and $8.458 \pm 1.231 \text{ mg/kg}$, $19.792 \pm 0.613 \text{ (mg/kg)}$; Nitrate-Nitrogen was $1.175 \pm 0.05 \text{ mg/l}$, $0.168 \pm 0.055 \text{ mg/l}$ and $0.998 \pm 0.082 \text{ mg/kg}$, $0.995 \pm 0.071 \text{ mg/kg}$ respectively. Chloride content of water was $25.56 \pm 2.42 \text{ mg/l}$, $24.14 \pm 2.32 \text{ mg/l}$ and Calcium content was $17.238 \pm 0.092 \text{ mg/l}$, $17.297 \pm 0.094 \text{ mg/l}$. Macrophytes like *Nelumbo.sp* and *Nymph.sp* separately showed an increase in growth in 100% control (Nutrient medium) is almost equivalent with that of the total raw water medium with increase in days of growth up to 12 days but in diluted water the growth of the species did not show any favourable growth.

Conclusion: The macrophytes play a crucial role in water quality assessment when nutrient medium is enriched and purify the eutrophicated water bodies naturally.

Key words: Macrophytes, Lentic, Eutrophic, Sediment.

RIVINIA HUMILIS L (PETIVERIACEAE): A NEW GENERIC RECORD TO THE FLORA OF ODISHA

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ABSTRACT

Documentation of exotic plant species, their distribution and biological attributes contributes to the pattern of floristic status in a region. The study on ecology of exotic species is useful in understanding their nature of adaptation and functioning in the ecosystem away from their natural habitat. The flora of Odisha is quite fascinating as it exhibits great affinities with other phytogeographic regions of India. As part of the collaborative study on “Invasive and exotic plants of Odisha” under the aegis of both Maharaja Sriram Chandra Bhanja Deo (MSCB) University and Fakir Mohan University a fascinating Angiospermic taxon namely *Rivinia humilis* L., a native of Tropical America, under the genus *Rivinia* L. of family Petiveriaceae was collected from a scrub or wasteland in the district of Khordha. *Rivina* is a monotypic genus of the family Petiveriaceae. After critical observation and review of literatures it was identified as *Rivinia humilis* L. The taxon finds its extension of distribution in the geographic boundary of Odisha has not yet been collected. Thus, it is reported as a new generic record to the Flora of Orissa. The nomenclature, Botanical description, photographs, notes on occurrence, phenology, ecology and distribution of the taxon have been provided to facilitate easy identification. It needs further study on its potential invasion, the major drivers of invasion, identification of potential invasion routes and its impact on local and indigenous vegetation of the state. This will generate information regarding the adverse impact of this exotic plant on the native flora and develop a policy framework or management plan for it.

Key Words: Distribution, Ecology, Generic, Khordha, Phenology, *Rivinia*

**PHYTOCHEMICAL ANALYSIS AND ANTIBACTERIAL ACTIVITY OF CITRUS LIMON
ESSENTIAL OIL (CLEO) AGAINST FLUOROQUINOLONE RESISTANCE CLINICAL
ISOLATES *ESCHERICHIA COLI* STRAIN (BME4)**

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Fluoroquinolone is frequent prescribed drug for Gastrointestinal bacterial infection. *E.coli* is commonly found bacteria in urinary tract infection and dysentery. However this study reveals the detection of Fluoroquinolone resistance *E.coli* strain in patients' sample collected from Veer Surendra Sai Institute of Medical Sciences and Research, Burla. This present work leads to carry out screening of herbal product as the alternatives of Fluoroquinolone survivor bacteria. The *Citrus Limon* essential oil (CLEO) was extracted using Clevenger's apparatus through hydro-distillation method in the laboratory of Medical Microbiology, Dept. of Biotechnology and Bioinformatics, Sambalpur University. The characterization of phytoconstituents were analysed by Gas-Chromatography Mass spectrometry (GCMS) and Fourier's transformed infrared spectroscopy (FTIR) for detection of Volatile compounds and functional groups respectively. The clinical BME4 was tested against azithromycin antibiotics for determining the resistance pattern following the growth curve method to a specific time periods. The assessment of CLEO against BME4 was occurred by following minimal inhibitory concentration (MIC). The MIC concentration of CLEO was considered for determining the inhibitory stage of bacteria growth (BME4). Here the growth curve method was assayed by taking the spectral absorbance at 600nm, which indicate the turbidity of bacterial broth sample..

Key words: *E.coli*, *Citrus Limon* essential oil, Fluoroquinolone

Acknowledgement: This study is part of the PhD thesis work under Sambalpur University.

THERAPEUTIC IMPORTANCE OF SOME ORCHIDS OF ODISHA AND THEIR CONSERVATION

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ABSTRACT

Odisha in the east coast of the Indian subcontinent lying in between 170 48'-220 94'N latitude and 81024' - 87029' E longitude is an abode of healing herbs which are being used in Indian system of medicine viz., Ayurveda, Siddha and Unani. Due to varied topographic conditions and varied range of microclimatic conditions Odisha enhouses around 650 species of plants having high medicinal value. The medicinal plants include several groups of plants like dicots, ferns, orchids etc. of which orchids of high medicinal value deserve special mention being the rare and special group among the plant kingdom. Orchids are used in curing several diseases and they play a pivotal role in health care programmes. Many orchids possess antimalarial, antibacterial, antiviral and even anticancerous properties. These therapeutic properties in medicinal orchids are attributed to a variety of phytoconstituents like alkaloids, flavonoids, terpenes etc. (Misra, 2004). In the remote past, Odisha had thick forest coverage of about 43.42% as against the total landmass. But during the recent times the forests are fast shrinking due to severe pressure in terms of rapid march of urbanization, clear off of forest lands for paddy cultivation, pisciculture, industrial complexes, human settlement etc. Hence this is the high time to conserve medicinal plant resources especially medicinal orchids for posterity. The existing forest coverage provides ideal abode for the tribals. In Odisha different tribal groups such as Bonda, DongariaKondha, Juang, Saora etc. are living in small pockets in harmony with nature by utilizing different plants and plant products. The study of plants in relation to primitive people constitutes an important branch of botany known as "Ethnobotany" and medicine is one of its facet. The mountainous forests of the Deomali hills, Gandhamardan hill range, Mahendragiri hills, Niyamagiri hill range, Malyagiri hills and Similipal Biosphere Reserve have high degree of biological diversity acting as grand repository of potential medicinal orchids. These forests have been the source of invaluable medicinal plants since the time man realized the preventive and curative properties of plants and started using them for human health

care. Unfortunately, the medicinal importance of orchids of this region has drawn least attention from both the scientific fraternity as well as general populace compared to their role in horticulture field. Orchid species of Odisha like *Acampe carinata* (Griff.) Panig., *A. praemorsa* (Roxb.) Blatt. & Mc Cann, *Geodorum recurvum* (Roxb.) Alston, *Habenaria marginata* Coleb., *Rhynchostylis retusa* (L.) Bl. and *Vanda testacea* (Lindl.) Rehb.f. are used to cure rheumatism, arthritis, dysentery, asthma and snake bite etc. However, the medicinal potentialities of these orchids are not so well exploited though they possess immense curative values. Further, as the forests of Odisha are experiencing various anthropogenic as well as abiotic pressures, many of the orchid populations are fast shrinking leading to their mass depletion. Realizing this, a study was carried out resulting in 26 medicinal orchids very often used by the tribal populace of Odisha like Bonda, Dongaria Kondha, Juang, Saora etc. to get relief from various ailments.



STUDIES ON TLC FINGERPRINT OF FLAVONOIDS IN RHIZOME OF *MARANTA ARUNDINACEA* L.

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ABSTRACT

Maranta arundinacea L. commonly called as arrowroot is a medicinally important rhizomatous plant used in Indian traditional system of medicine to cure diarrhoea. *Maranta arundinacea* is the main source of phytochemicals which has a number of pharmacological properties. The present study aims to develop TLC of flavonoid constituents from *Maranta arundinacea* for identification protocol of the herbal and provide scientific information for its quality control. The ethanol extracts from *Maranta arundinacea* L. were separated on silica gel precoated plate with a mixture of toluene: acetone: formic acid (4.5:4.5:1) as the mobile phase. The spots were visualized with phenols reagent. TLC analysis resulted in detection of metabolites with R_f value of 0.75. TLC finger prints that are analysed can be used as an alternative marker oriented method for evaluating the quality of *Maranta arundinacea* L.

Key words: *Maranta arundinacea*, flavonoid, fingerprint, phytochemical, diarrhoea

THERAPEUTIC POTENTIAL OF FLAVONOIDS: INSIGHTS IN TO BIOTECHNOLOGICAL ADVANCEMENT

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ABSTRACT

Flavonoids are one of the important class of natural products widely distributed in plant kingdom. They belong to a class of low molecular weight phenolic compounds most commonly found in fruits, vegetables, leaves, flowers, seeds and certain beverages. They are naturally synthesized through the phenyl propanoid pathway and their biological activities depend upon the type of flavonoids, mode of action and bioavailability. Flavonoids have been used over centuries in indigenous system of medicine for tackling various human ailments and promoting human health. There has been growing interest in the research on flavonoids from plant sources because of their versatile health benefits in several epidemiological studies. Thousands of flavonoids have been isolated so far and the number increases steadily. They have potential applications in nutraceutical, medicinal, pharmaceutical and cosmetic field due to their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties. Besides their neuro protective and cardio protective nature, flavonoids are also known to be potent inhibitors of several enzymes such as Xanthine Oxidase (XO), Cyclo-Oxygenase (COX), Lipoxygenase and Phosphoinositide 3-kinase. Many studies have suggested that daily consumption of flavonoids from various dietary sources reduce the risk of several life threatening diseases such as diabetes mellitus, cancer as well as lower the risk stroke and heart attack. In plant systems, flavonoids help in combating oxidative stress and act as growth regulators, attract the pollinators and help in spore germination. Some flavonoids act as signaling molecules and others as defense agents to fend off herbivores. Therefore current and future studies on therapeutic activities can be effective to use flavonoids as potential drugs target in preventing chronic diseases through research and development.

Key words: Flavonoids; Phenolic; Nutraceutical; Anti-oxidative; Anti-carcinogenic.

PHYTOCHEMICALS AS FINE TUNERS OF AUTOPHAGIC AND APOPTOTIC PATHWAYS IN ANTICANCER THERAPEUTICS DEVELOPMENT

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ABSTRACT

Naturally occurring bioactive phytochemicals have long been used for treating several pathophysiological disorders. Numerous studies have shown that some of the phytochemicals possess remarkable anti-cancer properties and can be utilized as potential anticancer therapeutics. Essentially, phytochemicals have the ability to regulate two essential cellular mechanisms, autophagy and apoptosis, which play significant roles in the underlying pathophysiology of carcinogenesis. Combining phytochemicals with conventional chemotherapy can potentially enhance the therapeutic effects while minimizing adverse side effects. Continued advancements in this field are essential for overcoming the challenges encountered in the development of anticancer therapeutics based on phytochemicals. By harnessing the potential of phytomolecules, there is a possibility of uncovering novel and effective treatments for various types of cancer, paving the way for advancements in anti-cancer therapy.

Keywords: Cancer therapeutics, phytochemicals, autophagy, apoptosis, chemotherapy

ETHNOBOTANICAL STUDY IN RICE-BASED CROPPING SYSTEM : AN OPPORTUNITY FOR INCOME GENERATION TO SMALL AND MARGINAL FARMERS

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ABSTRACT

Rice is one of the major staple cereals with more than 3.5 billion people depending on rice for more than 20 % of their daily calorie intake. It is estimated that the rice production must increase by 114 million tons by 2035, but farmers must achieve it under significant threats from climate change. To increase the profitability of rice farmers, possibility of growing medicinal crops in rice based cropping system is being evaluated at Basta Block, district Balasore of Odisha state. A field survey was conducted in 2016 and 2017 at revenue villages viz., Dandi, Darada, Dakhinasarisa, Kothapda, Palasia and Kundai and about 31 types of medicinal herbs were found growing naturally in rice ecosystem. These collections were evaluated under limited irrigation after rice harvest in 2018 to 2020 in rabi and post-rabi seasons. Seven medicinal crops like **Brahmi** (*Bacopa monnieri*), **Bhrungaraj** (*Wedelia chinensis*), **Bhuinkadamba** (*Sphaeranthus indicus*), **Kalakeshadura** (*Eclipta prostrata*), **Thalkudi** (*Centella asiatica*), **Juani** (*Trachyspermum ammi*), **Jalabrahmi** (*Enhydra fluctuans*) were found promising in uplands and rainfed lowlands, after rice harvest. Brahmi gave net return of Rs. 1.25 lakh/ha, followed by Bhrungaraj (Rs.0.85 lakh/ha), Bhuinkadamba (Rs.0.70 lakh/ha), Kalakeshadura (Rs. 0.35 lakh/ha), Thalkudi (Rs. 0.32 lakh/ha) and Juani (Rs. 0.21 lakh/ha) under limited irrigation. These medicinal crops are considered as basic raw materials for agro-medico-industries and also commonly used in preparation of mother tincture, hair oil, memory tonic etc. in commercially branded ayurvedic and homeopathic medicines. Cultivating medicinal crops in rice-based cropping system will improve the socio-economic condition of small and marginal farmers with setting up agro-medico-industries in villages to change the economic scenario of rural India.

Key words : Rice based cropping system, Medicinal crops, Agro-medico-industries

SCOPE AND OBJECTIVES OF PHARMACOGNOSY

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ABSTRACT

Pharmacognosy is the mother of pharmacy as it gives understanding of origin of drugs, its nature and properties. It is the only source to identify dried plant specimens that can yield a genuine drug. Modern pharmacognosy includes application of molecular, genomic and metabolic technique. All these provide significant knowledge on the clinical application of herbal medicine. Cultivation, collection and storage of drug yielding plants, should be maintained in their special condition. In Indian system of Medicine, herbal drugs play an important role and majority of crude drugs need correct identification and characterisation. The current pharmacognostical methods to identify are the morphological, anatomical examination of the plant or going for chemical analysis. In pharmacognosy a medicinal plant is any plant in which one or more of its organs contain substances that can be used for therapeutic purposes or which are precursors for the synthesis of useful drugs. As it involves identification, cultivation, extraction, preparation quality control and biological assessment of drugs, all the plant parts like root, leaf, flowers etc may be used to isolate the bioactive chemical. Mostly the bioactive chemicals are the secondary metabolites. For example-morphine atropine and galanthamine etc have originated from natural phytochemical resources. A few well-known phytochemicals are curcumin, carotenoids, flavonoids, isoflavones, phenolic acids, isothiocyanates etc. For getting these secondary metabolites, there should be useful development of cultivation technology for medicative aromatic plants. The developmental knowledge based on plant taxonomy, plant breeding, plant physiology, and plant genetics etc. The phytochemicals are important as they are the plant's immune system and also can offer humans some of the same protection. Modern pharmacognosy includes the application of molecular, genomics, and metabolomic techniques, providing a significant increase in the knowledge on the biological and clinical application of herbal medicines. If we consider the importance of anatomy in pharmacognosy, the anatomical features are potentially useful to identify small fragments of commercially important herbal products.

Pharmacognosy is still a relevant science for the discovery of future medicines. In Japan and America, the scientists are very active in this field. Researchers are going on keeping the

ethical issue in mind. The importance of medicinal plants and their derivatives is growing rapidly with human progress in pharmaceutical fields. Hence pharmacognosy gives benefit to the pharmaceutical companies by screening and characterising new drugs for the treatment of human diseases.

Keywords: Pharmacognosy



VALORIZATION OF AGROWASTE INTO VALUABLE BIOPRODUCTS AND THEIR USE IN DIFFERENT INDUSTRIES

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ABSTRACT

The foundation of our nation is agriculture. The agricultural industry and related areas have a gross value added (GVA) share of approximately 55.33% (according to the 2022 data). Though agriculture offers our nation options for food and nutrition security, one of the main environmental problems is the negligent disposal of the trash that agriculture produces. Untreated garbage can increase greenhouse gas emissions in a number of ways, which can worsen climate change. Interventions are therefore necessary for the sustainable utilization of waste generated by or during agriculture. The waste or byproducts that are generated from agriculture are primarily organic in nature and contain significant amounts of complex carbohydrates, proteins, fibers, polyphenolic chemicals, and other nutrients. As a result, they could be utilized as raw materials in a various industry to produce a broad spectrum of bioproducts. Since garbage is an easily ordered raw material, using it as a raw material might also lower the product's manufacturing rate. Additionally, the bioproducts made from this waste can be applied to a variety of businesses, including the food and beverage, pharmaceutical, and agricultural sectors. Pectin, for instance, can be isolated from the peel of various citrus fruits and utilized as a texturizer, thickener, emulsifier, and stabilizer. The aim of the abstract is to provide sustainable utilization of agrowaste to obtain valuable bioproducts.

Keywords: *Agrowaste; Bioproducts; waste management; climate change; sustainability*

ANTIMICROBIAL PROPERTY OF *GUILANDINABONDUC* L

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ABSTRACT

Ayurveda, the ancient Indian system of medicine, stands as the oldest traditional medical practice, evolving concurrently with Chinese and Western medicines. Rooted in the Atharva Veda, Ayurveda's extensive knowledge of medicinal plants, as exemplified by *Guilandinabonduc* L., spans treatment for mental illness. This plant, a staple in Ayurveda and other traditional systems, epitomizes "green medicine," distinguished for its efficacy, safety, and absence of side effects. It is a pantropical shrub native to India, has gained prominence for its diverse therapeutic benefits, including antioxidant properties and the production of antimicrobial compounds. Antibiotic resistance, a growing global concern, prompts the exploration of plant-based alternatives. The investigation focuses on identifying antibacterial properties within various components of *Guilandinabonduc* L., with a spotlight on its seeds. The plant's antibacterial capabilities, particularly in seeds, highlight its significance in Ayurveda, the ancient Indian system of medicine, stands as the oldest traditional medical practice, evolving concurrently with Chinese and Western medicines. The seeds exhibit not only antibacterial effects but also hypoglycemic, antihyperglycemic, and hypolipidemic activities. The inhibition of trypsin and chymotrypsin secretion by the seed extract further underscores its role in combating microorganisms, presenting valuable insights for human health and sustainable practices. Beyond its role in infectious diseases, *Guilandinabonduc* L. offers a range of therapeutic benefits, including antipyretic, antidiuretic, anthelmintic, anticonvulsant, anti-asthmatic, and antiestrogenic activities. As the world seeks sustainable alternatives amidst antibiotic resistance and global health crises, traditional medicinal practices and plant-based solutions emerge as valuable reservoirs of knowledge for a healthier future.

Keywords: Antiestrogenic, *Guilandinabonduc* L., hypolipidemic, green medicine

MICROSCOPIC MARVEL: MINIMIZATION OF CARBON FOOTPRINT THROUGH MICROALGAL CAPTURE

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ABSTRACT

Climate change is now a planetary emergency, posing an existential threat to humanity. Ever since the beginning of Industrialization, human activities such as burning of fossil fuels, including coal, gasoline and petroleum, have significantly increased greenhouse gas concentrations in the atmosphere. According to EPI 2022, the Energy sector in India generate the largest share of GHG emissions, contributing about 35% of the total gas emissions.

In the farthest reaches of Antarctica, a nightmarish scenario of crumbling ice sheets and rapidly rising sea levels could spell disaster, accelerating global crisis. Amidst the threat of catastrophic flooding, the constant search for effective systems to capture CO₂ has revealed the potential of microalgae to perform the foresaid task and the biomass retrieved can be used as a carbon source for attaining an array of diverse and multifaceted products.

Microalgae are microscopic, photosynthetic organisms that grow in aquatic environments and are able to uptake atmospheric CO₂ to create biomass. It's ability to transport bicarbonate into cells makes it well suited for capturing carbon. Microalgal CO₂ Concentrating Mechanism (CCM) is essential for the sustainable approach of bio-conversion and utilization in terms of the environment as well as the economy. The aim of the abstract is to mitigate the effects of global climate change and ensure a sustainable future.

Keywords: Climate change, Industrialization, GHG emissions, Microalgal CO₂ Capture, Sustainability

ANTIMICROBIAL STUDY OF *GLOBBAORIXENSIS*. ROXB

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ABSTRACT

Family Zingiberaceae is worldwide in distribution. Plants of Zingiberaceae family are used in traditional herbal folk medicines besides their uses in spices, cosmetic, ornamental, food preservatives etc. *GlobbaOrixensis*Roxb. is a potent plant, belongs to family Zingiberaceae. The plants are distributed in forest hillocks of North East states of India. The morphological character of this plant have been studied and characterized by available literatures. The plant is known for itsanti oxidant, anti inflammatory, antipyretic properties besides its use in asthma, cough, snake bite, rheumatic and many other treatments. In the present investigation, the medicinal use of various herbs of this family has attracted us to study the Biochemical and antimicrobial activity of this traditional herb. The plant is erect, aromatic perennial herb with creeping rhizome. Leaves are simple, alternate and broadly lanceolate with orange yellow flowers. The Rhizomes of *Globbaorixensis*Roxb. were collected at maturity stage. The powdered rhizome of the plant were put into Soxhelt apparatus to take the extract out by using Ethanol as solvent. The obtained Ethanolic extract of rhizome was taken for antimicrobial test by Agarwell diffusion method to evaluate activity against pathogenic bacteria *Vibrio cholera* and *Staphylococcus aureus* as they reported to cause watery diarrhoea and pneumonia respectively. The different concentration of extract indicated good activities in test organisms *in vitro* against antibiotics Ofloxacin.

Key words: *Globbaorixensis*Roxb., Antimicrobial, Rhizome, Agarwell diffusion

VERSATILITY AND ADAPTABILITY OF MILLETS CAN EFFECTIVELY REPLACE STAPLE FOOD

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ABSTRACT

India holds the position of being the second most populous country globally. As the population grows, the importance of nutrition increases. Adequate and balanced nutrition plays a crucial role in improving demographics and contributes to the overall health to the society. Cereal-based foods are widely recognized as the primary staple for the global population, yet millets possess adaptability and versatility that could potentially substitute these staples. The term ‘millet’ refers to cereal crops characterized by small seeds. In contrast to traditional cereals, millets boast higher levels of carbohydrates, fat, magnesium, potassium, and phosphorous. They thrive in low-rainfall conditions, can grow in nutrient-deficient soil, exhibit high resistance to drought, and are easily digestible—a crucial attribute for today’s population. In comparison to cereals, millets serve as a valuable source of protein and contain sulfur-containing amino acids such as methionine and cysteine. Additionally, millets exhibit an improved fatty acid profile. Most millets surpass common cereals like rice (*Oryza sativa*), wheat (*Triticum aestivum*), and maize (*Zea mays*) in nutritional value, boasting three to five times higher levels of vitamins, fiber, proteins, and essential minerals such as calcium and iron. Notably, millets are gluten-free, earning them the designation of “superfoods.” These nutrient-rich millets offer a practical solution to mitigate the increasing occurrences of malnutrition and metabolic disorders, potentially enhancing the overall nutrition and food security of the country. After years of neglect, nutri-cereals are experiencing a notable resurgence in the Indian cereal production sector. India currently leads the world in millet production, holding a substantial market share of approximately 40.62% and achieving an estimated production of around 10.91 million tons during the 2018–2019 period. The rich nutritional content of millets offers numerous health benefits including the potential to lower the risk of cancer, obesity, diabetes, cardiovascular diseases, gastrointestinal problems, migraines, asthma, managing hyperglycemia, slow-releasing carbohydrates and high dietary fiber content, making millets an ideal food choice for individuals with diabetes.

Despite the diversified and high nutritional value of millets, their consumption, particularly

among the Indian population, has not reached a significant level. However, there has been a recent trend where these grains are gradually becoming a driving force in the startup revolution. This movement aims to enhance the availability of nutrient-rich foods and generate employment opportunities.

Keywords: - Millets, Super food, Adaptability, Cereals, Malnutrition



PLANT IMMUNITY UNDER TEMPERATURE SURVEILLANCE

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Plant pathogens can damage crops, leading to reduced productivity and threatening global food security. Several strategies have been developed to mitigate the pre- and post-harvest loss of economical plants. The conventional approaches such as use of chemical compounds or biological agents against the pathogens and advanced techniques including gene editing have not been fully successful and thus it is vital to dissect underlying molecular mechanism(s) to understand the plant-pathogen interaction, which will result in developing disease resistant plants. The crop plants when exposed to pathogens leads to disease, resulting in severe pre-and post-harvest losses. Unfortunately, the immune activation events occurring due to the pathogen infection are not fully known, making it difficult to develop strategies to combat the microbial attack. We try to highlight the recent breakthrough findings which unravel the previously unexplored molecular mechanism related to differential immune response of *Magnaporthe oryzae*-challenged rice plant at varying temperature conditions. These finding opens up a novel rice- *Magnaporthe oryzae* system to study plant-pathogen interactions. The study demonstrates that the Jasmonate-mediated basal resistance in *Magnaporthe oryzae*-challenged rice plant is elevated at 28°C relative to those at 22°C. Further exogenous application of methyl jasmonate compromised the disease susceptibility in rice plants grown at 22°C, highlighting a strategy to ensure enhanced resistance in crop plants.

Keywords: Plant pathogens, disease resistant, *Magnaporthe oryzae*, Rice, Jasmonate

GROWTH, FROND PIGMENT CONTENT AND PHYTOCHEMICAL ANALYSIS OF *CHRISTELLA PARASITICA* (L.) H. LEV. IN ORGANIC MANURE

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ABSTRACT

Pteridophytes are the first vascular land plants, which reproduce by means of spores. These plants make an important contribution towards plant diversity and have a great economic utility as they are used for food, fuel, fiber, medicine and shelter etc. *Christella parasitica* (L.) H. Lev. is a fern species, belongs to the family Thelypteridaceae. It has high economical values as this is used for its ornamental value, air purifying property, pharmaceutical & therapeutic potential etc. It's extensive root system protects the soil from erosion. Due to all these beneficial properties an investigation was carried out to analyze the growth, frond pigment content, phytochemicals under the application of organic manure (vermicompost & cow dung) along with a control plant for comparative analysis. The growth in height, frond pigment content was reported in higher amounts in vermicompost treated plant followed by the cow dung treated & control plant. The phytochemical estimation (carbohydrate & protein) showed maximum amount in vermicompost treated plant in comparison to the cow dung treated & the control plant. Vermicompost is rich in humus that contains valuable vitamins, enzymes and hormones (auxins, gibberellins) etc. The high nutrient of organic manure (nitrogen, phosphorus pentoxide, potassium oxide) is the enhancer for the biosynthesis or accumulation of phytochemicals, which have potential implications for its medicinal & ecological significance.

Keywords: *Christella parasitica* (L.) H. Lev., vermicompost, cow dung

TRANSGENIC PLANTS IN PHARMACEUTICS

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ABSTRACT

Transgenic plants are the plants which have one or more genes from another species have been introduced into the genome, using genetic engineering process. The purpose of producing a transgenic plant is to obtain a species that has an ideal traits, high yield and quality. By using transgenic plants and animals called biopharming also known as molecular pharming. Biopharmaceutical production in plants necessitates a series of careful decisions regarding critical areas such as the gene expression system to be used, location of gene, expression with plant variety to be used. Such as banana, carrot, rice, tomato etc. have been used for producing vaccines against diseases like hepatitis B, cholera, HIV etc. The major group of flavonoids, terpenoids, carotenoids, organic acids, protease inhibitors due to properties like antimicrobial, anti-inflammatory, root, shooty teratomas with enhanced productive capacity have been obtained via agrobacterium mediated transformation. By using transgenic plants instead of naturally occurring plants we can produce more than normal pharmacologically active proteins, vaccines, hormones, cytokines. Efficient biopharmaceutical production in plants involve proper selection of host plant and gene expression system. Biopharmaceuticals have traditionally been produced using a variety of transgenic system including cultured mammalian cells, bacteria, fungi. Like erythropoietin to treat anemia and insulin to treat diabetes. Through genetic engineering, plants can now be used to produce variety of proteins, including mammalian antibodies, blood substitutes, vaccines and other therapeutic entities.

Keywords: Biopharmaceutics, therapeutic entities

A COMPARATIVE ANALYSIS OF PHYSICOCHEMICAL PROPERTIES OF SOIL AND WATER IN AND AROUND CHILIKA LAGOON

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ABSTRACT

Chilika lake is the largest brackish water lagoon in the subcontinent along the east coast of India in the state of Odisha. It was declared as a Ramsar site due to its significance as a unique and diverse ecosystem under the convention on “Wetlands of International Importance”. To analyse the physicochemical property of soil and water samples, the sampling was done at different sites i.e., Chilika, Gadarodanga and Brahmagiri of Puri district in Odisha. The evaluation of water and soil quality such as CO₂, dissolved O₂ and total dissolved solid contents in the collected samples. The collected samples were processed for checking of the pH, salinity, TDS with the help of Systronics Water Analyzer kit 371. The lagoon water is slightly alkaline. TDS is the estimation of all types of solute component present in the sample. In clean water the total dissolved solute is same as salinity. The low TDS in Chilika implies the post monsoon period which causes inflow of freshwater to lake. High salinity in Chilika water sample could be attributed due to large influx of seawater. A considerable decrease in salinity also seen in Brahmagiri and Gadarodanga water sample. The soil analysis report showed that the pH of Chilika soil is slightly alkaline, but in Gadarodanga is slightly acidic where in Brahmagiri is neutral. TDS is less in Chilika and high in Gadarodanga and Brahmagiri. Salinity is mostly high in Chilika as compared with Gadarodanga and Brahmagiri. Prawn culture is one of the anthropogenic factors responsible for the alteration of natural habitat in Chilika, affecting the existing flora and fauna leading to change in water quality sedimentation and disruption of ecosystem. Intensive prawn farming often involves the use of chemicals, antibiotic and excessive feed leading to water pollution. The comparative analysis provided some valuable insights into the ecosystem and also the development strategies can be implemented for conservation and management of that ecosystem.

Keywords: -Physicochemical Properties, Systronics Water Analyzer kit 371, Chilika lake, TDS

NEXT GENERATION SEQUENCING TOOLS (NGS) OF BIOINFORMATICS AND ITS IMPACT IN PLANT BREEDING

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ABSTRACT

Bioinformatics plays an important role by the application of tools to determine, analyse, capture and interpretation of biological data, the structure and function of genomic content and micro molecules. Next generation sequencing tool (NGS) of plant genomes provides opportunities to understand the genetic makeup and behaviour of plant genome. It allows to discover agronomically important genes that regulate yield and tolerance to biotic and abiotic stresses. The availability of genome and transcriptome sequence data helps in the development of genetic markers. NGS tools are powerful enough to provide high - resolution analysis of plant genomes. NGS generates huge amount of sequenced data in a cost-effective manner and allows profiling for nucleotide variation and large-scale discovery of functional markers. These markers help in the selection of economically important traits in plant breeding. The availability of NGS tools and online resources is leading to a gene revolution in plant breeding, as they facilitate the study of the genome and its relationship with the phenotype for complex traits. The analysis of NGS data allows plant breeders to discover regulatory sequences and their relative positions and subsequent development of molecular markers and marker assisted selection. Best example is, NGS has been applied to plant virology since 2009. Some molecular markers like restriction fragment length polymorphism (RFLP), simple sequence repeats (SSR), randomly amplified polymorphic DNA (RAPD), Amplified fragment length polymorphism (AFLP), are used for biotic and abiotic stresses in millets and Single nucleotide polymorphism (SNP) and the conversion of SNPs to cleaved amplified polymorphic sequence (CAPs) is used in cereals.

Keywords: Bioinformatics, NGS, Biotic and abiotic stress, Transcriptome, Plant breeding, RFLP, RAPD, AFLP, SNP, CAPs.

ELECTROHOMOEOPATHY: A BOON TO THE HUMAN SOCIETY

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ABSTRACT

Electro homeopathy is an electro bio-energy content extracted from plants by which a healthy balance is achieved and maintained throughout the whole body. It is a traditional medicine used for the treatment of a variety of ailments. It is a system of alternative medicine that emerged in 19th century, attributed to Italian physician Cesare Mattie. This practice involves the use of plant derived remedies energized through a process called “electrification”. Electro homeopathy is differing from homeopathy as it's a system of medicine that draws all of its remedies from non-poisonous plants. The remedies work with nature and help the healing force in the shape of electro element, whereas homeopathy medicine is prepared from poisonous and non-poisonous plants, metals, minerals and animals and have side effects. It explores the origin and development of electro homeopathic medicine, principle, preparation, plants use, remedies and current status in the world. Additionally, it touches upon the challenges and debates surrounding the scientific validation of these homeopathic remedy as a viable therapeutic approach. Currently the medicines like Pettoralel (P1) use in the respiratory organ, Cancerosol (C1) is preventive against cell and tissue damages, Scrofolosol (S1) acts on the lymph and also lymphatic circulation of the lung, Linfaticol (F1) acts on the lymphocytes and lymph gland and also increase the immunity of the lung, Blue Electricity (BE) acts as an antiseptic and neuro stimulator of the lung. It aims to provide a concise overview of electro homeopathy, offering insights into unique approach to holistic healing without any side effect.

Keywords: Electro homeopathy, Cesare Mattie, Electrification, Cancerosol, Scrofolosol, Blue electricity.

DAUCUS CAROTA L. NATURAL REMEDY FOR CARDIOVASCULAR HEALTH

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ABSTRACT

Carrot is a biennial herb belong to the family Apiaceae. It is typically orange in colour, though heirloom variants including purple, black, red and yellow cultivars exist, all of which are domesticated forms of the wild carrot, *Daucus carota* L. native to Europe and South-western Asia. Its wild ancestors probably originated in Persia, which remains the diversity for the wild carrot *Daucus carota* L. The modern carrot originated in Afghanistan at about this time. The main carrot growing states are Haryana, Andhra Pradesh, Punjab, Jharkhand and Uttar Pradesh. There're at least three known types of carrots: - Imperator, Danvers, Nantes. Carrots derive their colour from pigment compounds called carotenoids. Orange carrots are coloured by alpha- and beta- carotene. The red carrots get their colour from lycopene, yellow from lutein and purple from anthocyanin. These pigments also provide nutrition. The four types of phytochemicals found in carrots, namely phenolics, carotenoids, polyacetylenes and ascorbic acid. These chemicals aid in the risk of reduction in cardiovascular diseases due to their antioxidant, anti-inflammatory property. Cardiovascular diseases (CVD) remain a significant global health challenge. Carrots play important role to help our heart. All those antioxidants are also good for ticker. The potassium in carrots also can help keeping blood pressure in check. Carrot juice protect the cardiovascular system by increasing total antioxidant status.

Keywords: Phytochemicals, Cardiovascular diseases (CAD), Antioxidant.

TRANSCRIPTOMIC RESPONSES OF GARLIC (*ALLIUM SATIVUM* L.) TO HEAT & DROUGHT

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ABSTRACT

Garlic is a valuable market crop, notably consumed as a nutritious green vegetable, spice & medicinal herb. However, since garlic is sensitive to water deficit conditions, achieving maximum garlic bulb yield is predicted upon effective irrigation management. Garlic (*Allium sativum* L.) is native to South Asia, Central Asia and Northeastern Iran. China produced 73% of the World's supply of garlic in 2021. It is one of the World's oldest cultivated crops. It was said that garlic has been used as a medicinal plant and food source over 7000 years. Its medicinal benefits made it one of the most valued plants. In ancient China and Japan, garlic was prescribed to help digestion, cure diarrhea. It also used to cure depression. In India, a medicinal text titled 'Charaka-Samhita' recommended garlic to treat heart diseases. Today garlic is used as an herbal supplement to help in preventing heart disease, lower high cholesterol and high blood pressure and to boost the immune system. Heat stress is defined as soil and air temperatures elevated beyond a critical threshold and drought characterized by inadequate water availability due to minimal or no rainfall and influential factors that reduce crop productivity and yield, consequently decreasing farmer's income. The transcriptomic analysis elucidated the response of garlic (*Allium sativum* L.) towards drought and heat stress conditions. Transcriptome libraries were generated to identified differential expressed genes (DEGs) induced by drought and heat stresses. Functional classification and clustering analysis of DEGs revealed stress specific gene expression patterns. Notably cell wall related genes implicated in the drought response, whereas heat stress was associated with heat stress transcription chapters and heat shock proteins.

Keywords: *Allium sativum* L., Transcriptome libraries, DEG

TRAPPING & DIGESTIVE MECHANISM IN *NEPENTHES*

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ABSTRACT

Carnivorous plant attract animal, trap & kill them, absorb nutrients from the digested bodies. This unusual autotroph type of nutrient acquisition evolved through the conversion of photosynthetically active leaves into specialised organs commonly called traps. Traps are commonly grouped into 5 categories; sticky, adhesive trap (fly trap), pitcher shaped container, movable snap trap, suction bladder & eel traps. Carnivorous plant that produces a pitfall-formed trap are called “pitcher plant”, including *Cephalotaceae* and *Nepenthaceae*. The *Nepenthes* (*Nepenthaceae*) create jug shaped traps that acquire arthropods and other small animals. Pitcher plants grow in habitats of very low nutrient availability, such as health forest, peat swamp forests. The *Nepenthes* pitcher trap is divided into 3 functional parts - basic zone: - a peristome, waxy zone & a digestive zone. Peristome attract the prey to fall into trap. The ability to capture an insect is connected to the peristome geometry. The digestion that occurs inside the trap involves many enzymes. Reactive oxygen species (ROS) and Reactive nitrogen species participate in the digestive process. ROS & RNS, named together as RONS, exhibit concentration dependent bimodal functions (toxic or signalling). ROS act as antimicrobial agents, participate in protein modification. ROS react with nucleic acids, protein, lipid & sugars are key factors of carcinogenesis in animals. RNS include (NO) nitric oxide, generated in different cellular compartments of plant & animals. It also participates in tissue lesion during inflammatory process. *Nepenthes* pitchers are sometimes called as “external stomach”.

Keywords: fly trap, ROS, RNS

GENETICALLY MODIFIED FOODS: BENEFITS AND PUBLIC CONCERN

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ABSTRACT

Biotechnology offers a variety of potential benefits and risks. It has enhanced food production by making plants less vulnerable to drought, frost, insects, viruses and by enabling plants to compete more effectively against weeds for soil nutrients. In a few cases it has also improved the quality and nutrition of foods by altering their composition. A number of commercialized genetically engineered (GE) varieties most notably canola, cotton, maize and soybean have been developed using this technology and at present the traits introduced are herbicide and/or pest tolerance. Genetically Modified foods are useful in controlling the occurrence of certain diseases. These foods grow faster and moreover these foods are boon in places which experience frequent droughts or where the soil is incompetent for agriculture. Technologies for genetically modifying foods offer dramatic promise for meeting some areas of greatest challenge for the 21st century. However the use of biotechnology has also raised concerns about its potential risks to the human and environment. For instance there are possibilities that plant pests could develop resistance to the introduced pesticides in Genetically Modified crops that were supposed to combat them. It is also believed that consumption of these genetically engineered foods can cause the development of diseases which are immune to antibiotics. Many religious and cultural communities see it as an unnatural way of producing foods. Health risks associated with GM foods are usually concerned with toxins, allergens or genetic hazards. The products of the transgenic having any potential risks like immunological, allergenic, toxic or genetically hazardous need to be recognized and evaluated towards possible adverse health concern.

Keywords: Biotechnology; Genetically modified food; Gene Technology; Allergens; Transgenic plants.

THE ROLE OF PLANT GROWTH PROMOTING MICROBES IN AGRICULTURAL SYSTEM UNDER CHANGING CLIMATE

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ABSTRACT

Climate change refers to the ongoing increase in global average temperature and its effect on earth's climate system. At present the soil resources are under severe threats from various anthropogenic activities including climate change which adds more uncertainties and complexities to agriculture, ecosystem and intimidate their sustainability. Monsoon and summer season have faced comparatively lower timeline on earth than before leading to decline in soil health and yield of crops on a global scale.

A plant's micro biome plays an important role in guiding plant growth and development. Plants adapted to extreme conditions such as those in desert or saline environments, harbor microbes in their rhizosphere or endosphere that help to provide the required physiological resistance necessary to survive in those environments.

Plant growth-promoting microbes (PGPM) such as bacteria and fungi promote plant growth through various mechanisms such as siderophores production, nitrogen fixation and phyto hormone production. They directly promote plant growth as phytostimulators influencing the phytohormone metabolism by enhancing auxin, cytokinins, abscisic acid, gibberellins production and reduction of ethylene. Some PGPMs also help plants growth by sequestering heavy metals, producing antibiotics, hydrolyzing the cell wall of fungal pathogens and solubilizing nutrients and minerals.

The use of PGPMs as biofertilizers, biostimulants or biocontrol agents are potentially advantageous for improving crop productivity, food quality and security in more sustainable and eco-friendly agricultural systems.

Keywords: Plant microbiome; Climate change; crop production; PGPMs; Abiotic stress; Drought stress; Salinity stress.

VERSATILE POTENTIALITY OF SILICON IN PLANT TISSUE CULTURE

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ABSTRACT

Silicon is the second most abundant element in the earth's crust and is found in significant quantities in soil. One of the main functions of silicon is improving the plant growth and yield especially in stress condition. Composition of the culture medium greatly influences the growth and morphogenesis of in-vitro culture of plant cells and tissues and organs. Recent research on silicon exhibits extraordinary effects on plant growth and development unequalled by any other non-essential plant nutrient. It increases photosynthetic activity, creates better disease resistance, reduces heavy metal toxicity, improves nutrient imbalance and enhances drought tolerance. Silicon has been reported to improve many growth parameters including embryogenesis, organogenesis as well as morphological, physiological and anatomical characteristics of leaf. Incorporation of silicon to the tissue culture medium enhances tolerance to low temperature and salinity, protects the cell against metal toxicity, prevents oxidative phenolic browning and reduces the incidence of hyperhydricity in various plants. All inclusively, the corroboration implies the versatility of silicon in improving various aspects of plant tissue culture including micro-propagation, organogenesis, cryopreservation, somatic embryogenesis and secondary metabolite production.

Key Words: Silicon; Stress tolerance; Hyperhydricity; Somatic embryogenesis; Plant tissue culture; Micro- propagation.

DIVERSITY AND ETHNOMEDICINAL APPLICATIONS OF LEAFY VEGETABLES AGAINST GASTROINTESTINAL DISORDERS IN THE BALASORE DISTRICT OF ODISHA, INDIA

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Global population growth is accelerating, resulting in rising levels of food insecurity. To address this issue, food production must be increased to meet the growing population's food needs. In light of this, the exploration, identification, and utilization of lesser-known leafy vegetables could play a significant role in alleviating the world's growing population's hunger.

The current study was carried out to investigate the variety of leafy vegetables consumed by the inhabitants and to document their use for gastric disorders in the Balasore district of Odisha, India. A total of 126 leafy vegetables from 93 genera and 43 families were identified, indicating that local communities consume a lot of wild leafy vegetables. Twenty-five species were reported for ethnomedicinal claims against gastrointestinal complaints, signifying their role in maintaining the local population's good gut health. With a fidelity level of 93.83%, *Oxalis corniculata* L. is the most cited ethnomedicinal leafy vegetable for gastrointestinal ailment and diarrhoea. In the disease category of peptic ulcer, the factor of informant consensus value was found to be the maximum (Fic value 1). The current study's findings show that leafy vegetables not only meet nutritional needs but also have the potential to meet humankind's medicinal needs. It is suggested that further research be conducted to shed light on their efficacy as a suitable nutraceutical.

Keywords: Leafy vegetable, food insecurity, ethnomedicinal, gastrointestinal, nutraceutical.

EFFICACY OF PLANT PRODUCTS AS BIOFUNGICIDES FOR POSTHARVEST DECAY OF ROOT, TUBER, AND BULB CROPS: AN OPPORTUNITY FOR BIOENTREPRENEURSHIP

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Biofungicides are biologically pest (fungi) control agent and one of the solutions for sustaining agricultural output and environmental quality. In order to implement these eco-friendly biofungicides on disease causing fungi of crop plant effectively, it is important to pay attention to the ways of formulation and application. Biofungicides have many advantages over chemical fungicide, such as it is biodegradable and cheaper and harmful residues are not detected. An extensive survey undertaken in the storehouses and market places of Odisha could indicate that eight genera of fungi comprising of ten species were mostly responsible for causing postharvest decay in common root, tuber, and bulb crops. The incidence of rotting in the samples collected was observed in the frequencies ranging from 9.74% to 50.3% of the total samples studied. *Aspergillus*, *Geotrichum*, *Penicillium*, and *Rhizopus* were identified as the dominant genera of fungi for causing maximum loss of these vegetables in storage condition. Studies on the inhibition of mycelial growth of the ten fungal species under study by using aqueous, petroleum ether, and methanolic leaf extracts of sixteen angiospermic plants confirmed that the petroleum ether and methanolic leaf extracts were more effective than their respective aqueous extracts besides showing severe to moderate impact upon the test pathogens compared to the mild and insignificant effect of the aqueous leaf extracts. Of the sixteen experimental plants, *Ageratum conyzoides*, *Alstonia scholaris*, and *Averrhoa carambola* showed significant results in controlling the test pathogens than other plants tested. While comparing the efficacy of plant extracts (petroleum ether and methanolic extract of *Ageratum conyzoides*, *Alstonia scholaris*, and *Averrhoa carambola*) with the commercial fungicides (Blitox-50, Dhanustin, Indofil, and Mancozeb), it was found that plant extracts were more efficient to inhibit the mycelial growth of ten test fungi. It was further interesting to observe that as a result of the combined effect of petroleum ether and methanolic extracts of *Ageratum conyzoides*, *Alstonia scholaris*, and *Averrhoa carambola* could completely inhibit the mycelial growth of all the test fungi and could further be recommended as a suitable biofungicide. Further, these tested plant products can be recommended as suitable agents for bioprospecting under entrepreneurship development to be popularized in view of its effectiveness against fungi causing storage decay in root, tuber, and bulb crops.

Keywords: Rooted crops - Postharvest management - Biofungicides

LEAFY VEGETABLE DIVERSITY IN KEONJHAR DISTRICT OF ODISHA, INDIA

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The enhanced growth of the population worldwide results in rising levels of food inadequacy. To overcome this issue, food production needs to be boosted to satisfy the food requirements of the expanding population. In view of this, exploration, identification, and utilization of less known leafy vegetables could play an important role in alleviating the hunger of the world's rising population. Further, traditional leafy vegetables, being highly nutritive, play a crucial role during times of famine and poor harvest in ensuring food security. The leafy green vegetables are the excellent source of minerals such as iron, magnesium, calcium, and potassium, along with vitamins B, C, E, and K. Besides, they are bestowed with phytonutrients such as beta-carotene, lutein, zeaxanthin, and omega-3 fatty acids which protect cells from injury and age-related problems. They are enriched in compounds that possess antidiabetic, anti-histamine, and anti-carcinogenic properties. The Keonjhar district of Odisha is known for its tribal population, majority of tribes rely on traditional practice of using forest area for shelter and livelihood. The tribal people are using various wild leafy vegetable as the alternative food resources other than cultivated ones. The present study was undertaken to explore the diversity of leafy vegetables consumed by the inhabitants in the Keonjhar district of Odisha, India. A total of 42 species of leafy vegetables belonging to 33 genera under 21 families were recorded, which revealed that the local communities consume a good number of wild leafy vegetables. The findings of the present study indicate that leafy vegetables are capable of meeting to some extent the nutritional requirements of humankind. It can be recommended that further investigation could throw light on their efficacy as a suitable nutraceutical.

LICHEN DIVERSITY ON *SHOREA ROBUSTA* GAERTN. IN THE TRANSITIONAL ZONE OF SIMILIPAL BIOSPHERE RESERVE

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The Similipal Biosphere Reserve of Mayurbhanj district in north-eastern Odisha, is situated between 21° 28' to 22° 08' north latitude and 86° 04' to 86° 37' east longitude, which comprises many plant species including lichens. *Shorea robusta* Gaertn., forms the major tree vegetation in the area both in valleys and small hillocks. The present study reveals the occurrence of 88 numbers of species belonging to 18 genera and 13 families of lichenized fungi occurring on the bark of *Shorea robusta*, collected from the transitional zone of Similipal Biosphere Reserve. Members of the family Graphidaceae followed by Pyrenulaceae growing luxuriantly on the bark of *Shorea* together with the dominant genera *Pyrenula*. Crustose species are the dominant one followed by foliose taxa represented by 67 and 21 numbers species respectively. The North-West localities of Similipal contains a more diverse group of lichen taxa (52 species) than that of the South-West region represented by 44 species. The distribution of epiphytic lichen on *Shorea robusta* shows that it is one of the most suitable hosts for it. Single host plant in terms of lichen diversity is gaining more importance in order to understand the species-host interaction. From the earlier studies, it was clearly indicated that Sal or *Shorea robusta* Gaertn. is the suitable host for the growth of different groups of lichens for its bark properties.

Keywords: Lichen-host interaction, Lichenicolous fungi, Dry-deciduous forest, *Shorea robusta*.

NEW ADDITION OF TWENTY LICHEN SPECIES TO THE FLORA OF ODISHA: A REPORT

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Panchadhara Hill range is one of the distinguished forest ranges of Odisha highly enriched with a large number of angiospermic flora. This hill range has a dry deciduous type forest with *Shorea robusta* and *Diospyros melanoxylon* of frequent occurrence. The present paper reports the occurrence of 20 species of crustose lichens for the first time in the state of Odisha while exploring the lichen diversity of the area. A morpho-taxonomic note together with habitat and distribution of all the newly reported lichen species is provided. The newly recorded lichen taxa belong to 14 genera such as *Amandinea*, *Arthothelium*, *Arthopyrenia*, *Baculifera*, *Buellia*, *Cococarpia*, *Collema*, *Cratiria*, *Cryptothecia*, *Dimelaena*, *Fissurina*, *Graphis*, *Herpothallon* and *Pyxine* and 6 families including Arthoniaceae, Arthopyreniaceae, Caliciaceae, Coccocarpiaceae, Collemataceae, and Graphidaceae. The specimens were collected from different substrata such as bark and twigs from the forests of the hill range and the identification of lichen species was done by critically studying their morphology, anatomy and chemistry. The newly reported lichen taxa included *Amandinea punctata* (Hoffm.) Coppins and Scheid., *Arthopyrenia grisea* (Schleich. ex Schaer.) Korber, *Arthopyrenia minor* R.C. Harris, *Arthothelium abnorme* (Ach.) Muell. Arg., *Baculifera cutisii* (Tuck.) Marb., *Buellia aethalea* (Ach.) Th., *Buellia disciformis* (Fr.) Mudd., *Cococarpia erythroxyli* (Spreng.) Swinscow and Krog, *Collema nigrescens* Degel, *Collema pulcellum* var. *subnigrescens* (Muell. Arg.) Degel., *Collema subflaccidum* Degel, *Cratiria obscurior* (Stirt.) Marbach and Kalb, *Cryptothecia striata* G. Thor, *Dimelaena tenius* (Muell. Arg.) H. Mayrhofer and Wippel, *Graphis lineola* Ach., *Fissurina comparimuralis* Staig., *Graphis pseudoserpens* Chaves, Lucking and Umana, *Herpothallon granulare* (Sipman) Aptroot and Lücking, *Pyxine petricola* Nyl. and *Pyxine soledata* (Ach.) Mont. which were found to be an addition to lichen flora of Odisha. It is evident from the present study that Panchadhara Hill Range has a rich diversity of lichen flora. Since many of these lichen species are likely to be endemic to the special habitats of this region, they are most vulnerable to extinction and it is extremely important to document the existing lichen vegetation and to study the effect of biotic pressures on it.

Key words: Lichens, Flora, New records, Panchadhara, Odisha.

PHYTOREMEDIATION OF STEEL PLANT EFFLUENTS BY USING NATIVE MACROPHYTES - A CASE STUDY OF NEELACHAL ISPAT NIGAM LIMITED, ODISHA (INDIA)

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In recent times, the use of plants to remediate heavy metal pollution has become an effective technique in pollution control. Plants can take up heavy metals by their roots, or even their stems and leaves, and accumulate them in their organs. The present study aims at developing a protocol for decontamination of industrial effluents using a biological treatment system by employing selected floating and rooted macrophytes occurring in the native aquatic or marshy ecosystem. Industrial unit 'Neelachal Ispat Nigam Limited' - a public sector integrated Iron and Steel plant, located at 'Kalinga Nagar Industrial Complex' was chosen for the proposed investigation which belongs to the Jajpur district of Odisha. The pond or water body carrying effluents of Neelachal Ispat Nigam Limited was selected as the sampling site. Azolla strains and its associates were collected from the water bodies nearby the sampling site. Assessment of various physico-chemical characteristics of the effluents in different seasons (Rainy, Winter and Summer) of the year was undertaken. Studies on effect of effluents upon growth of macrophytes revealed that *Azolla pinnata* R.Br., *Lemna perpusilla* Torrey, *Spirodela polyrhiza* (L.)Schleiden, *Pistia stratiotes* L., *Salvinia cucullata* Roxb. ex Bory and *Eichhornia crassipes* (Mart.) Solms-Laub. grown in 20 % diluted NINL effluent had an increased fresh matter over those grown in tap water. Most of these species failed to grow beyond a week, when the effluent concentration exceeded 20%. The increase in biomass was maximum in *Eichhornia* and *Spirodela* when the industrial effluent was used. The fresh and dry matter of both these species were directly proportional to the increase in effluent concentration up to 20 %, beyond which growth of *Spirodela* was inhibited but *Eichhornia* could survive even at higher concentration (up to 30%). The application of effluents in the pot enhanced plant height and number of tillers in *Oryza sativa* L., *Oryza rufipogon* Griff. and *Typha angustata* Boary & Chaub. after one month of transplantation. The concentration of hazardous chemicals such as cyanide and ammonia was reduced by the culture of all the aforementioned macrophytes. The reduction in the pollutants level in the NINL effluent had a direct relationship with the increase in fresh matter production of all the plant species employed in this experiment.

SOME LESS-KNOWN CROP-WEEDS IN INDUCING LACTATION IN CATTLE OF JAJPUR DISTRICT OF ODISHA

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The natives of Jajpur district of Odisha depend basically on different herbs for a wide range of ailments including veterinary practices. An extensive survey of the crop fields was conducted to collect information about medicinally important weeds associated with various crops which are used as a galactagogue by the local populations. The indigenous knowledge of local traditional healers and native plants used for inducing lactation in nursing cattle were collected through questionnaires and personal interviews. A total of 25 informants within the age group of 50 to 70 were interviewed, among them five were tribal practitioners. The investigation revealed that, the traditional healers and the inhabitants use 29 species of plants distributed in 28 genera belonging to 22 families to induce lactation in nursing cattle especially cows. As regards to the efficacy of weeds it is reported that fresh plant materials were invariably preferred over preserved materials for inducing lactation. As per the information collected from the local practitioners these ethnomedicinally important herbs in the crop fields not only induce lactation but also contribute for the nutritional requirement of mother and child. The present work aims at documentation of some potential but less known crop weeds of galactogonic importance used by the locals for the purpose are *Aeschynomene americana* L. (whole plant as fodder), *Alternanthera philloxeroides* (Mart.) Griseb. (whole plant as fodder), *Aponogeton natans* (L.) Engl. & Krause (whole plant as fodder), *Azolla pinnata* R.Br. (whole plant), *Cardiospermum halicacabum* L. (decoction of the root with husk and water), *Coix lacryma-jobi* L. (whole plant as fodder), *Desmodium heterocarpon* (L.) DC. (whole plant as fodder), *Eichhornia crassipes* (Mart.) Solms-Laub. (dried plant as fodder), *Grangea maderaspatana* (L.) Poir. (whole plant as fodder), *Hedyotis corymbosa* (L.) Lam. (decoction of whole plant), *Hydrolea zeylanica* (L.) Vahl (whole plant as fodder), *Ludwigia adscendens* (L.) Hara (Whole plant), *Portulaca quadrifida* L. (whole plant as fodder), *Sida cordata* (Burm.f.) Borssum (Whole plant as fodder), *Smithia conferta* J.E. Sm. (Whole plant), *Spermacoce hispida* L. (decoction of whole plant) and *Sphenoclea zeylanica* Gaertn. (decoction of inflorescence). Further investigations on these potential lactation-inducing weeds required to be scientifically evaluated for the discovery of new bioactive molecules towards the development of drugs for safer use.

STUDIES ON THE MEDICO-BOTANY OF PLANTS USED IN HAWANIN JAJPUR DISTRICT OF ODISHA

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A Medico-botanical exploration was carried out to document and investigate on the plants used in Hawan (Homa) in different temples and family and festive rituals associated with God and Goddesses associated with Hindu culture in Jajpur district of Odisha revealed some interesting information regarding uses of different plant parts for the purpose. Offerings during the rituals used to sanctify flame and smoke is called as Hawan or Homa. One of the important characteristics of doing Hawan is it makes the environment toxic free and simultaneously many disease-causing agents are eliminated from the environment. The present study communicates regarding the practice of using different plants and plant parts like root, stem, leaf, flower, fruit, rhizome, tuber in ritualistic process of Hawan in the study area. Some of the widely used plants for the above said purpose with curative property include *Butea monosperma* (Lam.) Taub., *Curcuma zedoaria* (Christm.) Rosc., *Glycyrrhiza glabra* L., *Holarrhenapubescens* (Buch.-Ham.) Wall. ex G.Don and *Wrightia tinctoria* (Roxb.) R.Br. The present work attempts to document and design the ever-wiping traditional art and craft related to the medico-botanical potential of plants used in Hawan for the fulfilment of religious rites and home ceremonies by the populace of Jajpur district of Odisha.

WEED DIVERSITY OF RABI CROPS AND THEIR ETHNOMEDICINAL USES IN KENDRAPARA DISTRICT OF ODISHA (INDIA)

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An ethnobotanical exploration was carried out during 2010-2012 in four selected C.D. Blocks of Kendrapara district of Odisha namely Rajnagar, Rajkanika, Mahakalpada and Derabish to document the use of weeds found in crop fields during Rabi season. These crops include green gram, black gram, ground nut, mustard, sun flower, potato and other vegetables such as radish, coriander, cauliflower etc. Farmers, local people, agricultural labourers as well as herbal healers of the said area were approached to collect the information on the application of these weeds in traditional system of medicines. The present investigation revealed the occurrence of 60 weed species belonging to 32 families found associated with the principal crops in these crop fields. Out of these, 38 are used by the local populace for the treatment of various diseases and disorders of humans as well as domestic animals. Some of the widely used weeds include *Amannia baccifera* for skin infections, *Canscora decussata* for mental debility, *Caesulia axilaris* and *Centipida minima* against worm infestations, *Coldenia procumbens* to treat wound and injuries of domestic animals, *Chrozophora rottleri* for jaundice, *Seseli diffusum* used as diuretic and antispasmodic, *Sonchus asper* for wound and boils, *Sphaeranthus indicus* against Cough, *Spilanthes paniculata* against toothache, *Trichodesma indica* useful in stomach disorder and abdominal pains and skin diseases, *Urena lobata* in the treatment of rheumatism and *Xanthium indicum* against skin diseases of cattle. Further studies on these ethnomedicinal weeds occurring in the native crop fields are required to be scientifically analyzed for the discovery of new bioactive molecules towards the development of drugs for safer use. On the other hand, the above findings may be of immense help to the labourers or marginal farmers to get additional livelihood for organized collection, processing and marketing of these medicinal crop weeds depending on the demand of the pharmaceutical houses.

***SPILANTHESPANICULATA* (TOOTHACHE PLANT) ESSENTIAL OIL ON ORAL CANCER**

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Oral squamous cell carcinoma (OSCC) is the predominant form of epithelial oral malignancies, accounting for over 90% of oral tumor. Despite notable progress in cancer treatment, OSCC continues to pose significant challenges, marked by a considerable likelihood of disease recurrence and distant metastasis, leading to a correspondingly elevated mortality rate. Several research have highlighted the treatment methods for cancer, including synthetic drugs that have several adverse effects and the development of drug resistance is a potential concern. Nevertheless, the development of new anticancer medications necessitates the in depth understanding of molecular mechanisms that drive the onset and advancement of OSCC. In this regard, the use of plant based herbal medicines for the anticancer therapeutic purposes has significantly risen due to their impacts on multiple targets and lower cytotoxicity to normal cells. The alternative traditional medications such as plant extracts and essential oils have shown encouraging anticancer properties owing to their minimal impact on normal cells

Spilanthes paniculata, commonly known as the toothache plant, is an annual herb mostly located on different crop fields reported to have been historically employed in traditional medicine for addressing various oral ailments including cancer. Most importantly the toothache plant is reported to possess a diverse range of therapeutic properties, including antibacterial, antimalaria, local anesthesia, diuretic, antioxidant, antiulcer, anti-inflammatory, and anticancer activity. The therapeutic properties of *S. paniculata* are attributed to various phytochemicals present in the plant such as Spathulenol, Bisabolene, and Germacrene D.

The analysis of MTT assays , Apoptosis Assay with essential oil were studied in this report. The

cell viability activity of the essential oil of the *S. paniculata* was evaluated against oral cell line, using the standard MTT assay. When the cells were exposed to different concentrations of the essential oil there was a significant decrease in cell viability following treatment of oral cell line with essential oil.

In order to check the accurate number of cells counts undergoing early apoptosis following treatment of oral cell line with essential oils of the *S. paniculata* we conducted flow cytometry analysis. The study revealed that essential oil is ~2.5 fold more effective in inducing apoptosis.

TINOSPORACORDIFOLIA: AN AYURVEDIC BOON TO THE SOCIETY

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ABSTRACT

Tinosporacordifolia commonly named as “Guduchi” is known for its immense application in the treatment of various diseases in the traditional ayurvedic literature. A variety of active components derived from the plant like alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides have been isolated from the different parts of the plant body, including root, stem, and whole plant.

The plant has been reported various medicinal properties like anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritis, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, anti-malarial, hepatoprotective, immunomodulatory and anti-neoplastic activities.

- Aqueous *Tinospora* extracts has been also reported to influence the cytokine production, mitogenicity, stimulation and activation of immune effector cells. Alkaloids such as a choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine from *Tinosporacordifolia* showed protection against aflatoxin-induced nephrotoxicity.

- It has been reported to mediate its anti-diabetic potential through mitigating oxidative stress (OS), promoting insulin secretion and also by inhibiting gluconeogenesis and glycogenolysis, thereby regulating blood glucose.

The isoquinoline alkaloid rich fraction from stem, including, palmatine, jatrorrhizine, and magnoflorine have been reported for insulin-mimicking and insulin-releasing effect both *in vitro* and *in vivo*.

- Single or synergistic formulations of *Tinosporacordifolia* with *Zingiberofficinale* has been used in rheumatoid arthritis treatment in traditional medicine. Anti-HIV effects of TCE was revealed by reduction in eosinophil count, stimulation of B lymphocytes, macrophages and polymorphonuclear leucocytes and haemoglobin percentage thus, revealing its promising role of application in management of the disease.

- The methanol extracts of *Tinosporacordifolia* have been reported to have potential against microbial infections. The anti-bacterial activity of *Tinosporacordifolia* extracts has been assayed

against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella flexneri*, *Salmonella paratyphi*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Enterobacter aerogenes*, and *Serratia marcescens*.

Tinosporacordifolia has an importance in traditional ayurvedic medicine used for ages in the treatment of fever, jaundice, chronic diarrhoea, cancer, dysentery, bone fracture, pain, asthma, skin disease, poisonous insect, snake bite, eye disorders.

Key Words: Diterpenoid lactones, Anti-neoplastic, Immunomodulatory, Magnoflorine



A REVIEW ON MEDICINAL PLANT OF “AEGLE MARMELOS”

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ABSTRACT

Since the aeons ago, plants and their products such as flower, fruit, seeds, leaves etc. have been the primary resource of food and medicines for humankind, *Aegle marmelos* commonly known as bael or (bel) and golden apple, belonging to the family Rutaceae is a moderate sized, slender and aromatic tree. A number of chemical components and various remedial effects of leaves of *Aegle marmelos* (Bael) have been reported by different workers. Extensive investigations have been carried out on different parts of *Aegle marmelos* and as a importance, various classes of compound, alkaloid, terpenoids, fatty acids, amino acids, coumarins have been isolated from its different parts. Different pharmacological, ethnological, and phytochemical evaluations have been reported on the important potential of the *Aegle marmelos*.

Key words: *Aegle marmelos*, pharmacological, Ethnological, phytological

PHYTOREMEDIATION OF NICKEL STRESS BY AQUATIC SPECIES

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ABSTRACT

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. Examples of heavy metals include mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (Tl) and lead (Pb). Nickel (Ni) is just one of a variety of ubiquitous trace metals emitted into the environment from both natural and anthropogenic sources. Phytoremediation is the use of green plants to remove pollutants from the environment to render them harmless. 'Green' technology uses plants to 'vacuum' heavy metals from the soil through the roots. While acting as vacuum cleaner, the technique plants must be able to tolerate and survive high levels of heavy metals in soil.

Of particular concern is the increasing concentration of Ni deposited in agricultural soils by airborne Ni particles. The primary sources of Ni emissions into the ambient air are combustion of coal and oil for heat or power generation, Ni mining, steel manufacture, and other miscellaneous sources, such as cement manufacture. Nickel is an essential micronutrient for plant growth and it is also a component of the enzyme urease which is required for nitrogen metabolism in higher plants. Ni is strongly phytotoxic at high concentration.

The plant specimens i.e. *Azolla filiculoides*, *Eichhornia crassipes*, *Lemna minuta*, *Pistia stratiotes*, *Spirodella polyrhiza* were treated with Nickel for 7 days and 15 days. As a result all plants are not survive in treatment solution Nickel, only *Spirodella polyrhiza* can survive which shows biomass of 0.14gm. after 14 days. Chlorophyll a, Chlorophyll b, total Chlorophyll, Carotenoids content gradually decrease upto 100 ppm treatment per 500 ml of Hoagland's solution than the control one. Out of five species *Eichhornia crassipes* shows high Chlorophyll and Carotenoid content e.g. 1.73 and 0.047 respectively. The proline content was also affected which was increased with high concentration of NiCl₂ treatment. *Azolla filiculoides* shows high proline content.

The result obtain from the experiment that *Azolla filiculoides*, *Eichhornia crassipes*, *Lemna minuta*, *Pistia stratiotes*, *Spirodella polyrhiza* accumulate Nickel at a certain level and high level is toxic to plant, but further investigation is required to investigate the underlying mechanism.

Keywords: Nickel, Heavy metal, lemna, Azolla, Pistia, Spirodella

ROLE OF WILD EDIBLE PLANTS IN ENSURING FOOD SECURITY

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ABSTRACT

Wild edible plants are defined as native species that grow and reproduce naturally in their natural habitat without being cultivated. Consumption of wild edible plants is primeval that precedes the agriculture. Malnutrition is considered to be, in addition to climate change, a global threat, indicating an urgent need for a healthier and more sustainable food system. Under this scenario, they offer various benefits and opportunities to communities; for example, they enable communities to cope with food scarcity known as ecosystem-based adaptation. They play an important role when food crops are scarce, ensuring food sovereignty and food security. Wild edible plants are a rich source of antioxidants, vitamins, fiber, and minerals. Studies carried out in the last years revealed the important role of wild edible plants as sources of nutrients and contributors to human dietary requirements. It can therefore play an important role as an essential component of people's diets and provide greater dietary diversity. Wild plants are an integral part of local cultural heritage and are often also consumed for their socio-economic and environmental sustainability. In other words, their consumption and gathering can provide cultural ecosystem services. Additionally, these plants play a significant role in healthcare system and should be further researched for potential pharmaceutical advantages and unique nutritional attributes.

Keywords: Wild edible plants, food security, Malnutrition, Sustainability

INDIAN TRADITIONAL MEDICINAL PLANTS FOR THE TREATMENT OF DIABETES- POTENTIAL AND PROSPECTIVE

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ABSTRACT

Diabetes, a metabolic syndrome has emerged as a silent epidemic in the recent years. The failure of conventional medicines to provide a safe, effective, and affordable stance has rendered scientists to go back to the ancient literature on traditional plant-based therapies. Based on current experimental foundations, ayurvedic medicines have gained wider acceptance, and hence should be employed against diabetes as a complementary medication. Although many spices and herbs are used for usual cooking purposes, organized research on the advantageous effect of such herbs in regard to diabetes is less explored. Traditionally, many ayurvedic phyto-based polyherbal formulations have been described to reduce blood glucose levels and ease allied complications related to diabetes, but of them nine ethnomedicinal plants (cinnamon, fenugreek, bitter melon, neem, Indian bael, black myrobalan, Indian gooseberry, turmeric, and guduchi), are most commonly mentioned in traditional formulations. Systematic evaluation of various extraction methods, computational, in vitro, in vivo, and human trials for diabetes involving these plants, has been performed. These plants work for the antidiabetic property mainly via five major ways, viz. (i) maintenance and safe-guarding of pancreatic- β cells with improved insulin synthesis, (ii) exertion of antioxidant effect to prevent tissue and organ damage, (iii) reduction of tissue damage by anti-inflammatory effect, (iv) reduction in FBG levels with improved glucose metabolism, and (v) inhibiting α -glucosidase reducing the absorption of carbohydrates. The efficiency, and safety of such ancient plant-based organic compounds and their interaction with conventional drugs have to be proved using clinical trials. Due to a lack of thorough clinical trials, the journey of herbal products from in vivo studies to the final formulation stage is hindered. Hence, an active collaborative approach between pharmaceutical companies and academia should be boosted for scaling up plant extract-based products, which would not only increase the acceptability of traditional knowledge-based herbal practices but also accelerate the drug development process.

Keywords: Phytoconstituents; Herb-drug interactions; Fenugreek; Glucose transporter; Anti-inflammatory; Antidiabetic.

MICROBIOME- GUT- BRAIN- AXIS: UNRAVELLING THE COMMUNICATION BETWEEN THE BRAIN AND THE GUT

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ABSTRACT

The gut bacteria, the central nervous system, and the gastrointestinal tract interact in a complex and dynamic network known as the microbiome-gut-brain axis. This system of two-way communication is essential for controlling a range of physiological and psychological functions that affect both health and illness. The gut microbiota forms a symbiotic relationship with the host and is made up of billions of bacteria, viruses, and fungi. These microbes create beneficial molecules, influence the immune system, and aid in the metabolism of food ingredients. Significantly, they actively interact with the central nervous system as well. On the other hand, the central nervous system communicates with the gut through the autonomic nervous system, hormonal signalling, and immune mediators. Dysregulation of the microbiome-gut-brain axis has been implicated in various neurological and psychiatric disorders, including anxiety, depression, and neurodegenerative diseases. Research on the intricate relationship between the gut microbiota and host physiology is still in its very early stages. However, deepening our knowledge of this relationship may result in useful treatment approaches to enhance human health and see the potential impact this research will have on medical advancements. This overview aims to provide an idea of the present research on the relationship between host gut microbiota and health to fully understand the gut microbiome's function in the pathophysiology of disorders affecting the central nervous system.

Key words: Gut microbiota, Gastrointestinal tract, Central nervous system, Hormonal signalling, Neurological disorders

ANTI-CANCER ACTIVITY OF *MORINGA OLEIFERA* LAM SEED OIL ON ORAL CANCER

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Regardless of recent advancements in the diagnosis and treatment of oral squamous cell carcinoma, no significant change in relative survival rates is observed. There is a need of a better anti-cancer agent with fewer side effects to overcome the limitations of current cancer therapies. *Moringa oleifera* Lam(Family: Moringaceae) is one such miracle plant, as it is rich in vitamins, proteins, carbohydrates, fatty acids, fibers, trace elements, and phytochemical compounds. The anti-cancer activity of *Moringa oleifera* is accredited to its phytoconstituents. Our aim here is to find out the anti-proliferative and cytotoxic effect of MO seed oil on two cell lines CAL27 and SCC15. Phytochemical identification was done by 2DGC-TOF-MS and Heptacosane (52%) was obtained as the major component. The cytotoxic and anti-proliferative properties of the oil was evaluated using MTT assay with different concentrations (31.25, 62.5, 125, 250, 500 µg/ml). Our results demonstrates that CAL27, and SCC15 cell lines treated with MO showed decrease in cell viability within 24 hours with IC₅₀ value of 17.78µg/ml, 24.28µg/ml. *Moringa oleifera* seed oil exhibits anti-cancer activity by decreasing cell proliferation and exhibiting cytotoxicity in CAL27 and SCC15 cells. A low cell survival was detected on treatment with different concentrations in a dose dependent manner. Thus, our findings provide growing evidence supporting the promising role of *Moringa oleifera* seed oil as a potent anti-cancer agent. Additionally, the present work provides a preliminary platform for further investigation of the possible mechanism and role of *Moringa oleifera* seed oil on Oral cancer.

INDIGENOUS AND MEDICINAL PLANT SPECIES AS CARBON SEQUESTERS AND GLOBAL CLIMATE CHANGE PROTECTORS IN THE DRY DECIDUOUS FORESTS OF ODISHA, INDIA

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ABSTRACT

Considering the increased efforts of the world community to tackle climate change, forests—and especially indigenous tree species—have become more important in sequestering carbon. This study focuses on the importance of indigenous trees in the dry deciduous forests of Odisha, India, acting as efficient carbon sinks and mitigating the effects of global climate change. Odisha is known for its varied ecosystems and is home to a wide range of indigenous tree species that have adapted to flourish in the area's particular climate. Through photosynthesis and the storage of carbon in their biomass, these trees are essential in the sequestration of carbon dioxide from the atmosphere. To estimate the potential for sequestering carbon dioxide from a subset of indigenous tree species, the study combines field surveys with carbon accounting techniques. The findings show that the indigenous trees that have been discovered including *S. robusta*, *Buchnanian lanzan*, *Streblus asper*, *Morinda tinctoria*, *Cassia fistula* etc. have a major impact on the sequestration of carbon in the dry deciduous forests of Odisha. The study investigates the relationship between age structure, species variety, and environmental parameters and carbon sequestration rates. The study evaluates these trees' ability to withstand the effects of climate change as well as their capacity to lessen the effects of warming temperatures and changed precipitation patterns. The research also assesses the co-benefits of having indigenous trees, including improved soil health and biodiversity preservation. The results highlight how crucial it is to include afforestation and indigenous tree protection measures in the region's efforts for mitigating and adapting to climate change. In the context of Odisha's dry deciduous forests, this research offers important new insights into the possible role that indigenous tree species could play in the fight against climate change. These findings have global ramifications that underscore how crucial it is to identify and protect indigenous tree species in order to ensure a resilient and sustainable future.

Keywords-Indigenous tree species; carbon sequester; Climate change protector; dry deciduous forest; Carbon sink.

HARMONIZING AROMAS AND REMEDIATION: INTEGRATING ESSENTIAL OIL CULTIVATION WITH HEAVY METAL PHYTOREMEDIATION

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In our paper we highlight the pressing issue of heavy metal pollution and the increasing interest in using aromatic plants for phytoremediation. Aromatic plants, particularly from specific plant families, are recognized for their potential as hyperaccumulators and phytoremediators. This review emphasizes their economic importance in industries like perfumery and aromatherapy for relieving stress, treating depression, treating skin ailments, aiding with insomnia & respiratory problem. The cultivation of these plants is proposed as an environment friendly and aesthetically pleasing strategy with numerous ecological and socioeconomic benefits. When exposed to heavy metal stress, aromatic plants are stimulated to emit secondary metabolites, specifically essential oils like citral, geranyl acetate, geraniol, isogeraniol. This reaction not only boosts the plants' ability to produce oil but also elevates their economic worth. Specific aromatic plants, such as *Cymbopogon nardus* (L.) Rendle, *Ocimum basilicum* L., *Cymbopogon flexuosus* (Nees ex Steud.), *Cymbopogon martini* (Roxb.) Will. Watson, *Chrysopogon zizanoides* (L.) Roberty, and *Mentha* spp. are examined for their phytoremediation potential, providing valuable insights into their strategies and mechanisms. Overall, the review serves as a comprehensive resource for the scientific community, guiding future research and applications of aromatic plants in sustainable phytoremediation.

Keywords: Heavy Metal, Phytoremediation, Aromatic plants, Essential Oil

BIOACTIVE COMPOUNDS AND PHARMACOGNOSTIC PROPERTIES OF *ALOE VERA* [LINN.] –A REVIEW

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ABSTRACT

Aloe vera is a perennial succulent plant, a member of the Liliaceae family, and has a great history of therapeutic importance. For centuries, people have harnessed the potent healing power of the Aloe vera plant. With its spiny leaves and soothing gel, this succulent plant has been used in conventional medicine across diverse cultures to treat various ailments. Modern research unravels the scientific basis behind the traditional uses, revealing the rich tapestry of bioactive compounds within aloe vera and their diverse therapeutic potential. Aloe vera leaves contain many bioactive compounds such as barbaloin, aloe-emodin, chrysophanol glycosides, polysaccharides, anthraquinones, phenolic compounds, galacturonic acid and salicylic acid. Research highlights the diverse pharmacognostic properties of these phytochemicals. Polysaccharides in aloe vera have immune-boosting and anti-inflammatory effects and are commonly used to treat conditions such as diabetes, ulcerative colitis, and skin disorders. The anthraquinones in aloe vera have laxative effects. Phenolic compounds have antioxidant properties. Salicylic acid, the natural anti-inflammatory agent, helps soothe irritated skin and heal wounds. People have known and used the aloe vera plant for its health and skin benefits for millennia. The recovery of wounds, antioxidant, antifungal activity, anti-diabetic effects, anti-inflammatory, anti-cancer, immune-modulatory, and gastro-protective qualities are all benefits of Aloe vera's bioactive ingredients. The present review focuses on available literature on its chemical compositions, processing, pharmacognostic properties and advanced therapeutic applications.

KEYWORDS: Bioactive compound, aloe vera, antioxidant, succulent, therapeutic uses

RAPID PLANTLET REGENERATION OF *HELIOTROPIMUM INDICUM* L. – A POTENTIAL MEDICINAL PLANT

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ABSTRACT

Heliotropium indicum L. is commonly known as Hatisundha belongs to the family Boraginaceae. Pyrrolizidine alkaloids of *H. indicum* are considered for Chemotaxonomic and also for pharmaceutical interest.

A novel protocol for *in vitro* propagation of *Heliotropium indicum* L. has been established. Callus and shoot formation from the nodal explants with axillary buds of *H. indicum* L. was initiated on Murashige and Skoog's (1962) basal media supplemented with combinations of auxin Indole acetic acid (IAA) 0.5 mg/l with cytokinin 6-benzylaminopurine (BAP) 1.0 mg/l induced an organogenic and chlorophyllous callus with an average of 5 shoots per node. Subsequent culture for rapid multiplication of shoots on MS medium with combinations of 1 mg/l 6-benzylaminopurine, 0.5 mg/l Kinetin and 0.2 mg/l Gibberellic acid (GA₃) enhanced the number of shoots. Callus initiated from the basal cut end explants differentiated into more than 28 shoots. Shoots regenerated from *in vitro*, rooted on half strength MS medium supplemented with 1.0 mg/l Indole acetic acid (IAA) showed thick and stout roots. Seventy percent of the rooted shoots survived when transferred to the Greenhouse and subsequently to the natural environment.

Keywords: *in vitro* propagation, organogenesis, *Heliotropium indicum* L., medicinal plant & nodal explants.

ALGAE FOR BIOFUEL PRODUCTION

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ABSTRACT

The growing concerns about rapid depletion of fossil fuel reserves, increasing cost of crude oil, energy security, expanding population, global climate change & people's desire for higher living standards have led to growing worldwide interests in renewable energy sources such as biofuels. Biofuels are simply the chemicals enriched with energy which is gradually expended through biochemical processes. Biofuels are mainly classified into two categories: primary & secondary biofuels. The biofuels produced from burned woody or cellulosic plant material and dry animal wastes are considered to be primary biofuels. Based on the feedstock type & processing technologies used the secondary biofuels are categorized into three generations. The first-generation biofuel is ethanol which are derived from starchy food crops and biodiesel derived from waste animal fats. The second-generation biofuels is bioethanol derived from non-food cellulosic biomass and biodiesel derived from oil rich seeds. The biofuels derived from microalgal, cyanobacterial and other microbial residues are considered as the third generation and most efficient biofuel. Algal biomass is the most promising approach to meet the global energy demands due to its relatively high growth rate, its potential to reduce greenhouse gas emissions & climate change and their ability to store high amounts of lipids & carbohydrates. Algal biomass are the most versatile organism used for the production of biofuel and microalgal biomass is predominantly used which potentially offer greatest opportunities in longer term. Other potential applications and products from microalgal biomass are also conferred for biological sequestration of carbon dioxide, wastewater treatment, in human health, as food additive and for aquaculture.

Keywords: Microalgae, Biodiesel, Biofuel, Biomass

ANTI-BACTERIAL POTENTIAL AND QUALITATIVE PHYTOCHEMICAL ANALYSIS OF AN INVASIVE ALIEN PLANT *MIKANIA MICRANTHA* KUNTH FOUND IN DHENKANAL DISTRICT OF ODISHA, INDIA

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The objective of the present investigation was to evaluate the antibacterial potential of n-hexane and methanolic extracts of an invasive alien plant *Mikania micrantha* Kunth. The antibacterial potential of the plant was tested against 13 human pathogens such as *Enterococcus faecalis* (MTCC- 459), *Escherichia coli* (MTCC- 614), *Bacillus circulans* (MTCC- 490), *Salmonella paratyphi* (MTCC- 3220), *Vibrio cholerae* (MTCC- 3906), *Salmonella enterica typhimurium* (MTCC- 98), *Pseudomonas aeruginosa* (MTCC- 8076), *Shigella flexneri* (MTCC- 9543), *Salmonella enterica ser typhi* (MTCC-733), *Bacillus subtilis* (MTCC-1305), *Streptococcus mitis* (MTCC- 2897), *Klebsiella pneumoniae* (MTCC-109) and *Staphylococcus aureus* (MTCC- 1430) using agar well diffusion method. The results of the study revealed that n-hexane extract of sample was highly effective against *Pseudomonas aeruginosa* whereas *Staphylococcus aureus* and *Klebsiella pneumoniae* showed no response and other test pathogens under study responded moderately. It was observed that methanolic extract had high inhibition potential against *Pseudomonas aeruginosa* whereas *Salmonella paratyphi* and *Shigella flexneri* showed no response and other test pathogens under study responded moderately. Phytochemical analysis revealed presence of alkaloids, steroids, terpenoids, glycosides, tannins, proteins, carbohydrates and phenolic compounds in methanolic extract whereas n- hexane extract contains steroids, terpenoids and phenolic compounds.

Keywords: Agar well diffusion, Antibacterial activity, Dhenkanal, *Mikania micrantha*, Odisha, Phytochemical analysis.

ROLE OF MICROCLIMATE AND CANOPY COVER ON POPULATION STRUCTURE AND PHYSIOLOGICAL PERFORMANCES OF *RAUVOLFIA SERPENTINA* IN TROPICAL MOIST DECIDUOUS FOREST OF 'TERAI' ECOSYSTEM

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Rauvolfia serpentina (L.) Benth. ex Kurz is an endangered medicinal plant that is listed in Appendix II of CITES which is majorly harvested for its root. The plant is harvested from the wild for therapeutic purposes and its trade is causing the depletion of the species' natural population. This study examines the population structure of *R. serpentina* in three distinct forest communities (Sal, Teak, and mixed forests) in a North Indian Tropical Moist Deciduous Forest of Katarniaghat Wildlife Sanctuary (KWLS), India. The goal is to understand the relationship between the population structure (in terms of density) of the species, its physiological and phytochemical attributes in relation to microclimatic variables (photosynthetically active radiation (PAR), air temperature, soil temperature, ambient CO₂, and absolute humidity) and forest canopy cover. The population's sensitivity to variations in microclimatic parameters indicates a significant correlation between a species and its chosen microclimatic niche.

The findings indicate that the species demonstrates a strong preference for partially shaded areas as the density of the species was found to be higher in the areas receiving lower PAR. However, after a certain level as the PAR decreased, the density also decreased. Sal forest exhibited the highest population density, with 3653.33 individuals per hectare, followed by the mixed forest with 2973.33 individuals per hectare. The presence of a strong negative correlation ($r=-0.96$; $p<0.01$) between PAR and density in mixed deciduous forests further confirms the species' preference for low light conditions. Strong positive correlation ($r=0.93$; $p<0.05$) was found between absolute humidity and density. Physiology of the species was also affected by the different microclimate and canopy cover among forest communities. High photosynthetic rate was noticed in the population which received higher PAR. Our study demonstrates that characterization of the micro-habitat is crucial for predicting the future distribution pattern and developing conservation strategies.

Keywords: *Rauvolfia serpentina*, Tropical deciduous forest, microclimate, canopy cover, Katarniaghat Wildlife Sanctuary.

BACOPASIDE-I, AN ACTIVE COMPONENT FROM *BACOPAMONNIERI*, INDUCES PPA-MEDIATED MITOCHONDRIAL FISSION AND MITOPHAGY FOR TARGETING NLRP3 INFLAMMASOME ACTIVATION IN ORAL CANCER

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ABSTRACT

Consumption of areca nut containing principal alkaloid arecoline is a major contributor to oral cancer in India. In this study, we have investigated the role of arecoline in mitochondrial dysfunction and propose Bacopaside-I (BS-I), a saponin from *Bacopamonnieri*, to target the inflammatory effect of arecoline for oral cancer therapeutics. Increased mitochondrial fusion and ROS are found in arecoline-treated conditions compared to control in Cal33 cells. Additionally, arecoline contributes to the NLR family pyrin domain containing 3 (NLRP3) inflammasome activation in Cal33 cells. Inhibition of mtROS by Mito-Tempo suppressed the arecoline-mediated NLRP3 inflammasome activation. BS-I induces mitochondrial fission through the PPA2-DRP1 axis and activates PINK1-PARKIN mediated mitophagy to eliminate the dysfunctional mitochondrial population in Cal33 and FaDu cells. BS-I-induced mitophagy is compromised in parkin-deficient conditions, whereas mitochondrial fission is still evident in Hela Cells. BS-I further hinders arecoline-induced mitochondrial ROS production and NLRP3 inflammasome activation in Cal33 cells. Inhibition of mitochondrial fission through Mdivi1 and mitophagy through CQ and siPARKIN significantly hampers the inflammasome inhibition by BS-I. These results established that BS-I-induced mitochondrial fission and mitophagy help segregate and remove damaged mitochondrial sub-population, contributing to NLRP3 inflammasome inhibition in oral cancer cells.

Keywords: Arecoline, Bacopaside-I, Mitophagy, NLRP3, inflammasome, Oral cancer

COMPARATIVE PHYTOCHEMICAL ANALYSIS OF *CURCUMA LONGA* L. AND *CURCUMA CAESIAROXB.*

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ABSTRACT

Present study focuses on comparative phytochemical analysis *Curcuma longa* L. and *Curcuma caesia* Roxb. as both species have a great medicinal value. The phytochemical analysis of *Curcuma longa* L. revealed the presence of alkaloid, glycoside, saponin & carbohydrate in it and analysis of *Curcuma caesia* Roxb. showed the presence of alkaloid, phenolic compound, flavonoid, saponin, glycoside & carbohydrate. The GC-MS analysis of methanolic extract of *Curcuma longa* L. and *Curcuma caesia* Roxb. was carried out. Bioactive compounds like 9-Tricosene (Z), 1-Undecene & 1-Heptadecene, which are found in *Curcuma longa* L., have strong medicinal properties and bioactive compounds like octanol and oleic acid are the reason behind anti-microbial and anti-inflammatory activity of *Curcuma caesia* Roxb. Functional groups like N-H, O-H, C-a”C, C=O, C=C, C-H, C-F, C-O-C, =C-H, C-O, Ca”N, =C-H are present in both turmeric extracts, which can be proved useful in medicinal purpose.

KEY WORDS: Comparative, Phytochemical, GC-MS analysis, *Curcuma longa* L., *Curcuma caesia* Roxb., Medicinal property

THERAPEUTIC IMPORTANCE OF SOME ORCHIDS OF ODISHA AND THEIR CONSERVATION

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ABSTRACT

Odisha in the east coast of the Indian subcontinent lying in between 170 48'-220 94'N latitude and 81024' - 87029' E longitude is an abode of healing herbs which are being used in Indian system of medicine viz., Ayurveda, Siddha and Unani. Due to varied topographic conditions and varied range of microclimatic conditions Odisha enhouses around 650 species of plants having high medicinal value. The medicinal plants include several groups of plants like dicots, ferns, orchids etc. of which orchids of high medicinal value deserve special mention being the rare and special group among the plant kingdom. Orchids are used in curing several diseases and they play a pivotal role in health care programmes. Many orchids possess antimalarial, antibacterial, antiviral and even anticancerous properties. These therapeutic properties in medicinal orchids are attributed to a variety of phytoconstituents like alkaloids, flavonoids, terpenes etc. (Misra, 2004). In the remote past, Odisha had thick forest coverage of about 43.42% as against the total landmass. But during the recent times the forests are fast shrinking due to severe pressure in terms of rapid march of urbanization, clear off of forest lands for paddy cultivation, pisciculture, industrial complexes, human settlement etc. Hence this is the high time to conserve medicinal plant resources especially medicinal orchids for posterity. The existing forest coverage provides ideal abode for the tribals. In Odisha different tribal groups such as Bonda, DongariaKondha, Juang, Saora etc. are living in small pockets in harmony with nature by utilizing different plants and plant products. The study of plants in relation to primitive people constitutes an important branch of botany known as "Ethnobotany" and medicine is one of its facet. The mountainous forests of the Deomali hills, Gandhamardan hill range, Mahendragiri hills, Niyamagiri hill range, Malyagiri hills and Similipal Biosphere Reserve have high degree of biological diversity acting as grand repository of potential medicinal orchids. These forests have been the source of invaluable medicinal plants since the time man realized the preventive and curative properties of plants and started using them for human health care. Unfortunately, the medicinal importance of orchids of this region has drawn least attention

from both the scientific fraternity as well as general populace compared to their role in horticulture field. Orchid species of Odisha like *Acampe carinata* (Griff.) Panig., *A. praemorsa* (Roxb.) Blatt. & Mc Cann, *Geodorum recurvum* (Roxb.) Alston, *Habenaria marginata* Coleb., *Rhynchostylis retusa* (L.) Bl. and *Vanda testacea* (Lindl.) Rehb.f. are used to cure rheumatism, arthritis, dysentery, asthma and snake bite etc. However, the medicinal potentialities of these orchids are not so well exploited though they possess immense curative values. Further, as the forests of Odisha are experiencing various anthropogenic as well as abiotic pressures, many of the orchid populations are fast shrinking leading to their mass depletion. Realizing this, a study was carried out resulting in 26 medicinal orchids very often used by the tribal populace of Odisha like Bonda, Dongaria Kondha, Juang, Saora etc. to get relief from various ailments.



KITCHEN WASTE TO HYDROGEN, AN ALTERNATE OF FUEL ENERGY FOR THE FUTURE

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The kitchen waste is disposed in landfill or discarded which causes public health hazards and diseases like malaria, cholera, typhoid etc. So, to overcome this challenging situation, a new technique is introduced in Pune. The new facility will solve two major problems: Inefficient waste management and carbon emissions. With this project, Pune city can reduce up to 2.5 million tonnes of carbon dioxide equivalent, over 3.8 million tonnes of waste would be diverted from landfill/dumping site and more than 180000 estimated households will be served directly. Kitchen waste is organic material having the high calorie value and nutritive value to microbes. Methanogens (methane producing bacteria) degrade organic material in the absence of oxygen and hence generates mixture of gases. The gas produced is mainly Methane, which is used as Biogas and can replace fossil fuels. And from this methane, using steam-methane reformation, hydrogen can be obtained. Here, methane reacts with steam under pressure in the presence of a catalyst to produce hydrogen. It is an endothermic process. This hydrogen then can be used in transport as a fuel, power generation industries like refining petrol, manufacturing steel etc. This will bring a great revolution in waste management system and Fuel energy sources in India.

Keywords: Kitchen waste, Hydrogen, Methane, Waste, Fuel

COMBINING FERMENTED RICE-BASED HANDIA WITH ETHNOMEDICINAL PLANT EXTRACTS FOR NUTRITIONAL ANALYSIS AND MEDICINAL PURPOSES

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ABSTRACT

Tribal people in Mayurbhanj district of Odisha like to drink rice beer, which is also known as Handia. The purpose of this study is to record the traditional knowledge of the ethnic people of Similipal, Mayurbhanj district, about how to make handia, a fermented cereal-based food, as well as to test it for microbiology and nutrition. In turn, it changes their social, cultural, and economic lives. Following old information, it is made in almost every third house. Twenty different plant species' parts are used to make ranu or bakhar pills, which are used as starter cultures to make handia. After cooking, rice is fermented with the right amount of bakhar tablets for a certain amount of time. Most of the germs that are involved in fermentation are lactic acid bacteria and yeasts. The pH of the drink is 3.97 ± 0.91 , which is sour. The drink is made up for by the low cost (Rs. 7/- per L), which is very important for poor tribal people. It has a lower alcohol level ($1.22 \pm 0.97\%$), So even after drinking it several times, it doesn't make the people drunk. It helps to hydrate the body and to restore the water it loses when poor people work out hard, especially in the summer.

Keywords: Handia, Bakhar pills, Plant ingredients, Traditional processing, Nutritional Analysis

ETHENO BOTANICAL STUDIES OF SOME NON-CULTIVATED MEDICAL PLANT: THEIR USES BY THE TRIBALS OF KANDHAMAL (ODISHA) WITH SPECIAL REFERENCE TO CLIMATE FACTOR AND ITS CONSERVATION PRACTISES

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The District of Kandhamal (Odisha) is mostly predominate with hilly region and with special climatic condition like rainfall, chilly winter & moderate summer that prevails through out the year. Within the hilly region the tribals like Kutia, saora, Shabar, Oraon, Santal are living & they are mostly depends upon the local growing plants for their food, nutrition & medicines.

Till to-today it has been observed that for various types of disease viz:- Malaria fever, stomach problem, Amenorrhoea, rheumatism skin diseases, snake bite, dysentery, Anti-fertility, Asthma, leukomia, cold & cough etc.

The wildy growing some tress, herbs, shrubs have been observed to be mostly used by the tribal for various ailments viz:- cassia sps., Bauhinia sps., Aloe vera (Ghea kuanri), Cinchona Sps., Datura Stramonium L., Gloriosa Superba L., Piper Longum, Azadirata Indica A. juss, Rawolfia Serpentina (Patal Garuda), Papaver Somniferum, Ocimum sanctum L. (Tulasi), Nyctanthes arbor-tristis, Linn (Gangasiuli), Tylophora Sps., Embelica Officinalis, Bacopa Monniera (Brahmi), Marmelos (Bela), Abrus Precatoricus (Kaincha), Calotropis Gigantia (Arakha), Derris Indica (Karanja), Hyptis suaveolens L. (Banatulasi), Rhizophora mucronata L. (rai) etc.

Till date the research activities are not fully conducted to derive the active principle lies within the wildy grown plants, herbs etc. growing in & around hill region of Kandhamal w.r.t climatic conditions prevails within the year.

The plants parts these are being used by the tribes of Kandhamal belongs to family viz:- Fabaceae, Asteraceae, rubiaceae, Malvaceae, Solanaceae, Convolvulaceae, etc.

The trend of using herbal products as health care system, nutrition etc. by the tribals are still ignorant about the active principal lies within those plant parts & how those can enrich high degree of health care system within the body parts & blood plasma etc.

Now-a-days it has been marked that due to various reasons those valuable plants are being cut down & being exploited by the unscrupulous people for their betterment self interest like agricultural practices, for built up their houses, to get fuel, land acquire etc.

Also it has been marked that day-by-day many plants those which are provided with several medicinal ingredients are being extincted/vanished from those hilly region in the reason of road development and flourishing of town area & in some way due to lack of proper protection facility & knowledge by the local tribes. So the researchers have to look for developing scientific methods of preservation/conservation without any deteriorating effect on ingredients of the plant parts.

Regarding the conservation of these value based medicinal plants growing within tribal areas of Kandhamala district, it is utmost important that those have to be cultivated & propagated without going for indiscriminate cutting/exploitation. It has been necessary to emphasise a genetic improvement of plant sps. so that propagation of those medicinal value plants sps. by improvement in plant breeding method, by studying their genetic diversity with spl. reference to soil & climatic factor.

Following policies are needed to be undertaken both by Govt. level, ethnobotanist with active participation of for restoration, propagation in large scale for carrying out the preservation of plant parts for studies the active principle w.r.t medicinal aspects for local people.

- a) To Establish an inventory of those hilly region growing plants with medicinal prop.
- b) Promote the knowledge & practices of ex-situ conservation measure.
- c) Govt. support with scientific manpower to be provided to carry out details study & conservation practices for better health care facilities.
- d) Ban on indiscriminate exploitation of plants with medicinal properties from the dense/wild forest area.
- e) To create wide spread awareness on the need for medicinal plant conservation.
- f) To establish a long term research activities so as to establish the fact on which the local tribes get their benefits on health care purpose.

TRADITIONAL USE OF SOME NATURALLY GROWING MEDICINAL PLANT USED BY THE TRIBALS OF SUKINDA VALLEY IN JAJPUR DISTRICT, ODISHA AND THEIR NEED FOR CONSERVATION

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Sukinda the Chrome valley is situated at the Western part of Jajpur district, Odisha, Within the thick forest cover. In and around the valley various categories of tribals viz, Kolha, Kondha, Santal, Munda, Saoras are living in the lap of nature and they normally depends upon the naturally growing plant and the plant parts for treatment of various types of ailments throughout year without going for allopathic treatment. After several time of interaction with the local tribes during visit to the area it had been ascertained that they are mostly depends upon the wild growing plants like herbs, shrubs in their forest cover for treatment of various ailments like:- Common cold, cough, Migraine, Sprain, Piles, Gastric upset Jaundice, Miscarriage, oozing out of blood due injury, Bronchitis, Constipation dysentery, Mumps, respiratory disease, sterility problem with women, Gland swelling, Malaria fever etc. In the earlier days when there was no communication facilities & Health Care Facilities like Hospitals with Doctor at that time the local vaidyas with their indepth knowledge they were collecting the plant parts from the medicinal plants of the forest cover and usually treating the tribal people. Here some naturally growing plants herbs and shrubs have been cited below which are carrying medicinal properly and used by the tribes of Sukinds Hilly region very of and on

- a. Aegle marmelos (L) (oriya-Bela) family Rutaceae Cures Abdominal disorder.
- b. Cassia fistula (L) family caesalpinia-ceae (otriya-sunari) used over the affected part of swelling of gland.
- c. Bauhinia variegata L. (Family Caesals-piniaceae) (Oriya-kanchana) here roots used for diabetes problem.
- d. Crateva magna (lour) oriya-Baruna (family- Capraceae) the bark pest is used to reduce inflammation and pain.
- e. Dalbergia sissoo, Rox (Family-Fabaceae) Ory-Sal where the dried bark is used to cure diarrhoea.

- f. Shorea robusta Gaertn. (Dipterocarpaceae) (ory-sal) the dried bark is used to cure blood dystentery.
- g. Syzygium cuminii (L) family-Myrtaceae), (Oriya-Jammu) Bark Juice is given to cure diarrhoea along with leaf juice of basanga (Justicae adhatoda).
- h. Tinospora cordifolia (wild) (Ory Guluchi) The whole plant is pested and tied on the fractured bone and the decotion of the plant with honey is given for fever and headache cure.
- i. Curcuma longa L. (Fam Zingiberaceae) (Oriya-Manjal) the paste of rhizome of plant with neem leaf is applied to heal up the wounds.
- j. Croton bonplandianum Bail. (Eupfemorbiaceae). The roof extract with honey that is taken to stop abnormal bleeding after child birth.
- k. Datura metal L. (fam-solanaceae) (Ory dudura), The roots are worn over waist that inhibits miscarriage in women.
- l. Cleodendeom sps. (L) (Fam-verbenaceae) Applied as remedy for insect bite.
- m. Ficus religiosa L. (Farm Moracee) Juice of tender stem cure toothache.
- n. Mimosa pudica L. (Fami-mimosaceae) Root Pastes, cures scabies and root extract is being taken orally for to cure piles.

Traditional Medicinal Plants and their uses by the tribes:-

Till to day the different method of preparation of drugs and its dosages have remained secret to the outside society. Unfortunately, such valuable knowledges are vanishing day-by-day due to change of or non-exchange of ideas and exposure to modern health care system. Broad spectrum survey, research relating to etheno medicinal properties is to be under taken by the scholars, researcher so as to establish the fact finding report w.r.t. aliments like:- Antidotes, Astringent, Conjunctivites Contraceptives, Dental-care, Dysentry, Skin disorder, Asthma, Bronchitis, Gynic disorder, liver disorder, Cold and cough reheumatism etc.

Need of the Research Work:-

More emphasis to be given for extraction of alkaloid so that detail study can be undertaken by doctors (Ayurvedic) in a Long term basis by taking the knowledge from the local people and the process of their uses of different plant like leaf, bark, stem, fruits, flower, root etc. so that clear complied parts report on etheno botany can be published for better reference of new generation researcher. Also it is need of the time that as the said area is full of mine/mineral resources i.e. chrome Ore, so day-by-day those wild growing medicinal plants will be vanished during extraction process of the chrome ore. So some patches of those hilly area should be well protected and plants bearing medicinal properties to be conserved so as to maintain better ecological environment for our future generation & research work to be carried out.

EFFECT OF ORGANIC COMPOST ON THE ANTIOXIDANT PROPERTIES OF MUNG BEAN PLANT (*VIGNA RADIATA*)

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Plants have been an essential part of scientific study since the earliest studies of life processes began, and they were a central focus of investigation in the nineteenth and early twentieth centuries. It is this research that enriches our intellectual life as well as adds to our knowledge of other biological processes. Additionally, the study of plant systems can provide insight into how to address problems in agriculture, health, and the environment. This study aimed to evaluate the effect of adding organic compost compared with the normal soil on the antioxidant activity of the mung bean plant (*Vigna radiata*). The experiment was arranged in a randomised complete block design replicated three times. At the end of 16 weeks, it was observed that using organic compost enhanced the antioxidant activities in *mung bean leaves and seeds* compared to normal soil. The nitrate content was also reduced under organic compost. The DPPH and ABTS activity were also highest at 90 kg N/ha. The results indicated that using green vegetable compost can improve the antioxidant activity of this plant.

Keywords: *Vigna radiata*; Compost effects; antioxidant activity; Vegetable compost

MECHANISATION'S IMPACT ON AGRICULTURAL TOTAL FACTOR PRODUCTIVITY IN ORISSA

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ABSTRACT

Agricultural mechanisation is rapidly increasing in Odisha and will have an increasing impact on agricultural total factor productivity (TFP) in the future. Studies were conducted in Orissa to estimate the effects of mechanisation on the TFP, technical efficiency and the technological progress, over a period of five years.

The results revealed that the level of agricultural mechanisation can promote TFP. TFP has a cumulative effect in the previous period which can significantly affect TFP in the current period. According to solow's economic growth model, TFP is the residual part of economic growth after excluding such factor inputs such as labour, capital and natural resources. Agricultural mechnisation improves technical efficiency and promotes technological progress but this is not statistically significant. Regional heterogeneity exists in the mechanisation's effect on agricultural TFP, with the largest effect occurring in the group with the lowest TFP.

Therefore efforts to promote the use of agricultural machinery should increase. Odisha's agricultural machinery subsidy policy must further be adjusted and the agricultural machinery research investments increased, while the Government must address the heterogeneity between regions and focus on developing agricultural mechanisation in the central and western regions.

IMPACT OF EMF-RF RADIATION ON PLANTS

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ABSTRACT

EMF-RF radiation is being used in communication system to establish relationship and to send information for long range interactions. Cell phone technology also operates in that spectrum band. With due course of time GSM, WCDMA, LTE, VoLTE etc. new technologies have been evolved with higher bandwidth, frequencies and energies compared to previous ones to bring good resolution in communication world. Recently there is a plan of installing 5G technologies which would be of RF range and also some bands will possess millimeter range of wave. Many countries have opposed its installation that may cause damage to electronics system, birds and ecosystem. Higher energy will show ionization effect on plant cells and oxidative stress. Less number of literatures has been found with improper study on this field. In present study seed germination, plant growth, biochemical parameters, oxidative stress extents have been well studied in a well-designed chamber what merely allows radio waves to be reflected or interfere from the outside. Seeds of Mung beans (*Vigna radiata*) have been irradiated with RF waves in 4G range at 2.23-2.45 GHz in different time periods and doses to confirm its effect on germination, growth and seedling biochemistry after post growing it in plant growth chamber. Growth parameters have been found to be reduced to 30% in irradiated ones than control ones. The higher dose and time period show greater impact than lower ones. Biochemical parameters have been found to be altered. Chlorophyll synthesis was hampered. MDA, H₂O₂ content were increased with substantial increase in activities of antioxidant enzymes like SOD, POD, APX and GR etc. There was found clear cut evidence of oxidative stress and growth retardation in plants due to RF stress.

Keywords: EMF-RF, GHz, 5G, Green house, Oxidative stress.



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