



45th



**Annual Conference of
Orissa Botanical Society**

&

**National Seminar on
Biotechnological Approaches for Mitigating Climate Change**

December 10-11, 2022

ABSTRACT-CUM-SOUVENIR



**Udayanath (Auto.) College of Science & Technology
Adaspur, Cuttack-754011**

**ANNUAL CONFERENCE OF
ORISSA BOTANICAL SOCIETY
&
NATIONAL SEMINAR
ON
BIOTECHNOLOGICAL APPROACHES FOR
MITIGATING CLIMATE CHANGE**

ABSTRACT-CUM-SOUVENIR

**Udayanath (Auto.) College of Science & Technology
Adaspur, Cuttack-754011**



Prof. Ganeshi Lal
Governor, Odisha

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ରାଜ୍ୟପାଳ, ଓଡ଼ିଶା



Raj Bhavan
Bhubaneswar-751008

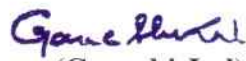
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MESSAGE

I am glad to know that the Department of Botany, Udayanath Autonomous College of Science & Technology, Adaspur, Cuttack is hosting the 45th Annual Conference of Orissa Botanical Society (OBS) along with a National Seminar on the topic “Biotechnological Approaches for Mitigating Climate Change” on December 10-11, 2022.

Orissa Botanical Society is a vibrant interactive forum contributing immensely to the study and promotion of research in the field of Botany in the State. A national seminar during the Annual Conference has witnessed enthusiastic participation and productive deliberation. The present seminar would be concentrating on mitigating climate change with biotechnological approaches and this is viewed with great optimism. I commend the endeavour and I am sure the deliberations would be enriching and enlightening and OBS would continue to be at the forefront in dissemination of knowledge and utilization of advanced technologies.

I wish the conference & seminar all success.


(Ganeshi Lal)



Trilochan Kanungo

Founder, President Governing Body
U.N. Autonomus College of
Science & Technology



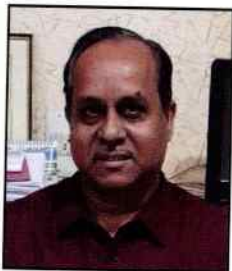
MESSAGE

It is heartening to learn the Orissa Botanical Society is organizing the National seminar on the topic " Biotechnological Approaches for Mitigating Climate Change" on 10th& 11th December, 2022 in U.N. Auto. College of Science and Technology, Adaspur. I wish a great success of the seminar & meetings of the Botanical Society. U.N. Auto. College of Science and Technology shall be glorified by such gathering in its campus. This is the second occasion for hosting national seminar by the Department of Botany of our college.

I convey my greatest salutation to all the participants.

Thanking you all

T. Kanungo
Trilochan Kanungo



Prof Arun Kumar Nayak
Principal
U.N. Autonomous College of
Sc. & Tech.
Adaspur, Cuttack

MESSAGE

I am very much glad to announce that our college is hosting the National Seminar-cum-Annual Conference of Orissa Botanical Society which is organized by the Department of Botany on 10th & 11th December, 2022. I am delighted to know that the seminar will focus on "Biotechnological Approaches for Mitigating Climate Change". I welcome all the Resource persons, Scientists, Researchers & Delegates from different corners of the country to this conference.

I hope the outcome of the conference will be highly beneficial for our students and researchers. I wish a grand success of this event.


11/12/22
Prof. Arun Kumar Nayak



Prof R.C. Mohanty
President
Orissa Botanical Society
Bhubaneswar



MESSAGE

We are happy that the U.N Autonomous College of Science and Technology, Adaspur is organizing the 45th Annual conference of Orissa Botanical Society and a National seminar on "Biotechnological Approaches for mitigating climate change" during December 10-11, 2022 in the college premises.

On this occasion a Souvenir-cum-Abstract is being released by the Chief guest Prof. Trilochan Mohapatra, Former D.G., ICAR and Secretary, DARE, New Delhi in presence of S.J. Trilochan Kanungo, President of the College Governing body and Former M. P. and Prof. Arun Kumar Nayak Principal of the college.

U.N. College, Adaspur is a lovely place with a huge campus of well designed and beautiful terrain of buildings, long swimming pool and a wonderful repository of picturesque plants in Botanical Garden and above all with affectionate members of Faculty and Students.

I wish all success of the conference and of proceedings including the publications.


Prof R.C. Mohanty

POTENTIALITY OF WILD AND UNDERUTILIZED CROPS OF KORAPUT FOR TRIBAL FOOD AND NUTRITIONAL SECURITY UNDER CHANGING CLIMATE

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ABSTRACT

Indigenous and wild crop resources play an important role in global food and nutrition security and also potential resources for sustainable food systems under climate change. Koraput district of Odisha is a part of Eastern Ghats in India, a hotspot of agro-biodiversity. The plant genetic repository of the region is of great significance in the global context, and Koraput is notably one of the centers of diversity for many food crops and forest species. Recently, Koraput has been declared by Food and Agriculture Organization (FAO) as the global agricultural heritage site. Historically, tribal and rural people identified and collected plants for food and medicine from forests and developed a range of processing methods in accordance with their needs. With modernization and settled agriculture, this knowledge is getting lost, a trend that may lead to decreased diversity of indigenous diets and poorer nutrition. 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. The aim of this study is to chronicle the nutritional value of selected neglected and underutilized crop species of Koraput. Though these are useful plant species for marginalized farmers but are largely ignored by researchers, breeders and policy makers. Therefore, this study highlighted the nutritional and climate-resilient traits of selected neglected and under-utilized crop species for conservation and further utilization. Mass consumption, commercialization and bio-prospecting of these valuable resources would be an appropriate approach for ensuring food and nutritional security of future generations in the era of climate change.

Keywords: Agro-biodiversity, Hotspot, Climate-resilient trait, Indigenous diet

PHYTOREMEDIATION POTENTIAL OF *Azolla pinnata* R.Br. AND *Salvinia molesta* MITCHELL TO REMOVE CHROMIUM FROM WASTEWATER

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ABSTRACT

The process of phytoremediation by using aquatic plants is a new, low cost and eco-friendly method for improving water quality and waste water. In the present study the ability of *Azolla pinnata* R.Br. and *Salvinia molesta* Mitchell to uptake Cr (VI) from aqueous environment as well as their potential application for phytoremediation were assessed. During 15 days of the experiment, the ferns were grown on the nutrient solution containing hexavalent chromium ions, each in a concentration of control, (0.0 mg/l), 0.07, 0.09, 0.11 and 0.13 mg/l. The biomass productivity and relative growth of *Azolla pinnata* were increased and in case of *Salvinia molesta* it was decreased with increase in the metal concentration of the treatment medium. After 15 days of treatment, the concentration of Cr (VI) in the medium decreased between 72.86 - 97.69 % and 75.71 - 90 % by *Azolla pinnata* and *Salvinia molesta* respectively. Both the fern took a lesser quantity of metal from 0.07 mg/l treatments compared to 0.09 mg/l, 0.11 mg/l and 0.13 mg/l treatments. In the *Azolla pinnata* tissue the concentration of heavy metal under investigation ranged from 0.106 - 0.216 mg/gm dry weight and for *Salvinia molesta* ranged from 0.094 - 0.321 mg/gm dry weight. Increasing concentration of Cr (VI) in the growth medium increased the bioconcentration factor of *Azolla pinnata* and *Salvinia molesta* up to an optimum value of 1630.76 and 2469.23 respectively. In the present study the higher BCF of *Salvinia molesta* Mitchell shows that it is a better candidate for phytoremediation of Cr (VI) from the treatment solution than *Azolla pinnata* R.Br. Overall results indicate that *Azolla pinnata* R.Br. and *Salvinia molesta* Mitchell can be used for phytoremediation of Cr (VI) from polluted water as it is a low-cost method satisfying the discharge standards.

Keywords: Phytoremediation, *Azolla pinnata*, *Salvinia molesta*, Cr (VI)

PRESENT SCENARIO OF DELETERIOUS EFFECT DUE TO THE LONG TERM EXPOSURE OF METALLIC POLLUTANT CHROMIUM ON PLANTS, SUKINDA VALLEY, ODISHA

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ABSTRACT

Chromium, a prominent carcinogen found in different oxidation state in the environment because of its high redox potential and valence shell chemistry. Chromite mines of Sukinda Valley produce around 334 million tons of chromium annually and this Valley of Jajpur district, Odisha has become a "Valley of Misery", despite its huge economic contribution to the country. A comprehensive production of different forms of chromite ore has made it a contamination prone region due to the deposition of an unacceptable amount of chromium in to the natural environment. The Cr[VI] and Cr[III] are two most lethal state of chromium that gets access to plants via mineral intake and other means. The trivalent form (Cr[III]) can infiltrate into plant tissues interrupting different cellular activities by attacking proteins, DNA and membrane lipids. It also hampers the plant growth by damaging the metabolic processes and produces reactive oxygen species which accelerates the stress condition when exposed to the plants tissues. The hexavalent chromium Cr[VI] supresses the development of cotyledons and inhibits root-shoot elongation as well. The detachment of plasma membrane from cell wall and reduction in chlorophyll and carotenoid levels in the plant also results from its long term exposure. Till now there is no proper estimation of the extent at which the plants are being affected by such heavy metals which ultimately deteriorates the crop productivity without any constraints. This study focuses to bring forth certain preventive measures to compensate the deleterious effect of chromium ions induced on the plants, hampering the productivity.

Keywords: Chromium, Sukinda Valley, Plant Productivity, Exposure

INVENTORIZATIION/DOCUMENTATION OF *Diploneis ehrenberg* EX. CLEVE FROM THE BHITARAKANIKA NATIONAL PARK OF ODISHA, INDIA

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ABSTRACT

Mangroves are one of the most extraordinarily diverse evergreen estuarine open ecosystems, formed by a variety of salt tolerant species growing in the inter-tidal areas and estuary mouth. They can provide critical habitat for a diverse marine, brackish and terrestrial flora and fauna. They act as nutrient sinks and protect offshore ecosystems and often referred to as bio-shields or natural sea defence. Bhitarkanika is the second largest mangrove ecosystem of India consist of mangrove forests, river deltas, creeks, estuaries, backwater, accreted land and mud flats. The report on algal diversity research from Bhitarkanika is scanty and no significant work on diatom taxonomy is available from this area. As, *Diploneis* taxa a peculiar diatom genus of family Diploneidaceae have a very complex ultrastructure and are very difficult to interpret accurately, the present investigation being the first attempt was made to examine the ultrastructure of some brackish water *Diploneis* taxa through scanning electron microscopy (SEM) from the Bhitarkanika mangrove ecosystem. Samples were collected randomly from different niches of mangrove sediments, mud surfaces, attached to pneumatophores during November-December 2018 from some selected sites within Bhitarkanika Wildlife Sanctuary and National Park viz. Khola, Dangmal, Kalibhanjadian, Bhitarkanika, and Ragarapatia. Detailed light and scanning electron microscopy were carried out to ascertain the identity and to ensure the enumeration of the genus *Diploneis* at species and variety levels together with comparison to morphologically related species. As a result, 10 *Diploneis* taxa were reported from Bhitarkanika as follows; *Diploneis weissûogii*, *Diploneis duplopunctata*, *Diploneis stroemii*, *Diploneis interrupta*, *Diploneis puella*,

Diploneis subovalis, *Diploneis smithii*, *Diploneis dilatata*, *Diploneis mereschowskyi*, *Diploneis cf. notabilis*. Greater knowledge of the genus *Diploneis* will pave the way for better understanding and more comprehensive approaches of uncovering diatom diversity of this area.

Keywords: Inventorization, Sem analysis, *Diploneis*, Bhitarkanika.

DIVERSITY OF PARASITIC PLANTS OF ODISHA

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ABSTRACT

Among the plant species, parasitic plants always show uniqueness with their habitat and ecological significance. Approximately, 1% of all angiosperms are parasitic on other plants, and these plants are distributed among 28 dicotyledonous families. They are still unexplored plant species. Keeping in view, the gaps in the science of parasitic plants, in the first phase, we are studying their diversity and distribution in certain districts of Odisha. Sundargarh, Mayurbhanj, Cuttack and Khordha districts are selected for the study. A random survey was carried out using line transect (1 km x 20 m). Results revealed that out of the four (4) Parasitic plants studied, *Dendrophthoe falcata* showed the highest diversity followed by *Cuscuta reflexa*, *Cassytha filiformis*, and *Viscum articulatum* in the above-selected districts of the state. It was noticed that *Mangifera indica* & *Shorea robusta* are the main host of *Dendrophthoe falcata*, *Shorea robusta* is the main host of *Viscum articulatum*, *Vitex negundo* is the common host plant of *Cuscuta reflexa* & *Cassytha filiformis*. The medicinal values of these studied species are gathered. Further, phytochemical screening is going on to evaluate their pharmacological potential.

Keywords: Parasitic plants, Ecology, Medicinal uses, Sundargarh, Mayurbhanj, Cuttack, Khordha

INTERACTIVE EFFECT OF AMF AND PGPR INOCULATION TO COUNTERACT HEAVY METAL TOXICITY IN PLANTS

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ABSTRACT

Several anthropogenic activities mediated heavy metal pollution posing detrimental impact on environment thereby imparting serious threats to the living organisms. It influences the researchers to develop alternative novel aspects to abate the negative impact of heavy metal toxicity. Interestingly, the use of microbes can improve abiotic stress tolerance in plants which is proven to be sustainable and eco-friendly approach. Interaction of plants with soil microorganisms play vital role in acclimatizing the plants to metalliferous environments through microbe-assisted metal tolerance. Arbuscular mycorrhizal fungi and plant growth promoting rhizo-bacteria (PGPR) are some of those microbes which can be used to facilitate the process of heavy metal tolerance by reducing metal absorption in plant tissue and also help to reduce metal bioavailability in soil through various mechanisms. Some of mechanisms highlighted for reducing heavy metal toxicity are toxic metal sequestration by cell wall components or metal binding protein, alteration of biochemical pathway to block metal accumulation, conversion of metals to nontoxic form by the help of enzymes etc. A better understanding of detailed mechanism involved in microbe mediated heavy metal toxicity tolerance is needed to resolve the current issue which can open up prospects for better growth and development of plants in metalliferous environment.

Keywords: AMF, PGPR, Heavymetal toxicity, Metaliferous environment

BIO-INDICATORS OF HEAVY METAL POLLUTION

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ABSTRACT

Heavy metals and oil products released in to environment from specific industrial activities, mining operations and fuel combustion. Heavy metals are not decomposed and therefore continuous inflow of heavy metals results in their accumulation thereby causing growth troubles. The term bio-indicator is used for organism associates that respond to pollutant load with changes in vital functions or that accumulate pollutants. Soil pollution bio-indicators are essential to establish environmental standards. Different heavy metals have different bio-indicators which show their presence in the soil. The moss species *Eurhynchium proelium* is the bioindicator for Zn, Cu, Ni, Co, Fe. Bioindicator can be used for direct determination of the pollutant effect and make possible the study of the effect of multiple pollutants on an organism. The early recognition of pollutant damage to plants as well as toxic damages to humans can be studied. Bioindicators are generally are less expensive as compared to technical measuring methods. Bryophytes can indicate the presence of elements and their concentration gradient. Mosses and lichens are the most effective biomonitors at low and moderate depositions. Fungi can also be used as bioindicators such as *Mucor sp.*, *Aspergillus*, *Trichoderma*, *Mortirella* sp. are the most common flora in polluted industrial zones. It can also grow in presence of mercury (Hg). Higher plants act as biomonitors in the assessment of heavy metal contamination due to their bio-accumulative properties where lichen and mosses are absent. Plants also demonstrate morphological and physiological responses to heavy metal pollution, some of which may be utilized in bioindication. Hence plants are good bio-indicators in the present scenario.

Keywords: Heavy metals, bio-indicators, pollutant load, Moss sps, Fungi

AERATION DEPENDENT VIABILITY OF FUNGAL PREPARATION FOR DEGRADATION OF ORGANOPHOSPHORUS INSECTICIDES

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ABSTRACT

Amongst organophosphorus (OP) insecticides, malathion is a broad-spectrum non-systemic chemical used to control agricultural pests. It is effectively degraded by a variety of bacterial strains but no fungal preparation is available for field application. *Aspergillus niger* MRU01 was developed on enrichment and grown in Czapek Dox medium with 1 mMol malathion and was harvested on filtration (Whatman No. 1) after proper sporulation. The fungal preparation was made by mixing aseptically air dried fungal mass (hyphae and spores) with sterilized and dry coir pith at a ratio of 3: 97. The preparation's viability was tested in both aerated and non-aerated-packaged conditions on every 15 days up to 60 days, and its efficacy was tested at 500 µM of an insecticide. The fungus showed better growth efficiency (dry and fresh weight) and high enzyme activity. All four insecticides (malathion, parathion, dimethoate and chlorpyrifos) were degraded by the preparation, though at different rates. The aerated samples had higher viability and degrading activity than of the non-aerated samples. This demonstrates that aerated preparations are preferable for long-term storage.

Keywords: *Aspergillus niger*, Malathion, Arathion, Dimethoate and Chlorpyrifos

BIOREMEDIATION OF CHROMIUM THROUGH PLANT-MICROBE INTERACTION FORM MINE OVERBURDEN DUMPS OF SUKINDA VALLEY

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ABSTRACT

Environmental pollution due to indiscriminate discharge of hazardous and harmful wastes containing toxic heavy metals at elevated concentrations from mining sites and industries has been a growing concern all over the world. Hexavalent chromium is mobile, highly toxic and considered as a priority environmental pollutant. Chromium resistant bacteria are known to catalyse the reduction of Cr(VI) to Cr(III) and different chromate reductases such as ChrR, YieF, Nema and LpDH have been identified from these sources which are located either in soluble fractions (cytoplasm) or bound to the membrane of the bacterial cell. Microbes present on the rhizospheric zone play an important role in catalytic reduction of Cr with the help of plant-microbe interaction. For the experiment, Lemongrass (*Cymbopogon flexuosus*) and Vetiver grass (*Chrysopogon zizanioides*) species has been used. These species had oil yielding capacity and we have compared the bioactive compounds with control plants and the presence of different compounds is in lesser percentages. This is a greener and safer technology and can be implemented as value addition and economically viable (from the grasses, we can extract oils and generate revenue. The fibrous root system helps to reduce the leaching and enhance the accumulation of heavy metals. The microbes and their association with plants will provide new improved processes in future.

Keywords: Environmental pollution, Hexavalent Chromium, Microbes, Rhizospheric zone, Plant-Microbe interaction, Bioactive compounds and Fibrous root system.

EMERGENCE OF PUBLIC HEALTH THREAT MICROBES DUE TO CLIMATE CHANGE

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ABSTRACT

Climate change afflicts all aspects of ecosystem including plants, animals, humans and microbes. The human pathogen, *Candida auris* has emerged as a drug resistant species simultaneously in three continents – India, South America, South Africa since 2009. The mechanisms responsible for simultaneous emergence of three distinct clades in three different geographically distinct regions are unexplained. The contributory cause is suggested to be wide spread use of antifungals like azole drugs. But, the acquisition of drug resistance alone is unlikely to confer pathogenicity since reduced susceptibility to drugs and virulence are different properties as evidenced earlier. In comparison to plants and other animals, mammals are resistant to fungal infections as they have high basal temperature which thereby creates a thermal restriction zone and advanced host-defense mechanism in the form of adaptive and innate immunity. The human induced global warming reduces the magnitude of the gradient between ambient temperature and mammalian basal temperature that leads to development of thermo-tolerant fungal lineages which can breach the mammalian thermal restriction zone. Many non pathogenic fungal species are likely to have the necessary virulence attributes by virtue of their survival and cause diseases with respect to climate change. Studies revealed that *C. auris* was an environmental fungus, first recovered from human ear which is much cooler than core body temperature and is capable of growing at high temperature. Other contributory factors such as over expression of HSP 90 may account for its multidrug resistance, virulence, thermal and osmotic stress tolerance. Therefore, intense research with greater vigilance and continuous monitoring is required to restrict the evolution of thermotolerant microbes like *Candida auris*, also to predict the future outbreaks and to adopt effective control strategies.

Keywords: *Candida auris*, Global warming, Thermo tolerant, Drug resistance

CROP PRODUCTION SUSTAINABILITY AMIDST CLIMATE CHANGE

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ABSTRACT

Sustainable agriculture is the process of farming to meet the needs of existing & future generation along with restoring environmental health & maintaining the social & economical equity. The practices of crop rotation, use of natural fertilizer not only benefits air quality but help to preserve earth's natural resources. When agricultural operations are sustainably managed, they can preserve & restore critical habitat, protect watershed, improve soil health & also improve water quality. The biggest threat to agricultural sustainability is the climate change. Statistically, approximately 5% decline per decade in crop yields, which is a direct result of heat, weather volatility, drought, super storms, insect infestation, flooding & seasonal changes. All the above changes are might be due to global warming. To meet with the above changes climate smart agricultural practices is the best way. It is much more efficient as it involves the application of sensors & automated irrigation that helps to monitor agricultural land, temperature, soil moisture etc. Climate smart agriculture is an integrated approach with three important outcomes like increased productivity, enhanced resilience & reduced emission. Now the World- Bank group is currently scaling up first Action plan (2016-2020) & the forthcoming update covering (2020-2025). The World- Bank backs researcher to develop smart technologies, management methods, early warning systems, risk insurances & other innovations. Overall aim at conserving soil moisture, retaining crop residues for soil fertility, disturbing the soil as minimally as possible intercropping & reducing the emission of green house gases. Aeroponics & hydroponics can also be practiced for future food securing programme amidst climate change scenario.

Keywords: Climate smart agriculture, intercropping, Aeroponics, hydroponics

GLOBAL CLIMATE RISK INDEX: A RESCUE FOR MARINE LIFE

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ABSTRACT

Factor affecting climate change such as increase in temperature, change in pattern of rainfall and variation in solar activity affects marine life. Warming up of oceans and unsuitable climatic conditions cause marine species to shift to milder geographic locations favorable for their growth and development and change their behavioral pattern. Gene expression varies within a species throughout the distributional range as a function of temperature but the variation may not follow simple latitudinal clines. Genetic selection under environmental forcing can lead to rapid shift in allelic frequencies in populations of short-lived organisms. Global climate risk index is a measure to what extent countries have been affected by weather related loss; annually released by German watch. Research published in "Nature climate change" assumed that 90% of the total 25,000 estimated species of marine ecosystem would be at a higher risk by 2100 if high emissions continue. Increasing CO₂ and atmospheric temperature may increase phytoplankton growth rates, but at the same time, may lead to physiological responses that render cells more susceptible to UV damage. The variation at pH may also interfere with ion exchange, depressing metabolism and reducing thermal tolerance. Animals and plants are weakened by accumulation of PCBs (Polychlorinated biphenyls). Climate Smart Management (CSM) and conservation strategies are needed to ensure the effective stewardship of living resources now and in the future. Climate vulnerability maps critical susceptibility and plan strategies to ensure resistance and adapt by climate proofing economic and infrastructure. It is evaluated on a scale of 0 to 1, which corresponds to species location where sensitivity is highest and adaptivity is at its lowest.

Keywords: Gene expression, Genetic selection, Allelic frequencies, Polychlorinated biphenyls, Climate Smart Management, Climate vulnerability, Adaptivity

SEAWEED: A BOON TO MITIGATE MARINE DEFORESTATION

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ABSTRACT

The tropical marine & coastal ecosystems are rich in biodiversity & represent some of the most productive resources for human life including coral reefs, mangroves, sea grass beds, sandy marine & estuarine environments. The aquaculture of finfish, crustacean, shellfish & seaweed is one of the fastest growing food sectors on the planet. The seaweed aquaculture demonstrates the fastest growth (8% per year). Sea weeds are cultured primarily for food, medicine, cosmetics & bio-energy, with little large scale strategic use of seaweed farming for explicit carbon offsetting-bio-fuel being the closest precursor to such an industry. However, interest in using seaweed aquaculture to combat GHG emissions is increasing. It is evidenced that 132 countries have likely suitable nutrient levels, but only 37 are currently producing, seaweeds. Notably several large GHG emitters, such as the United States, have no measurable seaweed aquaculture production. Notably strategic placement of seaweed production in highly nitrified waters could potentially reduce risk of diverting energy away from the wild ecosystem & instead improve water quality. Macro algae are invaluable constituents of marine forest environment & important source material for human needs. However they are currently at risk of severe decline due to global warming & negative anthropogenic factors. The restoration of macro algal environment is possible due to artificial seaweed reefs (ASRs). ASRs now play a critical role in marine forest formation, as they support the establishment of submerged aquatic vegetation beds that allow ocean macro algal afforestation. ASRs have evolved in terms of complexity & the materials used; they can sustainably mitigate marine deforestation. Many ASR projects have been launched in the USA, Japan & Korea; the ASRs have various shapes, sizes & they are constructed from different materials.

Keywords: Seaweed aquaculture, Carbon offsetting-bio-fuel, Macro algae, ASRs, Ocean macro algal afforestation, Marine deforestation

PHYCOREMEDIATION OF PAPER MILL WASTEWATER BY WASTE GROWN MICROALGAE

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ABSTRACT

Microalgae have gained a lot of attention in recent years because of their possible use in pollution management. They can be cultivated in unproductive habitats like nutrient rich wastewater as microalgae require high amount of nutrients for their growth that helps to reduce the pollution load from the environment. During this study six waste grown microalgal species, viz. *Limnothrix planctonica*, *Hapalosiphon hibernicus*, *Scytonema hoffmanii*, *Dolichospermum affine*, *Oocystis polymorpha* and *Tetrademus obliquus* sourced from different wastewater habitats were utilized for remediation of wastewater collected from effluent treatment pond (ETP) of Emami Paper Mill, Balasore. To measure efficiency of wastewater utilization, the physico-chemical parameters of standardised wastewater were ascertained before and after utilization by all the test algal species under controlled culture condition in laboratory. The phycoremediation results revealed that *H. hibernicus*, *O. polymorpha* and *L. planctonica* played better role for removal of pollutants from wastewater followed by *T. obliquus* and *S. hoffmanii*. *H. hibernicus* showed better performance by completely removing (100%) colour, turbidity, iron and phosphate from the wastewater. pH was corrected to normal after treatment by all the test algal species except *S. hoffmanii*. Moreover, the cyanobacterial species were found to be more efficient in removal of nutrients like nitrate, silica, potassium and sodium as compared to green algae.

Keywords: Microalgae, ETP, Phycoremediation, Cyanobacteria

REMOVAL OF POLLUTED RADIOACTIVELY CONTAMINATED SITES THROUGH PHYTOREMEDIATION TECHNOLOGY

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ABSTRACT

The environment was adversely affected by nuclear weapon testing, installation leaks, waste disposal, and unexpected nuclear accidents like Chernobyl in 1986 and Fukushima in 2011. The two main medium-lived fission products that comprise majority of the radioactivity of spent nuclear fuel after cooling for several years, maybe up to several hundred years after usage are, ¹³⁷Cs (Cesium, $t_{1/2}$ 30.17 years) and ⁹⁰Sr (Strontium, $t_{1/2}$ 28.8 years). The majority of conventional, non-ecofriendly approaches are used to clean up contaminated sites. Therefore, it is encouraged that phytoremediation technology be considered and employed as a novel and green technology. Therefore, in connection with an AERB, Department of atomic energy funded project, *Alstonia scholaris* was employed to investigate phytoaccumulation of Cs and Sr through hydroponic culture experiments. Experiments with Cs [0-5mM (CsCl)] and Sr [0-3mM (SrCl₂ · 6H₂O)] dosing in greenhouse for 21 days were undertaken. Cs and Sr accumulation in different plant parts (roots and shoots) quantified with atomic absorption spectroscopy (AAS) and inductively coupled plasma-optical emission spectrometry (ICP-OES) respectively. Hyper-accumulation capacity for Cs and Sr were estimated with indices like transfer factor (TF) and translocation factors (TrF). The uptake pattern of Cesium in *Alstonia scholaris* is 5452.8-24771.4 mg/kg.DW (TF= 85.2-57.6) and in case of Sr is 1307.4-8705.7 mg/kg.DW (TF=85.3-1.46). In experimentation with radioactive counterparts the plant was able to remediate 57% of the waste from the radioactively spiked substrate within one week.. Field emission electron

microscopy with energy dispersive spectroscopy (FE-SEM with EDS) was employed to assess the spatial distribution of Cs and Sr in plant leaf, indicating the accumulation of Cs, Sr, and their homologous components.

Keywords: Phytoremediation, *Alstonia scholaris*, Cs, Sr, AAS, ICP-OES

IMPACT OF CELL TOWER RADIATION ON PLANTS

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ABSTRACT

Electromagnetic field radiation (EMF-r) has been categorized into different energy bands like beta, gamma and x-rays with higher frequency and energy and microwaves and radio waves with lower frequency and energy. Higher energy radiation is capable of ionizing the cellular components and atomic structures, whereas lower energy radiations like radio waves is only capable of spinning the nucleus and can be stored as heating energy inside the cells. EMF-RF radiation is frequently used in communication networks and day to day due to technological advancement the frequency and power is getting increased. Previously in India 4G networks was operating within 3GHz but now 5G is going to be recently launched and that can be up to 100GHz. As a result of this, decrease in bird's and honeybee's population, hearing loss, change in cognitive behaviour, tumorigenesis etc. in human beings has been noticed from the previous studies. Not more literatures are available on plants regarding RF stress. Some studies have shown Reactive Oxygen Species (ROS) stress in plants previously. In the present study an attempt has been made to ascertain the effect of RF power on plants that has been emitted in and around of the respective cell tower. To start with the experiment around 100 plants have been collected from BSNL tower located in CSIR-IMMT campus. Biochemical test for herbs, shrubs and trees have been done to find out the extent of abiotic stress on them.

Keywords: Radio-Frequency, Reactive Oxygen Species, GHz, Power density, Tumorigenesis.

IMPACT OF CLIMATE ON INDUCING DRUG RESISTANCE IN DERMATOPHYTES

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ABSTRACT

Drug resistance of dermatophytic fungi is gaining importance. Treatment of fungal infections becomes difficult because of emergence of resistant strains. To rescue the human population from the dermatophytic infections, medicinal support was really needed. Over time it is being observed that synthetic compounds are losing their effective nature over infectious organisms. To adopt new climatic conditions, mutation in the causal organisms has been noticed. Compound like terbinafine and inositol, etc. shows less effect over infectious organisms such as *Trichophyton*, *Candida* etc. With the repeated use of same drug, the causal organism mutated for self existence and gets resisted towards the synthetic drugs. Research data revealed that terbinafine contains SE enzyme which is effective over *Trichophyton* species and can be inactivated by the amino acid sequence present in *Trichophyton* in certain circumstances. On other hand, synthetic drug application can result other side effects to human body. Hence, research is needed for development of natural alternative of synthetic dermatophytic compounds. Traditional plant medicinal knowledge and antagonistic effects are helpful towards dermatophytic infections. Use of plant metabolites to the target side can inactive the effect of causal organism. Application of plant metabolites can protect from dermatophytic infections. Apart from this, some other micro-organisms can also be used against dermatophytes to get relief. However, a new way to treat dermatophytic infections naturally can be developed without harmful side effects.

Keywords: Climatic conditions, Mutations, Terbinafine, Inositol.

OVERVIEW OF THE ROLE OF SOIL MICROBES IN THE DEVELOPMENT OF AGRICULTURE AND PRODUCTIVITY

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ABSTRACT

To decrease the use of chemicals in agriculture and increase the productivity of cultivars, integrated management approaches, which include nutrient management, disease control and pest management, rely heavily on agri-organisms as an ecological strategy. Many problems have evolved due to decades of careless use of chemical-based agronomic instruments to increase crop yields, and sustainable agriculture approaches are the answer to these problems. The development of biological tools to replace or complement chemicals is a promising and feasible option and microbial agents are a compelling choice due to their wide range of valuable properties. Therefore, it seems sensible to start by investigating the microbes that reside in the plant's immediate vicinity. In the rhizosphere, beneficial bacteria exist known as plant growth-promoting rhizobacteria (PGPR). Because of its high nutrient content, it is a very active biological and chemical environment. To conserve natural ecosystem resources from climate change, it centres on the appearance of microorganisms crucial to agriculture to set up an ideal agricultural system based on efficient nutrient usage and energy recycling. As such, it encompasses various microorganisms used in industrial settings like agriculture, food processing, and pharmaceuticals. It is crucial to encourage the activities of microbes that benefit plant nutrition, manage illnesses, and assist plants to survive with various abiotic difficulties to maintain and improve the global food supply in future climate scenarios while maintaining environmental health. Enhanced *in situ* survival and performance of beneficial microorganisms of soil microbial diversity lead to development of next-generation inoculants.

Keywords: Integrated management, Microbial agents, Rhizosphere, PGPR, Agricultural system.

CLIMATE CHANGE MITIGATION THROUGH BIOTECHNOLOGICAL APPROACH

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ABSTRACT

Climate change refers to long-term shifts in temperature and weather patterns. Climate change is the most alarming issue of our time and we are at a defining moment; from shifting weather patterns that threaten food production to rising sea levels that increase the risk of catastrophic flooding. The effects of climate change on agriculture may depend not only on changing climate condition, but also on the ability to adapt through changes in technology and demand for food. Biotechnology has positively reduced the effects of climate change by using modern technologies. Modern biotechnology through the use of genetically modified stress tolerant and high yielding transgenic crops also stand to significantly counteract the negative effects of climate change. Climate change mitigation is another policy retort to climate change which reduces the negative impact of climate change through by reducing the concentration of green house gasses either by decreasing the source and increasing their sink (plants). Biotechnology is a promising way of mitigating the negative effects of climate change through reduction of greenhouse gases. Under this context the present paper emphasizes on the intervention of biotechnology in climate change adaptation and mitigation for sustainable yield production and food security.

Keywords: Biotechnology, Climate Change, System biology, Mitigation

BIOTECHNOLGY IN FOOD SECURITY AND CROP ENHANCEMENT

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ABSTRACT

Environmental biotechnology is when biotechnology is applied to and used to study the natural environment, and could also imply that, one try to harness biological process for commercial uses and exploitation. Environmental biotechnology can simply be described as "the optimal use of nature, in the form of plants, animals, bacteria, fungi and algae, to produce renewable energy, food and nutrients in a synergistic integrated cycle of profit making processes, where the waste of each process becomes the feedstock for another process". Biotechnology applications in food security, agriculture and climate change, regarding climate change, the Intergovernmental Panel on Climate Change (IPCC) asserts that on an average, global temperatures will increase worldwide by 0.2 degrees per decade. There will be changes in rainfall regimes representing both an increase and decrease in precipitation, and an increased frequency of droughts and floods will result. Climate change will also have an impact on production losses, which could worsen hunger in developing countries, beyond the current one billion that are going hungry. Many of agricultural resources will become more threatened over time, as global climate change will erode genetic diversity and destabilize food ecosystems, significantly. Under these circumstances, there is a need to improve crops by means of genetic modification, for food safety and to sustain agriculture. Biotechnology approaches have the potential to enhance crop production under different stress conditions. On the one hand, abiotic stresses are complex in nature; on the other hand, there are several challenges that have restricted the realization of the full potential of using biotechnology approaches in crop breeding. Eventually, the adoption of biotech crops to mitigate abiotic stresses, that are expected to increase in frequency and intensity in coming years, will depend on public perceptions and public acceptance, as well as on cultural and institutional processes in developing countries.

Keywords: IPCC, Agricultural resources, Ecosystem, Abiotic stresses

**ORISSA
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**Sarojini G. Panigrahi
Memorial Award**

PLANT GROWTH PROMOTING FUNGAL ENDOPHYTES *Aspergillus terreus* AND *Colletotrichum gloiosporedes* PRODUCE GIBBERELIC ACID, ISOLATED FROM *Oryza* *sativa* L.

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ABSTRACT

Plant growth can be promoted by fungal endophytes because they secrete beneficial phytohormones into the host plant's microenvironment. *Aspergillus terreus* (Accession no. OM108145) OST-4 and *Colletotrichum gloiosporoides* (Accession number: OM115962) OSL-4 were isolated from stems and leaves of *Oryza sativa* Linn. and identified by morphological and molecular characterization of 18s rDNA gene sequencing. The growth stimulating attributes of the isolates, such as GA₃ synthesis siderophore activity, phosphate solubilization activity, and zinc solubilization activity, were first and foremost analyzed. Characterization of *In Vitro* synthesis of gibberellic acid (GA₃) was the primary focus of this research. High Performance Thin Layer Chromatography (Rf 0.88) analysis revealed GA₃ production. The selected strains OST-4 and OSL-4 significantly accelerated the development of four agricultural crop plants: *Oryza sativa* linn (Rice), *Vigna radiata* (Greengram), *Solanum lycopersicum* (Tomato) and (Flax). This strongly suggests that these GA₃ producing strains are promising candidates for plant growth promotion and can be used to boost crop production.

Keywords: *Oryza sativa* Linn., 18s rDNA, GA₃, HPTLC

IMPLEMENTATION OF MULTILAYER PERCEPTRON (MLP) ARTIFICIAL NEURAL NETWORKS (ANN) MODEL FOR PREDICTION AND OPTIMIZATION OF SHATAVARIN IV CONTENT IN *Asparagus racemosus* ACCESSIONS

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ABSTRACT

The principal bioactive ingredient of *Asparagus racemosus* is Shatavarin IV, a steroidal saponin found in roots with a wide range of medicinal properties. Many of the factors influence the production and accumulation of secondary metabolites including environmental, developmental, and genetic factors. An artificial neural network (ANN)-based model was developed in this study to evaluate the influence of abiotic factors (climate and soil) and to forecast a suitable site for collecting and cultivating *A. racemosus* with high Shatavarin IV concentration. A total of 103 *A. racemosus* accessions collected from various geographical regions of Odisha. Fourteen input parameters such as soil and climatic factors were considered for the study. A validated High Performance Thin Layer Chromatography (HPTLC) method was used to determine the Shatavarin IV content. The quantity of Shatavarin IV in *A. racemosus* root extracts varied from 0.010-0.400 % on dry weight basis among 103 accessions. The results demonstrated that an ANN-MLP(multilayer perceptron) architecture with a single hidden layer of 8 neurons having 14-8-1 topology could reliably predict Shatavarin IV content. The prediction efficiency of the developed model was found to be 90.740 %. Sensitivity analysis revealed that nitrogen and phosphorus have a greater impact on Shatavarin IV accumulation than the other parameters. This model could be efficiently utilized for optimization of Shatavarin IV content in *A. racemosus* at a given site by changing the tangible sensitive factors. The developed ANN model would be very useful in predicting the best regions/sites for collection and cultivation of *A. racemosus* with optimum Shatavarin IV yield. Besides, the ANN model could be applied to predict the yield of Shatavarin IV content of *A. racemosus* at a new site.

Keywords: ANN Model, ShatavarinIV, Bioactive compounds, HPTLC, *Asparagus racemosus*

AIR POLLUTION TOLERANCE, METAL ACCUMULATION AND DUST CAPTURING CAPACITY OF PLANT SPECIES FOR GREENBELT DEVELOPMENT IN INDUSTRIAL SITES

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ABSTRACT

Plant species sustaining under a polluted environment for a long time are considered as potentially resistant species. Those plant species can be considered as eco-sustainable tools, used to bio-monitor and mitigate pollution. Total ten species of common tropical trees were assessed for their air pollution tolerance, dust capturing capacity and possibility to act as metal bio-monitors in Angul-Talcher industrial sites. According to the anticipated performance index (API), *Lagerstromia speciosa* (L.) Press *Holarrhena pubescens* Wall. Ex G.Don and *Ficus hispida* Roxb. ex Wall are highly tolerant species while *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. And *Tremaorientalis* (L.) Blume are intermediate tolerant species. *F. hispida* was also shown to have the highest dust capturing capacity (DCC) (5.94 ± 0.43 mg/cm²) whereas that of *Woodfordia fruticosa* Kurz (1.03 ± 0.11 mg/cm²) was found to be lowest. The metal accumulation index (MAI) ranged from 17.29 to 4.5 and 6.38 to 1.94 at the mine and control areas, respectively. Two-way ANOVA analysis revealed area-wise significant differences between biochemical and physiological parameters. The results indicated that air pollution played an important role, which affected the biochemical and physiological parameters of plants located at a polluted site. The plant species with the highest API, DCC, and MAI value could be recommended for greenbelt development in different polluted areas. Higher levels of ascorbic acid content, at polluted site as compared to control site, were an indication of stress condition.

Keywords: Bio-monitor; Anticipated performance index; Dust capturing capacity; Metal accumulation index; Greenbelt development

PROFILING OF INDIGENOUS AROMATIC RICE LANDRACES OF KORAPUT, ODISHA FOR MULTIPLE STRESS TOLERANCE

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ABSTRACT

Aromatic rice assumes immense significance and has been in great demand in the international market for their pleasing aroma, taste, and quality traits. However, multiple abiotic stresses like drought, salinity and flooding occur more frequently which limits rice productivity in rainfed rice ecosystem. The present study evaluated physiological responses and molecular marker-based evaluation of 21 rice genotypes using 32 locus-specific SSR primers related to drought, flooding and salinity QTLs. Based on physiological responses, results revealed that drought, salinity and flooding significantly reduced plant biomass, RGI, RWC, PSII activity, SPAD index and leaf photosynthesis, with an elevated effect found in IR64 variety. Further, some indigenous aromatic rice landraces such as *Tikichudi*, *Kalajeera* and *Gangabali* showed superior drought tolerance response, whereas, *Bastabhoga*, *Muktabali*, and *Sapuri* having salinity tolerance potentiality and, *Tulasi*, *Kalajeera* and *Dudhamani* varieties identified as flooding tolerance genotypes of this region. Genetic analysis reported about a total of 96 loci with a mean of 2.906 polymorphic bands/ primer showed high polymorphism about 93.12%. The mean value of PIC, MI and RP and HI were 0.326, 1.037, 1.558 and 0.420 respectively. According to cluster analysis, all genotypes were grouped into two major cluster and five sub-clusters. Overall, six aromatic genotypes *Basubhoga*, *Dudhamani*, *Kalajeera*, *Laktimachi*, *Kuyerkuling* and *Tulasi* are genetically very close to drought-tolerant (N22) and flooding tolerant (FR13A) cultivar whereas, salt-tolerant (*Pokkali*) very close to *Sapuri* and *Muktabali*. The potential rice genotypes obtained from this profiling could be useful for multiple stress tolerance breeding and boon for future food security.

Keywords: Aromatic rice, SSR primers, QTLs, PSII activity, SPAD index

CYANOLYTIC PROPERTIES OF *Alkaligenes aquatilis* AGAINST ITS ASSOCIATED CYANOBACTERIA *Lyngbya* *aestuarii* ISOLATED FROM MANGROVE HABITAT

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ABSTRACT

Cyanobacteria and heterotrophic bacteria are found to live in close association with each other in natural habitats, exhibiting a variety of relationships ranging from commensalism to ammensalism through the exchange of growth-promoting/retarding allelochemicals. Although they have a lot of similar characteristics, their nutritional habits are different for which they interact with each other. In this study, the cyanobacteria and the associated bacteria that were isolated from the Bhitarkanika mangrove zone in Odisha, India were identified as *Lyngbya aestuarii* and *Alkaligenes aquatilis* respectively, using 16S rRNA sequencing. The initial inoculum ratio of cyanobacteria to bacteria was chosen at 1:1 to study their physiology of interaction. Cyanobacteria biomass under axenic and co-cultured conditions were compared and a 49.83% growth reduction of cyanobacteria was observed under co-culture conditions. Reduced biochemical parameters were also observed for co-cultured cyanobacteria as compared to axenic cyanobacteria. Axenic cyanobacteria and co-cultured cyanobacteria were observed using a scanning electron microscope (SEM) and a fluorescence microscope which showed the growth differentiation. The bacterium was found to produce extracellular cellulase and protease which was responsible for reduced cyanobacteria growth. Additionally, the bacteria secrete many allelochemicals in co-cultured medium such as phenol, tannin, amino acids (alanine and aspartic acid), hydroxamate siderophore, alkaloid, and bacteriocin, which were having cyanolytic activity. This antagonistic interaction study can be applied in algal bloom control and wastewater management.

Keywords: *Lyngbya aestuarii*, *Alkaligenes aquatilis*, antagonistic, Phenol, Cellulase, Bacteriocin

ASSESSMENT OF SYMMETRIC AND ASYMMETRIC KARYOTYPES FROM THE CHROMOSOME STUDY OF 15 VARIETIES OF NORTH-EAST INDIAN BANANA (*Musa spp.*)

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ABSTRACT

Genetic diversity assessment in *Musa* is important in the crop improvement of banana. The cytogenetically unexplored *Musa* germplasms of North-East Indian states can be utilized for this purpose which carries disease resistant gene pools. Detailed chromosome studies and karyotype analysis were performed in fifteen varieties of *Musa* out of which three varieties are diploid wild. Predominance of median constricted chromosomes was found more as compared to sub-median constricted chromosome in all genotypes. The maximum nine secondary constricted chromosomes were observed in var. Amritsagar, var. Chini Kol, var. Sobri, var. Jazi and var. Poitrish Kola and secondary constricted chromosomes were not clearly found in var. Blung Thali. Presence of more symmetric karyotype in the wild species with respect to that of the cultivated table top varieties was recorded. Among cultivated varieties var. Chini Champa and var. Poitrish Kola of Tripura found most symmetric as compared to var. Sobri with most asymmetric karyotype. Between the three wild *Musa*, var. Ram Kola has more karyotype asymmetry than var. Blung Thali and *M. laterita*. Phylogenetic tree obtained on the basis of chromosome characters revealed that var. Grand Naine ($2n=2x=33$), formed an out-group from the other 14 varieties. The large cluster of 14 varieties was divided into two sub-clusters. The first sub-cluster enclosed var. Tulsi Manohar and var. Chini Kol with close genetic distance and var. Poitrish Kola, var. Adil Kol, Champa Kola, var. Blung Thali and var. Sobri held together. The second sub cluster consisted of two group where wild Ramkola and *M. laterita* placed together while Gopi, Jazi, Masung Tabi and Luwaobi grouped together.

Key Words: Sobri, Chini Kol

**Prof. B.P. Choudhury
Memorial Award**

**ORAL
PRESENTATION**

QUALITATIVE AND QUANTITATIVE ANALYSIS OF HERBAL PRODUCTS OF *Andrographis paniculata* THROUGH CHEMICAL FINGERPRINTING FOR QUALITY CONTROL

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ABSTRACT

Andrographis paniculata (Burm. f.) Nees is an important medicinal herb of family Acanthaceae being widely used to treat a variety of health issues such as anticancer, antioxidant, antidiabetic, hepatoprotective, antivenom, antimalarial, anti-HIV, antimicrobial, antihyperlipidemic activities etc. Andrographolide is the principal secondary metabolite of *Andrographis paniculata* responsible for its spectrum of medicinal activities. *A. paniculata* is being used in about 26 Ayurvedic formulations. The high demand of this herb leads to adulteration of this herb and its herbal products. The aim of this investigation is to develop a chemical fingerprint of *A. paniculata* for checking the adulteration. A total of 20 accessions of *Andrographis paniculata* were collected from different geographical regions of Odisha in a single growing season for the development of chemical fingerprint. The developed fingerprint was used as reference chromatogram for quality assessment of 10 commercial products of *A. paniculata* procured from the market. A high-performance liquid chromatography (HPLC) method was used for identification of five marker compounds for establishing the chemical fingerprint and quantification of Andrographolide in *Andrographis paniculata* as well as its marketed products. The HPLC chromatograms were developed for each sample and compared with the standard Andrographolide chromatogram. The HPLC run time was set at 45 min, and the Andrographolide was detected at a retention factor (R_f) of 17.8 ± 0.05 min at a wavelength of 223 nm. The calibration curve of Andrographolide was linear and had shown a coefficient of determination (R^2) of 0.999. Andrographolide was

detected in all plant samples and all the commercial products except one. The HPLC chemical fingerprint developed in the study could be used for quality assessment of *A. paniculata* and its commercial products.

Key words: *Andrographis paniculata*, Andrographolide, HPLC, chemical fingerprint, quality control.

PROCESS DEVELOPMENT OF BIOFUEL AND OTHER PRODUCTS FROM MAHUA (*Madhuca latifolia* L.)

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ABSTRACT

The genus *Madhuca*, belonging to the family of *Sapotaceae*, is a multifunctional tree and is considered a boon by the tribal's who are forest dwellers and keenly conserve this tree. Mahua flower, seed, fruits and their products are used as a food, fodder and is a non-conventional ingredient in carp feed as well as used as an exchanger in tribal and rural areas. Mahua seeds are rich in edible oil so they have economic importance. Mahua seed oil proved to be cheap and suitable substrate for the production of biofuel. The bioethanol production from mahua flowers would be increased by developing the traditional methodology, as it is expected to benefit the people of tribal areas in India as well as the bioenergy demand in world in the long run. Flowers have been reported to have various bioactivities and ethno-medicinal uses. Mahua flowers are known to play an immense role in the preparation of valued added food products (biscuit, cake, laddu, candy, bar, jam jelly, sauces etc).

Keywords: Mahua, Bioethanol, Biodiesel, Food products, Seed oil cake, Economics

REMOVAL OF POLLUTED RADIOACTIVELY CONTAMINATED SITES THROUGH PHYTOREMEDIATION TECHNOLOGY

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ABSTRACT

The environment was adversely affected by nuclear weapon testing, installation leaks, waste disposal, and unexpected nuclear accidents like Chernobyl in 1986 and Fukushima in 2011. The two main medium-lived fission products that comprise majority of the radioactivity of spent nuclear fuel after cooling for several years, maybe up to several hundred years after usage are, ¹³⁷Cs (Cesium, $t_{1/2}$ 30.17 years) and ⁹⁰Sr (Strontium, $t_{1/2}$ 28.8 years). The majority of conventional, non-ecofriendly approaches are used to clean up contaminated sites. Therefore, it is encouraged that phytoremediation technology be considered and employed as a novel and green technology. Therefore, in connection with an AERB, Department of atomic energy funded project, *Alstonia scholaris* was employed to investigate phytoaccumulation of Cs and Sr through hydroponic culture experiments. Experiments with Cs [0-5mM (CsCl)] and Sr [0-3mM (SrCl₂ · 6H₂O)] dosing in greenhouse for 21 days were undertaken. Cs and Sr accumulation in different plant parts (roots and shoots) quantified with atomic absorption spectroscopy (AAS) and inductively coupled plasma-optical emission spectrometry (ICP-OES) respectively. Hyper-accumulation capacity for Cs and Sr were estimated with indices like transfer factor (TF) and translocation factors (TrF). The uptake pattern of Cesium in *Alstonia scholaris* is 5452.8-24771.4 mg/kg.DW (TF= 85.2-57.6) and in case of Sr is 1307.4-8705.7 mg/kg.DW (TF=85.3-1.46). In experimentation with radioactive counterparts the plant was able to remediate 57% of the waste from the radioactively spiked substrate within one week.. Field emission electron

microscopy with energy dispersive spectroscopy (FE-SEM with EDS) was employed to assess the spatial distribution of Cs and Sr in plant leaf, indicating the accumulation of Cs, Sr, and their homologous components.

Keywords: Phytoremediation, *Alstonia scholaris*, Cs, Sr, AAS, ICP-OES

LIGHT QUALITY AND NUTRIENT SUPPLY INFLUENCE THE 2D-3D TRANSITION IN THE MOSS *Physcomitrium* *patens*

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ABSTRACT

Bryophytes constitute a major group of early land plants which diverged from their aquatic ancestors approximately 450 million years ago. This divergence was accompanied by the acquisition of numerous evolutionary distinct adaptations suitable for survival in a land habitat. 2-dimensional (2D) to 3D growth is such an important innovation in the evolution of land plants. *Physcomitrium patens*, a moss, represents an early land plant system and has been instrumental to understand the basic questions in plant evolution. Growth and development of *P. patens* is endogenously regulated by phytohormones such as auxin and cytokinin. Auxin induces the transition of chloronema to caulonema which is a 2D growth. This transition is also regulated by additional factors such as quantity and quality of light, carbon supply, and other phytohormones such as strigolactones and precursors of gibberellic acid. On the other hand, cytokinins induce the formation of bud initials following caulonema differentiation, which is also the initiation of 3D growth. However, the influence of external factors such as light or nutrient supply on cytokinin-mediated bud initial formation has not been demonstrated in *P. patens*. In the present study, we have shown that the bud initial formation or the 3D growth is enhanced by red light and nutrient supply. In addition, we have also shown that the *cry1a* mutant which is defective in sensing the blue light develops more amount of bud initials as compared to the wild type plants under standard conditions, implicating the inhibition of 3D growth by blue light. This study implies that light quality and nutrient influence the 2D-3D transition in *P. patens*.

Keywords: *Physcomitrium patens*, 2D-3D transition, Auxin and Cytokinin

PHYTOCHEMICAL PROFILING AND FTIR ANALYSIS OF *Ixora coccinea* CRUDE EXTRACT USED BY MUNDA COMMUNITIES OF SAMBALPUR DISTRICT, ODISHA

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ABSTRACT

World Health Organization (WHO) estimated 80% people from the developing countries mostly depend on traditional herbal medicines to cure various ailments. Health problems in tribal communities are prevented and treated by traditional plants in accordance with their traditional customs, religious beliefs, myths and experiences. Phytochemicals present in plants are efficient in preventing disease and promoting health by understanding the underlying mechanism of their action.

Ixora coccinea leaves and flowers were collected from Sambalpur, Odisha. Determination of moisture content, extraction with distilled water was done by maceration method, qualitative phytochemical screening, FTIR analysis, total phenolic & flavonoid estimation was done by standard methods with slight modifications.

Flowers exhibited higher moisture content than leaves. Preliminary phytochemical screening of distilled water extract shown presence of phenol, saponin, terpenoid, steroids, flavonoid, carbohydrate, coumarin, fatty acid etc. FTIR analysis of leaf and flower resulted in presence of N-H, C-H, O-H, C-F, C=C=C, CH₃C-H etc. functional groups. Total phenolic and flavonoid content was calculated based on calibration curve of Gallic acid and quercetin respectively.

Leaves and flowers of *Ixora coccinea* exhibited presence of essential compound, which may show antibacterial, antioxidant and anticancer properties. FTIR analysis reveals a clear differentiation of phytochemical composition. It further reflects a new hope for the development of novel therapeutic agents.

DIVERSITY OF PANICLE ARCHITECTURE AND NUTRITIONAL TRAITS IN INDIGENOUS FINGER MILLET GENOTYPES FROM KORAPUT, ODISHA

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ABSTRACT

Exploration of diversity in indigenous germplasm is an essential step for future breeding programs. Present study evaluated the genetic variation on panicle traits proximate compositions and nutraceuticals in 33 traditional finger millet genotypes and five improved varieties from Koraput, Eastern Ghats of India. Significant difference of panicle characteristics: panicle length, panicle number, ear shape, panicle weight and seed weight were observed among finger millet genotypes. The yield was varied from 13.2 to 32.4 q ha⁻¹. The proximate compositions (g 100g⁻¹) such as moisture significantly varied from 9.4 to 18.4, ash 1.2 to 3.5, fat 0.9 to 2.7, protein 4.7 to 14.25, carbohydrate 66.6 to 77.1, fiber 4.7 to 18.3 and energy 324 to 360 kcal 100g⁻¹. The phenol, flavonoid, vitamin c and antioxidant capacity of studied millets were varied from 5.6 to 25.36 mg 100 g⁻¹, 2.75 to 39.36 mg 100g⁻¹, 7.2 to 105.44 µg 100g⁻¹ and 1.9 to 15.75%, respectively. The first two axes of principal component analysis explained 39.7 % of total variation and reflected huge difference between explored genotypes. Highest positive loading was observed for seed weight followed by fiber, panicle weight, Energy, protein, antioxidant and fat and are the major determinant for phenotypic variability. The heritability (%) and genetic advance (%) varied from 66.7 to 99.0 and 3.4 to 88.4. Indigenous finger millet genotypes: *Bhalu*, *Ladu*, *Telgu* and *Bada* recorded superior panicle traits and energy content whereas *Mami*, *Janha* and *Bada* are rich in flavonoid and antioxidants. These genotypes can be utilized in future crop improvement program.

Keywords: Finger millet genotype, Panicle trait, Phenotypic variability

A FEED FORWARD ARTIFICIAL NEURAL NETWORK (ANN) MODEL FOR PREDICTION OF VASICINE CONTENT IN *Justicia adhatoda*

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ABSTRACT

Justicia adhatoda (L.) is having enormous therapeutic potential, mainly due to the presence of major quinazoline alkaloids, 'vasicine'. However, 'vasicine' content in the *J. adhatoda* varies significantly in different habitat of eastern India as the biosynthesis and accumulation of secondary metabolites is strongly influenced by environmental factors. Thus, in the present study, a feed-forward artificial neural network (ANN) based model was developed to analyze the influence of climate and soil nutrient factors and predict an appropriate location for cultivation of *J. adhatoda* with high vasicine content. Results showed that the multilayer perceptron (MLP) neural network model having 12-06-1 architecture showed highest in accuracy for vasicine. Statistical measure such as coefficient of determination (R^2), root mean square error (RMSE) and mean absolute error (MAE) of 0.950, 0.075 and 0.055 respectively indicated high performance of ANN model. Additionally, sensitivity analysis revealed the influence of nitrogen and phosphorous on predicted vasicine content to be higher as compared to other input factors. This ANN based prediction model study revealed its significance in predicting optimum vasicine yields in *Justicia adhatoda* at a specific location.

Keywords: Artificial neural network, *Justicia adhatoda*, Vasicine, Climatic factor, Soil nutrients

WILD RELATIVES OF BRINJAL (*Solanum melongena* L.): THEIR TAXONOMY, DIVERSITY AND DISTRIBUTION IN ODISHA, INDIA

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ABSTRACT

In order to develop novel and improved crop varieties, new germplasm resources have been searched continuously. Especially, the wild relatives of crop plants are immensely useful for crop improvement and for carrying plant hybridization programs. Wild Relative of Crop Plants (WRCP) are the wild plants, which are closely related to domesticated plants. These might have originated from common ancestor(s) or may be genetically related taxa. They constitute essential components of both natural and agricultural ecosystems. Due to operation of various anthropogenic pressures, the crop wild relatives (CWR) are being depleted alarmingly. Moreover, the situation has been more critical in the changing situations like climate change and greater ecosystem instability. The exploration, characterization, utilization and conservation of wild relatives are essential for agricultural production and for ensuring food security. The state of Odisha is the cradle of innumerable potential wild relative of crop plant species. Keeping in view of the above objectives, an humble attempt was made to explore the wild relatives of brinjal (*Solanum melongena* L.) from different parts of the state. The taxonomy of wild relatives of brinjal (*Solanum insanum* L., *S. violaceum* Ortega, etc.) is quite interesting and challenging due to its wide morphological variations. Here, according to taxon group concept (Maxted *et. al.*, 2006) as many as 14 variants of wild species of *Solanum* L. have been collected from different parts of the state. Their taxonomy, diversity and distribution have been compiled. In addition to these, the information on their genetic relatedness and important desired characters have been documented. This information will be highly beneficial in future plant breeding and genetic engineering programs.

Keywords: Wild relatives, Crop improvement, *Solanum*, Distribution, Odisha

TAXONOMY AND ETHNOBOTANICAL INVENTORY OF 'GINGERS' OF ODISHA

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ABSTRACT

An inventory of the uses and values of different parts of Zingiberaceous plants of Odisha was made through interaction with local and tribal people. About 15 species of wild and cultivated gingers were found widely used by them as medicine, as well as food and food additives contributing to their livelihood and earning. The enlisted plants were identified by critical analysis of its morphology of each part. The enumeration of the plants with correct botanical name, parts used, mode of consumption, medicinal values, flowering & fruiting time were recorded. Characterization of genus *Curcuma* L. on the basis of rhizome has been carried out and presented with photographs. The importance and uses of some species of Zingiberaceae such as *Curcuma montana* Roxb., *Globba orixensis* Roxb., *Zingiber capitatum* Roxb., *Zingiber montanum* (J.Koenig) Link ex A.Dietr., *Zingiber zerumbet* (L.) Roscoe ex Sm. were documented by interviewing the rural and forest inhabitants through semi-structured interview. Due to the suitable climate and edaphic conditions *Curcuma angustifolia* Roxb., *Curcuma amada* Roxb., *Curcuma longa* L. and *Zingiber officinale* Rosc. are cultivated in acres of land. Therefore, we recommend the cultivation of other species of Gingers widely for commercialization in Odisha. Thus, this study highlights the medicinal importance of underground rhizomes of Zingiberaceous plants and these findings may have implications for human food supply and will provide clues for development of neutraceuticals.

Keywords: Taxonomy, Ethnobotany, Livelihood, Zingiberaceae, Odisha

OPTIMIZING LIGHT INTENSITY FOR PHYSIOLOGICAL CHANGES, CARBON ALLOCATION AND NEUTRAL LIPID ACCUMULATION, ADOPTING TWO STAGE CULTIVATION STRATEGY IN THE HYPERSALINE GREEN ALGA,

Dunaliella salina

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ABSTRACT

Dunaliella salina is a potential source of high lipid as a biofuel feedstock, and pharmaceutical compounds, largely dependent on the biomass. Lower biomass production from microalgae is a major constraint in the commercialization at industrial scale. This study aimed to investigate different light intensities (LI) on photosynthetic efficiency, carbon fixation, macromolecular synthesis, neutral lipid accumulation as well as antioxidative defence (ROS scavenging enzymes activities) in *D. salina*. High light exposure of microalgal cells led decrease in chlorophyll *a* content but carotenoid increased significantly. Interestingly, there was also change in carbohydrate content under high light and increase in carbonic anhydrase (CA) activity, and CO₂ fixation rate, thus maintaining the biomass content in spite of stress inflicted upon the cells under high light intensity. *D. salina* cells exposed to high light intensity were harvested and transferred in nitrogen deficient medium, raising the lipid content up to 60 % DCW (dry cell weight). However, neutral lipid (NL) constituted major proportion of the total lipid and other lipids such as glycolipid (GL) and phospholipid (PL) content reduced, indicating reallocation of the lipid in such cells under nitrogen deficiency, making the organism more suitable for biodiesel / jet fuel purposes. An economic analysis inferred that *D. salina* cells although possessed comparatively longer generation time (3.5 d) over other microalgal cells, but amount of carotenoid produced and lipid quality make it more suitable for commercialization.

Keywords : *Dunaliella salina*, carbonic anhydrase, neutral lipid (NL)

**Prof. B.K. Nanda
Memorial Award**

**POSTER
PRESENTATION**

***In vitro* MICROBIAL DEGRADATION OF POLYESTER MICROFIBER POLLUTANTS**

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ABSTRACT

The study of the microbial population and their role in the degradation of harmful pollutants from environment has provided an important foundation for the advancement of microbial biotechnology. In aquatic ecosystem, microorganisms form a biofilm on the microfiber surface and secrete different enzymes, which can degrade these microfibers slowly. The present investigation reports the isolation, identification and molecular characterization of indigenous microfiber degrading bacterial strains collected from Plastic contaminated sites of Bhubaneswar, India. Synthetic microfiber degrading ability of the bacterial isolates was tested by growing them on Polyethylene glycol supplemented culture plates. Screened bacterial isolates were subjected to morphological and biochemical analysis. Molecular characterization through 16S rRNA sequencing was carried out and the most potential bacteria was taxonomically classified as *Bacillus* sp. ON318306. After 45 days of incubation period, the biodegradation of polyester microfibers was calculated in terms of weight loss rate. *Bacillus* Sp. ON318306 showed maximum rate of biodegradation i.e., 0.03g per day. The potential bacterial isolate can degrade the synthetic microfiber material and can be employed as a promising solution towards this microfiber pollution.

Keywords: Synthetic, Microfiber, Indigenous, Bacteria, Characterization, Polyester, Degradation.

COMPARATIVE DROUGHT TOLERANCE RESPONSES IN LOCAL NIGER ACCESSIONS CULTIVATED FROM KORAPUT, INDIA

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ABSTRACT

Niger is an important oil seed crop and its production is significantly affected by water deficit. Precise physiological introspection of drought response in traditional Niger accessions is an important step in crop breeding program. A pot experiment was conducted to evaluate drought responses in 10 indigenous Niger accessions originated from Koraput valley of Eastern Ghats. Variations of growth and physiological traits such as seedling fresh and dry weight, relative growth index (RGI), relative water content (RWC), drought tolerance index (DTI), SPAD index along with photosynthesis gas exchange parameters and PSII activity were evaluated under simulated drought stress by withholding irrigation. There was significant reduction of RGI, RWC, SPAD index, photosynthetic rate and PSII activity under drought stress. The initial two axis of principal component analysis (PCA) captured 48.5 % of the total variation of studied traits and indicated wide variations among the genotypes. Among the traits, leaf area, Fm, Fo, RGI, DTI, NPQ and ETR are identified as the major determining factor for diversity of Niger accessions and are of larger interest for selection. Based on drought tolerance ranking, highest DTI recorded in *Niger 09* followed by *Niger 02*, *Niger 07* and *Niger 01*. These accessions showed better antioxidative protection under drought and showed superior drought tolerance response compared to other accessions. These accessions are identified as drought tolerant accessions of this region suited for cultivation in drought prone area and boon for future breeding program.

Keywords: Niger accession, RGI, RWC, DTI, SPAD index, Drought tolerance

EFFECT OF LIGHT ON THE ACCUMULATION OF POLYHYDROXY BUTYRATE (PHB) IN *Limnothrix planktonika* UNDER PHOTOAUTOTROPHIC CONDITION

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ABSTRACT

Cyanobacteria are a group of prokaryotes that are both evolutionary and ecologically significant. They can be found in a wide range of environments, from hot springs and deserts to glaciers and the open ocean. Their ability to sense and respond to changing environmental conditions helps them to occupy a wide range of habitats. Cyanobacteria are particularly interesting as they are a suitable candidate for low-cost polyhydroxybutyrate (PHB) production, a promising alternative to oil-based plastics due to its properties (biodegradability, thermal resistance, and biocompatibility). However, research is focused for increasing their PHB content for lowering the polymer cost. In this study, the effect of different wavelength of light (Red, Blue, Green, Yellow and White), light intensity ($19.35\text{--}106.50\ \mu\text{mol m}^{-2}\text{ sec}^{-1}$), continuous light and light dark cycle (14:10hr) in the *Limnothrix* sp. was investigated for growth and PHB accumulation. The maximum biomass and PHB accumulation were found at $74.69\ \text{mol m}^{-2}\text{ sec}^{-1}$ light intensity, after which growth and PHB accumulation decreased. When the isolate was exposed to continuous light and light dark cycle (14:10hr) the PHB accumulation was found to be 8.43mg/L and 11.03mg/L respectively, at its stationary phase of growth. Furthermore, when the mangrove isolate was exposed to different wavelength of monochromatic light, red light zone was found to be suitable for the PHB accumulation. Red light caused a 26.72% increase in PHB accumulation as compared to white light. PHB and biomass productivity were negatively affected by green or blue light.

Keywords: *Limnothrix* sp., Red light, PHB, Light dark cycle

PHYTOCHEMICAL SCREENING AND ANTIBACTERIAL POTENTIAL OF *Flacourtia indica* (BURM.F)

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ABSTRACT

Plants contain thousands of organic molecules with immense pharmacological values. Phytochemistry reports thousands of newer phytochemicals every year. Plants are being used traditionally since ages in Ayurveda (Indian Traditional Medicine) in treatment of various diseases. *Flacourtia indica*, a small shrub belongs to the Flacourtiaceae family is known for its medicinal properties. Parts like leaves, bark, stem, fruits, root and even whole plant have demonstrated several pharmacological activities including antiinflammatory, antimicrobial, antioxidant, hepatoprotective, antimalarial, antidiabetic, antiasthmatic activity. It is considered as a valuable source of unique natural products for development of medicines and targeting against various diseases. Phytoconstituents like glycosides, tannins, sugar, flacourtin, α -sitosterol, α -sitosterol- α -D-glucopyranoside, butyrolactone, lignin, coumarin, scoparone etc. has therapeutic effects. The purpose of the present research work is to isolate the most important group of phytochemicals in different polar solvent extracts like methanol, ethanol, water and nonpolar solvents like benzene, n-hexane and chloroform. Characterisation of the individual phytoconstituents as well as pharmacological profile based on *in vitro*, studies needs further investigation. The plant with its unique chemical profiles may be offered to cure many diseases and have much value for the human society.

Keywords: *Flacourtia indica*, Phytoconstituents, Antiinflammatory, Antimicrobial, Antioxidant, Antidiabetic

ISOLATION OF BIOACTIVE COMPOUNDS FROM MANGO SEED KERNEL AND PHARMACOLOGICAL ACTIVITY OF ISOLATED COMPOUNDS

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ABSTRACT

Natural products from plants, either as pure compounds or as standardized extracts, provide unlimited opportunities for new drugs because of the unmatched availability of chemical diversity. Due to the fact that plant extracts usually occur as a combination of various types of bioactive compounds or phytochemicals with different polarities, their separation still remains a big challenge for the process of identification and characterization of bioactive compounds. The present study aims to isolate active compounds present in the ethyl acetate extract of mango seed kernel and pharmacological activity such as antioxidant activity, antimicrobial activity, anti-inflammatory activity and cytotoxic activity of the isolated compounds. The isolation of bioactive compounds of ethyl acetate was done by TLC followed by column chromatography. Four compounds are isolated such as C1, C2, C3 and C4. The isolated compounds were then used for the determination of pharmacological activity. The investigation confirms the efficacy of compounds isolated from mango seed kernel that will enhance pharmaceutical exploration in the field of carcinogenic disease prevention.

Keywords: Bioactive compounds, Pharmacological activity, Mango seed kernel

BIOPROSPECTING AND FTIR ANALYSIS OF *Ixora coccinea* USED BY TRIBAL COMMUNITIES OF SAMBALPUR, ODISHA

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ABSTRACT

World Health Organization (WHO) estimated that 80% people from the developing countries mostly depend on traditional herbal medicines to cure various ailments. Health problems in tribal communities are prevented and treated by traditional plants in accordance with their traditional customs, religious beliefs, myths, practices and experiences. [Phytochemicals are efficient in preventing disease and promoting health by unravelling the underlying mechanism of their action.] *Ixora coccinea* leaves and flower were collected from Sambalpur, Odisha. Determination of moisture content, extraction with distilled water was done by maceration method, qualitative phytochemical screening by standard methods. Quantitative phenolic and flavonoid estimation was done with slight modification by Folin-Ciocalteu and Aluminium chloride method respectively. Flowers exhibited higher moisture content than leaves. Preliminary phytochemical screening shown presence of phenol, saponin, terpenoid, steroids, flavonoid, oil, fat, carbohydrate, coumarin, fatty acid test etc. FTIR analysis of leaf and flower resulted in presence of N-H, C-H, O-H, C-F, C=C=C, C=O, CH₃C-H etc. functional groups. The total phenolic and flavonoid content was calculated based on calibration curve of Gallic acid and quercetin. These results suggest that the leaves and flowers of *Ixora coccinea* is composed of essential compounds which may show anticancerous, antibacterial and antioxidant properties from the crude extract. These are possible due to the presence of some bioactive compounds in the crude extract. Identification of the secondary metabolites would possibly lead to the development of new antimicrobial and anticancer compounds for efficient treatment of various diseases.

Keywords: *Ixora coccinea*, FTIR, Quercetin, Anticancerous, Antioxidant

SCREENING OF MANGROVE ISOLATED BACTERIA FOR POLYHYDROXY BUTYRATE (PHB) ACCUMULATION

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ABSTRACT

The biodegradable polyester macromolecules known as polyhydroxybutyrates (PHBs) are accumulated by several bacteria under unfavourable growth conditions as carbon and energy source. Due to the environmental difficulties associated with petroleum-based plastics, PHBs are chosen as alternatives for the production of biodegradable plastics as they are biodegradable in a relatively short period of time under natural environmental conditions. Mangrove habitats possess a huge diversity of bacteria which have inherent properties of adaptation for adverse environments. In this study, 20 different species of bacteria were isolated from mangrove habitat Bhitarkanika, Odisha and tested for their ability to accumulate PHB under laboratory conditions and they are screened under minimal medium conditions for PHB accumulation. Out of the 20 isolated species screened over minimal media, 8 bacterial strains (B3, B4, B7, ST3, ST5, V2, V6 and S1B) were selected for further analysis. These selected bacterial strains were tested along with exogenous carbon sources (Glucose 0.1%, Acetate 2% & 4%) and the strain B4 showed maximum PHB accumulation (27.04%) under the supplementation of 0.1% glucose concentration at day 1 of incubation period. Further studies were required for testing the actual potential of selected bacteria of polymer accumulation.

Keywords: PHB, Mangrove, Bacteria, Glucose, Bhitarkanika

PHYTO-ECOLOGICAL STUDY OF HILLY LANDSCAPE SURROUNDING ANSUPA LAKE: A RAMSAR SITE OF ODISHA

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ABSTRACT

The Ansupa Lake, situated in the Cuttack district is Odisha's largest freshwater lake. The lake is renowned for its picturesque landscape. It gained recognition as a wetland of international importance under the Ramsar convention on 13th August 2022. It has garnered national as well as international importance due to its unique biodiversity. Phyto-ecological studies are essential for biodiversity assessment and sustainable planning. Through our present study, we have attempted to document the floristic composition and the Phyto-ecological relationships between the plant species of the entire landscape surrounding the lake. The objectives of our endeavour were to assess the species diversity, biomass and carbon stock analysis of this landscape. Simultaneously, it was also our aim to analyse the physicochemical characteristics of the soil, the interrelation between the environmental components and their impact on plant diversity and their distribution. Field studies have been conducted during the year 2021-2022 to collect vegetation data from the forest ecosystem present on the hills surroundings this lake. The vegetation sampling was done by establishing 30 quadrants in 3 selected sampling sites. A total of 111 plant species were recorded belonging to 48 different families and 98 genera. Fabaceae is the dominant family represented by 7 species followed by Moraceae (6 species), Rubiaceae (6 species), Verbenaceae (5 species), Mimosaceae (5 species), etc. Data analysis was conducted using Cluster analysis, ANOVA and Principal Component Analysis (PCA) of R software. This study will be helpful for orchestrating appropriate conservation strategies for the lake and its surrounding forest area.

Keywords: Phyto-ecology, Ansupa Lake, Principal Component Analysis, ANOVA, Ramsar site, Conservation

KENDU (*Diospyros melanoxylon* ROXB.): A MULTI-PURPOSE TREE SPECIES FOR SUSTAINABLE FORESTRY PROGRAMMES IN ODISHA

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ABSTRACT

Survey and documentation of plant resources of a region is prerequisite for the judicious utilization and conservation of biodiversity. The present study recorded all the important benefits of *D. melanoxylon* viz. ecological benefits, medicinal values, commercial importance and traditional uses. The genus *Diospyros* belonging to the family Ebenaceae represents about 66 taxa in India. In Odisha, this genus is represented by 10 species only. The results revealed that each part of the tree such as flower, fruits, leaves, bark, etc. contributes their vital role in various aspects of human being. This species is mostly popular for its edible fruits and the great economic viability of leaves and timber. The ethnomedicinal practices consist of effective treatment for diseases like stomach disorder, diarrhoea, dysentery, urinary disorder, vomiting, cough, diabetes and skin troubles. The important ecological benefits of the tree recorded were prevention of soil erosion, water use efficiency, stabilization of habitat, etc. In addition to the life sustaining values, we have also recorded about the cultural aspects of Kendu tree which is believed to protect from black magic and any kind of negative energy. Due to multiple usages, high economic importance, soil conservation, traditional and cultural importance of *D. melanoxylon*, it can be considered as agro-forestry tree species.

Keywords: Kendu (*D. melanoxylon*), Multiple usage, Agro-forestry, Odisha

RESIDUAL ANALYSIS OF TETRACYCLINE AND STREPTOMYCIN ANTIBIOTICS IN RICE SOIL

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ABSTRACT

Bacterial Leaf Blight in rice caused by *Xanthomonas oryzae* can be controlled by an antibiotic, Streptocycline, a mixture of Tetracycline (10%) and Streptomycin (90%). Applied antibiotics may enter into soil and interfere with the natural microbiota. To quantify the residues in soil, an experiment was conducted where the antibiotic mixture was applied at half the recommended dose (HRD at 75 mg/L), recommended dose (RD at 150mg/L) and double the recommended dose (DRD at 300mg/L). Antibiotics were extracted from soil samples and quantified in liquid chromatography- mass spectroscopy (LC-MS). Tetracycline residues prevailed in soil up to 9 days in HRD & 14 days in RD and DRD treatments. Tetracycline residue decreased from 71.7µg/kg to 2.11µg/kg in HRD on 9th day, 168.7µg/kg to 6.9µg/kg in RD and 405.9µg/kg to 35.8µg/kg in DRD on day-14 of the experiment. In case of streptomycin, the residue was detected up to 14 days in HRD, 21days in RD and 30days in DRD treatments. Streptomycin residue decreased from 57.6µg/kg to 14.9µg/kg in HRD on day-14, 108.2µg/kg to 13.5µg/kg in RD on day-21 and 223.4µg/kg to 14.7µg/kg in DRD on day-30 of the experiment. The results suggested that application of antibiotics in rice may not cause residue build-up over long run. We investigated the effect of the antibiotics on soil microbes and enzymes and found adverse impact of antibiotics on some of the microbial parameters. This may alter the soil biochemical properties in long run, which is yet to be investigated.

Keywords: *Xanthomonas oryzae*, LC-MS, Residue, Tetracycline and Streptomycin

**Smt. Priyambada Mishra
Memorial Award
STUDENTS
SECTION**

VERTICAL FARMING: AGRICULTURE OF THE FUTURE

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ABSTRACT

Vertical farming is the practice of growing crops in vertically stacked layers or integrated in other structures such as skyscrapers or old warehouse with use of minimal water and soil. The vertical farm is a world-changing innovation whose time has come. Here we can imagine a world where every town has their own food source, grown in the safest way possible, where no drop of water or particle of light is wasted. Smart farming makes a tremendous contribution for food sustainability for 21st century. The reason is that the environmental and water management affects plant growth directly. The hanging garden of Babylon poses as the earliest method to grow plants vertically. Vertical farming is considered as a modern tool for feeding large world population by year 2050. Erecting a farm that is in close proximity to the people which it serves, by availability of cheaper, organic, disease-free crops in addition to sustaining of the limited natural resources.

Keywords: Vertical farming, Food sustainability, Water management

BIODIVERSITY AND ROLE OF MICROORGANISMS FROM MANGROVE PLANTS

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ABSTRACT

Mangroves form a complex, dynamic ecosystem and contain diverse and distinct microbial communities. Studies of microbes and their interaction with other ecosystem components were critical for our understanding of mangrove ecosystem functioning and remediation. Microbes play a critical role in maintaining productivity of mangrove ecosystem and also play roles in plant fitness, survival and overall ecosystem resilience. Universally it was observed that microbes play critical role in nitrogen fixation, phosphate mobilization and production of plant growth hormones (IAA). Two strains of soil bacteria i.e. *Azotobacter vinelandii*, *Bacillus megatherium* have isolated from rhizosphere of *Rhizophora mucronata* performing above functions. Arbuscular mycorrhiza and phosphate solubilizing bacteria are also isolated from great Nicobar island mangrove ecosystem. Endophytic fungi is mostly an essential component in roots of *Acanthus ilicifolius*, *Brugieragymnorrhiza* is found to harbour eighteen classes of endophytic bacteria i.e. *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus subtilis* which functions as antibacterial compound producer. Besides all above mentioned microbes, bacterial types associated with mangrove ecosystem are *Desulfovibrio*, *Desulfotomaculum*, *Desulfococcus* etc. Some of them are N_2 fixers like *Azospirillum*, *Azotobacter*, *Rhizobium*, *Clostridium*, *Klebsiella* sp. Phosphate Solubilizing bacteria includes *Bacillus*, *Paenibacillus*, *Xanthobacter* sp. *Methanococcoides methylutens* is a methanogenic bacterium also found in mangrove ecosystem. In addition, some algae are also found in mangrove ecosystem of division Chlorophyta, Cryosophyta, Phaeophyta etc. This association elucidates the diversity of microbes residing with halophilic microbes.

Keywords: Mangroves, Arbuscular mycorrhiza, Phosphate solubilising bacteria, Endophytic fungi

BIOFUEL PRODUCTION AND IT'S INVOLVEMENT IN TECHNOLOGICAL ASPECTS

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ABSTRACT

Biofuel can be a viable source of renewable energy in contrast to the finite nature, geopolitical instability and deleterious global effects of fossil fuel energy. Biofuels include any energy rich chemical generated directly through the biological processes or derived from the chemical conversion from biomass or prior living organisms like photosynthetic organisms such as photosynthetic bacteria, micro- and macro algae and vascular plants. Biofuel is a sustainable alternative to fossil fuels like petroleum. The first generation of biofuel is ethanol derived from food crops rich in polysaccharides or other stored carbohydrate sources and biodiesel obtained from waste animal fats such as cooking oil. The second generation of biofuels is bioethanol derived from non food cellulosic biomass and biodiesel taken from oil rich plant seed. The third generation is the biofuels generated from cyanobacteria, microalgae and other microbes. From both ecological and economic aspects biodiesel may be less toxic and it may eliminate one of the major pollutants, olive residues and waste vegetable oils which may be involved in the production of biodiesel. In recent years biodiesel is used as a fuel for road vehicles. Some researches aimed to study the kinetic reaction of second used cooking oil transesterification into biodiesel and find the optimum condition of its process.

Keywords: Bioethanol, Transesterification, Microalgae, Cyanobacteria

CRISPR/Cas9 TECHNOLOGY

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ABSTRACT

CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats which is a nucleotide sequence. The CRISPR/Cas9 system, located as an important component of bacterial adaptive immunity has now been repurposed as a simple efficient tool for genome editing. This oligonucleotide has been adopted to expand our capacity for precise genome manipulation. CRISPR was discovered by Dr. Jennifer Doudna (US Berkely) and Dr. Emmanuel Charpentier (Max. planck unit for the science of pathogen, USA). Doudna and Charpentier won Nobel Prize in chemistry for their discovery in 2020. The CRISPR/Cas9 system is made up of 2 key components- a CRISPR associated(Cas) nucleases and a guide RNA sequence (gRNA). The guide RNA directs the Cas Nuclease. The Cas9 gRNA (Guide RNA) binary complex recognizes target sequence which is complementary to gRNA . The Cas9 nuclease recognizes PAM (Protospacer Adjacent Motif) sequence on non complementary strand and then subsequent cleavage of complementary and non complementary strand occurs. It creates a DSB, which is ultimately repaired and outcome is a desirable modified or edited genome. In just few years CRISPR technology has massive impact on scientific research, curing neural disorders like Alzheimer's and Parkinson's disease, deadly genetic disorders like Beta Thalassemia and Sick cell Anaemia. This technology is also applicable as a diagnostic tool for the recent pandemic (COVID -19) and in production of Bio fuel and Bio energy. CRISPR/Cas often triggers apoptosis due to DSB rather than desired genome editing.

Keywords: CRISPR/Cas9, PAM (Protospacer Adjacent Motif), gRNA, Sick Cell Anaemia, CRISPR crop.

USE OF MICROALGAE IN WASTE WATER MANAGEMENT

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ABSTRACT

Since the industrial revolution, water pollution has increasingly become a concern to the public and societal authorities. With the development of the industrial world and growing population, the demands for freshwater are drastically increasing. Wastewater is sewage, storm water and water that have been used for various purposes around the community. It can harm public health and environment unless properly treated. Many disease-causing viruses, parasites and bacteria are present in wastewater. Organic compounds in wastewater are biodegradable but they can also cause pollution. Inorganic minerals, metals and compounds like Ni, Zn, Cd etc. common in wastewater cannot be broken down by organisms in wastewater. The use of algae for wastewater management is applied due to their ability to utilize organic and inorganic carbon, nitrogen and phosphorous while simultaneously accumulating biomass and reducing N, P and Chemical Oxygen Demand (COD) in the wastewater. Several microalgae are capable of removing heavy metals from industrial wastewater via Bio-absorption. Therefore, microalgae can be seen as potential candidate for wastewater treatment.

Keywords: Microalgae, Waste water, Wastewater management, Bioabsorption

A REVIEW ON ECOLOGICAL RESTORATION OF ALGAL SPECIES IN CHILIKA LAKE

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ABSTRACT

Chilika lagoon, which represents Odisha's ancient legacy, is one of Asia's largest lagoons, with a water spread of 906sq km in summer and 1165sq km in monsoon. It is a significant ecosystem because of its species diversity, biological productivity, ecological complexity and sustainable life support. More than 300 angiosperms species, 100 phytoplankton genera, 14 algal species and 07 pteridophytic species have been recorded. However, members of algal group like *Polysiphonia*, *Enteromorpha*, *Gracillaria* and *Ceramium* etc., are very significant for their high nutrition contents and phytoplankton association. Though it has been designated as "Wetland of international importance" since 1981, because of lack of effort to protect its ecosystem, it was languishing every day. The lagoon was under ecological stress because of eutrophication, siltation shallowness, loss of salinity, resource depletion etc. From the records over three decades ago, the ecological conditions of Chilika lake were so severe that it has been enlisted in Montreux Record, 1993. It was since then CDA (Chilika Development Authority) initiated many steps to get this way out. The major one came into picture on the year 2000 when a new mouth was opened to Bay of Bengal, which helped in change in salinity and subsequent recovery of seaweeds or macroalgae. Other major changes had been recorded too. And hence, Chilika lake was removed from the Montreux Record, 2003. Since then, CDA has undergone many other preventive steps to restore fully and maintain ecological balance.

Keywords: Macroalgae, Phytoplanktons, Siltation, Salinity, Montreux Record, Opening of new mouth.

BIODEGRADABLE PACKAGING MATERIAL EMBEDDED WITH METAL NANOPARTICLES

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ABSTRACT

The current world population is 7.8 billion and the predicted population in 2050 is 9.7 billion. The limitations of resources such as land, air, water and increase in human population on earth demands a cost effective improvement in agriculture which and must be environmental friendly. The solution to these problems can be done either by increasing the agricultural production or by preventing the postharvest spoilage. Packaging materials are generally made from recalcitrant petrochemical plastics which pose hazard to the environment. So, developing biodegradable polymers can save the environment but making the polymer antimicrobial would prevent postharvest losses. By synthesizing metal nanoparticles like CuO and ZnO, which will exhibit antimicrobial properties and good mechanical and thermal properties. The nanotechnology used is nanoparticles with at least two dimensions between 1-100nm which can be synthesized using various physical, chemical and biological methods. Modifying parameters of producing nanoparticles can be used to modify the shapes of nanoparticles. Microbes grab metal ions from surroundings to convert it into 'zero valent / elemental metal nanoparticles'. This can be done by intracellular mechanism by uptake of metal ions into microbial cell, to produce nanoparticles using intracellular enzymes and pathways or by extracellular mechanism by binding ionic metals to cell's outer surface and reducing the metal ions via enzymes. The biodegradable polymers synthesized by blending PVA, starch, and glycerol exhibited good shelf life of food items stored in such packaging materials in comparison to petrochemical plastics packaging materials. The polymer embedded with the nanoparticles did not leach out Cu or Zn ions in the medium, thereby overcoming the safety concerns.

Keywords: Nanoparticles, Biodegradable polymers and Antimicrobial properties

GLOBAL WARMING AND THE ROLE OF THE OCEAN IN CLIMATE CHANGE

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ABSTRACT

Climate change refers to significant, long-term changes in the global climate. Global warming is the slow increase in the average temperature of the earth's atmosphere because an increased amount of the energy (heat) striking the earth from the sun is being trapped in the atmosphere and not radiated out into space. The ocean has absorbed about 90% of heat and energy stored in the air, sea, land and melted ice generated by rising emissions leading to Ocean Warming. The change in temperature cause ice-melting, sea-level rise, marine heat-waves and ocean acidification. It affects the distribution, diversity and abundance of marine species and coral reefs experience bleaching events. During the 20th century, the global mean sea level rose by about 15-20 cm. Sea level is currently rising more than twice as fast and will further accelerate reaching up to 1.10 m in 2100 if emissions are not sharply reduced. Mainly, low-lying coastal cities and small islands will be exposed to risks of flooding and land loss annually by 2050, especially without strong adaptation. The overall impacts of climate change on ocean affects the rates of species migration, elementary changes of the ecosystem, changing ocean circulation etc. consequently, in warmer sea water, low nutrient rich planktons become less abundance affecting the marine food webs. Measures like extending marine protected areas with carbon-storing habitats, protecting native species, restoring healthy coral reefs can adapt to combat these impacts.

Keywords: Hydrosphere, Acidification, Coral Reefs, Eutrophication, Hypoxia, Ocean Warming, Dead zone

MANAGEMENT OF TEMPLE WASTES: A STEP TOWARDS SUSTAINABLE GREEN ENERGY PRODUCTION

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ABSTRACT

Temple is a structure designed to bring human and god together through worship, sacrifice and devotion. People of Hinduism who are great believers of God visit temples everyday. As a part of worship flowers, fruit peels, coconut coir, Tulsi leaves, Bael leaves waste are generated from temples. The flowers along with other wastes are disposed either into rivers, ponds and other water bodies or left up on the open places. These waste materials cause various types of environmental pollution. Therefore, management of these wastes is a matter of concern. These waste materials are rich in ligno-cellulose, cellulose, crude protein, fiber and many nitrogenous compounds. Due to the above property, it can be used in the preparation of bioenergy, biofertilizer etc. To achieve the sustainable green energy demand, these wastes can be utilized for producing low cost renewable bioenergy (bio gas). Flower and other biodegradable wastes can be used as raw material for production of biogas by the process of anaerobic digestion process. The biogas produced from the waste materials can be used for cooking purposes and the residual products can also be used as compost/ biofertilizer for the crops.

Keywords: Bioenergy, Biogas, Temple wastes, Sustainable energy, Anaerobic digestion, Nitrogenous compounds.

VERMICOMPOSTING

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ABSTRACT

The origin of composting dates back to very old time; the earliest records & archaeological evidence relate to use of manure produced from animals as by-product of keeping livestock. The process of composting means to compost all types of organic waste like crop residues, kitchen & market wastes, bio-wastes of agro based industries, livestock wastes, etc. which tends to be get degraded by the action of natural decomposer bacteria to form the organic manure. But, when the biologists and agriculturists got to discover that even the earthworms are also very good natural decomposers, and they can also easily degrade the organic wastes, they introduced the technique of adding or introducing earthworms to the compost pile which will increase the productivity, the process is called vermicomposting. Vermicomposting was first introduced in the 1970s by a biology teacher, Mary Appelhif. Aristotle who recognized their importance as the "intestines of the earth". Vermicomposting involves breaking down of complex organic materials into nutrient rich compost by earthworm by its ingestion and digestion. In this process, worms help in transforming organic waste materials into high quality manure with ample amount of macro and micro nutrients for plant growth and development. Vermicomposting is an emerging technique for recycling of crop residues and other organic solid wastes by the utilization of earthworms to convert them into vermicompost. There are vast applications of the vermicompost manure in many different fields or areas like agriculture (organic farming), green houses, gardening, nursery propagation, floriculture, horticulture, etc.

Keywords: Earthworm, Organic waste, Organic farming

MECHANISM OF FLOWERING

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ABSTRACT

Flowers are organized into concentric whorls of sepals, petals, stamens and carpel. Sepals enclose and protect the flower bud, while petals can be showy so as to attract pollinators. Stamens produce pollen grains that contain male gametes, while the carpels contain the ovules that when fertilized produce the seeds. While the size, shape, number and elaboration of each of these organ types can be quite different, the same general organization of four floral organ types arranged in concentric whorls exists across all flowering plant species. The 'ABC model' is a simple and satisfying explanation for how this conserved floral architecture is genetically specified. The ABC model was first explicitly articulated in 1991, in a seminar paper by Enrico Coen and Elliot Meyerowitz. Although homeotic mutations affecting floral organ identity had been known for centuries, it was the systematic analyses of these mutations, and of the phenotypes produced by double and triple mutants, that proved to be critical in developing the ABC model. Building on previous genetic analyses in two different species, *Arabidopsis thaliana* and *Antirrhinum majus*, they proposed that distinct organ identities are specified by a unique combination of homeotic 'A', 'B' and 'C' gene activities within each whorl. The second tenet of the model was that the A and C functions negatively regulate each other. Together, these two components of the model can explain normal organ identity in each whorl, and at the same time explain a wide variety of homeotic mutant phenotypes

Keywords: ABC model, Mutant phenotype *Arabidopsis thaliana*, *Antirrhinum majus*

MICROBES AND THEIR ROLE IN CLIMATE CHANGE

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ABSTRACT

Now a day's climate change and global warming are major problems in the world. Greenhouse gas concentration is increasing through time as a result of various human and natural factors such as combustion of coal, oil and other fossil fuels, decay of plant matter and biomass burning. Microbes can have positive and negative responses to temperature, making them an important component of climate change models. Microbes are responsible for both using and producing greenhouse gases such as carbon dioxide and methane. They play key role in nutrient cycling, biodegradation/bio-deterioration, climate change, food spoilage, the cause and control of disease, and biotechnology. Microbes are versatile; they can be put to work in many ways: making life- saving drugs, manufacture of biofuels, cleaning up pollution and producing/processing food and drink. However, microbes live in diverse communities that interact with other organisms and the environment, making their impact difficult to predict. Microbial diversity in different ecosystem has much contribution in climate change controlling and fighting its negative impacts as their metabolism is amazingly versatile and they can grow in broad environmental conditions. In ecological processes microbes have significant value in consumption (transformation) and production of gases. Methylootrophs can use greenhouse gases as substrates to fulfill their energy and carbon needs. Humankind has recently started to alter the composition of the atmosphere and the energy balance of the planet and micro-organisms have been dictating global climate for billions of years.

Keywords: Climate change, Greenhouse gases, Microbes, Biofuel, Nutrient recycling

WASTE TO SUSTAINABLE BIOHYDROGEN PRODUCTION

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ABSTRACT

As the demand for energy increases, reserves of fossil fuel are steadily declining. The growing consumption of energy is responsible for the world's dependence on *non renewable energy source such as coal, natural gas, petroleum etc.* The burning of fossil fuel has several side effects such as green house gases resulting in increasing global temperature. To overcome these problems, there is an urgent need of alternative and advance fuels. Among the various renewable energy sources biohydrogen is gaining a lot of traction as it has very high efficiency of conversion to usable power with less pollutant generation. Hydrogen has a high heating value (142 MJ/Kg) over 2.75 times that of other hydrocarbon based petroleum fuels. Biological methods of hydrogen production are found to be best for producing green hydrogen because they use available renewable energy sources as feedstock. The dark fermentation technique is becoming more famous among all biological hydrogen generation method of its light autonomous nature and functional ability. By using suitable bio process technologies hydrogen can be produced through carbohydrate rich, nitrogen deficient solid waste such as cellulose and starch containing agriculture and food industry wastewater. This method yields hydrogen gas and different high volatility fatty acids, which could be used for industrial purposes after separation or as a precursor for the bio-methanation process for biogas production. Utilization of aforementioned wastes for hydrogen production provides inexpensive energy generation with simultaneous waste treatment.

Keywords: Biohydrogen, Dark fermentation, Solid waste, Alternative fuel

ORGANIC FARMING: THE FUTURE OF AGRICULTURE

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ABSTRACT

Organic farming, or organic gardening, is a system of crop cultivation that uses biological methods of fertilization and pest control as substitutes for chemical fertilizers and pesticides, which are regarded by supporters of organic methods as harmful to health and environment and unnecessary for successful cultivation. It was initiated as a conscious rejection of modern agro-chemical techniques in the 1930s by the British agronomist Sir Albert Howard. Miscellaneous organic materials including animal manure, compost, grass turf, straw, and other crop residues, are applied to fields to improve both soil structure and moisture-holding capacity and to nourish soil life, which in turn nourishes plants (Chemical fertilizers, by contrast, feed plants directly). Biological pest control is achieved through preventive methods, including diversified farming, crop rotation, planting of pest-deterrent species, and using integrated pest management techniques. Bioengineered strains are avoided. Since organic farming is time-consuming, organically grown produce tends to be expensive. Organic produce formerly accounted for a minuscule portion of total American farm output, but it has seen a huge proportional increase in sales in recent years.

Keywords: Organic farming, Chemical fertilizers, Soil structure, Pest control, Pest management

EUTROPHICATION

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ABSTRACT

Eutrophication is a widespread phenomenon that disrupts natural ecosystems around the globe. It is most commonly associated with the pollution of water with excessive nutrients. The primary limiting factors for eutrophication are nitrogen and phosphorus. This process causes algal bloom in the water bodies which prevent oxygen and light from entering the water thereby resulting in the depletion of dissolved oxygen in water. Eutrophication may be natural or human induced. Wastewater effluents, run-off from agricultural fields, mines and unsewered industrial sites are some of the sources of this phenomenon. It has both positive and negative effects. Positive effects include increased primary production, increased productivity of some fisheries, positive fertilization effect on farmland through the use of nutrients-enriched irrigation water. Negative effects include decrease in aquatic diversity, human health impacts, economical and ecological impacts. Eutrophication has become a global problem that is likely to intensify in coming decades because of increase in human population, demand for food, land conversion and fertilizer use. Halting of this phenomenon is difficult; however, it can be controlled by implementing various preventive measures.

Keywords: Algal bloom, Excessive nutrient, Decrease in aquatic diversity

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ABSTRACT

Bioethanol is simply ethyl alcohol obtained from biomass or biological resources by the fermentation of sucrose using yeast. It is currently being considered as a potential replacement for the conventional gasoline, especially as it possesses similar and some superior qualities enabling reduction in GHG and increases fuel reserve. Main source of sugar required for producing ethanol comes from energy crops like maize, wheat crop, waste straw willow, saw dust, reed canary grass, etc. On the basis of source of raw materials used, bioethanol can be classified into first generation, second generation and third generation. First generation ethanol is derived from food based feed stock such as starch, sugar, etc. High cost of these feed stocks is the driving force behind the search of second and third generations of bioethanol production as they are derived from non-food based feed stock and algal biomass respectively. Fourth generation bioethanol is being developed to further advance the 3G bioethanol to enhance the potential of algae to capture CO₂ and to increase the production of specific compounds. Despite the efforts been made to reduce the cost of production through the use of diverse non-edible feed stocks, the cost of processing feed stocks is still very high, thereby making bioethanol uncompetitive with the conventional gasoline. In order to increase the yield of bioethanol and minimize the cost of production, different processes maybe combined through integrated processes, for e.g., SHCF, SCCF and CBP. India has a strong focus in the area of biofuel and stimulated ethanol blending target of 10% by 2022 and 20% by 2030. Thus, using bioethanol as an alternative of fossil fuel results in reducing the green house gas emission and global warming potential substantially and thus, facilitates the protection of ozone layer.

Keywords: Biofuel, 3G Bioethanol, Feed stock, Gasoline, SHCF, Global warming, Ozone layer

ABIOTIC STRESS TOLERANCE AND ROLE OF ARBUSCULAR MYCORRHIZAL FUNGI IN PLANTS

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ABSTRACT

Abiotic stresses such as heavy metals, drought, salinity, temperature (high/ low) etc. are antagonist to plant growth and development that lead to loss in crop yield. Moreover, other factors like pesticides, fertilizers and chemicals applied in agricultural field inhibit the crop productivity and abolish the natural ecosystem. On other hand, so many eco-friendly techniques are now available to combat the various abiotic stresses. The application of arbuscular mycorrhizal fungi (AMF) is currently being considered as novel approach which not only enhances the plant growth and development but also act as stress stimulant. Many reports are available on the effect of AMF in plant growth regulation and improvement of tolerant capacity of different plant species. Different types of fungi associations have been observed however, in agriculture, the AMF of the phylum Glomeromycota are found to be the best for crop productivity. Most of the researchers have focused the impact of AMF on morphological, physiological, biochemical and molecular changes with respect to host plant. The understanding of AMF-mediated mechanisms in plants is most important for smooth regulating and establishing the relationship between mycorrhiza and the specific plant against specific stress.

Keywords: Abiotic stresses, Arbuscular mycorrhizal fungi, Crop productivity, Stress tolerance

ISOLATION, SCREENING AND IDENTIFICATION OF *Aspergillus parvisclerotigenus*: A KEY PECTINASE HYPER- PRODUCER

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ABSTRACT

Pectinases are a group of enzymes with wide range of applications such as fruit juice clarification, paper pulping, coffee & tea fermentation and waste water treatment. With growing industrial demand for pectinase, it is essential to isolate microbes that produces enormous amount of pectinase. Among all filamentous fungi, *Aspergillus* species are well known for it's capability as a bulk producer of extracellular enzymes and secondary metabolites. The present study focused on isolation of fungi, screening and identification of pectinase positive fungal isolates followed by phylogenetic analysis. In order to examine pectinase production from microbes, soil samples rich with decomposed fruits and vegetables were obtained from 5 different areas of Bhubaneswar, Odisha, India. A total of 15 fungal isolates were marked as producer of extracellular pectinase & four strains were proved to be great producers on the basis of halos size around the colonies against a white-opaque background in the plates containing media supplemented with pectin (1 % w/v). Among those 4 fungal strains, 2 of the fungal strains i.e. PDI 8 (8 mm clearance zone) and PDI 13 (6 mm clearance zone) were considered as key pectinase hyper-producers and hence subjected for further molecular characterization. The molecular characterization was carried out by sequencing D1/D2 domain of the LSU of rDNA by PCR amplification process. The hyper-producers identities were revealed as *Aspergillus niger* (PDI8) and *Aspergillus parvisclerotigenus* (PDI 13).

The resulting consensus sequence was submitted to NCBI with accession number KX928753 & KX928754 and a phylogenetic tree was constructed by UPGMA method.

Keywords: Pectinase, Pectin, *Aspergillus parvisclerotigenus*, Molecular characterization, Phylogenetic analysis, NCBI

CHANGES OF ANTIOXIDATIVE STATUS OF *TRITICUM AESTIVUM* DURING GERMINATION AND INITIAL PHASE OF GROWTH SUBJECTED TO ABIOTIC STRESS

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ABSTRACT

World's commonly cultivated species *Triticum aestivum* provides proteins, fibers, carbohydrates, lipids, minerals, and vitamins which are bioactive contributing to a healthy diet. Due to excessive ROS production under stress, plants ought to counteract oxidative damage; so they have developed a complex array of each non-enzymatic and enzymatic antioxidant mechanisms and collectively for maintenance of ROS homeostasis. In this study, the regulation of Proline, enzyme, Malondialdehyde (MDA), Peroxide, soluble protein, catalyses response to exceptional abiotic stresses have been investigated under the treatment of salt, water and metal stress and it was detected that there may be a sizable change in overall mechanisms of different type that will be answerable for increasing the plants tolerance towards them. ROS-scavenging systems additionally regulate its levels which end in increased nonenzymatic as well as enzymatic antioxidants. In future, we will look into changes in the assay of ascorbate peroxidase, glutathione reductase, peroxidase, NADH-peroxidase etc.

Keywords: *Triticum aestivum*, ROS, Proline, MDA

ETHNOMEDICINAL PLANT DIVERSITY OF MAHENDRAGIRI HILL COMPLEX IN GAJAPATI DISTRICT OF ODISHA

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ABSTRACT

Mahendragiri Hill Complex is an important geographical unit located around the southeastern boundary of Odisha in Gajapati district which spreads into Srikakulam district of Andhra Pradesh. The region lies between 83° 45' 2" and 84° 45' 2" and north latitudes 18° 15' 2" and 19° 30' 2". This area is found to be a potent source of a variety of medicinal plants. An ethnofloristic inventory conducted during 2019-2021 could reveal that 50 different plants belonging to 37 families were employed by the native tribes for treating over 30 different types of human diseases and 18 animal diseases. The human ailments addressed by using native plants included boils, bronchitis, cold and cough, colic pain, conjunctivitis, cracked nipples, diabetes, diarrhoea, dysentery (including blood dysentery), ear infection, fever, glycosuria, gastric troubles, hemicrania, jaundice, joint pain, migraine, miscarriage, mumps, night blindness, obesity, peptic ulcer, piles, scabies, sinusitis, sterility in women, sun stroke, swelling and sprain etc., while animal diseases included blood dysentery, blood urination, breathing trouble, constipation, dyspepsia, ectoparasites, enlargement of glands in throat, filariasis, fire-injury, flatulence, foot and mouth disease, galactorrhoea, indigestion, mastitis, mump, throat infection, yoke-wound and swellings etc. Plants enhancing the milching capacity as well as those adding to the strength and vigour of the livestock have also been included. Bronchitis, constipation, conjunctivitis, diarrhoea, dysentery (including blood dysentery), foot and mouth disease, mumps and respiratory diseases are the most common diseases prevalent among the local inhabitants. Similar to other aspects of plant science research, folklore herbal medicine also offers enormous scope providing clue for further research on drug development; therefore, all the existing information needs to be correctly recorded, before it is permanently lost.

Keywords: Ethnomedicinal, Mahendragiri Hill, Herbal medicines, Human diseases

EFFECT OF ETHYLENE UPON STARCH SYNTHESIZING ENZYMES AND SINK STRENGTH OF GRAINS OF CONTRASTING RICE CULTIVARS

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ABSTRACT

Three high yielding indica rice cultivars differing in grain size and weight, Jogesh (large), Udayagiri (medium) and Sidhanta (small) were grown in field condition in order to know the relationship exists between ethylene concentration and starch synthesizing enzymes activities. Ethylene production was manipulated by treating chemical growth regulators such as Cobalt nitrate ($10^{-5}M$), kinetin ($10^{-5}M$) and distilled water (control) at the time of booting (5 days before anthesis). The treatment was continued with one day interval for four days more. Starch synthesizing enzymes ADP glucose pyrophosphorylase, sucrose synthase and sucrose phosphate synthase as well as grain filling and cell division rate, sugar and starch content of grain organs and ethylene evolution of spikelets were studied in both apical and basal spikelets of a panicle during mid grain filling period. Enzyme activities as well as grain filling and cell division rate, starch content correlated negatively with ethylene concentration ($***P < 0.001$). Ethylene production decreased due to the application of both Cobalt nitrate and Kinetin in all the varieties. The activities of starch synthesizing enzymes however increased. The increase in panicle weight was 16.5-18.3, 22.7-27.0 and 19.6-22.7 % respectively, in Jogesh, Udayagiri and Sidhanta due to the application of Cobalt nitrate and Kinetin compared to the control. The study indicated that partially filled spikelets could be improved in rice panicle by increasing activities of starch synthesizing enzymes through manipulation of ethylene production.

Keywords: Indica cultivars, Anthesis, Cobalt nitrate, Kinetin, Spikelet, Ethylene

EXPLORING IMMUNE BOOSTING ASCORBIC ACID (VITAMIN-C) IN SOME WILD EDIBLE FRUITS USED BY TRIBALS' OF ODISHA

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ABSTRACT

Human body essentially requires certain amount of Vitamins in their daily intake for its metabolic regulations to satisfy the quality of living by acting as immunocompetence. Vitamin C, the bio-function of Ascorbic Acid, a water soluble organic compound acts as an Immune-regulator inside the cell. Vitamin-C can't be produced in human body due to the lack of *de novo* synthesis L-gulono- α -lactone-oxidase enzyme. Wild palatable fruits, at their various maturity stages, are enriched with nutrients, including vitamins. Though *Artocarpus lakoocha*, *Carissa spinarum*, *Glycosmis pentaphylla*, *Polyalthia suberosa* have been widely consumed by tribal communities, forest dwellers for their health benefits, yet there is a lack of adequate scientific reports on the presence of Ascorbic Acid in these wild fruits. Thus, in this study, above mentioned wild edible fruits collected from various agro-climatic zones of Odisha were taken in consideration for assessment of Ascorbic Acid. The quantification was done using spectrophotometric method. Results revealed that Ascorbic acid content was highest in *Polyalthia suberosa* (95.09 ± 1.417 mg/100 gm.fwt.) followed by *Carissa spinarum* (75.25 ± 2.19 mg/100 gm. fwt.), *Artocarpus lakoocha* (68.05 ± 0.856 mg/100 gm. fwt.) and *Glycosmis pentaphylla* (59.763 ± 2.269 mg/100 gm.fwt.). Since, Ascorbic acid content in all the studied wild fruits are quite promising as compared to some other popular cultivated fruit species like kiwi (90.20 mg/100g), orange 82.34 mg/100g, lemon (58.12 mg/100g) and Tomato (26.73 mg/100g). Thus these wild fruit species may be conserved and propagated for domestication and bio prospecting.

Keywords: Ascorbic Acid, Enzyme, Tribal, Vitamins, Wild fruits.

ETHNOBOTANICAL STUDIES WITH REFERENCE TO JUANG TRIBE IN KEONJHAR DISTRICT OF ODISHA, INDIA

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ABSTRACT

An ethnobotanical survey in Gonasika hill range and its adjoining areas of Keonjhar district (Odisha) could reveal interesting and a good deal of knowledge on medicinal plants and their uses among the Juang tribal population. The indigenous knowledge of the Juang healers and the native plants used by them for medicinal purposes were collected through semi-structured questionnaire and personal interviews during the course of investigation. The results of the present work revealed that the traditional healers and the Juang inhabitants of the area used 77 species of plants of 67 genera distributed in 43 families to redress their healthcare needs. The study also revealed that fresh plant materials were invariably preferred for better efficacy of the disease management. Several promising medicinal plant species were found growing in their natural habitat while others are domesticated. The forest tenants as a rule collect these plants from the adjacent forest regions which are readily available and medications are arranged under the supervision of local medicine men. The present work dealt with the ethnobotanical exploration, identification and documentation of potential medicinal plants used by the Juang tribe in Keonjhar district of Odisha. The findings of the present study will be of immense help to pharmaceutical industries to isolate bioactive compounds and development of new drug.

Keywords: Gonasika Hill, Juang tribal, Medicinal plants, Bioactive compounds

NUTRIENT MANIPULATION WITH INDUCED OVER-EXPRESSION OF ACCASE AND RUBISCO GENES FOR ENHANCED BIOMASS, AND LIPID PRODUCTION IN

Dunaliella salina

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ABSTRACT

Microalgae are being explored as renewable energy sources in recent times owing to diminishing petroleum reserves and climate change worries out of fossil fuel burning. Deficiency of nitrogen and phosphorus are the most effective inducers of lipid accumulation in microalgae but at the cost of biomass productivity. Therefore, manipulation of nitrogen, phosphorus, and carbon were adopted for maximizing lipid coupled to biomass production in *Dunaliella salina*. Phosphate deficiency and 1.25mM KNO₃ (1/8th of the basal) resulted in higher lipid content (341.1 mg g⁻¹ DCW), but lower biomass (13.12 mgL⁻¹d⁻¹ DCW). Augmentation of 10.00mM NaHCO₃ to above cultures not only enhanced lipid by 17% but also biomass productivity 125%. The increase in biomass may be correlated with the stress ameliorating effects of bicarbonate that helped in maintaining the robust photosynthetic performance of the cell. The two important enzymes, RuBisCO and ACCase were also monitored for their differential expressions. RuBisCO possesses large and small subunits (*rbcL* and *rbcS*) responsible for incorporation of CO₂ and beta carboxyl transferase (*accD*) of the heteromeric ACCase is associated with the first and committed step of fatty acid biosynthesis. Enhanced biomass and lipid content in *D. salina* cells after NaHCO₃ augmentation may be ascribed to 6.23 fold increase in the expression of *accD* and > 2.16 fold increase in *rbcL* and *rbcS* genes. Thus, the present work recommends a threshold level of nitrogen and bicarbonate in phosphate deficient *D. salina* cultures for simultaneously maximizing the biomass and lipid content.

Keywords: ACCase, RuBisCO, *Dunaliella*, Microalgae

CHANGES OF ANTIOXIDATIVE STATUS OF CERTAIN LEGUMINOUS SEEDS DURING GERMINATION AND INITIAL PHASE OF GROWTH SUBJECTED TO ABIOTIC STRESS

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ABSTRACT

India is a chief production house of cereals, pulses which is rich source of folic acid, vitamin B₁₂, and fibers. In plants, the function of ROS is well documented in abiotic stress that to evaluate the effect of stress situations on the synthesis of compounds with antioxidant properties. The seeds of *Vigna mungo*, *Vigna radiata* L., had germinated and emphasis is given to the regulation of Proline, Malondialdehyde (MDA), soluble protein, Peroxidase, catalase enzyme in leguminous plants in response to salinity, metallic and water stresses. Increased ROS levels consequences which are regulated through ROS-scavenging structures that consist of both non enzymatic and enzymatic antioxidant to deal with specific form of stresses that probable involve morphological modifications under stress, while other mechanisms can be chargeable for increasing the plants tolerance in the direction of them also. Future studies will investigate modifications in the assay of ascorbate peroxidase, glutathione reductase, peroxidase, NADH-peroxidase etc.

Keywords: ROS, *Vigna* sp, MDA, Ascorbate peroxidase, Glutathione reductase

DIVERSITY AND MEDICINAL IMPORTANCE OF INVASIVE ALIEN CROP WEEDS IN RICE FIELDS IN JAGATSINGHPUR DISTRICT OF ODISHA, INDIA

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ABSTRACT

An extensive floristic survey was conducted at low land rice fields of Jagatsinghpur district of Odisha during the year 2012-2014. Four community development blocks were selected for the study such as Jagatsinghpur, Balikuda, Tirtol and Kujang. Seventy invasive species of crop weeds were collected from the low land rice field ecosystem of the study area and studied taxonomically for proper identification. During the taxonomical study it was found that out of the 70 weeds collected, 35 species belonged to Invasive Alien category which was associated with the principal crop in low land rice fields that interfere the crop ecosystem and its productivity. Important Invasive alien crop weeds include *Alternanthera philoxeroides*, *Aeschymone americana*, *Aerva javanica*, *Bidens pilosa*, *Blumea lacera*, *Chrozophora rottleri*, *Corchorus aestuans*, *Croton bonplandianum*, *Eclipta prostrata*, *Eichhornia crassipes*, *Emilia sonchifolia*, *Gnaphalium polycaluon*, *Gomphrena celosoides*, *Ludwigia octovalvis*, *Oxalis corniculata*, *Portulaca oleracea*, *Saccharum spontaneum*, *Tribulus terrestris* and *Xanthium indium*. It is interesting to note that, the local farmers, agricultural labourers, and herbal practitioners of the area use some of these Invasive Alien Crop weeds for curing various human and animal diseases that include *Alternanthera philoxeroides* (cough), *Aeschymone americana* (impotency), *Aerva javanica* (diarrhoea), *Chrozophora rottleri* (hypertension), *Corchorus aestuans* (dysentery), *Croton bonplandianum* (injury healing on skin), *Eclipta prostrata* (hair vitalizer), *Eichhornia crassipes* (lactation of cow), *Emilia sonchifolia*, (cold and fever), and *Xanthium indicum* (jaundice). However, these plants are always under threat due

to intercultural field operations and excessive application of herbicides. It is evident that the conservation of such therapeutically potential crop weeds may be subjected for further evaluation in quest of pharmaceutically important formulations.

Keywords: Invasive crop weeds, Jagatsinghpur, Crop ecosystem, Human diseases

CHANGES OF ANTIOXIDATIVE STATUS OF *Triticum aestivum* DURING GERMINATION AND INITIAL PHASE OF GROWTH SUBJECTED TO ABIOTIC STRESS

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ABSTRACT

World's commonly cultivated species *Triticum aestivum* provides proteins, fibers, carbohydrates, lipids, minerals and vitamins which are bioactive contributing to a healthy diet. Due to excessive ROS production under stress, plants ought to counteract oxidative damage; so they have developed a complex array of each non-enzymatic and enzymatic antioxidant mechanisms and collectively for maintenance of ROS homeostasis. In this study, the regulation of Proline, enzyme, Malondialdehyde (MDA), Peroxide, soluble protein, catalyses response to exceptional abiotic stresses have been investigated under the treatment of salt, water and metal stress and it was detected that there may be a sizable change in overall mechanisms of different type that will be answerable for increasing the plants tolerance towards them. ROS-scavenging systems additionally regulate its levels which end in increased nonenzymatic as well as enzymatic antioxidants. In future, we will look into changes in the assay of ascorbate peroxidase, glutathione reductase, peroxidase, NADH-peroxidase etc.

Keywords: *Triticum aestivum*, ROS, Proline, MDA

16S rRNA GENE SEQUENCING - AN INDEX FOR RAPID IDENTIFICATION OF *Bacillus species* FROM BOVINE MASTITIS SAMPLE

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ABSTRACT

A major challenge in dairy diagnosis sector particularly in case of mastitis is to identify the causative pathogens rapidly, in accurate and reasonable way. This aspect is crucial for antibiotic treatment and efficient prophylaxes strategies. Unfortunately, the routine phenotypic, serological and automated biochemical tools don't allow for proper identification of certain closely related species of microbes due to their phenotypic and biochemical similarities. Over the years, a sizable database of 16S rRNA gene (rDNA) has been generated and successfully applied for identification of closely related species, as it possesses unique well conserved and hypervariable regions. The investigation was on the profile of *Bacillus* identified from Bovine mastitis sample by using 16S rRNA sequencing. For the purpose Genomic DNA was isolated and, a single band of high-molecular weight DNA has been isolated. 16S rRNA gene sequence was amplified by using universal primers; a discrete band of 1500 bp was observed when resolved on 1.0% agarose gel. The amplified PCR products were sequenced through Sangers method and the data of isolates were compared with gene bank database using BLAST. Based on maximum identity score first ten sequences were selected and aligned using multiple software program Clustal W. Phylogenetic analysis was carried out using software program MEGA 10. From the result 3 different species *Bacillus tropicus* strain MCCC 1A01406, *Bacillus safensis* LSRBM oF PIKRGCFTRI 40 and *Bacillus subtilis* strain UYY) were identified based on nucleotide homology and phylogenetic analysis.

Keywords: *Bacillus*, 16S rRNA gene, identification, Phylogenetic analysis

DIVERSITY AND DISTRIBUTION OF AQUATIC FLORA WITH REFERENCE TO ELEMENTAL EFFECT IN KHORDHA DISTRICT, ODISHA

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ABSTRACT

Aquatic plants are the major resources for maintaining their ecosystems. The present study was carried out to determine the species abundance, richness and evenness in the eight community Blocks of Khordha district, Odisha under study in order to assess the effect of elemental content of water bodies in distribution of aquatic flora. Species richness (Shannon index) and species abundance (Simpson index) were calculated in the study area by using 10 m x 10 m quadrat; plant species were collected from 20 meters apart each with three replications in eight different water bodies. Water sample was also collected from the same aquatic habitat for elemental analysis by using XRF. The results of the study indicated that the species abundance and richness of diversity of the aquatic plants vary significantly in different locations of the area. The low value of Simpson and Shannon index found in location 4 (Tangi) where as high value of Simpson and Shannon index is observed in location 1 (Begunia). Species richness study in locality 1 and 3 were found dominant with submerged plants whereas location 2, 4 and 7 were found rich with free floating surrounded by marshy species. Elemental estimation by linear multivariable analysis could indicate that Si and P significantly promoted the growth of submerged plants while the growth of free-floating plants was reduced. Further, presence of S increased submerged plant population, while Halogen, alkali metals and TDS significantly reduced their growth and encouraged the growth of free-floating forms. Besides, Fe played significant role for enhancing the growth of submerged and for decreasing marshy plant species.

Keywords: Species richness, Abundance, Distribution and MVA.

GAMMA IRRADIATION IMPROVED *Cadmium lenience* IN *Chlamydomonas reinhardtii* BY ALTERING PHYSIO-BIOCHEMICAL RESPONSES

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ABSTRACT

Microalgae are natural biotic models for studying heavy metal genotoxicity, irradiation, and other external stimuli, as well as toxicant elimination. The removal of heavy metals from the aquatic environment using microalgae has received a lot of attention. However, there has been little research on cadmium toxicity in microalgae and their use as bio-accumulators. Previous research suggested that low-dose priming with non-ionizing radiations like gamma radiation increased heavy metal tolerance in plants and aquatic photosynthetic microalgae. We hypothesized the growth inhibitory physiochemical properties of cadmium (Cd) in *Chlamydomonas reinhardtii* and investigated the protective role of low-dose gamma radiation priming against Cd-induced growth inhibition by emphasizing the mechanism of cell survival by antioxidant defence system. *C. reinhardtii* that had been gamma-primed demonstrated increased cell survival and Cd tolerance, as well as effective modulation of biochemical responses such as antioxidant enzymes. The current study found that low-dose gamma radiation priming masks Cd-mediated oxidative stress and boost cellular detoxification via intracellular antioxidant enzymes in *C. reinhardtii*.

Keywords: Antioxidant enzymes, Cadmium, *Chlamydomonas reinhardtii*, Gamma radiation, Reactive Oxygen Species (ROS)

IN-SILICO AND IN-VITRO INVESTIGATION OF *Microchirita* PROTEIN FOR CANCER THERAPEUTICS

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ABSTRACT

The present investigation focusses on protein derived from *Microchirita* and its anticancer activity. Selectively, we attempted to address the interactions of the proteins for therapeutic intervention using in silico and in vitro experimental approaches. The protein-proteins interactions between PHAN protein (PDB-3ZQC) from *Microchirita* and β -catenin (PDB-7CE4), a known cancer protein by molecular docking studies reflected H₂ bond among Arg15, Tyr 46 and Trp 3 and alkyl bond between Cys88 and Phe108 with CDocker energy and CDocker interaction energy of -8.46kcal/mol and -12.936 kcal/mol respectively. Corroborating our results, MTT assay of cancer cell line FaDu and CAL33 showed that cell viability decreased with increase in concentration of the dose. Viability of cells of FaDu and CAL33at compound dose of 1mg/ml were 39.705 and 49.609 as compared with the control. In this study, it was revealed that proteins from *Microchirita* have an important role in the development of advanced cancer therapeutics in the future.

Keywords: *Microchirita*, PHAN, β -catenin, Molecular Docking, CDocker energy, MTT assay

PHYTOTHERAPEUTIC RESOURCES USED BY ORAON AND BHUIYAN TRIBES FOR PRIMARY HEALTHCARE: A CASE STUDY OF SUNDARGARH DISTRICT IN ODISHA, INDIA

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ABSTRACT

Located in the northwestern part of the state of Odisha, the district of Sundargarh, with a geographical area of 9,712 sq km, extends from 21° 36' N to 22° 32' N and from 83° 32' E to 85° 22' E. The district is home to several tribal communities, two of the prominent ones reported to practise considerable use of Phytotherapeutic resources being the Oraon and the Bhuiyan. With an objective to prepare a substantial database of the phyto-therapeutic knowledge of the two communities, ethnobotanical studies were undertaken during 2021-2022 to survey and document the plant resources used by the two tribes to address their primary healthcare concerns. A secondary objective is to characterise the biochemical properties of the most promising phyto-therapeutic specimen/s to ascertain their potential for drug discovery. The results of the present investigation through field interview and cross-verification revealed the uses of plant resources in primary health care of the two tribes: *Argemone mexicana* (anti-helminthic), *Rauvolfia canescens* (Antidote for snake venom), *Terminalia chebula* (expectorant), *Euphorbia hirta* (deworming), *Olex scandens* (Joint pain), *Calotropis gigantea* (insect bite), *Tridax procumbens* (hair tonic), *Vitex negundo* (Cough relief), *Ipomoea aquatica* (lactation), *Terminalia bellirica* (Dysentery), *Achyranthes aspera* (indigestion), and *Portulaca oleracea* (female fertility).

Keywords: Tribal, Phyto-therapeutic, Oraon, Bhuiyan, Ethnobotany

BIOACTIVE MOLECULES FROM PLANTS: A PROSPECTIVE APPROACH TO MODULATE AUTOPHAGY-APOPTOSIS PATHWAY

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ABSTRACT

Autophagy and apoptosis are among the most important cellular mechanisms associated with cancer advancement and policies. With the increase in cancer every day new methods are being developed to ensure that this deadly disease is cured. Conditions that need to be improved requiring cancer pills are strongly associated with the complexity of many types of carcinoma. In addition, crosstalk takes place through signaling mechanisms, entailing those concerned with autophagy and apoptosis. Numerous cancer models grow into drug-resistant chemotherapy because of the defects in the signature pathways, especially the apoptosis process. A growing number of evidence points to the growing ability of cancer-fighting phytochemicals that regulate many manifestations involving autophagy and apoptosis. Bioactive plant compounds play myriad of functionalities, primarily applicability in treatment of several patho-physiological disorders including their involvement as cancer therapeutics owing to the astonishing anti-cancer properties of phytomolecules. Essentially, phytochemicals alter autophagy and apoptosis, both of which are critical cellular pathways involved in the basic pathobiology of cancer development as well regulation. Therefore, phytomolecules-mediated pharmacological targeting of autophagy and apoptosis can be extensively explored in order to offer a complementary strategy to the conventional cancer chemotherapy. The anti-cancer outcome of phytochemicals is considered as specific and to be different from most cancer cells that have been implicated in autophagy and cell death. Thus, many phytochemicals point to be a promising source for developing cancer pills. High level of phytochemicals that use their anti-cancer properties *in vitro* and *in vivo* by controlling suicide strategies (i.e., berberine, lycopene, sulforaphane, curcumin, and resveratrol) are recently studied under analytical investigation for multiple varieties of cancers. Indeed, the combined use of

phytomolecules and anti-cancer compounds are far more appealing and thus can result in developing of novel treatment strategies to critically evaluate early carcinogenic mechanisms, thereby targeting the path of autophagy and apoptosis.

Keywords: Apoptosis, Autophagy, Phytochemicals, Cancer

BIOCHEMICAL CHARACTERIZATION OF RICE (*Oryza sativa* L.) CULTIVARS FOR RESISTANT STARCH, AMYLOSE CONTENT AND THEIR RELATIONSHIP WITH GLYCEMIC INDEX.

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ABSTRACT

Rice is consumed by more than half of the world's population for whom it is the main source of nutrients and carbohydrates. Rice starch is hydrolyzed by enzymes in the digestive tract and converted into glucose which is the main energy source for metabolic functions. After meeting the energy requirement of the body, the extra calories from starch are stored as glycogen or fats for later use. Therefore, overeating rice with sedentary lifestyle potentially leads to some health problems, such as obesity, type-II diabetes, and colon diseases in long terms. Thus, in this study, biochemical analysis was done to determine the glycemic index (GI), resistant starch (RS) and amylose content (AC) in rice from different ecologies. Large variation in the value of GI (60.07-70.36), RS (0.35-2.57%) and AC (3.79%-23.32%) was observed. Among the genotypes studied, Mashuri showed lowest GI (60.07) and highest RS (2.57%). The highest value for GI (70.36) was found in Abhishek with relatively low RS (0.83%). *O. brachyantha* had the lowest RS content (0.35%) with relatively high GI (68.84). A significant negative correlation was also observed between GI and RS. These findings emphasize upon the need to identify and develop rice genotypes with high RS, amylose and low GI which may be suitable for consumption by people suffering from diabetes, obesity and colon diseases.

Keywords: *Oryza sativa* L., Glycemic index, Resistant starch

STUDY OF ANTIFEEDANT ACTIVITIES OF SELECTED PLANTS AGAINST *Tribolium castaneum*

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ABSTRACT

Global food supply is enduring an unprecedented convergence of stress due to continuous rise of global population. Food security cannot be attained only by enhancing global food production but preventing food loss from abiotic and biotic agents are also equally important. Therefore, control of storage insects are one of the major challenges in grain protection of the different insect pests that infest flour, the *Tribolium castaneum* commonly known as the red flour beetle, is extremely significant because of the damages it inflicts. Phyto-derived insecticides or botanical insecticides are naturally available toxin antagonistic to insects. The rationale of the present study was to evaluate the effect of several plant extracts for its repellency and lethal activity against stored grain pests, *Tribolium castaneum*. Survey information from local farmers was the basis for screening of plants with plausible insecticidal potential. *Andrographis paniculata* (Burm. f.) Nees, *Vitex negundo* (L.) and *Paederia foetida* (L.) were selected for the evaluation of insect specific bioactive role. Repellency effects of all the five solvent extracts were directly proportional to increase in exposure period and concentrations. Reverse phase HPLC analysis provides chromatographic profiling of solvent extracts. Bioactivity guided fractions of 2-propanol extract of *A. paniculata* was separated and re-evaluated for bioactivity studies. Among the major peaks eluted by HPLC fractionation, the fraction (Rt- 2.7 min) showed higher repellency and significant mortality on *T. castaneum* than the fraction (Rt- 5.7 min). Function driven purified fraction will serve in identification of bioactive specific compound and will act as lead compound in development of natural pesticide.

Keywords: *Tribolium castaneum*, HPLC, Antifeedant activities, *Vitex negundo* (L.), *Paederia foetida* (L.)

EXPLOITATION OF AQUATIC WEEDS IN DOMESTIC WASTEWATER TREATMENT – A CASE STUDY IN KHORDHA DISTRICT OF ODISHA

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ABSTRACT

Now-a-days environmental pollutions and contaminations are major issues across the globe. In turn to achieve sustainable development, it is obligatory to reduce pollutants and contaminants from the environment essentially by employing different types of remediation approaches. Because of increase in environmental pollution, the amount of good quality water and soil are depleting, primarily due to disposal of untreated toxic wastes rich in heavy metals from industries directly into water sources. Furthermore, the non-biodegradable nature of these contaminants make the situation worst and result in bioaccumulation leading to serious risk to living organisms. Though there are several pollutant-remedial approaches, maximum strategies are non-economical and not eco-friendly. On the other hand, phytoremediation employing macrophytes is an innovative, novel, green technology having a great potential of remediation besides cost effective and eco-friendly technology. The primary goal of this study was to assess the physico-chemical properties of municipal waste water from major water bodies including drains and other water resources of Bhubaneswar located in Khordha district of Odisha. The main objective of this investigation was also to develop an economically viable technology for the detoxification of contaminated waste water through phytoremediation using floating aquatic plants such as *Azolla pinnata* R.Br. and *Spirodela polyrrhiza* (L.) Schleid. The results of the present study indicated the potential of the test macrophytes in hyperaccumulating the toxic elements present in the waste water samples used for the experiment.

Keywords: Phytoremediation, Waste water, Macrophytes, Khordha

A COMPREHENSIVE REVIEW OF ABIOTIC STRESS RESPONSE AND REGULATION IN CYANOBACTERIA

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ABSTRACT

Cyanobacteria comprise a group of photosynthetic oxygenic prokaryotes. Cyanobacteria have the ability to cope with starvation and abiotic stress so, they are of universal occurrence and found in variety of habitats. Abiotic factors such as salt, temperature, oxidative stress, UV, pH, metal mostly affect cell growth and metabolism in cyanobacteria. In order to adopt these stresses and survive, they have developed adoptive responses. Cyanobacteria response to salt stress by accumulating organic solutes like sugar and active export of inorganic ion. They also have a set of salt inducible proteins to tolerate salt stress. Cyanobacteria developed both enzymatic and non-enzymatic anti oxidative system to avoid the production of ROS against stress. Against UV stress cyanobacteria synthesize UV absorbing compounds like Scytonemin. They also have DNA repair system against UV stress. Cyanobacteria membrane composition is significantly changed in response to temperature stress. Cyanobacteria regulate temperature stress by desaturation of fatty acid, induction of enzymes and evolution of proteins. Growth of cyanobacteria mainly affected by pH stress. They express proteins involved in carbon assimilation and pH homeostasis, adjustment in carbonic anhydrase activity for adaptation to pH stress. Heavy metals are accumulated due to anthropogenic and natural causes in cyanobacteria causing enlargement in polyphosphate granules. Cyanobacteria maintain metallic homeostasis by alternation in membrane structure and activation or inactivation of transfer pumps. Cyanobacteria are economically very important. The aim of this review is to gain knowledge about diversity of cyanobacteria response to abiotic stresses and the regulation of abiotic stresses by different mechanisms.

Keywords: cyanobacteria, abiotic stresses, metallic homeostasis

DIVERSITY OF SUBAERIAL ALGAE FROM SIMILIPAL BIOSPHERE RESERVE (SBR) WITH SEVEN NEW DISTRIBUTIONAL RECORDS TO INDIA

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ABSTRACT

Cyanobacteria and microalgae are important components of subaerial microbial community. Knowledge on diversity and distribution of cyanobacteria and green algae in subaerial habitats still lags behind than those of freshwater and marine environments. It is clear that these organisms have been affected by an extreme morphological convergence that has restricted their morphology to a narrow range, not indicative of their great genetic diversity. Though Similipal Biosphere Reserve is an untapped reservoir of diverse algal resources, the present work aims to investigate species composition of subaerial blue-greens, green algae and diatoms growing on tree bark (corticolus), soil crust and surface of stone (lithophytes) within the biosphere reserve and its adjoining regions like Devkund and Bhimkund. The subaerial taxa present in 61 different samples were keenly studied for morphometric enumeration and identification. Dominant taxa were isolated, cultured and preserved in algal germ-plasm collection of P.G. Department of Botany, MSCB University, Baripada, Mayurbhanj, Odisha. A total of 43 algal taxa belonging to Cyanoprokaryota, Chlorophyta and Bacillariophyta under 26 genera were recorded from these habitats. It is observed that genera like *Nostoc* (8) were found most abundant followed by *Leptolyngbya* (4), *Phormidium* (4), two species each from *Borzia*, *Hapalosiphon*, *Westiellopsis* and *Chlorococcum*, including 19 other genera represented by single species each. Our documentation showed wide range of algal diversity from this untapped ecosystem and the relative frequency of heterocystous cyanobacteria were found more than other group of algae recorded. This diversity study also focused on alpha-diversity and beta-diversity with diversity indices. The data revealed a total of seven new records to India namely *Leptolyngbya margaretheana*, *Phormidium coutinhoi*, *Nostoc undulatum*, *Nostoc copiosum*,

Nostoc locularis, *Hapalosiphon brasiliensis*, *Hazenella brasiliensis*. Further analysis of data will definitely generate a significant result on algal wealth of Similipal Biosphere Reserve.

Keywords: corticolus, morphometric enumeration, SBR

BIOACTIVE POTENTIALS OF THE CYANOBACTERIUM *Petalonema crustaceum* COLLECTED FROM SIMILIPAL BIOSPHERE RESERVE, ODISHA

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ABSTRACT

The present investigation aims at phytochemical and bioactive screening of cyanobacterium *Petalonema crustaceum*, a promising isolate sourced from Similipal Biosphere Reserve, Odisha. Its methanolic extract was found to possess phytochemicals like phenols, tanins, flavonoids, saponins, terpenoids, sterols, glycosides and alkaloids with significant antibacterial and antioxidant activity. The MIC analysis of the extract showed better inhibition towards test pathogens at low concentrations of metabolites. Thus GC-MS analysis was carried out to identify the compounds present in the extract. A total of 22 peaks revealed 20 different compounds in the methanol extract of *P. crustaceum* with diverse bioactivity i.e antibacterial, antiviral, antifungal, antiinflammatory, anticancer, antiparasitic and antioxidant as reported earlier. Considering the species as a promising isolate with potential bioactivity, its molecular analysis was carried out further for isolation and sequencing of 16S rRNA. The sequence result showed relation with *Scytonema crustaceum* which is no longer accepted taxonomically. Instead of *Scytonema crustaceum*, the species renamed as *Petalonema crustaceum* is significantly accepted worldwide. The sequence is submitted to NCBI genebank for this species being the first reported from Indian sub-continent.

Keywords: Cyanobacteria, *Petalonema crustaceum*, Phytochemicals, Bioactivity

IN VITRO EVALUATION OF ANTIBACTERIAL POTENTIAL OF *Abutilon indicum* (L.) SWEET LEAF

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ABSTRACT

Antibiotics are one of the most important weapons against bacterial infections and are beneficial to the human life since their introduction. However, over the past few decades their health benefits are under threat as many commonly used antibiotics have become less and less effective against certain illnesses not only because many of them produce toxic reactions but also due to emergence of drug resistant strains of the bacterium. So, it is essential to explore plant-based antibacterial drugs to overcome the adversity of using synthetic drugs besides addressing the resistant bacterial strains. In the present study an assessment of *in vitro* antibacterial activity of leaf extract of *Abutilon indicum* (L.) Sweet, with two solvents namely, petroleum ether and methanol, against clinical isolates of *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* was carried out following agar well diffusion technique. The concentration of test plant extracts was 20 mg/ml. The results of the present study revealed that both petroleum ether and methanolic extracts were highly effective against *Pseudomonas aeruginosa* (32.53 ± 0.41 mm) and (23.33 ± 0.47) respectively. But petroleum ether extract was found to be least effective against *Salmonella paratyphi* and *Bacillus subtilis* (10 mm) whereas the methanolic extract was least against *Streptococcus mitis* (10 mm). *Escherichia coli* were found to show resistance towards methanolic extract. The inhibitory activity of the leaf extracts was compared with Clarithromycin as reference antibiotic (RA). The concentration of (RA) was 0.5 mg/ml and the result of inhibition ranged between 38.33 ± 1.69 mm (*Escherichia coli*) to 27.66 ± 0.94 mm (*Salmonella paratyphi*).

Keywords: *Abutilon indicum*, Clarithromycin as reference antibiotic (RA)

ANTIMICROBIAL, ANTICANCER AND ANTIOXIDANT POTENTIAL OF TWO DOMINANT MACRO-LICHEN

Dirinaria aegialita AND *Parmotrema praesorediosum* COLLECTED FROM SIMILIPAL BIOSPHERE RESERVE OF ODISHA, INDIA

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ABSTRACT

The present study was undertaken to evaluate the antimicrobial, antioxidant and anticancer activity of *Dirinaria aegialita* (Afzel. ex Ach.) B.J. Moore and *Parmotrema praesorediosum* (Nyl.) Hale, the two dominant macro-lichen taxa from the Similipal Biosphere Reserve of Odisha. Both the lichens were evaluated for their efficacy against three bacterial species such as *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Bacillus subtilis*, and three fungal species such as *Aspergillus niger*, *Trichoderma harzianum* and *Candida albicans*. The *D. aegialita* and *P. praesorediosum* showed higher inhibitory effect against *Bacillus subtilis* and *Staphylococcus aureus* respectively. *D. aegialita* also showed the higher inhibitory activity against MCF-7 and MDA MB-231 breast cancer cell line as compared to *P. praesorediosum*. Besides, *D. aegialita* was found to have better antioxidant activity than *P. Praesorediosum* in scavenging assay. Thus, the results of the above study confirmed that *D. aegialita* species is having better potential in its antibacterial, antioxidant and anticancer activity as compared to *P. praesorediosum*.

Keywords: *Dirinaria aegialita*, *Parmotrema praesorediosum*, Macrolichen, Simlipal Biospere Reserve

IMPACT OF CLIMATE CHANGE ON THE WATER QUALITY AND AQUATIC FLORA BIODIVERSITY IN GHODAHADA RESERVOIR, GANJAM DISTRICT

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ABSTRACT

Impacts of climate change and biodiversity loss are two of the most important challenges posing today's living world. A preliminary study was conducted at Ghodahada, a water reservoir in Ganjam district to analyze the impact of climate change on the water quality that helps in the maintenance of its aquatic flora biodiversity. Water quality parameters such as pH, temperature, dissolved oxygen and biological oxygen demand were analyzed during the study period. The pH of water varied from 6.82 to 7.42 (7.12 ± 0.18), water temperature was in a range of 24.5°C to 33.7°C (29.1 ± 2.42), dissolved oxygen ranged from 3.91 to 5.48 mg/l (4.69 ± 0.47) and biological oxygen demand was observed to be 2.13 to 3.94 mg/l (3.03 ± 0.42). The maximum permissible limit of pH as prescribed by ICMR & BIS is 6.5 to 8.5 and WHO is 7.0 to 8.5. Hence, the present study is in partial accordance with the above standards. The aquatic flora biodiversity in the reservoir comprised of 28 macrophytes out of which 11 were rooted floating, one species was free floating and 16 were root emergent. *Hydrilla verticillata*, *Pistia stratiotes*, *Marsilea quadrifolia*, *Nymphaea stellata*, *Nelumbo nucifera*, *Ipomea aquatica*, *Chara* sp, *Salvinia natans*, *Colocasia* sp are few names that has been observed in the reservoir. The result indicated that the water quality of Ghodahada reservoir is quite suitable for growth of aquatic flora and carry high ecological status.

Keywords: Water quality parameters, Aquatic flora biodiversity, Ghodahada Reservoir

Bacillus* spp. PRIMING INDUCED DEFENSE IN RICE AGAINST *Xanthomonas oryzae* PV. *Oryzae

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ABSTRACT

Rice is an important staple food of India. Every year there is a huge reduction in rice production due to the attack of pathogens. Bacterial blight (BB) disease is caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) and is a serious threat to rice production and is responsible for 45-50 % loss of annual grain yield. Use of bactericides to provide protection against *Xoo* results in increased pathogen resistance and is a cause of environmental concern. Therefore, biopriming and chemopriming, with safe and novel agents, have emerged as ecofriendly ways to provide protection against broad spectrum of rice pathogens without any significant loss of rice yield. In the present investigation, rice seeds were treated with different biotic (*Trichoderma* spp. and *Bacillus* spp.) agents. The effect of these agents on physiological and biochemical parameters in plant was studied in the net house and in the field condition. Disease index and different agronomical parameters were recorded. The results suggested that *Bacillus* spp. was more efficient and promising in inducing defense against *Xoo* in rice plants by improving the photosystem II activity, chlorophyll content, and defense enzymes activity. So, use of *Bacillus* spp. provides an eco-friendly way to manage BB disease with any rice yield penalty.

Keywords: *Xanthomonas oryzae*, Biopriming, Chemopriming, *Trichoderma*, *Bacillus*

IMIDACLOPRID DELINKS PHYCOBILISOMES FROM PS II IN *Synechocystis* SP. PCC 6803

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ABSTRACT

Neonicotinoids are the fastest growing class of insecticides representing 17% of annual sales in global insecticide market. The increased consumption of pesticides in the agricultural land, significantly affects the native-non target soil microflora. In this study, effects of imidacloprid (0-5 mM) on photosynthesis and PS II function of *Synechocystis* sp. PCC 6803 was measured with exposure up to 6 hrs. There is no significant degradation of pigments (Chl a and Car) and no significant change in the protein but a marginal decrease in the carbohydrate content was seen. Activities of phosphatase and esterase decreased at high concentrations (10^{-2} mM). PS II fluorescence decreased but PBS fluorescence increased with an increase of PBS/PS II fluorescence ratio and indicating delinking of PBS from PS II. The J peak of OJIP rise was seen to be decreasing with concentration increase further confirming lower PS II function. No J-P rise at concentration greater than 3mM was observed. RE function and photosynthetic efficiency were low and high dissipation of energy was detected.

Keywords: Neonicotinoids, Imidacloprid, *Synechocystis*, PSII, PSB, Fluorescence

IMPACT OF SHORT-TERM EXPOSURE OF *Anabaena* sp. PCC 7119 TO ORGANOPHOSPHORUS INSECTICIDE CHLORPYRIFOS

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ABSTRACT

Application of synthetic pesticides and their residual toxicity greatly influences the density and diversity of cyanobacteria present in the soil. Chlorpyrifos (CP) is the most widely used chlorinated organophosphates (OP) with 36% world consumption market coverage and its residual toxicity has been reported in many organisms. A primary investigation on the effects of CP on *Anabaena* sp. PCC 7119 was done by taking different concentrations (1-30 μ M) of CP and with short exposure (3 and 6hr) duration. There was no change in culture absorbance and pigment content (chlorophyll *a* and carotenoides) during 3hr whereas a marginal but insignificant decrease of Chlorophyll and accumulation of pheophytin was observed at 30 μ M after six hr. No major changes were noticed in protein content, though a decreasing slope for carbohydrates was observed. Esterase and phosphatase activity were high and increased with CP concentration. There was concentration dependent increase of PSII and PBS fluorescence and decrease of PBS/PSII fluorescence ratio. Herbicide like J rise observed at both the treatment times associated with enhanced dissipation. ETR, exciton movement, and RE functions were low in all treated cultures. It is concluded that CP has a herbicide like action on the PS II activity in *Anabaena* sp. PCC 7119.

Keywords: Chlorpyrifos, Organophosphates, *Anabaena* sp, ETR, RE

CONSERVATION AND RESTORATION OF MANGROVES IN SARTHA ESTUARY

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ABSTRACT

Mangroves of Sartha Estuary in Balasore district of Odisha have been depleted at an alarming rate due to the operation of various biotic factors. The present vegetation is found in denuded condition and are at a great degree of threat due to various anthropogenic activities including prawn cultures, clearing mangrove forests for human habitation and development of tourism. Keeping the above facts in mind floristic studies have been conducted in different locations of Sartha estuary to get a comprehensive idea about the distributional pattern of mangroves, their socioeconomic importance, the impact of various biotic factors on the mangrove vegetation and to develop various strategies for its conservation. During the present investigation 24 species of mangroves and their associates have been reported from different locations of Sartha estuary. It has been observed that these mangrove forests harbors quite a good number of potential medicinal plants and other plants of various socio-economic importance. The results of the phytochemical analysis of some potential mangroves and their associates such as *Acanthus ilicifolius* L., *Avicennia alba* Bl., *Avicennia marina* (Forssk.) Vierh., *Rhizophora apiculata* Bl., *Sonneratiacaseolaris* (L.) Engl. showed the presence of various phytochemicals such as alkaloids, flavonoids, glycosides, phenols, tannins, saponins etc. Loss of mangroves in different areas 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 on top priority for the protection of coastal environment in this region.

Keywords: Sartha estuary, Mangroves, Phytochemical analysis, Conservation.

ISOLATION AND CHARACTERIZATION OF A PLANT GROWTH PROMOTING *Klebsiella* sp. FROM THE RHIZOSPHERE OF *Parthenium hysterophorus*

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ABSTRACT

Plant growth promoting rhizobacteria (PGPR) are the soil bacteria inhabiting around/ on the root surface and are directly or indirectly involved in promoting plant growth and development via production and secretion of various regulatory chemicals in the vicinity of rhizosphere. The PGPR helps in recycling of various plant nutrients including nitrogen and phosphorous which are two essential plant nutrients whose deficiency severely restricts crop yield. In this study, a luxuriantly growing *Parthenium hysterophorus* was selected and the microbial analyses of the rizospheric soils were done to study the presence different PGPR species. The study resulted in the isolation of phosphate solubilizing bacteria strain FMUEVSO1 which also has the capacity to produce HCN, IAA and ammonia in nitrogen free medium indicating its biofertilizer potential. This bacterium was utilized as a liquid biofertilizer against *Tagetes erecta* plant and resulted in better growth of root length, shoot length, fresh biomass, and dry biomass than control. The strain was identified to be *Klebsiella* Sp. (NCBI gene bank accession no. OP305782) on the basis of 16s ribosomal RNA gene sequencing report.

Keywords: PGPR, Rhizosphere, Biofertilizer, Rhizobacteria, IAA, HCN.

SUBAERIAL ALGAL FLORA OF SIMILIPAL BIOSPHERE RESERVE, ODISHA, INDIA

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ABSTRACT

The Similipal Biosphere Reserve spreads over an area of 2,750 km², is situated in the heart of Mayurbhanj district of Odisha, India. Its unique ecosystem caters diverse flora and fauna of Similipal forests. Keeping this in view, the present study aims to document subaerial algal forms from different habitats like tree bark, and rock surfaces of this biosphere reserve. A total of 49 algal species belonging to 32 genera, 23 families, and 13 orders under 4 divisions viz. Cyanophyta, Chlorophyta, Charophyta, and Bacillariophyta were reported from different sites, of which 45 species reported for the first time from the area. Out of the 49 algal species 29 belong to Cyanophyta, 15 to Chlorophyta, 3 to Charophyta, and 2 to Bacillariophyta. The algal species recorded are *Anabaena fuellebornii*, *Anabaena subcylindrical*, *Aphanocapsa testacea*, *Aphanothece microscopica*, *Calothrix clavatoidea*, *Chroococcus minor*, *Chroococcus minutus*, *Chroococcidiopsis kashayi*, *Gloeocapsa punctata*, *Gloeotheca palea*, *Haplosiphon hibernicus*, *Leptolyngbya foveolarum*, *Nostoc piscinale*, *Nostoc* sp., *Oscillatoria subbrevis*, *Phormidium ambiguum*, *Phormidium aerugineo-caeruleum*, *Phormidium bulgaricum*, *Phormidium kolkwitzii*, *Phormidium retzii*, *Planktothrix clathrata*, *Planktothrix isothrix*, *Scytonema burmanicum*, *Scytonema javanicum*, *Scytonema schmidtii*, *Scytonema stuposum*, f. *nanyohense*, *Tolypothrix rechingeri*, *Tolypothrix scytonematoides*, *Westiellopsis prolifica*, *Chlorella minuta*, *Chlorella vulgaris*, *Chlorococcum* sp., *Coelastrella* sp., *Desmodesmus subspicatus*, *Dictyococcus varians*, *Dictyochloropsis* sp., *Gloeocystis gigas*, *Kirchneriella aperta*, *Kirchneriella obesa*, *Monoraphidium contortum*, *Monoraphidium indicum*, *Monoraphidium tortile*,

Stichococcus minor, *Symbiochloris irregularis*, *Cosmarium* sp., *Klebsormidium dissectum*, *Klebsormidium flaccidum*, *Gomphonema* sp., *Pinnularia borealis*.

Keywords: Algal diversity, Biosphere reserve, Subaerial algae, flora and fauna

ANTIBACTERIAL ACTIVITY OF ENDOPHYTIC BACTERIA ISOLATED FROM SELECTED MEDICINAL PLANTS AGAINST HUMAN PATHOGENS

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ABSTRACT

Bacterial endophytes were isolated from medicinal plants such as *Tinospora cordifolia*, *Adhatoda vasica*, *Paederia foetida*, *Datura stramonium*, *Swertia chirayita*, *Artemisia nilagirica* and tested for their antibacterial activities against selected bacterial pathogens through Disk Diffusion Method (DDM). In total 52 bacterial endophytes were isolated from stem, leaf and petioles of above mentioned medicinal plants, of which 30 (58%) of the isolates showed antibacterial activity against test pathogens such as *Staphylococcus aureus*, *E. coli* and *Salmonella* sp. during preliminary studies. Isolates that showed positive activity in the preliminary test were subjected to secondary screening in Muller-Hinton agar plates against *Escherichia coli*, *Salmonella* sp. and *Staphylococcus aureus* by the cross-streaking method (BLIS). Only 10 (33%) numbers of isolates were able to inhibit all the 3 test pathogens on the crossing line there by exhibit bacteriocin like activity. Since the activity was observed on solid agar plates, it indicates that bacteriocin like compounds observed during this study are water soluble and extracellular in nature. All the potential isolates will be validated through further secondary screening methods, will be characterized and identified for possible bioactive compounds. The study requires further analysis for development of new antibacterial compounds from bacterial endophytes as multiple drug resistance in pathogens has become a great concern for mankind.

Keywords: Antibacterial activity, DDM, BLIS, Bacteriocin

PHYSIO-CHEMICAL CHARACTERIZATION OF PLANT-BASED SILVER NANOPARTICLES INCUBATED WITH BOVINE SERUM ALBUMIN AT VARIABLE TEMPERATURE

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ABSTRACT

In recent years, nanotechnology has emerged as the most exciting new frontier in science and technology. Because of the superior optical, chemical, photo-electrochemical and electronic properties than their bulk counterparts, nanomaterials are referred as the building blocks of nanoscience. In many sectors, including biology, industry, and medicine, the utilization of nanostructured materials has begun a new era. Nanoparticles can interact with many of the biomolecules such as proteins, nucleic acids, lipids in biological system with less toxicity. In this context, easily available and simple protein molecule like albumin can be served as scaffold for production of varieties of nanoparticles for biomedical purposes as a delivery agent for therapeutic molecules. Albumin is a component of human blood, which shows no immunogenicity as an endogenous protein and ensures its biocompatibility for albumin-based nanoparticles. In the present study the interaction between nanoparticles and BSA protein is carried out. For this purpose, silver nanoparticles are prepared by bio reduction method and allowed to interact with the native BSA. Exploring the effects of interaction between nanoparticles and BSA can be useful for designing the nanomaterials for the future applications in biological system.

Keywords: Silver nanoparticles, BSA, Nanoparticles -Protein interaction, Nano materials

IN SILICO INVESTIGATION OF PHYTOCONSTITUENTS FROM *Premna* AGAINST β -CATENIN FOR CANCER THERAPEUTICS

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ABSTRACT

The present investigation was carried out in silico to find the anticancer ability of the genus *Premna*. We specifically endeavored to investigate the interaction between β -catenin and phytoconstituents from *Premna*, which includes n-Tricosane, n-Tetracosane, n-Pentacosane, n-Heptacosane and n-Octacosane. Different computational tools such as Pymol, Castp and drug discovery studio, Biovia and site such as RSCB PDB and PUBCHEM were intermittently used to analyze the result. The ligands such as n-Tricosane, n-Tetracosane, n-Pentacosane, n-Heptacosane and n-Octacosane showed interaction with β -Catenin having CDocker and CDocker interaction energy in the range of 28.5798, 38.8747, 35.6683, 35.3119, 32.7446 and 27.336, 31.6522, 30.0805, 34.3935, 29.664 respectively. The receptor-ligand interaction i.e, the binding affinity revealed that the phytoconstituents from *Premna*, a medicinal plant could be a potential drug in cancer therapeutics which needs to be explored.

Key words: *Premna*, β -Catenin, Receptor, Ligand, Biovia

ALPHA AMYLASE ACTIVITY AS AN INDEX FOR GERMINATION POTENTIAL IN RICE

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ABSTRACT

Rice yield has been affected severely by unwanted cyclonic storms with heavy rains and flooding during the maturation period in October-November due to lacking of dormancy to escape the onslaught of the erratic weather and seeds germinate and spoil food quality. However, the instability of rice production due to such unwarranted conditions can be mitigated by introgression of seed dormancy trait in high yielding rice. Alpha-amylase is an enzyme that performs a major role in shifting a quiescent embryo to an active phase. Considering variations in dormancy, an experiment was conducted by taking dormant, semi-dormant and non-dormant rice seeds to understand the role of α -amylase activity in breaking seed dormancy. Rice Seeds were germinated in a growth chamber at 27°C under a 12h/12h light/dark cycle in Petriplates. The experiment was conducted during the entire period of 2021 from January to December. It was found that germination % was almost 100% in the non-dormant seeds during the entire period of the experiment whereas in semi-dormant seeds, it was lesser than that of non-dormant. On the other hand, the G% in dormant seeds ceased from August till December. α -amylase activity followed the same trend as that of G%. Hence, alpha-amylase activity may be taken as an index for germination potential and regulation of enzyme activities may prevent viviparous seed germination.

Keywords: Seed dormancy, α -amylase, Viviparous germination, Quiescent embryo

ASSESSMENT AND CONSERVATION OF WETLAND PLANT DIVERSITY IN JAJPUR DISTRICT OF ODISHA, INDIA

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ABSTRACT

Floristic studies have been conducted during 2016-2022 in different wetland habitats of Jajpur district of Odisha to document the phytodiversity in this region. Extensive floristic studies in these areas have been conducted, voucher specimens were collected, identified, and preserved in the form of herbarium following standard method. A total of 115 plant species belonging to 85 Genera and 45 Families were reported. Out of them, monocot flora was composed of 49 species under 33 genera and 10 family, whereas dicot flora was composed of 55 species under 44 genera and 27 family. Pteridophytes were composed of 11 species under 8 Genera and 8 Families. The monocot and dicot species ratio were 0.89, genus ratio was 0.75 and family ratio were 0.37. The family Poaceae (19 Species) was the most dominant family followed by Cyperaceae (13 Species), Asteraceae (9 Species), Araceae and Nymphaeaceae (4species), Pontederiaceae, Commelinaceae, Fabaceae, Scrophulariaceae, Rubiaceae, Euphorbiaceae, Onagraceae, Polygonaceae (3 Species each), Lemnaceae, Hydrocharitaceae, Amaranthaceae, Lythraceae, Molluginaceae, Boraginaceae, Convolvulaceae, Salviniaceae, Marsileaceae, Azolaceae (2 Species each). Other 21 families are represented by one species each. The water bodies of this area shrink down due to mining activities and industries and are now on the verge of severe threat. Over exploitation, interference of invasive alien species and other developmental activities in different areas are also responsible for loss of aquatic biodiversity. Adequate steps should be taken to conserve these plant resources which will improve the livelihood of the local people and promote biodiversity conservation in this region.

Keywords: Wetland, Floristic studies, Conservation, Bio-resources, Livelihood

NON-PHOTOSYNTHETIC PIGMENTS PROVIDES PROTECTION AGAINST UV-B RADIATION IN CONTRASTING RICE CULTIVARS

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ABSTRACT

Rice is one of the World's most important staple food crops. In the wake of changing climate, rice growth, productivity and consequently the food security has been seriously affected by abiotic stresses. UV-B radiation (280-315nm) is a minor component of the solar spectrum, but is the most energetic one that reaches the earth's surface and affects crop growth and productivity. 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 KJm⁻²d⁻¹) by UV-B emitting fluorescent tubes (TL20w/01). Morpho-physiological and biochemical parameters such as number of pubescent hairs and concentrations of chlorophylls, carotenoids, anthocyanins, flavonoids and lipid peroxidation were analysed during different days of treatment. In addition to fluorescence-mediated quenching of absorbed UV-B radiations, sterility of panicles were also analysed. It was found that supplemental UV-B radiation in Lalkain cultivar accumulated more amount of non-photosynthetic pigments like flavonoids and anthocyanin in comparison to Swarnaprabha whereas the concentration of photosynthetic pigments declined more in the later than the former. Lipid peroxidation after UV-B treatment was more prominent in Swarnaprabha than Lalkain and results were also reflected in grain yield. Results revealed that increased concentration of non-photosynthetic pigments might be responsible for UV-B resistance in Lalkain compared to Swarnaprabha.

Keywords: Rice cultivars, UV-B, Lipid peroxidation, Sterility of panicles

PRESENT SCENARIO OF DELETERIOUS EFFECT DUE TO THE LONG TERM EXPOSURE OF METALLIC POLLUTANT CHROMIUM ON PLANTS, SUKINDA VALLEY, ODISHA

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ABSTRACT

Chromium, a prominent carcinogen found in different oxidation state in the environment because of its high redox potential and valence shell chemistry. Chromite mines of Sukinda Valley produce around 334 million tons of chromium annually and this Valley of Jajpur district, Odisha has become a "Valley of Misery", despite its huge economic contribution to the country. A comprehensive production of different forms of chromite ore has made it a contamination prone region due to the deposition of an unacceptable amount of chromium in to the natural environment. The Cr[VI] and Cr[III] are two most lethal state of chromium that gets access to plants via mineral intake and other means. The trivalent form (Cr[III]) can infiltrate into plant tissues interrupting different cellular activities by attacking proteins, DNA and membrane lipids. It also hampers the plant growth by damaging the metabolic processes and produces reactive oxygen species which accelerates the stress condition when exposed to the plants tissues. The hexavalent chromium Cr[VI] supresses the development of cotyledons and inhibits root-shoot elongation as well. The detachment of plasma membrane from cell wall and reduction in chlorophyll and carotenoid levels in the plant also results from its long term exposure. Till now there is no proper estimation of the extent at which the plants are being affected by such heavy metals which ultimately deteriorates the crop productivity without any constraints. This study focuses to bring forth certain preventive measures to compensate the deleterious effect of chromium ions induced on the plants, hampering the productivity.

Keywords: Chromium, Sukinda Valley, Plant Productivity, Exposure

TRANSFORMATION OF CRISPR-Cas9 BASED CLONED AAP3 GENE IN SWARNA RICE VARIETY

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ABSTRACT

Rice is one of the prime source of dietary energy for more than 50% of the world's population as well as in India. One of the popular cultivated *indica* rice variety is Swarna with low glycemic index (GI). Out of many genes responsible for rice yielding one is Amino Acid Permease3(AAP3). Suppressing the expression of *OsAAP3* leads to reduce Arg, Lys, His concentrations to a modest level, promoting bud outgrowth, increasing tiller numbers and effective panicle numbers per plant, and improving grain yield and NUE. Thus, the knockout of AAP3 gene using CRISPR-Cas9 technology will leads to increase in tiller number, subsequently rice yielding. First the sgRNA construct were prepared using Cas9: gRNA binary vector cloning (PYLCRISPR/Cas9Pubi-H) through Golden Gate Assay. Then the cloned gRNA:Cas9 vector transformed to the Swarna through *Agrobacterium* mediated transformation to get the genome edited lines to increase tiller number and yield related traits.

Keywords: Rice, Swarna, tillers, AAP3, CRISPR-Cas9, sgRNA, golden gate assay, *Agrobacterium* transformation.

IDENTIFICATION OF ELITE GENOTYPES OF *Curcuma caesia* THROUGH AGROCLIMATIC ZONE BASED EVALUATION OF INDUSTRIALLY IMPORTANT QUALITATIVE TRAITS

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ABSTRACT

Curcuma caesia (Black Turmeric) an underexplored plant of zingiberaceae family, found to have great importance in the realm of traditional medicine. The indiscriminate exploitation of the plant for the sake of ailment remedy and other spiritual practices in the past has led it to the verge of extinction, making it under critically endangered category. The repercussion of its unavailability in the terrestrial flora exempts us from exploring such industrially important crop. Moreover, the deterioration of the species population is also induced by climatic changes and other environmental influences. Therefore, the present study initiates to evaluate its industrially important qualitative traits and identify elite genotypes from different agroclimatic zones of Odisha. For this study, 50 genotypes (n=50) from different places belonging to each of the 10 agroclimatic zones were collected, grown and subjected for analysis in terms of industrially important trait (anthocyanin and essential oil) yielding property. The highest content possessing genotype, one from each agroclimatic zone was first selected (n=10). Later, 6 genotypes (n=6) were chosen on the basis of Anthocyanin > 6%, leaf oil e" 1.2%, and rhizome oil >1.5% to be the promising elite genotypes. Among which, the genotypes of Koraput district (EGHCC27 and EGHCC28), belonging to Eastern Ghat High Land were observed to carry high drug yielding components where the major compounds, Eucalyptol and Camphor of leaf and rhizome respectively was also found highest. This study contributes for identification of elite genotypes and suitable agroclimatic conditions that promotes industrially important qualitative traits yielding property of the species.

Keywords: *Curcuma caesia*, Agroclimatic zones, Anthocyanin, Eucalyptol, Camphor

ALLEVIATION OF Cr^{+6} TOXICITY IN *CICER ARIETINUM* L. THROUGH ARBUSCULAR MYCORRHIZAL FUNGI (AMF) INOCULATION

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ABSTRACT

Heavy metal pollution has become a major concern in recent years. Cr^{+6} are known to be highly toxic to living organisms. Arbuscular mycorrhizal fungi (AMF), the symbiotic microbe of vascular plant root are well-known for promoting plant growth in heavy metals contaminated sites. AMF association has been reported to alleviate heavy metal stress of plants. The current study, therefore designed to study the efficiency of two AMF species *Rhizophagus irregularis* (Ri) and *Claroideoglomus claroideum* (Cc) reducing Cr^{+6} toxicity in *Cicer arietinum*. After 45 days of growth, the morphological and some biochemical parameters of *C. arietinum* in association with AMF were evaluated and compared with those of control plants (non-AMF). Better morphological and biochemical parameters were observed in AMF-inoculated plants (M) compared to control plants. It was revealed that the AMF *R. irregularis* was more effective than *C. claroideum* in reducing Cr^{+6} toxicity in *C. arietinum*. Thus, AMF *R. irregularis* can employed to alleviate Cr^{+6} toxicity in *C. arietinum* in Cr^{+6} contaminated soil.

Keywords: Cr^{+6} toxicity, *C. claroideum*, *R. irregularis*, *C. arietinum*, AMF

ESTABLISHMENT OF ROOT ORGAN CULTURE AND TRANSFORMED HAIRY ROOT CULTURE FOR AXENIC CULTURE OF AM FUNGI

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ABSTRACT

Arbuscular mycorrhizal (AM) fungi form symbiotic relationship with majority of vascular plants. The AM fungi obtain sugar and lipid for their sustenance from host plant and in return they provide host plants with increased access to soil resources through mycelial network. The symbiotic relationship is used as bio-fertilizer for sustainable agriculture and ecosystem management. Considering the benefits of AM fungi to the host plant, large-scale mass production of AM fungal inoculum is essential for long-term agricultural sustainability. Various methods are available for mass production of AM fungi. The *in vitro* culture system on root organ culture can guarantee production of high-quality pure AM fungi inoculum. The present study investigated the establishment of monoxenic cultures of *Claroideoglomus claroideum* in association with root organ culture and transformed hairy root. The cultural conditions were optimized for axenic culture of *Claroideoglomus claroideum* in root organ culture of dicot plants *Solanum lycopersicum* and *Daucus carota*, monocot plants *Zea mays*, *Triticum aestivum*, and *Sorghum bicolor*. Under different cultural conditions like media consistency, light intensity, pH, sucrose concentrations in culture media were optimized for root organ proliferation and AM fungi root colonization. Simultaneously transformed hairy root was developed in carrot root discs using *Rhizobium rhizogene* which will be further used for *in vitro* axenic culture of AM fungi.

Keywords: AM fungi, Axenic culture, *C. Clariodeum*, Culture media

EVALUATION AND CHARACTERIZATION OF ANTIGENIC FUNGAL PROTEINS FROM RHIZOME ROT INFECTED

Curcuma species

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ABSTRACT

Rhizomes of *Curcuma* species of family Zingiberaceae, widely used as spice and herbal medicine around the globe, where India accounting for 80% of global production and 60% of exportation. The yield of *Curcuma* species is reduced more than 60% due to rhizome rot. It has been found that the fungal pathogens mainly infect the rhizomes either during the growth or in the storage stage of these crops. Rhizome rot mainly caused by fungal pathogens such as *Pythium* sp., *Rosellinia* sp. and *Fusarium* sp. However, the pathogen infecting experimental rhizomes of the present work is yet unknown. This study describes the isolation and molecular characterization of antigenic fungal proteins of the causative pathogens from rhizome rot infected *Curcuma* species. The pathogens collected from infected rhizomes were cultured and their molecular identification were done by extracting and estimating the fungal protein content. Further investigation required to do protein sequencing to determine the novel antigen sequences of causative pathogens of rhizome rot disease and isolation of the epitopic regions of antigenic peptide fragments against which antibodies can be developed. Using antibodies, we can develop the rapid immunodiagnostic kit (ICT) for an early detection of rhizome rot. Further using this ICT kit one can easily evaluate the protein concentrations in rhizome rot infected samples based on their band intensity, thereby introducing an effective, early and easy disease management program.

Keywords: *Curcuma* rhizome, Molecular identification, Rot disease, Immunodiagnostic kit

ANALYSIS OF PHYTOCHEMICAL, NUTRITIONAL AND ANTIMICROBIAL POTENTIAL OF ARROWROOT YIELDING PLANT *Curcuma angustifolia* (ROXBY.)

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ABSTRACT

Curcuma angustifolia (Roxby.) is a significant ethno-medicinal plant with high nutritional content. CA is commonly known as Eastern arrowroot (Palua- a white, starchy powder of rhizome) yielding plant. This plant is used to cure a variety of illnesses, including menorrhagia, gastroenteritis, dysentery, fever, cough, and diarrhea. CA rhizome was screened for phytochemical content by preparing acetone, methanol, and aqueous extracts. The plant nutritional analysis was done. Antibacterial activity was determined by agar-well diffusion assay. The phytochemical analysis revealed the presence of certain bioactive substances like alkaloids, phenolic compounds, lipids, carbohydrates, proteins, flavonoids, steroid and curcumin. The plant nutritional analysis indicated the high content of carbohydrate (143.7 mg /100 gm) and protein (81 mg/100g). The antibacterial activity of the rhizome extract showed least amount of inhibition for *Shigella flexneri* and showed significant inhibition for *Streptococcus pyogenes*. The rhizome of this species is aromatic having high medicinal properties due to presence of various bioactive compounds. Because of region specific cultivation limited research work has been done and thus needs to be further explored. The plant when studied against several pathogens will help in determining the therapeutic potential of the plant. Studying its biological effect may provide further information on the medicinal properties. The probiotic and prebiotic potential needs to be investigated.

Keywords: *Curcuma angustifolia*, *Shigella flexneri*, *Streptococcus pyogenes*, Bioactive compounds

ETHNOMEDICINAL USES OF HERBACEOUS MEDICINAL PLANTS BY THE GOND TRIBES IN HADGARH WILD LIFE SANCTUARY OF ODISHA

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ABSTRACT

Ethnobotanical surveys were undertaken during 2017 to 2022 in the Gond tribe dominated area of Hadgarh Wild life sanctuary in Keonjhar district of Odisha. These data were collected through field assessment from traditional healers of the tribe through personal interviews and semi-structured questionnaires. The impacts of various biotic factors which were responsible for habitat destruction were assessed and the present status of different medicinal plants were evaluated. The phytochemical analysis was done for alkaloids, flavonoids, glycosides, phenols, tannins and saponins content for three different types of extracts (ethanol or n hexane or distilled water). A total of 86 herbaceous species belonging to 36 families were reported during the study. Ethnomedicinal uses and phytochemical analysis of 20 potential medicinal plants were carried out and documented. This investigation revealed that herbaceous medicinal plants were widely used as source of medicines for the primary health care of Gond tribe of this region. Herbaceous medicinal plants also have the potential to form the basis of pharmaceutical drugs for the treatment of various diseases. Phytochemical analysis of some selected herbaceous plants were done which are useful for the validation of the ethnobotanical data for further clinical use. Further study on the antimicrobial activity of these plants will provide much information for their applications in herbal drug industries.

Keywords: Ethnomedicinal use, Herbaceous medicinal plants, Gond Tribe, Hadagarh wild life sanctuary

HYPOLIPIDEMIC, HEPATOPROTECTIVE, AND RENOPROTECTIVE EFFECT OF *Moringa oleifera* SEEDS IN DIABETIC INDUCED DAMAGE IN RATS

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ABSTRACT

The chronic metabolic disorder, diabetes mellitus is a fast-growing global problem. Studies show that *Moringa oleifera* possess hepatoprotective, anti-inflammatory, anti-diabetic effects. Hence this study was taken up to investigate the hypolipidemic, hepatoprotective and renoprotective effects of *M. oleifera* seed aqueous extracts on diabetes. To study the improvement in glucose level, lipid levels (TC, HDL, LDL), hepatic (AST, ALT, ALP) and renal (Urea, creatinine) parameters *M. oleifera* seed extract are given in diabetic rats. A total of 36 healthy male wistar rats were taken and divided into six groups (Group I-VI). Diabetes was induced by administering single intraperitoneal injection of Streptozotocin 40mg/kg BW in overnight fasted rats. The aqueous extract of *M. oleifera* seeds was prepared and given to Group IV, V and VI daily for 4 weeks. After 28 days, blood sample was collected from all the rats and biochemical parameters were determined. All the values are expressed as Mean $\pm$ SD. Significant decrease in lipid levels, urea, creatinine and liver function tests were seen at the end of one month in all 3 groups receiving the extract. The administration of *M. oleifera* seed extract to rats provides excellent hypolipidemic, hepatoprotective and renoprotective property probably due to the presence of glucomoringin, phenols, and flavonoids having antioxidant activity.

Keywords: *Moringa oleifera*, Antidiabetic effect, Wistar rats, Hypolipidemic, Hepatoprotective properties

FTIR ANALYSIS OF LEAF SAMPLES OF *Hypericum gaitii* HAINES MOTHER PLANT AND *In vitro* REGENERATED PLANT: A COMPARATIVE STUDY

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ABSTRACT

Hypericum gaitii (Janglikaly) is an endemic shrub localized at eastern parts of India. The plant is reported to exhibit antiviral, anthelmintic, antimicrobial, antipyretic and wound healing properties. This FTIR spectroscopy analysis is aimed at finding, characterizing and comparing the qualitative aspect of functional groups present in the dried leaf samples of mother plant as well as *in vitro* propagated plants of *H. gaitii*. By comparing the major peak values obtained in both of the samples, the presence of hydroxy compounds (O-H stretch), saturated aliphatic compounds (C-H stretch), amines (N-H bend), ethers (aryl-O stretch), esters (C-O-C), and aromatic compounds etc. were confirmed. Further study on the functional groups present in this plant and determination of important secondary metabolites may open new path for herbal medicine research.

Keywords: Endemic, FTIR analysis, *Hypericum gaitii*, Secondary metabolites.

IN VITRO PROPAGATION AND CONSERVATION OF AN ENDANGERED SPECIES *Hypericum gaitii* HAINES FOUND IN SIMILIPAL BIOSPHERE RESERVE

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ABSTRACT

Hypericum gaitii Haines is a rare endemic shrub of family Hypericaceae. It is an endangered plant species of great medicinal importance. This species have been used as traditional medicine for wound healing, antibacterial and anti-inflammatory properties. Extracts of crude drug is widely used in treatment of mild and moderate depressions. Present investigation is an effort to establish *Hypericum* for direct and indirect organogenesis from nodal and inter nodal explants. Nodal and internodal explants were cultured on MS-media with different concentration of NAA, 2, 4-D, BAP and KIN were used either individually or in combination. Among all the growth hormone 2, 4-D was best for callus induction (92% in internodes) in 2 mg/l concentration followed by 1.5 mg/l. Callus induction was observed from 16th to 37th days. For direct regeneration, maximum growth of shoot was obtained on MS-medium supplemented with 1.5 mg/l (BAP) and 0.5 mg/l (NAA) i.e. 96% followed by 1 mg/l (BAP) and 0.5 mg/l (NAA)) i.e. 90% in nodal explants. Shoot induction was observed from 13th to 30th days.

Keywords: *Hypericum gaitii*, Endangered, *in vitro* propagation, Organogenesis

MORPHOPHYSIOLOGICAL RESPONSE OF MEDICINAL PLANT *Artimisia vulgaris* L. TO SALT STRESS AND AMF *Rhizophagus irregularis* INOCULATION

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ABSTRACT

Soil salinity is a major problem affecting plant growth and physiology around the globe. Arbuscular mycorrhizal fungi (AMF) can reduce abiotic stress like salt, drought, heavy metal etc. in plants. Medicinal plant *Artimisia vulgaris* L. belonging to family Asteraceae is popularly known for producing "artemisinin" the anti-malaria drug. In the present study morphophysiological and biochemical response of medicinal plant *Artimisia vulgaris* L. to salt stress and AMF inoculation it was studied in pot culture experiment. *A. vulgaris* was grown in sterilized soil and sand mix (1:2 ratio) with organic manure (1:3 ratio). The salinity was maintained by adding 50Mm of salt water in every week. AMF *Rhizophagus irregularis* inoculum was given after root stabilization. The treated plants were grown for 60 days and morphophysiological analysis was done. The effect of salinity with and without AMF inoculation on growth and morphology, biochemical content such as chlorophyll, carbohydrate, reducing sugar, protein, free amino acid, proline content, antioxidative enzyme activity CAT, GPX and APX of medicinal plant *Artimisia vulgaris* L. was analyzed. Mycorrhizal parameters AMF root colonization (%) and spore density in AMF inoculated plants were assessed. It was observed that morphological and biochemical parameters were drastically reduced by salt stress where as AMF inoculation significantly improved the studied parameters.

Keywords: *Artimisia vulgaris*, Artemisinin, AMF, GPX, APX, *Rhizophagus irregularis*

OVERVIEW OF THE ROLE OF SOIL MICROBES IN THE DEVELOPMENT OF AGRICULTURE AND PRODUCTIVITY

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ABSTRACT

To decrease the use of chemicals in agriculture and increase the productivity of cultivars, integrated management approaches, which include nutrient management, disease control and pest management, rely heavily on agri-organisms as an ecological strategy. Many problems have evolved due to decades of careless use of chemical-based agronomic instruments to increase crop yields, and sustainable agriculture approaches are the answer to these problems. The development of biological tools to replace or complement chemicals is a promising and feasible option and microbial agents are a compelling choice due to their wide range of valuable properties. Therefore, it seems sensible to start by investigating the microbes that reside in the plant's immediate vicinity. In the rhizosphere, beneficial bacteria exist known as plant growth-promoting rhizobacteria (PGPR). Because of its high nutrient content, it is a very active biological and chemical environment. To conserve natural ecosystem resources from climate change, it centres on the appearance of microorganisms crucial to agriculture to set up an ideal agricultural system based on efficient nutrient usage and energy recycling. As such, it encompasses various microorganisms used in industrial settings like agriculture, food processing, and pharmaceuticals. It is crucial to encourage the activities of microbes that benefit plant nutrition, manage illnesses, and assist plants to survive with various abiotic difficulties to maintain and improve the global food supply in future climate scenarios while maintaining environmental health. Enhanced *in situ* survival and performance of beneficial microorganisms of soil microbial diversity lead to development of next-generation inoculants.

Keywords: Integrated management, Microbial agents, Rhizosphere, PGPR, Agricultural system.

ASSESSMENT AND CONSERVATION OF MANGROVES IN DHAMRA ESTUARY

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ABSTRACT

Mangroves of Dhamra Estuary in Bhadak district of Odisha have been depleted at an alarming rate due to the operation of various biotic factors. 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 human habitation and development of port. Keeping the above facts in mind floristic studies have been conducted in different locations of Dhamra estuary to get a comprehensive idea about the distributional pattern of mangroves, their socioeconomic importance, the impact of various biotic factors on the mangrove vegetation and to develop various strategies for its conservation. During the present investigation 28 species of mangroves and their associates have been reported from different locations of Dhamra estuary. It has been observed that these mangrove forests harbors quite a good number of potential medicinal plants and other plants of various socio-economic importance. The results of the phytochemical analysis of some potential mangroves and their associates showed the presence of various phytochemicals such as alkaloids, flavonoids, glycosides, phenols, tannins, saponins etc which are responsible for their medicinal properties. Loss of mangroves in different areas of Dhamra 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 in this region.

Keywords: Conservation, Restoration, Mangroves, Dhamra estuary

AN INVESTIGATION ON POTENTIAL PLANT GROWTH PROMOTING RHIZOSPHERE BACTERIA ISOLATED FROM MINING AREA

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ABSTRACT

Through the process of symbiotic interaction, the soil in the rhizosphere is a source for a variety of microorganisms that are essential for improving plant health and affecting plant development. In non-agricultural conditions, the naturally occurring multifunctional, environmentally friendly rhizobacteria play a far larger part in restoring soil fertility than in traditional agriculture, where the use of agrochemicals is more prevalent and obscures the PSBs' involvement. By secreting different organic acids, phosphate-solubilizing bacteria have the capacity to convert soil's insoluble phosphates into soluble forms. A total of 22 bacteria were isolated and maintained as pure cultures. Out of the 22 isolates, 10 strains showed phosphate solubilizing ability and amongst them, 4 were highly potential which were subjected to morphological, biochemical and molecular characterization. Furthermore, the potential bacteria were analysed for Indole Acetic Acid (IAA) production, which was found to be directly proportional to the plant growth promotion. Upon the comparative analysis of the four potential isolates, PSBK2 exhibited remarkable plant growth promoting traits. The current study indicates that the most effective strains isolated from mining area should be investigated as an inoculant for raising phosphorus availability to plants, improving soil fertility, and promoting agricultural yield and sustainability. Thus, the isolated indigenous and stress-adapted rhizobacteria may serve as potential biotechnological tool for the successful eco-restoration of various metal-contaminated sites.

Keywords: Rhizosphere, PGPR, Mining, Phosphate-solubilizing bacteria

SELENIUM PRIMING ACTIVATES ANTIOXIDANT DEFENSE IN *Cajanus cajan* L. AGAINST OXIDATIVE STRESS INDUCED BY *Fusarium udum* B.

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ABSTRACT

Pigeon pea is the second most valuable pulse crop after chickpea. *Fusarium udum* is the major constraint to the production which warrants an urgent need to develop pigeon pea resistant. Therefore, priming of pigeon pea with a low dose of selenium (se) could be a strategy for conferring resistance against *Fusarium* infection. In this study, it was aimed to estimate physio-biochemical responses against infection in se-primed and unprimed seedlings. The se-primed seedlings were observed to be grown healthy than unprimed seedlings during *Fusarium* stress. An enhanced level of H_2O_2 and MDA were observed in unprimed seedlings as compared to primed seedlings during *Fusarium* stress. In primed seedlings, SOD, CAT, APX and GPX activity were observed to be high as compared to unprimed seedlings during *Fusarium* stress. Thus, a sub-lethal dose of 'se' priming protects pigeon pea against *Fusarium* infection by enhancing the level of antioxidant enzymes with the suppression of oxidants.

Keywords: *Cajanus cajan*, *Fusarium udum*, Selenium, Priming

STUDY OF GAMMA IRRADIATION (^{60}Co) INDUCED OXIDATIVE STRESS AND ITS RADIO- PROTECTIVE DEFENSES OF *Tolypothrix cytonemoides*

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ABSTRACT

Over the past billion years, gamma-ray is thought to have had a number of significant effects on Earth. The Earth's ozone layer would be rapidly destroyed by the gamma radiation from a burst within a few kilo per secs, increasing the amount of solar UVB radiation that reaches the surface. Approximately 3.5 billion years ago, a vast and widespread group of photoautotrophic microorganisms called Cyanobacteria (blue-green algae) first formed, developed, and diversified. Therefore, information on biochemical components significantly needs attention for their potential usefulness in counteracting gamma radiation-induced oxidative damage. The main objectives to decode the information of phytochemicals and antioxidants content in response to γ -irradiation on *Tolypothrix cytonemoides* (VBU173). This strain was treated with acute doses of α -irradiation (0.01 kGy, 0.05 kGy, 0.075 kGy, 0.1 kGy of ^{60}Co). The effect of higher dose α -irradiation resulted in a decline in growth, decrease of pigment, total phenolic, total flavonoid, antioxidant activity, free radical scavenging. In addition, protein content and antioxidant enzyme activities were increased as increasing of dose and the effective dose is 0.075 kGy. It was concluded that the *T. scytonemoides* (VBU173) showed radio resistance response to low dose of gamma radiation by synthesizing more proteins, phycobilin-proteins, and antioxidants compounds as radio-protective phytochemicals.

Keywords: Gamma ray, *Tolypothrix cytonemoides*, Antioxidants

THE ETHNOMEDICINAL USES, ANTIBACTERIAL ACTIVITY AND GCMS ANALYSIS OF *Kaempferia galanga* L.

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ABSTRACT

Zingiberaceae is the largest family of the order Zingiberales containing more than 1600 species and 200 genera. Out of them, *Kaempferia* is the ornamental genus containing near about 60 species, mostly distributed throughout the tropics and sub tropics of the world. Being aromatic and rich in diverse bioactive compounds, plants of this family are economically, ethnomedicinally and pharmaceutically very important. Apart from their traditional use as spices, food, ethnomedicine, dyes, perfume etc., they have got a huge future potential in new drug development due to their antimicrobial, anti-inflammatory, anti-diabetic, anti-cancer and antioxidant characteristics. In the present study, the ethnomedicinal uses of *Kaempferia galanga* were documented. In addition to this, the antimicrobial properties of this was examined by disc diffusion method. *K. galanga* exhibited anti-bacterial property against the gram +ve bacteria *Staphylococcus aureus* and gram the -ve bacteria *Escherichia coli*. 57 compounds were identified by GCMS analysis. Ethyl p-methoxycinnamate (55.60%) comprised the maximum area followed by Pentadecane (22.46%), 2-Propenoic acid, 3-phenyl-, ethyl ester, (E)- (7.78%), Eucalyptol (1.11%), alpha. -Pinene (.11%), endo-Borneol (0.57%), Germacrene D (0.14%), Camphene (0.07%) and 3-Carene (1.46%) were the major representative compound.

Keywords: *Kempferia galanga*, Ethnomedicinal uses, Anti-bacterial activities, GCMS analysis

COCCOID GREEN ALGAE *Coelastrum* AND DESMIDS FROM COASTAL REGION OF ODISHA, INDIA

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ABSTRACT

Coccoid green algae *Coelastrum* and desmids are important indicators of water quality. Their occurrence provides information on environmental conditions such as pH, conductivity and trophic state of a water body. In this study, a total of 08 species of *Coelastrum* and 22 species of desmids were recorded from different freshwater habitats of the coastal region of Odisha. Among these 30 algal species, 10 algal species were newly recorded from Odisha, namely *Coelastrum rugosum* (Rich) Tsarenko, *Coelastrum polychordum* (Kors.) Hind, *Cosmarium auriculatum* var. *Bogoriense* C. Bernard, *Cosmarium depressum* var. *reniforme* West et G.S. West, *Cosmarium subcostatum* Nordstedt, *Cosmarium tumidum* P. Lundell, *Staurastrum gracile* var. *Nanum* Wille, *Staurastrum indentatum* f. *minus* A.M.Scott & Prescott, *Staurastrum sebaldi* var. *Ornatum* Nordstedt and *Xanthidium subhastiferum* West.

Keywords: Coccoid algae, *Coelastrum*, *Staurastrum*, *Cosmarium*

COMPARATIVE FTIR ANALYSIS OF *In vivo* AND *In vitro* LEAVES OF *Uvaria hamiltonii* HOOK. F. & THOMSON

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ABSTRACT

Uvaria hamiltonii Hook. f. & Thomson belongs to the family Annonaceae is rich in medicinal properties. It is commonly known as 'Lakankuli' in Odisha. Traditionally, leaf, stem and root extracts of the plant is used for treatment of diabetes mellitus, malarial fever, gonorrhea, jaundice, bronchitis and bacterial infections. This FTIR spectroscopic study provided characteristic peak values which are used for identifying various functional compounds present in the shade dried *in vivo* and *in vitro* leaf powder of *U. hamiltonii*. In the present study of FTIR spectroscopy, functional groups of both types of leaf have been compared and found to be almost similar. Mainly, the bonds like O-H, $>CH_2$, C=C, C-I and Ca²⁺N are observed in both samples which are responsible for the presence of hydrogen bond, methylene group, alkenyl group, aliphatic iodo compounds and cyanide compounds. This work can further lead to detailed characterization of phytoconstituents present in the leaves.

Keywords: Functional groups, FTIR, Phytoconstituents, Spectroscopy, *Uvaria hamiltonii*

COMPARATIVE ANALYSIS OF PHYTOCONSTITUENTS OF *In vivo* AND *In vitro* LEAVES OF *Stemona tuberosa* LOUR. BY FTIR ANALYSIS

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ABSTRACT

Stemona tuberosa belonging to family Stemonaceae is a valuable medicinal plant. It is commonly known as 'Wild Asparagus'. The leaves of the plant are being used traditionally for treating night blindness. However, the active phytoconstituents present in the leaves of the plant is not much explored. The present study aimed to analyze the powder extracts of both *in vivo* and *in vitro* leaves of *S. tuberosa* by FTIR spectroscopy method. The FTIR spectroscopic studies revealed different characteristic peak values with various functional groups in the extract. Majorly, the presence of hydroxy compounds (O-H stretch), methylene ($>\text{CH}_2$ -) groups, aromatics, alkyl halides (C-X) and aryl disulphides (S-S) is confirmed in both the extracts. The similarity in the FTIR spectrum profile of both *in vivo* and *in vitro* extracts provides fidelity of their phytoconstituents. The results of the present study can be used as a preliminary tool for identification of various active compounds of pharmaceutical and biological significance in *S. tuberosa*.

Keywords: FTIR spectroscopy, Medicinal plant, Phytoconstituents, *Stemona tuberosa*.

BIOREMEDIATION OF CHROMIUM THROUGH PLANT-MICROBE INTERACTION FROM MINE OVERBURDEN DUMPS OF SUKINDA VALLEY

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ABSTRACT

Environmental pollution due to indiscriminate discharge of hazardous and harmful wastes containing toxic heavy metals at elevated concentrations from mining sites and industries has been a growing concern all over the world. Hexavalent chromium is mobile, highly toxic and considered as a priority environmental pollutant. Chromium resistant bacteria are known to catalyse the reduction of Cr(VI) to Cr(III) and different chromate reductases such as ChrR, YieF, NemA and LpDH have been identified from these sources which are located either in soluble fractions (cytoplasm) or bound to the membrane of the bacterial cell. Microbes present on the rhizospheric zone play an important role in catalytic reduction of Cr with the help of plant-microbe interaction. For the experiment, Lemongrass (*Cymbopogon flexuosus*) and Vetiver grass (*Chrysopogon zizanioides*) species has ben used. These species had oil yielding capacity and we have compared the bioactive compounds with control plants and the presence of different compounds is in lesser percentages. This is a greener and safer technology and can be implemented as value addition and economically viable (from the grasses, we can extract oils and generate revenue. The fibrous root system helps to reduce the leaching and enhance the accumulation of heavy metals. The microbes and their association with plants will provide new improved processes in future.

Keywords: Environmental pollution, Hexavalent Chromium, Microbes, Rhizospheric zone, Plant-Microbe interaction, Bioactive compounds and Fibrous root system.

COMPARATIVE ANALYSIS OF PHYTOCONSTITUENTS OF *In vivo* AND *In vitro* LEAVES OF *Stemona tuberosa* LOUR. BY FTIR ANALYSIS

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ABSTRACT

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Keywords: FTIR spectroscopy, Medicinal plant, Phytoconstituents, *Stemona tuberosa*.

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ABSTRACT

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Keywords: Environmental pollution, Hexavalent Chromium, Microbes, Rhizospheric zone, Plant-Microbe interaction, Bioactive compounds and Fibrous root system.

ETHNOBOTANICAL STUDIES AND MEDICINAL PLANTS DIVERSITY IN KULDIHA WILD LIFE SANCTUARY IN ODISHA

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ABSTRACT

Kuldiha wild life sanctuary in Balasore district of Odisha, India is endowed with rich biodiversity including medicinal plants. The present investigation was 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 were conducted in different seasons of the year to various locations of the study region to know the distribution pattern. The plant species were identified with the help of regional flora books. A total of 188 species belonging to 32 families were reported during the present investigation. Phytochemical analysis of some selected plants were done which were useful for the validation of the ethnomedicinal data for further use.

Keywords: Diversity, Medicinal plant, Kuldiha Wildlife Sanctuary

EFFECT OF MANCOZEB (A CONTACT FUNGICIDE) AND METALAXYL (A SYSTEMIC FUNGICIDE) ON *Piper betle* L. : A PHYSIOLOGICAL STUDY

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ABSTRACT

Betel vine (*Piper betle* L.) is a commercially cultivated potential cash crop in various parts of India. The betel leaves are also known to have many medicinal properties. In Odisha, betel vines are cultivated in large scale in coastal districts like Balasore, Bhadrak, Jagatsinghpur, Kendrapara, Khordha, Puri and Ganjam. The farmers face many challenges for cultivating betel vines among which fungal diseases are important. To control the fungal diseases the farmers mostly use different chemical fungicides some among these include mancozeb, metalaxyl, carbendazim, azoxystrobin, difenoconazole and fluazinam. In this work effect of mancozeb and metalaxyl on some physiological parameters in betel leaf has been studied. It was found that the treatment of Mancozeb and Metalaxyl has resulted in alteration of many physiological parameters within 7 days in *Piper betle* L. leaves. The total chlorophyll content and ascorbic acid content were decreased whereas proline content increased. The activities of catalase, peroxidase and SOD increased and the lipid peroxidation also increased. The alteration of these physiological parameters indicated that oxidative stress was imposed in the betel leaves due to Mancozeb and Metalaxyl treatment. This would adversely affect the growth, development of the plant. Further, it was found that, the application of neem leaf extract along with "MATCO" has resulted in neutralising the fungicide induced physiological anomaly in the plant. Thus, controlling fungal diseases through the fungicide like Mancozeb and Metalaxyl in betel vine crop has many adverse effects on the plants. Therefore, this practice should be substituted with some eco-friendly approach like use of bio-fungicide or biopesticide in place of chemical pesticide.

Keywords: Antioxidative enzymes, Ascorbic acid, Lipid peroxidation level, Proline, Total chlorophyll, Neem extract.

UTILIZATION OF MAINTAINER LINES FOR DEVELOPMENT OF HYBRID RICE: CAN DOUBLED HAPLOID APPROACH CAPABLE IN EXTRACTING YIELD RELATED FAVORABLE ALLELES?

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ABSTRACT

Rice as a cereal crop is the predominant staple food for a large part of the world's human population. It is estimated that by 2050 the need of the global food demand will be double. However, presently the production rate is in declining state. In developing countries like India, the changing climatic scenarios are the major constraints in rice production. Use of recent technologies offers a sustainable way to meet the demand and develop the agricultural system. Keeping in view of the diminishing land, development of High Yielding Varieties (HYVs) is essential in order to meet the farmers need for which development of sustainable HYVs is the need of the hour. However, production and productivity HYVs have almost come to a plateau. Alternatively, adoption of hybrid rice technology is being popular in achieving higher yield as it enhances farm productivity by 20-30% more than the HYVs. Most commonly, three-line system of hybrid rice (consisting of Cytoplasmic Male Sterile (A), Maintainer (B), Restorer(R) lines) development is followed in India. However, the prime limitations of hybrid rice are unstable male sterility, inherited CMS load, poor grain quality, hybrid sterility; moreover, farmers need to buy the seeds year after year due to segregation in each generation. Therefore, development of inbred lines from hybrid rice is a viable option for which Doubled Haploid technology is the most significant approach to extract the yield related favorable alleles in a short period of time. However, it is presumed that the developed inbred lines might show sterility in future as it carries the cytoplasm of A line which has defective mitochondria. Since B line is near isogenic to A, maintainer (B) line can be used in overcoming the sterility issue for generation of

inbred lines through DH approach. The study envisages generation of a large number of androgenic DHs from crosses of distantly related well combining maintainer and restorer lines. Further, these DHs are genotyped using molecular markers and phenotyped for yield and yield related traits.

Keywords: HYVs, Hybrid Rice, A line, B line, R line, DH technology

BIOREMEDIATION POTENTIAL OF *Chlorella vulgaris* AND *Chlamydomonas reinhardtii* ON AN AZO DYE (METHYLENE BLUE)

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ABSTRACT

Water as an essential component is used in all types of industries. The untreated or partially treated effluent comes with various contaminants in the environment. Synthetic dyes are the most important contaminants which are preferred over natural dyes due to their chemical stability, photostability and persistency in nature. Reactive azo dyes are the most prevalent type of synthetic dyes that have been used by the textile industry due to their colour intensity and good reactivity toward cellulose. Microalgae have been used widely in bioremediation processes to degrade or adsorb toxic dyes. Here, we evaluated the decolorization efficiency of *Chlorella vulgaris* and *Chlamydomonas reinhardtii* against toxic dye Methylene Blue (MB). The data showed that *C. vulgaris* was most efficient in decolorization of CB and the highest percentage of decolorization was 91 %. On the other hand, *C. reinhardtii* decolorized MB dye by 85.3%. Moreover, this is the preliminary investigation and the effect of MB dye on metabolic profiling of the studied algal species is continuing.

Keywords: *Chlorella vulgaris*, *Chlamydomonas reinhardtii*, Azo dye, Metabolic profiling

ETHNOBOTANICAL STUDIES, PHYTOCHEMICAL ANALYSIS AND ANTIMICROBIAL ACTIVITY OF POTENTIAL MEDICINAL PLANTS OF BHIMKUND AND ITS ADJOINING REGIONS IN MAYURBHANJ DISTRICT OF ODISHA

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ABSTRACT

Odisha is much rich with indigenous knowledge about the medicinal plants used by various ethnic groups. Bhimkund and its adjoining regions in Mayurbhanj district are endowed with rich biodiversity. People of these areas are utilizing various plant and plant products for the ailments of various diseases. Field studies have been conducted in different locations of the study region to know the distribution pattern and natural habitat of medicinal plants of the region. The plant species were identified with the help of regional flora books. The ethnobotanical data have been collected from the local ethnic groups and Vaidyas. The phytochemical analysis has been carried out by qualitative estimation of alkaloids, flavonoids, glycosides, phenols, tannins and saponins. The antimicrobial assays of the plant extract were carried out to establish the medicinal properties of the plant. The ethnobotanical studies revealed that the local people of various ethnic groups are using various plants and plant products for medicinal and other purposes. Antimicrobial activity of some selected medicinal plants collected from Bhimkund and its adjoining regions of Mayurbhanj district viz. *Cissampelos pareira* L., *Nyctanthes arbor-tristis* L., *Terminalia chebula* Retz., *Curcuma angustifolia* Roxb., *Rauvolfia serpentina* Benth. ex Kurz showed that the plants have inhibitory effects on the growth of the bacterium *Lactobacillus*.

Keywords: Ethnobotanical studies, Phytochemical analysis, Antimicrobial activity, Medicinal plant

ANTIBACTERIAL ACTIVITY OF *Chlorella vulgaris* BEYERINCK [BEIJERINCK] EXTRACT THROUGH MODERATION OF ANTIOXIDANTS

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ABSTRACT

The present study engrossed on the assessment of antioxidant potential as well as free radical scavenging activity such as DPPH, hydroxyl radical, hydrogen peroxide, and superoxide anion radical assay of *Chlorella vulgaris* Beyerinck [Beijerinck] (BUACC25) isolated from marine habitat. Additionally, the molecular method of action and anti-bacterial activities has been assessed. In the current investigation, the initial phytochemical screening of the methanolic algal extract revealed the presence of alkaloids, glycosides, proteins, terpenoids, saponins, coumarin, phenols, and tannins. These findings were confirmed by UV-visible and FT-IR spectroscopy, which revealed the distinct spectral peaks. The methanolic algal extract was found to be rich in flavonoid content (470 ± 0.25 mg of RUE g^{-1}) and phenolic content (45 ± 0.06 mg GAE g^{-1}). Furthermore, the methanolic extract revealed potent antioxidant scavenging activity to scavenge various free radicals with minimum IC₅₀ values of hydroxyl, DPPH, H₂O₂, superoxide 2.30 ± 0.25 , 2.82 ± 0.30 , 3.24 ± 0.32 , and 3.15 ± 0.02 $\mu g\ ml^{-1}$ respectively. Furthermore, the methanolic extract of *C. vulgaris* exhibited potent antibacterial activity which was evident with the reduction in CFU $\times 10^7/ml$ and % of cell viability. Mechanistically, the reduction of SOD, CAT, and GSH activity provoked ROS-mediated cell death after drug treatment. Moreover, in combination with norfloxacin and ciprofloxacin, the methanolic extract of *C. vulgaris* demonstrated enhanced antibacterial activity with an evident reduction in CFU/ml and % of cell viability.

Keywords: *Chlorella vulgaris*, DPPH, H₂O₂, SOD, CAT, GSH

A COMBINED APPROACH OF BOTH RESPONSE SURFACE METHODOLOGY AND ARTIFICIAL NEURAL NETWORK FOR MODELLING AND OPTIMIZATION OF PROPOLIS OIL, THE MOST FASCINATING HONEY BEE PRODUCT

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ABSTRACT

Propolis is a promising natural product that has been extensively researched and studied for its potential health and medical benefits. The lack of requisite high oil-containing propolis and existing variation in the quality and quantity of essential oil within agro-climatic regions pose a problem in the commercialization of essential oil. As a result, the current study was carried out to optimize and estimate the essential oil yield of propolis. The essential oil data of 31 propolis from 10 agro-climatic areas of Odisha and an investigation of their soil and environmental parameters were used to construct an artificial neural network (ANN) based prediction model. The influential predictors were determined using Garson's algorithm. To understand how the variables interact and to determine the optimum value of each variable for the greatest response, the response surface curves were plotted. The results revealed that the most suited model was multilayer-feed-forward neural networks with an R^2 value of 0.85. According to the model, altitude was found to have a very strong influence on response, followed by phosphorous & maximum average temperature. This research shows that using an ANN-based

prediction model with a response surface methodology technique to estimate oil yield at a new site and maximize propolis oil yield at a specific site by adjusting variable parameters is a viable commercial option. To our knowledge, this is the first report on the development of a model to optimize and estimate the essential oil yield of propolis.

Keywords: Propolis, Artificial neural network, Prediction model, Oil yield.

GREEN SYNTHESIS AND CHARACTERIZATION OF Fe_3O_4 AND CUO NPS USING *Chlorella vulgaris* EXTRACT AND EVALUATION OF THEIR ANTIMICROBIAL ACTIVITY

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ABSTRACT

Nanoparticles synthesis has developed a matter of noticeable interest in recent times due to their several beneficial properties and applications. Green synthesis of nanoparticles (NPs) is an important method have been used in the field of nanotechnology because this is eco-friendly and cost effective compared to chemical methods. In this investigation, iron oxide (Fe_3O_4) and copper oxide (CuO) nanoparticles were synthesized using a green biosynthetic method by reduction of ferric chloride and copper (II) sulfate solution using the cell extract of the *Chlorella vulgaris* (BUACC04). The structural uniformity and functional properties of the Fe_3O_4 and CuO NPs were investigated by X-ray diffraction, Fourier Transforms Infrared Spectroscopy (FT-IR), and Scanning Electron Microscopy (SEM). The average particle diameter as determined by SEM was found to be 18 nm and 54 nm respectively. X-ray diffraction (XRD) showed that the nanoparticles are crystalline with a spherical shape. Fe_3O_4 and CuO NPs also exhibited the antibacterial activity against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Escherichia coli*.

Keywords: *Chlorella vulgaris*, FT-IR, SEM, XRD, *Pseudomonas aeruginosa*

***Agrobacterium* MEDIATED TRANSFORMATION OF CYP71A1 GENE IN *Oryza sativa* BASED ON GENOME EDITING APPROACHES**

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ABSTRACT

Rice (*Oryza sativa*) is an important food crop as well as a model cereal for genetic research. Rice production is severely hampered by insect infestations and adversely impact global food security. Brown planthopper (*Nilaparvata lugens*) is one of the serious pests of rice that causes hopper burn. Insect infestation in rice causes the manufacture of serotonin, a neurotransmitter found in mammals, and its reduction imparts resistance to planthoppers, rice's most devastating pests. Chorismate is the source of serotonin and salicylic acid (SA). Tryptamine 5-hydroxylase, which catalyses the conversion of tryptamine to serotonin, is encoded by the cytochrome P450 gene *CYP71A1* in rice. Planthopper feeding induces biosynthesis of serotonin and SA, whereas in mutants with an inactivated *CYP71A1* gene, no serotonin is produced, SA levels are higher and plants are more insect-resistant. As a result, genome editing using the CRISPR/Cas9 method was used to knockout the *CYP71A1* gene in order to develop a higher yielding and BPH resistant rice variety.

Keywords: *Nilaparvata lugens*, Plant hoppers, Chorismate, Tryptamine, P450 gene *CYP71A1*

INDIGENOUS KNOWLEDGE, CONSERVATION AND SUSTAINABLE UTILIZATION OF MEDICINAL PLANTS IN CUTTACK DISTRICT, ODISHA

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ABSTRACT

Biodiversity of Cuttack is highly populated with large number of medicinal plants along with plants of other socio-economic importance. People of this district are utilizing various plants and plant products for the treatment of chronic disorders. From the past floristic studies conducted by earlier workers, it is evident that, this district along with other districts of Odisha was much rich with vegetable wealth in remote past. However, in course of time, flora of this district has been subjected to severe biotic pressures. As a result, plant diversity of this district has been depleted at an alarming rate and some medicinal plants of this area are on the verge of extinction. During the present investigation, intensive as well as extensive floristic studies have been conducted in different areas of this district for documentation of the traditional knowledge and to assess the distributional pattern and present status of medicinal plants as well as plants of other socio-economic importance. Two hundred fifty potential medicinal plants have been collected and preserved in the form of herbarium specimens from different areas of this district. Documentation of this rich traditional knowledge and conservation of medicinal plants of this district should be done for sustainable utilization of medicinal plants in this region.

Keywords: Indigenous knowledge, conservation, Medicinal plant, Cuttack district

INDIGENOUS FINGER MILLETS OF EASTERN GHATS IN ODISHA: THE SEARCH OF HOPE FOR FUTURE SMART CROP

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ABSTRACT

Crop growth and productivity has largely been vulnerable to various abiotic and biotic stresses that are only set to be compounded due to global climate change. Therefore developing improved varieties and designing newer approaches for crop improvement against stress tolerance have become a priority now-a-days. Most of the crop improvement strategies are directed towards staple cereals such as rice, wheat, maize, whereas attention on minor cereals such as finger millet [*Eleusine coracana* (L.) Gaertn.] lags far behind. Apart from its excellent nutraceutical value, its ability to tolerate various abiotic stresses makes it an excellent model for exploring vast genetic and genomic potential of this crop. Considering its vast genetic diversity present in the Eastern Ghats of Odisha, an approach has been made to collect the maximum available indigenous genotypes in the tribal belts of Malkangiri district of Odisha, where the crop is cultivated with minimum agricultural practices. 8 finger millet genotypes were collected from Kalimela, Khairput, Mathili, Chitrakonda, Malkangiri and Korukonda blocks of Malkangiri district. The genotypes found were *bada mandia*, *sana mandia*, *chili mandia*, *bhalu mandia*. These genotypes will be characterized further for drought tolerance.

Keywords: *Eleusine coracana*, Nutraceutical, Abiotic stress, Eastern Ghats, Genotypes

EFFECT OF MAGNESIUM SULPHATE ON

Macrotyloma uniflorum

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ABSTRACT

Macrotyloma uniflorum, commonly called horse gram, is known for its nutraceutical property and ethnomedicinal values. Besides nitrogen fixation, soil conservation, it increases soil fertility tremendously and hence used as green manure. Since it is low priced and drought resistant, very little scientific effort has been made and it has been prolonged neglected, ICAR and USDA are working together for conservation of its germplasm. Keeping in view the above reasons, the plant was subjected for magnesium stress. To get the mineral composition of the soil, the sample was taken for elemental analysis through XRF technique. Twenty six different compounds were obtained which facilitated the growth of plant and soil flora. The supplementation of $MgSO_4$ resulted in higher assimilation of compounds like silicon dioxide, aluminium oxide, potassium oxide, calcium oxide, but other compounds like carbon dioxide, arsenic trioxide and iridium dioxide are found in trace amount. The macronutrient magnesium necessary to both plant growth and development, is available as magnesium sulphate which is supplemented in different concentration from 0.1% to 0.5%, to the plants. After 30 days, the plants were subjected to biochemical analysis. It was observed that 3.36mg/g fresh wt chlorophyll, 15.84 mg/g fresh wt protein, 25.52 mg/g carbohydrate present in 0.3% $MgSO_4$ and also showed maximum seed germination. Thus it could be concluded that magnesium has a ubiquitous role in both quantitative and qualitative development of the plant but it should be provided in optimal quantity above which its effect could be deleterious.

Keyword: *Macrotyloma uniflorum*, XRF technique, phytochemical analysis, $MgSO_4$

ASSESSMENT, CONSERVATION AND SUSTAINABLE UTILIZATION OF MEDICINAL PLANTS IN MALAYAGIRI HILL RANGES

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ABSTRACT

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 medicinal and rare plants. From the past floristic studies conducted by earlier workers it is evident that intensive analysis have not been conducted in this region. Large number of tribal people also inhabit around Malayagiri and its periphery. These people are utilizing whole/ part of the plant & it's 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 fifty medicinal plants and plants of other socioeconomic importance have been collected and identified from different locations of this region. During the present investigation it is evident 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.

Keywords: Assessment, Conservation, Medicinal plant, Malayagiri hill ranges

TRADITIONAL PHYTOMEDICINE FOR HAIR-CARE AND SCALP INFECTIONS USED BY RURAL POPULACE IN BALASORE DISTRICT OF ODISHA

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ABSTRACT

Since the time immemorial herbal healing practices play a significant role in primary healthcare among indigenous communities in India. But this traditional knowledge is declining day by day among the youths due to change in lifestyles as well as dependency on the synthetic drugs. Main objective of the present study was to document these invaluable knowledge systems before they are lost forever. The present communication deals with 42 wild plant species belonging to 31 families used by the tribes and rural communities, inhabiting tribal-rich villages in Balasore district of Odisha to treat scalp infections and hair-care. The information was collected through semi-structured questionnaire and personal interviews during the course of investigation. Some usages of plant parts or produce as hair-wash, hair dyeing, hair oils, as well as in scalp-care mentioned herein are already in practice in the modern society. A few others are, however, new and interesting and these may find application towards development of novel medicated cosmetics or beautician preparations. The plant specimens with ethnomedicinal claims were collected, processed, critically studied, identified and preserved. The plants are arranged alphabetically, each by its botanical name, followed by family, accession number, local name, mode of administration and dosage.

Keywords: Phytomedicines, Scalp infection, Hair care, Balasore

FLORISTIC BIODIVERSITY AND CARBON STOCK OF URBAN CITY WITH REFERENCE TO EDUCATIONAL INSTITUTE OF BHUBANESWAR: AN APPROACH OF SUSTAINABILITY

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ABSTRACT

The current study was taken to determine the role of vegetation in urban city of Bhubaneswar with special reference to Regional Institute of Education (RIE). The results revealed that educational Institute (RIE) plays a prominent role not only in mitigating atmospheric carbon dioxide but also in its regulation. The study area was assessed quantitatively with Simpson's Diversity Index, Shannon-Weiner Index, Menhinick's Richness, Evenness and Sorensen Coefficient. The study revealed that the study sites are rich in vegetation and can prove to be helpful in long-term sequestration of carbon. Qualitative analysis revealed that *Azadirachta indica*, dominated at site-I in frequency, relative frequency, relative dominance and basal area while *Mangifera indica* showed highest density, relative density, abundance and Important Value Index. At site II frequency was shown highest by *Tectona grandis* and *Azadirachta indica*. The total carbon stock was observed highest at site-I (94.44 ton/ha) as compared to site II (89.83 ton/ha). The diversity of standing vegetation depicts that different plants of ornamental and medicinal value contribute towards the mitigation of atmospheric carbon dioxide. The study concluded that different green patches of the RIE campus play great role in sustainability of urban environment and also contribute towards aesthetic value of the city.

Keywords: Educational Institute, Phyto-sociological Parameters, Standing Vegetation, Urban area

STUDY OF ETHNOMEDICINAL PROPERTIES OF *Senna alata* (L.) ROXB. IN BHADRAK AREA OF ODISHA

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ABSTRACT

Senna alata (L.) Roxb (Syn: *Cassia alata* L.) a perennial shrub of 2-3 meters tall belongs to the family Fabaceae of subfamily Caesalpinoideae is commonly known as ringworm shrub, candle bush etc. Plants have pinnately compound leaves and yellow coloured flowers with apical orange coloured bracts of raceme type inflorescence giving it the appearance of a burning candle. Bhadrak is one of the coastal districts to Bay of Bengal of state Odisha in India with a tropical climate where the plants mostly grow in road side and wild areas. A lot of researchers have conducted many researches earlier on this plant about its traditional medicinal properties for cure of the diseases like ringworm, scabies and typhoid as well as its antifungal, antimalarial and anti-cancer properties due to presence of so many secondary metabolites like flavonoids, phenols, alkaloids, saponin etc. Here in this study, antioxidant and antibacterial activities of both methanolic and ethanolic extracts of its leaves and stems are analyzed for DPPH assay and MIC against two different bacterial strains with standard antibiotics. Ethanolic extract of leaves show significant results out of all other cases shown as per statistics used. Further researches on this plant from different parts of Odisha using other strains of bacteria may show much significant results.

Keywords: *Senna alata*, DPPH, MIC, Secondary metabolites

STUDIES ON THE ANTIDIABETIC ACTIVITY OF ROOT EXTRACTS OF *Alstonia scholaris* (L.) R.BR.

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ABSTRACT

Complementary therapies are being investigated extensively in the treatment of chronic disorders like *Diabetes mellitus* (DM). The anti-diabetic efficacy of a methanol extract of *Alstonia scholaris* root on normoglycemic, glucose-loaded, and streptozotocin (STZ)-induced diabetic rats were investigated in this work. Single and multiple doses of *Alstonia scholaris* root extracts at 200 mg/kg and 400 mg/kg body weight were given to normoglycemic, glucose-loaded, and streptozotocin-induced diabetic rats. At various points following administration, blood sugar levels were measured. One-way analysis of variance (ANOVA) and Dunnett's t-test were used to statistically analyse the data. Significant was defined as a p value of less than 0.05. In normoglycemic rats, the extract reduced blood glucose levels by 6.3 percent ($p < 0.01$) and 7.12 percent ($p < 0.01$) after 8 hours at doses of 200 mg/kg and 400 mg/kg body weight, respectively. The decline in blood sugar levels in STZ-induced diabetic rats was 44.28 percent ($p < 0.01$) and 56.66 percent ($p < 0.001$), respectively, at the same dosage level. During the research, the reference medication was glibenclamide. Thus, the hypoglycaemic activity of *Alstonia scholaris* root extract suggests that it could be used to generate a new herbal medication for diabetes treatment.

Keywords: *Alstonia scholaris*, Hypoglycaemic activity, Streptozotocin, Glibenclamide

OPTIMIZATION OF CULTURE CONDITIONS FOR ENHANCING CAROTENOID SYNTHESIS FROM *Desertifilum dzianense*, A SUB-AERIAL CYANOBACTERIUM AND EVALUATION OF ITS STABILITY AND ANTIOXIDANT PROPERTIES

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ABSTRACT

Most commercial carotenoids are extracted from plants or algae, have been formulated in global market due to the awareness of their putative health benefits and wide array of commercial applications such as antioxidant, antimicrobial, anti-inflammatory and therapeutic value. Some scientific studies also have proved the benefits of carotenoid in human health and since then their demand is increasing in day-to-day research activities. Owing to increase the carotenoids synthesis of the sub-aerial cyanobacteria, *Desertifilum dzianense* and to use them as natural colorants, the following different approaches and standardization of culture conditions were studied. The cells were cultivated in BG-11 medium and lysed by adding methanol in 1:3 ratio of wet cells to methanol. After extraction and purification, 0.24 µg/ml yield of carotenoids was obtained and its purity was confirmed. The stabilities of carotenoids at different pH in the presence of low-to high temperature with different light conditions and their antioxidant abilities were assessed. Results indicated that the natural carotenoids synthesis were stable and possessed antioxidant properties. Interestingly, the carotenoid synthesis of the isolated strain was less likely to deteriorate under acidic conditions. Overall, the present work indicated the low-cost process in the development and novel method for producing high functional carotenoids i.e., β -carotene and possibilities of adapting this new carotenoids biorefinery to unique bioreactor utilization in future which may give us the opportunity to exploit its various applications with regards to natural antioxidants.

Keywords: Antioxidants (*in vitro* and *in vivo*), Cell lysis, Carotenoids, Sub-aerial Cyanobacterium.

IMPA2 PROVIDES NONHOST RESISTANCE AGAINST RICE SHEATH BLIGHT CAUSED BY *Rhizoctonia solani*

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ABSTRACT

Rice sheath blight caused by *Rhizoctonia solani* AG-1 IA (*R. solani*) is one of the most devastating necrotrophic diseases with a wide-host range, poses a major threat to global rice production. There has been no fully resistant rice cultivar nor any effective control measures of it. Here, we have isolated an EMS-generated *Arabidopsis* mutant (Col-0 background) that is susceptible to *R. solani* and named as *rss1* (*R. solanisusceptible*). Bulk segregant analysis led us to identify a single recessive gene that mapped to the lower arm of *Chromosome 4* between *JAERI18* and *Ch4_9.18* (844.6 Kb). NGS data of bulked susceptible population aligned to reference genome (TAIR10) delineated nonsynonymous mutation ^{P65}_S in the mapped region. Further, T-DNA insertion lines screening showed correlated disease phenotype in *SALK_099707* (*At4g16143*) with *rss1*. We found that *rss1* negatively regulates photosynthetic pigment biosynthesis whereas defense responses *viz* HR, ROS, callose deposition, and cell death enhanced upon *R. solani* infection. In addition, a gradual decrease in *PR1* gene expression by 3 dpi upon infection revealed that *RSS1* positively regulates early SA-mediated resistance, whereas increased expression of *PDF1.2* by 3 dpi supports switching of SA-mediated defense to JA-mediated defense, leading to the necrotrophic mode of infection at a later phase. Enhanced expression of *ATG8a* in *rss1* supported autophagic cell death. Altogether, our results demonstrate that *IMPA2* provides NHR against *R. solani* in Col-0 that evoke SA-mediated early immunity with boulevard for potential biotechnological application.

Keywords: Ethyl methane sulphonate, *IMPA2*, Infection cushion, Nonhost resistance, Necrotroph, *Rhizoctonia solani*, Sheath blight

ETHNOBOTANICAL & PHYTODIVERSITY STUDIES OF WILD EDIBLE FRUITS IN KALAHANDI DISTRICT OF ODISHA, INDIA

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ABSTRACT

Food & nutritional security key concerns around the world over as low food intake & poor access to food in underdeveloped countries remain an unresolved issue. Feeding in excess of 800 million undernourished people depends not only on increased productivity of domesticated crops but also the use of underutilized wild species. The latter & their natural products make significant contributions to the human & animal food web & are often a means of survival for millions of poor rural households. Uses of forest food as a coping mechanism in times of food shortage, provides an important safety net for the rural poor. There is now greater recognition that products from the wild may support household subsistence & also that income may be generated from their sale, either in raw or processed forms. The Wild Edible Food Plants (WEFPs), available from their wild natural habitats are an important source of India & have a significant place in the dietary habits of small & marginally poor families & forest dwelling communities. The food habits of tribals are generally developed according to the availability of food and their nutritional value & hence, food supply is traditionally based on their own collection of food materials. The majorities of the tribal communities of India lives close to or within forests & depend on wild products & biomass for food & energy needs. Such communities have distinct socio-cultural traditions & food habits. Historically, tribal & rural people identified 7 collected plants for food & medicine from forests & developed a range of processing methods in accordance with their needs.

Keywords: Wild edible fruit, Phytodiversity, Ethnobotany, WEFPs, Socio-cultural.

SOME LESS KNOWN CROP WEEDS OF ETHNOVETERINARY IMPORTANCE IN ANGUL DISTRICT OF ODISHA

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ABSTRACT

Ethnoveterinary medicine provides the major source for the treatment of diseases in livestock throughout the world. Even today, a system based on folk beliefs, traditional knowledge, skills, methods and practices used for curing diseases and maintaining health of animals. Despite the fact that ethnoveterinary medicine has been very crucial for animal health care in most developing countries, the promising *phytoresources* has not yet been well documented in Odisha, for which the present investigation was undertaken. Ethnobotanical exploration during the year 2014-2015 in different C.D Blocks of Angul district could reveal that weeds grown in crop fields are used by the traditional healers, tribal practitioners, farmers and agricultural labourers for curing diseases in cattle and other domestic animals. Field survey in the study area were conducted in both Rabi and Kharif crops to collect the weeds of ethnoveterinary claims for taxonomic studies and identification. Uses of these weeds were documented by questionnaire methods. The results of the present study revealed that 40 species distributed in 30 genera belonging to 25 families were having ethno-veterinary claims. Some of the widely used crop weeds include *Aeschynomene americana* (whole plant as fodder for lactation), *Blainvillea acmela* (extract of the fresh twig to cure scabies of goat), *Centipeda minima* (root decoction against mastitis of cattle), *Desmodium heterocarpon* (inducing lactation), *Echinochloa colona* (used as fodder to cure intestinal worm), *Gomphrena celosiodides* (tick infestation in cattle), *Justicia trinervia* (root decoction for dysentery in cattle), *Neptunia oleracea* (plant decoction used to treat helminthiasis)

and *Trichodesma indicum* (root paste against snake bite). The folklore claims of the plants used for curing animal diseases in the study area may throw light for further study towards identification of novel bioactive compounds of pharmacological importance.

Keywords: Ethnoveterinary, Weeds, Rabi and Kharif crops, Angul district

STUDIES ON ANTHELMINTIC RESISTANCE OF MEDICINAL PLANTS AGAINST GASTROINTESTINAL HELMINTH PARASITES OF GOAT

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ABSTRACT

The development of anthelmintic resistance has made the search for alternatives to control gastrointestinal helminth parasite of goat imperative. Among these alternatives are numerous medicinal plants traditionally used as anthelmintics. The aim of this study will be to evaluate the anthelmintic effects of plant extract against stomach worms of goat. Three indigenous medicinal plants are selected and ethanol extracts will be prepared for anthelminthic trials and determination of anthelminthic properties of the selected plants against the gastrointestinal nematodes in goat will be done. This work can be used to evaluate the efficacy of ethanol on dried leaf and root extracts of plants to kill helminth parasites. Chemical extracts of each plant will be used at various concentrations then incubated with control cultures which will be treated with chemicals. Ethanol has been reported to be the most effective solvent. The result will indicate that the adult gastrointestinal helminths are more vulnerable to selected indigenous plants. The current study can be helpful in validating the traditional use of plants as a natural anthelmintic against helminth justifying a need to undertake detail pharmacological investigation on plants. This work can also be helpful for economic purpose as the medicinal plants can be use to recover the goats infected by helminths and increase its productivity.

Keywords: Medicinal plant, Helminth parasites, Goat, Anthelmintic properties

***Globba* L.: THE POTENT GENUS OF THE FAMILY ZINGIBERACEAE**

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ABSTRACT

Zingiberaceae comprises of 50 genera with approximately over 1,600 species. The family Zingiberaceae well known for its immense medicinal values. The Genus *Globba* L. is the third largest genus of the family Zingiberaceae ranked after polyphyletic genera *Alpinia* Roxb. and *Amomum* Roxb. The genus is represented by 110 species globally and 17 species in India. Members of the *Globba* are widely distributed in tropical and sub-tropical regions, including Asia (India, China) with the highest diversity centre in the Southeast Asia region. The members of the genus characterised by unique phytochemical profile in addition they exhibits good antioxidant and antimicrobial activities. The presence of carbohydrates, proteins, steroids, alkaloids, flavonoids, glycosides, saponins, tannins, terpenoids, coumarins, phenols, and phlobatannins found in phytochemical investigation of *Globba arracanensis*. Ethanolic extracts of the rhizomes of *Globba candida* Gagnep. confirmed the presence of levoglucosan, Allylhydrazon acetalddehyde, 2-methylcyclopentanone and 2-n-propyl-oxetan. Phytochemical investigation of methanolic extracts of *Globba marantina* revealed the presence of alkaloid, cardiac glycosides & steroids. Two new homodrimane sesquiterpenoids, globbatones A and B and one 16-norlabdane diterpenoid, globbatone C, were isolated from the chloroform extract of *Globba sherwoodiana* rhizomes. The methanolic leaf extract of *Globba marantina* exhibited remarkable antioxidant potentials as compared to the reference standard- ascorbic acid (AA) and butylated hydroxytoluene (BHT). Leaf extracts of *Globba arracanensis* Kurz. exhibits good antimicrobial activities against various pathogenic gram positive and negative microbes. Dichloromethane

extract of rhizome of *Globba schomburgkii* Hook. F. shows potential antimicrobial activities against *Staphylococcus aureus* and *Micrococcus luteus*. Different species of *Globba* having prominent ethnomedicinal significance as they are used in treatment of various ailments such as Post-partum flatulence, Conjunctivitis and eye abrasions, Asthma, mouth ulcer Leucoderma, hoping cough, Food poisoning, relieve the pain of scorpion sting, also as Analgesic and Antipyretics. *Globba* consist of many useful species but there is limited study available about their phytochemical evaluation and pharmacological activities. The pharmacological properties of *Globba* species still remains as an unexplored ethnobotany.

Keywords: Zingiberaceae, *Globba*, Globbatones, Antioxidant potentials, Antimicrobial activities.

STRUCTURAL CHANGES OF CHROMOSOME MORPHOLOGY IN TWELVE LOCAL *Musa* CULTIVARS OF ODISHA AS REVEALED BY KARYOTYPE ANALYSIS

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ABSTRACT

Chromosome is a prime genetic material with morphological entity that often has shown considerable change in its numerical and structural components. Somatic chromosome number, detailed karyotype and karyomorphological analysis were made in twelve *Musa* cultivars collected from different locations of Odisha to assess the phylogenetic relationships. The inferred chromosomal phylogeny provide the evidence that all *Musa* cultivars were with the ploidy level $2n=3x=33$. Out of the twelve *Musa* cultivars studied for karyomorphological analysis, six were of dessert type (cv. Amritpani, cv. Champa, cv. Grand Naine, cv. Dwarf Cavendish, cv. Patakpura and cv. Robusta) and rest were cooking types (cv. Gajabnata, cv. Paunsiabnata, cv. Mendhibantala, cv. Desi-Dakshinisagar, cv. Mutant-Dakshinisagar and cv. Shankara). The average mitotic metaphase chromosome length in plantains ranged from 1.20 μm in cv. Shankara to 2.15 μm in cv. Desi Dakshinisagara. The total chromosome length in dessert banana ranged from 53.95

μm in cv. Robusta to $75.5 \mu\text{m}$ in cv. Amritpani with symmetric karyotypes, whereas plantain showed chromosome length varied from $39.75 \mu\text{m}$ in cv. Shankara to $71.04 \mu\text{m}$ in cv. Desi-Dakshinisagar. Nearly median chromosomes were found in plantain in which the total form percentage (TF%) varied from 38.63% in cv. Mendhibantala to 45.31% in cv. Desi-Dakshinisagar. The total chromosome volume found highest in Desi-Dakshinisagar ($32.24 \mu\text{m}^3$) whereas the lowest one recorded in cv. Robusta ($10.78 \mu\text{m}^3$). The calculated interphase nuclear volume was highest in cv. Patakapura ($2054.49 \mu\text{m}^3$) and lowest in cv. Shankara ($520.50 \mu\text{m}^3$). Chromosomes with median, nearly median, sub-median position of centromere were prevalent in the karyomorphometric analysis. Plantains showed more chromosomal variations as compared to dessert banana. The cytological characterization enables us to know the ploidy of *Musa* cultivar with chromosomal evolution through karyotype asymmetry data.

Keywords: Chromosome structure, Plantain and dessert banana, Genetic diversity, Karyotype asymmetry, Phylogeny

CHROMOSOME NUMBER DETERMINATION AND KARYOTYPE ANALYSIS OF EIGHT DIPLOID AND TRIPLOID *Musa* VARIETIES FROM NORTH-EAST INDIA

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ABSTRACT

Banana (*Musa* spp.) belongs to family Musaceae is an important cash crop with high market demand all over the world as a staple food with a potential of addressing food security problems. Assessment of cytogenetic characters in *Musa* cultivars of North-East Indian banana is inevitable for its disease resistant gene pool. It is unexplored cytogenetically due to difficulties like small chromosome size, diversity in ploidy levels, and high cultivar diversity. In this report, somatic chromosome number, and detailed karyotype analysis including total chromosome length and Total form percentage (TF%) were accessed on eight *Musa* varieties from Northeast

Indian states. Out of these, four varieties were found triploid ($2n = 33$) and four to be diploid ($2n=22$) with a basic chromosome number of $x=11$. From karyotype analysis, the total chromosome length ranged from $37.68\mu\text{m}$ in var. BhimKol to $66.77\mu\text{m}$ in var. SitaKol among diploids $39.93\mu\text{m}$ in var. Malbhog to $81.88\mu\text{m}$ in var. JahajiKol among triploid varieties. The karyotype formulae, resultant of the structural alteration of chromosomes were deduced by grouping chromosomes based on F% variation. The TF% varied from 37.10% in var. JahajiKol to 42.52% in var. Kali which signified an abundance of nearly median constricted chromosomes and symmetric karyotypes in the studied varieties. Secondary constrictions found in the chromosomes varied in length ranging from $0.39\mu\text{m}$ in var. DhirmaniKol to $7.86\mu\text{m}$ in var. SitaKol. Chromosome number and karyotype analysis are vital for suitable parent selection in crop breeding programmes.

Keywords: Musaceae, karyotype analysis, var. DhirmaniKol, and var. SitaKol

RESOURCES SURVEY AND EXPLORATION OF WILD EDIBLE MUSHROOMS OF MEDICINAL IMPORTANCE IN WESTERN ODISHA, INDIA

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ABSTRACT

Wild edible mushrooms (WEM) are utilised in traditional remedies all over the world and are economically significant. The Western Odisha is home to a wide variety of edible mushrooms that are harvested by rural residents for both food and livelihood generation. In an attempt for the first comprehensive study on the variety and traditional applications of mushrooms in western Odisha extensive

surveys were undertaken from 2012 to 2019 to document the ethnomycological diversity and socio-economic significance of the value chain for wild edible mushrooms. The results identifying the gender, type of mushroom species, medicinal uses, and marketing of mushrooms were reported by a total of 750 informants from the study area. As a result of the floristic inventory in the study area 175 different species of mushrooms were collected and taxonomically identified by following the available literature of which 97 were new records for Odisha. Russulaceae was the most dominant family with 25 species followed by Agaricaceae (18 species). The most edible and medicinally significant fungi were found to be *Sparassis crispa*, *Pleurotus* sp., *Laetiporus sulphureus*, *Lentinus edodes*, *L. squarrosulus*, *Pleurotus ostreatus*, *P. pulmonarius*, *Pycnoporus cinnabarinus*, *Microporus xanthopus*, *Russula cyanoxantha*, *Schizophyllum commune*, *Trametes gibbosa*, *T. versicolor*, *Lycoperdon perlatum*, *L. sajor-caju*. Of all the macro-fungal species, morels were the most expensive and crucial in terms of medicine being widely used to treat common illnesses and primary health disorders by the local tribes. The collection and sale of wild edible mushrooms for food and medicine contributes in the socio-economic advancement, alternative employment, and food security of the rural folks in the study area. It is expected that further studies could isolate novel pharmaceutically potential bioactive substances from these mushrooms, which are now used by rural inhabitants as a source of food and medicines.

Keywords: Ethnomycological diversity, Wild edible mushrooms, Western Odisha

OVER-EXPRESSION OF EXON JUNCTION COMPLEX PROTEINS PROMOTES PLANT RESISTANCE AGAINST PATHOGEN INFECTION

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ABSTRACT

Plant-pathogen interaction is co-evolving and results in developed resistance in both the host and invader. Plants being sessile cannot physically escape from the pathogens and thus are armored with defense strategies resulting in neutralizing the pest effects. *Resistance (R)* genes in plants elicit a robust defense by synthesizing their protein products against pathogen effectors. Primarily, the expressions of a subset of *R* genes are tightly regulated by exon junction complex proteins (EJCs). Over-expression of EJCs confers resistance against bacterial pathogen in *Arabidopsis thaliana*. The EJC proteins localize in the nucleus and cytoplasm. Plants with ectopic expression of EJCs exhibits delayed flowering phenotype aligning with the fact that immunity costs growth. The over-expression of the EJCs in *Arabidopsis thaliana* results in enhanced immunity, primarily by modulating the basal immunity. The transgenic plant not only offers resistance against the *Pseudomonas syringae* but also favors the plant to withstand drought stress.

Keywords: Pathogen, Resistance, exon junction complex, over-expression, immunity

ETHNOBOTANICAL STUDY ON LIVELIHOOD DEPENDENCY OF LOCAL TRIBAL COMMUNITIES ON BAISIPALLI WILDLIFE SANCTUARY, ODISHA, INDIA

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ABSTRACT

Baisipalli wildlife sanctuary (BSW) is an important protected area of Odisha, located in Nayagarh district. Tribal communities residing in and around BSW are depended on sanctuary forest for their livelihood. Plants of the sanctuary area play vital role to fulfil basic needs of local tribes. Present study was designed for ethnobotanical analysis of livelihood dependency of tribal communities on BSW. Data were collected through field observation, focused group discussion and semi-structured interview method. Among the plants used for various purposes 49% were tree, 26% herb, 13% shrub and 12% climber species. Highest percentage of plant species were used for medicine (36%) followed by food (34%). Plant parts such as leaf, stem, wood, flower, fruit, seed etc. were commonly used for various purposes out of which leaf was the highly used plant part followed by wood. *Shorea robusta*, *Madhuca indica*, *Semecarpus anacardium* and *Bauhinia vahlii* are some examples of multipurpose species of which several plant parts were used for different purposes. Local tribal communities are rich source of traditional and ethnobotanical knowledge. Documentation of such indigenous knowledge will be useful for developing strategies for economic development of local communities, sustainable use of plant species and conservation of biodiversity.

Keywords: Baisipalli Wildlife Sanctuary, Ethnobotanical analysis, *Shorea robusta*, *Madhuca indica* and *Bauhinia vahlii*

NICKEL STRESS INDUCED ALTERATIONS IN PIGMENT CONTENT AND CHROMOSOMAL DISTURBANCES IN PLANTS

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ABSTRACT

Nickel is one of the micronutrients to plants, but there has been much more concern about the toxicity of Ni than about Ni deficiency. In general, the effect of long-term, low-level exposure to nickel is shown in growth inhibition with no other visible signs. However, many species of plants growing on soils contaminated with excess nickel show stunted and discoloured roots and tops, wilting, chlorosis, necrosis, twisted stalks, etc. In this study, the effect of nickel stress is shown by observing the alterations in pigment content and through different chromosomal abnormalities in plants. The toxic effects of various doses of nickel such as 50, 100, 200 and 300 ppm along with a control (0 ppm) were studied. Apart from cytotoxic effects, the growth was retarded at higher concentration of Nickel. The chlorophyll and carotenoid content gradually decreased with increase in concentration of nickel. The cells of the nickel treated samples showed different types of chromosomal abnormalities *viz.* chromosomal breaks, laggards, bridges, nuclear lesions, sticky chromosomes which depicted the toxic effects of nickel on plants. Thus, nickel at different doses showed visible and significant changes in the root morphology as well as the chromosome structure during cell division.

Keywords: Nickel, Chlorophyll, Carotenoids, Cytotoxicity, Chromosomal abnormalities

ROLE OF BIOINFORMATICS IN BIODEFENSE

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ABSTRACT

The concept of bioinformatics deals with the computational approach that consists of a number of tools and powerful software. It is developed for interpretation and analysis of biological complexity. Through this, one can analyze, manage and store the biological data. There are a number of applications of bioinformatics viz. Molecular modeling, docking, sequence alignment, annotations and dynamic simulation to accelerate the field of bio-defense in a greater way. As the bio-defense research is a high national priority, it's relation to bioinformatics offer the basic knowledge to understand the genotypic sequence of a genetically engineered pathogen and the respective infectious disease which is caused by it. However the existing researches in a normal way are not sufficient to gain a detailed map for standardizing the available pathogens genomic data and put it in a way to develop proper vaccines, diagnostics and broad spectrum therapeutics. Therefore advanced branches of bioinformatics viz. Genomic barcoding, active curation and next generation genome sequencing in medical intelligence are needed to introduce into the biodefense system. The proper monitoring of biodefense can save the society from bioweapons.

Keywords: Bioinformatics, Genome sequencing, Annotation, Biodefense, Bioweapons

POTENTIAL ETHNOMEDICINAL PLANTS WITH REFERENCE TO PRIMARY HEALTHCARE IN ODISHA

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ABSTRACT

Plants have been intimately associated with human civilization since time immemorial. Man being the most intelligent, rational and social amongst the animals first learnt to utilize the herbal wealth of their neighborhood for curative purposes besides exploiting plants, in general, to cater to their bare needs of living: food, clothes and shelter. Though as old as human civilization, pharmacognosy remained more an art than a science for several hundred years. It was left to the tribal medicine men, the 'witch doctors' or 'faith healers' to collect their own herbs, prepare extracts from them and prescribe to the local patients. This indigenous know-how gained through a life time of such efforts, were quietly carried over by words to another of his own creed of the succeeding generation. Thus, ethno-medico-botany has now become a specific branch of ethnobotany which had remained under-known to the scientific community for several years because of the lack of proper documentation. During the last three and half decades the author and his research associates had visited several tribal-rich pockets of Odisha and collected a good amount of information regarding the medicinal uses of plants by the tribal communities to cure various diseases. The present communication enumerates 65 plants useful in 20 categories of diseases and provides hints on preparation and application of recipes. The information has been gathered from old tribal or a tribal medicine-men practising herbal medication in rural Odisha. In addition, some prescriptions are also based on the personal experience of the author. The folklore data is presented here disease-wise citing botanical names along with their family names, followed by local name(s) and finally mode of use in brief. The findings embodied in this paper indicated that the age-old knowledge of tribes on medicinal use of plant parts or extracts could provide a clue in discovering new sources of bioactive molecules towards development of novel drug.

Keywords: Ethnomedicinal plants, Herbal medicine, Primary healthcare, Odisha

DOCUMENTATION OF INDIGENOUS USES OF FAMILY POACEAE OF BALASSORE, BHADRAK AND ITS ADJOINING AREAS

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ABSTRACT

Indigenous knowledge is the unique knowledge confined to a particular culture or society. It is also known as local knowledge, folk knowledge, people's knowledge, trading knowledge, traditional wisdom or traditional science. This knowledge is generated and transmitted by communities over time, in an effort to cope with their agro-ecological and socio-economic environment. It is generated through a systematic process of observing local conditions and experimenting with solutions. It is passed from generation to generation usually by words of mouth and cultural rituals and has been the basis of agriculture, food preparation etc. A preliminary survey was conducted on the indigenous uses of the members belonging to family Poaceae in different seasons like pre-monsoon, monsoon and post-monsoon during the month of June to October of 2022 in different areas of Balassore and Bhadrak district namely Chudamani, Irum, Baliapal, Chandabali and Dhamara. Out of the 103 plants collected and taxonomically studied uses of 37 species were reported with their indigenous uses by the local inhabitants including the tribes residing in the area under study. It was observed that family Poaceae which constitutes the second largest family among monocots, are having a great diversity and performed important role in the lives of man and animals.

Keywords: Documentation, Poaceae, Indigenous uses

SCREENING AND IDENTIFICATION OF CELL DEATH AND MITOPHAGY-INDUCING PHYTOCHEMICALS FROM *Bacopa monnieri* EXTRACT AGAINST ORAL CANCER CELLS

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ABSTRACT

Bacopa monnieri is a traditional herbal medicine well known for its antioxidant, anti-inflammatory and neuroprotective effect. Hyperactivation of inflammasome sustains cancer progression by promoting cell proliferation, metastasis, epithelial-mesenchymal transition and angiogenesis. Oral carcinogens such as arecoline promote NLRP3 inflammasome activation via mitochondrial dysfunction, which in turn promotes cancer progression. Hence, mitophagy-mediated removal of dysfunctional mitochondria maintains the mitochondrial pool and renders NLRP3 inflammasome activation. In this study, we have identified the anticancer and anti-inflammatory effect of ethanolic extract from *Bacopa monnieri* against Cal33 and FaDu cells which was further fractioned into ethyl acetate and aqueous fractions. Anticancer studies with Cal33 and FaDu indicate that the aqueous fraction of the ethanolic extract (BM-AF) is more potent than others. Interestingly, BM-AF inhibited clonogenic potential and cell migration and induced apoptosis in oral cancer. In addition, BM-AF induces mitophagy and mitochondrial fission in Cal33 cells, and it showed that BM-AF-induced mitophagy was abrogated in the presence of mitochondrial fission inhibitor Mdivi1 and autophagy inhibitors. Furthermore, BM-AF inhibits arecoline-induced NLRP3 inflammasome activation in Cal33 cells. In conclusion, *Bacopa monnieri* fraction BM-AF has potent anticancer activity through apoptosis and mitophagy-dependent inhibition of NLRP3 inflammasome activation in oral cancer cells.

Keywords: Apoptosis, *Bacopa monnieri*, Mitophagy, NLRP3 inflammasome, Oral cancer

STUDY ON BIOCHEMICAL AND CYTOLOGICAL CHANGES OF *In vivo* GROWN SEEDLINGS OF *Zinnia elegans* (L.) IN CHROMIUM STRESS

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ABSTRACT

The unrestrained escalation of urbanization and industrial activities triggered a curse for the planet earth leading to ecological imbalances, contamination of air, soil and water, risking flora and fauna and ultimately staking our own lives into an ambiguous game of contaminants and containment. The present *in vivo* pot experiments were conducted in a completely randomised strip-plot design to investigate the root morphological variations, physiological and biochemical changes in an ornamental plant *Zinnia elegans* (L.) using graded concentrations of hexavalent chromium ($K_2Cr_2O_7$). The physio-morphological parameters such as Chlorophyll *a* fluorescence transient (O-J-I-P), quantum yield of photosystem II ($\dot{O}P_0$), photosynthetic performance index of primary photochemistry (PI'), activity of antioxidant enzymes viz ascorbate peroxidase (APX), superoxide dismutase (SOD) and catalase (CAT) were analysed after 45 days treatment. The number of root hairs initially decreased with increase in the concentration of Cr^{+6} but at higher concentration of Cr^{+6} (75ppm), the number of root hairs were increased. Cr^{+6} stress induced chromosomal aberration viz change in the chromosome morphology and mitotic abnormalities. The experiments suggest that the Cr^{+6} stress leads to early flowering in *Zinnia elegans* (L.) species. This study demonstrates that phytoremediation of Cr^{+6} contaminated soils in mining sectors can be effectively carried out using non edible ornamental plants, thereby arresting the effects of the ion in the food chain.

Keywords: *Zinnia elegans*, Chromium, *in vivo*, Phytoremediation

PHYTODIVERSITY OF ATHAGARH FOREST DIVISION AND ITS ADJOINING AREA IN ODISHA: A FLORISTIC APPROACH

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ABSTRACT

Floristic study conducted in Athagarh Forest Division and its adjoining areas in Cuttack district of Odisha revealed that a total of 276 plant species belonging to 199 genera under 77 different families constitute the phytodiversity in the area. Habit-wise grouping could show that 86 (31%) were herbs followed by 54 (20%) grasses, 51 (19%) trees, 39 (14%) shrubs, 19 (7%) climbers, 15 (5%) hydrophytes, 6 (2%) pteridophytes, 3 (1%) parasites, 2 (1%) bryophytes and 1 gymnosperm. Taxonomic studies indicated that Poaceae with 36 species was the dominant family followed by Cyperaceae (19), Euphorbiaceae (16), Fabaceae (14) and Asteraceae (11). *Cyperus* was the dominant genus with 13 species followed by *Ficus* (6), *Phyllanthus* (5) and *Cassia*, *Crotalaria*, *Sida*, *Panicum* (4) species each. Important medicinal plant species collected and identified during the investigation include *Gymnema sylvestre*, *Saraca asoca*, *Phyllanthus emblica*, *Terminalia arjuna*, *T. bellirica*, *Tinospora cordifolia*, *Desmodium gangeticum*, *Evolvulus alsinoides*, *Bombax ceiba*, *Vanda tessellata*, *Vetiveria zizanioides*, *Pandanus fascicularis*, *Andrographis paniculata*, *Uraria picta* and *Adiantum phillippense*, etc. Further, a total of 49 invasive alien species belonging to 43 genera under 25 families were documented as a result of extensive vegetational survey in the entire forest division and nearby areas. The invasive plant species identified comprised *Eichhornia crassipes*, *Monochoria vaginalis*, *Salvinia molesta*, *Lantana camara*, *Mikania*

micrantha, *Parthenium hysterophorus* and *Emilia sonchifolia* etc. Among the plants *Shorea robusta*, *Terminalia alata*, *T. bellirica*, *T. chebula*, *Angeissus acuminata*, *Clerodendrum viscosum*, *Hyptis suaveolens*, *Chromolaena odorata* were found to be predominant. *Saraca asoca*, a critically endangered species in Odisha and endangered species like *Crateva magna*, *Cycas circinalis* (endemic) and threatened species *Micrococca mercurialis* of Odisha were also recorded. The Athagarh Forest Division was observed to maintain a rich phytodiversity and dense vegetation cover providing an excellent carbon sink to the forest region and its surrounding areas.

Keywords: Phytodiversity, Athagarh, Endangered sp, Threatened sp, Endemic sp

FREE RADICAL SCAVENGING ACTIVITIES OF LEAVES AND RHIZOMES OF *Maranta arundinacea* L.

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ABSTRACT

Maranta arundinacea L. is a very useful and valuable medicinal plant belongs to the family marantaceae. This plant is commonly known as arrowroot plant. The present study was aimed to investigate scavenging activities of leaf and rhizome extracts of *M. arundinacea*. The radical scavenging activity of leaf and rhizome was investigated by DPPH, H_2O_2 reducing power, metal chelating activity and nitric oxide scavenging activity. All the four different extracts exhibit concentration dependent scavenging activity. Out of the 4 solvent extracts ethanol was found to have the maximum scavenging potential followed by methanol, aqueous and hexane extracts. The IC_{50} value ($\mu g/ml$) of the extracts for this activity was in the order of ethanol < methanol < aqueous < hexane. Ethanol extract of rhizome exhibited the lowest IC_{50} (37.84 $\pm$ 1.27, 72.66 $\pm$ 0.78, 16.33 $\pm$ 0.64, 45.66 $\pm$ 0.75 and 68.33 $\pm$ 0.56 $\mu g/ml$) indicating the highest scavenging activity of DPPH, H_2O_2 reducing power, metal chelating activity, nitric oxide scavenging activity followed by methanol, hexane and aqueous extract. The present study reveals that the leaf and rhizome possess significant antioxidant activities & also can be used in treatment of chronic diseases. *M. arundinacea* L. plant may serve as a good pharmaceutical agent deviate oxidative stress.

Keywords: *Maranta arundinacea* L., Oxidative stress, Free radicals, DPPH, IC_{50}

IDENTIFICATION OF ELITE GERMPLASM OF MEDICINALLY IMPORTANT *Centella asiatica* WITH HIGH CENTELLOSIDE CONTENT

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ABSTRACT

Centella asiatica, popularly known as Indian Pennywort is a perennial, creeper belonging to the Apiaceae family. In India, *C. asiatica* is popularly known as "Brain food" and reported to have anti-inflammatory, anti-aging, anti-tumor, antioxidative properties. The medicinal properties of *C. asiatica* is due to the presence of triterpenoid saponins like asiaticoside, madecassoside, asiatic acid, and madecassic acid which are collectively known as centellosides. High demands by the pharmaceutical and cosmetic industries have led to uncontrolled exploitation of *C. asiatica* from the wild. Moreover, chemical synthesis of centellosides is exceptionally challenging and uneconomical due to its structural complexity, and there is also lack of high yielding varieties. Thus, the current study was undertaken to screen an elite germplasm by analyzing intraspecific variations of four major biochemical components. A total of 70 wild accessions of *C. asiatica* analysed through high-performance liquid chromatography (HPLC) revealed remarkable variation in sum of four active biochemical compounds in aerial parts, ranging from 0.37 to 10.91% on a dry weight basis. Three elite accessions (CA-18, CA-37, CA-38) having respectively 10.91%, 9.60%, 9.04% of sum of four major active triterpenoids were identified. These germplasms could be used for commercial cultivation and genetic improvement of *C. asiatica*.

Keywords: *Centella asiatica*, Germplasm, Triterpenoid saponins, Centelloside

STUDIES ON THE ETHNOMEDICINAL PLANT RESOURCES OF ADASPUR LOCALITY OF CUTTACK DISTRICT, ODISHA, INDIA

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ABSTRACT

As a result of intensive and extensive medico-ethnobotanical field explorations and interactions with traditional healers, tribals, village medicine-men and senior women folks who practiced native phytotherapy in Adaspur of Cuttack district, Odisha for nearly 2 months it became possible to generate enormous amount of data. After identifying the plant specimens in the Herbarium and scrutinizing the data, it was found that the information is quite interesting and worth pursuing for their efficacy. The data when cross checked with the published literatures, it was found a good number of plants to cure many diseases and related disorders, are either less known or not recorded earlier. This study records the types of therapeutic plants utilized by traditional healers and local villagers to cure different diseases. Plants were reported based on plant parts utilized, method of utilization, portions and method of administration of herbal drugs. With extensive and intensive field survey in the investigation region, data in regards to plants was gathered from local herbal practitioners, village elders and traditional healers through conversations, interviews and discussion with the standardized ethnobotanical questionnaire. An aggregate of 60 plant species belonging to 43 families were distinguished and reported which were utilized to fix various ailments. The families Fabaceae Lindl., Apocynaceae Juss., Rutaceae Juss Lamiaceae Martinov. and Nyctaginaceae Juss. were most dominated in representing the ethnomedicinal plants used to cure various ailments. Most favored plant parts were leaves, fruits, bark and roots. It is presumed that ethnobotanical plants of this area can be utilized as potential hotspot to find new bioactive compound of therapeutic value.

Keywords: Bioactive, Diseases, Ethnomedicinal, Herbal drugs, Adaspur

INTEGRATED MANAGEMENT OF RHIZOME ROT OF GINGER IN ODISHA

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ABSTRACT

Ginger (*Zingiber officinale* Roscoe), one of the most valued horticultural crops of the world, is used extensively as spice and for its medicinal properties. Rhizome rot or soft rot is a serious disease of ginger causing considerable economic loss to producers in different countries. Several *Pythium* spp. have been linked to the development of soft rot. There is less information on soft-rot resistant varieties among cultivars of *Zingiber officinale* available in Orissa condition. So we emphasize on the cultural practice, use of chemical fertilizer and pesticides, use of available biological control and integrated approach to control the rhizome rot disease in Orissa. In laboratory experiments it was observed that *Trichoderma viridae* inhibited the maximum growth of *P. aphanidermatum* in comparison to other antagonist. Four biological control agents were applied in the field and observed that *T. viridae* @ 10gm/kg of soil was more effective in reducing the rhizome rot of ginger. Seven fungicides were seed treated in the green house experiment against rhizome rot and observed that Ridomyl Mz (0.15%) cause maximum reduction of disease severity and increase rhizome yield in comparison to other fungicides. An integrated approach was adopted to reduce the rhizome rot of ginger by using different combinations. It was observed that all the treatment combinations reduce the disease severity in comparison to untreated inoculated control. A multipronged integrated disease management system involving phytosanitation, cultural and biological methods of control and coupled with moderately disease resistant variety would be the practical solution to check the crop losses.

Keywords: *Z. officinale*, Biologically activities, Gingerol and Shogaol, Soft rot, Biocontrol, Integrated disease management, Agroclimatic condition, Soil solarization.

MEDICO-BOTANY OF LEAFY VEGETABLES USED IN RITUALS AND FESTIVALS IN BALASORE DISTRICT OF ODISHA

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ABSTRACT

The use of leafy vegetables in religious functions, rituals, and festivals is well known among Hindus in India. In addition to their culinary uses, they are frequently used for worshipping various gods and goddesses, garlanding, and preparing "Prasad" in various Hindu rituals and festivals. Despite their increased popularity, traditional beliefs and myths about the use of leafy vegetables in religious practices are eroding with modern life style. The current survey was conducted in the Balasore district of Odisha, India, to investigate the medicinal uses of leafy vegetables utilized in rituals and festivals. A total of 36 leafy vegetables belonging to 32 genera under 19 families were documented being used in different rituals and festivals in the area, most of which were found to possess therapeutic and nutraceutical value. It is recommended to preserve the traditional knowledge behind the use of those leafy vegetables in view of their utilities not only for their religious significance but also intensive analysis of their pharmaceutical properties. Furthermore, culture and tradition play an important role in environmental conservation.

Keywords: Leafy vegetables, Rituals, Nutraceutical value, Traditional knowledge

RESIDUAL ANALYSIS OF TETRACYCLINE AND STREPTOMYCIN ANTIBIOTICS IN RICE SOIL

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ABSTRACT

Bacterial Leaf Blight in rice caused by *Xanthomonas oryzae* can be controlled by an antibiotic, Streptocycline, a mixture of Tetracycline (10%) and Streptomycin (90%). Applied antibiotics may enter into soil and interfere with the natural microbiota. To quantify the residues in soil, an experiment was conducted where the antibiotic mixture was applied at half the recommended dose (HRD at 75 mg/L), recommended dose (RD at 150mg/L) and double the recommended dose (DRD at 300mg/L). Antibiotics were extracted from soil samples and quantified in liquid chromatography- mass spectroscopy (LC-MS). Tetracycline residues prevailed in soil up to 9 days in HRD & 14 days in RD and DRD treatments. Tetracycline residue decreased from 71.7ig/kg to 2.11ig/kg in HRD on 9th day, 168.7ig/kg to 6.9ig/kg in RD and 405.9ig/kg to 35.8ig/kg in DRD on day-14 of the experiment. In case of streptomycin, the residue was detected up to 14days in HRD, 21days in RD and 30days in DRD treatments. Streptomycin residue decreased from 57.6ig/kg to 14.9ig/kg in HRD on day-14, 108.2ig/kg to 13.5ig/kg in RD on day-21 and 223.4ig/kg to 14.7ig/kg in DRD on day-30 of the experiment. The results suggested that application of antibiotics in rice may not cause residue build-up over long run. We investigated the effect of the antibiotics on soil microbes and enzymes and found adverse impact of antibiotics on some of the microbial parameters. This may alter the soil biochemical properties in long run, which is yet to be investigated.

Keywords: - *Xanthomonas oryzae*, LC-MS, Residue, Tetracycline and Streptomycin

OPTIMISATION OF PRETREATMENT AND SACCHARIFICATION OF INDIAN BAMBOO (*Bambusa tulda*) AS A LIGNOCELLULOSIC BIOMASS FOR MAXIMUM DELIGNIFICATION AND CONVERSION OF SACCHARIFIED PRODUCTS TO FERMENTABLE SUGARS

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ABSTRACT

Rapid increases in fuel consumption have led to depletion of fossil reserves and climate change. These have worsened by over-exploitation of resources thus increasing global greenhouse gas emission. Sustainable and environmentally friendly energy based on renewable resources such as lignocellulosic biomass that are derived from agricultural waste biomass continues to attract global interest as a sustainable alternative to fossil carbon resources to produce second-generation biofuels. Bamboo is a sustainable lignocellulosic feedstock for bioethanol production as it requires less water and has a faster growth rate in the tropical regions. This work aims to study the two pretreatment strategies i.e., alkaline and acid ($\text{NaOH}/\text{H}_2\text{SO}_4$) pretreatment in a combination with ultrasonication followed by optimisation of saccharification of bamboo chips biomass for release of fermentable sugars. Optimisation and screening of pretreatment technique was conducted by response surface methodology (RSM). The significant factors such as, substrate concentration (4g), alkaline concentration (3%), Incubation time (4hrs), and Temperature (50 °C) showed the maximum effect on delignification of bamboo chips. Further ultrasonication assisted alkaline (NaOH) pretreatment exhibited enhanced

delignification and cellulose exposure from bamboo chips in comparison to only alkali/acid pretreatment and ultrasonication assisted acid pretreatment. Under optimum conditions of ultrasonication-assisted alkaline pretreatment with different parameters of power supply i.e., 100 W, temperature of 30°C, time 60mins, alkaline conc. 3% and duty cycle of 70 % resulted in significantly higher delignification of bamboo biomass and maximum cellulose and hemicellulose content of 680.0 mg/g and 157.74mg/g respectively. SEM and FTIR analysis of the untreated and pretreated substrate exhibited significant structural changes. Optimisation of enzymatic hydrolysis by RSM technique using commercial enzyme mixtures resulted in a maximum reducing sugar concentration of 463.5 mg/g and 37.8mg/g of glucose and xylose respectively.

Keywords: Lignocellulosic biomass, Ultrasonication, Pretreatment, Hydrolysis, characterization

ABSTRACT

Rapid increase in fuel consumption have led to depletion of fossil reserves and climate change. These have worsened by over-exploitation of resources. Increasing global greenhouse gas emission, sustainable and environmentally friendly energy based on renewable resources such as lignocellulosic biomass that are derived from agricultural waste biomass continue to attract global interest as a sustainable alternative to fossil carbon resources to produce second generation biofuels. Bamboo is a sustainable lignocellulosic feedstock for bioethanol production as it requires less water and has a faster growth rate in the tropical regions. This work aims to study the two pretreatment strategies i.e., alkaline and acid (NaOH/H₂SO₄) pretreatment in a combination with ultrasonication followed by optimization of saccharification of bamboo chips biomass for release of fermentable sugars. Optimization and screening of parameters in this study was conducted by response surface methodology (RSM). The significant factors such as substrate concentration (3%), alkaline concentration (3%), incubation time (4hrs), and temperature (50 °C) showed the maximum effect on delignification of bamboo chips. Further ultrasonication assisted alkaline (NaOH) pretreatment exhibited enhanced

INVESTIGATION ON CYTOMORPHOLOGY AND PLOIDY INDUCED VARIABILITY OF MEDICINALLY IMPORTANT BIOACTIVE GLYCOSIDES OF *Drimia indica* (ROXB.)

JESSOP

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ABSTRACT

Since the beginning of human civilisation, plants played an important role in the protection of human and animal health against chronic degenerative diseases. An impressive number of phytochemicals have been isolated from nature and as per the estimation of WHO about 80% of total inhabitants on earth relying on traditional medicines for their primary health care needs. *Drimia indica* (Roxb.) Jessop. of family Hyacinthaceae commonly known as wild onion is one of the extremely medicinally important genus with about 100 species endemic to India, Africa and Mediterranean regions. Phytochemical extract from squill were mainly used as anticancer agent and cardiac stimulant. Somatic chromosome number, detailed karyotype and genome size analysis were made to assess specific chromosomal characteristics and structural alterations in chromosomes of the genome, with variations of ploidy. Highly significant variations in the genomic length, volume and total form (TF)% were noted at variety level. High nuclear volume in all the tetraploid Ecotypes could be due to the presence of extra set of chromosomes in the genome or high amount of repetitive DNA. For future crop improvement programme detailed chromosomal analysis of different ecotypes could help breeders to choose the diverse parents along with high drug yielding suitable varieties.

Keywords : Medicinal plant , *Drimia*, Karyotype, Genome, Secondary constriction, Ploidy

CYTOGENETIC STUDIES OF CHROMIUM (VI) OXIDE NANOPARTICLE ON ROOT TIP CELLS *Allium cepa* L.

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ABSTRACT

Potential health and environmental effect of nanoparticle need to be thoroughly assessed before their widespread commercialization. Though there are few studies on cytotoxicity and genotoxicity of nanoparticles on mammalian and human cell lines, there are hardly any reports on genotoxic and cytotoxic effect of nanoparticles in plant cell. The purpose of current study is to evaluate the cytogenetic effect of chromium (VI) oxide nanoparticle on root tip cells of *Allium cepa*. The plants were treated with aqueous solution of chromium (VI) nanoparticle at five different concentration (0.01, 0.1, 1, 10, and 100 µg/ml) for 4 hr. With increase of nanoparticle concentration mitotic index decreased from 25.90% (control) to 25.42% (0.01 µg/ml), 22.87% (0.1 µg/ml), 19.31% (1 µg/ml), 14.93% (10 µg/ml) and 8.1% (100 µg/ml) was noted. Diverse form of chromosomal abnormalities were recorded such as clumped metaphase, chromosomal break, diagonal anaphase, laggard chromosome, sticky anaphase.

The proline content is found to be highest in 100 µg/ml and lowest in 0.01 µg/ml like wise the protein content is found to be highest in 10 µg/ml and lowest in 1 µg/ml. The *Allium cepa* cytogenetic test can be successfully applied for evaluating environmental risk of chromium (VI) nanoparticles over a wide range of concentration.

Keywords : Cytotoxicity, Chromium (VI) nanoparticle

EFFECT OF CHROMIUM (VI) TOXICITY ON *Sesbania sesban*

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Chromium is an ecologically hazardous component and furthermore a carcinogenic agent. Expanding the centralization of hexavalent chromium in the dirt of chromite mining region definitely influences plant efficiency. Chromium toxicity severely damages plants. Sukinda chromite mines of Odisha is a heavily polluted site, generating huge overburden dumps. The present experiment was designed to evaluate the effects of chromium on *Sesbania sesban* (L.) Merrill. It was observed that germination percentage reduces by 36.66% at high concentration of chromium. The root and shoot length decreases with increase in chromium concentration. There was a gradual decrease in morphological parameters like root fresh and dry weight, shoot fresh and dry weight. Chlorophyll content also decreases and there is a decrease in efficiency of photosynthesis but proline content increases with increase in chromium concentration. There is also a decrease in protein and sugar content at high concentration but low doses of chromium stimulates the production of protein. The chromosomal aberration shown by the plant after treatment with chromium contaminated soil includes chromosomal laggard, diagonal anaphase, distorted metaphase and significant reduction in mitotic index of *Sesbania sesban*. It was found out that high concentration of chromium shows detrimental effects on *Sesbania sesban* whereas, low concentration shows stimulatory effects.

Keywords : *Sesbania sesban* (L.), Chromium

CHARACTERIZATION AND DETERMINATION OF BIODEGRADATION ABILITY OF POLY LACTIC ACID AND *Luffa* FIBRE COMPOSITES

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ABSTRACT

Surface modification of natural fibres by electron beam irradiation is an economical and potent technique. The biodegradation of electron beam irradiated *Luffacylindrica* (LC) fibres and poly lactic acid composites having response of doses (0.5Gy, 1Gy and 2Gy) are studied. The degradation process is carried out in various environments like compost, sand and soil for a period of 90 days and microbial degradation using bacteria and fungi for a period of 90 days. The rate of biodegradation was calculated by measuring the loss of weight of composites at an interval of 30 days in each environmental condition. Preliminary results reported that the bacterial environment was the most prominent medium for degradation than

fungi. B9 composites showed maximum degradation of 15.42 % and 4.73 % in bacterial and soil medium respectively. Minimum rate of degradation was observed in sand medium (0.49%, 0.96 %, 1.08%, 0.35%, 0.72%, 0.87%, 0.21 %, 0.56 % and 1.15 % for B1 to B9 respectively). For exploring the use of the composites in the field of biomedical sciences, the LC fibres are modified using calcium salts before reinforcement. X-ray diffraction (XRD) and scanning electron microscopy (SEM) of the composites were performed.

Keywords : *Luffa* fibre, X-ray diffraction (XRD), Scanning electron microscopy (SEM)

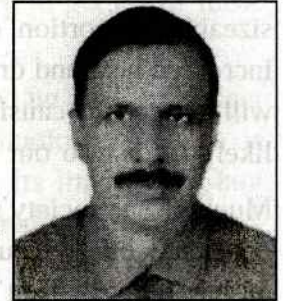
CLIMATE CHANGE – A REAL THREAT TO HUMANITY

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Climate change describes global warming- the ongoing increase in global average temperature and its effect on our climate system. It includes various long run changes to earth's climate. It refers to long term shifts in temperature and weather patterns. These shifts may be natural such as through variations in the solar cycle. Since 1800, human activities have been the main driver of climate change, primarily due to burning of fossil fuels like coal, oil and gas.

Climate change is now considered as one of the greatest threat to economic stability, as well as its serious impact on the environment and people. It is one of the biggest threats to economic stability. In brief heat waves make us less able to work and reduce Productivity.

Climate change is deeply influencing the economy and society. By the year 2100 the temperature would rise by 4 degrees which could reduce the global GDP by 30% in the worst case. Studies in 2019 suggest that economic damages due to climate change may be severe. These include property loss and damage, infrastructure and service costs and risks to financial stability. Agricultural sectors will likely to face some of the most significant challenges from climate change.

The fourth National Climate Assessment, 2018 warned that if we do not curb greenhouse gas emissions climate change could seriously disrupt society. Warmer temperatures, sea level rise and extreme weather will damage property and critical infrastructure, human health and productivity. The demand for energy will increase as power generation becomes less reliable as water supplies will be stressed.

The economic impacts of the changing climate are visible throughout the globe. The linkage of climate change to hurricanes, warmer temperatures and higher sea

levels are known to enhance their intensity and destructiveness. Science advances also give us more detailed spatial information to say which assets and operations are in danger with climate change for example how many buildings will be inundated due to sea level rise.

The sector which is most vulnerable to climate change is agriculture, on which a sizeable proportion of populations are dependent on. In addition to flooding, increased heat and drought will likely to reduce crop yields. The normal monsoon will be erratic causing abnormal occurrence of rain. Hence climate change is likely to disturb our socio-economic life of the people directly or indirectly.

Much of our society's critical infrastructure is at risk from flooding; Sea level rise could potentially cause a loss of value of assets in the trillion dollars by the end of the century. That's loss from damage to housing, damage to airports on the coasts, damage to docks, railway will adverse influence the basic infrastructure of the economy. Much of this infrastructure will likely need to be repaired or replaced. Military bases are also vulnerable. In addition, Our communication system will be affected.

Global warming primarily influence economic growth through damage to property and infrastructure lost of productivity, mass migration and security threats. The balance between winners and losers turns increasingly negative as temperature rise.

Humans and wild animals face new challenges for survival because of climatic change. More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers and warming oceans can directly harm animals, destroy the places they live and weak havoc on people's livelihoods and communities.

Climate change is the single biggest health threat facing humanity. Climate change impacts are already harming health, through air pollution, disease, extreme weather events, forced displacement, pressure on mental health and increased hunger and poor nutrition in places where people cannot grow or find sufficient food.

Thus climate change results in significant economic losses for India across sectors. The costs of climate change in agriculture are in the form of production or losses is rice; wheat and maize will go up. Climate change is expected to affect the human well being in many different ways such as capital, ecosystem, disease and migration. A meaningful development involves at least transformation from

agricultural to non agricultural economy reducing the dependence on agriculture. Since most of the labor force directly or indirectly depends on this sector for livelihood and employment, it is when this sector is more productive and ensures food self-sufficiency; it will release the necessary labor and capital for the manufacturing and service sectors. Hence, it is necessary to show the considerable actions in terms of policies, programs and projects to be taken to get rid of these threats to save humanity.

In this connection the seminar on climate change to be organized by the Department of Botany of U.N. Autonomous college of Science and Technology, Adaspur is appropriate in the present context of our life and livelihood. Its linkage to plant and agriculture will pave new way to get rid of evils of climate change.

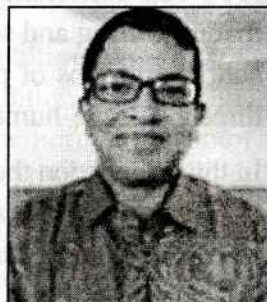
CLIMATE CHANGE: AN ETHICAL APPROACH

Bijaya Kumar Nayak

Senior Lecturer & HOD, Philosophy

"Clean air and water, and a livable climate are inalienable human rights. And solving this crisis is not a question of politics. It is our moral obligation"

Leonardo DiCaprio



In this small paper, a humble attempt is made to emphasize that only the anthropocentric approach is not the whole of life. Man-centric attitude endangers the natural environment, the existence of some non-human species like flora and fauna, and the aesthetic values in nature. plants are the converters of carbon dioxide and help fauna; fauna liberates carbon dioxide consumed by the flora for photosynthesis. Both are necessary for a healthy climate. We have enough money to fulfill our wants, enough property and houses to live in, and enough recreational facilities to enjoy, but we are poor in availing of clean air, water and a liveable climate. The use of chemicals and fertilizers in agriculture and the use of pesticides and poisons to kill insects and worms are endangering our life and making the land infertile. Earning profit in an easy way of going-the driving force of modern life has brought climate change. The biotechnological approach to mitigating climate change is supposed to be the plausible solution that flourishes human civilization and nature that keeps the climate intact-a conducive atmosphere for the present and future generations. We, as human beings, have an obligation towards nature, natural resources, flora and fauna as they provide the impetus for a good climate. But "Knowledge is Virtue". In the Vedantic language, we can say, "To know is to be".

Climate change now stands as one of the major threats to the whole cosmos. Seasons change in order following the laws of nature. Nature behaves uniformly under similar circumstances. Sometimes, we come across certain disorders and chaos in the form of natural calamities, such as volcanic eruptions, earthquakes, drought, famine, epidemics, glacier melting and so on over which we have no

control as they happen in nature in mechanical ways. The advancement of science and technology has made the whole world a village. Each one of us understands others' problems in a better way than we were doing previously. We are netizens. Our lifestyles are in tune with the outcome of the control over nature. In consequence, we find most of the predicaments are coming up due to human inventions for living a luxurious and pompous life without caring for the sustainability, and value of non-humans both in the present and future. We think only of human life-how to live pleasurably at the cost of the life of non-humans. To fulfill this goal, we tried to discover and invent more and more luxurious goods by exploiting natural resources. Consumption of fast food, junk foods, and skimmed items; living in painless conditioning at the cost of natural habitats rampantly created havoc for the entire globe. The way of dealing with nature and other animals as instruments for our enjoyment resulted in afforestation, deforestation, and the extinction of rare species that help nature for the sustainability of the whole cosmos. This anthropocentric attitude -man is at the top of the hierarchy of nature and other things, and beings are for the use of man led disastrous consequences one of which is climate change. It considers nature as a source of human enjoyment. It forgets that nature has value itself even if not used by humans. Nature and natural resources are considered to be the means to human pleasure. This anthropocentric outlook gave rise to massive industrialization resulting in air, water, and land pollution, and the extinction of some species. But only the cost-benefit outlook should not be the mongering factor for policymakers. Policymakers should have a holistic view of the world and how interference in one part of nature affects the whole. Therefore, human good is not the only good. A Cosmo-centric approach is the need of the day.

Aldo Leopold in his essay "The Land Ethic" says that the eco-system has a life of its own. It is not a dead machine and is meant for human consumption. The system preserves the integrity, stability and beauty of the biotic community. Andrew Brennan in his Book entitled *Thinking About Nature* speaks of "ecological humanism" where he highlights that human good cannot be separable from the good of the bio-system. He claims that the identity of the human race depends largely on the bio-system. Human activities like the burning of fossil fuels that emit carbon dioxide into the air are the major causes of climatic change. According to the WHO report, the warming of the planet caused an additional 140,000 deaths in 2004. Climatic-sensitive diseases such as malaria, dengue and diarrhea due to lack

of safe water, and malnutrition due to crop failure for scanty rainfall are the causes of extra deaths. Due to the increase in temperature the Sunderbans, islands in the Ganges delta are disappearing. Some small pacific nations like Maldives, Kiribati and Tuvalu are likely to be submerged in the water.

What is the urgency of the day is to reduce greenhouse gas emissions by replacing the use of fossil fuels, and methane emissions from cattle and sheep and find out sustainable methods so that human civilization and the bio-system would flourish together. Policy making at the government level, awareness among the youth in terms of organizing seminars and workshops, research and innovation for a bio-friendly life are the healthy practices for saving the planet. Realizing the importance of organizing such a seminar for the obligation to human society the Orissa Botanical Society in Collaboration with the PG department of Botany of our institute is conducting two-day deliberations on "Biotechnological Approach for Mitigating Climate Change". Along with this approach, the curtailment of the passion for maintaining luxurious life at the cost of deforestation and greenhouse gas emissions would fulfill the objectives of the seminar. Man is a part of the planet as other non-humans are. As I have the right to live and grow, they also have such rights. The identity of the human race depends on a healthy climate. My dignity as a healthy man is the product of my healthy planet. The journey to sustain this planet best should start with me.

I am grateful to Prof. Santilata Sahoo, the Chairman of the Organizing Committee of the National Seminar for allowing me to share my ideas from my little understanding. I am also thankful to Dr. Aparna Das, Lecturer in Botany for time-to-time reminders over the telephone for sharing some views regarding the theme of the seminar and its publication in time. Last but not least, I am grateful to all the members of the Organizing Committee, the patron, and the Chief Patron for their cooperation and inspiration in hosting of such academic activities.

