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A STUDY ON FLORISTICTIC DIVERSITY OF BIOPROSPECTING LICHENS FOR NOVEL CAUSES OF MANIPUR

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ABSTRACT

As lichens have been shown to be very sensitive to air pollution, they are sometimes dubbed the "litmus for air pollution" and the "permanent control system" for determining the effects of air pollution. It is possible to determine the biological consequences of a pollutant by using changes at the community or population level, or by analyzing the trace elements content of lichens. Because they soak up anything that floats their way (like little sponges), lichens may be used to foretell pollution levels and assess the state of an ecosystem. This includes water, gases, and other chemicals in the air. Lichens have extremely high ion exchange capabilities, quite similar to those of ion exchange resin, which allows them to capture and store metals from the air. It has been shown that lichens may store up to three times their body weight in a variety of contaminants in their tissues.

KEYWORDS: Floristictic Diversity, Bioprospecting Lichens, Novel Causes, Manipur, air pollution, foretell pollution

INTRODUCTION

Studying the presence/absence and dominance of a species or group of species in a given location may be used to infer whether or not the air quality in that area has changed as a result of air pollution or microclimatic changes. Because lichens are simple to evaluate, inexpensive, and the most effective indicator of air quality, their usage as a bio monitoring tool has expanded dramatically in recent years.

Many researchers have looked at the effects of air pollution on lichens by measuring changes in things like net photosynthesis, chlorophyll degradation, chlorophyll content and spectral reflectance response, and trace element concentrations in lichen thalli. Lichens may be sampled and analyzed for their mineral content, which might be used to track the elements that are being deposited to the ground from the atmosphere.

1.4 Lichens as biomonitors of ambient air quality

The physiology and morphology of lichens, their growth rates, reproduction, and the makeup of lichen communities can all be negatively affected by even modest quantities of sulphur, nitrogen, and fluorine-containing pollution (particularly SO_2, acidic or fertilizing substances). Chlorophyll breakdown, which causes bleaching of the thalli, is the most visible symptom of pollution harm to lichens. Environmental conditions, such as air pollution, can have a significant impact on lichen chlorophyll. Typically, the quantity of chlorophyll a, chlorophyll b, and total chlorophyll is inversely related to the concentration of sulphur dioxide (Le Blanc et al., 1974). The levels of nitrogen oxides (NO2) in an area have a significant effect on the fungi population there. NO2 in the air, often caused by traffic, can either reduce lichen variety or boost the growth of a few resistant lichen species.

Bioprospecting lichens for novel causes

From ancient times, lichens have been considered a veritable "treasure chest" of natural goods due to their wide variety of applications. Traditions of using lichens in the kitchen, as medicine, in the perfume and dying industries, in brewing and distilling, and as decorative accents date back centuries (Müller, 2001; Ingolfsdottir et al., 2000; Ingolfsdottir, 2002; Stocker-Wörgotter, 2008).

In nature, lichen metabolites serve a wide variety of purposes, including but not limited to: weathering rocks (Rundel, 1978); protecting the photobiont from harmful UV rays (Gauslaa and Solhaug, 2000); recycling nutrients; limiting herbivore damage; and maintaining the symbiotic balance (Kinraide and Ahmadjian, 1970; Huneck, 2003; Lawrey 1986; Rikkinen 1995).

In addition to providing nutrition for animals, lichens are also used as human food by several societies. Certain lichen species are eaten only in times of hunger, while others are eaten as a staple meal or even as a delicacy due to their high nutrient content. Researchers looking into the matter have found that the high carbohydrate content of lichens is what makes them so appealing as a food source. Lichens, despite their low protein concentration, have some potential as a protein replacement (Vinayaka et al., 2009). Because of their low fat content and high crude fiber content, lichens are an excellent dietary source.

In addition to their nutritional significance, several species of lichen have shown to have major commercial utility in the fields of cosmetics, fragrance, and as key sources of colors for apparel, particularly among the ancient Greeks, Romans, and Native Americans. There are many uses for lichens in the modeling world, including but not limited to trains and ships.

Extracellular production of a range of secondary compounds (Boustie and Grube, 2005) of relatively low molecular weight crystallized on the hyphal cell walls contributes to the lichens' wide variety of uses; these compounds can make up as much as 0.1 to 10% or even 30% of the dry weight of the thallus (Galun, 1988). The chemistry of lichens has been studied and has revealed the presence of anywhere from 800 (Elix, 1996; Muller, 2001) to 1050 (Stocker-Wörgötter, 2008) compounds, of which only 550 have been described because of their rarity.

Lichens have been widely used as a vital component in several medicinal practices. Lichens have been utilized in Indian, Chinese, Homeopathic, and Western herbal therapy since before the invention of modern pharmacological therapies. From ancient times, lichens have been used to cure a wide variety of conditions, including but not limited to: arthritis, alopecia, constipation, cough, jaundice, kidney illnesses, leprosy, pharyngitis, rabies, infection, worm infestation, and hair loss. Analgesic, anti-inflammatory, anti-microbial, antioxidant, anti-proliferative, anti-pyretic, antiviral, and cytotoxic characteristics have all been seen in lichens (Cyong et al., 1987; Yamamoto et al., 1993; Muzychkina, 1998; Shahi et al., 2001; Mitrovi et al., 2011). Very few lichens have been found to have anti-tumor action, and even fewer have been shown to have in vitro inhibitory effects on HIV.

However, lichens' sluggish growth rate and frequently severe environmental conditions have compelled them to create defensive compounds that can act as antigrowth, antiherbivore, or antibacterial agents (Hale, 1983; Rankovic et al., 2008). Phenolic metabolites, mainly usnic acid and anthraquinone endocrocin, are responsible for lichens' antibacterial effects (Hale, 1983; Marcono et al., 1999).

For example, lichens are a type of creature that may have antioxidant capabilities. By interacting with free radicals, scavenging free radicals, and chelating the free metallic catalysis, antioxidants limit or postpone the destruction of biomolecules or cells, as well as illnesses generated owing to an imbalance between intracellular antioxidants and intracellular reactive oxygen species (ROS). Many disorders, including heart disease, atherosclerosis, and chronic inflammation, are linked to the so-called condition of oxidative stress (Mahadik et al., 2011). Although organisms are able to guard against oxidative stress by creating antioxidants during aerobic cell respiration, additional antioxidants are typically necessary. In recent years, lichens have gained attention for the flavonoids and phenolic secondary compounds they contain (Hidalgo, 1994). Submerged fermentation of the lichen species Usnea complanata produces usnic acid and psoromic acid, two compounds with potent cardiovascular protective and antioxidative action (Behera et al., 2012). Anticancer activity and hydroxyl radical scavenging activity in lung cancer (A549) and breast cancer (MCF-7) model cell lines are demonstrated for compounds isolated from Parmotrema reticulatum (Ghate et al., 2014).

This cryptogam has attracted a lot of attention from scientists for its potential in the synthesis of bioactive nanoparticles, in addition to the many medicinal benefits of lichens. The remarkable optical and electrical characteristics of gold nanoparticles, also known as gold colloids, and their applications in optoelectronic devices, drug delivery, biosensing, and catalysis have garnered a great deal of attention (Hu et al., 2006; Ghosh, et al., 2008; Pingarron et al., 2008). Gold nanoparticles (AuNPs) are ideal for bioimaging, biomedical therapeutic, and biodiagnostic applications due to their surface plasmon resonance feature. To treat a wide range of illnesses, gold ashes have long been regarded as a staple of ancient Indian Ayurvedic therapy (Bajaj and Vohora, 2000; Shah and Vohora, 2002; Shah et al., 2005). Excellent antioxidant and antibacterial capabilities are also shown in surface-functionalized gold nanoparticles (Zhao, 2010; Singh et al., 2013).

As they include phytochemicals that can operate as natural reducing agents with high competence, biomaterials including algae, bacteria, fungus, and other plant components have been suggested as eco-friendly nano-factories (Nair and Pradeep, 2002). (Narayan and Sakthivel, 2008; Smitha et al., 2009; Song et al., 2010).

Only seldom have lichens been used for the production of noble metal nanoparticles. Metal ions may be neutralized by the unique metabolites found in lichen extracts such depside, depsidon, dibenzofurane, homo-D-glucan, and others. The secretion of Steptococcus mutans virulence factors like acid production, ATPase, enolase, protease, total exopolysaccharide content, and glucosidase was found to be inhibited by a herbo-metallic colloidal nano-formulation containing Swarna nanoparticles synthesized from a polyphenols rich lichen extract of Usnea longissima (Singh et al., 2014). Although harmful chemicals and costly physical procedures are now accessible, green-mediated production of gold nanoparticles from lichens can emerge as a viable alternative.

Due to the challenges in acquiring sufficient amounts and purities for structural elucidation and pharmacological testing, relatively few lichen compounds have been evaluated for biological activity and medicinal potential.

1.6 Floristictic diversity of lichens of Manipur

India takes up a major chunk of South and Southeast Asia, one of the world's six biogeographic regions. Conditions favorable to biodiversity had been created by geological processes operating on the country's landmass.

Moreover, the country's position between three evolutionary hotspots (originating in Gondwanaland, moving to northern Eurasia, and eventually receiving an inflow from Africa and Ethiopia) resulted in a wide range of edaphic conditions, phytoclimatic conditions, and bio-geographical zones.

As the country's landscape varies so greatly, from the permanently snowy peaks of the Himalayas to coastal plains, wetlands, mangroves, islands, tropical rain forests, rich alluvial plains, scorching deserts, and high altitude frigid deserts, the country's flora reflects this diversity. The region's diverse ecosystem necessitated the creation of three distinct ecological zones (Himalayan mountain system, Peninsular-Indian sub-region and the Tropical evergreen forests or Indo-Malayan sub region). In order to evaluate the hitherto unrecognized plant riches of a country, studies on floristic accounts of the country have assumed growing significance (Vediya and Kharadi, 2011).

One of India's most unique phytogeographic zones is the Eastern Himalayan region, which includes the North- Eastern states (Chatterjee, 1940; Jain, 1983, Balakrishnan, 1996). Due to its vast topography and different climatic circumstances, the region genuinely presents a greater picture of structural variety of flora, making it a focus of special attention among botanists and several of the world's major conservation agencies.

One-third of India's biodiversity can be found in the country's north-eastern area, which is an integral element of the Indo-Myanmar hotspot, Indo-Chinese, and Indian bio-geographical realms (Myers et al., 2000) and thus a gateway for the country's rich flora and fauna with the rest. Of of the country's total of 15,000 known plant species, 8,000 are found only in the northeastern area; this includes a quarter of the country's 54 species of gymnosperms, 500 of the 1012 species of pteridophyes, and 825 of the 1145 species of orchid. In addition, this area constitutes a sizable chunk of India's richest lichenogeographic zone (Singh and Sinha 1997). Among India's total 2303 lichen species, 1162 are found in this area (Sinha & Jagadeesh, 2011). (Singh and Sinha, 2010). While the North Eastern states are home to a wide variety of lichens, our understanding of their floristic composition is limited since so much of the region remains undiscovered. Located in India's far northeast, Manipur is one such area. The high degree of endemism in the state's flora is a result of the large percentage of land area covered by trees (approximately 77.12%, or 17,219 square kilometers). Non-timber forest products abound as well, with over 300 recognized and identified species of medicinal plants, in addition to 54 species of bamboo and 4 species of cane.

The state's diverse topography, mild winters, and abundance of lichens, mosses, and liver-worts are all thanks to its extreme range in altitude. Little on floristic accounts of lichen variety had been carried out via perfunctory collecting, therefore the plant resources of Manipur, especially lichen species, remained untapped (Rout et al., 2013).

While lichens are genetically and phenotypically diverse, they are often overlooked by locals. This is likely due to a lack of awareness of the countless benefits that lichens might provide. There is, however, a paucity of data on the use of lichens for regional air quality monitoring. In order to achieve sustainable development at this time of greatest peril, bioprospecting of lichen richness is essential. To evaluate and reevaluate the floristic diversity and species richness of lichens in this region, morpho-taxonomic study of lichens has become very necessary, to be followed by study on basic and applied aspects. For ecological sustainability, it is also important to spread information on bioprospecting lichen riches. In this context, this Ph.D. dissertation describes the investigation of lichen biodiversity in central Manipur with a focus on bioprospecting.

The goal is to travel to central Manipur, in order to study, collect, and store lichens.

Goal: to determine the lichen taxonomy by analyzing the gathered specimens' morphology, anatomy, and chemistry.

Using AAS, we will examine the levels of chemical pollutants in a subset of lichen species.

Examining the viability of certain lichens for use in bioprospecting (phytochemical screening, antimicrobial and antioxidant activity etc.).

The use of certain macrolichens in the bio-synthetic production of nanomaterials from gold chloride.

CONCLUSION

Floristic investigation of lichens collected from twenty sites around the central region of Manipur. Locations were chosen because of differences in lichen distribution and richness. Despite their adaptability, lichens' presence in the forest is influenced by local sources of disturbance such as roads, farms, and habitat fragmentation, which in turn influence microclimate factors such as precipitation, temperature, moisture status, light intensity, and nutrients. Based on morpho-anatomical and chemical analyses, a total of 131 species were assigned to 47 genera and 22 families, and their keys and identifying traits. The taxonomic composition and distribution in central Manipur were described, as was their phytogeographic associations.

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