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A Review on Biosorptive Nature of Food Dyes in *Lemna minor* from Polluted Freshwater Samples

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Abstract: ***Biosorption is a physio-chemical process that is performed by absorption of substance by microbial biomass. It is passive and reversible process based on the variety of mechanisms like Absorption, Adsorption, ion exchange, surface complexation and precipitation. Biosorption also has a faster rate and produces higher concentrations. Biosorption also has wider applications like mining, metal plating. Phytoremediation is the process that uses the plants to extract and remove elemental pollutants in soil. Dyes are colourful substance that is available in liquid, powder, gel, or paste. In this article, using different variety of food dyes to determine the absorbance of Lemna minor plant by spectrophotometric analysis.***

Keywords: *Lemna minor* plant, Food dyes, UV-spectrophotometre, paper chromatography, ecofriendly process

1.Introduction

Lemna minor is a Aquatic plant. It is also known as common duckweed. The family of duckweed is Araceae. It is a single root of 1-2 cm long hanging in water. Leaves are oval with 1-8mm and 0.6-5 mm broad has a light green with rare veins and small air spaces to assist flotation. This plant used as animal fodder, bioremediator for wastewater nutrient also other applications. The duckweed sticky root enables the plant to adhere to feet of birds and to colonize new ponds. Duckweed species like *Lemna major*, *Lemna trisulca*, *Lemna gibba* are growing by vegetative growth by appropriate conditions. Food dyes are coloring a substance that is available in the form of powder, gel, liquid or paste. These substances are added to the food to improve the taste, flavor, texture. Food dyes are also known as coloring substances that is available in different varieties of colors. Dyes are divided into Natural and synthetic dyes. It is mainly categorized into three main groups like cationic dyes that are basic dyes, now ionic dyes that are disperse dyes and anionic dyes that are acid, reactive and direct dyes. Dyes are active at low concentrations and their impact is detectable on water bodies is very acute. This article is aimed to determine the absorbance of food dyes on *Lemna minor* plant by spectrophotometer.

Medicinal properties of *Lemna minor*:

Lemna minor has a several medicinal properties. This was traditionally used as astringent, depurative, diuretic, antipruritic and soporific. This plant also used in the treatment of cold, difficulty in urination, inflammation, rheumatoid arthritis. The duckweed plant used to make medicine. This also has a antioxidant, antimicrobial, cytotoxic and immunomodulatory effects.

Water quality and sustainability:

Duckweed are floating aquatic plants which are monocots is known to produce at least two daughter fronds in its short life cycle. Lemnaceae have been found everywhere on earth with exceptions of the desert and tundra. In some studies, some species like *Lemna gibba*can grow over a wide temperature range of 5-30°c. It is uncommon to find duckweed in eutrophic ponds and lakes. This maybe be harvested for various purpose including biofuels.

The environmental conditions and treatment mechanisms in duckweeds that grow in ponds differ significantly from those found in ponds that are based on algal bacterial systems. The mechanism of treatment of waste water in a duckweed pond is simple. When growing rapidly, duckweeds run out of naturally available nutrients they undergo a notable metamorphosis where plant proteins drops to normal content and fiber increases roots belong stringy and fronds become larger and discolored.

Green technologies for the removal of Agrochemicals by Aquatic plants:

Duckweed species namely, *Lemna minor* and *Spirodela polyhriza* proved very efficient in removing fungicide dimethomorph. *Elodea canadensis* exhibited potential to remove copper sulphate and A. gramineus showed capacity to sorb HCB from water. High removal by aquatic plants results in the growth inhibition of the species. The compound being insoluble in water binds to the Suspended Matter (SM). The reduction of the compounds follows the first order reaction kinetics.

Phytoextraction:

Phytoextraction technique used in the absorption of organic and inorganic contaminants by roots of the plant. This is the type of phytoremediation. Phytoextraction is an emerging technology that clean up the pollutant from the plants. This is the best approach for isolating the contamination from soil. Phytoextraction cost is fairly inexpensive compared to conventional methods. In some cases, contaminates can be recycled.

Rhizofiltration:

This is similar to phytoaccumulation. This is the technique used in the treatment in aquatic environment. In this contaminants, clinge to the roots or absorbed with biotic and Abiotic process. During this process, contaminants transported by the plant. Rhizofiltration used to remove

the radioactive substances or metals from the contaminated water.

Phytotransformation:

Phytotransformation is also known as Phytodegradation. It is breakdown of the contaminants taken up the plants by metabolic process. Plants leave and roots that interact with organic pollutants can be done in the process of phytotransformed. This occurs in remediate sites with contaminated organic compounds. Enzymes produced by the plants can be able to break down and convert them in chlorinated solvents. Several field studies have been performed.

Phytodegradation:

This technique also known as Phytotransformation. This is a method un which organic compounds are degraded by the compounds are produced by plants through metabolic process. In this method, pollutants are broken by release of enzyme in the root zone or by plants with the help of microorganisms. It is the process in rhizosphere, degradation of organic xenobiotic by rhizosphere microorganisms. It is the process of plant assisted phytoremediation.

Phytovolatilization:

Phytovolatilization is the process of taking contaminants by plant roots and release into the atmosphere in gaseous state. Volatile organic contaminants that is phytochemically oxidized or volatilized from stems or leaves. Volatile organic contaminant that is phytochemically oxidized or volatilized from stems or leaves is Direct phytovolatilization. The process of contaminants that is from soil due to plant root activities is Indirect phytovolatilization. Phytovolatilized compounds are hydrophobic and moderate that can be diffuse hydrophobic barriers such as epidermis in cutin and in woody dermal tissues. Direct Volatilization requires plant uptake, translocate and volatilized compound that is produced or transformed by plant that are not considered to be direct phytovolatilized.

The compounds which are not considered to be direct phytovolatilized include diversity and vast quantity by plants.

Indirect phytovolatilization involves the increase in volatile plant root activities.

Phytostabilization:

This method involves the use of stabilizing the soil. Phytostabilization uses the plant to tolerate heavy metals like lead, copper and zinc also dyes that immobilize through sorption, sedimentation, complexation Or reduction. The addition of soil amendments such as phosphates, alkalizing agents, biosolids, organic matter can decrease the metal solubility and leaches to groundwater. The use of phytostabilization is to keep metals to remediate in large scale areas that has the low concentration.

Sample collection (*Lemna minor*):

The plant *Lemna minor* collected. Five different food dyes are used for experimental analysis. The sample collected can also be kept in hot air oven for 50°c. Food dyes are collected from retail shops to test the absorbance in Spectrometric analysis. The plant dried in the shade at room temperature until it turns to a constant weight.

Food dyes:

Food dyes are chemical substances that enhance the appearance of food color, taste and texture by giving artificial color. Nowadays food dyes are made from the petroleum and coal tar. Certain food dyes can cause allergic reactions, skin problems or other side infections to humans. This also linked to cancer, ADHD, hypersensitivity, Asthma, Hyperactivity. In children, Synthetic food dyes may cause neurobehavioral problems. These synthetic food dyes contain azo group and widely used in many foods like beverages, confectioners, bakery products also jellies to make it colured and tasteful. When comparing to natural colors, synthetic food colors have several economically important traits such as oxygen, low cost, pH changes, resistance to light, high color stability.

Food Dyes used, their chemical names and colour of the dye:

Erythrosine	2', 4', 5', 7'-Tetraiodo-3', 6',-dihydroxy-spiro (3Hisobenzofuran-1, 9'xanthene)-3-one disodium sal.	Pink dye (530nm)
Methylene blue	Phenothiazin-5-ium, 3, 7bis (dimethylylamine) chloride	Blue dye (450nm)
Tetrazine	Tri sodium5 hydroxy-1 (4-sulfonate phenyl-4-(4sulfonatophenyl azo) pyrazole-3-carboxylate.	Lemon yellow (425nm)
Allura red	Disodium 2-hydroxy-1-(2methoxy-5-methyl-4sulfonatophenyl azo napthlene-6-sulfonate)	Red dye (700nm)
Acid green	Sodium 5-(4dimethylamino) (4dimethylminocyclohexa-2, 5-benzyl)-6-hydroxy-7-sulfonate-naphthalene-2sulfonate. Green dye	Green dye (550nm)

Spectrophotometric analysis in food dyes:

Spectrophotometer is an instrument that can measure or determine the amount of light absorbed in the sample at different wavelengths. This is the standard technique that measures light absorption that uses a light beam which passes the sample and determine the wavelength. This is based on the Beer-Lambert's law which states that the amount of light absorbed by a color solution is directly proportional to the concentration of the solution and the

length of a light path through the solution. Spectrophotometer useful and essential in qualitative analysis that determines the unknown concentration of sample through absorption spectrophotometry. Five different types of food dyes taken in different concentrations to determine the absorbance by spectrophotometer at selected wavelength. The initial pH of dye ranged from 7.1 to 8.5.

Determination of plant growth rate:

Cell division causes increase in size to the plants. Plant growth determination the growth analysis in terms of root, shoot growth. The growth refers to the irreversible changes in the organ, size Or cell of the whole plant. The plant growth determination is done:

- To identify spatial and temporal integration of plant process.
- To quantify the environmental influence effects or genotypic difference in plants.

The growth rate of the plant was calculated using the RGR equation. This equation is based on determining the increasing fresh weight of plant sample after the exposure of food dyes.

RGR= (FWt-FW0) /t

FWt-initial weight at 0 hour FW0-initial weigh at t-hour t-time exposed

Biosorption process:

Lemna sp. was collected. The plants collected are washed and dried at oven in 50°c for 24 hrs and rinsed with 0.1M HCl for 4 hrs. This perform to determine and characterize HPL. After the process, the HPL suspension kept for room temperature at different pH and to determine each case the net surface charge. The dye and prepared biosorbent added in Erlenmeyer flask with constant pH level by adding prepared HCl and NaOH solution. Samples collected and centrigued at 3000 rpm for 5 mints. Supernatant taken for absorbance at 478nm by spectrophotometric analysis.

Phytoaccumulateddye contact:

The Phytoaccumulation is the type of Phytoremediation. The process of phytoaccumulation is the plant root take up the contaminants like heavy metals with other source of nutrients and water. This process is to remove the contaminants from soil or water into plant biomass. The plant absorbed by dye solution is taken and grinded into fine paste and frozen in liquid nitrogen and homogenized in ethanol and taken for centrifugation process supernatant determine by spectrophotometric analysis. Phytoaccumulation of plants accumulate the contaminants or chemicals in roots and leaves. The phytoaccumulated dye content and the mechanism of plants studied by UV spectrometer and FTIR analysis.

Phytoremediation process:

Phytoremediation is the process that uses the plant to reduce the toxic and contaminants in the environment. It has techniques like Phytoextraction, Rhizofiltration, Phytotransformation. Fresh plants are taken for centric process after complete drying and supernatant absorbance determine by spectrophotometer at 450nm wavelength. Phytoremediation is the technique that utilizes the plants to remove the contaminants that remediate in soil and water. The temperature is the major effect that showed during the process of phytoremediation of aquatic plant *Lemna minor*, biochemical process like enzyme activity, photosynthesis of plants and nutrients translocation.

Determination of photosynthetic pigments:

The photosynthetic pigments determined to biochemical responses of live biomass on Abiotic stress. These are the coloured biological pigments that has the ability to absorb energy from sunlight and present un chloroplast that captures the light energy from photosynthesis. The main pigment is chlorophyll a. The photosynthetic pigments are chlorophyll a, chlorophyll b and carotenoids. Both paper chromotography and thin layer chromatography are used to identify the photosynthetic pigments in plants. The chromotography solvents are hexane, methane, acetone are used. Here, acetone is used in the separation of photosynthetic pigments in plants by paper chromatography method.

Phytochemical screening in Plants:

The phytochemical screening is the process to identify important compounds like steroids and, tannins, alkaloids, terpenoids, saponins. This process also helpful to find bioactive agents that can be used in the synthesis of useful drug development. Phytochemicals have a range of protecting benefits like preventing infection, reducing inflammation, and also for fighting cancer. This was done to find the presence of organic compounds in the sample. By analysing the biochemical in plants, it contains steroids, sappanis and reducing sugar.

The phytochemicals are:

- Steroids: plant hormones that regulates growth and development to the plants. This is the most important hormone in plants.
- Tannins: These are water soluble polyphenols that are found in tress of barks, woods, buds, leaves, stem, roots, plant galls. This helps to protect from bacteria and fungi.
- Saponins: These are stable and natural that occurs in natural compounds in all cells of legume plants. This saponins can be extracted by using solvents like methanol, ethanol in Soxhlet extraction method or orbital shaker.
- Carbohydrates: This is the source of energy in plants. They function and is to help in growth and metabolism.
- Reducing sugar: These reducing sugar acts as a reducing agent.

2.Conclusion

Using of food dyes in aquatic plants showed that, it is environmental polluted. The absorbent of all dyes are mostly effective. It is absorbed by the plants. So, food dyes / colours that are used in foods not good for health and also to the environment.

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