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"Surface Water turbidity removal through sustainable approaches: A minireview"

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Surface water availability for drinking and domestic use purposes is rarely available in good conditions. Chemical coagulants are available but with side effects. This can be overcome using natural coagulants or biocoagulants found easily and cheap with no operational cost. Natural coagulants are utilized alone or addition to coagulant aids to remove turbidity. The literature findings support the domestication of biocoagulants from time immemorial by African community and other rural people. Different plants parts like seed, bark, leaves, roots are used as biocoagulant device due to their polyelectrolyte nature ad interaction with dissolved substances in water. A review of the potentiality of these plants like Moringa oleifera, Cicer arietinum P ovata, Jatropha curcas, Azaradichta indica, Strynos potatorium as biocoagulants with respect to turbidity removal has been discussed.

Keywords: biocoagulant, polyelectrolyte, Strynos potatorium, Jatropha curcas

I. INTRODUCTION

Water is the basic amenity of life but detoriated hugely nowadays. Safe or potable drinking water must be free from pathogenic organisms like bacteria, virus, zooplanktons and phytoplankton toxic and dissolved substances (Ugwu *et al*., 2017; WHO 2018).

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Effluents from different point or non-point sources change the water quality parameters and cause water contamination. The most harmful reactions involve oxidizing process, reduction, degradation, ad others.

Causes of water turbidity

Surface waters have become unfit for usage or drinking purposes mainly due to turbidity caused by silt, clay, anthropogenic pollutants, inorganic and organic matter, algae, planktons, dissolved organic dyes, and certain miniscule organisms. In recent years, anthropogenic contributions due to rapid industrialization, urbanization, and population explosion has led to unmanageable deformation to water bodies. The result being modifications in the physio-chemical and biological properties of water making it unsafe for drinking. Ecological productivity of water bodies are affected as light penetration is hampered due to high concentrations of particulate matter.

Coagulation/Flocculation strategy

Several treatment technologies based on coagulation and flocculation strategies are employed to process raw water sources into drinking water or as wastewater treatment procedure before effluents are discharged to water bodies. The processes require addition of coagulants and flocculants which can be chemicals like alum, iron salts, polymers or natural substances like plant seeds. Chemical coagulants have long term effect on human health which can be substituted by sustainable bio coagulants. Chemically these coagulants are divalent, positively charged chemical compounds which interacts with negatively charged suspended particles of water (Edzwald, 1993). Aloe vera, cactus powder, peanut powder, Rice husk, Chickpeas, palmyra palm, and methi seed has been used extensively to clarify the surface water (Ramavandi, 2014; Zainol and Fadli, 2020). The maximum coagulation activities (turbidity removal efficiencies) were found to be 88 %, 57%, 69%, 57% respectively (Azeez et al., 2020). These natural coagulants are more preferable to chemical coagulants because they are natural, edible, environmentally friendly, cheap and easily available.

Chemical composition and mode of action of biocoagulants

The natural coagulants obtained from seed, bark and leaves of plants used to reduce turbidity chemically consist of polysaccharides, starches, galactomannans, chitosan, alginates etc. They bridge with turbidity causing molecules by adsorption and charge neutralization. Chemical coagulants reduce turbidity at great speed but often results in charge destabilization with changes in water conductivity and pH. The amount of sludge precipitated out is very high and therefore sludge handling becomes difficult. Biocoagulant forms heavier flocs that settle quickly and the sludge volume is comparatively low and less toxic. The sludge produced can be recycled in agri-culture as organic manure. Many such Biocoagulants like Moringa oliefera seed, Tamarind seed, Chana seed, Neem seed have been reported to have high efficiency in removing turbidity from water and in this review we discuss such locally available common seeds only. For example Islam et al., 2017, reported on the application of sajna seeds to coagulate suspended solids from the Briganga River in Sadargat, Dhaka. From their study, when Moringa seed is applied turbidity of the sample is reduced to 1.96 NTU.

Therefore, Moringa seeds act as effective biocoagulants in water purification systems.

Working potential of seeds

Moringa oleifera: Locally called as 'Sajna' or drumstick it belongs to Family Moringaceae within the kingdom Plantae. Commonly found in sub-Himalayan tracts of Asian countries, Bangladesh and Pakistan and region-wise in states like West Bengal, Odisha, Madhya Pradesh Tamil Nadu and Gujarat. This plant has medicinal properties where each and every part like the leaves, flowers, seeds, and pods have been utilized for centuries. Its parts have healing properties against Diabetes, cancer, inflammation, Bacterial, viral, fungal infections, rheumatoid arthritis and cardio diseases. Moringa has abundant vitamins and minerals mainly in the leaves like calcium, protein, iron, and amino acids, and also packed with antioxidants (Desta and Bote, 2021). Apart from that it has excellent bio coagulant properties in surface water treatment. Different doses of Moringa oleifera has reduced water turbidity from 100 NTU to 9 NTU significantly and also 89-96% of coliform was reduced by the Moringa extracts (Razis et al., 2014; Abiyu et al., (2018). Other characteristics of water like removal of the hardness, saltiness has also been reported of Moringa oleifera seeds.

Tamarindus Indica: Tamarind tree commonly called 'Tentul" in Bengali is a leguminous tree with sour fruit belonging to the Fabaceae family (Zainol and Fadli, 2020). Though indigenous to Africa region, it has been popularized in India for quit a long time. India is the world's leading producer of Tamarindus indica with a production of 300,000 tonnes annually, especially in South India. Tamarind seed powder helps in the reduction of turbidity of surface water in the range of 65.82%. Other physiochemical properties like COD removal and hardness removal have been achieved with 97.78% and 43.50% efficacy and dye removal of 100% (Zainol and Fadli, 2020). It has also been observed that tamarind seeds can reduce water fluoride content. These properties may be attributed to the high polyphenolic content, especially tannins present in seed powder. The underlying chemical reaction shows that phenolic groups of tannins can be readily deprotonate to produce phenoxide which is stabilized via resonance which aids in coagulation. Tamarind husk too contains similar constituents like 39% of the composition has polymeric tannins and such tannins also made up 77% of total polyphenolic compounds and responsible for turbidity removal. Additionally, tamarind seed husks also contain polysaccharides such as xyloglucans, simple phenols such as epicatechin and 3,4-dihydroxy phenylacetate. All these compounds have a high number of hydroxyl groups, which imparts radical scavenging activity, and contributes to high coagulation properties.

Cicer arietinum

Commonly called as chickpea or Kabuli chana, it is a legume belonging to the Fabaceae family.

Widely found in countries like India and Africa and consumed heavily as source of protein. It is an alternative to the chemical coagulant which on long term usage causes disease like Alzheimer. Chickpea offers a cost effective treatment process play vital role in both large and small scale water purification

Conclusion

Plants discussed in this review show excellent and cost-effective bio coagulant properties along with antibacterial properties so that they could be adopted in waste water effluent treatment. Challenging task is to optimize the dosage parameters under different pH and temperature conditions so that the bio coagulant property is retained as long as possible. Moreover, they should simultaneously bear the antibacterial activity so that the water quality of the lake is improved and makes it available to the poor people adjoining the lake for daily activities.

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