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Potential use of Plant Extract for Water Purification: A Review

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ABSTRACT

Lack of treated water is one of the biggest problems encountered by humans. Microbial contamination is a major factor of water purity where enteric pathogens are typically responsible for water borne diseases. Research studies on the purification of water have been focused mainly on water purification systems using aluminium sulphate and chlorine which are expensive. Due to high cost of water treatment and rapid global spread of resistant microbes, there is the need for the discovery of new antimicrobial and water purification agents. The investigations into the possible usage of plant materials for water treatment is becoming a major focus. Many plants have been used to treat water due to their antimicrobial and purification properties. A number of effective coagulants and disinfectants have been identified of plant origin. Plants are rich in phytochemicals such as phenols, quinones, flavonols, tannins, coumarins and alkaloids which are responsible for the antimicrobial and water purification activities. This review discussed the potential application of indigenous plants to potabilisation. it was concluded that plant species have the potential to serve as water treatment agent.

Key words: Potabilisation; Plant extracts; Phytochemicals; Microbial contamination; Coagulants

1. INTRODUCTION

Water is used for several purposes by humans like drinking, washing, recreation, as well as numerous other varied industrial applications but the level of purity of the water being consumed has a direct effect on health. Untreated water usually contains microorganisms like bacteria, viruses and protozoa, some of which are disease-causing pathogens. They cause diarrhoea-related diseases such as cholera, typhoid and dysentery. These pathogens are commonly derived from human faecal material (Pritchard *et al.* (2009). Microbial contaminations, especially with pathogenic microorganisms, are major causes of water pollution where enteric pathogens are typically responsible for water borne diseases. Improper drainage of untreated industrial effluents directly into water bodies and agricultural fields is a major source of groundwater pollution. Coagulation/flocculation is one of the most widely used processes for the treatment of raw water, which allows the improvement of the quality of the treated water (Djeffal *et al.*, 2021; Khettaf *et al.*, 2021). Inorganic coagulants such as chlorine and aluminum sulphate have been linked to different diseases (Yongabi, 2004; Zhang *et al.*, 2009). Aluminium ions pollution of water bodies results in water contamination and health
risks. According to Tietz *et al.* (2019), traces of aluminium in foods can lead to acute carcinogenic and genotoxic diseases. The presence of acrylamide monomers in polyacrylamide or acrylamide sodium acrylate makes it potentially toxic and carcinogenic. (Im *et al.* 2019; Liu *et al.* 2019). The use of traditional flocculants has created many health hazards, therefore, bioflocculants or natural flocculants should be used instead. Bioflocculants have gained a lot of attention because of their unique

flocculating properties, as well as their non-toxic, biodegradable nature, which helps to create an environmentally friendly climate (Kothari *et al*. 2017; Shahadat *et al*. 2017). Seeds of the *S. potatorum* has been used to clarify turbid river water (Shultz and Okun 1984, Sanghi *et al*. 2006). The plant extracts of nirmali tree (*S. potatorum),* tamarind tree (*Tamerindous indica),* guar plant (*Cyamopsis psoraloides*), red sorella plant (*Hibisicus sabdariffa),* fenugreek (*Trigonella foenum*) and *Lens esculenta* have been tested for their application in water treatment (Shultz and Okun, 1984). This review discussed the potential application of plants to water potabilization.

2.1 Effect of Water Pollution on Human Health

Water is becoming a scarce commodity as a result of growing human population. Also, there is the challenge of water pollution which causes many pathogenic diseases due to contamination with microbes. When an individual does not have access to safe water we call that person water insecure (Rijsberman, 2006). Microorganisms that cause water borne diseases such as typhoid fever, diarrhoea, dysentery, gastroenteritis and cholera are *Salmonella* sp., *Shigella* sp., *Escherichia coli* and *Vibrio cholera*. According to Adetunde and Glover (2010), the presence of faecal coliforms of *E. coli* is an indicator for the presence of these water borne pathogens.

Heavy metals such as Fluoride, Arsenic, Lead, Cadmium, Chromium and Mercury are some of the chemicals affecting human health. For example, fluoride causes a condition called fluorosis, Arsenic can cause respiratory cancer, arsenic skin lesion, exposure to leads can lead to bladder and lungs cancer, mercury causes cancer (Tchounwou, *et al*. 2012; Abdulmoseen *et al*. 2021).

2.2 Use of Plant Extract as Coagulation

The use of plant extracts to coagulate suspended matter from water is an ancient practice. Forty plant species, belonging to 38 genera and 22 families, are reported to be used as coagulant and disinfectant. Among the plants that have been used for water treatment, Fabaceae families contributed more plant species. The trees constituted the highest proportion followed by herbs (Megersa, *et al.*2014). *Moringa oleifera* have been shown to be one of the most effective coagulants for water treatment especially in rural communities (Ali *et al.*, 2010; Yahya *et al*., 2011).

Extracts of *Moringa oleifera, Jatropha curcas* and *Guar gum* have also been investigated for their water treatment potential and reduction in turbidity of the treated water was observed (Abatneh *et al*., 2014). *Aloe vera* (Irma *et al.*, 2015; Jaouadi *et al.*, 2020), *Lepidium sativum* (Allafchian *et al*. 2019) *Moringa oleifera* (Agarwal *et al*., 2019; Zaid *et al.*, 2019); *Salvia hispanica* (Tawakkoly *et al*., 2019); guar gum (Dwari and Mishra 2019); *Abelmoschus esculentus* (Lee *et al.*, 2018); Opuntia *Ficus indica* (Miller *et al*. 2008; Sellami *et al*. 2014; Be-lbahloul *et al*. 2015; Nharingo *et al*., 2015 Bouaouine *et al.*, 2019); *Hibiscus esculentus* and *Trigonella foenum - graceum* (Jones and Bridgeman, 2019); *Albizia* gum (Afolabi and Adekanmi, 2017), Malva nut gum (Ho *et al.*, 2014) guar, Mesquite seed gum and *Opuntia* mucilage (Carpinteyro-Urban and Torres, 2013) *Plantago ovata* (Al-Hamadani *et al.*, 2011); Date palm (Khiari *et al*., 2010); *Tamarindus indica* (Mishra *et al.*, 2006); Acorn leaves (Benalia *et al*., 2019), banana fruit peel (Zaidi *et al*., 2019), lime seeds (Seghosime *et al*., 2017), and tamarind (Buenaño *et al*., 2019) have been identified as promising coagulants/flocculants (Muruganandam *et al.* 2017).

Plant-based bioflocculants were found to be capable of removing heavy metals from both synthetic and real waste- water, in addition to organic pollutant removal. *M. oleifera* seeds Swelam *et al*. (2019), *Opuntia ficus indica* Nharingo *et al.* (2015) have been used for the removal of heavy metals from waste water.

Turbidity usually caused by the presence of fine clay, silt, inorganic and organic elements, plankton, and microorganisms is a critical parameter that must be tested for both wastewater treatment and healthy drinking water use. *M. oleifera* seed powder was used as a bio-coagulant in the water treatment process to remove turbidity (Zaid *et al*. 2019). Dwari and Mishra (2019) recorded the use of guar gum as an effective flocculant that showed excellent turbidity removal performance. *Opuntia ficus indica* has been discovered to be a strong source of bioflocculant for turbidity removal (Bouaouine *et al*. 2019).

2.3 Multi-Drug Resistant Pathogen Treatment

Antimicrobial drugs have a crucial role in reducing the global burden of infectious diseases (Alam *et al.*, 2009; Bhatia and Narain, 2010). Because there are fewer, or even no effective antimicrobial treatments available for infections caused by pathogenic bacteria, the growth and spread of multidrug resistant (MDR) strains in pathogenic bacteria has become a significant public health problem (Giamarellou, 2010). In other words, when resistant organisms emerge and spread, antibiotic efficacy declines (Alam *et al.*, 2009). As a result, given the evidence of the rapid global spread of resistant clinical isolates, the need to discover new antimicrobial agents is important. However, given the history of rapid and widespread emergence of resistance to newly introduced antimicrobial agents, even new antimicrobial families are likely to have a short lifespan (Marasini *et al.*, 2015). Although different pharmaceutical companies have introduced a number of new antibacterials in previous years, but resistance to these agents has also increased and has now become a worldwide problem (Gratus, 2009). Plants produce a great diversity of phytochemicals which are antimicrobial compounds and have used to prevent and cure microbial diseases (Patra, 2012). Some bioactive compounds (alkaloids, tannin, flavonoid and phenolic etc.,) of these plants are responsible for their medicinal value (Thirumurugan, 2010).

Microbial resistance has increased with drug discovery resulting in serious health concerns globally (Coates *et al*. 2011; Vedadhir *et al*. 2020 26) and indiscriminate use of antimicrobial remains the main cause [VanBoeckel *et al.* 2015]. Therefore, the emergence of multidrug resist-ant microbes in water and undesirable effects of conventional antimicrobials call for alternative means of water treatment of plant origin [Yahya et al., 2014]. According to Chandra *et al.*(2017), microbial contamination of human origin in water may be controlled by extracts of plants. Kirui *et al*. (2015) reported that aqueous extract of *Acacia nilotica, Acacia seyal, Acacia tortilis, Acacia etbaica, Albizia anthelmintica, Euclea divinorum* and *Plumbago zeylanica* indicated an effect

3. CONCLUSION

This review established the applications of plant extract in water treatment. Plants have found great usefulness in water treatment as natural coagulants and in reduction of microbial count of water borne pathogens. There is need to screen the plant extracts with standard methods and isolate pure compounds in order to reduce the limitation against plant extracts safety and standardization

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