Tamarindus indica. - A Review Paper on Efficacy of Tamarind plant in Water Treatment and Purification

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Abstract

This work is aimed at analyzing the efficacy of tamarind seed in water purification. The plant is widely distributed across Asia, Africa, North and South America. Tamarind fruits are used for several nutritional and herbal purposes and the seed are disposed as waste. Antibacterial, antiviral as well as antifungal properties in addition to its coagulation potentials, tamarind seed and other parts of the plant showed a promising step in water treatment and purification and a potential solution to current problem in developing countries. It was used and tested as antimicrobial agent against some bacteria that are present in unpurified water sample and was found to be valuable. Tamarind seed powder has the capability of reducing turbidity in unpurified or raw water. Natural plants with antibacterial activity have special preference over chemicals; this is because bacteria developed resistance with chemicals with time. Therefore, more scientific approach could be developed and used to exploit the vast potentials in locally available natural coagulant to treat our water particularly in the rural areas where the water bodies are subjectected to numerous pollutants such as herbicides, insecticides and many other chemicals used for agriculture and industrial processes and hence where the government presence is virtually negligible.

Key words: Tamarind, Purification, Coagulant, Seed

Introduction

Turbidity and impurities in water is caused by suspended matter in the form of clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, zooplankton, phytoplankton and other microorganisms. Turbid water has muddy or cloudy appearance and it is humanly unappealing. The turbidity increases as dirt becomes stronger (Phani et al.,2013)

The history of the use of natural coagulant for the elimination of turbidity is long. Naturally friendly organic polymers have been adopted for over the past 2000 years in most part of India, some part of Africa and China as effective coagulants and coagulant aids in water containing high turbidities. They may be synthesized parts of plant such as plant seeds, leaves, and roots. Natural coagulants have bright future and are concerned by many researchers because of their plentiful source, costless, environmentally friendly or harmless as of natural food source, multifunction, and biodegradable nature by most microorganisms in water purification (Phani et al., 2013). A wide range of wastewater management techniques having some associated merits and disadvantages are widespread (Akanksha et al., 2013). Most commonly wastewater treatments involve biological treatment such as nitrification, denitrification and phosphorus elimination, physio-chemical treatment such as adsorption (Yunus, 2014),

ORIGINE OF TAMARIND PLANT

Tamarind is a fruit with a characteristic sweet and sore taste used in various foods preparation around the world, this appetizing pod-like fruit is dietary power house with an large quantity of health benefit. Tamarind trees are cultivated in abundance in regions of Africa, Asia, and South America however; India is the world’s prime

producer of tamarind products. Tamarind is abundantly available in the Indian states of Madhya Pradesh, Bihar, Andhra Pradesh, Karnataka, Tamil Nadu, West Bengal, Orissa and Kerala (Spice Board, 2011a).

The brown soft tissue of the fruit is juicy with characteristics acidic, and has a sweet-tangy taste. Aside from being in world cuisine, tamarind fruit is tremendously popular because of its perceived medicinal benefits (ICRAF, 2007). Tamarind plant grows up to 40-80 meters depending on soil condition and environment factors associated with the weather condition. Undercooked tamarind is fit for human consumption; it has an extraordinary sore taste. Full-grown tamarind pod or mature pods when cracked open have brownish-black colored fruit containing hard black seed (El-Siddig et al., 2006).

About one billion peoples across the globe lack safe drinking water and more than and as such six million people (of which two million are children) die from diarrhea every year due to water related infectious diseases (Cheesbrough, 2004) 2

Classification of Tamarind Plant

The genus *Tamarindus* is a monotypic genus containing the individual species T. indicus and belongs to the sub-family *Caesalpinioideae* of the family *Fabaceae (Leguminosae*). Tamarind is a large tree, which grew up to 24 m in height and 7 m in cinch. (Dubey et al., 1997). The most useful part is the pods which are 7.5–20 cm long, 2.5 cm broad and mostly 1 cm thick, slightly constricted, curved and brownish-ash in colour. The covering of the pod is fragile and easily detachable (Choudhary, 1997; Rao et al., 1999).

Utilization of Natural Coagulant for Water Purification

In view of the above mentioned catastrophic health condition, there is need to reconsider the utilization of natural water purification methods by selected plants with purification potentials such as coagulation, antimicrobial as well as detoxification capabilities. The coagulants and antimicrobial agents used for wastewater treatment, some of them are harmful to human body and are very expensive and hence not affordable by common man (Lu, 2002) used natural polymeric coagulant (Chitosan) in the management of chemical oxygen demand (COD) and colour in a soap and detergent industrial wastewater. The outcome of the analysis obtained revealed that chitosan was exceptionally efficient in treating the wastewater. Also, they were able to accomplish maximum COD and colour reductions of 83% and 90% respectively (Patil and Hugar; 2015). Efficiency of four different natural coagulants namely: *T.foenum-graecum, Moringa oleifera, Cicer arietinum* and *Dolichos lablab* to eliminate COD and turbidity from industrial wastewater. At the best possible dosage and pH, the turbidity removal efficiencies of *M.oleifera, Dolichos lablab, T.foenum-graecum* and *Cicer arietinum* were found to be 61.60%, 71.74%, 58.20% and 78.33% respectively while COD cutback efficiencies of these coagulation agents were estimated to be 65.0%, 75%, 62.5% and 83%, respectively. Based on the results obtained from the work, it was concluded that, among the coagulants considered in the work, *Cicer arietinum* was the most effective in treating dairy wastewater. Analysis on the coagulation efficiency of common bean extract in treatment of different distillery wastewaters was found to be the best achieved efficiencies of organic matter removal where 68.8% for juice extraction of wastewater at pH of 8.50 with coagulant dose of 5 ml/l, and 60% for molasses wastewater at the original pH of this spillage (5.40) with the same dose. They accomplished that natural coagulants obtained from common bean could be used effectively for organic matter removal from extraction juice wastewater (Prodanović et al., 2011)

Cicerarietinum, Moringa oleifera, and *Cactus* were used to treat turbidity and COD in tannery wastewater by different dosage of these coagulants and pH. It was revealed that 0.1 g/500 ml *Cicer arietinum*, 0.3 g/500 ml *Moringa oleifera* and0.2 g/500 ml Cactus and pH of 5.5, 4.5 and 5.5 respectively were the optimum parameters for the wastewater treatment. The results also indicated that all the three coagulants investigated happened to be promising in treating the pollutants since the turbidity reduction efficiencies for all of them were observed to reduce to to the range of 78-82% while that of COD was in the range of 75-90%. However, *Cicer arietinum* was found to be the most effective in treating tannery wastewater with highest turbidity and COD removal of 81.02 and 90%, respectively (Kazi, and Virupakshi; 2013). The efficiency of tapioca starch as coagulant in the treatment of semiconductor wastewater by changing the dosage of the coagulant and retention time were analyzed, and the observed variation of tapioca starch dosage highly influenced the COD and turbidity removal. The results obtained in their work further revealed that the optimum turbidity reduction was 99% at a settling time of 30 min with dosage of 0.1 g/L and that of COD was achieved to be 87% after 60 min of retention time and 0.1 g/L of dosage. They also discovered that high coagulant dosages between 0.8-1.0 g/L reduced the total suspended solids (TSS) concentration from 188 to 10.9 mg/L at retention time between 50 to 60 minutes. From the work carried on the natural coagulant it has been observed that Tamarind, to the best of our knowledge, no researcher has used tamarind seed to produce a coagulant that can treat wastewater from a detergent industry (Fatehah et al.,2013).

Tamarind as Agent of Fluoride Removal

Fluoride is known to be a natural contaminant for ground water resource globally. High fluoride content in ground water has been reported from India, China, Sri Lanka, the West Indies, Nigeria, Mexico, north and South America. (Danya and

Shaji; 2017). Ground water is one of the major sources of water and meets the needs of 60% of India's households. So the quality of ground water can potentially affect the lives of over 100 million households, rich and poor, urban dwellers and villagers alike.

However, Tamarind seed has been found to be effective in treating detergent industrial wastewater. It is, therefore, recommended that local industries should consider using this material (tamarind) for wastewater treatment as an alternative to chemical coagulant because it is biological origin, cost affordable cheap and readily available (Ronke et al.,2016)

According to the world health organization (WHO, 2011) the maximum acceptable fluoride concentration in drinking is 1.5mg/ L.

The conventional methods of removal of fluoride include ion exchange, reverse osmosis and adsorption. The ion exchange and reverse osmosis are relatively expensive and in most cases not good for human consumption as most mineral that are beneficial are removed as well. Therefore, adsorption is the feasible method for removal of fluoride. Plant materials are reported to accumulate fluoride and hence application as fluoride removing agents has been suggested. Example of such bio sorbents are tamarind seed (Sinha et al., 2000).

Coagulation-Flocculation Properties of Tamarind Seed

As many plants were utilized in one way or the other for water purification, tamarind seed is not an exception because of its vast phytochemical composition. Coagulation - flocculation of the sample of wastewater using the tamarind seed powder with optimum pH of 7.2, has a showed a capacity of COD removal of

97.01% and 24.86% respectively; the optimum mixing time was divided in to rapid and slow conducted at 3 and15 minutes respectively. The turbidity and COD removal of 97.78% and43.50% were attained at the optimum dosage of 400 mg/L. (Ronke et al., 2016)

Phytochemistry

Tamarind is reported to have amino acids, fatty acids, and minerals. Differences in composition found in the literature are perhaps due to differences in genetic variation or strains, stages of maturity at which the plant parts were harvested, growing conditions (Glew et al., 2005),

Tamarind pulp typically contains 20.6% water, 3.1% protein, 0.4% fat, 70.8% carbohydrate, 3.0% fiber and 2.1% ash (El-Siddig et al, 2006), consequently the pulp has small water content and a high protein quantity, carbohydrate and mineral. on the other hand, the proximate composition of the tamarind fruit depends on locality of cultivation (El-Siddig et al, 2006).

Antimicrobial Properties of Tamarind

Tamarind fruit and seed are reported to have certain level of anti-fungal and anti-bacterial properties. An agar diffusion assay method, extract from tamarind flowers showed anti-bacterial activity against four different bacteria tested (*Staphylococcus aureus, bacillussubtilis, Escherichia coli and pseudomonas aeroginosa)*. Tamarind leaves poses a strong invitro anti-bacterial activity common gram positive and gram negative bacteria that were tested (Al-fatimi et al,2007)

Anti-fungal Activity

Plant extracts from tamarind fruit appeared to be promising as fungicidal agent against cultures of *Aspergillus niger and candida albicans* (El-siddig et al, 2006).

Conclusion

The ability of tamarind to remove fluoride from our water bodies, its antimicrobial properties including organisms such as *Staphylococcus aureus, bacillus subtilis, Escherichia coli and Pseudomonas aeruginosa*, as well its coagulation potential makes it a good agent that if properly harnessed could be a good solution to emerging problem of water purification.

Tamarind seed in some community is a kitchen waste and usually disposed as waste, it is environmentally friendly, cost affordable and without any harmful effect on human.

In many parts of the developing world, people lack access to portable drinking particularly in the rural areas where such natural products are readily available.

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