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Moringa oleifera- A Herbal Coagulant for Wastewater Treatment

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Abstract: ***Moringa oleifera is a multipurpose, medium or small-sized tree, from regions of North West India and indigenous to many parts of Asia, Africa, and South America. Its pods are a non-toxic natural organic polymer, which have been employed as an inexpensive and effective sorbent for the removal of organics, and coagulant for water treatment. The main objective of this work was to use the Moringa oleifera seeds as a natural adsorbent for the treatment of dairy industry wastewater. In present study various doses of Moringa oleifera seed coagulant viz. 100 mg/L, 200 mg/L and 400 mg/L were taken and checked for the efficiency dose on treated and untreated wastewater. After treatment of water samples with Moringa oleifera coagulant were analyzed for different parameter like pH, turbidity, COD and salinity. All parameters were reduced with increased dose of Moringa oleifera except pH. Application of this low cost Moringa oleifera seed coagulant is recommended for ecofriendly non toxic, simplified waste water treatment.***

Keywords: Diary wastewater, Coagulant, Turbidity, *Moringa oleifera*

1. Introduction

Moringa oleifera is the most widely cultivated species of a monogeneric family, the Moringaceae, that is, native to the sub-Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan [1]. As well as medicinal plant, *Moringa oleifera* Lam. also can be used as an absorbent and coagulation. The seeds also have antimicrobial activity and are utilized for wastewater treatment. In some developing countries, the powdered seeds of *Moringa oleifera* are traditionally utilized as a natural coagulant for water purification because of their strong coagulating properties for sedimentation of suspended undesired particles. The seed extract contains very interesting behavior in removing anionic surfactants from surface water. A very high efficiency is observed in all of the studied cases, so it presents a promising future as water treating agent.

Waste water is the by-product from municipal, agricultural and industrial activity [2]. In the era of globalization, many water treatment processes have been invented but most of them require higher expenditure [3]. In large scale treatment plants aluminum sulfate is used as conventional chemical coagulant. As an alternative to conventional coagulants, *Moringa oleifera* Lam. seeds can be used as a natural coagulant (primary coagulant) in household water treatment as well as in the community water treatment systems. Increasing demands for water in the future requires the wastewater treatment and its reuse because it is finite and its availability is limited due to population pressure and increasing pollution. Low cost wastewater treatment technologies will continue to be viable and economical option in the recovery, recycle and reuse of water. The main objective of coagulation studies to explore effectiveness of *Moringa oleifera* for reducing waste water characteristics concerned with environmental pollution.

2. Materials and Methods

2.1. Preparation of *Moringa Oleifera* coagulant stock solutions

Moringa oleifera seeds were collected from the plant. The dried seed kernels were ground to a fine powder of approximate size 600 m to achieve solubilization of active ingredients in the seed. Tap water was added to the powder to make 2% suspension (2 g of *M. oleifera* powder in 100 ml water). The suspension was vigorously shaken for 30 minutes using a magnetic stirrer to promote water extraction of the coagulant proteins and this was then passed through filter paper (Whatman No. 1). Fresh solutions were prepared daily and kept refrigerated to prevent any ageing effects (such as change in pH, viscosity and coagulation activity). Solutions were shaken vigorously before use. Dosage solution was prepared from stock solution with concentration of 100mg/L, 200mg/L and 400mg/L.

2.2. Experimental Setup

Waste water samples collected from dairy farm situated at Ambalathara, Thriruvananthapuram district, Kerala State. Coagulation experiment was conducted using a range of coagulant dosage from the respective stock solution. For repeatability each experimental setup was repeated 3 times. Dosage of 100mg/L, 200mg/L and 400mg/L stock solution were applied to treated and untreated water sample. Then stir the raw water rapidly maintaining fast mixing for 60 seconds. After 30 second immediately initiate regular slow, gentle mixing (15 to 20 rotations per minute) to promote the flocculation of the suspended and colloidal particles present in the wastewater. After slow mixing, the beakers were carefully removed from the jar test set-up and the contents left to settle for 30 min. The supernatant thus formed were

taken without disturbance. The supernatant thus formed were sampled and measured for pH, turbidity, salinity and COD.

pH was measured using pH meter. Residual turbidities were used as a basis for comparing the efficiency of coagulation, which were measured by turbidity meter in Nephelometric turbidity units (NTU). COD analyses were performed by the dichromate closed reflux method. Salinity were determined by argentometric method. The procedures for pH, turbidity COD as well as salinity measurement conformed to those described in the APHA 1998 [4]

3. Results

pH: pH at the dosage of 100 mg/L, 200mg/L and 400mg/L in untreated water and treated water and the change is from 6.3 to 6.4, 6.5 and 6.6 and 6.2 changes to 6.5, 6.7 and 6.2 in untreated water and treated water respectively. The untreated and treated wastewater pH is slightly changed. The results obtained for the pH of the water samples after treatment with *Moringa oleifera* coagulant at different concentrations are presented in Table 1and Figure1.

Table 1: Changes in pH value for various dosages of *Moringa oleifera* coagulant of untreated and treated water

Parameter	*Conc.*	*Untreated*		*Treated*	
	(mg/L)	*Initial*	*Final*	*Initial*	*Final*
pH	100	6.3	6.4	6.2	6.5
	200	6.3	6.5	6.2	6.7
	400	6.3	6.6	6.2	6.2
Mean ± SD		6.3 ±.00	6.6±0.11	6.2±0.0	6.5±0.25

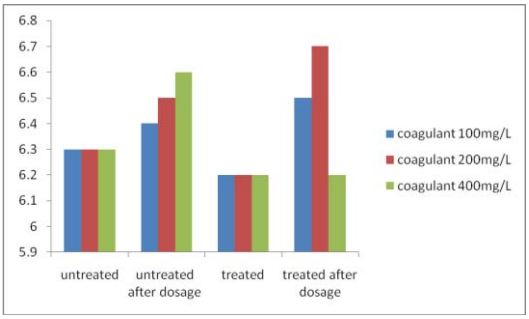

Figure 1: Change in pH before and after dosage of *Moringa oleifera* in untreated and treated water

Turbidity: From Table 2 and Figure 2 it was noted that initial turbidity of untreated water was 133.4 NTU and that of treated water was 10 NTU. *Moringa oleifera* dosage of 100 mg/L, 200mg/L and 400mg/L were used the turbidity of untreated water reduced to 56.2, 48.6 and 46.1 NTU and that of treated water is zero respectively.

Table 2: Change in turbidity values for various dosages of *Moringae oleifera* coagulant of untreated and treated water

Parameter	*Conc. (mg/L)*	*Untreated*		*Treated*	
		Initial	*Final*	*Initial*	*Final*
Turbidity (NTU)	100	134.4	56.2	10	0
	200	134.4	48.6	10	0
	400	134.4	46.1	10	0
Mean ± SD		134.4±0.0	50.3±5.3	10±0.0	0

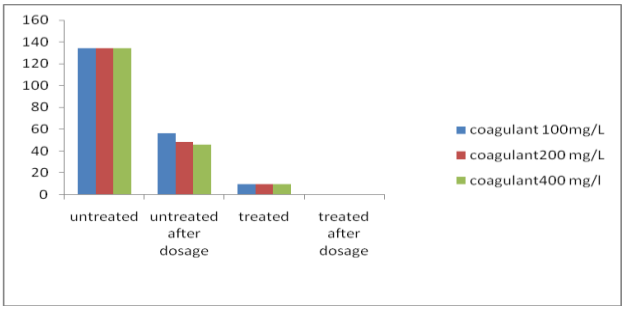

Figure :2 Change in turbidity before and after dosage of *Moringa oleifera* in untreated and treated water

COD: In the initial stage, COD of untreated water was 750mg/L and treated water was 224 mg/L. *Moringa oleifera* dosage of 100mg/L, 200mg/L, 400 mg/L, were applied the COD of untreated water is reduced from 750 mg/L to 552.5 mg/L, 480.1 mg/L and 360.4 mg/L respectively where in the case of treated water when same dose applied COD reduced from 224 mg/L to 176.2 mg/L, 165.4 mg/L, 140.8 mg/L respectively. The reductive value of untreated water value from initial is 197.9 mg/L, 269.9mg/L, 389.6 mg/L and treated water value in 47.8 mg/L, 58.6 mg/L 83.2 mg/L (Table 3 and Figure 3).

Table 3: Change in COD v alue for various dosages of *Moringae oleifera* coagulant of untreated water and treated water

Parameter	*Conc. (mg/L)*	*Untreated*		*Treated*	
		untreated	*treated*	*untreated*	*treated*
COD (mg/L)	100	750	552.5	224	176.2
	200	750	480.1	224	165.4
	400	750	360.4	224	140.8
Mean±SD		750±.00	464.3±97.01	224±0.0	160.8±18.15

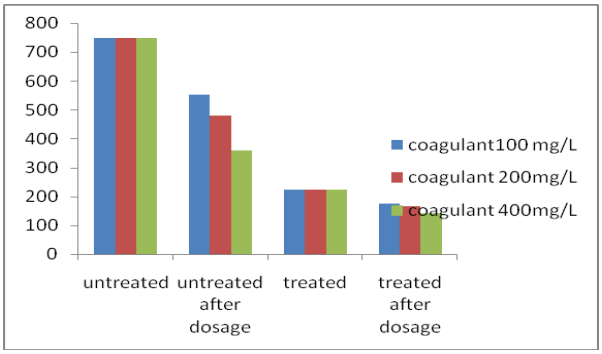

Figure 3: Change in COD before and after dosage of *Moringae oleifera* in untreated and treated water

Salinity: Untreated water contains salinity 2.5 ppt and treated water contain salinity 0.5 ppt and after adding *Moringa oleifera* the salinity amount reduced. The *Moringa oleifera* doses of 100 mg/L, 200 mg/L, and 400 mg/L were applied both untreated and treated water, it reduce the value 0.7 mg/L, 0.6 mg/L and 0.5 mg/L and 0.4 mg/L, 0.3 mg/L and 0.2 mg/L then reduction value of the salinity content of untreated water in 1.8 mg/L, 1.9 mg/L and 2 mg/L and treated water 0.1 mg/L, 0.2 mg/L and 0.3 mg/L respectively (Table 4 and Figure 4).

Table 4: Changes in salinity for various dosages of *Moringa oleifera* coagulant in untreated water and treated water

Parameter	*Conc. (mg/L)*	*Untreated*		*Treated*	
		Initial	*Final*	*Initial*	*Final*
Salinity (ppt)	100	2.5	0.7	0.5	0.4
	200	2.5	0.6	0.5	0.3
	400	2.5	0.5	0.5	0.5
Mean ± SD		2.5 ± 0.0	0.6 ± 0.1	0.5 ± 0.0	0.1 ± 0.0

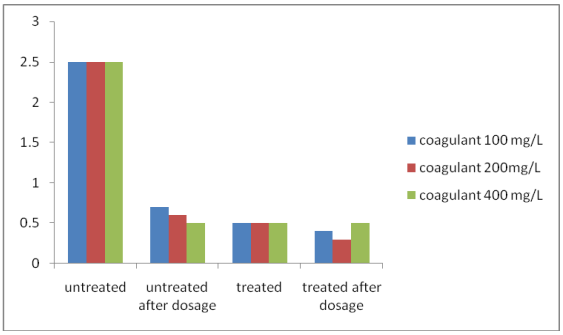

Figure 4: Change in salinity before and after dosage of *Moringae Oleifera* in untreated and treated water

4. Discussion

Present study reveals that the Moringa seed powder is an efficient and economically viable coagulant to purify water in rural areas. By adding Moringa seed coagulant, the pH of the water becomes basic with increasing coagulant concentration. Studies confirmed that the action of *Moringa oleifera* as a coagulant lies in the presence of water soluble cationic proteins in the seeds. This suggests that in water, the basic amino acids present in the protein of Moringa would accept a proton from water resulting the release of a hydroxyl group making the solution basic[5]. Similarly, the turbidity was considerably decreasing with increasing concentration. Chemically the seeds consist of low molecular weight proteins that are water soluble [6]. In the water, these proteins have an overall positive charge. Pollutants of turbid waters have an overall negative charge, such as sand, silt, clay and bacteria. *Moringa oleifera* powder has the capability of reducing low and high turbidity values in surface water. The finding from this study showed that the active agents in the *Moringa oleifera* seeds solution are water soluble [7]. However, *Moringa* solution showed 62.5 % turbidity removal which is in agreement with the reports of Katayon *et al*., 2004 [8]for low turbid water having initial turbidity level less than 50 NTU materials as seen from their coagulation and antimicrobial activities coagulation of the raw turbid water. The majority of COD removal occurred during the filtration process. This removal may also be attributed to the relatively strong *M. oleifera* flocs that formed: being non-settleable but filterable [9] The increase in removal efficiency of COD can be attributed to the coagulant powder of the moringa seed extract, as there was agglutination of the solid particles present in the wastewater, increasing its size and making it difficult to traverse the filter pores.

5. Conclusion

From the results of the study, it is observed that *Moringa oliefera* seed powder is effective as a coagulation aid in removing turbidity, COD and salinity from diary wastewater before discharging into the environment. Also, pH of raw refinery wastewater recorded slight change during and after coagulation. It was clear from the study *Moringa oleifera* seed was shown to be a potential biocoagulant, for treatment of wastewater from commercial activities.

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