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TREATMENT OF DAIRY WASTEWATER BY *MORINGA OLEIFERA* SEEDS

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ABSTRACT

Moringa oleifera (MO) 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 have been employed as an inexpensive and effective sorbent for the removal of organics. It can act as coagulant for water treatment. It is a non-toxic natural organic polymer. The main objective of this work was to use the MO seeds as a natural adsorbent for the treatment of dairy industry wastewater (DIW). Seeds of the plant, Moringa oleifera contain natural polyelectrolyte which can be used as coagulants to clarify turbid waters. During this study, dairy industry wastewater was collected for treatment by Moringa seeds in powdered form, resulting in an effective natural clarification agent for highly turbid and untreated pathogenic water. Various doses of *Moringa* seed powder viz. 1, 2 and 3gm/l were taken and checked for treatment of dairy wastewater. After treatment of seed powder with water samples were analyzed for different parameter like pH, Electrical conductivity, TDS, TSS, Hardness, Chlorides, COD, BOD. All parameters showed reduction with increasing dose of seed powder. Therefore, application of this low cost *Moringa oleifera* seeds is recommended for eco-friendly, nontoxic, simplified waste water treatment.

KEYWORDS: Dairy industry wastewater, *Moringa oleifera*, natural coagulant.

INTRODUCTION

The dairy industry is generally considered to be the largest source of food processing wastewater in many countries. These dairies collect milk from the produces and then either simply bottles it for marketing, or produce different milk foods according to their capacities. Large quantity of wastewater originates due to their different operations. The

organic substances in the wastes comes either in the form in which they were present in milk, or in a degraded form due to their processing. As such, the dairy wastes, through biodegradable, are very strong in nature.[1] In dairy wastewater is often discharged intermittently. The nature and composition of wastes depends on type of products produced and processing capacity of the plants. It contains a variety of sterilizing agents and various acid and alkaline detergents. Thus, the pH of the wastewaters can vary significantly depends on the cleaning strategy employed. Dairy wastewaters are characterized by high biochemical oxygen demand (BOD) and chemical oxygen demand (COD) concentrations.

The previously two most commonly used primary coagulants are aluminum and iron salts.[2] A large number of cheaper materials including industrial and agricultural wastes have been used to remove different pollutants from the industrial effluents for their safe disposal into the biosphere.[3] Many plants have been used to clarify water. These include *Moringa oleifera*, *Moringa stenopetala*, *Vicia faba*.[4&5] In recent years, there has been considerable interest in the development of natural coagulants such as *Moringa oleifera* (M O) and Chitosan. Naturally occurring coagulants are usually presumed safe for human health. Many researchers have reported *Moringa oleifera* various uses and as a coagulant specifically for the last 25years. Use of natural coagulants gives considerable savings in chemical and sludge handling cost may be achieved.[6] MO is among the 14 species of trees that belong to the family Moringaceae.[7] *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 coagulant. Encouraged results of natural coagulant studies, many developing countries have turned to use this plant as a viable coagulant in water and wastewater treatment on a small scale.[8] Muyibi and Evison[9] have reported *Moringa oleifera* powder has the capability of reducing low and high turbidity values in surface water.

MATERIAL AND METHODS

Collection of Dairy effluent

Dairy water samples were collected from the Kolhapur zilha Gokul Dudh Sangh. Gokulshirgaon, Dist. Kolhapur, Maharashtra, India. The physico-chemical characteristics

of samples were analyzed. Samples of dairy effluent were collected in clean can of ten liter capacity.

Collection of *Moringa oleifera* seeds

Moringa oleifera seeds were collected from local area of Kolhapur city. Good quality dried drumstick were selected. Wings and coat from seeds were removed. Fine powder was prepared by using mortar and pestle and this powder was directly used as coagulant.

Treatment of Dairy waste water with *Moringa oleifera* seeds

Dairy waste water was given exposed directly using seed powder. The water quality parameters were checked before and after treatment. Doses of seed powder i.e. 1, 2 and 3gm/l were selected for treatment.

The coagulant was mixed with dairy waste water and kept on the shaker for 45min at 110-120rpm. The settling time was 1–2 hours. After sedimentation, supernatant of treated water was used for testing. The water quality parameters were analyzed for understanding physic-chemical characters as per standard methods[10,11] before and after the treatment. The efficiency dose of *Moringa oleifera* seed powder was determined.

Fig. 1 *Moringa oleifera* tree

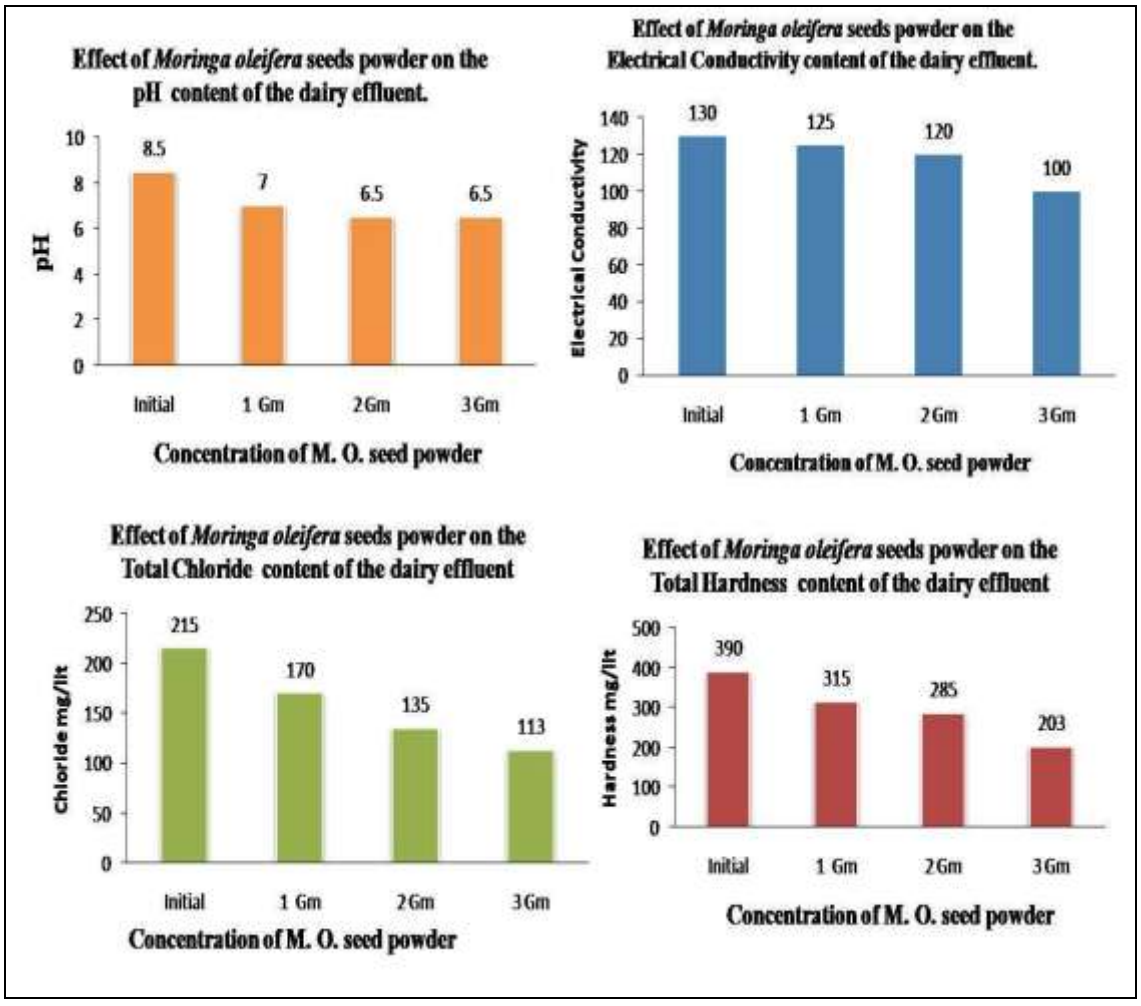
Fig. 2 *Moringa oleifera* seeds

RESULTS AND DISCUSSION

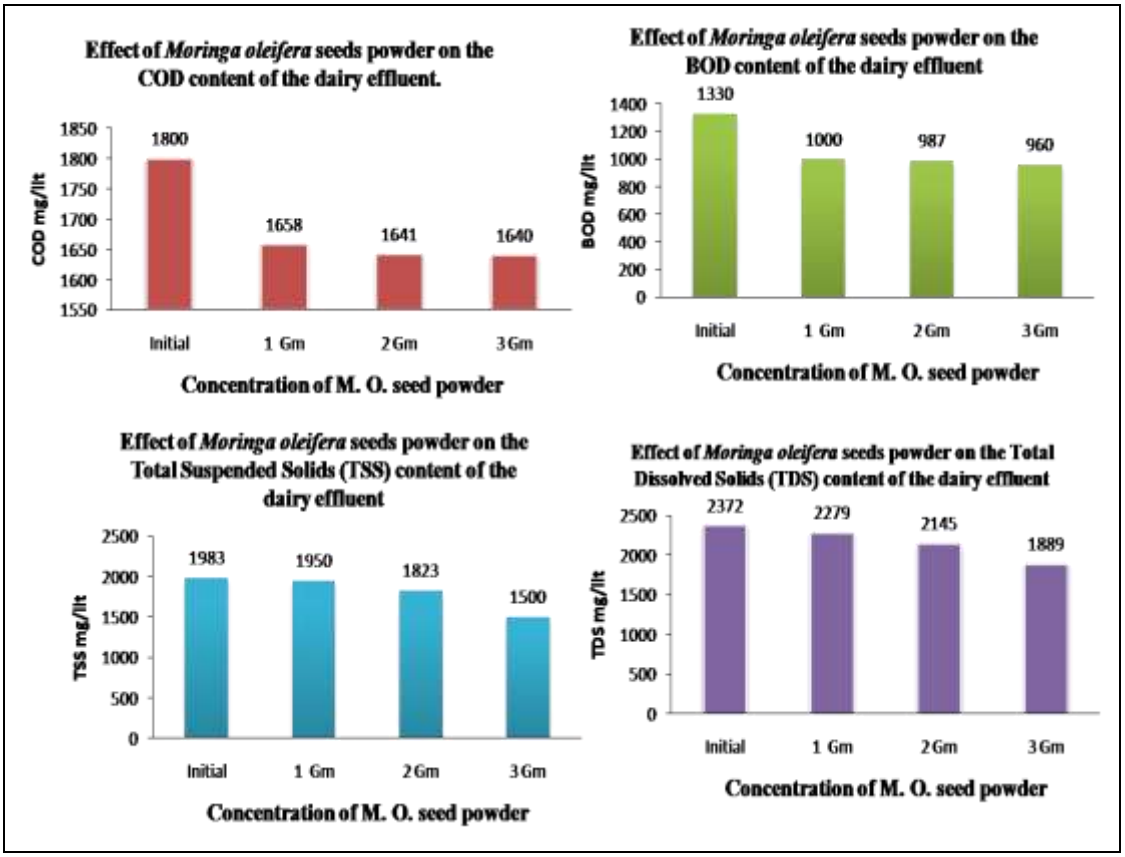
The treatment with *Moringa oleifera* shows best results for the water treatment.[12] The water quality parameters were analyzed for physic-chemical characters as per standard methods[10,11] before and after the treatment with *M. oleifera* seed powder.

Table no: 1 Treatment of dairy effluent by *M. oleifera* seed powder at different concentration

Sr. No	Parameters	Row Effluent	Treatment with *Moringa oleifera* seed powder		
			1 gm	2 gm	3 gm
1	pH	8.5	7.0	6.5	6.5
2	E. C. (µS)	130	125	120	100
3	Hardness (mg/l)	390	315	285	203
4	Chloride (mg/l)	215	170	135	113
5	COD (mg/l)	1800	1658	1641	1640
6	BOD (mg/l)	1330	1000	987	960
7	TSS (mg/l)	1983	1950	1823	1500
8	TDS (mg/l)	2372	2279	2145	1889



Graph I physico-chemical charcters of dairy wastewater before and after treatment with *M. oleifera* seed powder



Graph II physico-chemical parameters of dairy wastewater before and after treatment with *M. oleifera* seeds powder

A natural coagulant like Moringa seed powder is a substance which in solution, furnished ionic charges opposite to those of the colloidal turbid particle present in water. The coagulation and flocculation causes considerable increase in the density and size of the coagulated particle resulting in effective rate of settling of particle in wastewater.[13] Muthuraman and Sasikala in 1988 investigated the ability of the plant materials, seeds, such as *Moringa oleifera, Strychnos patatorum* and *phaseolus vulgaris* to act as natural coagulant was tested using synthetic turbid water formulation to resemble the drinking water. *Moringa* seeds are not only useful for drinking water treatment but also it is very helpful in wastewater treatment like dairy effluent. For the present study the dairy waste water was treated with different concentrations of the *Moringa oleifera* seeds which showed the following results.

pH

During the analysis, it was observed that after treatment with *Moringa* seed powder at 1 gm and 2gm/l dose the pH was found to be decreased. It changes from 8 to 6.5 and dose of

1gm/lit it changes to neutral. The pH increases with increasing concentrations of the *Moringa* seed powder as a *coagulant*. It was reported that the action of *M. 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* seed powder would accept a proton from water resulting in the release of a hydroxyl group making the solution basic.[14]

Electrical conductivity

The electrical conductivity of water samples was measured using digital conductivity meter, initially the Electrical conductivity of dairy waste water was 130µS. It changes to 125µS at the 1gm/lit dose of *M. oleifera* seed powder. Later on it get decrease to 100µS as the concentration of dose increases respectively.

Hardness

Before treatment the total hardness of waste water was 390 mg/lit. It was decrease to 315 at 1gm concentration of the *M. oleifera* seed powder. It decreases to 285 at 2gm concentration treatment and again it get little decreased up to 203mg/lit at 3gm concentration of *M. oleifera* seed powder. As a polyelectrolyte it may therefore be postulated that *Moringa oleifera* removes hardness in water through adsorption and inter-particle bridging.[15] According to Muyibi and Evison, 1994[16], as a polyelectrolyte *Moringa* seed powder *removes* hardness in water through adsorption and inter-particle bridging. Secondly, with the observation that light and slow-settling solids/flocks were formed, precipitation reaction leads to the conversion of soluble hardness-causing ions to insoluble compounds would also be a good prediction of the reaction mechanism.

Chloride

Initially the chloride content of dairy waste water was 215 mg/lit. It changes to 170 mg/lit at the 1 gm/lit dose of *M. oleifera* seed powder. Later on it decreases as to 113mg/lit as the concentration of dose increased respectively. It is because cations from *Moringa s*eed attract the negatively charged chloride ions present in water and neutralize the chlorides.[15]

Chemical Oxygen Demand (COD)

COD was determined by closed reflux, titrimetric method. In the initial stage COD of untreated wastewater was 1800mg/lit. It was decreased to 1658mg/lit at 1gm concentration

of the *M. oleifera* seeds powder. It gets decreased up to 1641mg/lit at 2gm concentration treatment and after that the COD remains constant with increase in concentration of *M. oleifera* seed powder.

Biological Oxygen Demand (BOD)

Before treatment of the waste water. the BOD of waste water was 1330 mg/lit. It has changes to 1000mg/lit at 1gm/lit dose of *M. oleifera* seed powder. Later on it gets decreased to 987mg/lit and 960mg/lit as the concentration of dose increases respectively.

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) of waste water was 1983 mg/lit. It was decreased to 1950 at 1gm concentration of the *M. oleifera* seed powder. It gets decreased up to 1823mg/lit at 2gm concentration treatment and after it becomes 1500mg/lit with increase in concentration of *M. oleifera* seeds powder.

Total Dissolve Solid (TDS)

Initially the TDS content of dairy waste water was 2372mg/lit. It changes to 2279mg/lit at the 1gm/lit dose of *M. oleifera* seed powder. Later on it gets decreases as up to 2145mg/lit and 1889mg/lit as the concentration of dose increases respectively. *Moringa oleifera* is known to be a natural cationic polyelectrolyte and flocculent with a chemical composition of basic polypeptides with molecular weights ranging from 6000 to 16,000 daltons, containing up to six amino acids of mainly glutamic acid, methionine and arginine.[16]

CONCLUSION

The use of natural coagulant from plant based sources represents a vital development in sustainable environment in sustainable environmental technology as it focuses mainly on the improvement of quality of life for underdeveloped communities. In case of waste water for large scale treatment plants aluminum sulfate is used as conventional chemical coagulant. As an alternative to conventional coagulant *M. oleifera* seeds can be used as a natural coagulant. The results obtained from the present study shows that powder from seed of *M. oleifera* contains some coagulation properties that have similar effect as the conventional coagulant, alum. This tends support to earlier findings of the use of powder processed from *Moringa* seeds as a coagulant in water and waste water purification system.[17] For the present study the dairy waste water was collected from MIDC area Kolhapur city, Maharashtra. The dairy waste water was treated with *M. oleifera* seed

powder with different concentration. *M. oleifera can act* as good coagulant for the treatment of dairy effluent as it shows maximum decrease in COD, BOD and hardness of the waste water. As the *M. oleifera* contains water soluble protein which can act as a good coagulant.[18] This property of the seed removes maximum COD and BOD load of the waste water.

It is eco-friendly and cheaper method of purification of industrial waste water. At 1gm concentration treatment it shows maximum decrease in value of the major parameter of the waste water which are COD, BOD. also it shows again reduction in hardness, COD, BOD Chloride, TDS and TSS at the concentration of 2gm and 3gm of M. o. Seeds. From the study it can be conclude that the *M. oleifera* seed powder is effective as a coagulant in removing the COD, BOD, Chloride, Hardness from waste water before discharging it into the environment.

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