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Use of Natural Coagulants (Moringa Oleifera) for Drinking Water Treatment

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ABSTRACT

In developing countries, getting access to cheap and clean drinking water is still a major problem. The present study aims to examine the drinking water treatment efficiency of natural coagulants, specifically Moringa Oleifera. Synthetic water was prepared to check the efficiency of Moringa Oleifera and was compared with alum. To assess these coagulants' effectiveness in removing turbidity under different circumstances, jar tests are performed. The results indicate to the great potential that Moringa oleifera shows for an affordable and sustainable method of treating water.

KEYWORDS: Coagulants, Moringa Oleifera, water, experiments, turbidity

1 INTRODUCTION

Cheap, clean drinking water is a major issue in many developing nations. Adding chemical coagulants, like aluminium sulphate, is typically the most expensive way to remedy this. In the treatment of water and wastewater, coagulation/flocculation is used to eliminate turbidity, colour, and naturally occurring organic materials [1, 2]. Common coagulants utilised in this treatment include synthetic organic polymers (polyaluminium chloride, or polyethylene imine) and inorganic coagulants such calcium carbonate, ferric chloride, and aluminium sulphate. But the sludge left over after treatments with aluminium salts causes issues with disposal, such as accumulation of aluminium in the environment [3]. Furthermore, some research has suggested that leftover polyaluminum chloride and aluminium sulphate (alum) may cause Alzheimer's disease [4, 5]. On the other hand, artificial organic polymers, such acrylamide, have cancer-causing and neurotoxic properties [6]. Natural coagulants, which are ideally a fantastic alternative way for removing turbidity from drinking water, may be one potential solution to these issues.

These coagulants must be biodegradable and safe to use around people. Numerous studies on a range of plant materials that can be a source of natural coagulants have been published recently. Natural coagulants derived, for instance, from Nirmali seed (Strychnos potatorum) [7, 8], common beans (Phaseolus vulgaris) [9], and Moringa oleifera (drumstick) [10] have all been studied. The M. oleifera seed is the substance that has drawn the most attention [11, 12]. Behen (or Ben) oil is a vegetable oil that is found in M. oleifera seeds with a weight percentage of 30% to 35% (w/w). The treatment of M. oleifera (drumstick) can lessen the turbidity of the treated water because it contains a water-soluble cationic coagulant protein.

There is no oil in common bean seeds, making them suitable for food [9]. Water turbidity and germs can be eliminated with the help of the non-toxic and efficient coagulant seed M. oleifera, also known as drumstick. The goal of this work is the use of the coagulant agent derived from M. oleifera and its comparison with commonly used coagulant (alum). One benefit of the natural coagulants' selectivity is that they possess antibacterial qualities [13, 14]. A cheap way to get rid of turbidity from drinking water is to use natural coagulants. In this work, we prepared synthetic water use kaolin and removed turbidity using readily accessible seeds and alum.

2 MATERIAL AND METHOD

2.1 Materials and analytical method

Alum was purchased from Merck (Pakistan). Nephelometric turbidity units (NTU) were used to express the measured turbidity, which was obtained using an ELICO CL 52D nephelometer. With an ELICO LI 120 pH metre, pH was measured, and the concentration of calcium and magnesium hardness was using standard method. Chloride was ascertained using an ELICO SL 59% UV-Vis spectrophotometer in accordance with established titrimetric procedures (APHA-2012).

2.2 Preparation of kaolin synthetic water

For the purpose of this research, distilled water was mixed with a kaolin suspension to create synthetic turbid water, which was then used in all coagulation tests. One litre of distilled water was used to dissolve 10g of kaolin powder to create the stock kaolin suspension. To achieve uniform dispersion of the kaolin particles, the suspension was agitated slowly for one hour at a speed of 20 rpm. The suspension was then let to stand for 24 hours so that the kaolin could fully hydrate. For the coagulation tests, water samples with different turbidities were prepared using this suspension as a stock solution. To get the appropriate turbidity and pH values for the synthetic turbid water, the original pH was changed with either 0.1 M NaOH or 0.1 M HCl.

2.3 Preparation of natural coagulant

Sample 1: M. oleifera.
Sample 2: alum.
The moringa husk was carefully removed. High-quality seeds were chosen, and using a standard food processor, the kernels were ground into a fine powder (63–500 mm). Next, each experiment made use of the powdered seed.

2.4 Coagulation experiments

The purpose of the jar test was to assess how well the coagulants agent isolated from the various processes mentioned above based on standard procedures. A jar tester with an illuminator was used to measure the turbidity of six 1000 mL beakers that were filled with 800 mL of water. To ensure quick mixing, different amounts of seed extracts were added to each beaker and shaken for 4 minutes at 100 rpm. After 25 minutes, the mixing speed was lowered to 40 rpm. Following the sedimentation of all the suspensions, the clarified samples were taken from the beaker's top and

filtered through filter paper to get rid of any sediment that remained. Next, a turbidity metre was used to measure the turbidity of each clarified sample. To find the optimum circumstances for each parameter, these variables were changed one at a time. To maintain consistency and average the results, each experiment was conducted at least twice.

Figure 1: Coagulation and fluctuation process to remove turbidity

3 RESULTS AND DISCUSSION

Synthetic water was prepared and its characterization before and after treatment was done using standard methods. Table 1 shows the physical and chemical parameters of treated and untreated water. Table 1 also shows the comparison with the WHO standard values of drinking water. pH of the treated water was 7 that is in limits of standard value. The turbidity of untreated water was 100 NTU while after treatment with natural coagulant it reduces to 4 that is also in limits. The hardness and chlorides of treated water were also within the limits of WHO standards. Therefore, the treated water using natural coagulant can be used for drinking purposes.

Table 1: Physical and chemical parameters for untreated and treated waters.

Sr. No.	Parameters	Untreated	Treated	WHO standard
1	pH	7.7	7	6.5-9.2
2	Turbidity (NTU)	100	4	<10
3	Hardness (mg/L)	430	170	<600
4	Chloride (mg/L)	300	120	<100
5	Total suspended solids (mg/L)	1200	285	<600
6	Calcium hardness (mg/L)	250	105	<600
7	Magnesium hardness (mg/L)	180	65	<600

Figure 2:Moringa oleifera

Figure 3:Aluminium sulphate

Moringa oleifera (Figure 2) and aluminium sulphate (Figure 3) were used for the treatment of turbid water. The study concentrated on how well Moringa oleifera worked as a natural coagulant to purify drinking water. Figure 4 is a summary of the outcomes attained at various doses using Moringa Oliefera. Maximum turbidity removal efficiency was achieved at 500 mg/L dose.

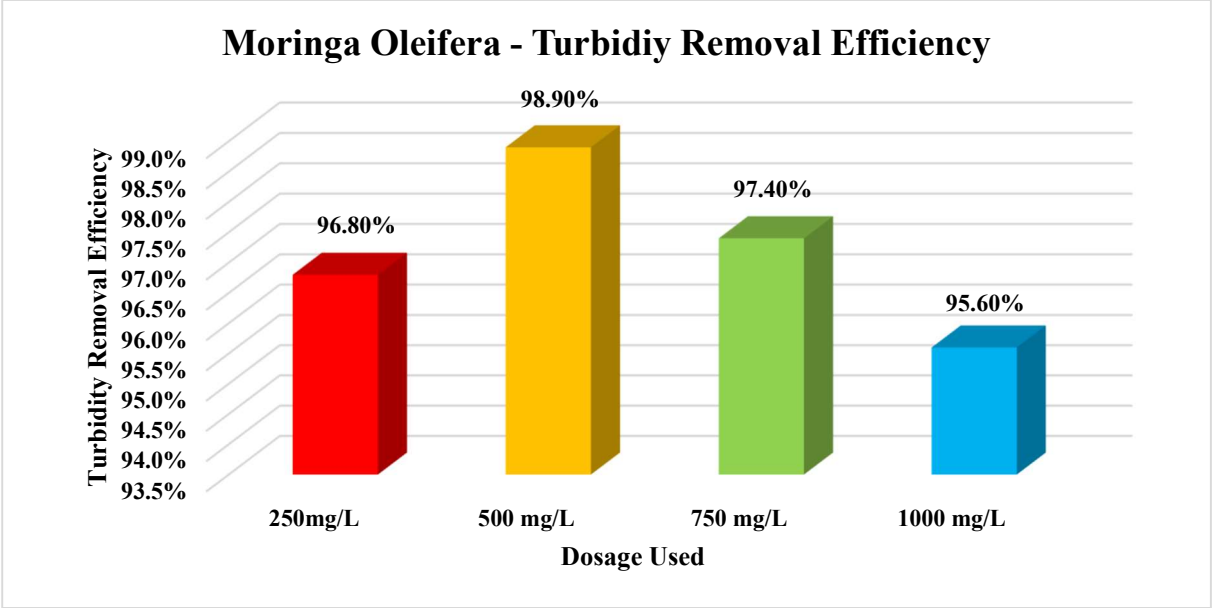

Figure 4: Effects of Moringa oleifera seed coagulant

The outcomes show how effective Moringa Oleifera is at removing turbidity at a variety of dose levels. With a removal effectiveness of 98.90% at 500 mg/L, the coagulant exceeded the industry

standards for treating drinking water. Moringa oleifera showed notable effectiveness even at lower dosages, with a minimum removal efficiency of 95.60% at 1000 mg/L.
The problems with synthetic and inorganic coagulants are addressed by these results, which show the potential of Moringa oleifera as an affordable and environmentally beneficial alternative for water treatment. Based on its performance, the natural coagulant seems to be a good choice for areas with limited resources were getting access to clean drinking water is a major issue. Furthermore, the efficiency of turbidity removal at lower dosages that has been found highlights the economic viability of Moringa Oleifera as a water treatment option. The findings stimulate additional research into and improvement of Moringa oleifera as a sustainable coagulant, furthering the progress towards easily accessible and uncontaminated drinking water.

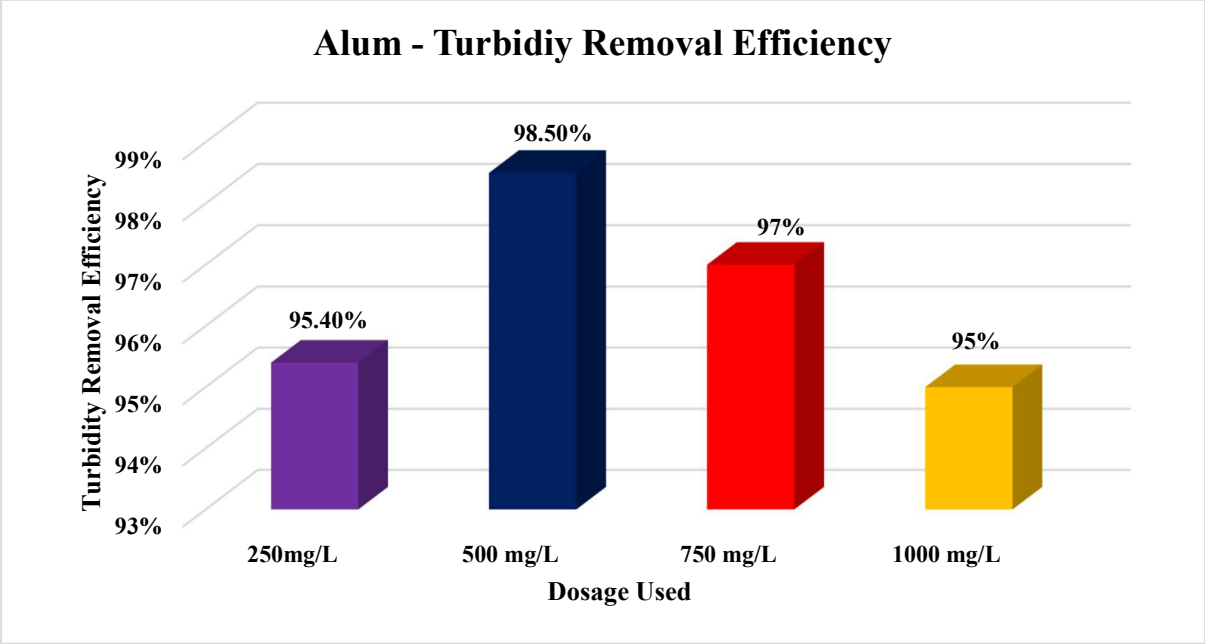

Figure 5: Effects of Aluminium sulphate (alum) coagulant

As a traditional coagulant, alum shows significant turbidity reduction efficacy at various dosage levels, according to the results as shown in figure 5. Comparable to Moringa Oleifera's performance, alum at 500 mg/L demonstrated a high removal efficiency of 98.50%. The removal effectiveness of alum, however, was shown to diminish with increasing concentrations; at 1000 mg/L, 95.00% efficiency was recorded.
Alum has promising results in removing turbidity, but it's important to consider the drawbacks as well, like sludge development and possible aluminium buildup in the environment.

4 CONCLUSIONS

In this study, Moringa oleifera, a naturally occurring coagulant, can effectively reduce turbidity in drinking water at various dosages. Comparable to, or even better than, the traditional coagulant alum, Moringa oleifera has a good removal efficiency. According to the research, Moringa Oleifera is a good and eco-friendly substitute for traditional methods of treating water, since it can effectively remove turbidity at different dose levels.

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