

Assessment on the Potential of Moringa Oleifera Seed Extract in the Clarification of Turbid Surface Water

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Abstract- The high cost of treating drinking water makes most poor people in the rural communities resort to readily available sources which are mostly polluted, thus, exposing them to water borne diseases. It is in the light of this that this research was carried out to find out the effectiveness of powder extracted from mature-dried *Moringaoleiferaseeds*; a cheap and readily available natural coagulant. The physiochemical treatment of water treated with Moringa seed powder and alum were compared and analyzed. 2g, 3g, 4g and 5g concentrations for both alum and Moringaseed powder were used and their result compared. A control was also included. The settlement time of suspended particles, pH and conductivity measurements were noted prior and after treatments. Even though alum was a better coagulant judging from the settling time, Moringa concentrations did not influence the pH to acidic level. There is a slight increase in conductivity for Moringa treatment while there was a high increase in conductivity with increase in concentration of alum. Findings from this study indicates that *Moringaoleifera* seed powder can be a potentially viable substitute to alum in the treatment of water.

Index Terms- Moringaoleifera, Coagulant and Alum

I. INTRODUCTION

Water is an essential component of all living systems and is the medium from which life evolves and in which exists. Water covers about 70% of the Earth's surface, 97% of this water is in oceans and most of the remaining fresh water is in form of ice. Therefore, only a relatively small percentage of the total water on earth is actually involved terrestrial, atmospheric and biological processes. Almost all of the freshwater that is available for human use is either contained in soils and rocks below the surface, called groundwater or in rivers and lakes (Crapper et al., 1973).

Water is used for several purposes by humans but the level of purity of the water being consumed is very crucial since it has a direct effect on health. The conventional method of water purification using aluminiumsulphate (alum) and calcium hypochlorite puts pressure on the nation's over-burdened financial resources since they are imported thereby making treated water very expensive in most developing countries and beyond the reach of most rural folks. Hence, they resort to sources such as dams, dug outs, streams, rivers, and lakes. Water

from these sources is usually turbid and contaminated with microorganisms that cause many diseases including diarrhoea and malaria. According to the World Health Organization, 1.8 million die every year from diarrhoeal diseases (including cholera); 98% of which are children under the age of 5. 88% of diarrhoeal diseases are attributed to unsafe water supply, inadequate sanitation and hygiene.

Earlier research findings of Crapper et al. (1973) and Miller et al. (1984) showed that the chemicals used for water purification can cause serious health hazards if an error occurs in their administration during the treatment process. These reports suggested that a high level of aluminium in the brain is a risk factor for the development of neurological abnormality (Alzheimer's disease or pre-senile dementia). Subsequently, large non-biodegradable sludge volumes are produced comprising of residual aluminiumsulphate which requires treatment facilities to prevent further contamination into the environment.

There is therefore the need to investigate the use of non-chemicals which would be available locally in most developing countries. The use of natural materials of plant origin to clarify turbid water is not a new idea (Folkard et al., 1989). Among all the plant materials that have been tested over the years, powder processed from the seeds from *Moringaoleifera* has been shown to be one of the most effective as a primary coagulant for water treatment and can be compared to that of alum (conventional chemical coagulant) (Madsen et al., 1987; Postnote, 2002). It was inferred from their reports that the powder has antimicrobial properties. Earlier studies have found *Moringato* be non-toxic (Okada et al., 2000).

It is a well-established fact that *Moringaoleifera* is available in most rural communities in Maiduguri where access to improved drinking water is a problem. It is in the light of this that this research seeks to investigate the effectiveness of powder extracted from mature-dried *Moringaoleifera* seeds in the improvement of water quality.

II. METHODS

Study Area

Maiduguri is located between 11°50'N and 13°9'E of Nigeria. It was the formal capital city of the North-eastern zone of Nigeria and now the capital of Borno state. Maiduguri is geographically located in North-eastern part of Nigeria and share

boundaries with Chad and Cameroun Republic. According to the 2006 National Population Census, Borno State has a population

of 4,151,193 people. Maiduguri in particular has a population of 521,492.

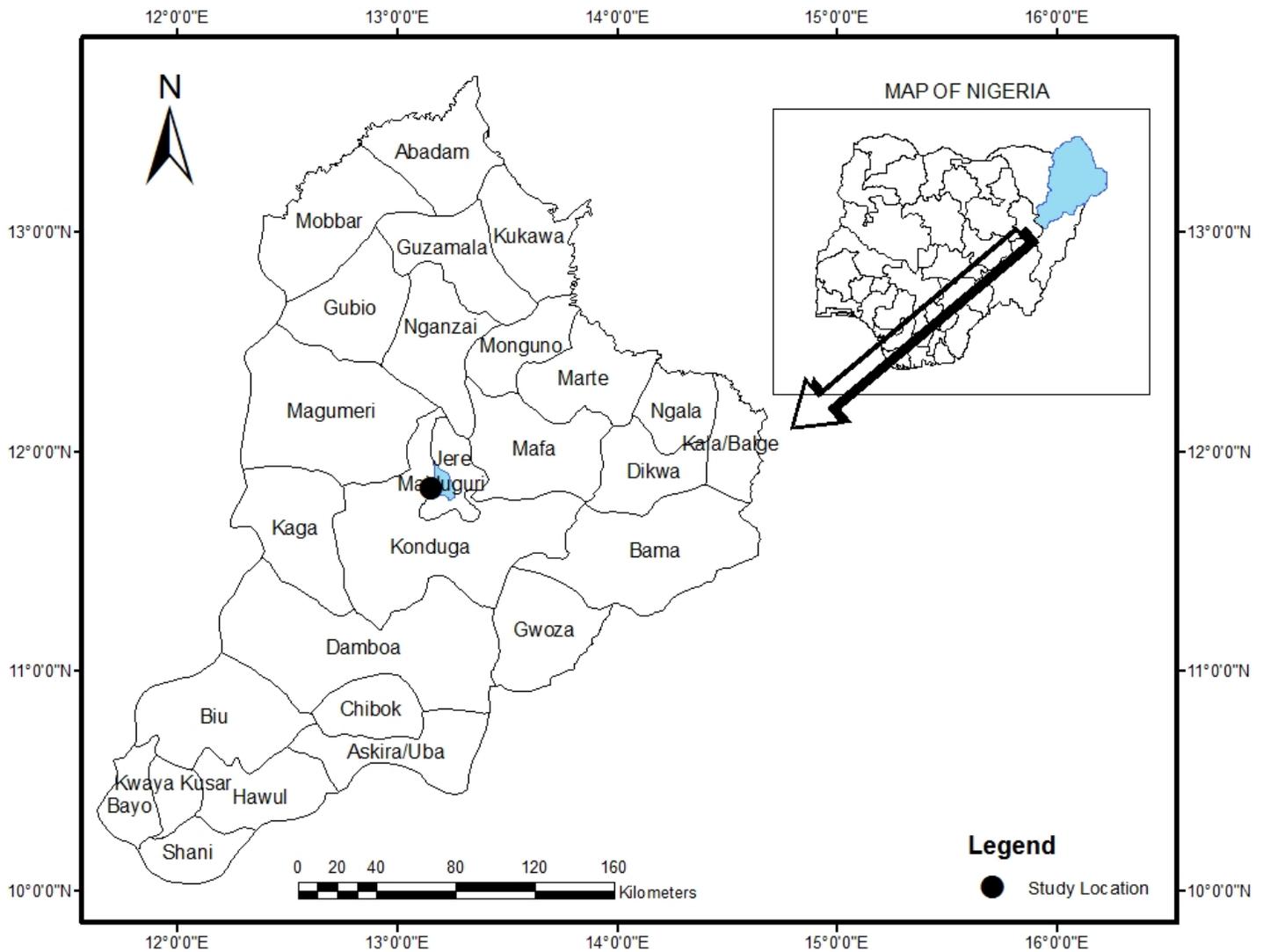


Figure 1: Map of Borno State showing the study location

Sample Site

The water sample used in this study was collected from the Maiduguri Water Treatment, a branch of the Ministry of Urban and Rural Water supply, Maiduguri. It is located along Bama Road, opposite Gate 2, University of Maiduguri, Borno State, Nigeria. The source of water to the Treatment Plant is Lake Alau.

Lake Alau

Lake Alau is situated off Maiduguri-Bama Road, some 14km away from Maiduguri Metropolis. The Lake is a natural water formed by River Ngadda- characterized by an undulating landscape which is further beautified by savannah vegetation. History has it that the Basin is the spot where IdrisAloma, one of the famous warrior, hero and charismatic leader of the ancient KanemBorno Empire was buried, hence the name, Alau. Lake Alau is now a site of intensive farming especially irrigation during the dry season where spinach, onions,

tomatoes etc. are being cultivated by individuals. Fishing is another economic activity that takesplace in the Lake shores.

Collection of Water Sample

The raw water sample was collected using a five(5) litre Jerrycan from Maiduguri Water Treatment Plant. A Secchi disc was used to determine the transparency of the water body and the water sample was brought to the laboratory for further analysis.

Coagulants Used

The Moringa seeds from mature fruits used in the study were harvested from a household at the University of Maiduguri Teaching Hospital, Borno State. This is determined by observing if there are any cracked pods on the plants. The plucked pods were cracked to obtain the seeds which were sun-dried for five(5) days. The shells surrounding the seed kernels were removed and

the kernels were powdered using a laboratory mortar and pestle. The Aluminium sulphate (alum) used in the study was obtained from The Maiduguri Water Treatment Plant. The Alum was pounded using a laboratory mortar and pestle into powder.

Experimental Procedures

Small quantity of sample water (200ml) was taken in a beaker to determine the pH and conductivity. Nine (9) beakers of 500ml eight (8) flat bottomed flasks of 500ml each were used for the experiment. Water sample, 400ml was then measured using a measuring cylinder and poured into each beakers. Four (4) beakers were treated with doses of 2g, 3g, 4g and 5g aluminium sulphate and the other four (4) beakers were treated with doses of 2g, 3g, 4g and 5g of Moringa seed powder respectively. The powdered alum and Moringa seed were weighed using an Electric precision Balance (TL-5000). The solutions were mixed rapidly for 5 minutes using glass rod to aid in coagulant formation. The time taken for both treatments to sediment were noted. After sedimentation, the supernatants were decanted into their respective flat-bottom flasks while the residues were filtered using filter paper and funnel. This method is adopted since there is no standard method for conducting the jar test (Ndabigengesere et al., 1995). The pH and conductivity of the supernatants for both treatments were measured for comparisons.

pH Measurement

The pH of the treated samples were read using a pH Meter (model PHS-25). A volume of 200ml of the supernatants obtained from the beakers containing the treatments was measured into a beaker. The pH meter probe was then inserted making sure it did not touch the beaker. The pH reading was then taken from the display screen after it had stabilized.

Conductivity Measurement

The samples used for the pH measurements were used for the conductivity test. A calibrated conductivity meter (model EC215) was used. The conductivity meter probe was then inserted making sure it did not touch the beaker. The reading was recorded from the display screen after it had stabilized.

III. RESULTS

Physiochemical Parameters before and after Treatments

Table 1: The time taken for both Moringa and Alum treatments to sediment at varying concentrations are as presented below

Concentrations(g/400ml)	Time taken for Moringa Treatment	Time taken for Alum Treatment
2	3hrs	2hrs
3	3hrs 30mins	2hrs 30mins
4	4hrs	3hrs

5	4hrs 30mins	3hrs 30mins
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Table 2: The pH of supernatants from both Moringa and Alum treatments at varying concentrations are as presented below:

Concentrations(g/400ml)	pH for Moringa Treatment	pH for Alum Treatment
2	7.04	3.82
3	7.05	3.69
4	7.05	3.62
5	7.05	3.60

Table 3: The conductivity of supernatants from both treatments at varying concentrations are presented below

Concentrations(g/400ml)	Conductivity for Moringa Treatment (mS)	Conductivity for Alum Treatment (mS)
2	0.3	2.6
3	0.4	3.7
4	0.5	4.8
5	0.5	5.3

IV. DISCUSSION

Results from the experiment indicates that 2g of Moringa seed powder took 3hrs before sedimenting while at 5g, it took 4hrs 30mins, which showed that the lower the concentration of Moringa seed powder, the higher the sedimentation and vice versa. Also, 2g of Aluminium sulphate took 2hrs while 5g took 3hrs 30mins to sediment, which showed that the lower the concentration of Alum powder, the sedimentation and vice versa.

pH The World Health Organization (WHO) classifies as standard drinking water, any water with pH between 6.5 and 8.5. Although, pH usually has no direct effect on water consumers, it is one of the most important water quality parameters. pH of supernatants from Moringa treatment remained constant irrespective of the varying concentrations. This conforms to the World Health Organization standards for drinking water. Alum however, reduced the pH to acidic levels.

The effectiveness of Moringa seeds as 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 seeds would accept a proton from water, resulting in the release of hydroxyl group (Ndabigengesere et al., 1995). In a similar study, Muyibi (1993) observed that in a completely randomized factorial experiment with different concentrations of Moringa seed powder, pH did not have any significant effect on quality of treated water.

Alum at different concentrations significantly influenced the pH of the water, causing a decrease with increasing concentrations. The low pH resulting from the use of Alum could be altered by addition Sodium hydroxide, thereby increasing treatment cost. The addition of Alum in the treatment procedure produced Sulphuric acid which lowered the pH levels. This tendency towards increase in acidity could be due to the trivalent cation Aluminium that can accept lone pair of electrons (Miller et al., 1984). High dosage of Alum in water even though a better a coagulant, may lead to high acidity, raising health concerns about Alum related diseases as reported by Martyns et al., (1989).

Conductivity

Conductivity, which is a measure of total dissolved solids in water varies considerably in different geographical regions owing to differences in the solubility of minerals, hence there is no standard value for it but high levels in drinking water may be objectionable to consumers (WHO, 2006).

Treatments with Moringa and Alum concentrations influenced conductivity of water greatly. Increasing concentrations of both coagulants was attended by increase in conductivity of supernatants. This may be attributed to the increase in cationic polyelectrolyte in Moringa seeds and Sulphate ions in Alum as the concentrations increased thereby producing high dissolved solids that increased the conductivity (Okada et al., 2000). However, from the results obtained, Alum increased the conductivity of the supernatants a great deal compared to Moringa treatment.

V. CONCLUSION

Moringaoleiferaseed powder is an effective natural coagulant which can be used in improving the quality of water especially in terms of pH, turbidity, and conductivity. In coagulation, Moringa seeds hardly affect pH of water as compared to Alum which requires pH adjustment after treatment. This is likely to reduce the high cost of the water treatment systems.

Moringaoleifera seeds present a possible alternative coagulant to Alum in treating water for rural dwellers because It is cheaper, It has a comparable effect to Alum in terms of sedimenting time; and It is environmentally friendly since its concentration in water has not being found to be harmful as against Alum whose high concentrations has been associated with Alzheimer's disease.

Also, sludge that contains milled *Moringaoleifera* seeds when discharged into the environment improves soil quality and plant growth as against Alum sludge which requires proper treatment before discharging into the environment.

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