

## Original Research Article

## Application of *Moringa oleifera* Seeds Extracts in Purification of Ground Water

Zainab Y. Makarfi<sup>1</sup>, Muhammad Ali<sup>2\*</sup>, Lurwan Mu'azu<sup>3</sup>, Rukayya H. Sudawa<sup>3</sup>

<sup>1</sup>Department of Applied Science, Shehu Idris College of Health science and Technology Makarfi, Kaduna State, Nigeria

<sup>2</sup>Department of Microbiology, Federal University Gusau, 4QHM+62V, Zaria Road, Sabon Gida Village, Gusau, Nigeria

<sup>3</sup>Department of Biological Sciences, Federal University Gusau, 4QHM+62V, Zaria Road, Sabon Gida Village, Gusau, Nigeria

**\*Corresponding Author:** Muhammad Ali

Department of Microbiology, Federal University Gusau, 4QHM+62V, Zaria Road, Sabon Gida Village, Gusau, Nigeria

### Article History

Received: 03.05.2022

Accepted: 09.06.2022

Published: 24.06.2022

**Abstract:** Drinking water needs to be treated in order to remove impurities and bacteria to meet the quantity guidelines which satisfy for drinking water requirement according to world health organization. The aim of the study is utilizing *Moringa oleifera* seeds suspension in ground water purification as coagulating and softening agent. Ground water was collected from four different locations at Challawa industrial area of Kumbotso Local Government Kano State, Nigeria. The water samples were subjected to physico-chemical analysis using standard laboratory methods. Suspension from the seeds of *Moringa oleifera* was prepared in different concentration and used in the process of purifying the water as coagulating and softening agent. The physico-chemical analysis of the water samples showed that the samples have turbidity of between 108 – 126 NTU, which indicated that the samples have high turbidity with moderate hardness ranged from 75.25 - 125.61 mg/L. The pH of the water samples ranges from 6.7 - 6.8. Both the water samples were colorless, tasteless and odorless. The result showed that different concentration of *Moringa* seed suspension has a pronounce effect as coagulating and softening agent. The seed suspension reduces the turbidity and hardness of ground water from up to 82% and 42% respectively after exposing for 90 minutes. Therefore, *Moringa* seeds suspension can be regarded as one of the natural coagulating and water softening agent and could be used for turbidity reduction and water softening.

**Keywords:** *Moringa oleifera*, Coagulant, Hardness, Physico-chemical, Water.

## INTRODUCTION

Drinking water needs to be treated in order to remove impurities and bacteria to meet the quantity guidelines which satisfy for drinking water requirement according to world health organization [1]. Water is used for several purposes by human but the level of purity of the water being consumed is very crucial since it has direct effect on health. The conventional method of water purification using Aluminum sulphate (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 resources such as dams dug outs, streams, rivers and lakes. Water from these sources is usually turbid and contaminated with microorganisms that cause many diseases are one of the main problems in developing countries, about 1.6 million people are compelled to use contaminated water and more than a million people (of which two million are children) die from diarrhea each year [1].

Earlier research findings of US Environmental Protection Agency (USEPA) [2] 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 aluminum in the brain is a risk factor for Alzheimer's disease. There is therefore, the need to investigate the use of non-chemicals which would be available locally in most developing countries. Recently however, there has been a resurgence of interest in natural coagulants for water treatment in

**Copyright © 2022 The Author(s):** This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

**Citation:** Zainab Y. Makarfi, Muhammad Ali, Lurwan Mu'azu, Rukayya H. Sudawa (2022) Application of *Moringa oleifera* Seeds Extracts in Purification of Ground Water. *South Asian Res J Bio Appl Biosci*, 4(3), 69-73.

developing countries, mainly due to the advantages such as biodegradability, low sludge production and fewer risks to health and environment [3, 4].

Several studies suggested that the use of natural materials of plant origin to clarify turbid water i.e. not a new idea [5, 6]. Among all the plant materials that have been tested over the years, powder processed from the seeds from *Moringa Oleifera* has been shown to be one of the most effective as a primary anti-coagulant for water treatment and can be compared to that of alum (conventional chemical coagulant) [7]. It was inferred from their reports that the powder has antimicrobial properties. Earlier studies have found *Moringa* to be non-toxic [8], and recommended its use as anti-coagulant in developing countries [7]. The use of *Moringa* has an added advantage over the chemical treatment of water because it is biological and has been as edible. The cost of this natural anti-coagulant would be less expensive compared to the conventional coagulant (alum) for water purification. *Moringa oleifera* Lam. (*Moringa*) is the most widely cultivated species of a monogeneric family, the Moringaceae. It is a tree native to India and cultivated in all sub-tropical areas. This tropical multipurpose fast growing tree is resistant to drought. In the present study, *M. oleifera* seeds were used in purification of ground water and evaluated for their efficiency in removing turbidity and softening from the water samples.

## MATERIALS AND METHODS

### Sample Collection

Ground water samples with different proximity to industrial area were collected from four (4) different locations within Challawa industrial area in Kumbotso Local Government Area Kano State, Nigeria. The water samples were collected in sterile bottles, transported to the water laboratory Department of Geography, Bayero University Kano for analysis.

### Preparation of *Moringa oleifera* Seed Suspensions

*Moringa oleifera* seeds used were collected from the compounding Laboratory in the Department Pharmaceutical Technology, Kano State Polytechnic. Identification and authentication of the seeds was done at Herbarium in the Department of Plant Science, Bayero University Kano with the following voucher number BUKHAN 011 and voucher specimen were deposited there for reference. The seed wings were removed and the kernels were air dried for two weeks, then grounded into a fine powder using sterile pestle and mortar under laboratory condition. Fifty grams (50g) of the seeds powder were extracted using 250ml of 1 molar solution of sodium chloride by maceration for 2 days [9]. The resulting suspension was filtered through a muslin cloth to give a stock solution of approximately (200mg/L). From the stock solution different concentrations (50, 100, 150, 200 mg/L) were prepared and used for turbidity assessments.

### Physico-chemical Analysis

The physico-chemical tests included the determination of temperature, turbidity, odour, colour, total solid, total dissolved solid, total suspended solid, pH, conductivity, acidity, total hardness and chloride content using the methods of FAO [10].

### Turbidity and Hardness Assessment

Turbidity measurement was performed following the method of Myuibi and Evison [11]. *Moringa* seeds concentrations (50, 100, 150 and 200 mg/L) were used. Hanna instrument (H193703) was used to assess turbidity in treated and non-treated ground water. The instrument has been designed according to the ISO 7027 international standard, the turbidity measurement units is Nephelometric Turbidity Unit (NTU). The four different concentrations of *Moringa* seeds were used at different time's intervals to assess its ability to coagulate tap water. Turbidity readings were taken at three times at intervals of 30 minutes each. The hardness and pH of the water samples was measured before and after dissolving the extracts in the water samples at each time interval. Synthetic alum (100mg/L) was used as positive control for the study.

## RESULTS

### Physicochemical analysis of water

The average physicochemical analysis of the water samples is presented in Table 1. Both physical and chemical properties of water are presented. The samples have turbidity of between 108 – 126 NTU, which indicated that the samples have high turbidity with moderate hardness ranged from 75.25 - 125.61 mg/L. The pH of the water samples ranges from 6.7 - 6.8. Both the water samples were colorless, tasteless and odorless.

**Table 1: Physicochemical analysis of water samples from 4 different locations**

S/N	Properties	Sample 1	Sample 2	Sample 3	Sample 4
1	Odor	Odorless	Odorless	Odorless	Odorless
2	Taste	Tasteless	Tasteless	Tasteless	Tasteless
3	Temperature ( $^{\circ}$ C)	24	23	22	25
4	PH	6.7	6.8	6.8	6.7
5	Turbidity (NTU)	112	119	126	108
6	Tot. diss. Solid(mg/l)	410	390	400	410
7	Chloride (mg/l)	210	187	192	155
8	Calcium (mg/l)	51	48	49	48
9	Magnesium (mg/l)	44	49	45	47
10	E. conduct. (us/cm)	161	627	622	101
11	Hardness (mg/l)	85.29	112.23	125.61	75.23

### Turbidity assessment

The turbidity assessment of the water sample after using *Moringa* seed suspension is presented in Table 2. The result showed that different concentration of *Moringa* seed suspension has a pronounce effect as coagulating agent. The effect of the seed suspension was dose dependent according to the result of this study. Higher coagulating activity was shown by *Moringa* seed suspension at concentration of 200 mg/L which reduced the turbidity of ground water from 115 NTU to 21 NTU after exposing for 90 minutes with turbidity reduction of 82%.

**Table 2: Turbidity assessment of the sample using Moringa seed suspension**

Seed conc. (mg/L)	Initial turbidity (NTU)	After 30 min (NTU)	After 60 min (NTU)	After 90 min (NTU)	Turbidity reduced (NTU)	Turbidity reduction (%)
50	115	92	74	59	56	55
100	115	88	71	52	63	33
150	115	80	65	41	74	64
200	115	73	54	21	94	82
Control	115	59	44	20	95	83

### Hardness and pH Assessment of the Water Sample

The hardness and pH assessment of the water after mixing the water with *Moringa* seed suspension for 90 minutes is presented in Table 3. The result showed that; different concentration of *Moringa* seed suspension can reduce the hardness and pH of ground water after exposing for 90 minutes.

**Table 3: pH Assessment of the Water Sample**

Seed conc. (mg/L)	Initial hardness (mg/L)	Final hardness (mg/L)	Initial pH	Final pH
50	82.5	64.5	6.70	6.55
100	82.5	57.2	6.70	6.52
150	82.5	55.7	6.70	6.50
200	82.5	48.3	6.70	6.45
Control	82.5	45.8	6.70	6.68

## DISCUSSION

The results of turbidity assessment from the study indicated that the Seeds of *M. oleifera* reduced ground water turbidity in the range of 55-82 % at different concentrations after 1 hour 30 minutes. Turbidity of ground water tested was best reduced up to 21 NTU (82%) after 1 hour 30 minutes application of *Moringa* seeds suspension at the concentration of 200 mg/L. This result of this study was inconformity with the results obtained from previous researchers who documented 70-99 % turbidity removal by *M. oleifera* seeds as primary coagulant both for raw waters and synthetics turbid waters [12]. The coagulating property of *Moringa Oleifera* seed extract in this study corroborated the earlier findings by Muyibi and Evison [11] also worked in Kano and used water samples from Challawa and Dambatta water works, and Rimin Gada reservoir. The report showed that for Challawa and Dambatta water works water samples, turbidity removals were 36-98.2% and 14.3-99.4% respectively, with the dosage varying from 100 to 450mg/l and 100 to 250mg/l, respectively. The optimum dose of *M. Oleifera* for the two samples was 250mg/l. For the Rimin Gado reservoir water samples, turbidity removal varied from 17.1-95.7% with the *M. Oleifera* dose varying from 100 to 450mg/l.

The seed kernels of *Moringa* contain significant quantities of a series of low molecular weight, water-soluble proteins which, in solution, carry an overall positive charge. The proteins are considered to act similarly to synthetic,

positively charged polymer coagulants. Amino acid analysis and sequencing of *M. oleifera* showed high contents of glutamine, arginine and proline as well as total of other 60 residues [13]. The results of this study, confirms that the use of Moringa seeds as natural coagulants for ground water removes turbidity up to 75 %. Comparing with other results using synthetic coagulants the average most probable number (MPN) reductions in turbidity obtained with alum it was only 7.7% [14]. Finally, *M. oleifera* is a non-toxic [15] i.e. it could be used as a safe natural organic polymer coagulant. However, an extract from *Moringa* seeds is principally a low molecular proteins which is the main effective coagulant agent used for water treatment [16].

According to World Health Organization, hardness is mostly expressed as milligram of calcium carbonate equivalent per litre. Water containing calcium carbonate at concentration below 60 mg/L is generally considered as soft water; 60 – 120 mg/L, moderately hard; 120 – 180 mg/L, hard and more than 180 mg/L considered very hard. Therefore, based on the findings of this study, the water sample used is moderately hard and after exposing to different concentration of Moringa seed suspension, it became soft except at 50 mg/L. The effect of *M. oleifera* seed suspension on pH showed that extract has a minimal effect on the pH of the samples. However, it can reduce the pH slightly after exposure for 90 minutes. This result was in agreement with that obtained by Yarahmadi *et al.*, [17] who reported that the efficiency of the *M. oleifera* extract as a coagulant is not affected by pH.

## CONCLUSIONS

*M. oleifera* offers an alternative solution to the use of expensive chemical coagulants. The experiments with these natural coagulants gave filtered water turbidity less than or almost equal to 21 NTU and thereby met the turbidity criteria for drinking water as per WHO guidelines. Turbidity of ground water tested was best reduced up to 21 NTU (82 %) after 90 minutes application of *Moringa* seeds suspension at the concentration of 200 mg/L. it was also found that the *Moringa* seed suspension reduced the hardness of water effectively. Therefore, *Moringa* seeds suspension can be regarded as one of the natural coagulating and water softening agent and could be used for turbidity reduction and water softening.

## REFERENCES

1. World Health Organization. (2004). Guidelines for drinking water quality. 3rd edition, Switzerland: WHO press, Pp.16-89.
2. United State Environmental Protection Agency (USEPA). (1995). Guidelines for water supply, 7<sup>th</sup> edition, New York: WHO press, Pp.144 -162.
3. Shahriari, T., NABI, B. G., & Shahriari, S. (2012). Evaluating the efficiency of plantago ovata and starch in water turbidity removal. *Int J Environ Res*, 6(1), 259-264.
4. Kaspar, P., Guillen, I., Rivelli, D., Meza, T., Velazquez, G., Mino de Kaspar, H., ... & Zoulek, G. (1992). Evaluation of a simple screening test for the quality of drinking water systems. *Tropical Medicine and Parasitology: Official Organ of Deutsche Tropenmedizinische Gesellschaft and of Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ)*, 43(2), 124-127.
5. Jahn, S. A. A. (1988). Using Moringa Oleifera seeds ascoagutal in developing countries. *J. Am. Water Works Assoc*, 6, 43-50.
6. Sani, M. A. (1990). The use of Zogale (*Moringa Oleifera*) for water treatment; B. Eng. Final Year project; Bayero University, Kano, Nigeria.
7. Olsen, A. (1987). Low technology water purification by bentonite clay and Moringa oleifera seed flocculation as performed in Sudanese villages: effects on *Schistosoma mansoni* cercariae. *Water research*, 21(5), 517-522.
8. Okuda, T., Baes, A. U., Nishijima, W., & Okada, M. (2001). Isolation and characterization of coagulant extracted from Moringa oleifera seed by salt solution. *Water research*, 35(2), 405-410.
9. Katayon, S., Noor, M. M. M., Asma, M., Ghani, L. A., Thamer, A. M., Azni, I., ... & Suleyman, A. M. (2006). Effects of storage conditions of Moringa oleifera seeds on its performance in coagulation. *Bioresource technology*, 97(13), 1455-1460.
10. Food and Agriculture Organization (FAO). (1997). Chemical analysis manual for food and water, 5<sup>th</sup> Edition FAO Rome, 1, 20-26.
11. Muyibi, S. A., & Evison, L. M. (1996). Coagulation of turbid water and softening of hardwater with Moringa oleifera seeds. *International journal of Environmental studies*, 49(3), 247-259.
12. Mark, D. S., & Frederic, K. P. (2002). Evaluation of the H<sub>2</sub>S Method for Detection of Faecal Contamination of Drinking Water, WHO/SDE/WSH/02.08 Geneva.
13. Genthe, B., & Franck, M. (1999). A Tool for Assessing Microbial Quality in Small Community Water Supplies. *WRC Report Pages to Water Research Commission by Division of Water, Environment and Forestry Technology, CSIR, Stellenbosch*, 33(961/1), 99.

14. Venkobachar, C., Kumar, D., Talreja, K., Kumar, A., & Iyengar, L. (1994). Assessment of bacteriological water quality using a modified H sub (2) S strip test. *Aqua- Journal of Water Supply: Research and Technology*, 43(6), 311-314.
15. Rijal, G. K., Fujioka, R. S., & Ziel, C. A. (2000). Evaluation of the Hydrogen Sulfide Bacteria Test, a Simple Test to Determine the Hygienic Quality of Drinking Water, Abstracts of the General meeting of the American Society for Microbiology. *Poster Presentation (Unpublished), American Society of Microbiology, Washington DC*.
16. Martins, M. T., Castillo, G., & Dutka, B. J. (1997). Evaluation of drinking water treatment plant efficiency in microorganism removal by the coliphage, total coliform and H<sub>2</sub>S paper strip tests. *Water science and technology*, 35(11-12), 403-407.
17. Yarahmadi, M., Hossieni, M., Bina, B., Mahmoudian, M. H., Naimabadie, A., & Shahsavani, A. J. W. A. S. J. (2009). Application of Moringa oleifera seed extract and poly aluminium chloride in water treatment. *World Appl Sci J*, 7(8), 962-967.