International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Efficacy of *Moringa oleifera* as a natural coagulant in household water treatment in South West Nigeria

Rachel Oluwatoyin Rojugbokan *

Department of Science Education (Science Unit) Federal College of Education, Osiele, Abeokuta, Ogun State Nigeria.

International Journal of Science and Research Archive, 2025, 16(01), 1830-1833

Publication history: Received on 14 June 2025; revised on 21 July 2025; accepted on 24 July 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.16.1.2147

Abstract

Moringa oleifera (Lam) seeds have been identified as a potential natural coagulant with effective water purification properties. The aim of this study was to evaluate the efficacy of the seeds as coagulants in improving the quality of household water in South West Nigeria, focusing on its ability to reduce turbidity and microbial contamination. Water samples were collected from household water sources in selected rural and peri-urban communities in the South West region, including wells, boreholes, and surface water bodies. Treatment with the seed powder at an optimal dosage of 100 mg/L resulted in reductions between 85% and 96%, achieving near World Health Organization (WHO) standards. Statistical analysis was performed to compare pre- and posttreatment water quality parameters. Results showed that treatment with the seeds powder at a dose of 100 mg/L yielded significant reductions in total coliform and E. coli counts by over 90%, compared to the control group. These results suggest that the use of the seed in household water treatment is feasible and effective.

Keywords: Water Treatment; Household Hygiene; Water Purification; Plant Based Coagulants; Microbial Contamination

1. Introduction

Access to safe drinking water remains a critical challenge in many parts of Nigeria, especially in rural and peri-urban communities in the South West region. Conventional chemical coagulants used in water treatment can be costly and may pose health and environmental risks. *Moringa oleifera*, a locally available plant, has been identified as a potential natural coagulant with effective water purification properties. *Moringa oleifera* seeds contain cationic proteins that act as natural coagulants by neutralizing negatively charged particles in turbid water, promoting flocculation and sedimentation of impurities (Nordmark et al., 2016). Studies have demonstrated that crude water-soluble extracts from *Moringa oleifera* seeds can reduce turbidity by 80% to 99.5% and bacterial contamination by 90% to 99.99%, making it suitable for treating highly turbid and microbiologically contaminated surface water (Abdullahi and Sulaiman, 2021). Research conducted in Ile-Ife, Nigeria, showed that purified proteins from *Moringa oleifera* seeds effectively coagulated water from the Opa reservoir, improving water quality significantly (Scholes et al., 2020). Additionally, studies in Niger State confirmed that *Moringa oleifera* seed powder reduced turbidity and coliform bacteria in river water samples, suggesting its suitability for domestic water purification in Nigerian rural settings (Aduro and Ebenso, 2019). The seed powder is also reported to be eco-friendly, cost-effective, and non-toxic, making it a viable alternative to chemical coagulants. However, variability in seed quality, dosage optimization, and potential organic matter introduction remain challenges requiring further investigation.

Despite promising results, there is limited research specifically focused on household-level application of *Moringa oleifera* in South West Nigeria, where water contamination and access issues are prevalent. This study will build on existing knowledge by evaluating practical household treatment scenarios and community acceptance, contributing

* Corresponding author: Rachel OluwatoyinRojugbokan

original data relevant to local conditions. This research aims to evaluate the efficacy of *Moringa oleifera* seeds as a natural coagulant for household water treatment, focusing on its ability to reduce turbidity, microbial contamination, and improve overall water quality in South West Nigeria.

Research Objectives

The broad objective of the research is to evaluate the efficacy of *Moringa oleifera* seeds as a natural coagulant in improving the quality of household water in South West Nigeria.

- To determine the efficacy of *Moringa oleifera* seed powder in reducing turbidity and microbial contamination in household water sources.
- To determine the optimal dosages and treatment conditions for *Moringa oleifera* seed application in household water treatment.
- To compare the Moringa based-treated water quality to national and WHO drinking water standards.
- To identify the perceptions and acceptance level of *Moringa oleifera* treatment among local households.

2. Methodology

2.1. Study Area and Sample Collection

Water samples were collected from household water sources in selected rural and peri-urban communities in South West Nigeria, including wells, boreholes, and surface water bodies. Sampling was done during both dry and rainy seasons to capture variability in water quality.

2.2. Preparation of *Moringa oleifera* Seed Coagulant

Moringa oleifera seeds were harvested locally, dried, and ground into fine powder. A stock solution was prepared by dissolving known amounts of seed powder in distilled water, following protocols of Abubakar and Haque (2020).

2.3. Experimental Design

Jar tests were conducted to determine the optimal dosage of *Moringa oleifera* seed powder for coagulation. Dosages ranging from 50 mg/L to 150 mg/L were tested. Water samples were treated with the seed powder under controlled laboratory conditions, with parameters such as pH, turbidity, color, total coliform, and *E. coli* counts measured before and after treatment.

2.4. Water Quality Analysis

- **Physical parameters:** Turbidity (using turbidity meter), color (using colorimeter), pH (pH meter).
- **Microbiological parameters:** Total coliform and *E. coli* counts using membrane filtration techniques.
- **Chemical parameters:** Chemical oxygen demand (COD) and total dissolved solids (TDS) using standard methods.

2.5. Data Analysis

Statistical analysis was performed to compare pre-and post-treatment water quality parameters. Effectiveness was evaluated based on percentage reductions and compliance with Nigerian and WHO water quality standards.

2.6. Community Survey

Structured interviews and questionnaires were administered to households to assess awareness, acceptance, and willingness to adopt *Moringa oleifera* seed treatment for drinking water.

3. Water Quality Improvement after Treatment

3.1. Turbidity Reduction

Initial turbidity levels of collected household water samples ranged from 45 to 120 NTU (Nephelometric Turbidity Units), indicating highly turbid water sources (Table 1). Treatment with *Moringa oleifera* seed powder at an optimal dosage of 100 mg/L resulted in turbidity reductions between 85% and 96%. The average turbidity decreased from 82 NTU to 6.5 NTU, bringing most samples within the WHO recommended limit of 5 NTU or close to it.

Table 1 Water quality parameters of samples before and after treatment with moringa

Parameter	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	% Reduction / Change	WHO/Nigeria Standard*
Turbidity (NTU)	82.0 ± 22.5	6.5 ± 2.1	92.1% reduction	≤ 5 NTU
Color (Pt-Co units)	45 ± 10	5 ± 2	89% reduction	Colorless or negligible
pH	7.1 ± 0.3	7.2 ± 0.3	No significant change	6.5 – 8.5

3.2. Color Reduction

Water color, measured in Pt-Co units, averaged 45 units before treatment. Post-treatment values reduced to an average of 5 units, representing an 89% decrease, significantly improving water aesthetics (Table 1).

3.3. pH Stability

The pH of water samples ranged from 6.8 to 7.4 before treatment and remained stable between 6.9 and 7.5 after treatment, indicating that *Moringa oleifera* seed powder did not significantly alter water pH (Table 1).

4. Microbiological quality improvement

4.1. Total Coliform Reduction

Total coliform counts in untreated water samples ranged from 1,200 to 3,500 CFU/100 ml, indicating heavy contamination. Treatment with *Moringa oleifera* seed powder reduced total coliform counts by 90% to 98%. The mean total coliform count decreased from 2,400 CFU/100 ml to 180 CFU/100 ml (Table 2).

Table 2 Microbiological Quality Improvement After Moringa oleifera treatment

Parameter	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	% Reduction / Change	WHO/Nigeria Standard*
Total Coliform (CFU/100 ml)	2,400 ± 850	180 ± 70	92.5% reduction	0 (absence in 100 ml)
E. coli (CFU/100 ml)	1,200 ± 3500	80 ± 40	93.3% reduction	0 (absence in 100 ml)

4.2. *E. coli* Reduction

E. coli counts, an indicator of fecal contamination, ranged from 800 to 2,000 CFU/100 ml before treatment. After treatment, counts dropped to between 20 and 150 CFU/100 ml, representing a 92% to 99% reduction (Table 2).

Table 3 Chemical Parameters of water before and after treatment with Moringa

Parameter	Before Treatment (Mean ± SD)	After Treatment (Mean ± SD)	% Reduction / Change	WHO/Nigeria Standard*
Chemical Oxygen Demand (COD) (mg/L)	60 ± 18	21 ± 7	65% reduction	≤ 10 mg/L (WHO guideline)
Total Dissolved Solids (TDS) (mg/L)	350 ± 50	340 ± 45	~3% reduction (negligible)	≤ 1000 mg/L
Temperature (°C)	25 ± 2	25 ± 2	No significant change	25 – 30 °C (typical range)

*WHO = World Health Organization drinking water guidelines; Nigerian standards are generally aligned.

5. Chemical parameters

5.1. Chemical Oxygen Demand (COD)

COD levels ranged from 35 to 90 mg/L in untreated samples, indicating moderate organic pollution. Treatment with *Moringa oleifera* seed powder resulted in COD reductions of approximately 65%, lowering average COD from 60 mg/L to 21 mg/L (Table 3).

5.2. Total Dissolved Solids (TDS)

TDS values showed minimal change post-treatment, remaining within acceptable limits (average 350 mg/L before and 340 mg/L after treatment), indicating that coagulation did not significantly affect dissolved mineral content (Table 3).

5.3. Dosage Optimization

Jar tests revealed that a dosage of 100 mg/L of *Moringa oleifera* seed powder was optimal for balancing turbidity and microbial reduction without excessive organic residuals. Dosages below 50 mg/L were less effective, while dosages above 150 mg/L showed diminishing returns and slight increases in organic matter (Table 3).

5.4. Community Acceptance Survey

A survey of 100 households revealed that 85% of respondents found *Moringa oleifera* seed treatment easy to use after demonstration. 78% reported improved water clarity and taste post-treatment. 70% expressed willingness to adopt *Moringa oleifera* seed treatment regularly for household water purification. Concerns included seed availability (40%) and the need for education on preparation (35%).

6. Conclusion

Moringa oleifera seed powder effectively reduced turbidity by over 90%, achieving near WHO turbidity standards. Significant microbial reductions were observed, with total coliform and *E. coli* counts reduced by over 90%. Chemical parameters improved, notably COD, indicating removal of organic pollutants. The optimal dosage was identified as 100 mg/L for household water treatment. High community acceptance suggests potential for sustainable adoption in South West Nigeria.

References

[1] Abdullahi, S., and Sulaiman, H. (2021). Effectiveness of Moringa oleifera seeds powder as a natural coagulant for water purification. Forest and Forest Products Society Proceedings.

[2] Abubakar, A. R., and Haque, M. (2020). Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. Journal of Pharmacy and Bioallied Sciences, 12(1), 1-10.

[3] Aduro, A., and Ebenso, B. (2019). Qualitative exploration of local knowledge, attitudes and use of Moringa oleifera seeds for home-based water purification and diarrhoea prevention in Niger State, Nigeria. Journal of water, Sanitation and hygiene for development, 9(2), 300-308.

[4] James, D., Mohammed, M., and Adekeye, S. A. (2021). Purification of water using Moringa oleifera seeds. IEEE-SEM.

[5] Lea, M. (2014). Bioremediation of Turbid Surface Water Using Seed Extract from the Moringa oleifera Lam. (Drumstick) Tree. Curr Protoc Microbiol.

[6] Nordmark, B. A., Przybycien, T. M., and Tilton, R. D. (2016). Comparative coagulation performance study of Moringa oleifera cationic protein fractions with varying water hardness. Journal of Environmental Chemical Engineering, 4(4), 4690-4698.

[7] Scholes, T. A., Kuku, A., and Okoya, A. (2020). Efficacy of a natural coagulant protein from Moringa oleifera (Lam) seeds in treatment of Opa reservoir water, Ile-Ife, Nigeria. ScienceDirect.