



## EFFECTIVENESS OF *Moringa oleifera* SEEDS POWDER AS A NATURAL COAGULANT FOR WATER PURIFICATION

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### Abstract

The effectiveness of *Moringa oleifera* seeds powder as a natural coagulant for water purification was conducted in Kwalwalawa area of Usmanu Danfodiyo University, Sokoto. The seeds were obtained from the nursery of the Department of Forestry and Environment, Usmanu Danfodiyo University, Sokoto. The seeds were dried and pulverized using mortar and pestle to produce a fine powder. This fine powder was dissolved in a Litre of distilled water to form a stock solution of 2g/L, 4g/L, 6g/L, 8g/L and 10g/L dosages after which Jar test was carried out. The subjected parameters like pH, Turbidity, Temperature, Conductivity and Total Coliforms were compared before and after the water purification. The findings of this study reveal that 10g/L dosages of *Moringa oleifera* seeds powder gave the best values for all the parameters measured after treatment and are acceptable according to the World Health Organization (WHO) guidelines for safe drinking water. Thus, this Research affirms earlier findings that recommend the use of *Moringa oleifera* seeds powder as a natural coagulant for water purification.

**Keywords:** Water, Consumption, *Moringa oleifera* seeds powder, Treatments, WHO, Water quality parameters.

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### Introduction

Water is a relevant natural resource that all organisms especially humans depend on (Ali *et al.*, 2009). It performs several purposes for man, water is used for consumption and is been used for other chores. The most important purpose which is its consumption depends on the level of purity as it has direct effects on health. But, the high cost of treated water makes most people in the rural communities satisfy their thirsty desires with available sources which are normally of low quality exposing them to waterborne diseases (Amagloh and Benang, 2009). The World Health Organization (WHO) has estimated that up to 80% of all disease and sickness in the world is caused by inadequate sanitation, polluted water or unavailability of water. Poorly treated water causes waterborne diseases that kill people every blessed day while some keep on suffering on negative side effects (Ali *et al.*, 2009). According to Postnote (2002), Waterborne diseases are one of the main problems in developing countries, about 1.6 million are compelled to use contaminated water and more than a million people; of which two million are children, die from diarrhoea each year. For these reasons, water for consumption needs to undergo a purification process before it can be regarded as "safe" for drinking. To achieve the purification process the water is said to must undergo a common technique applied in the water treatment process, which is coagulation-flocculation followed by sedimentation, filtration and disinfection, But due to the latest technology, chemicals such as aluminium sulphate which is a synthetic coagulant are used to enhance the water purification (Tunggolou and Payus, 2017)

Earlier findings of Postnote, (2002) showed that the use of synthetic materials for water purification can be severely hazardous to human health if something goes wrong in their treatment during processing. Thus, naturally occurring coagulants are usually presumed safe for human health while synthetic coagulants especially aluminium salt which has been speculated to induce Alzheimer's disease (Egbiukwem and Sangodoyin, 2013). The use of natural ingredients from local indigenous plants to clear muddy water is not a new idea (Sutherland *et al.*, 1994).

*Moringa oleifera* is a perfect example of an indigenous plant. It is biological and edible which makes it an added advantage over the chemical treatment of water (Rohan *et al.*, 2017). From existing reports, there were allegations that the powder of *Moringa oleifera* seeds has antimicrobial properties and act as an agent against microorganisms that are present in drinking water and decrease the number of bacteria (Mangale *et al.*, 2012). Many researchers have reported *Moringa oleifera* to be non-toxic and recommended for use as a coagulant in developing countries (Sutherland *et al.*, 1994). According to Hegazy *et al.*, (2011), the seeds show similar effects as alum and less effective in low turbidity water. The seeds contain proteins that are essential in ant-oxidants properties and water purification. It can remediate water pollution & numerous arrays of illnesses (Amagloh and Benang, 2009). Therefore, it is not difficult to use the seeds as a natural coagulant because the use of natural coagulants in the water treatment process is expected to provide more advantages than the use of synthetic materials as they are natural and reported safe to be consumed (Hendrawati *et al.*, 2016). Thus, this study aimed at finding out the effectiveness of *Moringa oleifera* seeds powder as a natural coagulant for water purification.

## Materials and Methods

### Study Area

The study was conducted in *Kwalkwalawa* area in the permanent site of Usmanu Danfodiyo University, Sokoto (UDUS). *Kwalkwalawa* area lies on latitude 13°06'22"N and longitude 5°12'02"E of UDUS (GIS Lab, 2019). The climates of the study area are distinguished into rainy season (May to October) and dry season (November to April) with a relatively cool harmattan period from November to February (Nigeria meteorological Agency, 2009; Sokoto Agricultural Development Agency, 2009).

### Sample Collection and Preparation

Water samples were obtained from three different wells in *Kwalkwalawa* area of Usmanu Danfodiyo University, Sokoto.

The seeds were obtained from the Forestry departmental nursery. The seeds were air-dried. The shells surrounding the seed kernels were removed and the seed kernels were pounded using laboratory mortar and pestle into powder and sieved using a strainer with a pore size of 2.5 mm<sup>2</sup> to obtain a fine powder. This method is a slight modification of the one proposed by Ghebremichael (2004).

### Laboratory Analysis

#### Stock Solutions

The fine powdered *Moringa oleifera* seeds were weighed 2g, 4g, 6g, 8g and 10g using a weighing balance. A stock solution of varying concentration 2g, 4g, 6g, 8g and 10g were prepared by dissolving each of the weighed fine powder separately in 1L of distilled water and were all allowed to form a gelatinous solution.

#### Jar Tests

*Moringa oleifera* powder stock solution was measured 5ml using a pipette and added to the beakers of the water samples to be tested. The Jar test equipment accommodated six beakers with six spindle paddles. The water was mixed homogenously and rapidly for 5minutes (at 200-250rpm) and then slowed down for 30minutes (at 30-40rpm); the water was left undisturbed to settle for 1hour. This method is a slight modification of the method used by Tunggolou and Payus, 2017. This was repeated for all the samples.

#### Parameters

Important parameters such as turbidity, water pH, conductivity, temperature and the coliforms present were tested before and after the treatment. The supernatant of all the treated water samples was decanted in different beakers and the parameters were measured following the drinking water guidelines quality of the World Health Organization (WHO) to ensure that the water is safe for consumption.

#### Experimental Design

A Complete Randomized Design (CRD) was used for the experiment. Five treatments with varying concentration which consist 2g, 4g, 6g, 8g and 10g of *Moringa oleifera* seeds powder and a control (without *Moringa* seeds powder). Each treatment effects in the experimental unit were replicated 3times.

#### Data Analysis

All the parameters were analyzed using Paired sample T-test to compare their means using Statistical Package for Social Sciences (SPSS) version 22. Limit of Statistics significance (*p*-value) was set as *p*<0.05 except for the Total coliforms that were read using its charts.

## Results and Discussion

### Effects of *Moringa oleifera* seeds powder on Water quality Parameters

Table 1 revealed that there is a significant difference (*P*<0.05) between all the water quality parameters before and after the application of *Moringa* seed powder solution. It also shows that the *p*-value of all the water quality parameters was highly significant at (*p*<0.00).

Table 1: Effects of *Moringaoleiferaseeds* powder on water quality parameters

S/No.	Water Quality Parameters	Mean		SE±	t-value	p-value
		Before	After			
1	pH	5.4	6.8	0.135	-10.01	0.00**
2	Temperature	26.33	24.79	0.167	9.277	0.00**
3	Turbidity	69.93	6.93	11.375	5.539	0.00**
4	Conductivity	63.50	75.46	2.032	-5.844	0.00**

### The Effects of *Moringa oleifera* on Total Coliforms

Table 2, 3 and 4 show the results of the total coliforms before and after application of *Moringa*coagulant. The results revealed that *Moringa oleifera* due to its effectiveness was able to reduce the Coliform counts that were observed before purifying the water.

Table 2: Total coliform result for Well A

Total coliform counts per 100ml of the sample

Dosage	1ml	0.1ml	0.01ml	MPN/100ml
0g/L	3	3	0	17
2g/L	2	0	3	12
4g/L	1	3	1	10
6g/L	3	0	0	8
8g/L	0	1	1	4
10g/L	0	0	0	0

Table 3: Total coliform result for Well B

Total coliform counts per 100ml of the sample

Dosage	1ml	0.1ml	0.01ml	MPN/100ml
0g/L	3	3	0	17
2g/L	2	0	2	9
4g/L	2	0	2	9
6g/L	0	1	1	4
8g/L	0	0	1	2
10g/L	0	0	0	0

Table 4: Total coliform result for Well C

Total coliform counts per 100ml of the sample

Dosage	1ml	0.1ml	0.01ml	MPN/100ml
0g/L	4	2	0	20
2g/L	2	3	1	14
4g/L	2	1	2	12
6g/L	3	0	0	8
8g/L	0	2	1	6
10g/L	0	1	0	2

### The Relationship between Water Quality Parameters and Dosage

Figure 1, 2, 3 and 4 illustrates the relationship between water quality parameters and the dosages. The results revealed that the higher the dosage of *Moringa oleifera* seeds powder solution the effective it was on the water quality parameters in purifying the water.

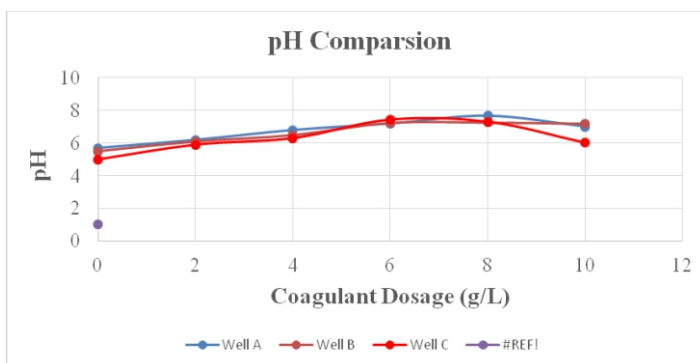


Figure 1: Relationship between pH and *Moringa*dosage

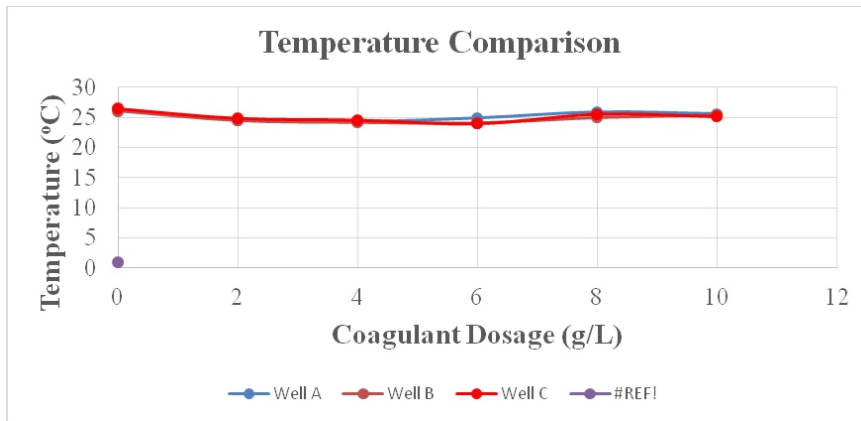


Figure 2: The relationship between Temperature and *Moringa* dosage

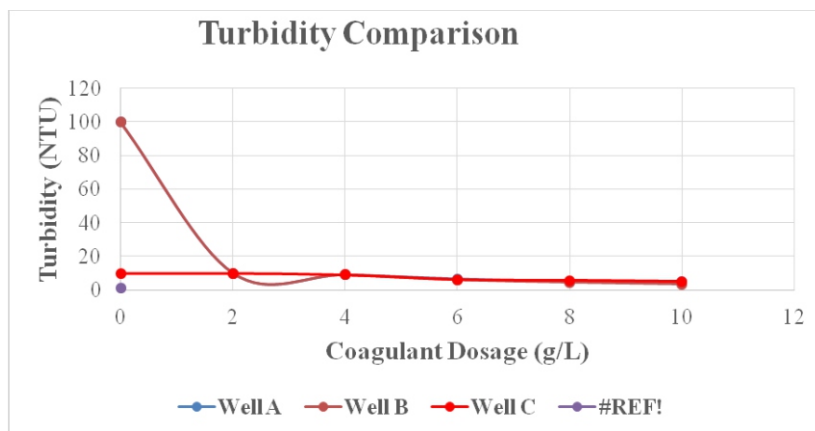


Figure 3: The relationship between Turbidity and *Moringa* Dosage

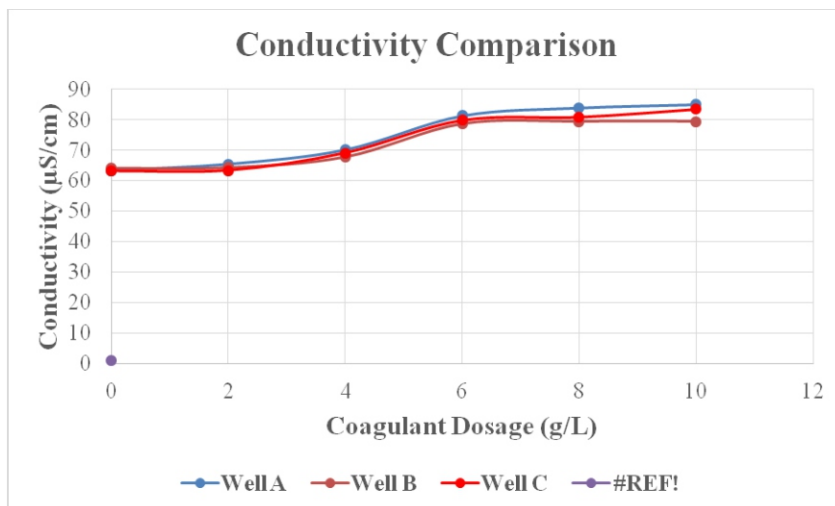


Figure 4: The Relationship between Conductivity and *Moringa* Dosage

### pH

The initial pH of the raw water samples which were acidic and not in range of the permissible limit of the World Health Organization turns out to be alkaline after the addition of varying concentration of *Moringa oleifera* seeds powder. During the analysis, it was observed that after the coagulation process the pH increased slightly due to the increasing concentration of *Moringa oleifera* stock as compared to the raw water samples and this is because *Moringa oleifera* does not affect pH significantly as reported by (Tunggolou and Payus, 2017). The treatments of the samples gave a range of 6.1 – 7.43 and are within the permissible limit of the World Health Organization (WHO). This also agrees with the work of Mahmud, (2018) who reported that the addition of *Moringa* dosage affects the pH of raw water because of decreased acidity and increased alkalinity, which made the treated water to be clean and safe for consumption.

### Temperature

The temperatures of all the water samples after the coagulation process compared with the initial temperature was not too affected and were still in the normal range of temperature, this is in accordance with the study from Tunggolou and Payus, (2017). The result was also compared with WHO standard and found out to be within the recommended limit. At 95% confidence level, there was a significant difference ( $P>0.00$ ) and among all the treatments at the varying concentrations on the temperature.

### Turbidity

The initial turbidity reading for all the water samples was considered too high according to the permissible limit of WHO but after the application of the *Moringa oleifera* seeds powder solution, there was improvement reaching the permissible limit of the WHO. The turbidity of the raw water reduced with the increasing dosage of different *Moringa* concentration. All the treatments of all the samples decreased well at 10g/L of *Moringa oleifera* concentration and were within the permissible limit of the World Health Organization (WHO). At 95% confidence level, there was a significant difference ( $P>0.00$ ) among all the treatments of varying concentration on the turbidity which is in line with the report of Osman *et al.*, (2016) which stated that *Moringa oleifera* powdered extract could reduce turbidity by a range between 92% and 99%.

### Conductivity

It was observed that the initial conductivity for the raw water samples increased when *Moringa oleifera* stock solution was applied to the raw water and this was due to the increasing concentration of *Moringa oleifera* stock as compared to the raw water samples. This affirms the work of Tunggolou and Payus, (2017) who mentioned that the higher coagulant dosage in the solution will eventually lead to an increase in conductivity as observed.

### Total Coliforms

After the treatment, it was observed that *Moringa* as a coagulant availed over the microbial loads present in the raw water and the 10g/L was observed to give the best lower counts for the Most Portable Number (MPN) of total coliforms per 100ml. This is in line with the WHO guidelines for water quality and in accordance with the findings of Amagloh and Benang (2009), which observed that the *Moringa* coagulant treatment had an added advantage of reducing microbial load. This also supported the findings of Schwarz (2000), who stated that the process of flocculation removes about 90-99% of bacteria which are normally attached to the solid particles. These reasons affirm the earlier statement in the introduction “water must undergo purification process before they can be considered safe for consumption” and this accounted for the effectiveness of *Moringa oleifera* seeds powder for water purification.

### Conclusion

The water used for this research study was observed to have associated impurities which make the water unsafe for consumption. The results obtained shows that the treatments of water using powder extracts from *Moringa oleifera* seeds were achieved because all the parameters measured were within the acceptable limit of the World Health Organization standard. The results obtained also shows that 10g/L is the best dosage for water with similar characteristics to the water samples used in this research and this corresponds to the report Amagloh and Benang (2009), who concluded that the powder from seeds of *Moringa oleifera* has some coagulating properties at loading doses of 10g/L. Conclusively, the use of *Moringa oleifera* as a natural coagulant decreases bacteria in water, has no toxic effect, eco-friendly and a cheaper method of water purification.

### References

- Ali, E.N., Muyibi, S.A., Salleh, H.M., Salleh, M.R.M and Alam, M. (2009). *Moringaoleifera* seeds as natural coagulant for water treatment. Proceedings of the 13th International Conference on Egyptian water technology 2009, March 12-15, 2009, International Islamic University Malaysia, Hurghudah, Egypt, pp: 163-168
- Amagloh, F. K and Benang, A. (2009). Effectiveness of *Moringaoleifera* seed as coagulants for water purification. *African Journal of Agricultural Research* **4(1)**:119-123.

- Egbuikwem, P.N and Sangodoyin, A. Y (2013). Coagulation Efficacy of *Moringa oleifera* seeds Extract Compared to Alum for Removal of Turbidity and *E. Coli* in three different Water Sources. *European International Journal of Science Technology*, **2**: 13-20.
- Ghebremichael, K. A. (2004). *Moringa* seed and Pumice as Alternative Natural Materials for Drinking Water Treatment. a Dissertation, Royal Institute Technology (KTH), Stockholm, Sweden. Internet: [http://www.lwr.kth.se/publikationer/Pdf\\_Files/LWR\\_PHD\\_1013.Pdf](http://www.lwr.kth.se/publikationer/Pdf_Files/LWR_PHD_1013.Pdf) Accessed On 31st June, 2019.
- Geography department (2019). GIS Lab, Usmau Dan fodiyouiversity, Sokoto.
- Hegazy A. K., Abdel; Ghani and El-Chaghaby G. A. (2011). Phytoremediation of industrial wastewater potentiality by *Typha Domingensis*. *International journal of Environmental science technology* **8(3)**: 639-648.
- Hendrawati, I.R., Yuliasri, E., Rohaeti, H., Effendi and Darusman L.K. (2016). The use of *Moringaoleifera* seed powder as coagulant to improve the quality of wastewater and ground water. IOP Conference Series, *Journal of Earth and Environmental Science* **31**.012033
- Mahmud, A.Y. (2018). Comparative study on bio-flocculants and chemical flocculants for raw water treatment from Sokoto bi-water treatment plant. Dissertation for the award of MSc in purechemistry, UsmanuDanfodiyo University, Sokoto
- Mangale, S. M., Chonde S. G and Raut P. D. (2012). Use of *Moringa Oleifera* (Drumstick) Seed as Natural Absorbent and an Antimicrobial Agent for Ground Water Treatment, *Research Journal of Recent Sciences*, **(1) 3**.
- Nigeria Meterological Agency (NMA, 2009). Sultan Abubakarna III international Airports, Sokoto. Pp. 1-2
- Osman A. A., Hamza, H and Elsheikh F.A. (2016). Effect of moringa oleifera seed powder on Blue Nile water purification as compared to Poly Aluminium Chloride. *International journal of science and research (IJSR)* 5(12, DECEMBER 2016):1574-1579. DOI: 10.21275/ART20163753. ISSN (online):2319-706
- Rohan, P. R., Jagadale S. S., Gaikwad A. A., Mane A., Anekar N. R and Awasare S. D (2017). Use of *Moringaoleifera*(Drumstick) seeds as natural coagulant for well & bore well water treatment. *International Journal of Engineering Research and Technology*. ISSN 0974-3154. **10(1)**. International Research Publication House. <http://www.irphouse.com>
- Postnote. (2002). Access to water in developing countries. No.178 Internet: [www.parliament.uk/post/pn178pdf](http://www.parliament.uk/post/pn178pdf) accessed on 19th May, 2019.
- Schwarz, D. (2000). Water clarification using *moringaoleifera*. Technical information W1e, Gate information service, Eschborn, Germany Accessed June 19, 2019.
- Sutherland, J.P., Folkard, G. K., Mtawali M. A and Grant, W.D. (1994). “*Moringaoleifera* As Natural Coagulant”. Paper presented at the 20th WEDC Conference, Affordable water supply and sanitation, Colombo, Sri Lanka.
- Tunggolou, J and Payus, C. (2017). Application of *Moringaoleiferaplant* as water purifier for drinking water purposes. *Journal of Environmental Sciences and Technology*.
- World Health Organization (WHO) (1986). Working Group. Health impacts of acidic deposition. *Science of the total environment*, 1986, **52**:157-187