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Comparative Analysis of Ground Water Treatment Obtained from Jalingo Metropolis Using Moringa Oleifera Seeds and Aluminum Sulphate as Coagulants

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Abstract - **This study investigated on the comparative analysis on the use of M. oleifera seeds and alum in water treatment. The study aimed at the use of natural coagulants in removing impurities from water samples and it effectiveness by comparing between the synthetic coagulants such as alum and natural coagulants which is the M. oleifera seeds. Six (6) raw water samples were collected from three (3) sampling location, borehole and well from each location in Jalingo Metropolis and was transported to the laboratory immediately for analysis. When these water were subjected to the M. oleifera seed solution, the turbidity reduced drastically from 80%-40%, pH was decreased from 70% to 40% for almost all the samples, conductivity increases from the range of 88 – 825µS/cm to the range of 113±1.5 - 960±2.0 µS/cmand TDS decrease from the range of 178-489 mg/l to 99-304 mg/L and when same was subjected to alum it also reduced turbidity as from 80%-20%, pH from 4.13 to 4.43, conductivity increased to the range of 252 - 1025 µS/cm and TDS decreased to the range of 99 – 305mg/L. For bacteriological analysis, the both coagulants work simultaneously in reducing and removing of the bacterial (E-coli and Coliforms). The use of the natural coagulant (M. oleifera seeds) in water treatment is of great important because of it medicinal properties and also it reduces all the parameters to within the range of permissibility by WHO as reported by some researchers years ago. The findings revealed that Moringa oleifera seeds can be used as a coagulant to replace conventional coagulants, flocculant, hard water softener, disinfectant, and for removing of microbes (bacterial) in drinking water treatment.**

Keywords: *Moringa-oleifera*, Alum, Ground-water treatment, natural-absorbent, Antimicrobial-activity, Jalingo, Natural Coagulant, Water Treatment, Coagulation, Flocculation, Turbidity Removal, Water Quality, Bacteriological Analysis, E. coli, Coliforms, TDS, pH, Water Purification.

I. Introduction

Water is an inorganic, transparent, tasteless, odourless and nearly colourless chemical substance apart from its intrinsic blue colour that is as a result of its molecular structure and its selective absorption and scattering of white light. It is by far most studied chemical compound and is described as the "universal solvent" and the "solvent of life". It is the most abundant substance on the surface of earth and the only common substance to exist as a solid, liquid and gas on Earth's surface. 71% of the Earth's surface is covered with water. The amount of drinking water required to maintain good health varies, and depends on physical activity level, age, health-related issues, and environmental conditions (Adelodun *et al.*, 2020). The water emerging from some deep ground water may have falling as rain many decades, hundreds, thousands or in some cases millions of years ago.

The environment has the potential to be polluted by organic, inorganic and heavy metal substances. The existence of these contaminants will disrupt the existing ecosystem, including humans. Therefore, environmental sustainability of contaminants must be maintained and continue to receive attention from the surrounding community, which is an element of the environment itself Mishra (2023).

Higher efficiency to treat turbid water has made inorganic chemicals favorite coagulants. Not only are they low priced but are also readily available (Koul *et al.*, 2022). In water, most of the particles are negative charged, to neutralize the charge a positive ion (cation) may be used as a coagulant. According to Zhang *et al.*, (2025), higher the charge of cation, more effective is charge neutralization.

For water treatment, the coagulants used more frequently are the inorganic salts of aluminum. When added to water, Alum ions hydrolyze rapidly and form a range of metal hydrolysis species (Jiang, 2015). These cationic species adsorb

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onto the negatively charged particles and neutralize the charge. In this mechanism, particles get destabilized and aggregation occurs (Malik, 2018).

Coagulation depends on coagulant dosage and also the pH. Almost all of the colloids in water are negatively charged and because of electrical repulsion they may remain stable. Destabilization could be made by addition of salts or cations that will interact with negative colloids to neutralize their charge (Pivokonsky *et al.*, 2024).

Ground water is particularly important as it accounts for about 88% safe drinking water in rural areas, where population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist. Nevertheless, there are various ways ground waters may suffer pollution which will lead to the water turbidity e.g. land disposal of solid wastes, sewage disposal on land, agricultural activities, urban runoff and polluted surface water (Osisiogu *et al.*, 2024).

This study will be aimed at comparing the use of Moringa Oleifera seeds which has vernacular name (Zogale in Northern Nigeria), and Aluminium Sulfate as coagulants in the treatment of ground water such as boreholes and dug water wells which are the chief sources of water supply in Jalingo, Jalingo Local Government Area of Taraba State.

II. Materials and Methods

The study Area

The study area is Jalingo metropolis in Taraba state located at latitude 8^{o} 47' to 9^{O} 01'N of the equator and longitude 11^{O} 09' to 11^{O} 30'E of the Greenwich Meridian. It is situated within the Northern Guinea Savannah ecological zone. It is bounded to the North by Lau LGA, to the East by Yorro LGA, to the South and West by Ardo-Kola LGA. Jalingo has a total land area of about 195.071km^2. Nine of the ten (10) wards are located within the metropolis. These include Barade, Kona, Maji Dadi, Sarkin Dawaki, Sintali A, Sintali B, Turaki A, Turaki B and KachallaSembe wards (Oruonye & Abbas, 2011). Presently, Jalingo has a projected population (Organization, 2021) of 191,443 people at 2.83% annual growth rate (Commission, 2021).

Jalingo and its environments exhibit a tropical wet and dry type climate. The wet season runs from months of March to October, while the dry season commences in November and end in February. The annual rainfall is about 900 mm with the highest occurrence in July and August. The temperature regime in Jalingo is cold to hot throughout the year usually relatively evenly distributed throughout the year. However, there is usually a cool period between November and February with gradual increase from January to March. Asa *et al.*, (2023) pointed out that relative humidity is low, however it starts rising as from April and reaches the maximum in August.

Sample Collection

Water samples were collected randomly from borehole and dug well which were extensively used for drinking and domestic purposes in each sampling location in Jalingo Metropolis and were transported to the laboratory in the department of Quality control and sewerage services at the Taraba Water and Sewerage Corporation (TAWASCO) Jalingo Taraba State for analysis.

Determination of Physicochemical Parameters of Water

Physicochemical parameters such as pH and temperature were directly evaluated on the point of sample collection, while other parameters were analysed in the laboratory. Physicochemical parameters such as pH, Temperature, Total Dissolved Solids (TDS), Turbidity and conductivity (EC) of the water samples were determined according to the methods highlighted by Dewangan *et al.*, (2023).

Powder preparation of Moringa oleifera seeds

The seeds of Moringa oleifera were obtained and then turned into a soft powder using mortar and pestle even getting consistency a very fine (Ntibrey, *et al.*, 2020), and sieved through 500 µm to obtain uniform particle size (Adelodun *et al.*, 2020), and dried in an oven for 30 min at 105°C to reduce moisture content, because the strong affinity of the powder to attract moisture whether when grinding or after (Zaid *et al.*, 2019). The powder and extract of M. oleifera seeds was prepared and kept at room temperature.

Extract preparation of Moringa oleifera Seeds

Ten gram (10g) of the powder was added to 100 ml of distilled water and mixed for 30 minutes using a stirrer, until a uniform solution and the extract was passed through a muslin cloth. This solution is recommended to be freshly prepared when used in water treatment to avoid coagulant activity decrease (Andrade *et al*., 2021). In order to avoid the viscosity and pH changes it was stored in a cool and dry place with a maximum temperature of 20˚C (Dehghani and Alizadeh, 2016).

Preparation of Alum Stock Solution

$(Al_2(SO_4)_3.18H_2O)_{(s)}$

10g of dry Aluminium sulphate were dissolved in 100ml of distilled water (Normality), stirred until it dissolves.

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It was stirred until it dissolves

Coagulation-flocculation and Sedimentation process

The process of coagulation-flocculation was performed by the use Jar test

Procedures

1litre of raw water was collected from different sampling location and unit in a container. 1litre in each Jar or beaker.

The stock solution of 3mg/l were introduced using pipette into the beakers containing or indicating the names of the sample as SL-B, SL-W, MG-B, MG-W, ABJ-B and ABJ-W respectively.

The machine was set at different RPM (Revolution per minute), starting from higher RPM to lower RPM.

After all, it was allowed for 30min. to 1hr settling time.

Then the Test of the following was conducted i.e Turbidity, pH, EC, Temperature and TDS was done after filtration.

The results were recorded.

The tests were carried out in two separate stages, with the same operating conditions. The first stage was conducted with alum alone, and the second one was done using extract of Moringa oleifera seeds, alone too.

After the settling process, the supernatant (top layer) of treated effluents were sampled to analyze the studied parameters.

Bacteriological Analysis

Bacteriological analysis of water is a method of analyzing water to estimate the number of bacteria present and also to find out what sort of bacteria they are and also a microbiological analytical procedure which uses samples of water and from these samples determines the concentration of bacteria. This analysis was carried out using a pour plate method as described by Silva et al., (2018).

Media Preparation

Preparation of Mac-conkey Broth (Purple Media)

The preparation of the Mac-Conkey Agar was done following the manufacturer's specification.

Preparation of Eosin methylene blue (EMB) Agar

The preparation of this agar was done following the manufacturer's specifications.

Inoculation, Incubation and Analysis

The samples were inoculated into the media prepared using the fume cupboard and it was incubated for 48hrs before carrying out the analysis on the samples to check the presence of the bacteria. This sample procedure was done using both the Mac-Conkey agar and EMB agar.

Method of Data Analysis

The data obtained from the study were analyzed using descriptive statistics. Values of different parameters were expressed as mean ± standard deviation (SD).

III. Results and Discussion

Results

Table 1: Physicochemical Parameters of Water Samples before Treatment

S/N	Samples (L)	Turbidity (NTU)	pH	Temperature (^{O}C)	E.C (µS/cm)	TDS mg/L
1.	SL-B	6.5±0.2	6.54±0.03	26.4±0.3	458±1.5	178±1.5
2.	SL-W	8.6±0.2	7.23±0.03	26.3±0.3	88±1.0	203±2.0
3.	MG-B	4.2±0.2	6.84±0.03	27.3±0.3	771±2.0	220±1.5
4.	MG-W	5.7±0.2	6.25±0.03	26.4±0.3	623±1.5	489±1.5
5.	ABJ-B	4.3±0.2	6.54±0.03	26.4±0.3	493±2.0	361±1.5
6.	ABJ-W	8.7±0.4	5.87±0.03	27.5±0.2	825±2.0	282±1.5
WHO/NSDWQ Standards		≤5	6.0-8.5	-	≤1000	≤500

Values are expressed as mean + SD, n = 3.

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Table 2: Physicochemical Parameters of Water after Treatment with M. oleifera

S/N	Samples (L)	Turbidity (NTU)	pH	Temperature (^{O}C)	E.C (μS/cm)	TDS mg/L
1.	SL-B	4.4±0.2	7.60±0.02	27.4±0.2	503±2.0	120±2.0
2.	SL-W	6.2±0.2	5.25±0.02	27.4±0.2	113±1.5	99±1.0
3.	MG-B	3.3±0.3	6.44±0.02	27.2±0.2	801±1.0	107±2.0
4.	MG-W	3.6±0.3	7.38±0.02	26.8±0.1	782±1.5	304±1.5
5.	ABJ-B	3.3±0.2	6.65±0.02	27.0±0.2	682±1.0	299±1.0
6.	ABJ-W	7.3±0.2	6.43±0.02	27.1±0.2	960±2.0	226±2.0
	WHO/NSDWQ Standards	≤5	6.0-8.5	-	≤1000	≤500

Values are expressed as mean + SD, n = 3.

Table 3: Physicochemical Parameters of Water after Treatment with Alum

S/N	Samples (L)	Turbidity (NTU)	pH	Temperature (^{O}C)	E.C (μS/cm)	TDS mg/L
1.	SL-B	2.1±0.2	4.13±0.03	25.7±0.3	722±1.5	120±1.5
2.	SL-W	3.6±0.2	4.37±0.03	25.4±0.l	252±1.5	99±1.5
3.	MG-B	1.4±0.2	4.23±0.03	26.4±0.3	1016±1.5	107±2.0
4.	MG-W	4.3±0.2	4.43±0.03	25.8±0.2	913±1.5	305±2.0
5.	ABJ-B	0.7±0.2	4.36±0.02	26.4±0.2	1025±1.0	299±1.0
6.	ABJ-W	2.4±0.2	4.36±0.03	26.2±0.2	985±1.5	228±2.0
	WHO/NSDWQ Standards	≤5	6.0-8.5	-	≤1000	≤500

Values are expressed as mean + SD, n = 3.

Note:

SL-B and SL-W represent Sintali borehole and Sintali Well respectively.
MG-B and MG-W represent Magami borehole and Magami Well respectively.
ABJ-B and ABJ-W represent Abuja phase I borehole and Abuja phase I Well respectively.

Discussion

For ground water in open dug well and boreholes, following drinking water quality parameters were analyzed before and after the treatment of various samples with Moringa oleifera seed powder and alum.

This section presents the results of the analysis of the data collected during the physic-chemical and bacteriological analysis, and the interpretation and discussion of the results. The variables analyzed in the study includes the physicochemical and bacteriological properties of the drinking water, comparison of natural coagulant (M. oleifera seeds) and chemical coagulants (Alum) on ground water treatments in Jalingo side-by-side. WHO standard quality of drinking water in developing countries and the relationship between water sources and the physicochemical characteristics of water in Jalingo Metropolis. In all, the study examined five (5) physicochemical parameters of water and two (2) bacteriological analysis or bacterial counts.

Physicochemical Analysis of Water

Turbidity

For turbidity, turbidity is the cloudiness of water caused by a variety of particles and is a key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from surface runoff. The turbidity values obtained from the study sites range from 4.2±0.2 - 8.7±0.4 NTU. The standard recommended maximum turbidity limit, set by WHO for drinking water is 5 nephelometric turbidity units (NTU). The lowest turbidity values of 4.2±0.2 NTU and highest value of 8.7±0.4 NTU were found for samples from site MG-B and ABJ-W, respectively (Table 1). All sites in the study area except for sites MG-B and ABJ-B were above the WHO permissible levels of 5NTU.

Table 2 shows the results of analysis after treatment with M. oleifera. When M. oleifera seed was introduced into the samples, the use of Moringa oleifera seed powder showed

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decrease in turbidity of ground water by almost 60%. It was observed that, the turbidity of the sample was reduced from 80% to 40% for all the samples. Sample ABJ-W shows the highest turbidity value of 7.3±0.2 which is above the permitted level, these decrease in turbidity is based on the coagulant's dosage. Residual turbidity reduces below 5 NTU. Due to this there was an improvement in the flock size and flock settled rapidly. The dosing resulted in the saturation of the polymer bridge sites and caused restabilization of the destabilized particles due to insufficient number of particles to form more inter-particle bridges. The high positive charge and small size suggest that the main destabilization mechanism may be adsorption and charge neutralization. This was also reported by Wagh *et al*., (2022) and found that 90-99% of turbidity was removed by using Moringa seed Powder.

It was observed that after the introduction of the alum solution into the turbid water, the turbidity value decreased rapidly to the permitted level. The higher the value of turbidity in water samples the more rapid coagulation and flocculation takes place. The high positive charge and small size suggest that the main destabilization mechanism may due to or could be adsorption and charge neutralization. In this case when alum was added to water, Al ions hydrolyze rapidly and form a range of metal hydrolysis species (Jiang, 2015). These cationic species adsorb onto the negatively charged particles and neutralize the charge. In this mechanism, particles get destabilized and aggregation occurs Wang *et al,* 2020). Coagulation depends on coagulant dosage and also the pH. Almost all of the colloids in water are negatively charged and because of electrical repulsion they may remain stable. Destabilization could be made by addition of salts or cations which is the alum that will interact with negative colloids to neutralize their charge (Duan and Gregory, 2003).

pH

For pH, pH is one of the important water quality parameters. Measurement of pH relates to the acidity or alkalinity of the water. A sample is said to be acidic if the pH is below 7.0 and it is said to be alkaline if the pH is higher than 7.0. Acidic water can lead to corrosion of metal pipes and plumbing system as well as harmful to human life. The highest pH value recorded during the analysis was 7.23 which were higher than the range of 5.76 to 6.01 reported by Ikhuoriahand Oronsaye (2016) in Ossiomoo river ologbo - a tributary of a well in Benin, Southern Nigeria. The pH values reported in this study is also higher than the range of 5.96–5.54 reported by Chinedu, *et al.,* (2011) is assessing the water quality in cananland, Ota, Southwest Nigeria. The results gotten in this analysis is in agreement with the WHO/NSDWQ standards.

Table 2 shows the results of physicochemical analysis of ground water samples after treatment with M. oleifera seed powder from different sampling location. During the analysis, it was observed that after treatment with Moringa seed powder; pH was decreased from 70% to 40% for almost all the samples. After treatment the range of pH was 5.25 - 7.60 for the samples which were within the permitted limit of the WHO/NSDWQ except for sample SL-W with pH value of 5.25 which is below the range. The recommended acceptable range of pH for drinking water specified by WHO is between 6.0 and 8.0. It was reported that the action of M. oleifera as a 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 would accept a proton from water resulting in the release of a hydroxyl group making the solution basic (Asif *et al,* 2024).

From table 4.3 which shows the pH values after treatment with Alum, the pH not only affects the surface charge of coagulants, but also affects the stabilization of the suspension. The effectiveness of coagulants used gets affected with increase or decrease in pH (Saritha, *et al*., 2017). It was observed that, initially, the pH values of all the samples were within the permissible range of 6.0-8.0 as recommended by WHO/NSDWQ but after the treatment the pH of the water decreased to 4.13 to 4.43 which were lower than the permitted level. This shows the water becomes highly acidic after treatment due to the alum chemical composition and its reactivity.

Conductivity

For Conductivity, electrical conductivity is the ability of any medium, water in this case, to carry an electric current. The presence of dissolved solids such as calcium, chloride, and magnesium in water samples carries the electric current through water. Conductivity values obtained in this study showed that all the sample sites contained appreciable amount of dissolved ions. It was observed that sample ABJ-W has the highest conductivity value of 825µS/cm and sample SL-W has the lowest or least value of 88µS/cm. All the results obtained from all the sites fall in the range of 88 – 825 which is within the permissible range of the WHO/NSDWQ of 1000.

Conductivity values obtained in this study after treatment with M. oleifera showed that there are increases in the conductivity of all the samples. It was observed that sample ABJ-W has the highest value of 960±2.0 and sample SL-W has the lowest or smallest value of 113±1.5 which were all within the permissible limits.

With reference to Table 1 which shows that the conductivity of the water samples before treatment were in the range of 88 – 825µS/cm which were all within the permissible

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range of ≤1000µS/cm as recommended by WHO/NSDWQ. It was observed that sample SL-W contain the least value of conductivity (252 µS/cm) and sample ABJ-B has the highest conductivity value of 1025 µS/cm. On the addition of alum to the samples its shows rapid increase in the conductivity of the ground water samples because the alum solution which is believed to have positively charged ions been introduced to the sample will interact with the negatively charged particles which are suspended on the turbid water bodies, by this time the reactivity of the water is increased which leads to the increment in the conductivity of the treated water. Minerals in different geographic regions also varies, so the rising or increase in the conductivity will also differs. Comparing the initial conductivity of the samples with when alum was added to the ground water made the conductivity value increased to the range of 252 - 1025 µS/cm, respectively which some were above the permissible limits.

Total Dissolved Solids (TDS)

For TDS, these are the inorganic matters and small amounts of organic matter, which are present as solution in water. The study found TDS values from the drinking water samples are all within the maximum limit of 1000 mg/L. The highest TDS values of 489 mg/L and the lowest TDS values of 178 mg/L correspond to samples from MG-W and SL-B, respectively. This is higher than the range of 37.67 mg/L to 476.67 mg/L reported by Moses and Ishaku (2020) in the evaluation of physicochemical properties of well water qualities in selected villages in Zing Local Government Area of Taraba State, Nigeria. The standard or allowable value of the TDS set by WHO is 1000 mg/L. Therefore, the TDS values obtained in this study are within the WHO permissible standards.

As observed above, initial ranges were 178-489 mg/l which are within the permissible limit. After the treatment M. oleifera seed powder, the total dissolved solids were reduced from ground water. The total dissolved solids ranges were from 99-304 mg/l for the samples. It was observed that sample SL-W has the lowest value of 99±0.1mg/L and sample MG-W has the highest value of 304±1.5mg/L and all these were present within the limit according to WHO standards. Moringa oleifera is known to be a natural cationic polyelectrolyte and flocculant with a chemical composition of basic polypeptides with molecular weights ranging from 6000 to 16,000 daltons, containing up to six amino acids of mainly glutamic acid, methionine and arginine.

After the treatment with alum, the total dissolved solids were reduced. The range of total dissolved solids after treatment with alum reduced to the range of 99 – 305 which were still present within the limit according to WHO/NSDWQ standards of ≤500 mg/l. Total Dissolve Solid (TDS) is the total concentration of the substances or particles dissolved in the water bodies. It measured in milligram per litre (mg/L). The maximum permitted level according to NSDWQ is equal or less than ≤500 mg/L.

Temperature

For temperature, it was observed that, all the temperatures were within the permissible range of drinking water by WHO. Sample ABJ-W has the highest temperature of 27.5°C and sample SL-W has the least temperature of 26.3°C. The high temperature values obtained from sites ABJ-W (27.5°C) and MG-B (27.3°C) of the sample were higher than the values of 25.87 to 27.56°C reported by Ikhuoriahand Oronsaye (2016) from water samples collected from river source. The temperature values obtained from this study are within the WHO permissible limit of 40°C.

Temperature observed after treatment with M. oleifera in water samples from all sites were within the range of 26.8°C – 27.1°C as shown in Table 2. The high temperature values obtained from sites SL-B and SL-W were within the range of results of the values of 25.87 to 27.56°C as reported by Ikhuoriahand Oronsaye (2016) from water samples collected from ground water. The temperature values obtained from this study are within the WHO permissible limit of 40°C.

Temperature after treatment with Alum**,** the use of coagulant in water treatment process did not drastically change the temperature. The addition of alum as a coagulant in water treatment processes and water purification did not significantly affect the temperature. The initial temperature of the ground water samples was between 26.3 °C and 27.5 °C for all the samples under treatment and the highest temperature after the addition of coagulant was 26.4°C. Temperature of each sample was still in the normal temperature range for water for it is ambient as the temperature of an environment increase, so also the temperature of the water also increases.

Bacteriological Analysis

Table 4: Bacteriological Analysis of water before Treatment

S/N	Samples	E-coli (CFU)	Coliform (CFU)
1.	SL-B	1	3
2.	SL-W	1	5
3.	MG-B	0	4
4.	MG-W	2	16
5.	ABJ-B	0	12
6.	ABJ-W	5	TNC
	WHO/NSDWQ Standards	0	≤10

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Table 5: Bacteriological analysis after treatment with M. oleifera

S/N	Samples	E-coli (CFU)	Coliform (CFU)
1.	SL-B	-	-
2.	SL-W	-	-
3.	MG-B	-	-
4.	MG-W	-	-
5.	ABJ-B	-	-
6.	ABJ-W	-	2
	WHO/NSDWQ Standards	0	≤10

Table 6: Bacteriological Analysis after Treatment with Alum

S/N	Samples	E-coli (CFU)	Coliform (CFU)
1.	SL-B	-	-
2.	SL-W	-	-
3.	MG-B	-	-
4.	MG-W	-	-
5.	ABJ-B	-	-
6.	ABJ-W	-	1
	WHO/NSDWQ Standards	0	≤10

Table 4 shows the bacteriological analysis of the water sample before treatment. SPC (Standard Plate count) means total bacterial count which is calculated by quantitatively. Due to high microbial load drinking water samples are unsafe for drinking purpose. The presence of bacterial indicates water is fecally contaminated and not safe for drinking purposes. Due to coliforms various waterborne diseases occur and therefore MPN should be nil for drinking water.

E-coli

For E-coli, it was observed that all the water sample except sample MG-B and sample ABJ-B contains e-coli which are not acceptable by the WHO/NSDWQ. Sample ABJ-W shows the highest number of e-coli counts which is 5CFU and sample SL-B and SL-W shows 1CFU which is the least, sample MG-W which has an e-coli count of 2CFU but sample MG-B and ABJ-B contain no e-coli.

It was observed that, after treatment with M. oleifera there were no e-coli found in the sample due to the action of the coagulants as it clumps the bacterial and sediment. Microorganisms were removed by settling in the same manner as the removal of colloids is properly coagulated and flocculated in water sample. The result of this analysis is in line with the standards given by the WHO/NSDWQ of 0CFU.

M. oleifera seeds are also acting as antimicrobial agent against variety range of bacteria and fungi (Wagh, *et al.*, 2022). The seed contain number of benzyl isothiocyanate and benzyl glucosinolate which act as antibiotic (Li, *et al.*, 2021). It is believed that the seed is an organic natural polymer. The active ingredients are dimeric proteins. The protein powder is stable and totally soluble in water. The coagulation mechanism of the M. oleifera coagulant protein has been explained in different ways. It has been described as adsorption and charge neutralization and interparticle bridging. Flocculation by inter-particle bridging is mainly characteristic of high molecular weight polyelectrolytes. Due to the small size of the M. oleifera coagulant protein, a bridging effect may not be considered as the likely coagulation mechanism (Taiwo*et al.*, 2020). Moringa seeds possess antimicrobial properties reported that a recombinant protein in the seed is able to flocculate gram-positive and gram-negative bacterial cells. In this case, microorganisms can be removed by settling in the same manner as the removal of colloids in properly coagulated and flocculated water. On the other hand, the seeds may also act directly upon microorganisms and result in growth inhibition. Antimicrobial peptides are thought to act by disrupting the cell membrane or by inhibiting essential enzymes reported that Moringa seeds could inhibit the replication of bacteriophages.

It was also observed that after treatment with alum the E-coli bacterial count was found to be nil. The removal of this bacterial were due to the actions of the alum stock solution which clumps the bacterial together and settles before been filtered out as reported by Wagh, *et al*., (2022).

Coliforms

For coliform, from the analysis it shows that all the samples contain coliforms. Sample ABJ-W shows the highest coliform count which were Too Numerous to Count (TNC) and sample SL-B shows the least coliform count of 3CFU. All the sample except for sample SL-B, SL-W and MG-B contain coliform count above the WHO/NSDWQ standards.

It was observed that after treatment with M. oleifera, the coliform where absent in all the samples except sample ABJ-W which contain 2CFU which were within the permissible limit as described by WHO/NSDWQ of ≤10CFU. It was observed initially from Table 4 that, sample ABJ-W coliform was were found to be Too Numerous to Count (TNC) but after treatment, the number of bacterial count drastically reduced to only two (2). This is due to the action of the coagulant that clumps the bacterial together and settles.

It was observed that there were no coliforms found in all the samples after treatment with alum except for sample ABJ-W which has coliform bacterial count of 1CFU and this is within the permitted level as recommend by WHO/NSDWQ of ≤10CFU.

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IV. Conclusion

The study set out to undertake the physicochemical and bacteriological analysis of water quality from two sources in Jalingo Metropolis Nigeria, and also the comparative treatment of these water using M. oleifera seed and Alum as coagulants. In Nigeria today, the use of ground water has become an agent of development because the government is unable to meet the ever increasing demand of water supply. Water from natural sources is never completely pure. Most of the earth's water sources get their water supplies through precipitation. During precipitation water passes over (runoff) and through the ground (infiltration), acquiring a wide range of dissolved or suspended impurities that intensely alters its usefulness. The physicochemical parameters identified before treatment include temperature, electrical conductivity, total dissolved solids, pH and turbidity and some of the bacteriological analysis that include E-coli and coliforms; which were either lower or higher values outside the permissible standards of WHO and NSDW. The study sampled two sources; well and borehole water. The findings revealed that the values of the physicochemical and bacteria contents of water samples from the different sources differ. Well water was found to be objectionable as compared to borehole sources. Physicochemical parameters of Total Dissolved Solids, Turbidity, pH and EC recorded significant difference across the various water sources. As same as the bacteria loads were different across the different water sources in the study area.

Moringa oleifera seeds can be used as a coagulant to replace conventional coagulants, flocculant, hard water softener, disinfectant, and for removing of microbes (bacterial) in drinking water treatment. Thus improved application of this should be encouraged, especially in rural water supplies where the water requirement is relatively small and the production of Moringa is likely to be high and constant.

REFERENCES

[1] Adelodun, B., Ogunshina, M. S., Ajibade, F. O., Abdulkadir, T. S., Bakare, H. O. and Choi, K. S., (2020) Water, 12(7), pp. 14.

[2] Andrade, P. V., Palanca, C. F., de Oliveira, M. A. C., Ito, C. Y. K., & dos Reis, A. G. (2021). Use of Moringa oleifera seed as a natural coagulant in domestic wastewater tertiary treatment: Physicochemical, cytotoxicity and bacterial load evaluation. *Journal of Water Process Engineering*, 40, 101859.

[3] Asa, P. S., Umar, I. S., & Zemba, A. A. (2023). Experimental study of spatial and seasonal temperature characteristics of Jalingo metropolis. *Journal of the Bulgarian GeographiYcal Society*, 48, 65-71.

[4] Commission, N. P. (2021). *National housing Demarcation Survey: NPC*.

[5] Dehghani, M., & Alizadeh, M. H. (2016). The effects of the natural coagulant Moringa oleifera and alum in wastewater treatment at the Bandar Abbas Oil Refinery.

[6] Dewangan, S. K., Shrivastava, S., Kadri, M., Saruta, S., Yadav, S., & Minj, N. (2023). Temperature effect on electrical conductivity (EC) & total dissolved solids (TDS) of water: A review. *Int. J. Res. Anal. Rev*, 10(2), 514-520.

[7] Duan, J. and Gregory, J., (2003) Coagulation by hydrolysing metal salts. *Adv Colloid Interface Sci100*: pp. 475–502.

[8] Li, P., Zhao, Y. M., Wang, C., & Zhu, H. P. (2021). Antibacterial activity and main action pathway of benzyl isothiocyanate extracted from papaya seeds. *Journal of food science*, 86(1), 169-176.

[9] Ikhuoriah, S.O. and Oronsaye, C.G. (2016). Assessment of Physicochemical Characteristics and some Heavy Metals of Ossiomo River, Ologbo – A Tributary of Benin River, Southern Nigeria. *Journal of Applied Science & Environmental Management*, 20(2) 472 – 481.

[10] Jiang, J. Q (2015) The role of coagulation in water treatment. *Curr Opin Chem Eng* 8:36–44.

[11] Koul, B., Bhat, N., Abubakar, M., Mishra, M., Arukha, A. P., & Yadav, D. (2022). Application of natural coagulants in water treatment: a sustainable alternative to chemicals. *Water*, 14(22), 3751.

[12] Wagh, M. P., Aher, Y., & Mandalik, A. (2022). Potential of moringa oleifera seed as a natural adsorbent for wastewater treatment. *Trends in Sciences*, 19(2), 2019-2019.

[13] Malik, Q.H. Performance of alum and assorted coagulants in turbidity removal of muddy water. *Appl Water Sci* 8, 40 (2018). https://doi.org/10.1007/s13201-018-0662-5

[14] Mishra, R. K. (2023). Fresh water availability and its global challenge. *British journal of multidisciplinary and advanced studies*, 4(3), 1-78.

[15] Ntibrey, R. A. K., Kuranchie, F. A., & Gyasi, S. F. (2020). Antimicrobial and coagulation potential of Moringa oleifera seed powder coupled with sand filtration for treatment of bath wastewater from public senior high schools in Ghana. *Heliyon*, 6(8).

[16] Asif, M. N., Imran, M., Ahmad, M. H., Khan, M. K., & Hailu, G. G. (2024). Physicochemical and functional properties of Moringa seed protein treated with ultrasound. *ACS omega*, 9(3), 4102-4110.

[17] Chinedu, S. N., Nwinyi, O. C., Oluwadamisi, A. Y., & Eze, V. N. (2011). Assessment of water quality in

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Canaanland, Ota, southwest Nigeria. *Agriculture and Biology Journal of North America*, 2(4), 577-583.

[18] Organization, W. H. (2021). Working for health: a review of the relevance and effectiveness of the Five year action plan for health employment and inclusive economic growth (2017-2021) and ILO-OECD-*WHO Working for Health programme*.

[19] Oruonye, E., & Abbas, B. (2011). The Geography of Taraba State, Nigeria. *LAP LAMBERT Academic Publishing GnBH& Co. KG and licensors*.

[20] Pivokonsky, M., Novotna, K., Petricek, R., Cermakova, L., Prokopova, M., &Naceradska, J. (2024). Fundamental chemical aspects of coagulation in drinking water treatment–Back to basics. *Journal of Water Process Engineering*, 57, 104660.

[21] Saritha, V., Srinivas, N., Srikanth, N., Vuppala, N. S. (2017). Analysis and optimization of coagulation and flocculation process. *Appl Water Sci* 7(1): pp. 451–460.

[22] Silva Da, N., Taniwaki, M. H., Junqueira, V. C., Silveira, N., Okazaki, M. M., & Gomes, R. A. R. (2018). Microbiological examination methods of food and water: a laboratory manual. *CRC Press*.

[23] Taiwo, A. S., Adenike, K., & Aderonke, O. (2020). Efficacy of a natural coagulant protein from Moringa oleifera (Lam) seeds in treatment of Opa reservoir water, Ile-Ife, Nigeria. *Heliyon*, 6(1).

[24] Wang, X., Sun, T., Zhu, H., Han, T., Wang, J., & Dai, H. (2020). Roles of pH, cation valence, and ionic strength in the stability and aggregation behavior of zinc oxide nanoparticles. *Journal of environmental management*, 267, 110656.

[25] Zaid, A. Q., Ghazali, S. B., Mutamim, N. S. A., & Olalere, O. A. (2019). Experimental optimization of Moringa oleifera seed powder as bio-coagulants in water treatment process. *SN Applied sciences*, 1(5), 504.

[26] Zhang, S., Wang, S., Liu, Z., He, X., Shi, L., Liu, Y., & Wang, H. (2025). Mechanism and Improvement of Electrocoagulation Technology for Removing Microplastics from Wastewater-Current Status and Future Directions. *Water, Air, & Soil Pollution*, 236(15), 990.

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