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# The Use of Moringa Oleifera Seed As A Coagulant For Domestic Water Purification

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***Abstract:*** *The efficiency of Moringa Oleifera seed powder as a coagulant for domestic water purification was investigated using the Jar Test.The optimum dosage of moringa oleifera seed powder was observed to be at 90mg/L. The results of the physiochemical parameters tested at the point of sample collection and at 90mg/L optimal dosage respectively are as follows: pH (8.1 and 7.9) temperature (26.6$^{o}$C and 26.8$^{o}$C), conductivity (1.75 µs/cm and 1.78 µs/cm), dissolved oxygen (0.30mg/l and 0.10mg/l), turbidity (339 and 4.10NTU), and hardness (212mg/l and 300mg/l) respectively. Analysis of some metals such as copper, chromium, lead, calcium, magnesium, cobalt and zinc were performed before and after treatment of the water sample with the Moringa oleifera seed. The metals analyzed (Cu, Zn, Ca, Cr, Pb, Co, and Mg) before and after coagulation showed that concentration of Zn, Cu, Co, Pb and Ca as increased in the most optimally purified water containing 90mg/L Moringa Oleifera seed Powder from, 1.12 to 2.54mg/L, 0.18 to 0.39mg/L, 0.00 to0.19mg/L, 0.00 to 0.08mg/L and 1.02 to 2.10 mg/L respectively. And magnesium concentration decreased from 36.32 to 27.89 mg/L.*

***Keywords:*** *Coagulant,Hardness, Metals, Moringa oleifera, Turbidity,and Water treatment.*

## I. Introduction

River water is mostly the exclusive drinking water source for many tropical developing countries and treatment processes heavily depend on the use of chemical water treatment agents, which are mostly imported and are usually very expensive (Schulz and Okun, 1983) .Several chemical coagulants have been used in conventional water treatment processes for potable water production that includes inorganic, synthetic, organic polymer and naturally occurring coagulants (Okuda et al, 2001). Many water treatment plants resort to under dosing of chemicals so as to meet the increasing water demand of a fast growing population, which resulted to supply of low quality water especially during the rainy season when rivers carry highly turbid water (Muyibi and Alfugara, 2003).Historically, the use of natural materials of plant origin to purify water has been practiced for long (Dalen et al, 2009). Egyptians inscription afforded the earliest recorded knowledge of plant materials used for water treatment, dating back perhaps to 2000BC in addition to boiling and filtration, in which Moringa Oleifera seed is one of the plant materials used in treatment of turbid water (Fahey, 2005). Moringa has been described as native to India and widely grown in the tropics. It is also called horse radish or drumstick tree and known by manynative names in Nigeria such as Zogalle (in Hausa), okweoyibo (in Igbo) eweigbake (in Yoruba) and ladenn (in Tangale).In the use of Moringa oleifera seed powder for the treatment of turbid water, the paste must be made fresh each time water is to be purified. And the seed cake from which oil has been extracted, retain its coagulating property which can be dried and stored in powdered form for water clarification as needed (Gowon et al, 2006).The Moringa oleifera seed is rich in copper, reported to have potentials in water treatment, where it functions in complementing the coagulating properties of the moringa oleifera seed (Muyibi and Okuofo, 1995). As such, in order to alleviate the prevailing difficulties of providing potable drinking water, approaches should focus on sustainable water supply and treatment system that are cheaper, requiring minimal maintenance and operation skills (Doerr, 2005). This research therefore, investigates the efficiency of moringa oleifera seed as a coagulant for domestic water purification. Some physiochemical parameters (pH, Temperature, Conductivity, Turbidity, Hardness, Dissolve Oxygen, Odour, Appearance and Taste) and some metals(Mg, Pb, Cu, Zn, Cd, Ni, Co, Cr and Ca) were also determined.

## II. Materials and Methods

**Sample Collection:** The sample of ripped moringa oleifera seed pods were obtained from Kasuwan Barchi in Tudun /Wada market of Kaduna, Kaduna State. And eight litres (8L) of raw water sample was collected from River Kaduna along Kachia Road within Kaduna Metropolis, Kaduna State.

**Sample Preparation:**The seeds were peeled to obtain the nuts and it was air-dried for a week. Thereafter, the dried nuts were pulverized to a fine powder and sieved to a mesh size of 150µm to obtain the seed powder.

**Determination of Optimum Dosage using Jar Test Machine:** The jar test was observed in Kaduna State Water Board, Barnawa Kaduna. Kaduna State. A stock solution was prepared by weighing one gram (1g) of the

seed powder of Moringa Oleifera and transferring same quantitatively into a 1000ml flask, made up to the mark with distilled water and shaken vigorously for 10-15mins. Five different clean beakers labeled A to E were placed on a working desk, a dose of 60, 90,120,150 and180mg of the stock solution were measured and transferred into the flasks respectively. Each beaker was made up to 1000ml with the water sample collected and placed under the stirring paddles, the jar test mixer was turned on and a flash fast mixing was done for 1minute at a speed of 120rpm, followed by slow mixing for 15minutes at 30rpm. The jar test mixer was turned off and the optimum dosage of the sample that started flocculating and settling first among the labeled samples A to E was recorded under 30minutes. The coagulation took place and the floc settle at the bottom leaving the transparent medium at the top due to the presence of a water-soluble cationic coagulant protein (Folkard et al 2005). The transparent medium of the most optimally purified water at 90mg/L dosage was transferred into a plastic container for further analysis.

**Determination of Some Physiochemical Parameters:**
**Turbidity:** This test was determined by Nephelometric method using Naphla – HACH 2100N turbidimeter, before and after treatment of the water sample.

**pH:** The test was carried out using pH meter model 400.
**Conductivity:** The test was determined using conductivity meter model inolab cond 720.

**Temperature:** The test was determined using the mercury-in-glass thermometer.

**Dissolve Oxygen (Do):** 200ml of water sample was measured and transferred into a bottle, covered and incubated in the dark at a temperature of 20$^{o}$C for a period of five days, and then the sample was removed and read in order to get the difference between the Dissolved Oxygen concentration in the sample before and after the incubation period.

**Hardness:** 50ml of water sample was measured and transferred into a beaker, two drops of Erodirine black indicator was added and the colour changed to wine red. A standardized Ethylene Diamine Tetra Acetic acid(EDTA) was run into the sample until the sample changed to blue which indicated the endpoint. Total hardness $CaCO_3$ in mg/L was calculated from the hardness obtained from the relation. Therefore, ML of 0.02M EDTA?

**Determination of Some Heavy Metals:** Both the most optimally purified water sample of 90mg/L dosage and the untreated raw water sample were digested using the standard method of Association of Official Analytical Chemistry (AOAC) for further analysis of some metals (Zn, Cu, Pb, Mg, Ca, Cr, and Co) using Atomic Absorption Spectrophotometer (AAS).

## III. Results and Discussion:

**Table1: Results of Optimum Dosage Determination and Some Physiochemical Parameters**

| S/NO | PARAMETER | UNIT | RESULT | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Untreated sample | (A) 60mg/l | (B) 90mg/l | (C) 120mg/l | (D) 150mg/l | (E) 180mg/l |
| 1. | pH | | 8.1 | 7.2 | 7.9 | 8.1 | 8.1 | 8.2 |
| 2. | Temperature | $^{o}$C | 26.6 | 26.8 | 26.8 | 26.9 | 27.0 | 27.0 |
| 3. | Conductivity | µs/cm | 1.75 | 1.82 | 1.78 | 1.14 | 0.92 | 1.28 |
| 4. | Turbidity | NTU | 339 | 5.46 | 4.10 | 5.57 | 6.00 | 6.35 |
| 5. | Hardness | mg/l | 212 | 213 | 300 | 380 | 580 | 1000 |
| 6. | Dissolve Oxygen | mg/l | 0.30 | 0.60 | 0.10 | 0.90 | 0.50 | 0.30 |
| 7. | Odour | - | Unpleasant | Odourless | Odourless | Odourless | Odourless | Odourless |

**Table 2: Results of Some Metals in the most purified water at 90mg/l and the raw water**

| S/NO. | METALS | Raw Water (mg/l) | Purified Water (mg/l) |
|---|---|---|---|
| 1. | Magnesium (mg) | 36.32± 0.02 | 27.89± 0.07 |
| 2. | Lead (Pb) | ND | 0.19± 0.00 |
| 3. | Copper (cu) | 0.18± 0.00 | 0.39± 0.01 |
| 4. | Zinc (Zn) | 1.12± 0.01 | 2.54± 0.02 |
| 5. | Cobalt (Co) | ND | 0.08± 0.02 |
| 6. | Chromium (Cr) | ND | 0.09± 0.00 |
| 7. | Calcium (Ca) | 1.02± 0.01 | 2.10± 0.03 |

## IV. Discussion

The result of Moringa Oleifera seed powder at different concentrations of 60, 90, 120, 150 and 180mg/L in 30minutes settling time showed that, the 90mg/L gave the optimum dosage for the most optimally purified water sample. This result is in agreement with 75-200mg/L range of optimum dosage research work by (Folkard et al 2005). The turbidity test revealed that the dose of 90mg/L reduced the water turbidity from 339NTU to 4.10NTU, which is within the maximum permissible limit of World health Organization (WHO) standard for drinking water of 5NTU (WHO, 1993). However, other doses have turbidity values higher than 5NTU. The pH of all dosages ranged from 7.9 to 8.2, all of which are within the World Health Organization permissible limits of 6.5 to 8.5 for drinking water (WHO, 1971). The action of Moringa Oleifera as a coagulant lies in the presence of water soluble cationic proteins in the seed (Doer, 2005). This suggests that in water, the basic amino acids present in proteins of Moringa Oleifera seed would accept a proton from water resulting in the release of hydroxyl group making the water solution basic (Dalen et al 2009).This accounted for the slight tendency towards basic pH values. The conductivity (1.78 µs/cm), hardness (300mg/L) and Dissolve oxygen (1.10mg/L) obtained were within the maximum permissible limit of World Health Organization of hardness 45-575mg/L, conductivity 250µs/cm respectively in the optimal dosage of 90mg/L, with the exception of hardness at 150 and 180mg/L which were above the limit (WHO, 1993). The Appearance was dirty brown at point of sample collection, after addition of the Moringa Oleifera seed the appearance turned to Colourless in all the jars labeled A-E. The water samplewas tasty at the point of collection, after addition of the Moringa Oleifera seed powderthe water was observed to be tasteless in all the jars labeled A-E.The odour of the water sample at point of collection was unpleasant, after addition of the Moringa Oleifera seed, the water in all the jars labeledA-E became odourless.The concentrations of Cu, Zn and Ca were 0.39, 2.54, and 2.10mg/L in the most optimally purified water, which as increased compare to 0.18, 1.12 and 1.02mg/L respectively in the raw water sample after addition of moringa oleifera seed.This suggest that moringa oleifera seed powder as effect on the increase in concentration of the metals in the most optimally purified water due to addition of the moringa oleifera seed, which is not in agreement with the result of findings by (Vikashni et al 2012), that Moringa oleifera seed as potentials in adsorbing metals in treatment of turbid water. And all are within the maximum permissible limits of Cu 2mg/L, Zn 3mg/L and Ca 75mg/L (WHO, 1993).After addition of moringa oleifera seed, Mg concentration in the raw water sample reduced from 36.32mg/L to 27.89mg/L in the most optimally purified water, which is in agreement with the result of findings by (Vikashni et al, 2012), that moringa oleifera seed as potentials on metal concentration adsorption in treatment of turbid water, which is also within the World health Organization limit of 50 mg/L [WHO, 1993). Pb, Co and Cr concentrations in the raw water sample were Not Detected (ND), and in the most optimally purified water Pb, Co and Cr concentrations were; 0.19mg/L, 0.08mg/L and 0.09mg/L respectively, which is also not in agreement with the result of findings by (Vikashni et al, 2012), that moringa oleifera seed as the potentials to adsorb metals in treatment of turbid water. And all are above the World Health Organization maximum permissible limits of Pb 0.01mg/L, Co mg/L and Cr 0.05mg/L respectively (WHO, 1993)**.**

## V. Conclusion

At 90mg/L dosage the turbidity of the sample water reduced from 339 to 4.10NTU. Also, some of the metals analyzed were within the World Health Organization (WHO) maximum permissible limit and some were not detected. The quality and accessibility of drinking water are of paramount importance to human health. Drinking water may contain disease-causing agents and toxic chemicals and to control the risks to public health, systematic water quality control and monitoring are required. This research revealed that Moringa Oleifera seedhas the potential of being an alternative or a supplement to aluminium sulphate or other proprietary polyelectrolytes and can save cost.The advantage of moringa oleiferaseed over the conventional chemical coagulants is that it is an environmentally safe method of water purification. Therefore more research work needs to bedone on the optimum dosage determination, elemental determination and some physiochemical parameters that give water potability for drinking.This will go a long way in improving the quality of drinking water in the rural areas.

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