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PRELIMINARY INVESTIGATION ON THE BIOCOAGULANT PROPERTIES OF MORINGA OLEIFERA SEEDS, ALUM AND ACTIVATED CARBON MIXTURE IN WATER TREATMENT

Alfa, T. A. Samuel, A. E. Idris, U. Zubairu, Z. Abdullahi, B. Musa, B. Z. Itodo I. N.
Department of Chemistry, Federal University of Agriculture, P.M. B. 28 Zuru, Kebbi State-Nigeria
*Corresponding author. Tel: +234 8069352467. E-mail: alfatijjaniabdulrahman@gmail.com

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Moringa Oleifera, activated carbon, alum, biocoagulant, TDS, Dissolved oxygen, impurity, turbidity, extraction, jar test, composite.

Abbreviations: MO; moringa oleifera**,** AC; Activated Carbon, TDS; Total dissolved solid

ABSTRACT

The study focused on effective combination of *moringa oleifera* seeds; alum and activated carbon used in treatment of water samples such as raw water (Dam), simulated water (prepared), mixture of well water (composite) and distilled water. The produced natural coagulant can be used as an alternative to aluminum sulphate and other coagulants used worldwide for water treatment. (Eman, 2009). This study involves processing *Moringa oleifera* seeds to concentrate the biocoagulant constituents which have coagulation activity. *Moringa oleifera* seeds were prepared for oil extraction using electro thermal soxhlet. (Matawal, and Kulack, 2004). After extraction of oil from *moringa seeds*, the powder obtained was used to prepared matrices of different proportions: matrix A (90%MO+5%AC+5%Alum), matrix B(80%MO+10%AC +10%Alum) and matrix C(70%MO+15%AC +15%Alum). The matrices were prepared at temperature of 40^0c in electric oven. These matrices were used to treat water samples, alongside with control 1 2 and 3 that is moringa seeds powder, alum and activated carbon respectively. The result was analyzed using the following physico-chemical parameters such as turbidity, pH, Conductivity, TDS, Alkalinity and DO, which were determined before and after treatment. From the data recorded for treatment with matrix C and data recorded before treatment, the recommended ratio for combined coagulant dosage is matrix (80%MO +15%AC +15%Alum)

INTRODUCTION

Moringa oleifera is versed and important plant used for various medicinal applications, production of biodiesel oil, essential oil as well as acting as bioactive coagulant in water treatment. The provision of potable water is an enormous undertaking, especially in developing countries. This is so because the chemicals required for treatment, namely: alum for coagulation, polyelectrolyte as coagulant aids, lime for softening and pH correction, and chlorine for disinfection; needs to be imported with scarce foreign exchange. In reaction to this, local materials are being considered as substitute. Moringa oleifera seeds extract has been a subject of research by several scholars in this regard. (Eman, 2009) Moringa seed (Zogale in Hausa) is applied as coagulant in place of Aluminium Sulphate (Alum) used in conventional treatment plants. (Aho and Lagasi, 2012) Water is essential for human life. Potable water should be free from contaminants. Children bear the greatest health burden associated with unsafe water supplies through preventable diseases like diarrhea. In developing countries about 2 million people die every year due to diarrhea disease; most are children of less than 5 years of age (WHO, 2006). Unprotected water sources receive pollutants from runoff thus necessitating treatment at household level, the common methods of treatment requires coagulation/flocculation followed by sedimentation, filtration and disinfection, the common coagulants use are Aluminium sulphate, ferric chloride, polyaluminium chlorides and synthetic polymers (Schwarz, 2000).

Materials

Desiccator, beakers 250ml, measuring cylinder 1000ml, mortar and pestle, round bottom flask 600ml, heating mantle, oven, weigh balance, crucibles, thermometer, filter paper muslin bag, flocculator, turbidimeter, pH Meter, beakers conical flasks, washed bottles, pipette, soxhlet set up

Methodology

Seed collection

This involves the collection of the fruits of Moringa oleifera and drying it. The drying process stimulates the opening of the fruits to release seeds embedded inside. The seeds were separated from the chaffs and other impurities. This Preparation is very important since any impurity in the seeds will eventually reflect on the oil extracted.

Drying and Weighing

After the seeds had been cleaned thoroughly; they were dried in an electric oven to reduce the moisture content of the seeds. The weight was taken and recorded before and after drying using electronic weighing balance.

Preparation of Biocoagulant and oil Extraction

Dried moringa oleifera seed was crushed with a clean domestic mortal and pestle then grinded to a fine powder with a Moulinex domestic blender, the samples grinded were washed with distilled water and then air dried in the laboratory. 218.9g of it was weighed and placed on a filter paper which was folded carefully and placed in sample compartment. The sample compartment was attached to a 600 mL round bottom flask containing 500 ml n-hexane, and heated on the mantle at recommended temperature. The soxhlet extraction ran for 2 hours. The hexane solvent distilled out in the oil extract. The mixture was washed with 15 ml cold saturated NaCl solution for 2 to 3 times (Eilert, 1978).

This sample was then weighed and the difference was calculated as: weight of sample before extraction – weight of sample after extraction, divided by the initial weight of sample, and multiplied by 100 to give the percentage yield oil. The oil was recovered by solvent evaporation. It was heated at a low temperature until the solvent finally evaporates leaving behind the oil extracted (Malusare *et al.,* 2011).

Matrices Preparation

The composite coagualnts were prepared as matrix by blending various amounts of *moringa oleifera,* activated carbon and alum in a definite proportion by mass.

1. Matrix A (0.25g alum +0.25g AC + 4.5gMO)
2. Matrix B (0.5 g alum + 0.5gAC + 4.0gMO)
3. Matrix C (0.75Alum +0.75gAC + 3.5gMO)

All the matrix composites are heated in oven at temperature of 40^0C for three hours, after which they were stored properly for use (Ndabigengesere *et al.,* 1995).

Collection of Well Water Samples

The five samples were collected randomly at different location in Kaduna metropolis. Each sample container was properly labeled as 1, 2, 3, 4 and 5 respectively. The samples were collected at various wells 100meters apart at Unguwan Dosa, and Badarawa kaduna. Before sampling, the plastic containers and the glass apparatus were washed thoroughly with detergent and soaked in 10% nitric acid. They were rinsed thoroughly with distilled water and dried. The five samples collected from different wells were mixed together to form a mixture of well water.

Water samples used for analysis

- Dam water
- Well water (mixture)
- Simulated water (2% solution)
- Distilled water (Control)

Jar Test

The test is use for measuring coagulation activity of a given coagulant, such as turbidity, pH, conductivity, TDS, alkalinity and DO using the raw water from different sources Alfa, (2014).

Coagulation: This is the gentle mixing of coagulant with raw water, in order for flocculation to take place so as to collect the settled sludge, then clean, clear and pure water was separated from its impure part by decantation. This process is generally used by many treatment plants (adepoju, 2005).

Procedure for Jar Test

200ml of dam, well, simulated water and distilled water were collected into 500ml beakers, rinsed with distilled water, after which they were arranged in flocculating machine. 0.2mg Coagulants (moringa powder) was added to each beaker. After flocculator is set on, 120 revolutions was observed for 1min (120 rev/min) and thereafter reduced to 30 revolution for the next 15 min (Folkard *et al*., 2000). This is done in order to ensure gentle and perfect flocs formation, the flocs were therefore allowed to settle after ten minute. The clean water was then decanted into separate containers for further test such as pH, turbidity, conductivity, alkalinity, total hardness and dissolve oxygen. The same procedure was repeated for; activated carbon, alum, matrix A (90% moringa+ 5%AC+5% Alum), matrix B (80% Moringa +10% AC +10% Alum), matrix C (70%Moringa +15%AC + 15%Alum). After jar test, other test were carried out to determine acidity or alkalinity of the raw water as well as treated water. This is done using the pH Meter. The standard pH by WHO for portable drinking water is 6.5-8.5 (WHO 2006).

Result and Discussion

Extraction of Oil From Moringa Seed

Total weight of the sample + container = 419.0g

Weight of container =200.1g

Weight of moringa before extraction = 218.9g

Weight of the sample after oil extraction and draying =114g

Percentage weight extracted is therefore calculated,

% weight extracted = (wt before extraction – wt of sample after extraction)/initial wt multiply by 100

% wt extracted = $\left[\left(\frac{218.9 - 114}{218.9}\right)\right] \times 100$

= 47.92%

This therefore means that at least 47.92% of moringa powder according to cheebrough,(1984) will be required to blend with other coagulants to form an effective matrix.

Jar Test Results

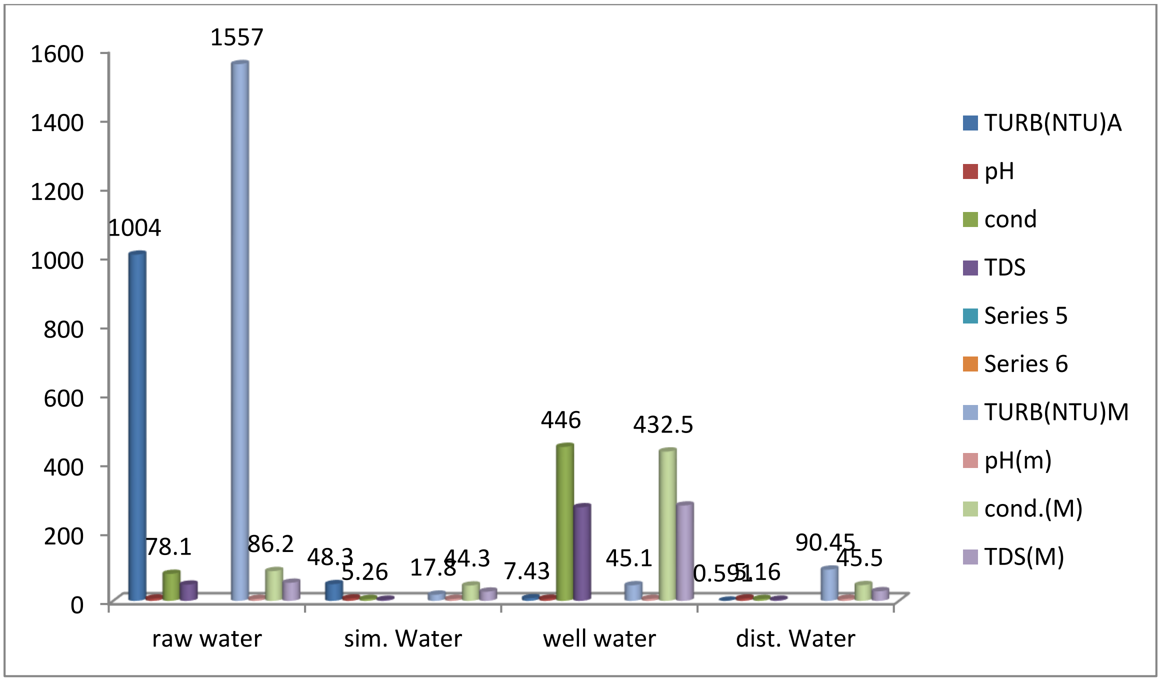

Figure: 1 physicochemical properties before and after treatment with (moringa powder)

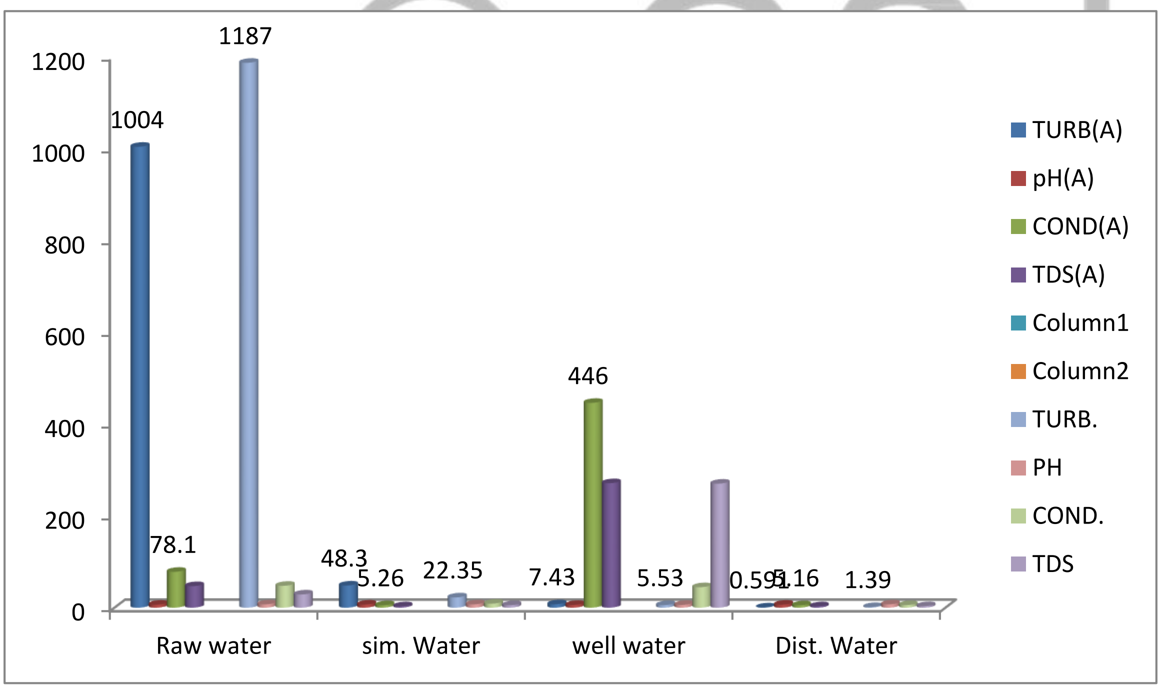

Figure: 2 physicochemical properties before and after treatment with (activated carbon)

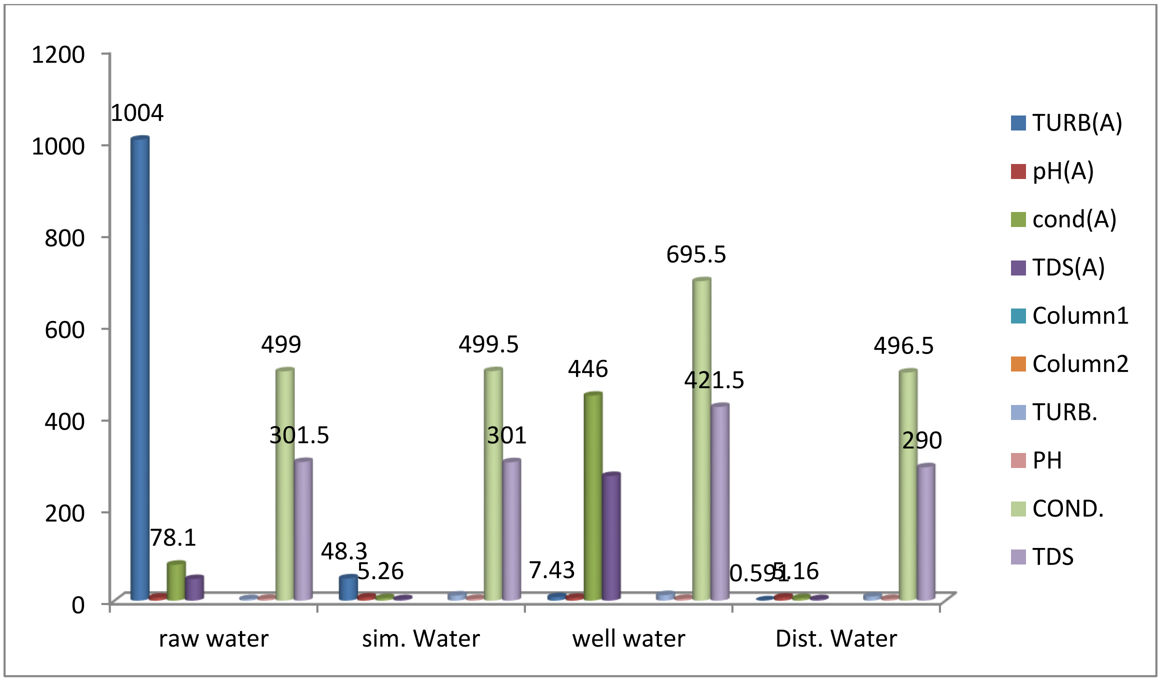

Figure: 3 physicochemical properties before and after treatment with (alum).

The pH value of the raw water ranged between 6.0 and 6.6. When this raw water was treated with 100% MO the pH changed to the range of 5.26 to 5.8, this is in agreement with result of Muyibi and Evison (1995) which showed that pH of the water softened with MO seed powder was within the recommended WHO standards. Also Katayon *et al*. (2004) explained that MO seeds did not affect the pH value of water samples significantly although a slight decrease in pH was seen after the coagulation process of MO Katayon *et al*. (2004) and suggested that the decrease in pH when using MO seed powder may be due to hydrogen ions of the weak acidity of MO stock solution, which balances the hydroxide ions in the raw water.

The addition of alum to the water samples reduced the pH in the treated water below the WHO acceptable limit of 6.5 (WHO, 1996). When 100% alum was added to the water, the pH reduced from the range of 6.0 – 6.8 to 3.7-4.0. Alum caused a marked changes in the pH of the raw water from a value of 6 points to a treated water value of 4 points, so lime can be use to correct the pH of water sample.

The main concern in using MO for water treatment is the significant increase in organic load, as organic matters originating from the seeds can be released into the water during treatment. The presence of organic matter in treated water can cause problems of colour, taste, and odour and also facilitates the development of microorganisms upon storage. Water treated with crude *moringa oleifera* extract should not be stored for more than 24 hours. (Jahn, 1979). The crude extract is therefore not generally suitable for large water supply systems where the hydraulic residence time is very high (Eman *et al.,* 2009.)

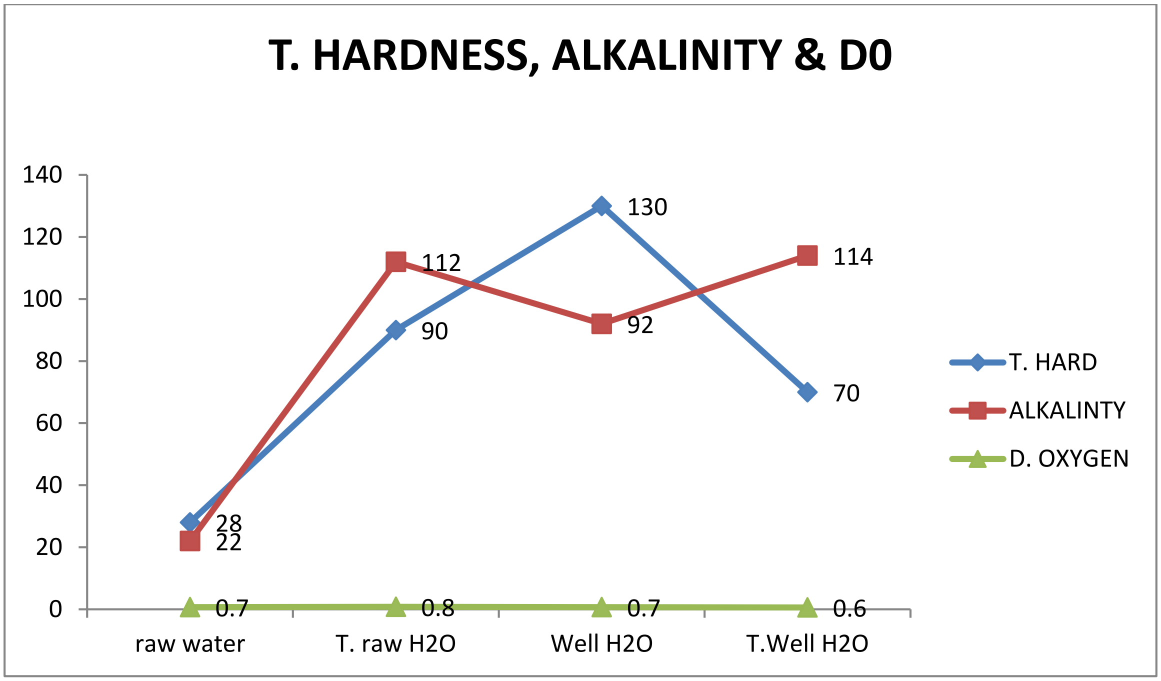

Figure 4 shows physico-chemical properties such as tds, alkalinity and DO

Various percentage combinations of MO seed powder, aluminium sulphate and activated carbon in Figure. 1, 2 and 3 revealed drop in the pH values for the treated water at different degrees. The quantity of MO seed powder was more than the quantity of alum and activated carbon in any water samples treated, the pH reduction was not within the WHO approved range of 6.5 to 8.5 but the reverse was the case when alum and AC were either in equal proportions or greater in amount than MO seed powder in combination. Therefore there was no need for pH correction using lime, but to increase the percentage of alum and AC. Considering only pH as a determining factor for selection of optimum combination, matrix B was found to be closest to the WHO recommended range. All the reductions in pH values were corrected when using the well water (adepoju, 2009). Generally there was increment in the values of total dissolved solids (tds) with the treated water above the raw water values as seen figure 4 in comparison to treated samples.

When organoleptic properties of treated water were considered as described by (WHO 2003) "The presence of dissolved solids in water may affect its taste (Sridhar *et al.,* 2008, Sridhar *et al.,* 2009). The palatability of drinking water has been rated by panels of tasters in relation to its TDS level as follows: excellent; is less than 300 mg/litre; good, between 300 and 600 mg/litre; fair, between 600 and 900 mg/litre; poor, between 900 and 1200 mg/litre; and unacceptable, greater than 1200 mg/litre (Anyakora, 2010). Water with extremely low concentrations of TDS may also be unacceptable because of its, insipid taste". In accordance with above palatability range all water treated with matrix A, Band C were found within the range.

Conclusion

From the results of the study, the turbidity of the treated water was not greatly influence by percentage of MO present in the matrix, but effect on pH according to (Katayon *et al*. 2004) was due to presence of H^+ from weak acid in MO. It was noted that there were general reduction in TDS values and were all within the range specified by WHO standard which is of value less than three hundred milligram per liter < 300mg/L (Marcovecchio, 2007). In line with the discussion above there was marked decrease in pH values for the whole matrices used, since MO is in high percentage in all matrices. Low TDS values and average conductivity as well as closeness of pH values to recommended range given by WHO, made matrix B best of three matrices prepared despite the fact that they are all within the recommented standard(Mataka *et al*., 2006). The composite well water can be treated effectively using matrix B with the aid of lime for pH correction.

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