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Comparative Analysis on the Coagulating Ability of Shelled and Unshelled Moringa Seed in Water Treatment

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***Abstract*-**This research presents the coagulation ability of shelled and unshelled moringa seed in water treatment. Physico-chemical analysis was conducted on turbid water to examine the efficiencies of the shelled and unshelled moringa seed. The treatment variables, shelled and unshelled moringa seeds were used under the same temperature and environmental conditions. Raw water samples were collected and subjected to post-treatment analysis. The treatment variable was used at a treatment level of 50ml moringa aqueous solution which was produced at 40g/l. The following parameters were analyzed; Turbidity, Total dissolved solid(TDS) and Total suspended solid(TSS).The Unshelled moringa produced a 98% turbidity removal level as against the shelled moringa with 96% turbidity removal level. Other results produced for the Shelled and Unshelled moringa were; Turbidity: 38NTU and 19NTU, Total dissolved solid (TDS): 273mg/l and 91mg/l, Total suspended solid (TSS): 472mg/l and 389mg/l respectively. The analysis showed clearly that both the shelled and unshelled moringa are good for coagulation but the unshelled moringa will serve as a better coagulant.

Keywords*–Shelled Moringa, Unshelled Moringa, Turbidity, Total Dissolved Solid, Total Suspended Solid, Coagulation*

I. INTRODUCTION

The quality of water has a lot to do with the usage and acceptability of the natural resource for whatever purpose. Whatever the case, for water to be acceptable as safe enough for direct human consumption and good enough for domestic uses, the water quality must be ascertained and the portability of the water verified. Water is portable when its physico-chemical and bacteriological characteristics meet certain prescribed standards (Fatombi et al, 2012 [7]; Pindi et al, 2013 [16] and Mulamattathil, et al. 2015) [10]. Water treatment being a means of water quality improvement, remains a visible tool for making polluted water portable. In treatment, the sources and level of pollution tends to determine the extent of treatment and type of treatment facility to be adopted. There are physical treatment methods and chemical treatment processes depending on what is to be treated in any source water. Treatment for physical quality management includes: clarification and discoloration among other things. Chemical treatment methods include coagulation and disinfection.

Coagulation is the clumping together of very fine colloidal and dispersed particles into larger and visible agglomerate of the particles caused by the use of chemicals called coagulants. There are different coagulants in use of which aluminum sulphate (alum) is the most widely used. However, recent researchers have identified the seeds of moringa oleifera as an important coagulant in water treatment (Nwoke et al, 2015 [15] and Mustapha, 2013) [11]. Studies (Ndabigengesere, et al, 1998) [13] have indicated a number of serious drawbacks linked to the use of aluminum salts such as Alzheimer's disease associated with high aluminum re-siduals in treated water, excessive sludge production during water treatment and considerable changes in water chemistry due to reactions with the OH– and alkalinity of water. Moringa Olefiera seeds have been found to contain water soluble substances, proteins, with high coagulation and antibacterial efficiency in water treatment (Ndabigengesere et al,1995 [12]; Sulaiman. et al, 2015) [20] and Kebreab et al., 2005) [9]. Different researches have also shown and confirmed moringa oleifera seed extracts as very good alternatives for alum as coagulants in drinking water clarification, Turbidity removal and Total coliform reduction. This natural coagulant can be prepared as shelled seed of moringa reported by some researchers (Sarpong & Richardson, 2010 [18]: Nwaiwu & Bello,2011[14] and Adejumo et al, 2013 [1]) or unshelled seeds of the moringa (Eze, V. C. and Ananso, J. D. 2014[6]:Emelie, et al 2008, [5]: Amagloh, F.K. and Benang (2009)[2]: Dehghani and Alizadeh, (2015)[4]: Sanchez-martin et al., 2012 [17] and Saulawa et al., 2011) [19]. Therefore the paper is focused on presenting comparism on the coagulation ability of shelled and unshelled moringa seed in water treatment.

II. PROCESSING OF MORINGA (REVIEW)

The first stage in the application of Moringa Oleifera seeds extract in water treatment is the production of Moringa Oleifera seeds powder and normally involves manually removing the seed coat and wings, grinding the seeds in to fine powder using a domestic blender, and sieving. The second stage comprises extracting the active ingredients. Earlier researchers used mixing in water and filtering through Mosley cloth and mixing with a stirrer and filtering with whattman filter paper (Mustapha, 2013) [11]. Six different methods for moringa seed extraction have been used: normal aqueous extraction (M1), normal salt extraction (M2), oil removal

followed by aqueous extraction (M3), oil removal followed by salt extraction (M4), oil removal followed by aqueous extraction and micro-filtration or cross flow filtration (M5), and oil removal followed by salt extraction and micro-filtration or cross flow filtration (M6). Bichi et. al.(2012)[3]. However, There have been research on moringa Olifera seeds by manually removing the dry seeds from the dry fruit. It was manually grinded with the winged cover and thus, proceeded with the extraction. Adejumo et.al. (2013)[1].

III. MATERIALS AND METHOD

The Moringa Oleifera seeds were sourced from a Moringa Oleifera tree. The seeds were obtained fresh from its tree. Some of the seeds (shelled), grayish black in color were split open to obtain the white seeds (unshelled). These are the two Moringa seeds used in the study. The raw water samples were fetched from highly turbid water. Figure 1&2 show the Moringa Oleifera seed samples.

Figure 1. Shelled moringa seed

Figure 2. Unshelled moringa seed

The seeds were obtained and allowed to sun-dry under ambient temperature for a period of 10 days. This was done for both the shelled seeds and the unshelled seeds. The dried seeds were ground into fine powder using a manual kitchen grinder. The seeds were ground twice in order to obtain a homogenized seed powder. The seed powder was then sieved using a Standard Test Sieve (ASTM) 460 of 1.1mm

Aqueous solution of the Moringa seed was prepared by dissolving 40g of the ground seed in 1liter of distilled water respectively, thereby making a concentration of 40g/l. These concentrations were used in the study. The seed powder was weighed using an electronic weighing balance (Search Tech). The Moringa Oleifera seed solutions were stirred for 25minutes using a magnetic stirrer (Search Tech). The Moringa solution was filtered with Chi-filter cloth and whitman filter papers (110mm diameter). The treatment variables, shelled and unshelled moringa seeds were used under the same temperature and environmental conditions. The raw water sample was collected and analyzed for treatment and was poured into 1000ml beakers up to 500ml. 50ml of the aqueous solutions were dosed into the beakers respectively. The mixtures were vigorously shaken and allowed to stand. 25mls of the treated water were collected for the analysis at every four hour interval after it was treated with the variables. The activity lasted for 72hours.

IV. MEASUREMENT OF TURBIDITY

Turbidity was determined by photometric method using HACH DR/2010 spectrophotometer at a wavelength of 860nm and programme number 750.

25ml of filtered de-ionized water was poured into a 25ml sample cell bottle as blank. The blank was to zero the spectrophotometer. The sample was vigorously shaken and 25ml of the sample was poured into another 25ml sample cell bottle. The sample was put into the light shield and closed after the blank was removed and the red button was pressed. The value was then digitally displayed in NTU.

V. MEASUREMENT OF TOTAL DISSOLVED SOLID (TDS)

Conductivity is measured using hand held conductivity meter model H198302 (HANNA). The conductivity was then calibrated using conductivity solution. The Meter was then switched on and inserted into the water sample. The value is deduced. TDS was determined from the conductivity with the relationship:

TDS = 0.65 x conductivity. Glen carlson (2005)

VI. MEASUREMENT OF TOTAL SUSPENDED SOLID (TSS)

TSS was determined by weighing a dish on weighing beam balance. The water sample was then poured into the dish. The dish was then put in a hot air oven at 103OC to 105OC to dry, after which the dish was removed and reweighed. The difference in weight (which is an increase in weight) between the dish before and after drying was recorded as the total suspended solids in the water samples.

VII. RESULTS AND DISCUSSIONS

The results of the analysis of the treated water with shelled and unshelled moringa with respect to Turbidity, Total Dissolved Solid (TDS) and Total Suspended Solid (TSS) are presented in Fig 3 to Fig 10.The results indicated that the Turbidity levels were less when treated with the unshelled moringa as against.

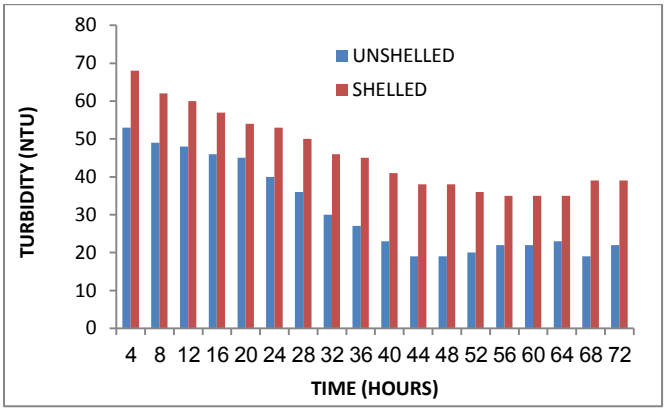

Figure 3. Graph Showing Turbidity As The Parameter

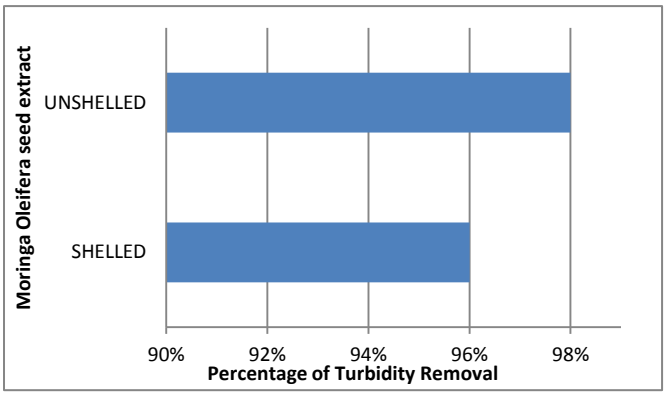

Figure 4. Graph showing turbidity removal level of shelled an unshelled moringa.

As shown in Fig 4, the unshelled moringa recorded 98% turbidity removal against the shelled moringa at 96% .This has shown that the unshelled moringa has an edge as a natural coagulant.38NTU and 19NTU was used as best fit results after shelled and unshelled moringa treatment .However, the post treatment analysis recorded Turbidity value as 1006.49NTU.

The results of the physico-chemical analysis of the treated water samples as presented in Fig 3, Fig 5 and Fig 6 shows different degrees of treatment by the different treatment variables with the best results being; Turbidity: 38NTU and 19NTU, Total dissolved solid (TDS): 273mg/l and 91mg/l, Total suspended solid (TSS): 472mg/l and 389mg/l respectively for shelled and unshelled moringa.

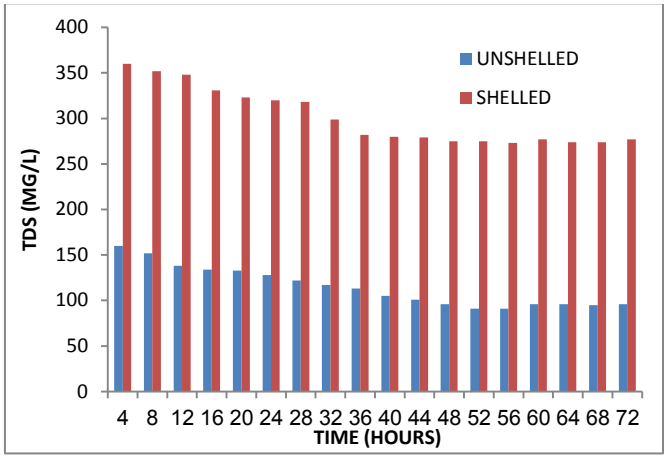

Figure 5. Graph Showing Total Dissolved Solid(tds) as the Parameter

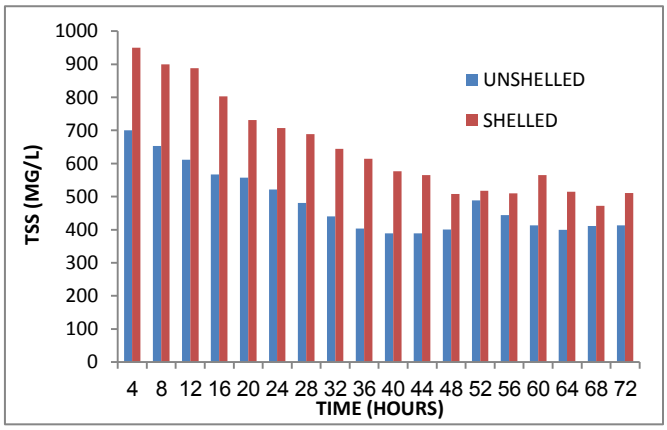

Figure 6. Graph Showing Total Suspended Solid(Tss) As The Parameter

The unshelled moringa seed extract had a better Turbidity removal ability than the Shelled while there was a reasonable level of decrease on the TDS. TSS was being treated in all cases and obviously significantly decreased in number. The result of the TDS and the TSS is an affirmation that the unshelled Moringa Oleifera seed is a better coagulant given the result in Fig 5 and Fig 6 as they produced same sequence of result in Fig 3.Again, from the results, it could be seen that Moringa Oleifera seeds, shelled and unshelled are both good in coagulating and precipitating particles in water. Turbidity reduction shows that coagulation took place and to the degree the turbidity was reduced, the coagulation ability of the treatment variables can be evaluated. Therefore, shelled and unshelled moringa seeds are satisfactorily good for high turbid water.

A relationship between turbidity and time of collection (hours) was established. This is to aid in studying the turbidity behaviours using the shelled and unshelled moringa seed sample at 50ml treatment level. This relationship and model was also established for the Total Dissolved Solids (TDS), and Total Suspended Solids (TSS).

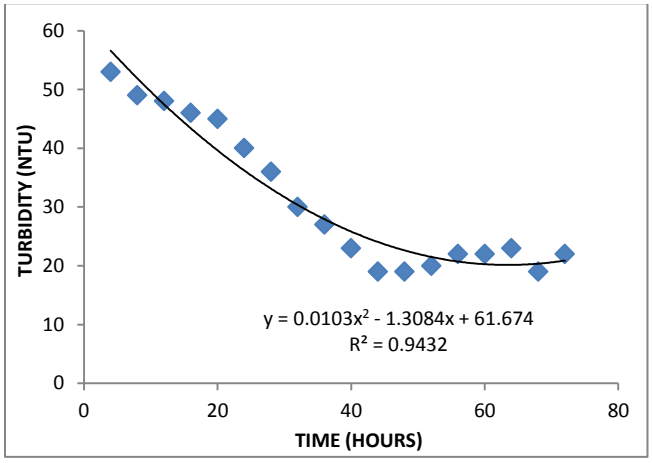

Figure 7. Turbidity –Time relationship with unshelled moringa sample as coagulant.

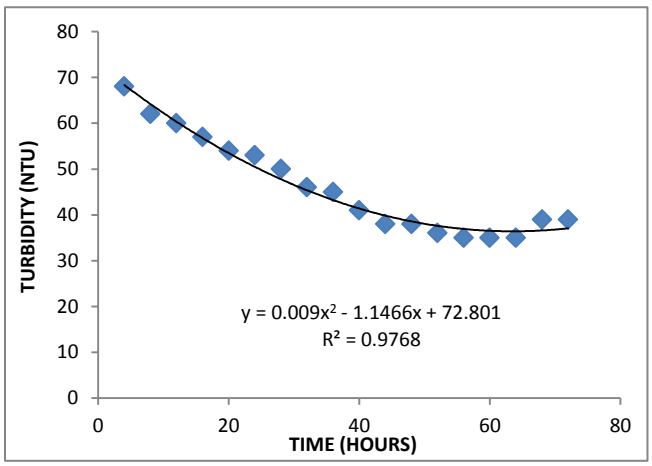

Figure 8. Turbidity –Time relationship with shelled moringa sample as coagulant.

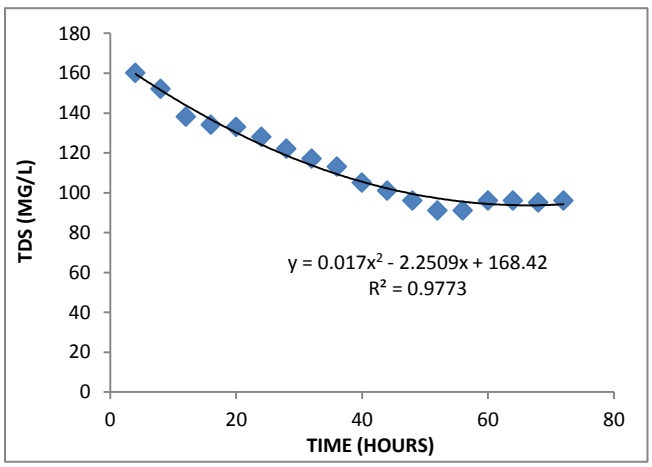

Figure 9. TDS – Time relationship with unshelled moringa sample as coagulant.

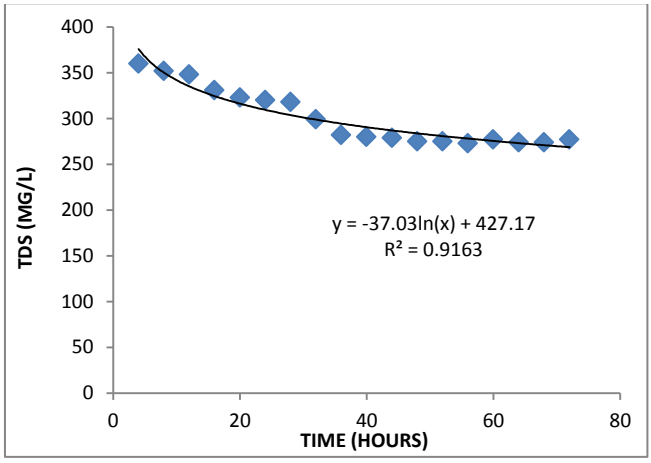

Figure 10. TDS – Time relationship with shelled moringa sample as coagulant.

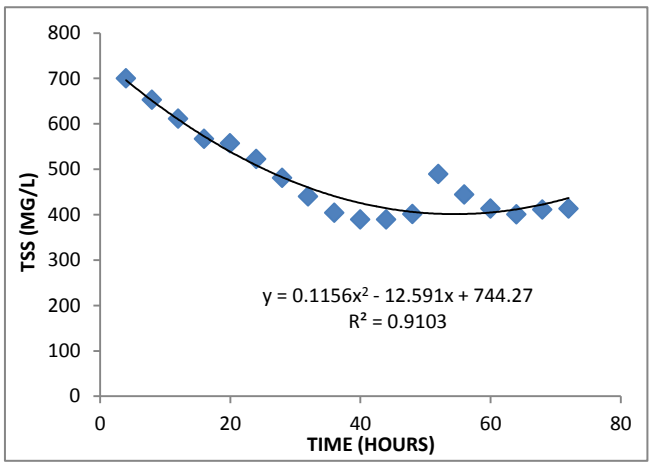

Figure 11. TSS – Time relationship with unshelled moringa sample as coagulant.

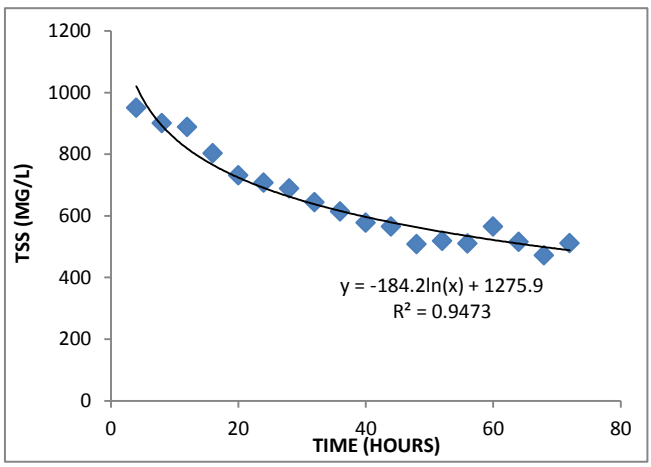

Figure 12. TSS –Time relationship with shelled moringa sample as coagulant.

From Figure 7, it will be observed that the turbidity of water treated with unshelled moringa seed as coagulant follows a polynomial function with R2 value of 0.943. The minimum and best value of turbidity occurred at the 44th hour after the treatment had started.

From Figure 8 the turbidity of water treated with shelled moringa seed follows polynomial function with the R2 values of 0.976. The minimum turbidity level occurred between 44th

From Figure 9, it can be seen that the relationship that exist between total dissolved solid and time for unshelled moringa seed treatment, follow polynomial function with R2 values of 0.977 while that the relationship that exist between total dissolved solid and time for shelled moringa seed treatment in Figure 10 follows a logarithmic function with R2 value of 0.916

From Figure 11, the relationship between the total suspended solid and days for unshelled moringa seed follows a polynomial function with R2 value of 0.910. While in Figure 12, the relationship between the TSS and days for shelled moringa, follows quadratic function with R2 value of 0.923 with minimum value occurring at the 56th hour after the treatment had started.

From Figure 16, the relationship that exist between total dissolved solid for shelled follows logarithmic function with R2 value of 0.916 The minimum value of TDS occurred at 52nd after the treatment had started.

From Figure 19, the relationship between the total suspended solid and days for unshelled moringa seed flows polynomial function with R2 value of 0.910. From Figure 21, the relationship between the TSS and days follows a logarithmic function with R2 value of 0.947 with minimum value occurring at the 40th hour after the treatment had started.

VIII. CONCLUSIONS

After the study on the comparative analysis on the coagulating ability of shelled and unshelled moringa seed in water treatment, the following conclusions were drawn.

The analysis has shown that the unshelled moringa has an edge as a natural coagulant.

The moringa seed is edible, non-toxic, locally available and is a simple, cost-effective and a safe water purification agent. It is therefore necessary that inhabitants of rural communities where conventional water treatment technologies are completely absent and borehole facilities are lacking or are far from their homes to treat water from streams, rivers, lakes and springs with unshelled moringa Oleifera seeds for effective turbidity removal before use for domestic purposes.

From the turbidity removal analysis, the unshelled moringa recorded 98% turbidity removal against the shelled moringa at 96%.

The study has developed models that can predict water quality parameters for shelled and unshelled moringa seed. This is to aid in studying the turbidity movement and other water quality behaviors against time.

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