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PHYSICO-CHEMICAL CONTROLLED INVESTIGATION OF COAGULATION EFFICIENCY OF *Moringa oleifera*

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Abstract
High population growth rate and small per capital investment are among major challenges facing water sector. To optimize the quench by supplementing with reasonable quality water, water treatment is inevitable. During the course of this study amount of turbidity and pH of water as Moringa oleifera (MO) performance indicators upon water treatment individually were investigated against Electrical Conductivity, salinity, Total Dissolved Solids, total hardness and copper content. By using fixed 200 mg/L of MO it was revealed at low turbidity that MO significantly reduced the amounts of pH, EC, TDS, Total hardness and Cu. Variations of pH against turbidity, conductivity, hardness and TDS revealed a significant performance of MO between 6.3 to 8.7 pH range. Meanwhile copper was highly reduced at a pH value of 4.71, variations of turbidity and pH had no substantial effects on salinity reduction. Turbidity variations had uniform trends while pH variations did not have prospective uniformity. These findings depicted obvious possibilities of local communities using cheap available MO seeds for water treatment instead of expensive chemicals, leading into reduction and elimination of waterborne diseases.

Key Words: *Water Treatment; Moringa, Coagulation Efficiency, Dodoma, Ng'ong'ona*

Introduction

Crisis for availability of reliable domestic water supply is internationally mentioned whereby Sub-Saharan countries being main victims. Although states and UN have struggle to set strategies and targets yet beneficiaries remained to be urban areas while peripheral areas end up in using whatever source of water nature supplies. Peripheral areas suffer this because of lack of sanitation facilities and education, negligence, absence of community efforts in addressing the problem, low per capita income and insufficient investments (Miraji *et al.,* 2014). To address and serve the purpose Eman (2010), Ndabigengesere and Narasiah (1998) appreciated the use of *Moringa oleifera* seed for water treatment as an advantageous alternative to commercial available water treatment chemicals. Using Moringa involves low costs, less sludge production and environmental friend as suggested by Muyibi (2003).In addition, a recent study by Vijayaraghavan (2011) reported MO being effective and cheap than commercial salts. Coagulation property of MO is induced by proteins acting as a cationic polyelectrolyte which bind together soluble particles in the water (Sutherland *et al.,* 1994). Okuda *et al.,* 2001 reported that Moringa is effective and optimum close to neutral pH while Katayon *et al.* (2004)

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show that MO activity is controlled by turbidity. The course of this study assumed ideal conditions moderate to low turbid water, and with pH range close to neutral point. Other water quality parameters are presumed being at a state of quantitative acceptability with negligible MO performance interference.

Study Area

Moringa seeds and water samples were collected from Ng'ong'ona village bordering with the University of Dodoma at the Eastern of 6º14′17.98″ S, 35º.50′17.08″ E with an elevation of 1187 meters from the sea level. The village as the part of semi-arid climate located at Dodoma Municipal has a scattered coverage of shrubs and naturally grown moringa plants. The area experiences wet seasons around November to April.

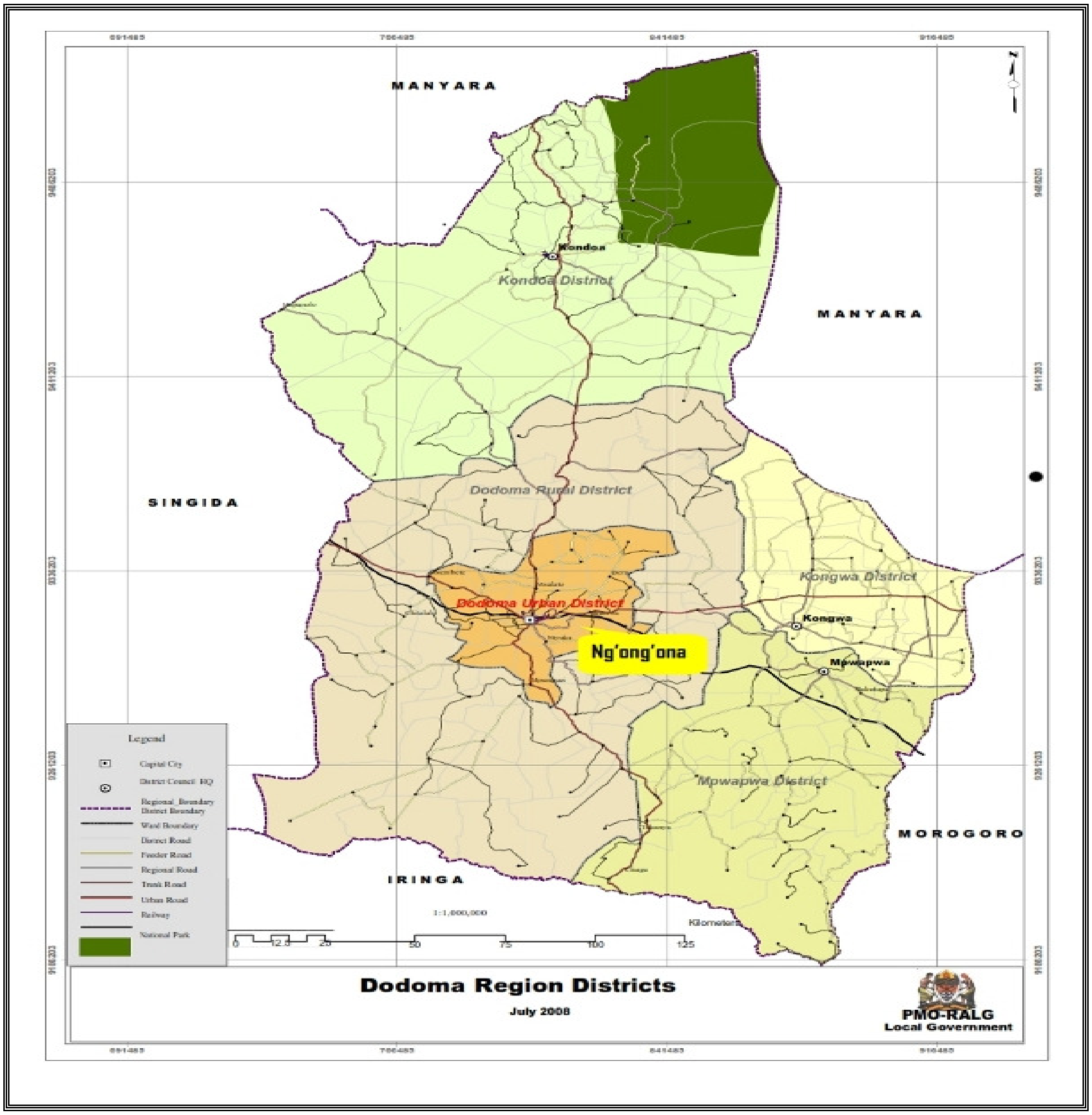


Figure 8: Map Showing Ng'ong'ona Village

Hand and animal-based agriculture conducted once per year is common where maize, groundnuts and beans are main food crops while sunflower and grapes are commercial crops.

Methodology

Sampling and water sample collection done on wet season of March 2014 from Ngo'ong'ona village was aiming at obtaining real field representative samples for treatment. Areas around sampled shallow well had little trees covered with sands everywhere. Among other sources of water, in the village this well is wider about 2 m, never cased and narrowing down to a depth of about 1.75 m usually filled with sands and sediments during rain seasons. Water samples were drew by using regularly public used plastic container into separate 1 L cleaned and rinsed polyethylene bottles, making total volume of 12 liters. Samples were collected once during the peak periods of 10 am. They were tightly closed into well labeled containers, and then placed into a cool jar before taking them to Dodoma Urban Water Supply and Sewage Authority laboratory for analysis as per Doug, J. 2007 guidelines.

Mature MO seeds obtained from the same village located nearby the University of Dodoma were dried, shelled, crushed then sieved to obtain fine powder. 0.2 g of the obtained powder was mixed with 1000 mL of distilled water to form solution of 200 mg/L, a similar approach to Ndabigengesere and Narasiah 1998. From five bottles one bottle remained with original 1000 mL sample while the remained four bottles had a 900 mL, 850 mL, 800 mL and 750 mL which were then filled with distilled water to the mark in order to vary turbidity of water samples. From another separate five bottles of 1 L, two bottles were acidified, another two bottles alkalized for the purpose of varying pH and the last bottle was left with its original pH. Into each bottle 200 mg/L of prepared and well shacked MO solution were added then vigorously stirred. Obtained mixtures were covered and allowed to stand for about 2 hours before filtering the supernatant out into clean beakers for analysis. Turbidity was measured by using nephelometric method (NTU), total hardness by EDTA titration (mg/L), electrical conductivity (μS/cm) and pH by potentiometric method, copper by flame ionization Atomic Absorption Spectrometry and salinity electrometrically (ppt) by using Hydrology Project, 1999 and Environmental Protection Agency, 2001 guideline and procedures without replications.

Results and Discussion

Turbidity Interference against pH and Conductivity

From figure 1, initial turbidity of water sample was 49.1 NTU with pH 6.23, after treatment pH decreased continuously with decrease in turbidity. This finding suggests that MO has excellent pH control at low turbid waters. The same applied to conductivity of water as per figure 2.

Turbidity Interference against salinity and TDS

Figure 3 reveals that no significant changes observed on salinity before and after sample treatment. This indicates that MO has no effect on water salinity contrary to TDS detailed in figure 4 that uniformly reduced as the turbidity level was decreasing.

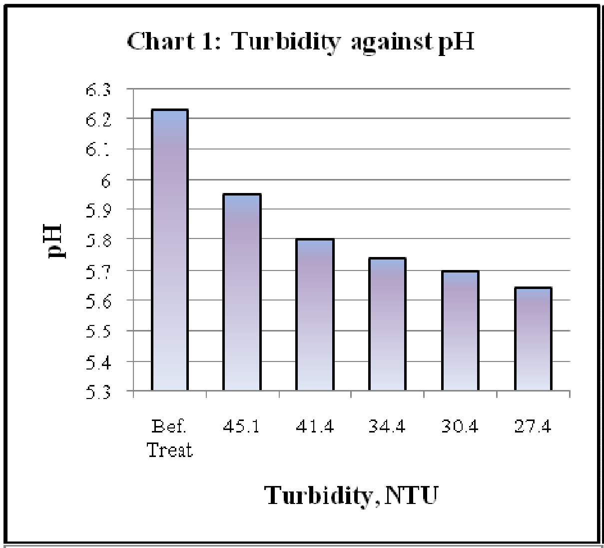


Chart 1: Turbidity against pH
pH
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
Bef. Treat
45.1
41.4
34.4
30.4
27.4
Turbidity, NTU

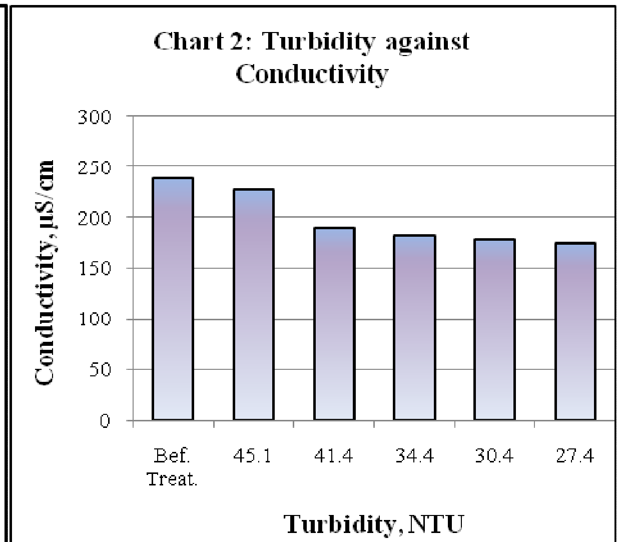


Chart 2: Turbidity against Conductivity
Conductivity, µS/cm
300
250
200
150
100
50
0
Bef. Treat.
45.1
41.4
34.4
30.4
27.4
Turbidity, NTU

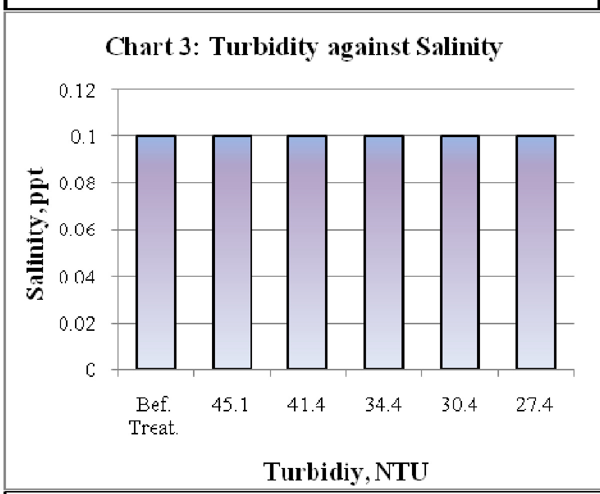


Chart 3: Turbidity against Salinity
Salinity, ppt
0.12
0.1
0.08
0.06
0.04
0.02
0
Bef. Treat.
45.1
41.4
34.4
30.4
27.4
Turbidiy, NTU

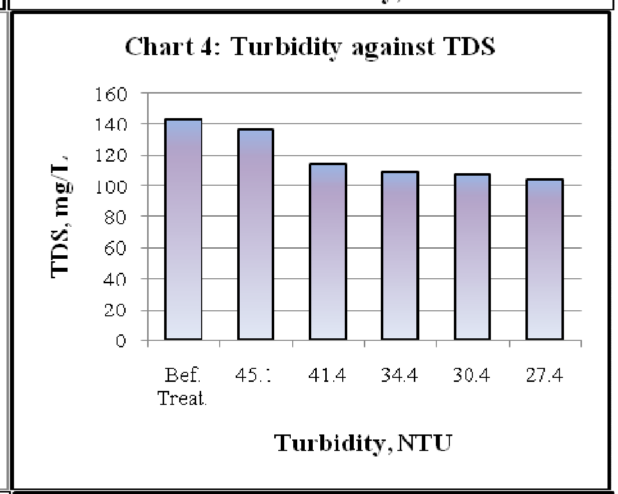


Chart 4: Turbidity against TDS
160
140
120
100
80
60
40
20
0
Bef. Treat.
41.4
34.4
30.4
27.4
Turbidity, NTU

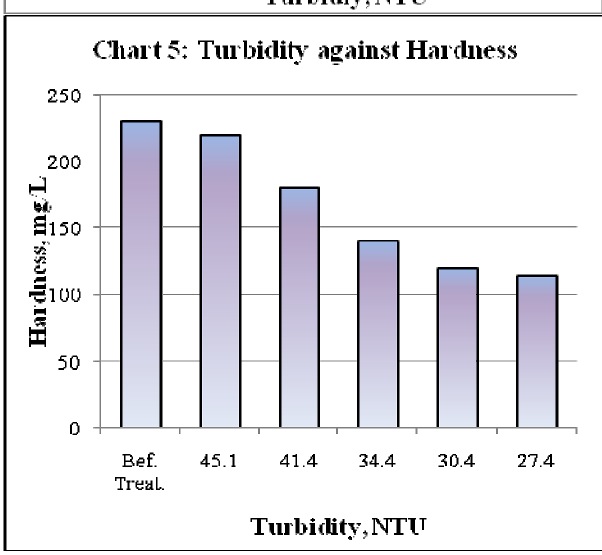


Chart 5: Turbidity against Hardness
Hardness, mg/L
250
200
150
100
50
0
Bef. Treat.
45.1
41.4
34.4
30.4
27.4
Turbidity, NTU

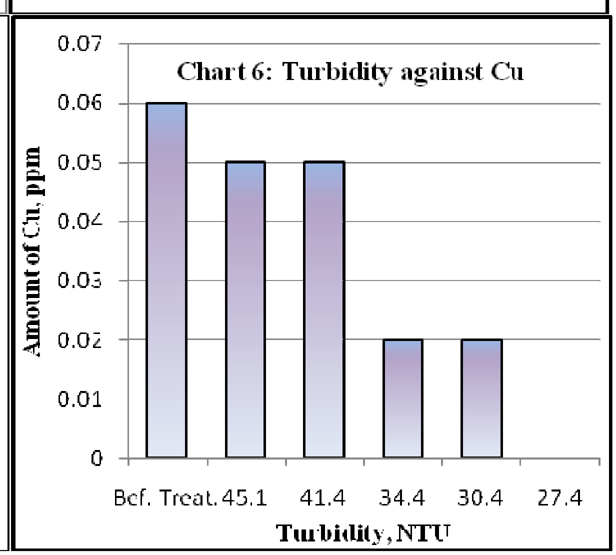


Chart 6: Turbidity against Cu
Amount of Cu, ppm
0.07
0.06
0.05
0.01
0
Bef. Treat.
45.1
41.4
34.4
30.4
27.4
Turbidity, NTU

Turbidity Interference against Total Harness and Cu contents

Figure 5 shows that total hardness of sample decreased from 230 to 114 mg/L as the turbidity of water was decreasing. Also the fact that Cu in Chart 6 fairly decreased from 0.06 to 0.02 mg/L after addition of MO is an indication of MO effectiveness at low turbidity samples.

pH Interference against Turbidity and Salinity

Observed from Chart 7 that, turbidity reduced after treatment of water with MO where optimal pH values being 8.70. This implied that MO performs well at the pH range 6.23 to 8.70. Both pH variations and MO treatment did not interfere with salinity reduction proving that MO has no effect on salinity content of water. However, Chart 8 revealed anomalous observation at pH 10.34 where turbidity increased to 0.4 ppm. This phenomenon definitely resulted from *in-situ* addition of alkaline counter-ions that contributed to generation of saline medium.

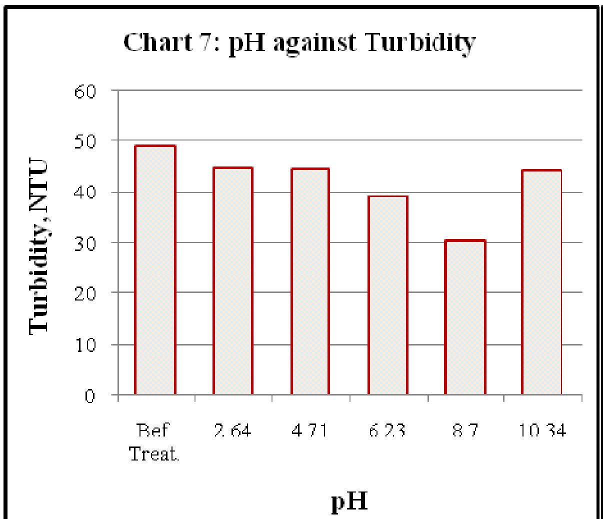


Chart 7: pH against Turbidity

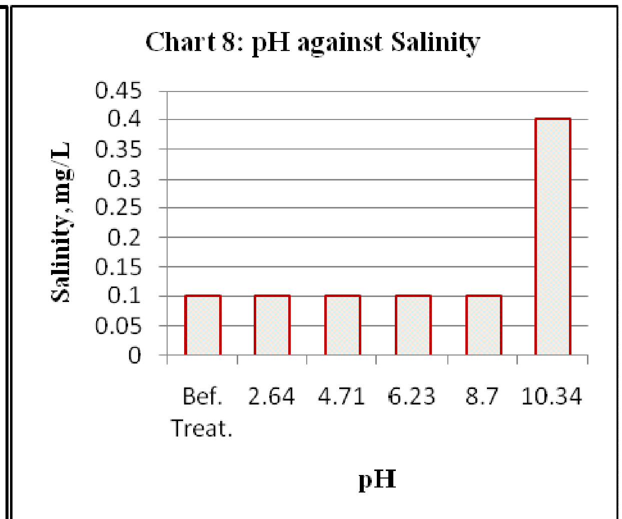


Chart 8: pH against Salinity

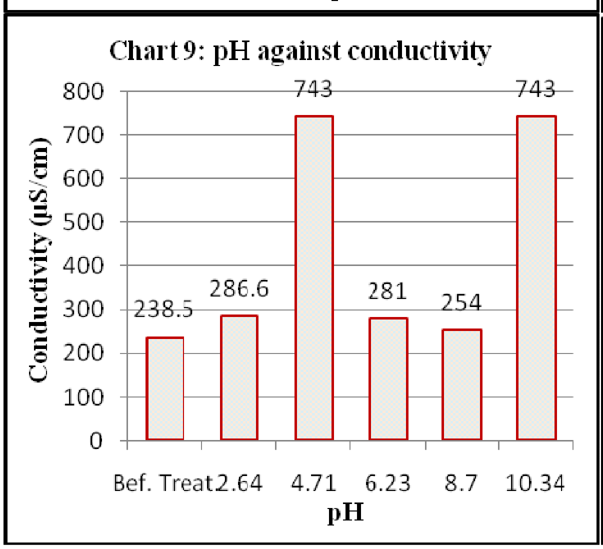


Chart 9: pH against conductivity

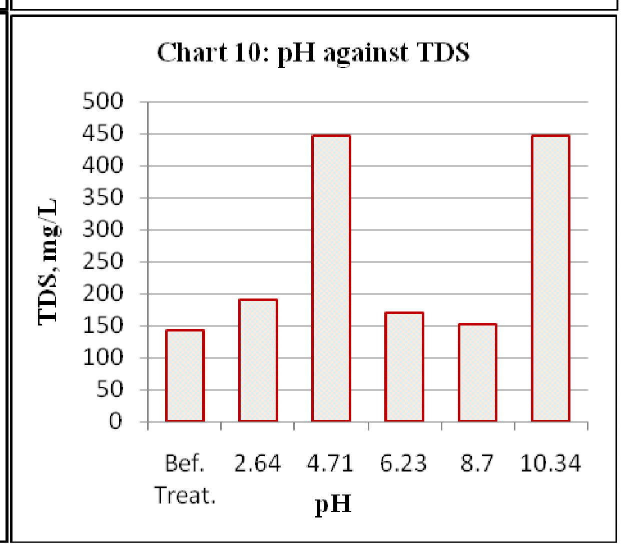


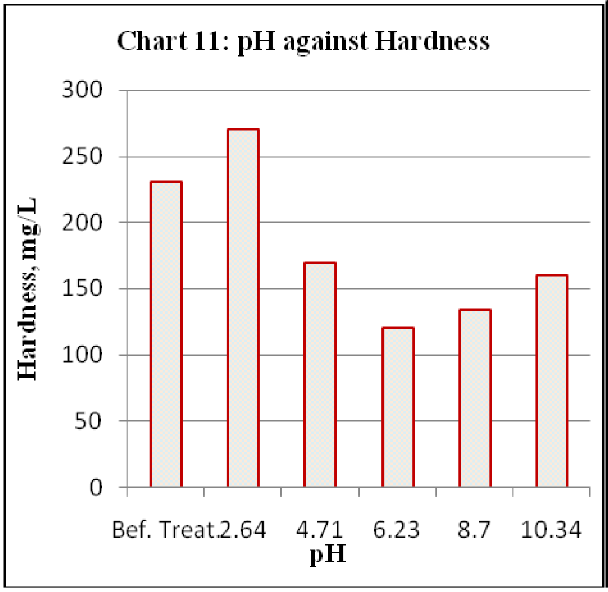
Chart 10: pH against TDS

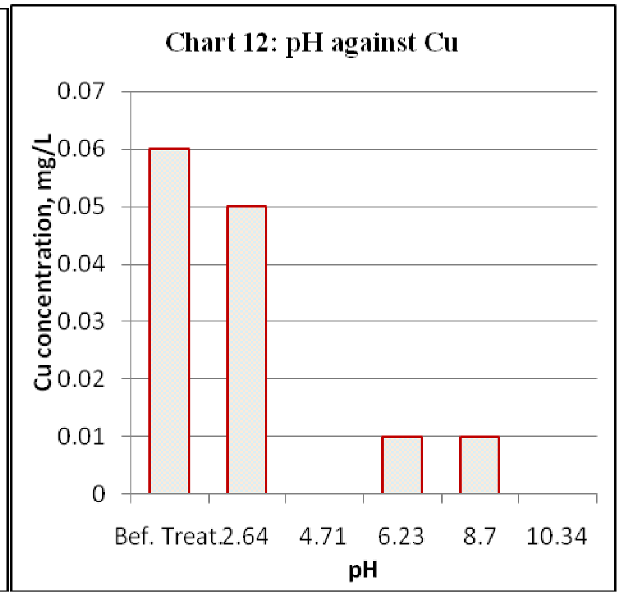
pH Interference against Conductivity and TDS

The observed conductivity increase at pH of 4.71 and 10.34 on Chart 9 was a result of optimal addition of ionic solution. High MO performance on conductivity reduction was between 6.23 to 8.70 pH values. The same scenario observed to TDS in Chart 10 since TDS is a function of conductivity.

pH Interference against Total Hardness and Cu contents

High performance in hardness reduction on Chart 11 observed at 6.23 pH value because at that point the pH values are relatively neutral. Similarly, MO show good performance to the same pH range in the treatment of Cu in Chart 12.





Conclusion and Recommendation

Moringa oleifera performance observed to work the best al low turbid levels and moderate pH range. Thus, because MO is ecological friendly and cheaper method for water purification it is therefore recommended in the rural areas. It's important that water treated with MO should be used within few days since long time storage results into water quality deterioration as also reported by Katayon *et al.* (2006).

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