BIOSORPTION OF TURBIDITY USING *MORINGA OLEIFERA* (MALUNGGAY) LEAVES

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ABSTRACT

This study attempts to determine the effectivity of Moringa oleifera (MO) leaves as a natural coagulant. Specifically, the study aims to determine the turbidity level of the water that is treated by Moringa oleifera leaves and determine the quantity of MO leaves that will be used to remove turbidity. The researchers predicted that MO leaves are effective coagulant in reducing the turbidity level of the water. In addition, MO leaves can completely absorb turbidity in water. Sythetic turbid water was prepared from solid Kaolin powder. MO leaves were oven-dried until excess water was removed afterwards; it was activated by soaking in NaCl solution. Coagulation efficiency test was performed in two batches: (1) using activated MO leaves; and (2) using non-activated MO leaves. The Nephelometric Turbidity Unit (NTU) was identified using Merck SQ Method 113.Based on the result of the testing of Turbidity levels of the samples sent to SGS, the MO leaves were not able to absorb the turbidity of the sample water hence it worsen the water turbidity as the chlorophyll combines with the solutions. Further test must be employed to determine the complete absorptive capacity of the Moringa oleifera leaves.

Keywords: *Turbid Water, Nephelometric Turbidity Unit, Biosorption, Moringa oleifera, Turbidit*

INTRODUCTION

Water is very essential to our lives. The search for clean and healthy water is already a subject of priority concern among countries. The World Health Organization defines potable water as a clear, transparent, odorless, no objectionable taste and free from microorganisms or chemicals in concentration lead to a risk to human health (Ali,Badr, Fouad, El-hefny, 2008). Most people especially in remote areas are exposed to hazards from pollutants in drinking water. Water treatment is used to remove those pollutants and to obtain palatable drinking water. Many chemical coagulants are used in conventional water treatment processes. However, studies have reported that usage of those chemical coagulants could have a bad effect on people's health. The use of biological materials like plants to clarify turbid raw water is not a new idea. In fact, indigenous material like charcoal is used to treat water and lower its turbidity level. Charcoal can be used as an effective fiber medium for the pre-treatment of wastewaters and can also be an alternative for gravel. There is even a study that shows how charcoal can performed better than gravel in turbidity removal (Nkwonta, Olufayo, Ochieng, Adeyemo, Otiemo, 2010).

Today by means of industrialization, pollution is present in our environment, especially on our water systems. Water contamination is due to improper disposal of chemicals from factories and from people's waste throw in the water system. Such pollution may occur at the time of extraordinary situations. Such a situation is triggered by the failure of large tanks containing pollutants. With a certain approximation we may consider that in a short period of disposal there occurs only the displacement of clean water from the space surrounding a tank and the filling of this space with sewage (Kerimova, 2011). This has resulted to many health problems that can affect our human body system. There are many methods of removing the chemical wastes on water but it is too expensive and needed high maintenance on each process. There are low-cost coagulants that are available but this study aims to do a coagulant that can be attained easily.

Turbidity is caused by particulates in the water and it is the same as with cloudiness (Satterfield, 2006 p.1). Turbidimeter was used to measure the turbidity level of the water (Bina, Mehdinejad, Dalhammer, 2010). Turbidity is a principal physical characteristic of water. Also, it is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. It is caused by the impurities or suspended matter that interferes the clarification of water. These impurities may consist of soil, deposit, finely separated inorganic matter, soluble color organic compounds Basically, coagulation is the process of getting particulates to bond collectively (Satterfield, 2006).

Coagulation is achieved by the addition of chemical reagents, which by a bonding or adsorption mechanism abolish the repulsive forces on the colloidal particles surface. These reagents are called coagulants. Poor developed countries used traditional processes of water purification have been using native sources of vegetable, animal or mineral nature, as coagulants. The use of *Moringa oleifera* seed as a coagulant in the removal of water turbidity would be a possible substitute and or supplement to the usual chemicals (Abbas, 2001).

Moringa oleifera, a tropical plant that has been shown to be one of the most promising natural coagulants for the removal of turbidity in raw water for drinking purposes, with a potential usage in tropical countries. It contains active agents having excellent coagulation properties. Seed extracts have been reported for its ability to decrease clay and bacteria contents in raw water (Fahmi, Najib, Ping, Hamidin, 2011). The water soluble *Moringa oleifera* lectin which is a component of *Moringa* seeds is implicated on antibacterial effect against *Staphylococcus aureus* and E. coli cell growth. The seed extract could promote coagulation and inactivation of *Staphylococcus aureus* in the water (Ferreira, Napoleão, Santos, Sá, Carneiro-da-Cunha, Morais, Silva-Lucca, Oliva, Coelho, Paiva, 2011). The seeds of *Moringa Oleifera* have been traditionally used in many rural areas of Africa and Asia for drinking water purification as they possess strong coagulation properties for sedimentation of suspended mud, turbidity and give a disinfecting effect in pathogens. This is particularly true in the remote areas of West and East Africa (Ndibewu, Mnisi, Mokgalaka, McCrindle, 2011). *Moringa oleifera* is among the 14 species of trees that belong to genus Moringaceae (Bina, Mehdijinad, Dalhammer, Rajarao, Nikaeen, Attar, 2010). It is the most widely known species and others still try to research

into their other use. It is called a clarifier tree because of its coagulating property (Ndibewu, Mnisi, Mokgalaka, McCrindle, 2011). On account of the enormous pharmacological significance and water coagulation properties of this plant, efforts have been made by various groups of workers to isolate its constituents responsible for these activities while much less research has focused on the study of its metal biosorption capacity. This explains why literature on heavy metal removal in aqueous systems using *Moringa oleifera* is very exiguous (Ndibewu, Mnisi, Mokgalaka, McCrindle, 2011).

Chlorophyll plays an important role in the absorption of light energy of the plant. Chlorophyll a is found in all green plants including algae (Kolitari, Gjyli, Mukli, Vukaj, 2013). For this reason it can be used to estimate the quantity of algae present in a water body. Chlorophyll can be extracted with a range of solvents. After extraction of the chlorophyll pigments with 80% acetone or 100% methanol, they can be measured in the spectrophotometer. When measured in the red light part of the spectrum there is no interference through absorbance by carotenoids (Poorter, H & Berkel, Y.J.V., 2011).

It is very important to find an effective new material and an innovative way for the biosorption of turbidity. This can be a very big help to many poor communities on our country that lack on water supply. There are studies showing the efficacy of *Moringa oleifera* seeds as a biosorbent, coagulant and turbidity remover. This study attempts to determine the effectiveness of *Moringa oleifera* leaves as a natural coagulant. It also aims to determine the turbidity level of the water that is treated by *Moringa oleifera* leaves. Moreover, find out the quantity of *Moringa oleifera* leaves that will be used to remove turbidity.

MATERIALS AND METHODS

Preparation of Synthetic Turbid Water

The solution for synthetic turbid water was prepared by dissolving Kaolin ($Al_2Si_2O_5(OH)_4$) powder to distilled water to yield 0.001 M. Distilled water was used in the solution because it does not contain any mineral that can affect the result of the turbidity test. The suspension was shaken until there was no trace of insoluble Kaolin powder. This is to ensure uniform mixing of Kaolin particles. The solution was left for 24 hours to allow complete hydration of particles. The suspension will undergo sedimentation.

Preparation of *Moringa oleifera* Coagulant

The *Moringa oleifera* leaves were obtained from San Andres Bukid, Vito Cruz, Manila. These were oven-dried for 45 minutes until all excess water from the leaves were eliminated. After the drying process, the leaves were osterized until it became fine powder using an osterizer. Different masses were added to 100 mL NaCl solution – 5 grams, 10 grams, 15 grams, 20 grams, 25 grams –

and the sodium chloride solution was used to extract the active component of *Moringa oleifera*. The MO leaves were soaked for 2 minutes (Nurfahasdi, Ridwan, Selamat, 2011).

Coagulation Efficiency Test

300 mL of synthetic turbid water was subjected to coagulation efficiency test. Activated *Moringa oleifera* leaves were added to the five bottles containing turbid water. Separate five samples of turbid water was tested with oven-dried non-activated *Moringa oleifera* leaves. Container was the capped sealed and shaken for 25 minutes.

Turbidity Test

After the MO leaves were allowed to settle at the bottom, samples were obtained by pipetting from the bottle 3 centimeters on top of the sediments. Samples were then brought SGS Philippines, Makati City for further turbidity analysis.

RESULTS AND DISCUSSION

Table 1. Result of Turbidity Test Using Activated MO leaves (Using Merck SQ Method 113)

Sample	Turbidity
Stock Solution	236 NTU
A1 (5 grams)	299 NTU
B1 (10 grams)	368 NTU
C1 (15 grams)	394 NTU
D1 (20 grams)	750 NTU
E1 (25 grams)	1575 NTU

Table 2. Result of Turbidity Test Using Non-Activated MO leaves (Using Merck SQ Method 113)

Sample	Turbidity
A2 (5 grams)	385 NTU
B2 (10 grams)	1285 NTU
C2(15 grams)	1445 NTU
D2 (20 grams)	1755 NTU
E2 (25 grams)	3380 NTU

In Table 1, the initial turbid sample has the turbidity rate of 236 NTU (Nephelometric Turbidity Units) and was tested through the Nephelometer by using the Merck SQ method 113. Starting with the samples with NaCl solution, sample A1 that contains 5 grams of MO (Moringa Oleifera) with NaCl solution resulted with the turbidity rate of 299 NTU that is 63 NTU higher from the initial turbidity rate. Sample B1 with 10.09 grams of MO with NaCl solution possessed the turbidity rate of 368 NTU that has 132 NTU greater than the initial NTU. Sample C1 with 15.20 grams MO with NaCl solution has 394 NTU that is 158 NTU greater than the initial turbidity rate. Sample D1 with 20.05 grams of MO with NaCl solution has 750 NTU of turbidity rate, which is 514 NTU higher. Sample E1 with 25.03 grams of MO with NaCl solution possess the turbidity rate of 1575 NTU, 1339 NTU higher than the initial NTU.

In Table 2, proceeding with the samples that do not possess NaCl solution, sample A2 with 5.05 grams of MO has the turbidity rate of 385 NTU, 149 NTU higher than that of the initial turbidity rate. Sample B2 with 12.14 grams of MO with the turbidity rate of 1285 NTU is 1049 higher than that of the initial turbidity rate. Sample C2 with 12.14 grams of MO has 1445 NTU, 1209 NTU higher than that of the initial turbidity rate. Sample D2 with 20.07 grams of MO has the turbidity rate of 1755 NTU, 1519 NTU higher than the initial turbidity rate. The final sample, E1 has 25.01 grams of MO that has the turbidity rate of 3380 NTU, 3144 NTU higher than the initial turbidity rate.

We can clearly see the result of adding 5g of MO to each sample causes the turbidity rate to be higher than the previous sample containing much less MO. Turbidity rates went as high as 3144 NTU difference for the samples without NaCl solution and as much as 1339 NTU difference for the sample with NaCl solution. Looking back at the results, greater turbidity rates were recorded for the samples that do not involve NaCl solution. The explanation to this is that the NaCl solution extracts the active component of MO that is said to clear turbidity.

CONCLUSION

Based on the result, we can say that the *Moringa oleifera* leaves are not a source of Biosorption. Hence, it worsens the water turbidity as the chlorophyll combines with the solutions (Snyder, 2007). MO leaves are not effective as a natural coagulant. As the quantity of leaves added to the solution increases, the more it will become turbid. The turbidity level of the water that has been treated by oven-dried MO leaves was very high. In contrast, MO leaves that treated with NaCl solution has much lesser NTU.

RECOMMENDATION

Having a failed result in the experiment, we are recommending the future researchers that they need to make sure to sundry the *Moringa oleifera* for 3-5 days for easier grinding. The Chlorophyll must be removed so that the color of the leaves will not combine with the turbid water.

The amount of chlorophyll in a lake is just one example of a factor that affects turbidity; high amount of chlorophyll can lead to high turbidity and murky water (Snyder, 2007).

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