PURIFYING TURBID WATER BY MORINGA SEEDS AND SAND FILTER METHODE AT NORTH HUIDU VILLAGE, GORONTALO DISTRICT, INDONESIA

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ABSTRACT

Water is a essensial for live. Water for consumption purpose needs to be treated to meet the quality guidelines of 5 Nephelometric Turbidity Unit (NTU) according to World Health Organization. There was some treatment like the use of chemical water treatment agents, which are mostly imported and are usually very expensive, and toxic. The community of North Huidu have a serious problem with turbid water. The community service team of Health Polytechnic of Gorontalo want to solve this problem. Team introduce moringa seed and sand filter as purifier water. As an underutilized tree in Gorontalo Province, Moringa oleifera (drumsticks) seeds can be used as a coagulant agent that can purify turbid water. The community service was held at 21 November 2018 at Village Office of North Huidu and attended by 50 people. After the average of pretest was 73 and the average of post test was 82. It means there was a significant enhancement of knowledge about purifying water. Moringa seeds and sand filter can be used as effective purifier at North Huidu Village.

***Keywords*:** *Moringa, Purifying, Water, turbid, sand filter*

INTRODUCTION

Water is a resource that is essential for life and is required by almost every living organism. This resource is, however, becoming very limited in its pure state due to the many anthropogenic means of contamination which arise from the different industrial advancements made over the years. Water pollution is a serious problem for the entire world. Water pollution has contributed to neg-ative environmental and human health impacts [34]. River and well water are 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. 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).

Water for consumption purpose needs to be treated to meet the quality guidelines of 5 Nephelometric Turbidity Unit (NTU) according to World Health Organization [32].

Historically, the use of natural materials of plant origin to purify water has

been practiced for long [13]. 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 [34].

The community of North Huidu Village have some problem with turbid water. The community service of Health Polytechnic of Gorontalo want to inform moringa seed and sand filter method as purifier turbid water.

LITERATURE STUDY

Moringa has been described as native to India and widely grown in the tropics [34]. Moringa oleifera (Saijan or drumstick), a cos-mopolitan tropical, drought-tolerant tree, available throughout the year, has been well documented for its various pharmacological importance, viz., its analgesic, antihypertensive and anti-inflammatory effects (Joshi et al. 2012). It called miracle tree [29].

It is one of the richest plant sources of Vitamins A, B {1,2,3,6,7}, C, D, E and K. The vital minerals present in Moringa include Calcium, Copper, Iron, Potassium, Magnesium, Manganese and Zinc. It has more than 40 natural anti-oxidants. Moringa has been used since 150B.C. by ancient kings and queens in their diet for mental alertness and healthy skin. The leaves, pods, seeds, gums, bark and flowers of Moringa are used in more than 80 countries {including Pakistan} to relieve mineral and vitamin deficiencies, support a healthy cardiovascular system, promote normal blood-glucose levels, neutralize free radicals {thereby reducing malignancy}, provide excellent support of the body's anit-flammatory mechanisms, enrich anemic blood and support immune system. It also improves eyesight, mental alertness and bone strength. It has potential benefit in malnutrition, general weakness, lactating mothers, menopause, depression and osteoporosis. It is also used to make an efficient fuel, fertilizer and livestock feed. Moringa is an edible extremely safe plant [18] & [12].

The powdered seed of the M. oleifera has coagulating properties that have been used for various aspects of water treatment such as turbidity, alkalinity, total dissolved solids and hardness A research project was commissioned to investigate the performance of Moringa oleifera compared with that of aluminium sulphate (Al2(SO4)3) and ferric sulphate (Fe2(SO4)3), termed alum and ferric respec- tively. A series of jar tests was undertaken using model water, different raw water sources and hybrid water containing a mixture of both of these types of water. The model water consisted of deionised water spiked with Escherichia coli (E. coli) at 104 per 100 ml and turbidity (146 NTU) artificially created by kaolin. Results showed that M. oleifera removed 84% turbidity and 88% E. coli, whereas alum removed greater than 99% turbidity and E. coli. Low turbidity river water (<5 NTU), with an E. coli count of 605 colony forming units (cfu)/100 ml was treated with M. oleifera and ferric. Results showed an 82% and 94% reduc- tion in E. coli for M. oleifera and ferric respectively. Tests on turbid river water of 45 NTU, with an E. coli count of 2650 cfu/100 ml, showed a removal of turbidity of 76% and E. coli reduction of 93% with M. oleif- era. The equivalent reductions for alum were 91% and 98% respectively. Highly coloured reservoir water was also spiked with E. coli (104 cfu/100 ml) and turbidity (160 NTU) artificially created by kaolin; termed hybrid water. Under these conditions M. oleifera removed 83% colour, 97% turbidity and reduced E. coli by 66%. Corresponding removal values for alum were 88% colour, 99% turbidity and 89% E. coli, and for ferric were 93% colour, 98% turbidity and 86% E. coli. Tests on model water, using a secondary

treatment stage sand filter showed maximum turbidity removal of 97% and maximum E. coli reduction of 98% using M. oleifera, compared with 100% turbidity and 97% E. coli for alum. Although not as effective as alum or ferric, M. oleifera showed sufficient removal capability to encourage its use for treatment of turbid waters in developing [22]. The results showed the significant decreased, up to 92% in the reduction of microbial counts. Treatment with these natural extracts also helped in the coagulation of the heavy metals like lead, copper, nickel etc. present in the treated water samples [11].

A research in Gorontalo found that one seed of Moringa able to purifying oneliter turbid water. To simply the procedure, team have modified the seeds into powders [27].

Pieces of evidence indicated that wastewater treatment using the conventional physical method and chemical coagulants is costly and caused side effects to the health of humans and their existing environment (Fig. 1). Coagulants can either be inorganic such as aluminum-sulphate, poly-aluminum-chloride or synthetic organic polymers such as polyacrylamide derivative [31].

Historically, the use of natural materials of plant origin to purify water has been practiced for long [13]. 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 [34].

Moringa seeds contain between 30-42% oil and the press cake obtained as a by-product of the oil extraction process contains a very high level of protein (Olsen, 1987). Some of these proteins (approximately 1%) are active cationic polyelectrolytes having molecular weights between 7-17 K Dalton (Olsen, 1987). The cationic polyelectrolytes neutralize the colloids in muddy or dirty water since the majority of these colloids have a negative electrical charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimenting mineral particles and organics in the purification of drinking water, for cleaning vegetable oil, or for sedimenting fibers in the juice and beer industries. It thus works as a primary coagulant as natural bridges are continuously formed between the colloid particles. In contrast, industrial coagulants such as alumina can be toxic. Their proper use requires qualified personnel and the majority of underdeveloped countries don't have the means of producing them. In addition, these industrial coagulants are expensive and represent a considerable drain on the hard currency reserves of developing countries. It hasbeen employed with particular effectiveness in both Egypt and Sudan for cleaning water from the Nile specifically for human consumption (Berger et al., 1984). The wings are removed from the dry seeds and then the seeds are ground to powder. The powder is mixed with water, agitated for approximately five minutes and after about an hour, then filtered through a piece of woven fabric to obtain pure water. Alternatively, a cloth containing the seed powder is suspended in water, generally overnight, to coagulate impurities (Berger et al., 1984). The cloth containing the seeds is then removed, and the purified water is decanted leaving behind the coagulated particles on the bottom. Up to 99% of colloids can be removed. Only one seed is required per litre for slightly contaminated water and two seeds for very dirty water [24].

Seeds of the tropical tree Moringa oleifera contain small storage proteins able to flocculate particles in suspension in water. The cDNA encoding one of these flocculent proteins, MO2.1, was cloned and the recombi- nant protein was

expressed in Escherichia coli. The flocculent activity of the purified recombinant MO2.1 was assayed on clays and bacteria using light and confocal microscopy and GFP-overexpressing bacteria. We show that MO2.1 is able to aggregate montmorillonite clay par- ticles as well as gram-positive and gram-negative bacteria. MO2.1 contains eight (13.1%) positively charged ami- no acids (7 arginines and 1 histidine) and only one (1.6%) negatively charged residue (aspartic acid). As a consequence, the protein in solution is highly positively charged, as illustrated by a theoretical pI of 12.6. It has been proposed that the coagulation mechanism of MO2.1 mainly relies on a patch charge mechanism (Ndabig- engesere et al. 1995; Gassenschmidt et al. 1995). Posi- tively charged proteins bind to part of the surface of neg- atively charged particles through electrostatic interac- tions. This leads to the formation of negatively and posi- tively charged areas of the particle surface. Due to parti- cle collision, interparticle neutralization of the different- ly charged sectors and formation of flocs take place. In- terestingly, MO2.1 is also very rich in glutamine (14 resi- dues, 23%). It has been shown that glutamine-rich re- gions in proteins cause their aggregation [10]. Traditionally, the seeds are used in rural areas of Sudan and Malawi for the clarification of drinking water (Muyibi and Evison 1995; Anwar et al. 2007). Flocculation of raw Nile water revealed that M. oleifera seeds could remove up to 97% of the algae present (Shehata et al. 2002). Dehusked M. oleifera press cake is efficient in the removal of hydrophobic organic pollutants from water (Boucher et al. 2007), and extracts might remove other pollutants, such as heavy metals and surfactants (Beltrán- Heredia and Sánchez-Martín 2008, 2009). M. oleifera pods are efficient in absorbing organic pollutants and pesticides (Akhtar et al. 2007a, b). High-quality activated carbon can be prepared from the waste husks of M. oleifera (Pollard et al. 1995; Warhurst et al. 1997a), which could effectively remove up to 98% of the cyanobacterial microcystin-LR (Warhurst et al. 1997b). In addition to the strong water- clarifying properties, Moringa seeds have also been reported removing more than 90% of cercariae from the water phase (Olsen 1987). Bacterial numbers can be reduced drastically due to coagulation (Madsen et al. 1987), and a pronounced hygienic effect is caused by a strong antibacterial potential against Gram-negative and Gram-positive bacteria (Suarez et al. 2003, 2005). How- ever, so far, no study has examined direct effects of filtrates from crushed M. oleifera seedsongrowthof cyanobacteria and on their ability in terminating cyano M. oleifera seed extract exerts bactericidal activity in vitro against Gram-positive and Gram-negative bacteria (Cáceres et al. 1991; Ali et al. 2004; Oludoro and Aderiye 2007). This study is the first one reporting a cyanobactericidal activity, which is in line with the findings of others as cyanobacteria are Gram-negative bacteria. Initially, the antimicrobial activity of Moringa seeds was attributed to the presence of 4-α-L-rhamnosyloxy benzyl isothiocyanate, the only known glycosidic mustard oil (Eilert et al. 1981). However, later studies revealed that the Moringa seed- derived polypeptide (Flo), which is responsible for the sedimentation, also mediated bacterial disinfection (Suarez et al. 2003). In The majority of the studies on water purification with M. oleifera seeds have focused on flocculation–coagulation; 97–99% reduction in turbidity can be reached, while 90% of bacteria and 99% of coliforms can be precipitated (Ali et al. 2004; Liew etal. 2006; Oludoro and Aderiye 2007). The results presented here of a clear cyanobactericidal activity of crushed Moringa seeds combined with a growing number of more frequent and

longer lasting cyanobacterial blooms (de Figueirdo et al. 2004; Paerl and Huisman 2008) show that Moringa seed extracts might have a potential as an effect-oriented measure lessening cyanobacterial nuisance, especially at household and community level in tropical regions [15].

In this study the experimental procedure was conducted and operated at 200 rpm for 4 minutes, followed by 40 rpm for 30 minutes and 1 hour of sedimentation. The Jar tests carried out before and after treatment with Moringa Oleifera seed powder to evaluate the quality parameters such as pH, turbidity, conductivity, Total Dissolved Solid (TDS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Ammonia-Nitrogen (NH3-N) and Nitrate-Nitrogen (NO3-N). The result obtained showed that conductivity, TDS and COD increase as the Moringa seed powder dosage increased. Moreover, the turbidity of the treated water decreased by 98.80% and 96.71% for high and low turbid water, respectively. Also, the maximum BOD reduction was 66.67% 27.27% for high and low turbid water, respectively. Lastly, the NH3-N and NO3-N values were unstable. The results obtained showed that the cross-flow filtration using microfiltration is sufficient to produce the natural coagulant which is more efficient and cost-effective. The coagulant in the seeds is believed to comprise of one or more proteins that act as a cationic polyelectrolyte. The soluble particles in the water attach to the active agent and bind them together to form large flocs in the water. It Lastly, optimum dosage of 0.05g/500mL MOSP was able to remove NO3-N. It was observed that the 1 mm microfiltration sizes performed better in terms of turbidity removal efficiency (98.80%) treated with 0.05 g (50 mg) of MOSP. In conclusion, 0.05g/500mL of MOSP used for river water treatment gave a significant improvement in the quality of water. (Qannaf, Zaid, & Ghazali, 2019)

Conventional jar test apparatus was used in coagulation process. The optimum dosages were obtained at 50 mg/L, 175 mg/L and 150 mg/L which gave represented residual turbidity of 3.73±0.09, 4.93±0.31 and 3.27±0.45 for alum, crude Moringa oliefera seed powder and defatted Moringa oliefera seed powder respectively. Total coliforms were reduced to between 93.48% to 96.96% by all the coagulants; However, E. coli was not detected in raw turbid water and clarified sample. In the study, it was observed that Moringa oliefera seed showed a good alternative as coagulants reducing water parameters to values below maximum permissible limits as stipulated by WHO [14].

An investigation on the effectiveness of Moringa oleifera seed for the treatment of domestic sewage was carried out in 15 litres plastic pots. Completely randomized design (CRD) experimental design was adopted. The treatments included: the control culture (no Moringa seed), 2 g of Moringa oleifera,4 gof Moringa oleifera and 6 g Moringa oleifera. Physical, bacteriological and chemical properties of domestic sewage were investigated before and after treatment. The turbidity value was reduced drastically for the treatments. Water hardness was reduced from 64.2 mg/l to 36 mg/l for the treatments. Alkalinity was reduced from 148 mg/l to 114 mg/l for the treatments, total solids were reduced from 1280 mg/l to 1129 mg/l for the treatments, suspended solids were reduced from 384 mg/l to 306.3 mg/l for the treatments, dissolved oxygen was reduced from 124.8 mg/l to 112.7 mg/l for the treatments, dissolved solids were reduced from 896 mg/l to 820.3 mg/l for the treatments, and acidity was increased from 0.84 to 2.02 for the treatments. The pH value was reduced from 9.6 to 7.5 for the treatments. BOD was reduced from 96.5 mg/l to 80.2 mg/l for the treatments and COD was reduced from 81.6 mg/l to 72 mg/l for the treatments. Generally, the

results showed that the higher the quantity of Moringa oleifera seed applied to sewage, the better the purification of the sewage [2].

Moringa seed (Zogale in Hausa) is applied as coagulant in place of Aluminium Sulphate (Alum) used in conventional treatment plants. Design and construction of a water treatment system based on average water demand for drinking of 25 litres per person per day is undertaken. Components of the system include a coagulant tank. Hand mixer, Sedimentation and Filtration tanks of diameters 0.690m, 0.230m, 0.391m and 0.44m respectively. Jar test analysis for Well, Borehole and surface water samples revealed that between 120,000 - 3000,000mg/L of Moringa seed powder is adequate enough to reduce the turbidity of Well and Borehole water samples to between 0 – 3 NTU, which satisfies WHO standards for portable water. The research is viewed as revolutionary for small household applications, particularly in rural areas, where water purification is absent and moringa widely consumed. Nigeria Application of plant coagulants such as Moringa oleifera is highly recommended for domestic water purification in Nigeria, where people are used to drinking contaminated turbid water. The low volume of sludge precipitation is biodegradable and hence environmentally sound technology. Furthermore, the flow of water from coagulation to filtration tank is achieved by gravity, thus eliminating the cost of pumping [4].

The aim of this community service was to solved North Huidu Vilage community about turbid water by introduce moringa seeds and sand filter as purifying method.

METHOD OF COMMUNITY SERVICE

Community service team of Gorontalo Health Polytechnic had a persuade North Huidu Village at Gorontalo District to use drumstick as simple and cheap natural coagulant of drinking water. The team demonstating the used of Moringa seed at Village Office of North Huidu at 21

November 2018. The team had socializated and demonstrated the purifying water by Moringa seeds and sand filter [20]. This event attended by head of village and community of North Huidu (50 people). There were pre and post test to ensure the effectiveness of this programme.

To prepare the seed for use as a coagulant, remove the seed coats including the "wings." The white kernel is then crushed to a powder using a mortar or by placing in a cloth on top of a stone and crushing. Two heaping teaspoons or two grams of the powder should be mixed with a cup of clean water in a bottle (e.g. a soda bottle). The water and moringa kernel powder should be shaken for five minutes to form a paste. This paste is then poured through a cloth strainer into 20 liters of the water to be purified. The water is stirred rapidly for two minutes, and then slowly for 10-15 minutes. Leave the bucket of water undisturbed for at least an hour. Impurities will then sink to the bottom. The water should be strained again into a storage container for use. This process removes 90-99% of impurities. If there is a possibility of disease in the water, it can be purified by chlorine, boiling or solarizing (placing in the direct sun in a clear bottle for two hours) [21].

RESULT AND DISCUSSION

Gorontalo community less to take advantage of Moringa both leaf and seeds. But the other hand, North Huidu Village have a problem that they have a turbid water from their well.

The team socializated and demonstrate two method of purifying turbid water, Moringa seeds and sand filter method.

The average of pretest was 73 and the average of post test was 82. It means there

was a significant enhancement of knowledge about purifying water.

There were not a measuarement of microbial count in this community service.

Moringa seeds contain some of proteins (approximately 1%) are active cationic polyelectrolytes having molecular weights between 7-17 K Dalton.

Table 1. Characteristic of Respondents

Category	Number	Procentage
Sex		
- Male	23	46
- Female	27	54
Age		
- <20	-	-
- 20-29	11	22
- 30-39	15	30
- 40-49	18	36
- >50	6	12
Village		
- I	15	30
- II	15	30
- III	20	40
Work		
- Farmer	20	40
- Seller	5	10
- Worker	16	32
- Others	9	18

Source: Primer data

The cationic polyelectrolytes neutralize the colloids in muddy or dirty water since the majority of these colloids have a negative electrical charge. This protein can therefore be used as a non-toxic natural polypeptide for sedimenting mineral particles and organics in the purification of drinking water. Kernels of Moringa oleifera contain significant quantities of low molecular-weight, (water-soluble proteins) which carry a positive charge. When the crusheed seeds are added to raw water, the proteins produce positive charges acting like magnets and attracking the predominantly negatively charged particles (such as clay, silk, bacterias, and other toxic particles in water). The flocculation process occurs when the proteins bind the negatives charges forming flocs through the aggregation of particles which are present in water. These flocs are easly to remove by settling or filtration. The material can clarify not only highly turbid muddy water but also water of medium and low turbidity [28].

This method was cheap and easy method forde veloping countries (specially at household level), The efficiency is independent of raw water pH, the processing doesn´t modify the pH of the water, it doesn´t alter the water taste (unless a very high dosis is added). The low volume of sludge precipitated is biodegradable and hence an environmentally sound technology.

Disadvantages of this method was the treatment makes the water clear and drinkable but the purified water might still carry some (very few) pathegonic germs or microorganisms, a secondary increase of the bacterial afterthe water coagulation could be possible, and coagulant is not available in pure form (should be prepared fresh), [28].

The use of Moringa seed powder as a natural coagulant, therefore, has no effect on measured parameters and was found to be most efficient at high turbid water. North Huidu Village as a purifier water.

CONCLUSION

Moringa seeds is effective used as a water purifying agent. The Nort Huidu Village Community can use Moringa seeds as a natural and effective water purifying agent. Powders from one of Moringa seed able to purify turbid water in 20 minutes.

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