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Purification of Water using *Moringa oleifera* Horse radish) Leaf Powder and Seeds Flour.

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Abstract

High cost of treated water in the rural communities makes people to resort to readily available water sources which are normally of low quality exposing them to waterborne diseases. The present study was carried out to confirm the effectiveness of seeds flour and leaf powder extracted from mature-dried Moringa oleifera seeds and leaves which are commonly available in most rural communities. During this study, surface water samples were collected for treatment by Moringa seeds and leaves in powdered form, resulting in an effective natural clarification agent for highly turbid and untreated pathogenic water. Application of this low cost Moringa oleifera seeds is recommended for eco-friendly, nontoxic, simplified water treatment where rural and peri-urban people living in extreme poverty.

Keywords: (*Moringa oleifera* seeds and leaves, cationionic protein, clarification agent, antimicrobial activity, human health)

Introduction

Chemical coagulants like Aluminum sulphate (alum) are used in drinking water treatment plant for purification process (Mangale *et al.*, 2012). This excess use of amount of chemical coagulants can affect human health as aluminum has also been indicated to be a causative agent in neurological diseases such as pre-senile dementia (Amagloh and Benang, 2009). In rural areas people living in extreme poverty are presently drinking highly turbid and microbiologically contaminated water as they lack knowledge of water treatment and also cannot afford the high cost of chemical coagulants.

Moringa oleifera (Moringaceae) is a fast-growing softwood tree indigenous to Northern India (Leone *et al*., 2015a). Naturally occurring coagulants are usually presumed safe for human health. All parts of the *Moringa* tree (leaves, seeds, roots and flowers) are suitable for human and animal consumption.

The leaves, which are rich in protein, minerals, β-carotene and antioxidant compounds are used not only for human and animal nutrition but also in traditional medicine (Leone *et al*., 2015b). The seeds contain a significant amount of oil (up to 40%) with a high-quality fatty acid composition (oleic acid > 70%) and after refining, a notable resistance to oxidative degradation will be recorded (Ahaotu *et al.*, 2013a). The oil is commercially known as ben oil. Its properties make it suitable for both human consumption and commercial purposes. Moreover, after oil extraction, the seed cake can be used in waste water treatment as a natural coagulant and also as an organic fertilizer to improve agricultural productivity (Ahaotu *et al.*, 2013b and Mangale *et al*., 2012). Clean water sources has always been a major problem in many developing countries, especially for the rural poor. Many rural dwellers, since they have no alternative, have to consume surface water either from rivers or rain-fed ponds (Emmanuel *et al.*, 2011 and Boskou, 2011).

Table 1. Proximate Composition of Moringa oleifera seeds

Nutrients	Percentage of Total Weight (grams)
Skin	35.08
Seed	64.92
Calcium	0.18
Phosphorous	0.69
Protein	36.00
Fat	32.09

After mixing one powdered seed in 1 litre of turbid water, all the solids will be coagulated and fallen to the bottom of the container after two hours as shown in Fig 1a below. By then, 98 per cent of the coliform bacteria were removed from the water. The settling occurs in one and the clarified water is stored in the second.

The use of *Moringa* seeds in water purification has an added advantage over the chemical treatment of water because it is biological and has been reported as edible. Ogunsina *et al.*, (2014) discovered that hardness removal efficiency of *Moringa oleifera* was found to increase with increasing dosage. These seeds also act as antimicrobial agent against variety range of bacteria and fungi (Rockwood *et al*., 2013).

Among all the plant materials that have been tested over the years, powder processed from the seeds from *Moringa oleifera* has been shown to be one of the most effective as a primary coagulant for water treatment and can be compared to that of Alum (conventional chemical coagulant).

Fig 1a: Water Purifying Properties

Fig1b. Water Clarity Using Grinded Moringa Oleifera Seeds with Moringa seed powder dirt sinks to the bottom in dirty water.

Fig 1 c. Moringa oleifera Leaf Powder

Fig 1 d. *Moringa oleifera* Tree displaying Mature Pods

Fig 1e. Moringa seeds without coatings.

Materials and Method

Collection of Moringa Seeds and Leaves

The *Moringa oleifera* seeds and leaves used for this work were obtained from the Forestry unit, Imo State Polytechnic Umuagwo, Nigeria as shown in fig 1d and e.

Processing of Moringa Seeds and Leaves

Moringa oleifera kernels were cleaned to remove stones, dirt, sand and other extraneous materials as shown in (Fig 1 e). The cleaned kernels were cracked by hand to remove the shell from the nuts as shown in (Fig 1 e) above. The seeds were dried in the cabinet oven at 60^0C for 2 hours, after which it was milled to flour in an attrition mill to obtain a smooth *Moringa oleifera* seeds flour. Also the horse radish leaves collected were dried at room temperature until the leaves became crispy. The leaves were then sent to a hammer mill to get the powdery form of the leaves as shown in (Fig 1c). The grinded horse radish leaves was mixed with baking soda and water in a container. The mixture

was then used to remove stained areas (kitchen sink, refrigerator wall and tile walls). Fine powder prepared was directly used as coagulant.

Purification of Water

Water samples were collected from Ota miri river water near the Department of Animal Production and Health Technology, Imo State Polytechnic Umuagwo, Nigeria was used for the study purpose. Treatment to water was assessed by directly using seed and leaf powder. The water quality parameters were checked before and after treatment. Doses of seed powder which is 50, 100 and 150 mg/l were selected for treatment by supporting table of Micheal Lea Clearing house, Low cost water treatment technologies for developing countries, Ottawa, Canada. (Table 2).

Table 2. Dose range of *M. oleifera* seed powder given by Mangale *et al*., (2012)

S/N	Raw Water Turbidity (NTU)	Dose Range of M. oleifera seeds Powder (mg/l)
1	**<50**	**50**
2	**50-150**	**100**
3	**>150**	**200**

The coagulant was mixed with drinking water sample and kept on the shaker for 45 min at 110 - 120 rpm. The settling time was 1 - 2 hours (depending on the water turbidity).

Results and discussion

Water samples were collected from Otamiri River, following drinking water quality parameters were analyzed before and after the treatment of various doses of *Moringa oleifera* seed and leaf powder.

Colour. The initial brown colour of the river water sample was completely removed after the treatment of *M. oleifera* seed powder. This suggests that the *M. oleifera* seeds show absorbent properties. Good clarification is obtained if a small cloth bag filled with the powdered seeds of the moringa is swirled round in the turbid water (Kien *et al.,* 2009 and Amagloh and Benang, 2009).

Acidity. Acidity during the present study was observed to be 35 mg/l for the river water sample. At various doses of *M. oleifera, it* was observed that the acidity decreased and was present in the range of 5-20 mg/l within the limits of WHO standards. When the seeds were crushed and added to water, the protein produces positive charges acting like magnets and attracting predominately negatively charged particles leading to maintain acidity within range.

Alkalinity. Alkalinity during the present study was observed to be 104 mg/l. At various doses of *Moringa oleifera* seed powder, it was observed that the alkalinity reduced after the treatment at 50 mg/l dose but at higher doses of 100 and 150 mg/l, the alkalinity was increased. The alkalinity observed was in the range of 95-100 mg/l which was within the limit. The *Moringa oleifera* seed extract appears to have natural buffering capacity. The chemical constituent of the precipitate was however not known, but it was found that alkalinity reduction in the coagulation of water sources was visible in using *Moringa oleifera* seeds.

Chloride. Chlorides initially were 17 mg/l in the river water sample, but often treatment with Moringa seed reduced it three fold. This was because cations from *Moringa* seed attract the negatively charged chloride ions present in water and neutralize the chlorides. Chloride range was 5-9 mg/l in water samples and is within limits of drinking water standards (Srivastava *et al.,* 2011).

Hardness. Hardness ranges from 100-170 mg/l after treatment which is within the limits of WHO standards. As a polyelectrolyte it may therefore be postulated that *Moringa oleifera* removes hardness in water through adsorption and inter-particle bridging (Mishra *et al.,* 2011). These authors further stated that Moringa seed powder as a polyelectrolyte removes hardness in water through adsorption and inter-particle bridging. The higher value for the surface water samples was due to the fact that they contain hardness due to calcium, magnesium and other hardness causing substances. This implies that as the number of hardness increases, the required dosage of *Moringa oleifera* seed powder *increases*.

SPC (Standard Plate count). SPC means total bacterial count which is calculated quantitatively. Due to high microbial load, drinking water samples are unsafe for drinking purpose. Initial Standard Plate Count was beyond the limit of USPH standards in river water sample. The *Moringa oleifera* seed powder treatment had an added advantage of reducing microbial load. After the treatment, the numbers of bacterial colonies were reduced with increased dose of *Moringa* seed powder. However after treatment, SPC which was total bacterial count range was found in between 104 to 105 and is within permissible limit in river water. At 100 and 150 mg/l dose of *Moringa* seed powder, the plate shows very few colonies (fig 1b) as treated. It was further more observed that the *Moringa oleifera* seed powder act as an antimicrobial agent against microorganisms (Kien *et al.,* 2009).

MPN (Most Probable Number). MPN means total coli forms which are calculated quantitatively. The presence of coli forms indicates that the water was feacally contaminated and not safe for drinking

purpose. Due to coli forms, various waterborne diseases occur and therefore, MPN should be nil for drinking water. In the present study, it was observed that the initial MPN was present beyond the limits of WHO standards. After the treatment, MPN / 100 ml coli form was decreased from low dose to high level dose of *M. oleifera* seed powder**.** The MPN was present in the range 20 - 180 coli forms/ml in all samples after the treatment which indicates that it was above the limits of WHO standards.

Conclusion

Moringa oleifera seeds acts as a natural coagulant, flocculent, absorbent for the treatment of drinking water. It reduces the total hardness, turbidity, acidity, alkalinity, chloride after the treatment. It also acts as a natural antimicrobial active against the micro-organisms which is present in the drinking water and decrease the number of bacteria. The MPN test had shown positive which indicates the water samples are feacally contaminated and not safe for drinking. MPN test reading was reduced after treatment of higher dose at 150 mg/l of *Moringa* seed powder. If we can use combined *Moringa oleifera* seed powder and chlorine it can give best results and the water can be suitable for drinking.

Moringa oleifera seed is not giving any toxic effect. It is eco-friendly and cheaper method of purification of water and therefore can be used in the rural areas where no facilities are available for the treatment of drinking water. After the treatment of *Moringa oleifera* seed, sludge gets settled at the bottom of tank.

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