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ANTIBACTERIAL AND COAGULANT PROPERTIES OF LOCALLY GROWN MORINGA SEEDS IN SWAZILAND

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ABSTRACT

Moringa oleifera is a tree that has many valuable properties including medicinal and nutritive properties. Different parts of the plant have been found to possess important antioxidants, vitamins and minerals. The current study investigated the coagulant and antimicrobial properties of moringa seeds on raw water. The seeds were collected from the highveld, middleveld, and lowveld areas of Swaziland. The coagulant and antimicrobial properties were determined by adding either an aqueous solution of moringa seed powder or the powder directly into raw water. The water was taken from Lobamba river and Mbekelweni dam. It was observed that using an aqueous solution containing 200mg/L moringa seed powder was not effective in treating the water. Both turbidity and Escherichia coli counts remained high after 22h of contact. After adding the moringa powder directly into the raw water, the turbidity was significantly reduced after 7h contact at a concentration of 0.2g/L moringa powder. The turbidity was reduced to less than 5NTU, the recommended WHO limit for safe drinking water. Higher amounts of moringa seed resulted in increased turbidity, which did not settle even after 7h contact time. E. coli counts remained high in the treated water (>200 MPN/100mL) at all concentrations of moringa seed powder used even after 22h contact time. Safe drinking water should not have viable E. coli. Microbial counts (MPN/100mL) between 100 and 1000 are considered high risk in drinking water. It can be concluded that moringa seed has some coagulant properties which may be suitable for treating raw water. However, the seeds did not exhibit antimicrobial properties. The treated water was not suitable for drinking because of the high microbial load.

INTRODUCTION

Moringa oleifera is a tree that has many valuable properties including medicinal and nutritive properties (Anwar et al., 2007). Different parts of the plant have been found to possess important antioxidants, vitamins and minerals. Its leaves, bark, flowers, fruit, seeds, and root are used to treat conditions like anaemia, arthritis, joint pain, high blood pressure as well as bacterial, fungal, viral, and parasitic infections (Anon., 2012). The seeds of Moringa have been reported to show antimicrobial activity (Broin et al., 2002; Lar et al., 2011; Gustavo et al., 2010). It has also been suggested that the dry crushed seed and seed press cake contain polypeptides that act as natural coagulants for water treatment (Ndabigengesere and Narasiah, 1998; Omodamiro et al., 2014; Santosh et al., 2014).

Contaminated water, together with food, accounts for most diarrhoea cases worldwide. In 2002, the World Health Organisation (WHO) estimated that 2.1 million deaths from diarrhoea worldwide were mainly caused by contaminated food or water and that annually up to one third of the population, even in developed countries, suffered from food-borne diseases. A major threat to human health in untreated water is pathogenic Escherichia coli. Although several strains of E. coli are known, only a few such as E. coli O157:H7 cause deadly gastroenteritis and other complications such as kidney failure (Hwang et al., 2007). Raw water is also a source of viruses and parasites. It is expensive and time consuming to test for specific harmful bacteria, viruses and parasites. The

normal practice is to test for indicator microorganisms such as coliforms or E. coli, whose presence indicates the likely presence of other pathogens from the same family. Many enterobacteria are of intestinal origin.

Techniques for water treatment include use of chlorine, ozone, or ultraviolet light, flocculation/sedimentation, filtration, ion exchange, adsorption, disinfection, and use of metals (Varkey and Dlamini, 2010). However, attempts are being made worldwide to find alternate simple and cost effective ways of treating water. Methods that can be easily adapted in rural communities would be desirable. Moringa seeds have been touted as a possible option for water treatment. However, proteins and polypeptides in the seeds that are responsible for turbidity removal may vary in concentration depending on climatic and geographic conditions. It is therefore necessary to study the ability of local seeds to treat water.

PROBLEM STATEMENT

Many rural communities in Swaziland do not have easy access to clean drinking water and resort to river or dam water for domestic use. However, with increasing pollution of rivers and dams, use of raw water for drinking and other domestic purposes can lead to diseases. The conventional method of water purification using aluminium sulphate (alum) as a coagulant to remove turbidity is not easily available to rural communities. In most places in developing countries, including Swaziland, pipe-born water supply systems are not affordable and as such people depend on river water for all domestic use including drinking and cooking. Therefore it is important to investigate the use of other methods that are available locally.

OBJECTIVES

General Objective

The general objective of the study was to investigate the coagulant and antibacterial properties of locally grown moringa seeds in river water as a means of purifying it for domestic use.

Specific Objectives

The specific objectives were to:

1. Determine the concentration of dried moringa seed powder needed to treat river water to reduce turbidity and E. coli counts to acceptable and safe levels for domestic use.

2. Determine the exposure time for treatment of river and dam water using moringa seed powder or solution that gives safe drinking water.

MATERIALS AND METHODS

Collection and preparation of moringa seeds

Moringa tree seeds were collected from Kwaluseni, Malindza, and Mfishane, representing the geographic regions of the country, i.e., Middleveld, Lowveld, and Highveld, respectively. The samples were labelled K (Kwaluseni), A (Malindza), and B (Mfishane). The seeds were ground using a laboratory mill to pass through a 0.8 mm sieve.

Collection of water samples

Raw water samples were collected from Lobamba River and Mbekelweni dam in 250ml sample bottles and transported to the laboratory in a cooler box with ice packs. Before analysis, the water was filtered using muslin cloth to remove any large suspended particles.

Determination of coagulant and antimicrobial properties of moringa seeds

The coagulant properties of moringa seeds were determined by using (a) an aqueous solution of the powder, and (b) the powder directly.

(a) Aqueous solution

Moringa seed powder (200mg) was dissolved in 250mL distilled water and mixed thoroughly. The solution was filtered using a Whatman Number 541 filter paper to obtain a clear solution. A portion of the solution (10mL) was then added to 200ml raw water and stirred. The water was left standing for 2, 4, 7, 12, 18 and 22hours, then the turbidity and E. coli counts were determined. The E. coli counts were estimated using the Most Probable Number (MPN) method.

(b) Moringa powder

Similarly, moringa seed powder was directly added into the raw water at the following concentrations (g/L): 0.1, 0.2, 0.3, 0.4, and 0.5. The mixture was allowed to stand for 1, 3, 5, 7, 9, and 12hours and the turbidity and E. coli counts (MPN/100mL) in the supernatant were determined.

RESULTS AND DISCUSSION

Trials with aqueous moringa solution

The turbidity of treated water was monitored after adding aqueous solutions containing 200 mg/L of moringa seed powder. It was observed that at 200 mg/L moringa seed powder in water, there was no major change in turbidity of the treated water even after 22 hours settling time. The final turbidity values in the two water samples were 10.6 and 16.1NTU, which are much higher than the maximum recommended limit of 5.0 NTU (WHO, 2017). According to the HO guidelines, the desired turbidity in drinking water should be less than 1NTU. At the end of the trial, there was no significant difference in the turbidity of the raw water and the treated water.

For both water samples from Lobamba River and Mbekelweni dam, lowest E. coli counts (MPN/100mL) were obtained after 7 and 12h, respectively. Thereafter, the numbers increased as the water continued to be stored. The numbers of viable bacteria did not show much change in the raw water over the 22 hours although a slight increase was observed after 18 hours in both trials. The increase in turbidity towards the end of the study period was probably linked to the increase in microbial counts. At the concentration used (200mg/L), possible contact time for treatment is between 7 and 12 hours. However, the increase in microbial counts was a negative outcome.

Trials with moringa seed powder

After adding moringa powder (0.2g/L) into raw water, the turbidity in the two water sources decreased with time, especially after 7 hours. There were no significant differences in the final turbidity values obtained with the moringa seed samples from the three regions (K, A, and B). The average final turbidity values were 4.6 (range 3.5-5.8) NTU, and 4.2 (3.3-5.2) NTU, for Lobamba river and Mbekelweni dam samples, respectively, which were below the recommended WHO value of 5.0 NTU, suggesting that the water had an acceptable clarity.

There were no significant differences between the initial E. coli counts and the final counts for the different moringa samples. In all cases the final MPN values were high and the water was not suitable for drinking according to the WHO Guidelines for drinking water quality (WHO, 2017), which recommends that drinking water should not have viable E. coli. MPN values between 100 and 1000/100mL are considered high risk. In the trails above, all water samples had MPN values above 200/100mL.

Effect of different concentrations of moringa seed powder

Different amounts of moringa seed powder were used to treat raw water to ascertain whether high concentrations could provide clearer and safer water. The turbidity and E. coli counts increased with increasing moringa powder concentration. The final turbidity microbial counts in all trials were too high after 4hours to give acceptable clean water. Further trials are necessary to establish the ideal concentration for domestic water treatment.

CONCLUSIONS

The study has shown that moringa seeds can be used to clarify raw water. The seeds in aqueous solution were not effective in reducing the turbidity. However, when the powder was added directly at a concentration of 0.2g/L, the turbidity can be reduced to levels below the WHO recommended value of 5.0NTU after holding for at least 7 hours. The moringa seeds did not seem to have antibacterial effect as the numbers of E. coli remained high under all the treatment conditions. It can be concluded that moringa seed powder has coagulant properties but does not have antimicrobial properties and water treated with moringa seed powder is not suitable for drinking.

RECOMMENDATION

It is recommended that further studies be conducted to establish an effective and economic application rate for the Moringa seed powder. The amounts used in this study were not conclusive.

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