EVALUATION OF THE EFFICACY OF *MORINGA OLEIFERA* SEED POWDER IN PURIFICATION OF WATER

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ABSTRACT

The high cost of treating water makes most people in the rural communities to resort to readily available source which are normally of low quality exposing them to water borne disease. It is in this light that this study was carried out to confirm the effectiveness of powder extracted from matured dried *Moringa oleifera* seeds which is commonly available in most rural communities of Africa. The study was carried out using doses of 50g,100g,200g,300g,4000g,500g of *Moringa oleifera* seed powder in 1000ml of the water sample (obtained from river Lanzo). And aluminum sulpate (alum) as a coagulant ,a control (water from river Lanzo without Moringa and alum treatment)was included. The 500g/ml treatment of Moringa and 60g/ml of alum treatment gave values that are acceptable according to the World Health Organization (WHO)guidelines for safe drinking water. However the treatment with Moringa seed powder is more effective than the treatment with aluminium sulphate(alum). The control sample gave higher extremes values which are unacceptable. The results from this study agrees with earlier works recommending the use of Moringa for water treatment (Ndabigenegesere, *et al* 2017). The seed kernels of *Moringa oliefera* contains lower molecular weight water soluble protein which carry a positive charge, when the seeds are crushed and added to water, the protein produces positive charges acting like magnets and attracting predominately negative charged particles such as clay, silk, and other toxic particles. Under proper agitation these bounded particles grows in size to form the flocculates which are left to settle by gravity. The possibilities of using *moringa* seed coagulant for water treatment is great, it provides realistic alternatives to the conventional methods using adequate quantity.

Keywords: Moringa oleifera, Seeds, water, Alum, Treatment

INTRODUCTION

Water has several purposes for humans but since it has direct effect on health when consumed its level of purity is very important (Crapper *et al.,* 2018). The accepted method of water treatment using aluminium sulphite (alum) and calcium hypochlorite mount pressure on the nation over burdened financial recourses since they are imported thereby making the cost of

treatment very expensive in most developing countries, which cannot be afforded by some habitants rural areas (Donald, 2016). Therefore they resort to sources of water such as dams, lakes, logout, streams and river. The water from these sources are usually unclean, turbid, and contains microbial contamination and pathogens, that causes harmful diseases of man as well as animal, these disease include guinea worm and bilharzias (Miller *et al.,* 2015). Waterborne diseases are one of the major problems faced in developing countries; over 1.6 millions of people are forced to use contaminated water of which one million are children which die from diarrhoea per annual (Postnote, 2013). The early research finding carried out by (Crapper *et al.,* 2018) and (Miller *et al.,* 2015) reveals that chemicals used for the treatment of water can lead to serious health issues if an error occurs in the course of administration and treatment processes. This report suggests that very high aluminium content in the brain a risk factor for Alzheimer's disease. However (Davis, 2016) couldn't find any conclusive evidence linking aluminium (alum) to the Alzheimer's diseases. Also, research works by workers (Letterman and Driscoll, 2014) have raised doubt about the frequently introduction of aluminium into the environment by the continuous use of aluminium sulphate as a coagulant in water purification. Many of the ill-health that affects human most especially in the developing countries can be linked to lack of safe and wholesome water supply, or water which is easily accessible, and free from contamination (Abilgos and Barba 2016). A good health condition as well as the well-being of human can not be achieved without safe and potable water. (Cadenas, 2019). Water is not just an important environmental factor for all forms of life, but it also plays a major role in the socio-economic development of human population (Harborne, 2017). Water is highly considered as an important economic tool, to this regard it should be potable, and used properly, efficiently, and equitably (Davis, 2016). Water intended for human consumption should be potable, safe and wholesome.

In many developing countries water pollution has become a growing hazard owing to human activities without potable, safe and ample drinking water we cannot provide health care to the community (Fahey, 2020). *Moringa oleifera* has been compared to alum in terms effectiveness in the removal of suspended particulates or solids for turbid or contaminated water, but with great advantages (Harborne, 2017). It is locally produced by using *moringa* rather than alum, would reduce and safe the cost of foreign exchange, and generate farm and employment income. *Moringa oleifera* has the potential to create new market for a community, research works, studies and projects are being carried out to examine this potentials (Folkard et al., 2016). Another major point is that *moringa* leaves contains essential amino acids, which are the backbones of proteins (Heikens et al., 2014). Of all plant materials tested over the years *Moringa oleifera* seeds powder has shown to be one of the most effective with adequate efficacy as a primary coagulant for water purification,(Fahey, 2020).And it can be compared to the conventional chemical coagulant(alum) (Madsen *et al.*,2018). It is shown in their studies that *moringa* powder has antimicrobial properties and it is also non-toxic (Postnote, 2020). In developing countries it use

as a coagulant for water treatment is recommended (Bart, 2020). Because the application of *moringa* is a biological method and has been reported to be edible, it has added advantages over the chemical application method which is the use of aluminium suphate (alum) (Oslen, 2021). Although much as not been done in Nigeria using *moringa* in water treatment system. The cost of water treatment using this natural coagulant (*moringa)* would be less expensive when compared to the cost of the conventional chemical coagulant (alum) for water treatment since it is available in rural communities in Nigeria where potable, safe, and treated water is a scarce resourses. It is on this basis that this study was carried out to confirm the efficacy and effectiveness of powder extracted from dried *Moringa oleifera* seeds (Oslen, 2021).

MATERIALS AND METHOD

Plant collection and preparation

Dried *moringa* seed pods were collected from within the school compound. The seeds were removed from the pods and were dried at ambient temperature and the samples were blended into powder using electric blender

Phytochemical screening

Simple chemical tests to detect the presence of alkaloids, tannins, saponins, carbohydrates, reducing sugars, proteins, flavonoids and other phenolic compounds were done in accordance with standard methods as described by Sofowora (2013).

Source of test sample

The water sample employed in this study was obtained from River Lanzo Bida, Niger State.

MEDIA PREPARATION

MAC-CONKEY AGAR

According to standard specifications for preparation of MacConkey agar recommended by the manufacturer, 49.53 grams of dehydrated medium was suspended into 1000ml of distilled water, and heat to boil to dissolve the medium completely. Sterilize by autoclaving at 15 Ibs pressure (121°C) for 15miuntes. In this research 8 grams of MacConkey agar was weighed and dissolved in 120ml of distilled water and was heat to boil to dissolve properly then, it was sterilized at 121°C for 15miuntes (Sofowara, 2013). The sterilized medium was allowed to cool to about 40 - 45°C before pouring into the respective plates

NUTRIENT BROTH

According to standard specification for preparation by the manufacture for the preparation of nutrient broth, 13 grams was dissolved in 1000ml of distilled water and sterilized at 121° C for 15minutes. In this research 0.78 grams of nutrient broth was weighed and dissolved in 60ml of

distilled water, and sterilized at 121°C for 15miuntes (Sofowara, 2013). The sterilized medium was allowed to cool to about 40 - 45°C before pouring into the respective plates

PREPARATION OF SERIAL DILUTIONS

Using a sterile disposable pipette, 9ml of distilled water was dispensed into 5 test tubes each, from the water to be sampled, 1ml was added to the first test tube containing 9ml distilled water. The tube was vigorously shaken for even distribution, 1ml was drawn into the second test tube, and was mixed well, and the procedure was repeated till the last tube from which 1ml was discarded. From each of the dilutions, a loopful was inoculated onto the Petri dishes containing solidified media using streaking techniques, and was incubated at 37°C for 24 – 48 hours.

PREPARATION OF INOCULUM

The *moringa* seed powder was weighed as follows; 500g, 400g, 300g, 200g, 100g, and 50g, into sterile beakers, and 10g, 20g, 30g, 40g ,50g and 60g of aluminium sulphate (alum) was also weighed into sterile beakers. 1000ml of the water sample was measured into each of the beaker containing the solute, and was vigorously shaken to mix well. The mixture was allowed to stand for 2hours. Using streaking techniques, from each of the sample mixture a loopful was inoculated onto plates containing Mc-Conkey agar and was incubated at 37°C for 24 – 48 hours.

RESULTS AND DISCUSSION

RESULTS

Table 1: Phytochemical composition of extracts of leaf and seed of *Moringa oliefera*

Phytochemical	Dichloromathane (+ /-)	
Leaf	Seed	
Alkaloids	_	+
Carbohydrates	+	+
Reducing sugars	_	+
Saponins	+	+
Phytosterols	_	_
Tannins	_	_
Phenolic compounds	+	+
Flavonoids	+	+
Proteins	_	+

Keys: +: Presence of active substance in the plant extracts

-: absence of active substance in the plant extracts

Table 2: Bacteria count of untreated water collected from Lanzo River.

The mean TVC of the untreated raw water collected from river Lanzo is shown in Table 1

Plates	**Microbial plate count**
10^{-1}	$6.2x10^{2}$
10^{-2}	$4.4x10^{3}$
10^{-3}	$3.1x10^{4}$
10^{-4}	$1.5x10^{5}$
10^{-5}	$8.0x10^{5}$
Mean growth	$\mathbf{1.97x10^{5} \pm 3.06x10^{2}}$

Table 3: Physicochemical analysis of the water sample

S/No	Parameters	Result
1	pH	7.30 -7.60
2	Odour	No odour
3	Colour	Milky in colour
4	Chemical oxygen demand(COD)	300-350mg/L
5	Biochemical oxygen demand(BOD)	1.50 -3.10mg/L
6	Temperature	$22.1^{0}C - 23.5^{0}C$
7	Dissolved oxygen	3.1 – 5.5 mg/L
8	Total dissolved solid	100 – 1200mg/L
9	Turbidity	Log_{10} 2.26S/cm

Table 4: Biochemical test and Isolation of the Organisms

Test organism	Coagulase	Catalase	Oxidase	Gram staining	Shape	Indole
E. coli	+	+	+	-	Rod	+
P. aeruginsa	-	+	+	-	Rod	+
B. subtilis	+	+	+	+	Rod	-

Escherichia coli

Pseudomonas aeruginosa

Bacillus subtilis

Table 5: Total viable count of treated water form lanzo with *moringa* seed powder and alum

Sample	Total viable count (cfu/ml) at 50/10g	Total viable count (cfu/ml) at 100/20g	Total viable count (cfu/ml) at 200/30g	Total viable count (cfu/ml) at 300/40g	Total viable count (cfu/ml) at 400/50g	Total viable count (cfu/ml) at 500/60g
Water treatment with moringa	$2.68 \times 10^{2} \pm 3.38 \times 10^{0b}$	$1.70 \times 10^{2} \pm 8.8 \times 10^{-1b}$	$3.1 \times 10^{1} \pm 5.8 \times 10^{-1b}$	$1.43 \times 10^{1} \pm 1.20 \times 10^{0b}$	$1.04 \times 10^{1} \pm 8.8 \times 10^{-1}$	$9.00 \times 10^{0} \pm 5.8 \times 10^{-1b}$
Treatment wih Aluminium sulphate (Alum)	$4.68 \times 10^{2} \pm 4.16 \times 10^{0a}$	$3.7 \times 10^{2} \pm 5.8 \times 10^{-1a}$	$2.18 \times 10^{2} \pm 4.41 \times 10^{0a}$	$1.61 \times 10^{2} \pm 1.86 \times 10^{0a}$	$5.10 \times 10+ \pm 5.8 \times 10+$	$2.27 \times 10^{1} \pm 1.45 \times 10^{0a}$

DISCUSSION

The phytochemical analysis of the seed extract of *Moringa oliefera* revealed that it contains alkaloids, Proteins, Flavonoids, Phenolic compounds, Saponins, Carbohydrates, Reducing sugars. However phytosterols and Tannins are not detected. This indicate the possibilities of the plant application in varied medicinal uses.(Table 1) which is in agreement with the reports of Harborne,(2013) and Kim *et al.*(2013). These scientist reported that the seed extract contents of *Moringa oliefera* shows the presence of alkaloids, proteins, flavonoids, phenols, saponins carbohydrates, reduced sugar among others.

These experimental results (Table 2) showed the bacteria count of the untreated water obtained from river Lanzo at different dilution (10^1 10^2,10^3,10^4, and 10^5) of the sampled water. It was observed to contain very high values of bacterial count ranging from 6.2×10^2 to 8.0×10^5,the mean total viable count was $1.9 \times 10^5 3.06 \times 10^2$ which is not acceptable by the World Health Organization guideline for drinking water quality(WHO, 2016).

The experimental results (Table 3) showed the ranges of values obtained from the physicochemical analysis : pH(7.3-7.6),Total dissolved solids(100-1200mg/L, BOD(1.50-3.10mg/L), COD(300-350mg/L), Temperature(22.1-23.5°C),Total hardness(305-325mg/L), Dissolved oxygen(3.1-5.5mg/L),Odour(nil), Colour(milky). These result obtained in this study was seen to be in line with findings of earlier works on the physicochemical analysis of fresh water by Smitha and Sivashankar, P.(2021) and Kotadiya, *et al* (2020).

(Table 4) showed the biochemical test and isolation of the microorganisms (bacteria) present in the water at different dillutions, the organisms includes; *Escherichia coli, Pseudomonas aeruginosa,* and *Bacillus subtilus.* (Table 5) shows the total viable count (cuf/ml)of the water obtained from river Lanzo treated with moringa seed powder at different concentration(50-500g)and alum (10- 50g). At 50-500g concentration treatment with *Moringa oliefera* seed powder the total viable count ranges from 2.78×10^2 3.38×10^{0b} to 9.00×10^{o} 5.8×10^{-1b} (cfu/ml).At (10-60g) concentration treatment with aluminiumm sulphate(alum)the total viable count are statistically significant ($p<0.05$)and ranges from 4.6×10^2 4.16×10^{0a} to 2.27×10^1 1.45×10^{0a} (cfu/ml) These

results obtained in this study indicate that the treatment with moringa is more effective as the dose/concentration increases. The recorded values for total viable count obtained from 500g moringa and 60g of alum treatment were acceptable according to WHO, (2016) guideline for drinking water. As expected the control gave the highest Total viable count values, it is clearly seen that higher concentration of moringa seed powder of 500g/1000ml loading dose as coagulant is effect as that of the conventional coagulant(alum).

CONCLUSION

The *Moringa oliefera* seed powder showed good coagulating properties at highest loading doses/concentration of 500g/ml have similar effect on the turbidity compared with the conventional coagulant (alum) of loading dose 50 and 60g/ml. This lends support to earlier findings of the use of Moringa seed powder as coagulant in water purification system by (Madsen *et al*, 2018 and Olsen, 2018). According to (Postnote, 2013) a prolonged sedimentation period of atleast one hour together with *Moringa oliefera* seed coagulant (MOC) improves the treatment by reducing turbidity. *Moringa oliefera* seed powder can reduce turbidity close to the acceptable values by World Health Organisation guideline which establishes that the turbidity of drinking water should not be more than 5 Nephelometric Turbidity Unit(NTU), and should ideally be below 1 NTU (WHO, 2016). High concentration of *moringa* seed coagulant 4 – 6% (w/v) can reduce the faecal coliform level. *Moringa* is found to be sustainable and cheap coagulating agent in water treatment. *Moringa* seed can be produced locally at a low cost therefore having several technical benefits in tropical, developing countries and rural communities. The possibilities of using *moringa* seed coagulant for water treatment is great, it provides realistic alternatives to the conventional methods using adequate quantity. There is need in creating more awareness in the use of *Moringa oliefera* seed powder in water purification system.

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