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Purification of Water Using Wonder Plant (*Moringa Oleifera* L.) Seed Extract

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Abstract
The many health benefits of Moringa oleifera have led to its remarkable rise in popularity in recent years. The purpose of this study was to assess how well miracle plant (Moringa oleifera) seed extract can purify water. The plant's phytochemicals were screened, the water samples' turbidity and pH were assessed both before and after the seed extract was applied, and the extract's ability to purify the water samples against total heterotrophic and total coliform bacteria was assessed. To determine the most likely quantity of coliforms in the water samples, single- and double-strength versions of the lactose broth medium were created. The serial dilution pour plate method was used to count the populations of bacteria present in the water. The outcome demonstrated that nine phytochemicals in all were present in the wonder plant seed namely, alkaloids, anthraquinones, anthocyanins, cardiac glycosides, carotenoids, flavonoids, saponins, tannins and terpenoids. Before the seed extracts were applied, the turbidity of the water samples was 30.2±1.42 NTU, 33.7±2.22 NTU, and 37.8±1.87 NTU, respectively. However, after the extracts were applied, the turbidity of the water samples was 0.2±0.00, 0.1±0.00, and 0.3±0.00 NTUs in 0.05 g/100 ml; 0.3±0.00, 0.2±0.01, and 1.0±0.00 in 0.15 g/100 ml; 3.0±0.00, 2.7±0.02, and 3.1±0.01 in 0.25 g/100 ml and 3.0±0.00, 3.5±0.00, and 4.1±0.15 in 0.35 g/100 ml, and so on. Before applying M. oleifera seed extract, the pH of the water samples was 6.3±0.12, 6.6±0.1, and 6.1±1.21, respectively. After applying seed extract at concentrations of 0.05g/100 ml, 0.15g/100 ml, 0.25g/100 ml, and 0.35g/100 ml, the pH of the water samples was 8.34±0.01, 8.03±0.00, 7.65±0.04 and 7.91±0.02; 8.25±0.02, 8.03±0.00, 7.74±0.02 and 7.71±0.02; and 8.34±0.01, 7.81±0.01, 7.75±0.04 and 7.28±0.15, respectively. Before seed extract was applied, the total counts of heterotrophic bacteria were 8.8x106, 7.6x106, and 2.7x106, and the colony counts were 88, 76, and 27. Following treatment, the mean colony values of M. oleifera seed extract at 0.05 g/ml were 35, 30, and 25. Before applying M. oleifera seed extract, the most probable number (MPN) per 100 ml for stream, well, and borehole waters were 1600, 33, and 17, respectively; however, following the administration of M. oleifera seed extract, the MPN of all coliform bacteria was less than 2. The study's findings demonstrated that M. oleifera seed extract has antibacterial qualities against both heterotrophic and total coliform bacteria, as well as beneficial effects on the water's pH and turbidity. Therefore, it is advised that M. oleifera should be used in water purification as an alternative measure to chemicals.
Keywords: Purification, Water, Wonder Plant, Seed Extracts.

Introduction
According to Bichi (2013), Moringa oleifera, also known as Moringa, is the most extensively grown variety of the genus Moringa. It is referred to as the miracle tree or wonder plant in Nigeria, particularly in the south. It is a willowy tree that can reach a height of 10 metres, drooping. But usually, it is trimmed back each year to a height of little more than one metre, then left to grow back so that pods and leaves are still accessible. Botanically, *Moringa oleifera* Lam. is a perennial drumstick tree of about 40ft with a diameter of 1.5ft. It is of the family of *Moringaceae*. The importance of this tree plant cannot be over-estimated as it has been used in different ways for phytoremediation (i.e domestic cleaning agent–crushed leaves, blue dye (wood), fencing (living trees), fertilizer (seed-cake) (Emmanuel et al., 2018). Nutritionally, the young leaves are edible and are commonly cooked and eaten like spinach or used to make soups and salads (Zaku et al., 2015). The boiled leaves yield three times more bio-available iron than the raw leaves; this has also been seen in the extracted leaves (Zaku et al., 2015). *Moringa oleifera* has been reported to contain many essential nutrients such as vitamins (Kasolo et al., 2019). The tree plant is known to play an important function in medicine, nutrition and therapeutic properties (Kasolo et al., 2019).

Dehulled seeds have an oil content of about 42% and a vivid yellow colouring that is useful in cooking and frying. Moringa seeds are used as a coagulant in turbid water cleaning techniques that have been documented by numerous authors (Aruna & Srilatha, 2016; Atieno et al., 2017). Since most of the colloids in muddy or dirty water have a negative electrical charge, the cationic polyelectrolytes of the tree plant neutralise the colloids. This protein is a naturally occurring polypeptide that is non-toxic and can be used to clean vegetable oil, sediment organics and mineral particles in drinking water purification, and settle fibres in the juice and beer industries (Delelegn et al., 2018). Additionally, according to Delelegn et al. (2018), the proteins from *Moringa oleifera* seed extracts were introduced to raw water, and the resultant positive charge attracted (magnetised) the majority of the negatively charged particles present in the water, such as silt, clay, bacteria, and other hazardous particles.

The one molecule that keeps life on Earth alive is water. Water is essential to all life on Earth. Water covers over 70% of Earth, with 97% of that area being ocean. Freshwater, which is utilised by people for drinking, farming, and washing, makes up a very small portion of all water. One of the most important needs of every civilization is clean drinking water. Millions of people's lives will be improved if clean, safe drinking water and proper sanitation are made available to them. The WHO study "Safe water for better health" claims that". Safe and clean drinking water is substantial for the overall health and well-being of an individual in a given society. Access to this potable drinking water which is one of the basic amenities of man, particularly in rural areas of the world has posited a huge problem because of the high-consumption pattern of the teeming population inhabiting the areas (Rawat & Siddiqui, 2019). As a result, the availability of potable water for drinking and other uses in communities has proven to be problematic worldwide, especially in developing nations where rural residents depend on tainted water from wells, rivers, streams, and dams for domestic and other uses. According to a series of reports from the UN, 2.1 billion people do not currently have access to portable drinking water (UN, 2018). The survey also claimed that two million tonnes of industrial, agricultural, and sewage pollutants are released into different aquatic habitats every day. According to a 2019 World Health Organisation (WHO) research, 502,000 fatalities from diarrhoea are thought to occur each year as a result of tainted drinking water. During World Water Day in 2022, UNICEF claimed that approximately 70% of Nigerians

Water purification, according to Idris et al. (2017), is the process of eliminating pathogens from water by treatment. For this reason, it is crucial to confirm that the disinfectant being used has sufficiently disinfected the water. This is the case because drinking dirty or polluted water has the highest risk of microbiological contamination. In developing nations, the main risk to public health is acute microbial diarrheal illnesses. Among the most significant bacterial illnesses spread by water are shigellosis, cholera, vibriosis-induced gastroenteritis, typhoid fever, other severe salmonellosis, bacillary dysentery, acute diarrhoea, gastroenteritis, and viral hepatitis. The study was significant in a couple of ways**;** to the rural dwellers of Ikot-Ekpene who lack access to portal drinking water, reduction of waterborne diseases, commercial application will reduce dependence on chemical water purifiers and new mode of water treatment that reduces chemicals that are hazardous to human.

Materials and Methods

Collection and Preparation of the *M. oleifera* seed extract. *M. oleifera* seeds were bought from the Agricultural Development Program (ADP) in Rumuodomaya, Port Harcourt. The variety was noted, and the seeds were transported to the Research Laboratory of the Department of Biology, Ignatius Ajuru University for study. After the M. oleifera seed covers were peeled off, the kernels were electrically crushed into an extract. An electronic weighing scale, model number XY2000B, was used to weigh about 50 g of pulverised seed. In the conical flasks, the weighed samples were submerged in 100 ml of room-temperature water for 72 hours. The extracts were filtered through Whiteman size No. 1 filter paper, and the filtrate was dried in a water rotary vaporizer set at 60 °C. To obtain the crude extracts, the acquired residues were stored, freeze-dried, and refrigerated until needed again.

Awodele et al. (2012) suggested a method for preparing water extract that involved soaking 100 g of ground seed in 2 L of distilled water (MILLPORE, Q-gard1) and letting it stand for a full day. Gradually, the mixture drained out, and contaminants were eliminated by running the solution through Whatman filter paper No. 1 (QUALIGEN-Germany). For four days, the scum was dried at 40°C in a Hexatec model HIPL03A oven. The solid was preserved for additional examination after being reconstituted in distilled water. The experiment was repeated three times to ensure accuracy and to test for alkaloids, flavonoids, saponines, sterols, and tannins in the dried scum.

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Alkaloids: The method proposed by Sabri et al. (2012) was used. where evaporation was used to dry 10 millilitres of the extract. Wagner's reagent was added to the solution along with a few drops of 2% HCL acid that had been left on the dried scum. When a reddish-brown precipitate was seen, the alkaloids were verified. Flavonoids: To conduct this test, the method outlined by Pamar et al. (2012) was followed: 2 ml of dried scum was mixed with two to three drops of NaOH, and a bright yellow colour was seen. Drops of diluted HCL were added further, producing a colourless solution that served as a flavonoid indicator.

Saponins: Application of the precipitation and foam observations as stated and suggested by Devmurari (2010) was made. Add 3 to 4 drops of a 1 percent lead acetate solution to 1 millilitre of the scum. Saponins were confirmed to be present based on the intense white precipitate appearance. The presence of saponins was further confirmed by the foam test, which involved adding 20 millilitres of distilled water to one millilitre of the extract in a graduated cylinder and shaking the mixture violently for five to fifteen minutes. The production of stable foam was an indicator of saponin content. Tannins: Ugochuhwu et al. (2013) described the tannin testing procedure. Using this procedure, 1 cc of the dried seed scum was mixed with 3% ferric chloride. Brownish green colour observation indicates the presence of tannins.

M. oleifera seed extract: A HACH spectrophotometer and a HACH pH meter were used in the laboratory to measure the turbidity and pH of water samples that were taken from the study sites. Each 100-millilitre of water sample received around 50 milligrams of M. oleifera seed extract extracted by hand. The mixture was well stirred for about 30 minutes using a stirrer, and then the samples were allowed to settle for three days at room temperature. The sample solutions were decanted to separate the sediments at the bottom from the clean water at the top following the experiment. To evaluate the modifications following treatment with M. oleifera seed extracts, the turbidity and pH were then measured once more.

Treatment with *M. oliefera* seed extract: According to Benson (2002) and Pepper and Gerba (2005), the serial dilution pour plate method was used to count the populations of bacteria in the water samples. An aliquot of each dilution was aseptically plated into Nutrient Agar after 0.1 ml of the water sample had been serially diluted in sterile distilled water. To count the aerobic bacteria, the agar plates were inverted and incubated for 24-48 hours at 37°C. The ensuing growth/colonies on the plates were counted and quantified as colony-forming units per millimetre (cfu/ml) of the water samples.

Estimation of the Total Coliform of the water (well, stream and borehole) before and after treatment with *M. oleifera* seed extract. The multiple-tube fermentation method was used to ascertain the most likely quantity of coliforms that were present in each of the treated water samples. The bacterial growth medium utilised was lactose broth. There were two varieties of lactose broth made. These were the lactose broths that come in single strength (SSLB) and double strength (DSLB). 13.0 g of the lactose extract in the single strength was weighed and diluted in 1000 ml of distilled water. Alazin Red was weighed out at 0.08 g and added to the mixture. To dissolve and thoroughly combine the mixture, the solution was gently swirled with a magnetic stirrer for ten minutes. Exact duplicates of each of the ingredients were used to make the twofold strength. For ten minutes, this solution was gently swirled with a magnetic stirrer. 1.0 ml of the control, 10.0 ml, and M in volume. The supernatant from the treatment of oleifera seed extract was quantified and added to test tubes holding 10 millilitres each of the double-strength and single-strength lactose broths. Ten millilitres of the single-strength lactose broth were placed in a separate set of test tubes, and 0.1 millilitres of the same supernatants as before were measured and added. Following a 24-hour incubation period at 37°C, the test tubes were examined. Wright et al. (2004) were consulted to get the most likely figure with a 95.0% confidence level based on the given results. Version 23 of the statistical software for social science (SPSS) was used for all statistical analyses. To find variations in the values obtained, Analysis of Variance (ANOVA) was employed.

Results

Qualitative and quantitative screening of phytochemical composition of the *M. oleifera* seed extract.

The wonder plant seed extract's chemical components or secondary metabolites were identified through qualitative screening. Alkaloids, anthraquinone, anthocyanin, cardiac glycosides, carotenoids, flavonoids, saponins, tannins, and terpenoids were found in this study according to the phytochemical screening.

Every phytochemical under investigation was present in the wonder plant seed extract. According to the secondary metabolites, tannins (11.36) and anthraquinone (11.68) were the two most common compounds. Anthocyanin (0.16) and cardiac glycoside (0.46) had the lowest amounts (Table 1).

The phytochemical components found in the M. oleifera seed extract showed statistically significant differences at $p < 0.05$.

Table **1: Phytochemical composition of the *M. oleifera* seed extract.**

Phytochemicals	**Qualitative Property**	**Quantitative Property**
Alkaloids	+	3.17±0.11
Anthraquinone	+	11.68±0.14
Anthocyanin	+	0.16±0.00
Cardiac glycosides	+	0.46±0.07
Carotenoids	+	2.1±0.15
Flavonoids	+	3.56±0.03
Saponins	+	1.44±0.03
Tannins	+	11.36±0.14
Terpenoids	+	4.84±0.56

Legend: The data were in ±SEM triplicate.;

Turbidity and pH of the well, borehole and stream water before and after treatment with *M. oleifera* seed extract.

Before the application of wonder plant seed extract, the turbidity of water samples from wells, boreholes, and streams exhibited extremely high Nephelometric turbidity units (NTUs) in comparison to water samples treated with different concentrations of wonder seed extract (Table 2a). Comparing the water samples treated with different quantities of the wonder plant seed extract to the untreated water samples, there was also an improvement in the pH (Table 2b). This shows that the pH value of drinking water is considerably raised by seed extract, regardless of concentration.

Table 2a: Turbidity of the well, borehole and stream water before and after treatment with *M. oleifera* seed extract.

concentration	**Turbidity**					
	Before treatment			**After treatment**		
	Well	**Borehole**	**Stream**	**Well**	**Borehole**	**Stream**
0.00 g/100 ml	**30.2**±1.42	**33.7**±2.22	**37.8**±1.87	-	-	-
0.05 g/100 ml	-	-	-	**0.2**±0.00	**0.1**±0.00	**0.3**±0.00
0.15 g/100 ml	-	-	-	**0.3**±0.00	**0.2**±0.00	**1.0**±0.00
0.25 g/100 ml	-	-	-	**3.0**±0.00	**2.7**±0.02	**3.1**±0.01
0.35 g/100 ml	-	-	-	**3.0**±0.00	**3.5**±0.00	**4.1**±0.15

Legend: ±SEM data was in triplicate.; NTU = Nephelometric turbidity units

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Table 2b: The pH of the well, borehole and stream water before and after treatment with *M. oleifera* seed extract.

concentration	pH					
	Before treatment			**After treatment**		
	Well	**Borehole**	**Stream**	**Well**	**Borehole**	**Stream**
0.00 g/100 ml	**6.3**±0.12	**6.6**±0.11	**6.1**±1.21	-	-	-
0.05 g/100 ml	-	-	-	**8.24**±0.01	**8.25**±0.02	**8.34**±0.01
0.15 g/100 ml	-	-	-	**8.03**±0.00	**8.03**±0.00	**7.81**±0.01
0.25 g/100 ml	-	-	-	**7.65**±0.04	**7.74**±0.02	**7.75**±0.04
0.35 g/100 ml	-	-	-	**7.91**±0.02	**7.71**±0.02	**7.28**±0.15

Legend: ±SEM data was in triplicate

Total Heterotrophic bacteria load before and after treatment with *Moringa oleifera* seed extracts on water samples (stream, well and borehole).

The outcome demonstrated that, in comparison to the water samples treated with miracle plant seed extract at different concentration levels, the mean colony number for the water samples from the stream, well, and borehole was relatively high before the application of the seed extract. The growth of heterotrophic bacteria differed significantly before and after the extract treatment, according to the data. Additionally, the extract killed every bacterium found in the water samples at a concentration of 0.35 g/ml. This suggests that the ideal quantity to eradicate every bacterium in the water was 0.35 g/ml (Table 3).

Table 3: Total Heterotrophic bacteria load before and after treatment with *Moringa oleifera* seed extracts.

			Stream		**well**		**Borehole**	
Moringa oliefera seed extract extracts	**Conc. Of the extracts (g/ml)**	**Dilution factor**	**No. of colonies formed**	**Cfu/ml**	**No. of colonies formed**	**Cfu/ml**	**No. of colonies formed**	**Cfu/ml**
Before	0	$8.8x10^{-6}$	88	$7.6x10^{6}$	76	$2.7x10^{6}$	27	$2.7x10^{5}$
After	0.05	$1.0x10^{-4}$	35	$3.5x10^{6}$	30	$3.0x10^{6}$	25	$2.5x10^{6}$
	0.15	$1.0x10^{-4}$	20	$2.0x10^{6}$	22	$2.2x10^{6}$	11	$1.1x10^{6}$
	0.25	$1.0x10^{-4}$	19	$1.9x10^{6}$	12	$1.2x10^{6}$	0	0
	0.35	$1.0x10^{-4}$	0	0	0	0	0	0

The most probable number of the total coliform bacteria of water (well, borehole and stream) before and after treatment with *M. oleifera* seed extract.

Before and after the M. oleifera seed extract was applied, the water samples (stream, well, and borehole) were examined for the most likely quantity of total coliform bacteria. According to the results, prior to the administration of M. oleifera seed extracts, the borehole had the lowest most probable number (17) and the water sample from the stream had the highest most probable number (1600). This indicated that the WHO minimum limit of 3 coliforms per 100 ml was not met by any of the water. However, the MPN was less than 2 at all concentrations used following the application of M. oleifera seed extracts. This suggested that the total coliform count in water might be brought down below the WHO guideline limit of 3 by using M. oleifera seed extract (Table 4).

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Table 4: The most probable number (MPN) 100 ml-1) for (5 tube methods) presumptive test analysis of the total coliform bacteria of the water (well, borehole and stream) before and after treatment with *M. oleifera* seed extract.

Sample	Positive tubes in sample concentration (10 ml, 1 ml & 0.1ml	MPN Index 100 ml^{-1}	95% confidence limit		WHO standard (count $100ml^{-1}$)
			Low	**High**	
SB	**5-5-4**	**1600**	**400**	**4600**	**3**
SA 0.05	**0-0-0**	**2**	**-**	**-**	**3**
SA 0.15	**0-0-0**	**2**	**-**	**-**	**3**
SA 0.25	**0-0-0**	**2**	**-**	**-**	**3**
SA 0.35	**0-0-0**	**2**	**-**	**-**	**3**
WB	**4-3-1**	**33**	**11**	**93**	**3**
WA 0.05	**0-0-0**	**2**	**-**	**-**	**3**
WA 0.15	**0-0-0**	**2**	**-**	**-**	**3**
WA 0.25	**0-0-0**	**2**	**-**	**-**	**3**
WA 0.35	**0-0-0**	**2**	**-**	**-**	**3**
BHB	**4-1-0**	**17**	**15**	**46**	**3**
BHA 0.05	**0-0-0**	**2**	**-**	**-**	**3**
BHA 0.15	**0-0-0**	**2**	**-**	**-**	**3**
BHA 0.25	**0-0-0**	**2**	**-**	**-**	**3**
BHA 0.35	**0-0-0**	**2**	**-**	**-**	**3**

Discussion

Alkaloids, anthroquinone, anthocyanin, cardiac glycosides, carotenoids, flavonoids, saponins, tannins, and terpenoids were found in the miracle plant's seed, according to secondary plant metabolites of the aqueous seed extract. Alkaloids, anthraquinone, flavonoids, tannins, and terpenoids were the predominant phytochemicals identified; these findings and reports are consistent with those of Kasolo et al. (20110), Kawo et al. (2009), Fowoyo and Oladoja, (2015), Nweze and Nwafor (2014), and Moyo et al. (2012). Bamishaiye et al. (2012) reported the lack of cardiac glycosides, terpenoids, and steroids, which is different from Oluduro (2012), who also noticed the absence of these substances. Additionally, while reporting fewer phytochemicals, Patel et al. (2014), Arya et al. (2012), Gupta et al. (2013), and Elzein et al. (2018) highlighted the presence of alkaloids, flavonoids, saponins, and tannins in their studies. In numerous studies, phytochemicals, or the secondary metabolites of plants, are identified as a unique source of medications and dietary supplements. Researchers Kuhmarawa (2007) and Mensah (2008) reported that plant-containing alkaloids, saponins, and tannins are used as antimicrobial agents against many pathogens. George et al. (2002) and Fowoyo and Oladoja (2018) reported that tannin-containing plant extracts are used as astringents, anti-diarrhoea, anti-diuretics, anti-deudenal tumours, and as pharmaceuticals for anti-inflammatory, antiseptic, antioxidant, and hemostatic properties. While Bamishiye et al. (2011) contended that saponin, an established antimicrobial agent in plants, inhibits the growth of mould and protects plants from herbivorous insects, making saponins a part of plants' defence systems and belonging to a large group of protective molecules found in plants called phytoanticipins or phytoprotectants. Alo et al. (2012), and Fowoye and Oladoja (2015) reported that alkaloids specifically play a leading role in plant survival and protection against micro-organisms, insects, and other harmful organisms through the use of allelopathically active chemicals.

Both organic and inorganic suspended materials are the cause of turbidity in water. Rock cracks, sand particles, mud, and dissolved metals are examples of inorganic substrates, whereas organic materials can come from industrial and household waste and provide an ideal habitat for bacteria. In addition to bacteria, plankton and algae can also produce cloudiness in the water. Before treatment, the turbidity of the raw water from the borehole, stream, and well was 33.7±2.22 NTU, 37.8±1.87 NTU, and 30.2±1.42 NTU, respectively. Following the application of four distinct concentrations of M. oleifera seed extract (0.05, 0.15, 0.25, and 0.35 g/100 ml), the turbidity values for each treatment utilised varied from 0.1 NTU to 4.0 NTU. This work is consistent with the findings of Babu and Chaudhuri (2005), who reported 1.5 NTU following treatment with M. oleifera seed extract extracts; Katayon et al.

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(2006) for low turbid water with an initial turbidity level of 50 NTU; and Alo et al. (2012), who reported 28 NTU initial turbidity before treating the water with M. oleifera seed extract extracts for turbidity. Additionally, the flocculations created by the M. oleifera coagulant proteins were found to be small and light, and they settled very slowly, in contrast to the larger and faster-settling flocculations formed by the raw water after stirring.

The pH of the water after treatment with M. oleifera seed extract at varying concentrations exhibited a significant difference ($p<0.05$) among all the treatment levels compared to the pH of the water before treatment. The WHO (2006) advised that drinking water has a pH between 6.0 and 8.0. The range that the treatment produced, 7.28±0.15 to 8.34±0.01, is within an acceptable bound. As the amounts of M. oleifera seed extract extract increase, so does the pH. As a result, when a proton from the water is taken up by the basic amino acids in the protein, a hydroxyl group is released, rendering the solution basic. This accounted for the basic pH values observed for Moringa treatments compared to the untreated water.

M. oleifera is more effective than traditional water coagulants at lowering bacterial populations. Antioxidants and phytochemicals found in the plant have been related to the researched plant's antimicrobial action. Sidhuraju and Becker (2003) stated that the presence of flavonoids, anthroquinone, saponins, and tannins in M. oleifera sections such as the root, stem, leaf, and seed makes them rich in natural oxidants. The seed extracts under investigation included varied amounts of alkaloids, anthroquinone, anthrocyanin, cardiac glycosides, flavonoids, saponins, tannins, and terpenoids. The reduction in the numbers of heterotrophic and coliform bacteria may be attributed to these phytochemicals, which are present in the seed extracts at different concentrations. In addition to phytochemicals, the seed extracts contain additional antimicrobial agents as reported by Anwar and Bhanger (2003) and Osarugue et al. (2020). These agents include 4-(4'-O-acetyl-α-L-rhamnopyranosyloxy) benxyl isothiocyanate, (-α-L-rhamnopyranosyloxy) bezyl isothiocyanate, niazimicin, pterygospermin, benzyl isothiocyanate, and 4-(-α-L-rhamnopyranosyloxy) benzyl glucosinolate.

As the dosage of M. oleifera seed extract increased, the number of microbial colonies, the number of heterotrophic bacteria, and the number of coliform bacteria in the water samples were all drastically reduced. The results shown in Tables 3 and 4 above indicate that the extract functions in a dose-dependent way, with an increase in M. oleifera seed extract concentration corresponding to an increase in activity. This observation is consistent with the findings of Ordonez et al. (2006), Rahewla et al. (2008), and Alo et al. (2012). Bichi et al. (2012) contended that the proteins in the seed extracts lyse the bacterial cell by rupturing the cell wall and damaging the intercellular components when water enters the cytoplasm of the cell, causing it to swell more and burst, ultimately leading to the death of the bacterial cell. Suarez et al. (2003) reported that M. oleifera seeds contain proteins that may be a viable alternative to chemicals commonly used as food preservatives or for water purification. According to research by Ghebremichael et al. (2005), Hendrawati et al. (2016), and Fayos et al. (2010), M. oleifera seeds have a low molecular weight and are soluble in water, which makes them suitable as a coagulant. These proteins will function as artificially charged positive materials when dissolved in water (Sahni, 2008; Broin et al., 2002), and can be used as synthetic polymer coagulants (Hendrawati et al., 2016).

Conclusion

The study successfully revealed that wonder plant(*M. oleifera*)seed extract is a good water purifier and should be used in the purification of drinking water instead of chemicals such as chlorine, alum etc that have deleterious health effects.

Recommendations

Based on the findings of the study, the following recommendations were made:

i. The wonder plant (*M. oleifera*) seed extract should be used in drinking water purifications because it contains a large quantity of anthroquinone which possesses antibacterial, antifungal and antiviral properties and flavonoids possesses anticancer, antioxidant, anti-inflammatory and anti-viral properties. These confer the drinking water with pharmaceutical properties besides purifying the water. However, the tannin content should be reduced because tannin produces liver necrosis and modulate immune responses.

ii. The*M. oleifera* seed extracts having the capability and capacity to reduce turbidity of the water samples, should be used instead of chlorine or any other chemical to purify drinking water.

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iii. The water samples treated with *M. oleifera* seed extracts had pH values that lie between 6.5 and 8.0. This pH value is more alkaline, which implies that the water treated with the extracts does not pose health risks to humans nor cause water to be biter. Alkaline water is recommended for drinking instead of acidic water.

iv. Due to the success of *M. oleifera* seed extract in the control and management of heterotrophic and coliform bacteria, the seed of *M. oleifera* should be adopted as an alternative measure to chemical water treatment.

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