



Use of Neem Leaf, Pawpaw Seed and Moringa Seed as Natural Coagulants for Surface Water Treatment

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ABSTRACT: Access to save water is a serious issue affecting people of all ages for those living in remote communities where availability of improved water sources is limited; the quality of water and its treatment has become an increasing concern in developing nations like Nigeria, where proper treatment is lacking. The high cost of treated water makes most people in rural communities to employ readily available sources which are of low quality exposing them to water borne diseases. This study assessed the use of natural coagulants such as: *Papaya*, *Sodom apple*, *Neem*, *Moringa oleifera*, in the treatment of surface water. Physical, chemical and bacteriological analysis before and after treatment with each coagulants was carried out. Aluminum Sulphate was also used as a chemical coagulant. From the experiment *Moringa seed* was the best coagulant of all the seeds used to treat the water samples. The following parameters showed its result before and after treatment with *Moringa oleifera*: pH (7.6, 7.8), Total alkalinity (180, 126), Calcium hardness (156, 140), Calcium ion (62.4, 56), Magnesium hardness (14, 36), Magnesium ion (3.42, 8.78), Chloride (55, 62.8), Sulphate (50, 60), Silica (4, 2), COD (28.4, 4.13), Colour (50, 20), Turbidity (5.73, 3.98), Total solids (836, 696), Total suspended solid (642, 384), Total dissolved solid (194, 312), fell within the WHO guideline for drinking water except total hardness which is given as (170, 180). This could be as a result of high mineral content. The result obtained for the heavy metals and bacteriological analysis also showed that *Moringa oleifera* was the most active agent of all the coagulant used. Therefore, *Moringa seed* can be used conveniently as an alternative to Aluminum sulphate for the treatment of surface water for drinking purposes without causing detrimental effect on human health.

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Water quality is of concern to the populace. The acceptability of the water for uses include drinking, cooking, bathing, and laundering. Most municipally treated water is safe and generally of good quality. Water from private or community wells can be contaminated. Contaminated water may have off-tastes, odours, or visible particles, (Renuka and Jadhav, 2013). Due to improper water treatment many people are getting diseases and mostly in Nigeria the shortage of water is more and for the surface water also we need the purification because it contain harmful chemical. Rural communities most often rely greatly

on surface water provided that it is available in sufficient quantities. The need to treat water with natural coagulants became a common practice because the realization that the agencies saddled with the responsibility of providing potable water to the public cannot cope with the present demand, this often lead to scarcity and supply is rather epileptic. This scarcity is often attributed to several reasons such as power failure, lack of chemicals, and breakdown in operational system. Thus, the problem associated with this and its health implications are important. The provision of adequate treated water to the majority of

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people in the developing countries such as Nigeria, is a goal, which must be achieved if there is need to be healthy at all time and at any time in the future (Okonko *et al.*, 2008). The conventional method of water purification using Aluminium Sulphate (Alum) and Calcium hypochlorite puts pressure on the nation's over-burdened financial resources since they are imported thereby making treated water very expensive in most developing countries and beyond the reach of most rural folks. Hence, they resort to the sources like dams, streams, rivers and lakes. Water from these sources is usually turbid and contaminated with microorganisms that cause many diseases. In Nigeria, where significant reports of waterborne infections and diseases such as diarrhea, cholera and typhoid occur as a consequence of poor sanitation and poverty as reported by (Coleman *et al.*, 2013). Over 66 million Nigerians in the cities and rural area lack access to potable drinking water supply, and this has resulted to an increase in consumption of contaminated or polluted water (Ologbosere *et al.*, 2016). Hence, the objective of this paper is to purify surface water treatment using natural coagulants such

as: neem (*Azadiracta indica*) leaf, pawpaw seed (*Carica papaya*) and moringa seed (*Moringa oleifera*)

MATERIALS AND METHODS

The Study Area: The study area is Osara River, in Osara village in Odeda Local Government, Abeokuta. Its geographical coordinate falls at latitude $7^{\circ}12'5.6812''N$ and longitude $3^{\circ}24'46.1195''E$. The Climate is tropical, typical of the sub-equatorial belt of the South-Western Nigeria, with an average annual temperature in the range of $25^{\circ}C - 27^{\circ}C$.

Climate: The climate in this region is characterized by two seasonal climate regimes: the wet and dry seasons. These climate regimes are dependent on two prevailing air masses blowing over the Nigeria nation. The two air masses are the Tropical Maritime (Tm) and the Tropical Continental (Tc). The study area experiences rainfall all year round. Although the rainfall pattern varies significantly from year to year, the dry months are mostly dry (November to March). The onset of rains begins in April while the retreat is usually around November.

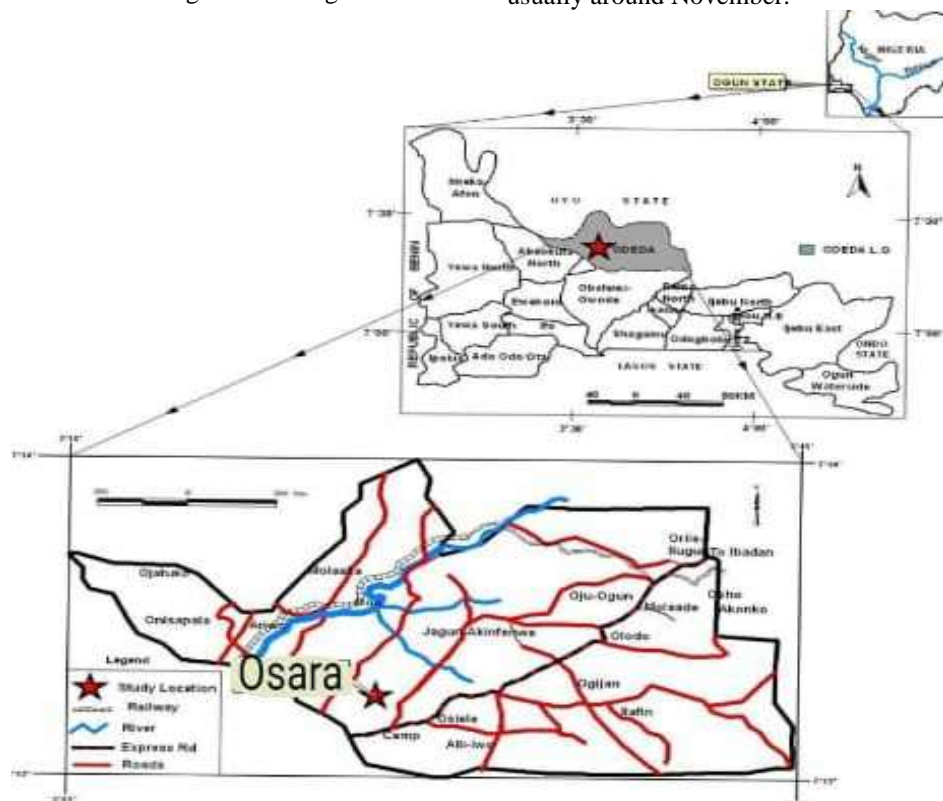


Fig 1: A map showing Osara River in Odeda Local Government

Sampling Procedure: The water samples was collected with 2 litres bottle container which was washed with distilled water, and collected twice from the stream. *Carica papaya* seeds was sourced locally. The seed was boiled and dried at $103-105^{\circ}C$ for

5hours and were crushed by using mortar and pestle and were sieved with a pore size of 0.4 mm mesh. About 0.2, 0.4 and 0.6 mg/l of the seed were placed in water and mixed for 10 min. The latex of *C. procera* was gathered by withdrawing the leaves from the

steam at the petioles as portrayed by Aworh et al. (1993).



Fig 1: Neem leaf grinded into powder with 0.6mg/l dosage to treat surface water



Fig 2: Sodom Apple, its latex used as a coagulant for surface water treatment



Fig 3: Papaya seed grinded into powder use for surface water treatment

The latex was likewise sourced locally as exudates from culled of *C. procera* plant used immediately. Neem leaves was gathered and washed with water and dried normally at room temperature for 4 days. The dried neem leaves is then squashed and crushed into powder and goes through 0.44 micron seiver. The powder is then filled with water and mixed thoroughly for 5 minutes. *Moringa oleifera* seed were harvested when they were completely mature. This is done by noticing any broken parts of the plants. The part of the leave were culled and broken to get the seeds which were air-dried at 40°C for two days. The shells

encompassing the seed portions were taken out with the use of blade and the bits were grinded with mortar and pestle into powder and sieved with a pore size of 2.5 mm² to get a fine powder.



Figure 4: *Moringa seed* grinded into powder to treat surface water

RESULT AND DISCUSSION

From the result, the physical and chemical properties of the raw water sample used in this study are presented in each tables 1, 2 and 3. From the table, the values obtained for colour, turbidity, total suspended solids, total alkalinity, total hardness, coliform organisms, E-coli and colony count were higher than the WHO guideline for drinking water. From table 1: The value obtained from the water sample before and after treatment using papaya seeds are as follows: pH ranged from 7.6 for the raw water and 7.0 after treatment, the pH of the treated water increased but fell within WHO guideline for drinking water given as 6.5-8.5, Calcium hardness ranges from 156 for the raw water and 140 after treatment, Calcium ion ranges from 62.4 for raw water and 56 after treatment, Magnesium hardness ranges from 14 for raw water and 40 after treatment, Magnesium ion ranges from 3.42 for raw water and 9.76 after treatment, Chloride ranges from 55 for raw water and 61 after treatment, Sulphate ranges from 50 for raw water and 60 after treatment, Silica also ranges from 4 for raw water and 2 after treatment, COD also ranges from 28.4 for raw water and 4.86 after treatment, Total dissolved solid ranges from 194 for raw water and 344 after treatment, Total suspended solid ranges from 642 for raw water and 496 after treatment.

Total solid ranges from 836 for raw water and 696 after treated with papaya seed which also fell with WHO guideline for drinking water 2000, Turbidity also range from 5.73NTU for raw water and 4.43 after treated with papaya seed which also fell within the WHO guideline for drinking water 5.0NTU. All these values fell within the range of WHO, guideline for drinking water and agree with work of (Shweta Verma et al., 2015).

Total alkalinity: The value obtained from the water sample using Papaya seed ranged from 180 for raw water and increased to 184 after treated with papaya seed which above the WHO guideline for drinking water given as 50-150.

Total Hardness: The value obtained from the water sample using Papaya seed ranged from 170 for raw water and increased to 180 after treated with Papaya seed which above the WHO guideline for drinking water given as 50-150.

Table 1: Result of the Physical and Chemical parameters of the raw water treated with both the natural and the chemical coagulant.

S/N	Parameters	unit	Raw water	Treated with Papaya seed	Treated with Moringa seed	Treated with Neem leave	Treated with AHC	WHO 2017
1	Manganese	mg/l	0.16	0.08	0.05	0.10	0.10	0.05-0.5
2	Iron	mg/l	0.08	0.02	0.04	0.14	0.02	0.1-1.0
3	Chromium	mg/l	0.12	0.01	0.02	0.07	0.02	0.08
4	Zinc	mg/l	0.02	0.00	0.00	0.00	0.00	5-15
5	Nickel	mg/l	0.00	0.00	0.00	0.00	0.00	-

Table 2: Result of heavy metals parameters compared with the natural coagulants and chemical coagulant

S/N	Parameters	Raw water	Treated with Papaya seed	Treated with Moringa seed	Treated with Neem leaf	Treated with AHC	2017 WHO
1	Coliform organism (100/100ml)	32	11	05	17	07	0
2	E-coli organisms	34	03	02	04	02	0
3	Colony count (100/100ml)	102	18	11	38	10	10

AHC: Aluminum Hydroxide Chloride

Table 3: Result of Bacteriological analysis using natural coagulants and chemical coagulant

S/N	Parameters	units	Before treatment	After Treated with Papaya seed	After Treated with Neem leaf	After Treated with Moringa seed	After Treated with Sodom apple	After Treated with AHC	WHO 2017
1	Appearance		PWTNBP	CWNTP	BWT&BP	CWNTP	SPWNP	CWFTP	CWP
2	Odour		Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Inoffensive
3	Colour	HU	50	20	40	20	35	20	5-20
4	Temperature	°C	25.8	25.8	25.6	25.8	25.9	25.9	25-35
5	Turbidity	Mg/l	5.73	4.43	9.75	3.98	6.20	2.62	5.0
6	Total solids	Mg/l	836	840	1040	696	964	640	2000
7	Total dissolved solids	Mg/l	642	496	832	384	558	264	500
8	Total suspended solid	Mg/l	194	344	208	512	406	376	500
9	pH	Mg/l	7.6	7.0	7.0	7.8	7.5	7.5	6.5-8.5
10	Total alkalinity	Mg/l	180	184	222	126	182	168	50-150
11	Total hardness	Mg/l	170	180	160	135	202	162	50-150
12	Calcium hardness	Mg/l	156	140	80	140	160	98	-
13	Calcium ion	Mg/l	62.4	56	32	56	64.2	39.2	100
14	Magnesium Hardness	Mg/l	14	40	80	36	42	64	-
15	Magnesium ion	Mg/l	3.42	9.76	19.5	8.78	10.25	14.34	50
16	Chloride	Mg/l	55	61	55	62.8	45	57	250
17	Nitrate ion	Mg/l	ND	ND	ND	ND	ND	ND	50
18	Phosphate		ND	ND	ND	ND	ND	ND	-
19	Sulphate	Mg/l	>50	>60	>50	>60	>70	>80	200-400
20	Silica	Mg/l	<4	<2	<2	<2	<2	<2	-
21	COD	Mg/l	28.4	4.86	7.12	4.13	5.47	2.85	<250

Coliform Organism: Coliform organism of raw water was 32 (100/100ml) initially, after treating with papaya seed the value decreased to 11, E-coli in raw water was 34 (100/100ml) before treatment and become 03 after treatment with papaya seed, Colony count of raw water was 102 (100/100ml), then after treatment with papaya seed powder the value become 18 which are above the WHO guideline for drinking water given as 0 for Coliform count, E-coli and 10 for colony count. This conforms to the work of (Unissa

and Bi, 2018). The value obtained from the water sample before and after treatment using Neem leaf as follows: pH ranged from 7.6 for the raw water and 7.0 after treatment, the pH of the treated water decreased and fell within WHO guideline for drinking water given as 6.5-8.5, Calcium hardness ranges from 156 for the raw water and 80 after treatment, Calcium ion ranges from 62.4 for raw water and 32 after treatment, Magnesium hardness ranges from 14 for raw water and 80 after treatment, Magnesium ion ranges from

3.42 for raw water and 19.5 after treatment, Chloride ranges from 55 for raw water and 55 after treatment, Sulphate ranges from 50 for raw water and 50 after treatment, Silica also ranges from 4 for raw water and 2 after treatment, COD also ranges from 28.4 for raw water and 7.12 after treatment, Total solid ranges from 836 for raw water and 1040 after treatment, Total suspended solid ranges from 194 for raw water and 208 after treatment with Neem leaf which also fell with WHO guideline for drinking water 500, All these values fell within the range of WHO, guideline for drinking water and agree with work of (Mohan *et al.*, 2019).

Turbidity: The value obtained for the raw water sample taken was 5.73NTU which was beyond the limits of WHO standards. It was observed after treatment with Neem leaf powder the turbidity got increased from 5.73 NTU to 9.75NTU. This value is above the WHO guideline for drinking water, recommended level of 5NTU. Due to this treatment there was no improvement in the flock size and flock settled rapidly.

Total Dissolved Solid (TDS): The value obtained from the water sample using Neem leaf ranged from 642 for the raw water and 832 after treating with Neem leaf powder, the TDS of the water sample increased and did not fall within the WHO guideline for the drinking water.

Alkalinity: The value obtained from the water sample using Neem leaf ranged from 180mg/L for raw water and 222mg/L after treating with Neem seed. The alkalinity present was above range of WHO guideline for drinking water standards. It was observed the seeds had the natural buffering capacity.

Hardness: The value obtained from the water sample using Neem leaf ranged from 170mg/L for raw water and 160mg/L after treating with Neem seed. The hardness present was above range of WHO guideline for drinking water.

Bacteriological analysis: Coliform organism of raw water was 32 (100/100ml) initially, after treating with Neem leaf powder the value decreased to 17, E-coli in raw water was 34 (100/100ml) before treatment and become 04 after treatment with Neem leaf powder, Colony count of raw water was 102 (100/100ml), then after treatment with Neem leaf powder the value become 38 which above the WHO guideline for drinking water given as 0 for Coliform count and E-coli and 10 for colony count. The value obtained from the water sample before and after treatment using *Moringa* seeds are as follows:

pH ranged from 7.6 for the raw water and 7.8 after treatment, the pH of the treated water increased but fell within WHO guideline for drinking water given as 6.5-8.5, Total Alkalinity ranges from 180 for the raw water and 126 after treatment, Total alkalinity decreased and fell with WHO guideline for drinking water 50-150, Calcium hardness ranges from 156 for the raw water and 140 after treatment, Calcium ion ranges from 62.4 for raw water and 56 after treatment, Magnesium hardness ranges from 14 for raw water and 36 after treatment, Magnesium ion ranges from 3.42 for raw water and 8.78 after treatment, Chloride ranges from 55 for raw water and 62.8 after treatment, Sulphate ranges from 50 for raw water and 60 after treatment, Silica also ranges from 4 for raw water and 2 after treatment, COD also ranges from 28.4 for raw water and 4.13 after treatment, Total dissolved solid ranges from 194 for raw water and 312 after treatment, Total solid ranges from 836 for raw water and 696 after treated with *Moringa* seed which also fell with WHO guideline for drinking water 2000, Turbidity also range from 5.73NTU for raw water and 3.98 after treated with *Moringa* seed and fell within WHO guideline for drinking water 5.0NTU. All these values fell within the range of WHO, guideline for drinking water and agree with work of (Eman *et al.*, 2009).

Total Hardness: The value obtained from the water sample using *Moringa* seed ranged from 170 for raw water and increased to 180 after treated with *Moringa* seed which above the WHO guideline for drinking water given as 50-150

Bacteriological analysis: Coliform organism of raw water was 32 (100/100ml) initially, after treating with *Moringa* seed powder the value decreased to 05, E-coli in raw water was 34 (100/100ml) before treatment and become 02 after treatment with *Moringa* seed powder, Colony count of raw water was 102 (100/100ml), then after treatment with *Moringa* seed powder the value become 11, this conforms the work of (Francis and Amos 2009). The value obtained from the water sample before and after treatment using Latex of Sodom apple are as follows: pH ranged from 7.6 for the raw water and 7.5 after treatment, the pH of the treated water increased but fell within WHO guideline for drinking water given as 6.5-8.5, Calcium hardness ranges from 156 for the raw water and 160 after treatment, Calcium ion ranges from 62.4 for raw water and 64.2 after treatment, Magnesium hardness ranges from 14 for raw water and 42 after treatment, Magnesium ion ranges from 3.42 for raw water and 10.25 after treatment, Chloride ranges from 55 for raw water and 45 after treatment, Sulphate ranges from 50 for raw water and 70 after treatment, Silica also ranges from 4 for raw water and 2 after treatment, COD also

ranges from 28.4 for raw water and 5.47 after treatment, Total solid ranges from 836 for raw water and 964 after treated with Latex of Sodom apple which also fell with WHO guideline for drinking water 2000, All these values fell within the range of WHO, guideline for drinking water.

Turbidity: The value obtained for the raw water sample taken was 5.73NTU which was beyond the limits of WHO standards. It was observed after treatment with Sodom apple, the turbidity got increased from 5.73 NTU to 6.20NTU. This value is above the WHO guideline for drinking water, recommended level of 5NTU. Due to this treatment there was no improvement in the flock size and flock settled rapidly.

Total Dissolved Solid (TDS): The value obtained from the water sample using Sodom apple ranged from 642 for the raw water and 558 after treating with Sodom apple, the TDS of the water sample increased and did not fall within the WHO guideline for the drinking water.

Alkalinity: The value obtained from the water sample using Sodom apple ranged from 180mg/L for raw water and 182mg/L after treating with Sodom apple. The values obtained for alkalinity were higher than the WHO guideline for drinking water.

Total Hardness: The value obtained from the water sample using Sodom apple ranged from 170mg/L for raw water and 202mg/L after treating with Sodom apple. The hardness present was above range of WHO guideline for drinking water.

Bacteriological Analysis: Coliform organism of raw water was 32 (100/100ml) initially, after treating with Sodom apple latex the value decreased to 14, E-coli in raw water was 34 (100/100ml) before treatment and become 02 after treatment with Sodom apple latex, Colony count of raw water was 102 (100/100ml), then after treatment with Sodom apple latex the value become 23.

Conclusion: From this study, four natural coagulants were used in treating surface water. The pH was alkaline when *Moringa oleifera* seed was used, but its alkalinity slightly decreased when Pawpaw seed powder, and Neem leaf powder were being used. From the result obtained, Neem leave powder, *Moringa oleifera* seed powder, and pawpaw seed powder were an excellent coagulant in treating surface water. Therefore, Neem leaf, *Moringa oleifera* seed powder, and Papaya seed powder are more effective than the

chemical coagulant, and can be termed as an excellent coagulant in treating river water.

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