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COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF DIFFERENT DOSAGE OF *MORINGA OLEIFERA* SEED (GRANULAR FORM) AND BANANA PEEL AS A NATURAL COAGULANT IN TREATMENT OF WASTEWATER FROM A FISH POND IN FEDERAL POLYTECHNIC NEKEDE OWERRI.

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Abstract

This research work investigated the comparative effectiveness of Moringa oleifera seed (granular form) and banana peel powder as natural coagulants in the treatment of wastewater obtained from a fish pond in Federal Polytechnic Nekede Owerri, Imo State Nigeria. The study was aimed at determining the effectiveness of both coagulants at different dosages (0.5%, 1.0%, and 1.5%) and identifying the most suitable natural coagulant for fish pond wastewater treatment. Wastewater samples were collected from the discharge point of a fish pond within the institution and analyzed for selected physicochemical parameters before and after treatment. Parameters tested for included acidity, alkalinity, hardness, turbidity, pH, total suspended solids (TSS), total dissolved solids (TDS), and total solids (TS).The experimental procedure involved drying, grinding, and sieving banana peels and moringa seeds into powdered forms before preparing different dosage concentrations with distilled water. The prepared coagulants were applied to the wastewater samples, stirred thoroughly, and allowed to settle before laboratory analysis was carried out. Results obtained showed significant improvement in water quality after treatment with both coagulants. Treatment with moringa seed at 0.5% dosage reduced acidity from 150.0 mg/L to 56.0 mg/L, turbidity from 7.0 NTU to 3.0 NTU, TSS from 145.0 mg/L to 70.0 mg/L, and TDS from 255.0 mg/L to 140.0 mg/L. While for the \Banana peel treatment at 0.5% dosage also reduced turbidity to 1.0 NTU, TSS to 30.0 mg/L, and acidity to 60.0 mg/L. The pH values for both treatments remained within the permissible limits recommended by the World Health Organization (WHO). The study revealed that lower dosages, particularly 0.5%, produced better treatment efficiency than higher dosages. Comparatively, banana peel demonstrated better turbidity and TSS reduction, while moringa seed showed better reduction in acidity and TDS. The study concluded that both moringa oleifera seed and banana peel are effective, low-cost, eco-friendly, and sustainable natural coagulants for fish pond wastewater treatment. However, banana peel was observed to be slightly more effective overall due to its superior reduction of suspended particles and turbidity. The use of these natural coagulants is therefore recommended as an alternative to conventional chemical coagulants in wastewater treatment.

Keywords: Moringa oleifera seed, Banana peel, Natural coagulant, Fish pond wastewater, Wastewater treatment, Coagulation, Dosage optimization.

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1. INTRODUCTION

Water is one of the key factors for economic development worldwide as it is widely used in different production sectors including industry, agricultural production, livestock and urban supply. The fast-paced industrialization, economic growth and population growth in developing countries has implications in unpredicted water requirements in cities.

In the last few decades, the water used capacity and wastewater production in domestic sector has increased remarkably. Wastewater treatment is an annual process in sanitation system. Effective municipal wastewater resource treatment and contamination control are necessary to ensure compliance to environment and reutilization of resources. Amongst the wide range of existing methods accessible for wastewater treatment, are coagulation and flocculation process which are considered the most preferable. This treatment is commonly being practiced as it is cost effective, reliable, and simple and best regarded as low energy consuming process.

In conventional treatment processes, various types of coagulants are often used depending on chemical traits of the contaminants present in the wastewater. Some of the organic and inorganic polymer coagulation includes alum, ferric chloride; calcium carbonates as well as poly aluminum chloride are generally used in wastewater treatment. But most of these inorganic polymer coagulants usually introduce metals into the treated water. The alternative solutions to these problems are replacement of metal and coagulant which are more environmentally friendly.

Some of the natural water coagulants used includes Banana peels, moringa seeds, cassava peel starch, watermelon, paw-paw, beans, Nirmali seeds and okra. The banana peels as well as moringa seeds are some of the natural coagulants used for the treatment of wastewater from fish pond, in this study

The banana peel called a banana skin in British English is the outer covering of the banana fruit. Banana peels are used as food for animals, as ingredient in cooking, in water purification and for manufacturing of several biochemical products. The nutritional value of banana peel depends on the stage of maturity and the cultivar. On the average, banana peels contain 9% dry matter of protein and 20-30% fiber (Measured as NDF) (stover & simmonds, 1987). Banana peels are also used for water purification, to produce ethanol, cellulose, lactase as fertilizer in composting. They are used for purification by adding an amount of dried banana peel powder to obtain crystal-clear water that is safe for use (Smiths, James P. (1977).

Moringa oleifera seeds as one of these coagulants contain water soluble proteins that can be used either in drinking water clarification or waste-water treatment.

Moringa seeds contain dimeric cationic proteins which absorb and neutralize colloidal charges to clump together, making the suspended particle easier to remove sludge by either settling or filtration. Moringa seed cake removes most impurities from water. This use is of particular interest for being nontoxic and sustainable compared to other materials in moringa growing regions where drinking water is affected by pollutants.

Moringa oleifera seeds and banana peels have been in use for the treatment of waste water and they are both effective in the sense that banana peels clean the water of metals such as lead; copper and other metals and it is also less expensive and healthy. Also, moringa oleifera is

effective in purification of waste water such as, the conductivity and also it's BOD (Biological Oxygen Demand).

In this study we will be comparing the effectiveness of the Moringa oleifera seeds and the Banana peels as a natural coagulant based on different dosages, and also know and select which one is the best coagulant to be used in the treatment of wastewater from a fish pond.

OBJECTIVES OF THE STUDY

Among the objectives of this research includes,

i. To determine the effectiveness of both coagulants (moringa oleifera seed and banana peels) at different dosages, in the treatment of wastewater from fish pond in federal polytechnic nekedeowerri, Imo State Nigeria.

ii. To compare and determine which of the coagulants is best suitable/effective for treatment of wastewater from fish pond in federal polytechnic Nekede Owerri , Imo State Nigeria.

II LITERATURE REVIEW

Moringa Oleifera seed (granular form) and banana peels have been used as coagulants for the treatment of wastewater because Moringa seeds contain water and soluble positively charged proteins that act as an effective coagulant for wastewater treatment and also banana peels contain polymeric substance such as fiber (11.04%) and protein (10.14%) (Memon et al., 2008).These two coagulants are used in the treatment of water and wastewater because of the natural substances present in them.

Moringa Oleifera was discovered in the northern India around 2000BC. Traditional doctors quickly discovered its medicinal impact and called it the "miracle tree".

The Moringa is grown mainly in semiarid tropical and subtropical areas, corresponding in the United States to USDA hardiness zone 9 and 10. It tolerates a wide range of soil conditions but prefers a neutral to slightly acidic (pH 6.3 to 7.0) well-drained sandy or loamy soil. (Radovich Ted (2011)).

Moringa oleifera is widely cultivated for its pods and leaves, used as vegetables and for traditional herbal medicine. It is also used for water purification (Kalibbala H.M; Wahlberg, O, Hawumba T.J; (Mpagi, Kalibbala, Herbert (2012)).

The fruit is a hanging three-sided brown 20-45cm (8 – 17.5 inch) Capsule which holds dark brown globular seeds with a diameter around 1cm. The seeds have three whitish peppery wings and are dispersed by wind and water. (Parotta John. A . 1993).

The Indians are the largest producer of Moringa with an annual production of 1.2 million tons of fruits from an area of 380km^2 (150 square meters) (Radovich ted 2011). Moringa is also grown in home gardens and even fences in south and Southeast Asia where it is commonly sold in local markets. In the Philippines and Indonesia, it is commonly grown for its leaves which are used as food.

The toxicity data of Moringa in humans are limited although laboratory studies indicate the certain compounds in the bark and roots or their extracts may cause adverse effects when consumed in excess. Supplementation with moringa oleifera leaf extract is potentially toxic at levels exceeding 3000mg/kg of body weight but safe at levels below 1000mg/kg (Asara, G.A Nyark O.A (2012).

The edible parts of the plant include the whole leaves (leaflets, stalks, and stems), the immature green fruits or seed pods, the fragrant flowers and young seeds and roots. (Lim Tk (2012)).

Below is the nutritional value per 100g of Maringa Oleifera leaf.:-

1. Energy = 37kcal (150kg)
2. Carbohydrates = 8.53g
3. Dietary fiber = 3.2g
4. Fat = 0.20g
5. Protein = 2.10g

(CABI 17 December 2019. Retrieved 17 may 2020).

In developing countries, Moringa has the potential to improve nutrition, boost food security, foster rural development and support sustainable land care. It may be used as forage for livestock, a micro nutrient liquid, a natural anthelmintic and possible adjuvant (Makkar HP, Francis G, Becker (2007); (Mahajan SG, Mali RG, Mehta AA (2007)).

Moringa Oleifera seeds are used as an alternative natural material for drinking water treatment because it shows coagulant activity similar to aluminums sulfate (Mangale et al (2012)), Egbukwen and Sangodoyin (2013).

The effect to elucidate the coagulation and heavy metal removing properties of Moringa Oleifera plants in general and moringa Oleifera seeds in particular includes many physiochemical parameters such as the biological oxygen demand (BOD) chemical oxygen demand (COD), Dissolved oxygen (DO), Total dissolved solids (TDS), salinity and electrical conductivity (EC), they are found to be particularly successful at removing colour, turbidity and COD from water sample with diverse characteristics.

In the aspect of the banana, bananas are believed to have originated up to 10,000 years ago and some scientistbelieved that they may have been the world's first fruit.

It is an elongated edible fruit botanically a berry (Morton, Juliam 2013). Produced by kinds of large barbacoas flowering plant in the Genus musa (Mariam – Webster online dictionary, achieved from the original on March 9, 2013 Retrieved January 4, 2013).

In some country's bananas used for cooking may be called "plantains" distinguishing them from desert bananas. The fruit is variable in size color and firmness but it is usually elongated and covered with soft flesh in starch, covered with a rind which may be green, yellow, red purple or brown when ripe.

Banana, fruit is of the genus musa. The musaceae is one of the most important fruit crops of the world. The banana is grown in the tropics and though it is most widely consumed in those

regions, it is valued worldwide for its flavor, nutritional value and availability throughout the years. A ripe fruit contains as much as 22% of carbohydrate and is high in dietary fiber, potassium, manganese and vitamin B and C.

The banana plant is a gigantic herb that springs from an underground stem or rhizome to form a fat trunk 3 – 6 meters (10 – 20 feet) high. This trunk is composed of basal portion of leaf sheets and is crowned with a rosette of 10 to 20 oblong to elliptic leaves that sometimes attain a length of 3 – 3.5 meters (10 – 11.5 feet) and a breath of 65cm (26 inches). A large flower spike carrying numerous yellowish flowers protected by large purple red bracts, emerge at the top of the false trunk and bends downward to become bunches of 50 – 150 individual fruit or fingers. The individual fruit or bananas are grouped in clusters or hands of 10 – 20, after a plant has fruited; it is cut down to the ground because each trunk produces only one bunch of fruit. The dead trunk is replaced by others in the form of sucker or shoot which arise from the rhizome at roughly six-month intervals.

Banana plant thrives naturally on deep, loose well drained soil in humid tropical climates and they are grown successfully under irrigation in some semi-arid regions as southern Jamaica.

Below is the nutritional value per 100g of Banana.

✓	Energy	371kg (89 kcal)
✓	Carbohydrates	22.84g
✓	Sugars	12.23g
✓	Dietary fibre	2.6g
✓	Fat	0.33g
✓	Protein	1.09g

Percentages are roughly approximated using US recommendation for adults (USA food data control) (National nutrient database for standard reference release 28).

Banana peels are found to be effective in coagulation of waste water treatment. Banana peel powder as a coagulant has tremendous potential for wastewater treatment. The treatment of wastewater using banana peel coagulant is found to be effective at pH 1 and dosage of 100mg/l. Banana peels can be said to be highly feasible in removing turbidity of the synthetic wastewater with removal efficiency of 88% under optimum condition ,(Minard, Anne (March 11, 2011)) (Castro et al 2011). The banana peels can also be used for other purposes which include skincare, hair health, teeth whitening, first aid, household cleaning, and gardening.

In 2007, banana peel powder was tested as a means of filtration for heavy metals and radio nuclides occurring in water produced by the nuclear and fertilizer industries (Cadmium contaminant is naturally present in phosphate ores). When added and thoroughly mixed for 40 minutes, the powder can remove roughly 65% of heavy metals and this can be repeated.

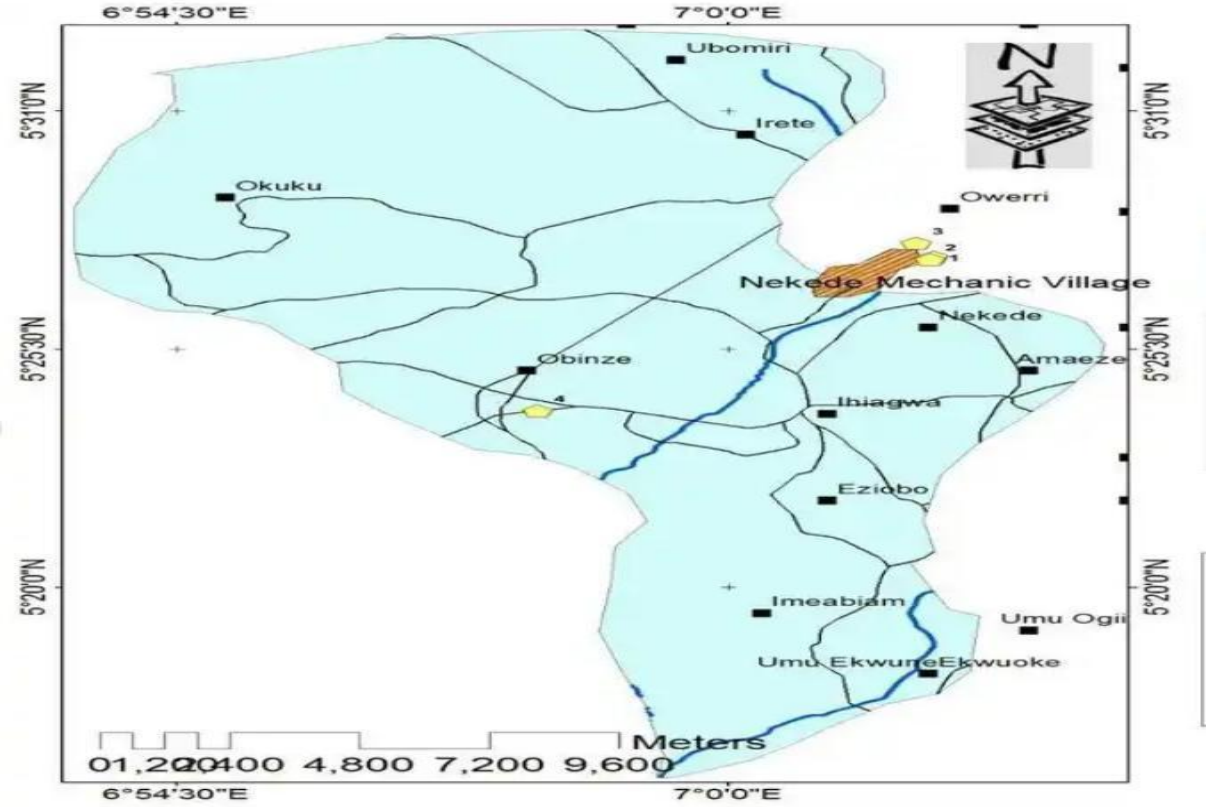
Considering the coagulating ability of both banana peels and moringa seeds, therefore there is a need to ascertain the most effective among them in the treatment of waste wa ter (precisely pond water). The effectiveness is what will determine which of the coagulant should be used for the coagulation / treatment of waste water (particularly fish pond water).

III MATERIALS AND METHODS

DESCRIPTION OF THE STUDY AREA

The fish pond wastewater effluent was collected at the discharge point into the stream at a fish pond in Federal Polytechnic Nekede Owerri, in Owerri west Local government Area Imo State Nigeria.

The study location (Federal Polytechnic Nekede Owerri), is situated at latitude 10°28:043'N, longitude 7°23:194"E, and at an elevation of 590.3m above sea level.

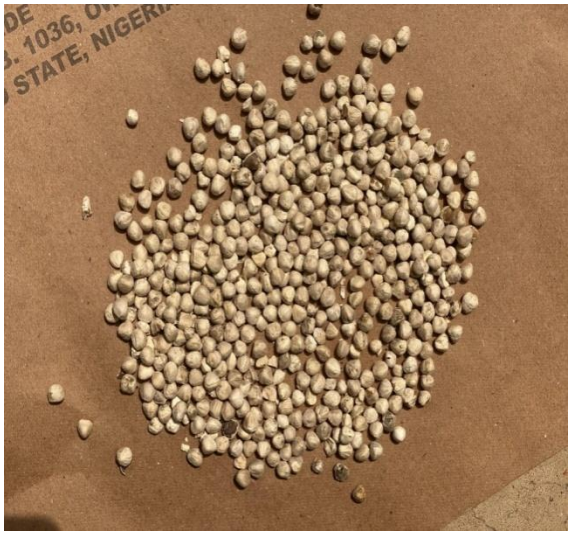


SAMPLE COLLECTION

The water sample for the analysis was collected from a fish pond located in Federal Polytechnic Nekede Owerri, using a 10 liters container. The container was properly covered and secured to avoid any environmental effect on the sample. Also, a good quantity of the Moringa oleifera seed and Bananas was bought from the market and properly preserved for the analysis.



DRIED MORINGA SEEDS BEFORE DEHUSKING.



DRIED MORINGA SEEDS AFTER DEHUSKING



SAMPLES OF DRIED BANANA PEELS



SAMPLES OF BANANA PEELS BEFORE DRYING



POND WATER

MATERIALS

The following materials were used in carrying out the experimental Analysis

- ✓ Wastewater from fish pond
- ✓ Morninga oleifera seed (granular form)
- ✓ Banana peels (dried and mashed)
- ✓ Pan
- ✓ Sieve of different sizes (125mm)
- ✓ Motar and pestle.
- ✓ Oven
- ✓ Test jar
- ✓ COD digester
- ✓ pH meter
- ✓ Turbidity meter (Nephetometric turbidity unit)
- ✓ Spectrophotometer
- ✓ Grindomix domestic grinder
- ✓ Weighing balance
- ✓ Beakers

METHODS

The experiment was carried out in the federal polytechnic Nekede soil and water laboratory, and the following steps/procedures were followed in carrying out the analysis.

STEP 1: Ripe Banana was bought from the local market and the edible parts were removed, leaving the peels. The banana peels were diced, washed thoroughly with distilled water and air

dried under sunlight for two weeks (14 days), after which it was oven dried for 24hrs at 105°C to ensure zero moisture content. The dried banana peel was grinded to fine powder form using Mortar and pestle, after which it was sieved with a sieve size of 125mm. in diameter.

STEP 2: The moringa seed was also bought and De husked, and the external coats were removed. The kernel was dried in an oven at 100°C for 48 hours, and pulverized to a fine powdered form using a Grindomix domestic grinder, after which it was sieved with same size sieve as above.

STEP 3: The Moringa seed and banana peel solution was prepared by using 100ml of distilled water as follows; firstly, the powders were weighed 0.5g, 1.0g, and 1.5g respectively, after which they were dissolved into 100ml of distilled water each contained in a beaker to obtain 0.5%, 1%, and 1.5% concentration of solution respectively. To obtain a clear solution and to extract the active ingredients, the solutions were filtered using a filter paper to remove insoluble solids. The extracts obtained were used for the water purification.

STEP 4: The removal of the percentage (%) of Color, COD, and turbidity was determined based on the operating parameters.

The color removal percentage of waste water was determined using a Spectrophotometer (JASCO, V-570) at a wavelength of 450mm maximum absorbance.

STEP 5: The general water quality parameters like acidity, alkalinity, hardness, turbidity, pH, Total suspended solids (TSS), Total dissolved solids (TDS), Total solids (TS), were tested for the raw and treated pond water samples.

Each of the concentrations of moringa seeds and banana peels solution (0.5%, 1%, and 1.5%) were added to the pond water sample contained in the different plastic containers. The mixture was stirred vigorously for 60 seconds. The water samples were then allowed to stand undisturbed for at least 2 hours, after which it was tested of the general water quality parameters. The result of the raw pond water was compared with the treated water quality parameters for the banana peels and moringa seed under permissible levels.

IV RESULTS AND DISCUSSIONS

RESULTS

The results of the physiochemical characteristics of the pond water sample, before treatment with different dosage of banana and moringa, are shown in Table 1.

The results from the treatment of the pond water samples with different dosage of moringa seeds and banana peels are shown in Table 2.

TABLE 1: Physiochemical parameters of untreated pond water sample.

PARAMETER	MEASURED
Acidity (mg/L)	150.0
Alkalinity (mg/L)	87.5
Hardness (mg/L)	72.1
Turbidity (NTU)	7.0
pH	7.5
TDS (mg/L)	255.0
TSS (mg/L)	150.0
TS (mg/L)	290.0

Table 2: **Physiochemical properties of pond water before and after treatment.**

Parameters	Raw water before treatment	Treatment with Moringa seed			Treatment with Banana peels			WHO Standards
		0.5%	1%	1.5%	0.5%	1%	1.5%	
Acidity	150.0	56.0	60.0	64.0	60.0	66.0	77.0	70.0
Alkalinity	87.5	38.0	40.0	45.0	38.0	40.0	45.0	200
Hardness	72.1	85.6	90.1	103.6	90.1	94.6	112.6	500
Turbidity	7.0	3.0	4.0	4.0	1.0	2.0	3.0	5
pH	7.5	7.1	7.1	7.2	7.4	7.5	7.6	6.5-8.5
TSS	145.0	70.0	80.0	120.0	30.0	40.0	60.0	100
TDS	255.0	140.0	260.0	320.0	160.0	200.0	260.0	500
TS	290.0	180.0	220.0	240.0	220.0	280.0	320.0	

DISCUSSIONS

TREATMENT WITH MORINGA SEEDS (GRANULAR FORM)

At 0.5%, 1% and 1.5% of the moringa seed dosage, the parameters of the treated pond water were as follows:

i. Acidity = the acidity of the water reduces drastically to 56.0 at 0.5% dosage, after which it displays a value of 60.0 mg/l at 1.0% and 64.0mg/l at 1.5% dosage.
ii. Alkalinity = the alkalinity level of the treated pond water using moringa seed, reduces to 38.0 at 0.5%, and further to 40.0 at 1.0% and 45.0mg/l at 1.5% dosage respectively.
iii. Hardness = the hardness of the pond water was found to be 85.6 at 0.5%, and 90.1 at 1.0% and 103.6mg/l at 1.5% respectively, which shows a significant increase in the treatment with high dosage.
iv. Turbidity = the turbidity of the pond water reduces to 3.0 at 0.5%, 4.0 at 1.0% and still 4.0 at 1.5%, which shows a slight increase with high dosage applications.
pH = the pH of the pond water was 7.1 at 0.5%, 7.1 at 1.0% and 7.2 at 1.5% respectively, which shows that the pH reduces and remains the same at dosage 0.5% and 1.0% but slightly increased at 1.5%.
TSS = The TSS value of the pond water after treatment with the different dosage of moringa seed (granular), reduces significantly to 70.0 at 0.5%, 80.0 at 1.0% and 120.0mg/l at 1.5% respectively.
TDS = the TDS of the treated pond water also decreases rapidly to a value of140.0 at 0.5%, 260.0 at 1.0% and 320.0mg/l at 1.5% respectively. There was a recurrence in the TS values, where the TS of the pond water drops rapidly to180.0 at 0.5%, 220.0 at 1.0% and 240.0mg/l at 1.5% respectively.

TREATMENT WITH BANANA PEELS

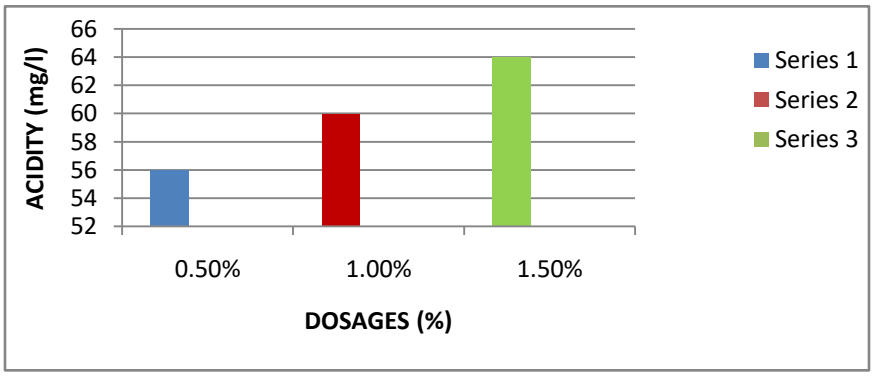
At 0.5%, 1% and 1.5% dosage of the banana peels application; the parameters of the treated pond water were as follows
i. Acidity = the acidity of the pond water was 60.0, 66.0 and 77.0mg/l respectively which shows a significant reduction compared with the raw water value.
ii. Alkalinity = the alkalinity of the water was 38.0, 40.0 and 45.0mg/l respectively, also revealing a high reduction in the alkalinity value compared with the raw value.
iii. Hardness = the hardness value of the pond water dropped significantly to85.6 at 0.5%, 90.1 at 1.0% and 103.6mg/l at 1.5% respectively.
iv. Turbidity = the turbidity value of the treated pond water shows a significant change with different dosage of the banana peels application. It is observed to be 3.5 at 0.5%, 4.0 at 1.0% and 4.0 at 1.5%.
pH = the pH value of the pond water after treatment with different dosage application, shows a slight reduction in the results. i.e 7.5 at 0.5%, 7.6 at 1.0% and 7.4at 1.5% applications respectively.
TSS = the TSS of the water also reduces significantly to30.0, 40.0 to 60.0mg/l respectively at the different dosage applications.
TDS = the TDS value of the treated pond water rapidly decreased in value compared to the raw water value, i.e160.0 at 0.5%, 200.0 at 1.0% and 260.0mg/l at 1.5% respectively.
TS = Also the TS values of the pond water displayed similar vales from 220.0 at 0.5%, 240.0 at 1.0% and 280.0mg/l at 1.5% respectively.

GRAPHS SHOWING RESULTS OF DIFFERENT TEST PARAMETER AT DIFFERENT DOSAGE WITH MORINGA SEEDS.

ACIDITY RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
56.0	0.5
60.0	1.0
64.0	1.5

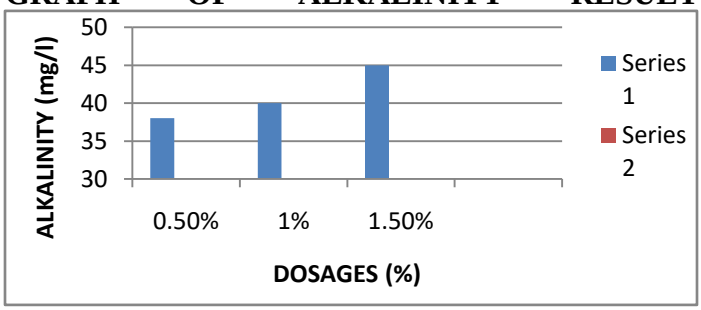
GRAPH OF ACIDITY RESULT WITH MORINGA SEEDS



ALALINITY TEST RESULT WITH MORINGA SEED

PARAMETERS (mg/l)	DOSAGE (%)
38.0	0.5
40.0	1
45.0	1.5

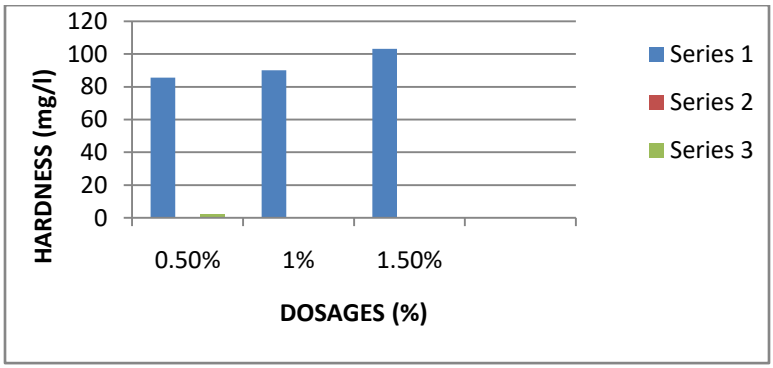
GRAPH OF ALKALINITY RESULT WITH MORINGA SEEDS



HARDNESS TEST RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
85.6	0.5
90.1	1.0
103.6	1.5

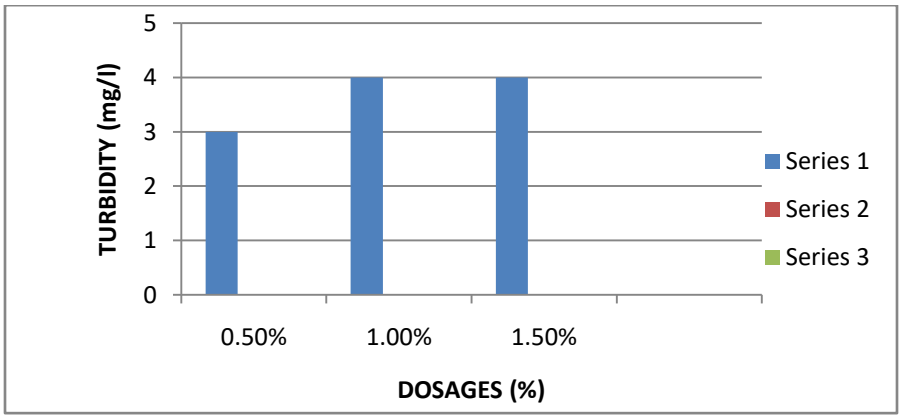
GRAPH OF HARDNESS RESULT WITH MORINGA SEED



TURBIDITY TEST RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
3.0	0.5
4.0	1.0
4.0	1.5

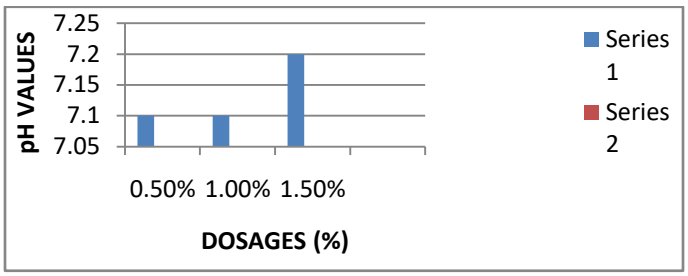
GRAPH OF TURBIDITY RESULT WITH MORINGA SEEDS



pH RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
7.1	0.5
7.1	1.0
7.2	1.5

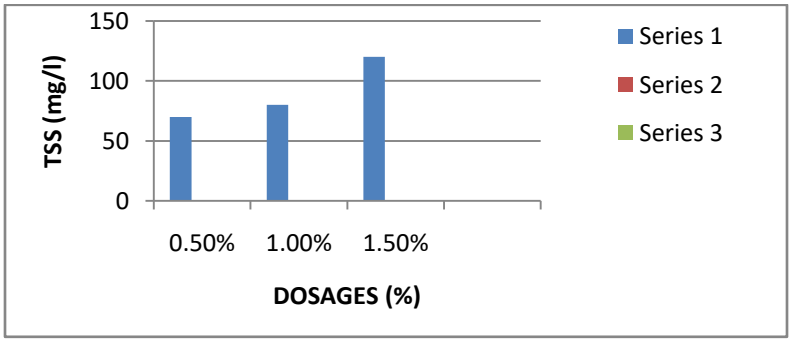
GRAPH OF pH RESULTS WITH MORINGA SEEDS



TSS TEST RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
70.0	0.5
80.0	1.0
120.0	1.5

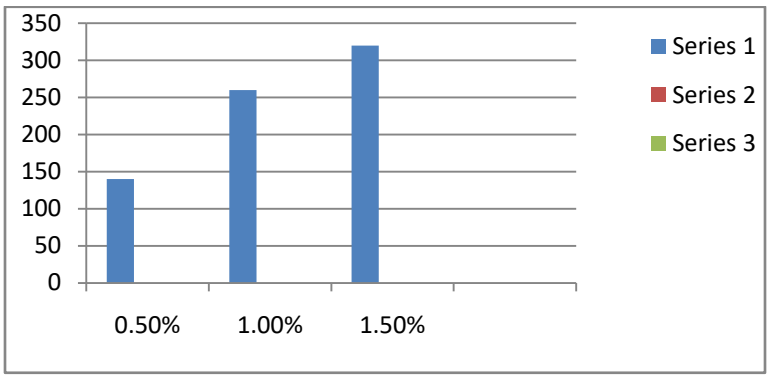
GRAPH OF TSS RESULTS WITH MORINGA SEEDS



TDS TEST RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
140.0	0.5
260.0	1.0
320.0	1.5

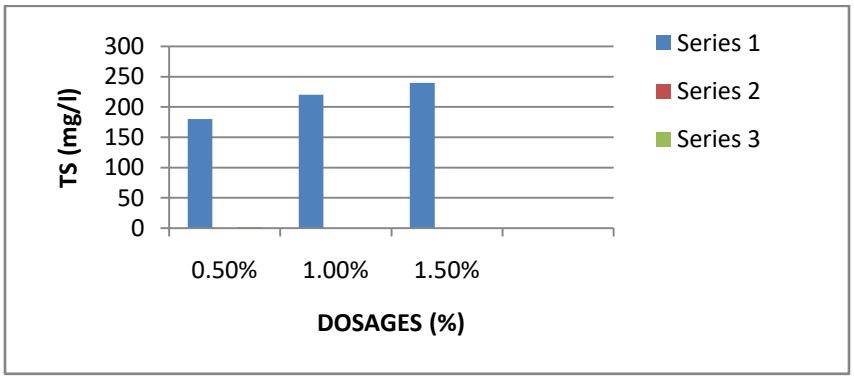
GRAPH OF TDS RESULT WITH MORINGA SEEDS



TS TEST RESULTS WITH MORINGA SEEDS

PARAMETERS (mg/l)	DOSAGES (%)
56.0	0.5
60.0	1.0
64.0	1.5

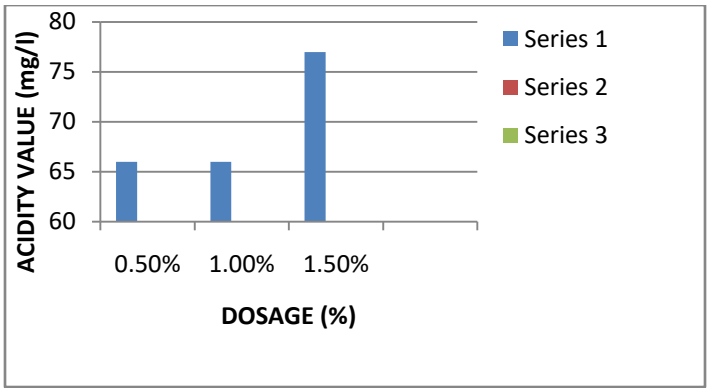
GRAPH OF TS RESULTS WITH MORINGA SEEDS



GRAPHS SHOWING RESULTS OF DIFFERENT TEST PARAMETER AT DIFFERENT DOSAGE WITH BANANA PEELS.

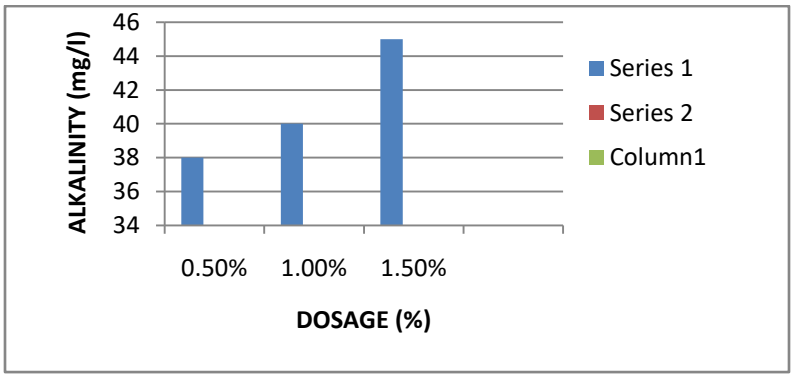
ACIDITY RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
60.0	0.5
66.0	1.0
77.0	1.5



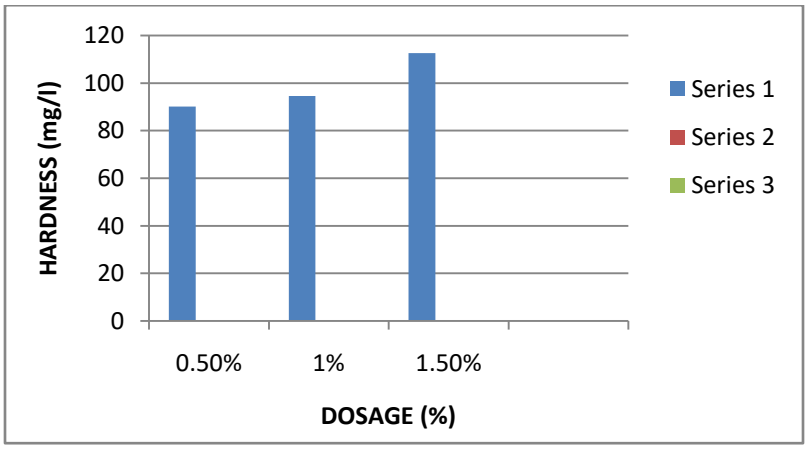
ALKALINITY RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
38.0	0.5
40.0	1.0
45.0	1.5



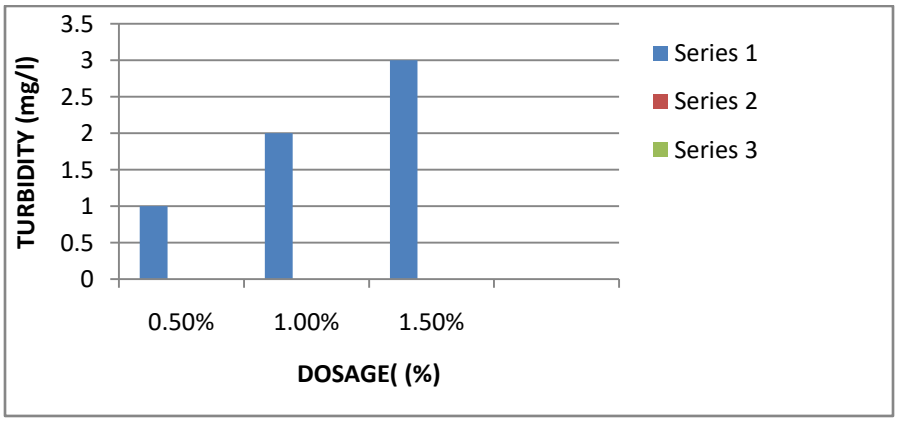
HARDNESS RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
90.0	0.5
94.6	1.0
112.6	1.5



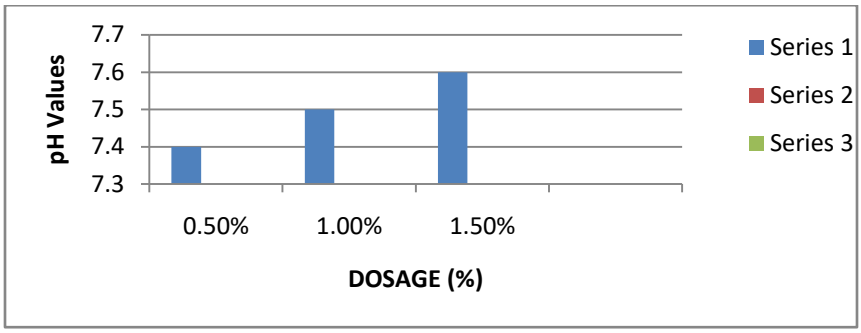
TURBIDITY RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
1.0	0.5
2.0	1.0
3.0	1.5



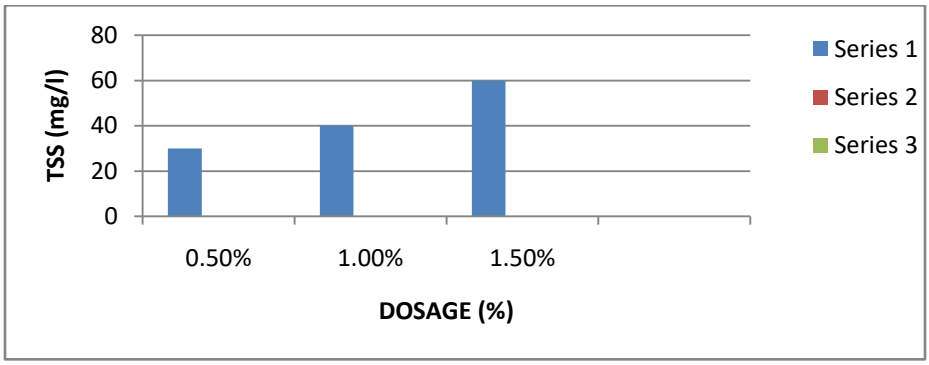
pH RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
7.4	0.5
7.5	1.0
7.6	1.5



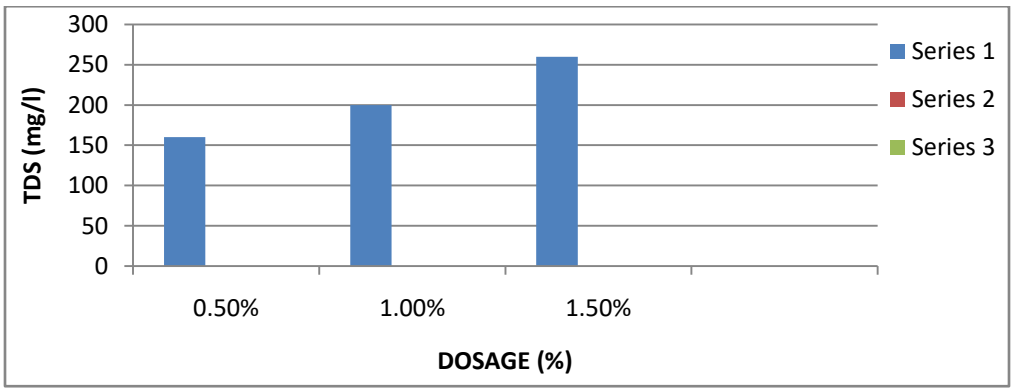
TSS RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
30.0	0.5
40.0	1.0
60.0	1.5



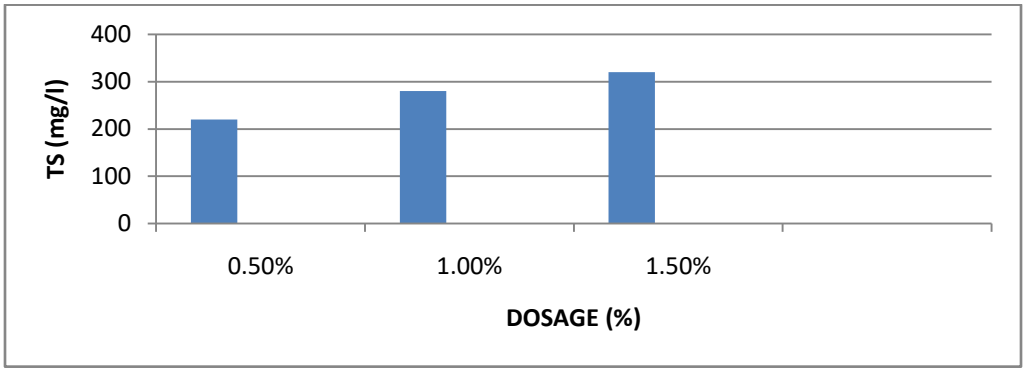
TDS RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
160.0	0.5
200.0	1.0
260.0	1.5



TS RESULTS WITH BANANA PEELS

PARAMETERS (mg/l)	DOSAGES (%)
220.0	0.5
280.0	1.0
320.0	1.5



V. CONCLUSION

The study successfully evaluated and compared the effectiveness of Moringa oleifera seed (granular form) and banana peel powder as natural coagulants in the treatment of fish pond wastewater collected from Federal Polytechnic Nekede, Owerri. The results obtained from the laboratory analysis revealed that both coagulants were effective in improving the physicochemical quality of the wastewater by reducing parameters such as acidity, turbidity, total suspended solids (TSS), total dissolved solids (TDS), and total solids (TS).

The study further showed that the efficiency of treatment depended greatly on the dosage applied. Lower dosage concentrations, particularly 0.5%, produced the best treatment results for most of the parameters analyzed. As the dosage increased from 0.5% to 1.5%, some parameters such as hardness, TDS, TSS, and TS also increased, indicating that excessive application of the coagulants may introduce additional solids into the water.

Comparatively, banana peel demonstrated better performance in reducing turbidity and suspended solid levels, while Moringa oleifera seed showed better reduction in acidity and dissolved solids. Both coagulants maintained the pH of the treated water within acceptable WHO standards, confirming their suitability for wastewater treatment applications.

The study therefore concludes that both Moringa oleifera seed and banana peel are efficient, affordable, environmentally friendly, and sustainable natural coagulants that can serve as alternatives to conventional chemical coagulants in fish pond wastewater treatment. However, based on overall performance, banana peel at 0.5% dosage was found to be the most effective treatment option for improving the quality of fish pond wastewater.

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