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Research article

Comparison of Zea Mays, Moringa Oleifera and Carica Papaya in Water Coagulation

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ABSTRACT

Water coagulation using locally available materials is a way to avoid the stress and hazards involved in using chemical coagulants. Moringa oleifera, Carica papaya and Zea mays seeds are known to possess coagulation properties but its difference and efficiency of active duration is achieved in this work. The seeds were prepared in solutions which were added to a turbid runoff water collected from ESUT. 3ml, 5ml and 10ml of the seed's solution was introduced to 400ml of turbid water. It was observed that after 24 hours, the runoff water treated with 5ml of Moringa oleifera seed solution had the lowest turbidity value of 3.38 NTU and 10ml of Carica papaya had the highest turbidity of 7.1 NTU. After 7 days, it was observed that the runoff water treated with 5ml of Moringa oleifera seed solution had the lowest turbidity value of 5.1 NTU and Carica papaya had the highest turbidity value of 6.85. After 14 days, it was observed that the water treated with 3ml of Moringa oleifera seed solution had the highest turbidity value and the water treated with 10ml of Zea mays had the lowest turbidity value of 2.85. These observation shows that Zea mays has the longest effect on coagulation while Moringa oleifera had the fastest effect on coagulation for the volume of water used.

Keywords: *Moringa Oleifera; Carica Papaya; Zea Mays; Turbidity; Water Coagulation*

Introduction

Water can be described as the liquid that forms the seas, lakes, rivers and rains and is the basis of the fluids of the living organisms as defined by The Oxford Concise English Dictionary (11th Edition). According to Michael and Ojha (2011), water covers about 70.8% of the earth's surface and only 29.2% land. This water is continually replenished through the hydrologic cycle. The major sources of water are ground water from wells and boreholes, surface water from rivers, streams and oceans and rainwater.

Turbidity is the cloudiness of a fluid caused by large number of particles invisible to the naked eye. It is an expression of the amount of light that can be scattered by material in a water sample. Materials that cause turbidity include clay, silt, algae, inorganic and organic matter and other elements that can only be seen with a microscope (Muyibi et al., 2009). Water with high turbidity level is aesthetically displeasing, unappealing and unsafe for human and livestock consumption as water of poor quality can cause water related illnesses and diseases such as typhoid and cholera. Drinking water treatment involves a number of combined processes based on the quality of the water source such as turbidity, amount of microbial load present in water and the others include cost and availability of chemicals in achieving desired level of treatment (Muyibi et al., 2009).

The use of local materials as coagulants creates a readily available and cheaper method of treating water. Among plant materials that have been tested over the years, the seeds from Moringa oleifera have been shown to be one of the most effective primary coagulants in water treatment or purification. Moringa oleifera is the best natural coagulant discovered so far that can replace Aluminum Sulfate (alum), which is used widely for water treatment around the world (Ali et al., 2010). Natural coagulants have been used for domestic purposes since traditional time in tropical rural areas. The main advantage of using natural plant-based coagulants are cost effective, less production of pH and biodegradability (Shweta et al, 2015).

Materials and Methods

The materials used in this work as coagulants are *Moringa oleifera, Zea mays* (Maize) and *Carica papaya* (paw paw) seeds. These seeds were obtained locally from Ogbete market in Enugu State. Eurosonic Multifunctional blender of item no Ef 173IF was used to grind the seeds into fine powder. A burette and a pipette were used for measurements of the samples. Test tubes and beakers were used to collect the samples. Aluminum foils were used to cover the beakers to prevent contamination and make the beakers air tight. A spoon was used for stirring the seeds solution. A weighing balance was used to weigh the samples. A timer was used for timing the experiment. HACH; 2100N turbidity meter was used to take readings. The coagulation experiment was carried out with runoff water from ESUT culvert.

Method

The experiments were carried out in ESUT soil and water laboratory according to Okoli et al (2014) and with little modifications to fit into a local setting. The pods of *Carica papaya* were sliced open with a clean knife and the seeds were removed. These seeds were then carefully removed from their skins. *Moringa oleifera* seeds were removed from the pod and the seeds were further removed from the kernels. All the seeds were carefully sorted out to remove defective ones.

The three seeds were then washed to remove dust and other impurities. The three seeds were later sun-dried for three days to reduce the moisture content. After three days, the seeds were crushed into fine powder with the electric blender.

The fine powder of each seed was weighed with a weighing balance to a weight of 0.0069kg of each powder was used. The powders of the three seeds were then collected in a beaker covered with foil to prevent contamination from dust and other particles in the environment.

In each treatment case, the finely ground seed powder was mixed with clean water to form a paste. The solution was then shaken for five minutes in order to release the active chemicals in the powder. Insoluble material was filtered out using a fine cloth. Nine runoff water samples each of 100ml were collected and put in beakers. 3ml, 5ml and 10ml of *Moringa oleifera* seed samples were put in three different beakers containing the runoff water samples.

3ml, 5ml and 10ml of *Carica papaya* seed solutions were put in the three beakers containing runoff water. 3ml, 5ml and 10ml of *Zea mays* seed solution were put in three beakers containing runoff water. The experiments were carried out five times and the mean readings were taken. All experiments were carried out at room temperature of 21 degree Celsius.

Results and Discussions

Turbidity Analysis

Each experiment was carried out five times to prevent errors and to get accurate results. After the experiments were carried out, mean values of the readings were taken and recorded. Observations were made after 24hours, 7days and 14 days. A turbidity meter was used to take NTU (Nephelometric Turbidity Unit) readings of the water samples to know the seed solution that is the best coagulant. According to the Standard Organization of Nigeria (2007), the maximum allowable limit for drinking water turbidity is 5 NTU.

Observation after 24hours

After 24 hours, it was observed that the runoff water treated with 5ml of *Moringa oleifera* seed solution had the lowest turbidity value with a reading of 3.38 NTU. The water was clear and aesthetically pleasing after 24hours. This showed that *Moringa oleifera* was the fastest coagulant as it had the lowest turbidity value after 24hours. The water sample treated with 3ml of *Moringa oleifera* seed solution gave an NTU reading of 3.5 while the water sample treated with 10ml of *Moringa oleifera* seed solution gave a reading of 3.70 NTU showing that 10ml of *Moringa oleifera* seed concentration was excess did not improve the water quality after coagulation. The treated water in each case was clear and odorless after 24 hours as shown in table 1.

Table 1: Turbidity Values after 24 hours (first day)

Seeds Solution	*3ml*	*5ml*	*10ml*
Zea mays	3.90	3.80	4.20
Moringa oleifera	3.50	3.38	3.70
Carica papaya	7.10	6.72	6.61

The water sample treated with 3ml of *Zea mays* seed solution gave readings of 3.90, 5ml NTU of *Zea mays* solution gave a reading of 3.80 NTU and 10ml of *Zea mays* solution gave 4.20 NTU indicating that 10ml of *Zea mays* seed concentration was excess and that 3ml was too small. In each case, the treated water was odorless and appeared turbid making it aesthetically displeasing.

The water treated with 3ml of *Carica papaya* seed solution had the highest turbidity with a reading of 6.61 NTU. 5ml of *Carica papaya* seed solution gave a reading of 6.72 NTU and 10ml of *Carica papaya* seed solution gave a reading of 6.61 NTU. The treated water had no visible change and gave a bad smell.

Observation after 7 days

After 7 days, further observations were made. It was observed that the runoff water treated with 5ml of *Moringa oleifera* seed solution had the lowest turbidity value with a reading of 5.1NTU while 3ml of *Moringa oleifera* seed solution gave a reading of 3.32 NTU with a slight odor. The water treated with 10ml of *Moringa oleifera* seed solution gave a reading of 5.10 NTU and had a slight odor as shown in table 2.

Table 2: Turbidity Values after 7 days

Seeds Solution	***3ml***	***5ml***	***10ml***
Zea mays	3.50	3.31	3.64
Moringa oleifera	3.32	3.30	5.10
Carica papaya	6.85	6.22	6.10

The water that was treated with 3ml of *Carica papaya* had the highest turbidity with a reading of 6.85NTU. The water treated with 5ml of *Carica papaya* gave a reading of 6.10 NTU and the water sample treated with 10ml of *Carica*

papaya gave a reading of 6.10 NTU. All the water samples treated with *Carica papaya* had bad odors. The observations are shown in Table 2.

Water treated with 3ml of *Zea mays* of had a reading of 3.5NTU, 5ml of *Zea mays* seed solution gave a reading of 3.31 NTU while 10ml of *Zea mays* seed solution gave 3.64 NTU. Compared to the results after the 1st day, the results gotten after 7 days showed that the turbidity values of *Zea mays* had reduced indicating that *Zea mays* was more effective after a period of 7 days. In each case, the water sample treated with *Zea mays* remained odorless and clearer.

Observation after 14 days

After 14 days, it was observed that the water treated with 10ml of *Moringa oleifera* seed solution had the highest turbidity value. The water also produced an odour and appeared cloudy. The water treated with 5ml and 3ml of *Moringa Oleifera* had readings of 2.9 and 3.1 NTU respectively. Thus, indicating that even though *Moringa oleifera* acted rapidly in coagulation after 24 hours, it has a short active period. It also produced a bad odour.

Water treated with 10ml of *Zea mays* had the lowest turbidity value of 2.85 NTU. With 3ml and 5ml of *Zea mays* seed solution, the NTU readings were 3.20 and 3.01 NTU respectively. The samples treated with *Zea mays* were odorless, clear and aesthetically pleasing after 14 days. The results are shown in Table 3.

Table 3: Turbidity Values after 14days

Seeds Solution	***3ml***	***5ml***	***10ml***
Zea mays	3.20	3.01	2.85
Moringa oleifera	3.1	2.9	8.23
Carica papaya	6.1	5.51	5.33

The runoff water treated with *Carica papaya* seed solution had an NTU reading of 6.1 and the samples treated with 5ml and 10ml of *Carica papaya* seed solution had readings of 5.51 and 5.33 NTU respectively. The treated water in this case appeared cloudy. The water treated with 10ml of *Carica papaya* seed solution had a thin layer floating on the surface indicating that Carica papaya has a short active period.
All experiments were carried out at room temperature of 21 degree Celsius.
Raw water Turbidity = 39.6-42.5 NTU

Conclusion

The conclusion drawn from the results gotten after the experiments shows that *Zea mays* had the longest active period as the water sample treated with *Zea mays* seed solution had the lowest turbidity value and produced no odor after 14 days. The water was clear and aesthetically pleasing. Among the three seed solutions, the water treated with *Zea mays* was the clearest after 14 days thus, it is safe to conclude that in a rural setting, *Zea mays* can be used in water coagulation where the water is not urgently needed as it needs adequate time to cause coagulation.
The results also showed that the runoff water sample treated with *Moringa oleifera* seed solution had the lowest turbidity value after 24hours and this indicates that it takes the shortest time to cause coagulation in water among the three seed solutions. The water treated with *Moringa oleifera* also produced a bad smell after 14 days and had high turbidity values indicating that *Moringa oleifera* seed solution has a short active period. Therefore, *Moringa Oleifera* should be used when the water needs to be urgently used. *Carica papaya* took a long time to cause water coagulation and it has the highest turbidity value. The water samples treated with *Carica papaya* produced a bad smell after 24hours and a thin layer was seen floating in the beaker after 2 weeks. This indicates that *Carica papaya* has the shortest active period among the three seed solutions. It is also obvious from the results, that different concentrations of the seed solution affect the strength of the coagulants. The seed solutions in liquid form caused coagulation and therefore it is safe to conclude that the best form in which *Zea mays*, *Moringa oleifera* and *Carica papaya* cause coagulation in water is the liquid form.

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