Removal Of Turbidity Using Papaya Seed As A Natural Coagulant

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ABSTRACT

This research aims to use papaya seeds to make a Natural Coagulant. Natural coagulants are compounds that can cause coagulation in liquids, particularly in water treatment procedures, and can be derived from plant, animal, or microbiological sources. This particular substance was selected based on research showing it to be an effective coagulant in the water treatment process. The objectives of this project are to create non-chemical coagulants using natural resources like papaya seeds, create ecologically friendly coagulants from these materials, and measure the turbidity of water samples after utilizing these plant materials. Papaya seeds should then be dried, ground into smaller bits, and extracted. Filtering should be completed following extraction. Papaya seeds were used in three separate ratio tests. When the three papaya seed amounts are ready, they will be measured in quantities varied to approximate six beakers full of sample water from Lake Sultan Idris Shah Polytechnic for the jar test procedure. The papaya seeds will be extracted using 50 ml of distilled water. Of the three papaya seed ratios, the lowest turbidity value is 3.45 NTU for 10 grams, 1.77 NTU for 12 grams, and 4.97 NTU for 14 grams. The primary finding of this experiment is that papaya has qualities that can reduce the amount of turbidity in water. In conclusion, papaya seeds have demonstrated their ability to function as a natural coagulant and to lessen water turbidity.

KEYWORDS

natural coagulant; turbidity

1. INTRODUCTION

Water that is suitable for drinking or use in food preparation is referred to as drinking water. Furthermore, tap water in developed nations satisfies water quality criteria, even when only a small amount is utilized for drinking and food preparation. In less developed and developing nations, treating drinking water with recommended treatment techniques is highly costly and unsuitable. This can also be because of the hazardous chemicals employed in the treatment, which is caused by a lack of appropriate infrastructure and accessories.

The next applications for this water are drinking, irrigation, industrial water supply, maintaining river flow, recreational, and other uses. Human health benefits from drinking and using irrigation are made possible by this treatment (Singh et al., 2018). Furthermore, the consequences of contaminated water and inadequate sanitation are associated with the spread of illnesses like cholera, dysentery, diarrhoea, hepatitis A, typhoid, and polio.

1.1. Water treatment process

The water treatment process, coagulation-flocculation is known to be a successful and important physicochemical process for treating various types of wastewater. In these processes, the coagulant used can be either chemical or derived from natural sources (Nurul et al.,2023). A primary water treatment method called coagulation is used to get rid of tiny, suspended solids from all kinds of water. Sludge disposal is currently a big issue, and garbage management is one of the biggest environmental problems municipalities confront globally. The purpose of this research is to treat water with natural coagulants. Watermelon seeds, fennel seeds, okra seeds, papaya seeds(Carica papaya)and other seeds are natural coagulants. Alum, sodium aluminate, and ferric sulfate are examples of chemical coagulants. Chemical testing, including turbidity and pH measurements, will be performed on both treated and untreated water samples.

Substances that lessen the medium's acidity or alkalinity are used to neutralize pH as part of the treatment process. The coagulation process starts with the addition of coagulants, which can be chemical (lime, sodium aluminate, ferric sulphate, and plant-based) or natural (plant- and animal-based) coagulants. The next step is the sedimentation of the particles and sludge separation before the residual solution is transferred for filtration in the pressure filter, which is composed of a sand-and-rock filtration layer that filters the wet sludge to extract the remaining water. Verifying the final effluent load in the water before its release into the environment is the last step in the effluent treatment process.

1.2. Plant-based coagulant (natural)

Nonetheless, the majority of papaya seeds' composition contains potentially useful by-products, such as protein (21.88%), lipids (21.88%), and fiber (18.03%), on a wet basis (Marfo et al., 1986; Ávila et al., 2020). Monounsaturated fatty acids, which include useful chemicals, are abundant in papaya seed oil (Samaram et al., 2015). The most prevalent fatty acids in papaya seed oil are palmitic, stearic, oleic, and linoleic, coupled with tocopherols and carotenoids with beneficial and functional qualities.

Plant-based coagulants and non-plant-based coagulants are the two categories of natural coagulants. Tree bark, leaves, seeds, and fruit scraps can all be used to make plant-based coagulants. Because they are more affordable than nonplant-based coagulants, research on plant-based coagulants has been conducted more extensively.

Carica papaya seeds can be used as a coagulant since it is a tropical tree comprised of water-soluble and positively charged protein known as cystine protease which emerged as a putative coagulant in both water and wastewater treatments. Carica papaya is widely used as a herbal cure in traditional medicine to treat, protect against, and prevent a wide range of ailments.

2. METHODOLOGY

It is necessary to know the location of the water sample collection and experiment conduct area to carry out this experiment. This is because it will significantly affect the outcomes. The Sultan Idris Shah Polytechnic's lake area is the chosen venue for this experiment. Next, we utilize untreated raw water as our sample of water.

Papaya seeds are a well-known ingredient in this coagulant experiment, and since they are inexpensive when purchased in bulk, it is also advantageous to get them from the market to expedite the next step. It will also begin supplying ingredients right away.

Cleaning the seeds is the first step in the other phases that make up the preparation process. Wash the material with clean water to remove the mucus from the seeds. For this reason, it won't use seeds that contain mucus. the seed is subsequently dried to eliminate any remaining moisture.

After that, the seeds need to be dried for an hour at 100°C. However, first, they need to be pressed using a tissue to absorb any remaining water from the washing procedure. The goal of this drying session is to make the seeds sufficiently dry so that they powder to the ideal consistency. After that, grind the seeds into a finer powder with a mortar or blender. The seed powder will next be sieved to get a fine texture that will make it easy to dissolve in water for the experiment.

The next step is crucial which is to extract the seed to get liquid. Combine with purified water. Papaya seed powder should be combined in three different amounts (10 grams, 12 grams, and 14 grams). Then, to obtain a liquid, dissolve in 50 millilitres of distilled water. Next, use a laboratory magnetic stirrer to stir for 30 minutes to ensure that the powder dissolves completely. To obtain just water, also separate the water from the essence. After being made into a liquid, it will be filtered first to get a clean liquid from the solution and to remove impurities.

The removal of turbidity by using natural coagulant is the water treatment process in this study. Coagulation is to balance the negative charges on non-settlable solids (such clay and organic materials that provide colour), coagulants which have charges opposite to those of the suspended solids are introduced to the water. The little suspended particles can cling to one another once the charge is neutralized. These somewhat bigger particles are not visible to the unaided eye and are referred to as microflocs. The newly created microflocs should be surrounded by clear water.

Sample water that has been added to a beaker and given a minute of 200 rpm stirring. The next step is to pour the liquidized substance into a container and add six different dilution quantities (2, 4, 6, 8, and 10 milliliters), and stir at 100 revolutions per minute for five minutes. This process takes place after one minute. Following a five-minute delay, the jar test procedure will be repeated, this time agitating at 20 rpm for fifteen minutes. This prolonged stirring will induce coagulation and cause the water to somewhat turn clear after the sedimentation process.

Using the data from the jar test procedure for both the turbidity and pH parameters to see the reading after adding the substance that has diluted to check how well the material works with the natural coagulant process and to see the reduction in the lake water's turbidity measurement.

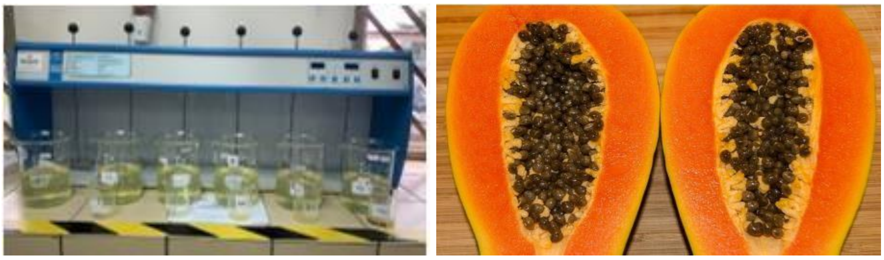


Figure 1. Coagulants used in coagulation-flocculation process

3. RESULTS AND DISCUSSION

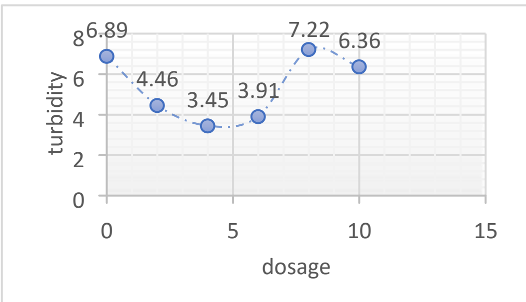
This chapter compiles the experimental data obtained from the coagulation technique used. For further information and a fundamental comprehension of the consequences that are crucial to this coagulant process, analysis is carried out appropriately. The primary objective of the coagulation/flocculation process is to remove turbidity As a result, information regarding the pH and turbidity of papaya seed natural coagulants is also covered in more detail. Consideration is given to variables that impact the coagulants' natural process, like removal effectiveness, as well as operational variables like pH and turbidity. Following that, data tables, line charts, and bar charts are used to illustrate the results. The different coagulation-flocculation tests are performed using the Jar Test consisting of a series of 6 jars (VELP Scientifica JLT 6 Flocculator). The turbid water had an initial turbidity of 24.5 NTU when it was prepared in the lab 20,000 mg/L of coagulant was found to be the ideal dosage, and a final turbidity of 3.45 NTU was achieved.

The turbidity removal rate (TRR) is defined by Eq. (1).

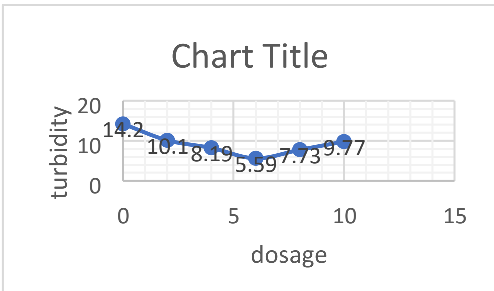
$$(\boldsymbol{TRR})\% = \frac{\textbf{Initial turbidity} - \textbf{final turbidity}}{\textbf{Initial turbidity}} \; \boldsymbol{x} \; \mathbf{100}$$

Table 1. The data or turbidity reduction by using Carica Papaya Seeds

Volume of coagulant (mL)		0	2	4	6	8	10
Turbidity (NTU)	10(g)	6.89	4.46	3.45	3.91	7.22	6.36
	12(g)	14.2	10.1	8.19	5.59	7.73	9.77
	14(g)	14.7	14.5	14.5	4.97	10.4	10.6



(a)



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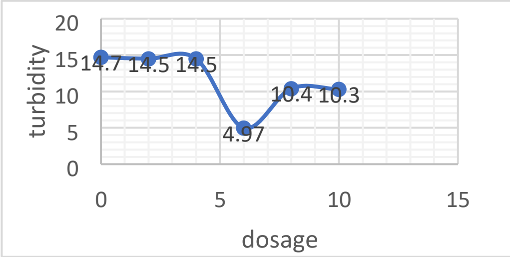

(c)

Figure 2. Optimum dosage from different weights of coagulant (a)10g (b)12g (c) 14g

Table 2. The optimum turbidity reduction by using Carica Papaya Seeds

Optimum Volume (mL)		4.8	6.0	9	Removal Efficiency
Turbidity (NTU)	10(g)	3.2	NA	NA	87
	12(g)	NA	5.2	NA	79
	14(g)	NA	NA	4.9	80

Polymer bridging or charge neutralization are two ways that naturally occurring plant-based coagulants can function. Colloids are usually negatively charged in water. Ionizable polymer coagulants are used in charge neutralization to stabilize the particles (Aminaet al.,2021). Thus, from the initial turbidity 24.5 NTU can be reduced up to 87% from the optimum dosage of coagulant and volume of Carica papaya seeds.

Design components like pH, coagulant dosage, stirring rate, and time have an impact on the coagulation and flocculation process. Changes in one parameter relative to the other showed the strongest effects on coagulant efficiency, each response, and each other (Moltot et al.,2024). As a result, they could influence removal effectiveness favourably or unfavourably. Therefore, the input components utilized during the coagulation and flocculation process determined how much the chosen natural coagulants were able to remove the colour and turbidity %.

From Table 3.0, the highest turbidity removal rate was when using the lowest amount of Caprica seeds with a volume of only 4 ml, where the removal rate increased to 86% with PH2.

Table 3. The PH reading during the coagulation process

Volume of ***0 2 4 6 8 10 coagulant (mL)***							
PH	10(g)	2.00	2.00	2.00	2.00	2.00	2.00
	12(g)	2.16	2.15	2.14	2.12	2.14	2.11
	14(g)	2.06	2.10	2.03	2.04	2.04	2.04

4. CONCLUSION

Plant-based coagulants, such as polymer bridging and charge neutralisation, can stabilize negatively charged colloids in water. Carica papaya seeds' optimal dosage and volume can reduce turbidity by up to 87%. Design components like pH, coagulant dosage, stirring rate, and time affect the coagulation and flocculation process, influencing removal effectiveness. Turbidity removal efficiencies higher than 80% can be achieved using natural coagulants. However, there is a challenge of lower efficiencies with water of lower turbidity if the amount of coagulant increased.

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