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WATER TREATMENT USING NATURAL COAGULANTS

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Abstract - *Water is undoubtedly the most vital element among the natural resources. In many developing countries, access to clean and safe water is a crucial issue. More than six million people die because of diarrhea. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity which is caused by polluted water. Commonly used chemicals for various treatment units are synthetic organic and inorganic. In most of the cases, these are expensive since they are required in higher dose and do not show cost effectiveness. Many of the chemicals are also associated with human health and environmental problemsic substances. Because of that we are using natural coagulants like cicer aritinum, myristica fragrance and sesame seed Turbidity of water is obtained after treating with the above three natural coagulants with the concentration of coagulant solution as 1%. From the results obtained it was clear that water treated with sesame seeds has obtained comparatively lesser values for turbidity. The value for pH was also obtained satisfactorily for water treated with sesame seeds. So sesame was selected as the best natural coagulant from the three coagulants used. But the result obtained for turbidity after treating the water with 1% solution was not satisfactory when compared with the chemical coagulant. So 2% & 3% solution of sesame seeds was prepared and was treated with water. Turibidity and pH of the water treated with 2% & 3% solutions of sesame seeds were obtained. From the obtained results it was clear that 3% solution of sesame seeds had given the lowest turbidity*.

Key Words: **Turbidity, pH, Coagulants, Sesame seed, Cicer aritinum, Myristica fragrance**

1. INTRODUCTION

Water is undoubtedly the most vital element among the natural resources. In many developing countries, access to clean and safe water is a crucial issue. More than six million people die because of diarrhea which is caused by polluted water. Developing countries pay a high cost to import chemicals for water treatment. This problem is critical in Bangladesh. About more than 80% of people in Bangladesh lack clean, safe water. In the case of Dhaka, the capital city of over 10 million city dwellers, due to rapid urbanization and migration from rural areas there is a tremendous load on water consumption in the city. The water condition of the surface water of Dhaka region has become highly polluted due to indiscriminate discharge of untreated waste from tannery, textile, and other industries, municipal waste into water bodies, poor drainage system, population increasing and urban encroachment, and river bank erosion, Hossain. Water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal variation in turbidity, Mc Connachie et al. For the treatment of surface water, some traditional chemicals are used during the treatment of surface water at its various steps. Commonly used chemicals for various treatment units are synthetic organic and inorganic substances. In most of the cases, these are expensive since they are required in higher dose and do not show cost effectiveness. Many of the chemicals are also associated with human health and environmental problems, Kaggwa. So, there raised a voice to develop cost-effective, easier, and environmental friendly process of water clarification. The history of the use of natural coagulants is long. Natural organic polymers have been used for more than 2000 years in India, Africa, and China as effective coagulants and coagulant aids at high water turbidities. They may be manufactured from plant seeds, leaves, and roots. These natural organic polymers are interesting because, comparative to the use of synthetic organic polymers containing acrylamide monomers, there is no human health danger and the cost of these natural coagulants would be less expensive than the conventional chemicals alike since it is locally available in most rural communities of Bangladesh. A number of effective coagulants from plant origin have been identified: Nirmali, Okra, red bean, sugar and red maize, Moringa oleifera, Cactus latifera, and seed powder of Prosopis juliflora. Natural coagulants have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction, and biodegradable nature in water purification. The aims of the present study were to reduce the level of turbidity and bacteriological contaminants from water using locally available natural coagulants, to make the water treatment process easier and environmental friendly for household applications.

1.1 OBJECTIVES

- To reduce the level of turbidity and bacteriological contaminants from water using locally available natural coagulants like Cicer arietinum, Myristica fragrans, Sesamum indicum.

- To make the water treatment process easier and environmental friendly for household applications.

1.2 SCOPE OF THE STUDY

- Water is undoubtedly the most vital element among the natural resources.
- In many developing countries, access to clean and safe water is a crucial issue.
- Developing countries pay a high cost to import chemicals for water treatment.
- In most of the cases, these are expensive since they are required in higher dose.
- Many of the chemicals are also associated with human health and environmental problems.
- So natural coagulants can be used for water treatment as they do not causes any problems which occur due to the use of chemical coagulants

2. METHODOLOGY

2.1 Materials

1. Myristica fragrans (nutmeg)

Myristica fragrans (nutmeg), belonging to the family Myristicaceae, is a spice seed from the fruit of a tropical evergreen tree. It is a well-known aromatic perennial plant with a characteristic scent that possesses multiple medicinal applications, being used to treat stomach ulcers, indigestion, liver disorders, and as emmenagogue, nervine, diuretic, diaphoretic, and aphrodisiac. Nutmeg essential oil has been used as a natural flavoring agent and as a perfume in the cosmetic industries. Owing to its demonstrated antimicrobial and antioxidant properties, nutmeg essential oil is considered to be a promising biopreservative. Its main phytochemicals include limonene, sabinene, α-pinene, β-pinene, myristicin, sabinene, and safrol. This chapter describes the botanical aspects, medicinal uses, and applications of nutmeg essential oil and explores its potential role in food science.

2. Sesamum indicum (sesame)

Sesame seeds are truly one of the most ancient foods on Earth. Sesame seeds are derived from a flowering sesame plant in the genus Sesamum. Sesame seed pods burst open when they reach full maturity, revealing the seeds of the sesame seed plant, which hold its valuable oils. Sesame seeds contain up to 60 percent oil and 20 percent protein, making them a high source of both essential fatty acids and amino acids.

3. Cicer arietinum (chickpeas)

Cicer arietinum known as chickpea is the second most widely grown legume crop after soybean, accounting for a substantial proportion of human dietary nitrogen intake and playing a crucial role in food security in developing countries. Natural coagulants have bright future and are concerned by many researchers because of their abundant source, low price, environment friendly, multifunction, and biodegradable nature in water purification. The properties of Cicer arietinum is suitable to be used as coagulant aid.

4. Clay
5. Water
6. Filter paper (whatman no.42, 125mm dia)

2.2 Preparation of synthetic turbid water

Synthetic turbid water for the jar tests was prepared by adding clay materials to tap water. About 30 g of the clay materials was added to 1 liter of tap water. The suspension was stirred for about 1 hour to achieve a uniform dispersion of clay particles. Then it was allowed to settle for at least 24 hours for complete hydration of the clay materials. The supernatant suspension of synthetic turbid water was added to the sample water to achieve the desired turbidity just before coagulation.

2.3 Stock solution of natural coagulants

Myristica fragrans seed pods are allowed to mature and dry naturally to a brown color on the tree. The seeds were removed from the pods, kept for sun dry, and external shells were removed. Mature seeds showing no signs of discoloration, softening, or extreme desiccation were used. The seed kernels were ground to fine powder using a kitchen blender to make it of approximate size of 600 µm to achieve solubilization of active ingredients in the seed. Powder of Cicer arietinum (commercial name bashion) was bought from local market of Thodupuzha City. The grains of powder were maintained approximate size less than 600 µm to achieve solubilization of active ingredients in the seed. Using grinder, fine powder achieved from seeds. Distilled water was added to the powder to make 1% suspension of it. The suspension was vigorously shaken for 45 minutes using a magnetic stirrer to promote water extraction of the coagulant proteins, and this was then passed through filter paper (Whatman no. 42, 125 mm dia.). The filtrate portions were used for required dose of natural coagulants. Fresh solutions were prepared daily and kept refrigerated to prevent any ageing effects (such as change in pH, viscosity, and coagulation activity). Solutions were shaken vigorously before use.

3. TESTS ON SYNTHETIC TURBID WATER

The physical properties pH and turbidity were evaluated after jar test was conducted.

Test-1: Using ALUM as Coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 30 Mint

Table 1:Using alum as coagulant

Trial No.	Coagulant Dose (mL)	Turbidity in NTU	pH
1	50	39	6
2	60	20	7.06
3	70	12	6.55
4	80	22	6.34
5	90	24	6.2
6	100	30	6.76.

Test-2: Using 1% of solution Cicer aritinum (Chick peas) as Natural Coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 1.30 hrs

Table 2:Using cicer aritinum as coagulant

Trial No.	Coagulant Dose (ml)	Turbidity in NTU	pH
1	50	39	6.2
2	60	25	7.1
3	70	20	6.45
4	80	27	6.44
5	90	32	6.9
6	100	42	7.01

Test-3: Using 1% solution of Myristica fragrans (nutmeg) as Natural Coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 1.30 hrs

Table 3:Using nutmeg as coagulant

Trial No.	Coagulant Dose (ml)	Turbidity in NTU	pH
1	50	89	6.44
2	60	78	6
3	70	76	6.98
4	80	77	6.71
5	90	80	7
6	100	86	7.11

Test-4: Using 1% solution of Sesamum indicum (sesame) as Natural Coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 1.30 hrs

Table 4: Using Sesame as coagulant

Tral No.	Coagulant Dose (ml)	Turbidity in NTU	pH
1	50	25	6.82
2	60	19	6.98
3	70	10	7
4	80	12	7.1
5	90	20	7.16
6	100	22	7.19

Turbidity of water is obtained after treating with the above three natural coagulants with the concentration of coagulant solution as 1%. From the results obtained it was clear that water treated with sesame seeds has obtained comparatively lesser values for turbidity. The value for pH was also obtained satisfactorily for water treated with sesame seeds. So sesame was selected as the best natural coagulant from the three coagulants used. But the result obtained for turbidity after treating the water with 1% solution was not satisfactory when compared with the chemical coagulant. So 2% & 3% solution of sesame seeds was prepared and was treated with water. Turibidity and pH of the water treated with 2% & 3% solutions of sesame seeds are obtained are as follows.

Test-5: Using 2% solution of sesamum indicum as natural coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 1.30 hrs

Table 5: Using 2% solution of sesame seed as natural coagulant

Trial No.	Coagulant Dose (ml)	Turbidity in NTU	pH
1	50	6	4.68
2	60	4	4.30
3	70	3	4.23
4	80	4	4.19
5	90	6	4.26
6	100	8	4.22

Test-6: Using 3% solution of sesamum indicum as natural coagulant

- Initial Turbidity -245 NTU
- Initial pH -6.73
- Settling time : 1.30 hrs

Table 6: Using 3% solution of sesame seed as natural coagulant

Trial No.	Coagulant Dose (ml)	Turbidity in NTU	pH
1	50	6	6.82
2	60	4	6.59
3	70	3	6.64
4	80	8	6.7
5	90	12	6.76
6	100	9	6.87

4. CONCLUSIONS

- From the experimental investigation conducted sesame seed has obtained lesser values for turbidity.
- The value for pH obtained is satisfactorily for water treated with sesame seeds.
- Sesame was selected as the best natural coagulant from the three coagulants used.
- The result obtained for turbidity after treating the water with 1% solution of sesame seeds was not satisfactory when compared with the chemical coagulant alum.
- 2% & 3% solution of sesame seeds was prepared and was treated with water and turibidity and pH are obtained.
- From the obtained results it was clear that 3% solution of sesame seeds had given the lowest turbidity value of 3 NTU for the coagulant dosage of 70 ml.
- The pH value obtained for this dosage was 6.64 which lies at the normal pH range.
- It is concluded from the project that 70ml of 3% solution of sesame seeds is the best natural coagulant.
- The water treated can be used for common household purposes.

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