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Assessment of Watermelon Seed (*Citrullus Lanatus)* as a Potential Coagulant for Water Purification

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***Abstract*-** The potential of watermelon seed as natural coagulant for water purification was evaluated. It was aimed at identifying watermelon seed as a possible replacement for alum and other synthetic polyelectrolyte in treating water Jar test experiment was performed on raw water from Dakachi Dam, Zaria, Kaduna State with initial turbidity of 62.6NTU. Results obtained showed that at a dosage of 0.1g/L with stirring time of 8 minutes and mixing speed of 100rpm, the highest turbidity reduction to 3.68 NTU was observed. This was below the World Health Organizations (WHO) recommended value of 5NTU. However, the best color removal was 30TCU but not up to the WHO recommended value of 15 TCU. The results showed that watermelon seed can be used as a natural coagulant for water treatment.

***Keywords*:** Water, Water Melon, Natural Coagulant, Water Purification

I. INTRODUCTION

Coagulation and flocculation has remained the most prominent method for the removal of colloidal particles and organic matter in water and wastewater treatments for several decades [1]. The process is generally initiated by adding coagulant agent to react with the particles in the water to form hydrophobic hydroxide and polymeric compounds. These synthetic coagulants are actually expensive to purchase and are chemicals that when used for water purification may have negative effects on health if not properly administered during the water treatment process [2-3]. Aluminium-based coagulants have shown negative effect on humans such as the development of Alzheimer's disease [4,5,6,7,8,9,10,11], pre-saline dementia [12] resulting from high amount of aluminium remaining in treated water.

The use of natural materials of plant origin in water purification or treatment of raw waters is not a new idea [7,9]. Natural coagulants have been used for domestic household for centuries in traditional water treatment in tropical rural areas [7]. Natural coagulants are usually presumed safe for human health [9,13]. Natural coagulants obtained from plant sources such as Narmali seeds, Okra, Cassava, *Dutchus lablab*, broad beans, *flava* beans, watermelon [14], *Moringa* [14,15,16,17], Maize, and *Cactus latifaria* [15] are more widely studied by researchers. One of the advantages of using natural plant-based coagulants for water treatment is that, they are cheaper to purchase, they do not produce treated water with extreme pH [2] and they are highly biodegradable [2,18,19]. Some of the plants are able to be a coagulant because they are able to conduct some of the coagulation mechanisms which are neutralizing the charge in colloidal particles and perform polymer bridging [20,21].

Citrullus lanatus popularly known as watermelon is a popular seasonal plant found in sub-Sahara [22]. It is a member of the cucurbit family (Cucurbitaceae) and have four distinct parts which include the rind/peel, the seed, the fleshy white and the fleshy red/pink/yellow parts [4]. The seeds can be brown, white green, or yellow and a few varieties are actually seedless [4]. Reference [23] stated that the composition of the watermelon seed kernel was determined to be 35.7% crude protein, 50.1% crude Oil, 4.83% crude fiber, 3.60% total ash, and 5.81% nitrogen free extract approximately 4.36% of the rind is peel and the other is the inside whitish portion. One study states that the rind is 93.8% moisture, 0.49% ash, 0.1% nitrogen, and 2.1% sugars determined the skin of fully ripened watermelon to contain approximately 20% cellulose, 23% hemicelluloses, 10% lignin, 13% pectin, 7 mg/g silica, and 12% silica free minerals. The seeds can be used as effective water purifiers because of their adsorbent properties like most indigenous seeds [22,24,25]. Citrullus *lanatus* has the potentiality of treating water on two levels, acting as both a coagulant, an

antimicrobial agent and can be used to enhance the filtration process during water treatment [3,26,]. This research aimed at investigating the potential of water melon seed as a coagulant for water treatment and to compare the result obtained with World Health Organization (WHO) Standard for Drinking water.

II. MATERIALS AND METHODS

In the preparation of reagents chemicals of analytical grade were used with deionized water. All glass ware were cleaned and rinsed with detergents and immersed in 25% nitric acid and finally rinsed with de ionized water [27].

II.I Samples Collection

The raw water sample was collected from Dakachi Dam located in Zaria, Kaduna state. The water was collected from the side of river by immersing at plastic container until it was full at three different regions. The cap was inserted while it is still under way.

The fresh seeds of water melon (*Citrullus lanatus*) of the *Cucurbitaceae* family was obtained from Sabon Gari market in Zaria, Kaduna state. The fruit was sliced open using a clean stainless knife. The seed was washed severally with distilled water, sun dried for a week, sorted to remove bad ones; de-shelled and pounded into fine particles using motar and pistol. It was then be placed in air tight container.

150g of the crushed seed was packed into a thimble and placed into a soxhlet extractor. 500ml of the n-hexane was used to extract oil from the crushed seed in the column. The apparatus was left to run for 6 hours and stops when the extraction is complete. The cake was then washed with distilled water to remove residue n-hexane; dried in an oven till constant weight is obtained and then sieve. The finer particles will be used as the coagulant as adopted by [3].

II.II Water quality test

The following was used to test for the quality of water (raw and treated water):

pH and Temperature: The pH of the sample was measured using a digital pH ―HACH sension 1. The probe was inserted directly into the water sample, the reading where recorded after it had stabilized [3].

Turbidity: Turbidity of the water sample was measured before and after treatment using a Eutech TC201 turbid meter. The probe was inserted directly into the water sample, the reading where recorded after it had stabilized [3].

Color: The color of the water sample was measured before and after treatment using a HARCH DR/2000 spectrometer. The first sample blank was filled with distilled water and other with the water sample, which was filtered prior to this procedure and measured [3].

Conductivity: The conductivity test was carried out before and after treatment using HACH Sension 5 conductivity/TDS meter. The conductivity was taken by inserting the electrode directly into the water sample, the reading where recorded after it had stabilized [3].

Total Dissolved Solid (TDS): the total dissolved solid (TDS) value was simultaneously displayed and taken with the conductance (dual display) when measuring the conductivity, using a HACH Sension5 conductivity/TDS meter [3].

Jar Test: Jar test apparatus was used to carry out coagulation and flocculation on the water samples. Six beakers (1litre) was used to study the. The following parameter was measured on the filtrate after the coagulation is complete; turbidity, color, pH, conductivity, and total dissolved solid. 0.1g weights of the coagulant was placed in each beaker, the raw water sample was added to make up the 250ml mark and the jars was placed in the jar test kit and the stirring peddles lowered into each. The jar test mixer was turn ON and the stirring speed was set at 100 rpm varying the time at 2-5 minutes. After, the completion the samples were allowed to settle and the flocs were filtered using a filter paper and the parameter listed above was measured on the filtrate [3].

III. RESULT

This study shows that, the result of some physiochemical parameters of raw water sample before and after treatment as presented in Table 1 and 2.

Table 1: Physiochemical Parameter of Raw Water Sample

Parameters	Result	WHO Standard, 2003
Temperature (^{0}C)	26.8	25-30
pH	6.9	6.5-8.5
Conductivity (µS/cm)	352	1400Max.
Turbidity (NTU)	62.6	5 Max.
Total dissolve Solid (mg/L)	178	933 Max.
Color (TCU)	300	15 Max.

Table 2. Physiochemical Parameter after Addition of Watermelon Seed on Raw Water Sample after Treatment at 0.1g/l

S/No	Time (min)	Temperature (^{0}C)	pH	Conductivity (µS/cm)	Turbidity (NTU)	TDS (mg/L)	Color (TCU)
1	2.0	22.5	7.70	416	4.53	209	55
2	5.0	22.5	7.65	419	4.80	210	50
3	8.0	22.5	7.69	413	3.68	207	30
4	10.0	22.5	7.63	418	3.99	209	40
5	12.0	7.57	7.57	406	3.68	204	35
6	15.0	7.36	7.36	457	3.88	238	60

IV. DISCUSSION

From table 1. The physiochemical parameters of the raw water; temperature, pH, conductivity, turbidity, total dissolved solid, and color was found to be 26.8 ^{0}C, 6.9, 352 µS/cm, 62.6 NTU, 178 mg/L and 300 TCU respectively. Turbidity and color are above the recommended value for good water quality [28], hence the need for treatment. However, conductivity, total dissolved solid, pH and temperature are within the accepted value and safe without treatments. From Table 2, the result of physiochemical parameter of the sample after treated with watermelon as coagulant, indicated an excellent turbidity removal of 3.68 NTU which was obtained at a stirring time of 80 minutes. These values were below the [28] recommended value and best color removal of 30 TCU. The results show that there is increase in the temperature, pH, and conductivity as stirring time increase. However, at a stirring time of 12 minutes there is a sharp decline in turbidity and color, these are in agreement with [3].

V. CONCLUSION

At the end of this research work, watermelon seed was used for water purification. The result of the physiochemical parameters shows that there was an excellent reduction in turbidity at concentration of 0.1g/L with a mixing speed of 100rpm at a stirring time 8minutes from 62.6-3.68 NTU was observed. These values were within the WHO recommended standard. The result inferred that watermelon seeds can be used for coagulation processes due to its potential as natural coagulant and eco-friendly.

VI. RECOMMENDATIONS

The following recommendation are made based on the result obtained; Watermelon seed is eco-friendly and cheaper method of water treatment, it is highly recommended for water treatment especially in rural communities where people have little or no access to drinking water. It is also recommended that further research should be investigated on more natural coagulant for coagulation abilities.

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