

1 **Original Research Article**  
2 **Application of *Moringa oleifera* powder and**  
3 **seeds to remove turbidity from water**  
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**Aims:** Recent discoveries of the use of syringe seeds for water treatment at a cost of only a fraction of conventional chemical treatment are a very important alternative. The objective was to apply the powder and the syringe seeds to the removal of water turbidity in three sedimentation times.

**Methodology:** The research was carried out at the Agricultural Products Storage Processing Laboratory of the Federal University of Campina Grande. Twelve g of powder and moringa seeds were used to remove water turbidity. A Jar Test was used to test the application of the coagulant based on powder and moringa seeds. In the equipment were introduced 12 g of powder and seeds to 500 mL of water with turbidity obtained by adding 0.5 g of clay. The Jar Test was connected to a rotation of 120 rpm for 30 minutes, then was turned off and kept at rest for 45, 53 and 61 minutes. Subsequently, approximately 50 mL of sample were collected from each pitcher for analysis of the turbidity parameter.

**Results:** The application of the seeds was more efficient than the powder. Sedimentation times influenced the removal of turbidity.

**Conclusion:** The turbidity values are outside of what is allowed by current Brazilian legislation.

Comment [n1]: Rephrase the sentence.

Comment [n2]: application

Comment [n3]: of this study is to analyze the removal efficiency of turbidity by applying syringe seeds as a natural coagulant at three different retention time.

Comment [n4]: syringe seeds as a natural coagulant for...

Comment [n5]: for

Comment [n6]: mention the name of the powder

Comment [n7]: jar test should not be capitalized letters as it is not a proper noun.

Comment [n8]: Rephrase sentence

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12 *Keywords: Coagulant; efficiency; plants; water treatment.*

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15 **1. INTRODUCTION**  
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17 Water is necessary for the economic, social and political development of a country. Due to  
18 the hydrological cycle, water is renewable, but because it is too contaminated in its springs,  
19 it undergoes a process of potability, which can often require a high investment. For a long  
20 time, the conventional water treatment process has been known, which transforms fresh  
21 water into drinking water, when submitted to a processing, usually called classic or  
22 complete, performed in a conventional water treatment plant [1].

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24 The most commonly used coagulants in water treatment plants (ETAs) are inorganic,  
25 trivalent salts of iron and aluminum or synthetic polymers. Despite the proven performance  
26 and cost-effectiveness of chemical coagulants, natural coagulants/flocculants are being  
27 studied, of which some biopolymers are being investigated more intensively, as is the case  
28 of *M. oleifera* [2].  
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30 Moringa seeds have been widely used to remove water turbidity for drinking purposes,  
31 especially in rural communities where water treatment does not occur [3]. In places where  
32 there is no water supply through the distribution network or where there are no improved

33 water sources, it is possible to treat water at the point of use to make it safer for human  
34 consumption. An alternative that can be used, in certain situations, is the application of  
35 *Moringa oleifera* seed powder to clarify turbid waters.

36 The use of moringa seeds for water purification is an economical alternative. A small dosage  
37 of this biopolymer can greatly reduce the consumption of chemical coagulants, making it a  
38 viable alternative in water treatment to chemical coagulants due to its coagulant properties  
39 and its ability to remove bacteria [4].

40 Due to its versatility, the moringa presents effective action on various types of water, as well  
41 as various types of effluents. The methods of application of natural coagulants in water are  
42 still empirical, requiring scientific work to prove its effectiveness in water treatment. The  
43 study was carried out with the objective of applying the powder and moringa seeds in the  
44 removal of water turbidity in three times of sedimentation.  
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## 46 2. MATERIAL AND METHODS

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48 The research was carried out at the Agricultural Products Storage Processing Laboratory of  
49 the Federal University of Campina Grande, Paraiba. Two different methods of coagulant  
50 application were tested. The first was the direct method with the application of seeds without  
51 peel, which were peeled manually before application. To obtain the powder, the seeds were  
52 crushed in a domestic blender.

53 Initially, the water was characterized with high turbidity, using distilled water, to be compared  
54 with the water after the application of the coagulant. A Jar Test was used for the coagulant  
55 application tests based on powder and moringa seeds. In the Jar Test 12 g of powder and  
56 seeds were introduced to 500 mL of water with turbidity obtained by adding 0.5 g of clay  
57 (Table 1).  
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**Table 1. Initial characterization of water with high turbidity.**

Parameter	Standard (distilled water)	Addition of 0.5 g of clay
Turbidity (NTU*)	0.09	287

Note: \*Nephelometric turbidity unit.

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62 The equipment (Figure 1) was connected to a rotation of 120 rpm for 30 minutes, then was  
63 turned off and kept at rest for 45, 53 and 61 minutes. Subsequently, approximately 50 mL of  
64 sample were collected from each Jar Test pitcher for analysis of the turbidity parameter, in  
65 order to verify the removal efficiency by comparing the results with the water before  
66 treatment. The turbidity analysis of the samples was performed using a microprocessed  
67 digital turbidimeter model DLT-WV.  
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**Comment [n9]:** The Material and Methods must later be divided into subsections of 2.1 Materials, followed by 2.2 Methodology. Each subsection must be later elaborated clearly. For example, under 2.1 Material, this can be further expanded to 2.1.1 Preparation of Moringa seeds as a natural coagulant.

In the case of 2.2 Methodology; this can be expanded further to 2.2.1 Characterization of water samples; 2.2.2 Application of Moringa seeds to the water samples.....etc.

**Comment [n10]:** What is the reference and basis of this method. Please state in the methodology for validation and credibility.

**Comment [n11]:** Mention where the seeds were obtained from, whether they were bought from a local market or a commercial product of analytical grade.

**Comment [n12]:** Rephrase sentence as it is unclear what type of water samples were tested, or sampled. How was the water characterized as highly turbid? What material was used in this test?

**Comment [n13]:** Restructure the sentence.

**Comment [n14]:** Restructure the sentence

**Comment [n15]:** Sentence left hanging.

**Comment [n16]:** Measured / analyzed / tested



Fig. 1. Jar Test equipment.

**Comment [n17]:** Photo is not required to explain the jar test method. What is required is the volume of the water samples poured in each beaker. How many beakers were used and of what volume, what type of brand. Was a control applied? What is the difference of the dosage in each beaker. What is the reference of the method. Etc. This can be elaborated extensively.

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### 3. RESULTS AND DISCUSSION

The coagulant obtained from the seeds of *M. oleifera*, usually, presents satisfactory results regarding the removal of turbidity, achieving reductions of 80 to 99% for this parameter. However, in the course of the study, there were large variations in the percentage of removal (Figure 2).

**Comment [n18]:** This proper noun should have been used earlier in the context to explain the paper.

**Comment [n19]:** Please indicate specifically which part of the experiment achieved this success rate. In the other part of the text, it is not shown.

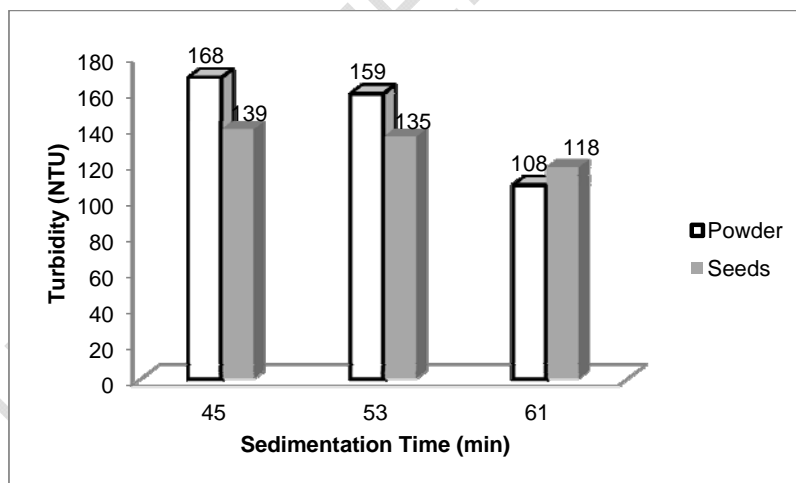


Fig. 2. Removal of water turbidity with application of powder and moringa seeds.

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The application of the powder presented removal efficiency of 41.46, 44.6 and 62.37%, respectively, for the sedimentation times studied, while the seeds presented efficiency of 51.57, 52.96 and 58.88% of efficiency in removing this parameter, being more efficient than the powder.

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92 It was observed that the sedimentation times influenced the turbidity removal, since, with the  
93 gradual increase of the sedimentation time, the turbidity decreased. However, the turbidity  
94 values are outside of what is allowed by current legislation. Ordinance N<sup>o</sup>. 5/2017 of the  
95 Ministry of Health establishes a maximum value of 5.0 NTU for turbidity in water considered  
96 potable [5].

97 Pereira et al. [6] verified that for the removal of turbidity the solution containing *Moringa*  
98 *oleifera* presented better values for 100 NTU, obtaining a reduction of 70.67%, for the time of  
99 30 minutes, and for 150 NTU reducing 56%, in the time of 10 minutes. Muniz et al. [7] when  
100 studying the use of moringa seeds in the removal of water turbidity found that the seeds  
101 without bark provided a reduction from 400 to 0.8 NTU. Lo Monaco et al. [8] when evaluating  
102 the sedimentation times of 2 and 24 h observed that the time of 24 h provides greater  
103 reductions in water turbidity. Pritchard et al. [9] obtained, using moringa seeds confined in  
104 sachets in the treatment of water with turbidity of 146 UNT, a reduction in turbidity of  
105 approximately 85% in sedimentation tests.

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#### 107 **4. CONCLUSION**

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109 There were large variations in the efficiency of turbidity removal. Seed application was more  
110 efficient than dust. The sedimentation times influenced the turbidity removal, because with  
111 the gradual increase of the sedimentation time, the turbidity decreased. Based on the  
112 conditions under which the survey was conducted, the turbidity values are outside the scope  
113 of current legislation.

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#### 116 **COMPETING INTERESTS**

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118 Authors have declared that no competing interests exist.

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