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## Original Research Article

# Application of *Moringa oleifera* powder and seeds to remove turbidity from water

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**Aims:** The use of natural, on-site, low-cost coagulants can reduce problems related to the consumption of non-potable water and untreated wastewater discharges into receiving bodies. A natural solution for acting as a coagulant is the *Moringa oleifera* seed. The objective of this study is to analyze the efficiency of turbidity removal through the application of moringa seeds as a natural coagulant in three different retention times.

**Methodology:** The research was carried out at the Agricultural Products Storage Processing Laboratory of the Federal University of Campina Grande. The powder obtained after trituration of the seeds and the seed without bark was used. A jar test was used to test the application of the coagulant based on powder and moringa seeds. To obtain artificial water, 0.5 g of clay was added to the jars of the jar test. 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.

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

## 1. INTRODUCTION

Water is necessary for the economic, social and political development of a country. Due to the hydrological cycle, water is renewable, but because it is too contaminated in its springs, it undergoes a process of potability, which can often require a high investment. For a long time, the conventional water treatment process has been known, which transforms fresh

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31 water into drinking water, when submitted to a processing, usually called classic or  
32 complete, performed in a conventional water treatment plant [1].

33

34 The most commonly used coagulants in water treatment plants (ETAs) are inorganic,  
35 trivalent salts of iron and aluminum or synthetic polymers. Despite the proven performance  
36 and cost-effectiveness of chemical coagulants, natural coagulants/flocculants are being  
37 studied, of which some biopolymers are being investigated more intensively, as is the case  
38 of *M. oleifera* [2].

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40 Among the coagulants, the most commonly used are aluminum sulphate and ferric chloride.  
41 Ndabigengesere and Narasiah [3] have pointed to several drawbacks of the use of aluminum  
42 salts, such as Alzheimer's disease and similar health problems associated with residual  
43 aluminum in treated waters. According to Ghebremichael [4], when compared to chemical  
44 coagulants, moringa seed has a number of advantages, among them: reduced need for pH  
45 readjustment, low operation cost and reduced sludge volumes.

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47 Moringa seeds have been widely used to remove water turbidity for drinking purposes,  
48 especially in rural communities where water treatment does not occur [5]. In places where  
49 there is no water supply through the distribution network or where there are no improved  
50 water sources, it is possible to treat water at the point of use to make it safer for human  
51 consumption. An alternative that can be used, in certain situations, is the application of  
52 *Moringa oleifera* seed powder to clarify turbid waters.

53 The use of moringa seeds for water purification is an economical alternative. A small dosage  
54 of this biopolymer can greatly reduce the consumption of chemical coagulants, making it a  
55 viable alternative in water treatment to chemical coagulants due to its coagulant properties  
56 and its ability to remove bacteria [6].

57 Due to its versatility, the moringa presents effective action on various types of water, as well  
58 as various types of effluents. The methods of application of natural coagulants in water are  
59 still empirical, requiring scientific work to prove its effectiveness in water treatment. The  
60 objective of this study is to analyze the efficiency of turbidity removal through the application  
61 of moringa seeds as a natural coagulant in three different retention times.

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## 63 2. MATERIAL AND METHODS

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### 65 2.1. Research venue

66 The research was carried out at the Agricultural Products Storage Processing Laboratory of  
67 the Federal University of Campina Grande, Paraiba. Two different methods of coagulant  
68 application were tested.

### 69 2.2. Preparation of coagulant

70 The first was the direct method with the application of seeds without peel, which were peeled  
71 manually before application. To obtain the powder, the seeds were crushed in a domestic  
72 blender.

### 73 2.3. Application of coagulant

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75 Initially, the water was characterized with high turbidity, using distilled water, to be compared  
 76 with the water after the application of the coagulant. A jar test was used for the coagulant  
 77 application tests based on powder and moringa seeds. In the jar test 12 g of powder and  
 78 seeds were introduced to 500 mL of water with turbidity obtained by adding 0.5 g of clay  
 79 (Table 1).  
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81 **Table 1. Initial characterization of water with high turbidity.**

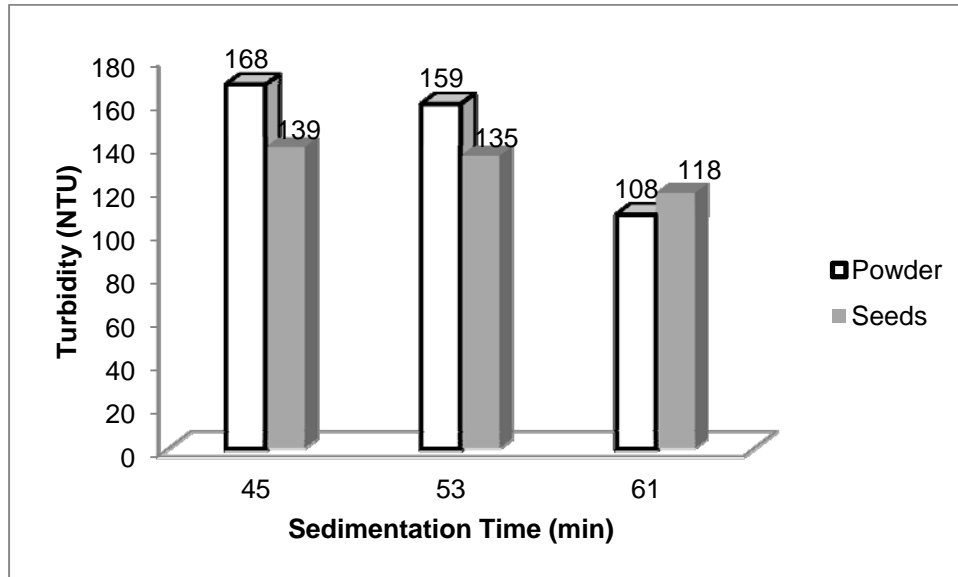
Parameter	Standard (distilled water)	Addition of 0.5 g of clay
Turbidity (NTU*)	0.09	287

82 *Note: \*Nephelometric turbidity unit.*

83  
 84 The equipment was connected to a rotation of 120 rpm for 30 minutes, then was turned off  
 85 and kept at rest for 45, 53 and 61 minutes. Subsequently, approximately 50 mL of sample  
 86 were collected from each Jar Test pitcher for analysis of the turbidity parameter, in order to  
 87 verify the removal efficiency by comparing the results with the water before treatment. The  
 88 turbidity analysis of the samples was the portable equipment using a microprocessed digital  
 89 turbidimeter model DLT-WV.  
 90

91  
 92 **3. RESULTS AND DISCUSSION**

93  
 94 The coagulant obtained from the seeds of *M. oleifera*, usually, presents satisfactory results  
 95 regarding the removal of turbidity, achieving reductions of 80 to 99% for this parameter [7].  
 96 However, in the course of the study, there were large variations in the percentage of removal  
 97 (Figure 1).  
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99 **Fig. 1. Removal of water turbidity with application of powder and moringa seeds.**

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 103 The application of the powder presented removal efficiency of 41.46, 44.6 and 62.37%,  
 104 respectively, for the sedimentation times studied, while the seeds presented efficiency of  
 105 51.57, 52.96 and 58.88% of efficiency in removing this parameter, being more efficient than  
 106 the powder.

107 It was observed that the sedimentation times influenced the turbidity removal, since, with the  
108 gradual increase of the sedimentation time, the turbidity decreased. However, the turbidity  
109 values are outside of what is allowed by current legislation. Ordinance N<sup>o</sup>. 5/2017 of the  
110 Ministry of Health establishes a maximum value of 5.0 NTU for turbidity in water considered  
111 potable [8].

112 Pereira et al. [9] verified that for the removal of turbidity the solution containing *Moringa*  
113 *oleifera* presented better values for 100 NTU, obtaining a reduction of 70.67%, for the time of  
114 30 minutes, and for 150 NTU reducing 56%, in the time of 10 minutes. Muniz et al. [10] when  
115 studying the use of moringa seeds in the removal of water turbidity found that the seeds  
116 without bark provided a reduction from 400 to 0.8 NTU. Lo Monaco et al. [11] when  
117 evaluating the sedimentation times of 2 and 24 h observed that the time of 24 h provides  
118 greater reductions in water turbidity. Pritchard et al. [12] obtained, using moringa seeds  
119 confined in sachets in the treatment of water with turbidity of 146 UNT, a reduction in  
120 turbidity of approximately 85% in sedimentation tests.

121 Moringa has not been applied as a primary coagulant only in the treatment of natural surface  
122 water, but also in wastewater from domestic and industrial effluents. In the treatment of  
123 industrial effluents, Song et al. [13] evaluated residual water from tanneries by applying  
124 *Moringa oleifera* in the removal of suspended solids (30-37%) and chromium (38-46%).

125 A negligible interference characteristic has also been demonstrated in the effluent pH  
126 values. The results obtained support the hypothesis that the use of natural coagulant from  
127 *Moringa oleifera* seeds may be satisfactory in the treatment of textile effluents by restricting  
128 the use of chemical substances, such as aluminum sulphate [14].

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#### 130 **4. CONCLUSION**

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

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145 **COMPETING INTERESTS**

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147 Authors have declared that no competing interests exist.

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149 **AUTHORS' CONTRIBUTIONS**

150

151 Semirames do N. Silva developed the following research. Suiane M. Moraes and Joana  
152 D'arc P. Matos were responsible for the bibliographic review. Roberta de S. O. Wanderley,  
153 Luís P. F. R. Silva and Antônio J. R. Barroso assist in conducting the analysis and  
154 interpretation of the data obtained in the research and Josivanda P. Gomes, research  
155 supervisor.

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