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Resources Comparison Between Some Parts Of Moringa Tree To Remove Turbidity From Water

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Abstract:

Because water is one of the basic natural environmental resources for life on Earth, we must preserve it with the lowest percentage of pollutants for life. Therefore, this research aimed to use a natural material to remove turbidity from water, which is the parts of Moringa tree, where a comparison was made between (seed extract, leaf extract, seed extract with leaves) to find out which of them would be better for removing turbidity from water, where synthetic water with turbidity was used. An initial value is 55 NTU, and the extracts were prepared by extraction method using an ultrasonic device and using hexane as an organic solvent in a ratio of (1:10) and at concentrations of these extracts of (10, 20, 30, 40) mg/L. Using a gartest device, fast rotation for two minutes and a rotation speed of 200 rpm, and slow rotation for ten minutes and a rotation speed of 20 rpm, with different deposition times whose values range between (1, 2, 3, 4) hours.

It was found that the optimal concentration for the three extracts was 10mg/L, and that the seed extract with leaves gave a higher efficiency than the leaf extract, and this was higher than the seed extract, as the turbidity values after treatment at this concentration were (4.3,4.87,4.9)NTU, respectively, and The removal efficiency values at the same concentration were (92.16, 91.14, 90.09)%, respectively, after a sedimentation time of four hours, meaning that all moringa parts gave drinking water in terms of turbidity according to the Syrian standard.

Key words: Natural, Turbidity Removal, Moringa Tree, Drinking Water Purification.

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المقارنة بين بعض أجزاء شجرة المورينغا لإزالة العكارة من المياه

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الملخص:

لأن المياه من الموارد البيئية الطبيعية الأساسية للحياة على وجه الأرض لذلك علينا المحافظة عليها بأقل نسبة للملوثات مدى الحياة. لذلك هدف هذا البحث إلى استخدام مادة طبيعية لإزالة العكارة من المياه وهي أجزاء من شجرة المورينغا، حيث تم المقارنة بين (مستخلص البذور، مستخلص الأوراق، مستخلص البذور مع الأوراق) لمعرفة أي منها سيكون أفضل لإزالة العكارة من المياه، حيث تم استخدام مياه تركيبية بعكارة ابتدائية قيمتها 55NTU، وتم تحضير المستخلصات بطريقة الاستخلاص soxhelt باستخدام جهاز الأمواج فوق الصوتية ultrasonic وباستخدام الهكسان كمذيب عضوي بنسبة (1:10) وبتراكيز لهذه المستخلصات قيمها (10،20،30،40)mg/L وباستخدام جهاز الجارتست وبدوران سريع لمدة دقيقتين وبسرعة دوران 200 دورة في الدقيقة ودوران بطيئ لمدة عشر دقائق وبسرعة دوران 20 دورة في الدقيقة وبأزمنة ترسيب مختلفة تتراوح قيمها بين (1،2،3،4)hour.

تم التوصل أن التركيز الأمثل للمستخلصات الثلاثة كان 10mg/L وأن مستخلص البذور مع الأوراق أعطى كفاءة أعلى من مستخلص الأوراق وهذه أعلى من مستخلص البذور (وجميع القيم تقريباً متقاربة)، حيث أن العكارة كانت قيمها بعد المعالجة عند هذا التركيز (4.3،4.87،4.9)NTU على التوالي، وكانت قيم كفاءة الإزالة عند نفس التركيز (92.2،91.14،91.09)% على التوالي وذلك بعد زمن ترسيب أربع ساعات، أي أن أجزاء المورينغا جميعها أعطت مياهاً صالحة للشرب من حيث العكارة حسب المواصفة القياسية السورية.

الكلمات المفتاحية: الموارد الطبيعية، إزالة العكارة، شجرة المورينغا، تنقية مياه الشرب.

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lutants and purify drinking water, but the seeds are also eaten green or roasted, ground and steeped to drink as tea or the seeds can be used in curries. The tree has recently been promoted as a good source of highly digestible protein and a source of calcium, iron and vitamin C. These diverse uses have been documented by many researchers, and detailed studies have been conducted on the use of Moringa seed extract in water treatment (Bichi, 2013,1).

The Moringa tree according to Lowel (2001) is a small, fast-growing tree, ranging in height from 5 to 12 metres with an open umbrella-shaped trunk, and when fully grown it is straight with cork bark and evergreen foliage with leaflets 1-2 cm in diameter, the flowers are white or cream in colour and the fruits are initially light green, thin and soft, then become dark green and firm.(Aho et al., 2014,1)

1- literature review:

Biological methods use microorganisms to remove contaminants from water. Such methods are effective in removing organic components of water turbidity, but are less efficient in removing turbidity associated with inorganic matter. Therefore, researchers often combine biological methods with other treatment methods to remove turbidity. For example, an activated carbon method is combined with a moving bed biofilm method to remove turbidity from landfill leachate, removing about 90% of the turbidity and 70% of the colour from landfill leachate samples (Ganjo et al., 2023,1).

An aerobic filtration method was combined with a hypoxic filter layer and was found to be effective in reducing turbidity to about 94% of the turbidity of textile industry wastewater

Researchers have shown that biological methods are effective in removing turbidity from water. However, these methods face many limitations including treatment time and space as well as organic load (Shabaa et al., 2021,3).

Physical methods such as sand filter and screening remove contaminants from water without changing the chemical composition of the contaminants (Shabaa et al., 2021,3).

For example, a rubber crumb filter has been used to remove turbidity from water and about 47.8% of the turbidity was removed using a bead size of 2 to 4

introduction:

Safe and clean water is extremely important for human health and well-being, and water must undergo purification and treatment to reach the global standard of drinking water before consumption. Different methods of water purification and treatment are used to make the water safe and healthy for the consumer. The treatment method used depends on the nature of the raw water used, as turbidity is one of the most common water pollutants due to soil erosion, runoff, or the presence of high numbers of microorganisms and these factors in turn lead to an increase in the turbidity value (Shabaa et al.,2021,1) as turbidity negatively spoils the appearance of the water, affects fish production, damages water quality, and can cause many diseases such as nausea (Rasheed et al, 2023,2) Therefore, the permissible values of turbidity according to the Syrian Standard are 5NTU. To achieve this requirement, there are many physical, biological and chemical methods to bring the turbidity value to the permissible value according to this standard, and many methods have been used to reduce water turbidity, which may be biological, physical or chemical.

Natural materials are used for drinking water treatment and wastewater treatment, where researchers (Alhajali & Ali-Nizam, 2022,2) removed the bacteriological contamination of wastewater using powdered leaves of the Atlantic duck plant, and natural materials are also used to treat industrial water, where researchers (Al-Mokhalelati et al., 2021,2) removed triple chromium using a natural material which is the residue of sugar cane juice. Since natural materials are environmentally friendly and inexpensive, they are favoured over other treatment methods.

Moringa tree and its uses

Moringa is a tree that is grown in the entire tropical belt. It belongs to the Moringa family and is one of 14 known species. The tree has been described as a multipurpose tree for life. It has been used in some fields of medicine, cosmetics, dietary supplements, and water treatment .

In West Asia one of the most well-known uses of Moringa is the use of seed powder to coagulate pol-

trees.

.2 Separate the leaves from their stalks.

.3 Wash the leaves and dry them in the oven at 60 degrees centigrade for 20 minutes.

.4 Grind the leaves with a grinder to be fine powder.

3 -3- Preparation of the seed extract by removing the oil from it:

The plant extract was prepared by the soxhelt extraction method using an ultrasonic device, where the organic solvent hexane was used in a ratio of 1:10 (1 part of fine powder and 10 parts of hexane solvent) to obtain the crude extract, according to the following steps:

Weigh a certain amount of seed powder (15 g) and measure the required amount of hexane solvent (150 ml) and place them in a beaker with the mouth of the beaker closed to prevent volatilisation of hexane.

.1 Place the flask in an ultrasonic device at a frequency of 20 kHz for one hour.

.2 Remove the beaker from the ultrasonic device and separate the seed powder from which the oil was extracted from the hexane solvent by filtration through filter paper.

.3 Evaporate the remaining hexane from the seed powder by drying under sunlight to ensure the volatilization and separation of all the hexane from the seed powder.

.4 Store the plant extract at low temperature for use in later experiment.

3 -3- Preparation of leaf extract:

The leaf extract was prepared in the same way as the seed extract, but leaf powder was added instead of seed powder.

4 -3- Preparation of seed extract with leaves:

Seed extract and leaf extract were prepared in the same way as seed extract and leaf extract, but leaf powder was added with the seeds instead of seed powder or leaf powder.

mm and a flow rate of 24.4 m3/hour. Research has also indicated that slow sand filters can remove more than 85% of turbidity from water. On the other hand, some researchers have combined polyaluminium chloride coagulant with fast sand filtration and reached a turbidity removal efficiency of 80.0%. However, physical methods either have low cost and low turbidity removal efficiency or have high cost and good removal efficiency (Shabaa et al., 2021,3).

There are many natural coagulants that are usually recommended instead of chemical coagulants, because chemical coagulants have adverse effects on the environment due to the effect of these chemicals present in the coagulant. Many new researches have been on the use of plants that can act as a natural coagulant in water treatment such as peanut seeds and watermelon seeds (Zaid et al., 2019,2).

Moringa is an important commodity plant that has been traditionally used for water treatment in the tropics as it offers many advantages over conventional coagulants in water treatment around the world. Moringa seeds are cost-effective, environmentally friendly, do not require pH change, act as a bio-coagulant, and reduce sludge volumes. Many researchers have studied the use of moringa seeds as a bio-coagulant for water treatment (Zaid et al., 2019, 2).

Idris focussed on the properties of moringa and its potential applications. It is a source of protein, calcium, iron, carotenoids and phytochemicals and can be used in

2- Research materials and methods:

2-1-Preparation of raw moringa seeds:

.1 Picking and collecting Moringa fruits (pods) from trees.

.2 Clean the pods and dry them in the oven at 60C° for 20 minutes.

.3 Peel the pods and separate the black seeds from inside the pods.

.4 Grind the seed pods with a grinder to be fine powder.

2-2- Prepare the leaves:

.1 Pick and collect Moringa leaves from the

Table (2) Effect of different concentrations of Moringa seed extract on reducing the turbidity of raw water with initial turbidity of 55NTU with varying settling times

Sedimentation times (hour)	Added concentration of seed extract(g/l)							
	0.1		0.2		0.3		0.4	
	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency %	Turbidity (NTU)	Removal efficiency %
0.5	20.3	63.0	19.9	63.8	25.8	53.1	27.2	50.5
1	14.7	73.2	16.2	70.5	22.9	58.3	23.3	57.6
1.5	11.6	78.9	13.3	75.8	19.8	64.0	20.9	62.0
2	8.7	84.2	9.8	82.2	15.9	71.1	18.6	66.2
2.5	6.8	87.6	8.9	83.8	12.3	77.6	16.2	70.5
3	6.0	89.1	7.7	86.0	10.8	80.3	14.3	74.0
3.5	5.7	89.6	6.3	88.6	8.9	83.8	12.5	77.3
4	4.9	91.09	5.7	89.6	7.6	86.2	10.0	81.8

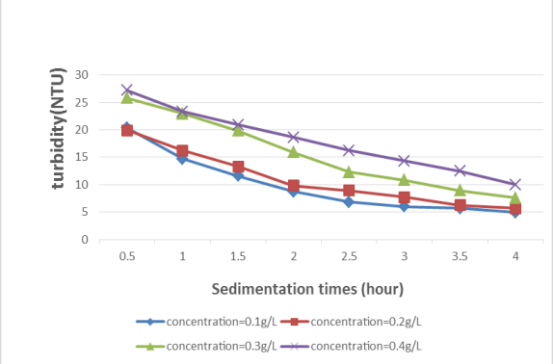


Figure (1) Change of turbidity values of raw water with initial turbidity of 55NTU by changing the concentration of Moringa seed extract and changing the settling times.

5 -3- Preparation of synthetic turbid raw water:

Synthetic water with an initial turbidity of 55NTU was prepared using kaolin (Chinese clay), which is known to be a clay mineral, white in color, with a high melting point, one of the most heat-resistant clays with the chemical formula: AL2SI2O5(OH)4

6 -3- Adding seeds to the water:

6 -4 pitchers were filled with 4 litres of turbid water.

−Different concentrations of seed powder (0.1, 0.2, 0.3, 0.4) gr/l were added to each beaker.

−Rapid agitation of the samples for 2 minutes using the Gartest appearance at 200 rpm

−Slow agitation for 10 minutes at 20 rpm.

-Allow the samples to settle with different settling times.

4- Results and discussion results and discussion :

4-1- Study of the effect of Moringa seed extract in removing the turbidity of the initial turbidity water sample of 55NTU with different settling times and different seed concentrations:

After preparing the water and adding the seed extract, the characteristics of the treated water in terms of pH, TDS and transmissivity are shown in Table (1). The values of these tables were obtained as a result of laboratory work

Table (1) Effect of different concentrations of Moringa seed extract on pH, TDS and electrical conductivity of raw water with initial turbidity of 55NTU and after precipitation for four hours.

	Raw water	Added concentration of seed extract(g/l)			
		0.1	0.2	0.3	0.4
pH	8.6	7.5	7.3	7.2	7.5
TDS(ppm)	319	252	250.6	248.5	252
(µs)الناقلية	446	360	358	355	360

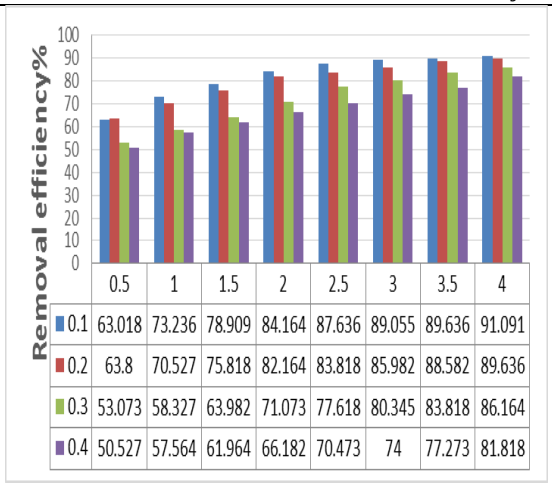
The turbidity results during the different deposition times are shown in Table (2) and Figures (1, 2) illustrate the results obtained:

tom and increasing the sedimentation time increases the opportunity for these particles to accumulate to form larger and heavier precipitates.

.4 The turbidity removal efficiency decreases as the concentration of the seed extract increases, where the concentration of 0.1g/L gave the highest removal efficiency where the turbidity became 4.9NTU and the removal efficiency reached 91.09%, and the water became potable as the turbidity values were within the permissible limits according to the Syrian standard, which allows a turbidity value of 5NTU. After that, the removal efficiency started to decrease due to the fact that applying a high dose of Moringa seed extract has negative consequences, because fine particles of Moringa seeds release cationic proteins and these cations will combine with anions present in water through a series of electrostatic reactions leading to the neutralisation of this electrical charge and thus forming precipitable flakes, As the concentration of moringa seeds increases, an excess fraction of cations remain unbound with anions, saturating the polymer bridge sites and causing a re-stabilisation of electrical charges due to insufficient anions to form further binding between the colloids and the polymer bridge, thus leading to a slight increase in turbidity values in the water (Nkalane et al. , 2019,8)

4-2- study the effect of Moringa leaf extract in removing turbidity of the initial turbidity water sample 55NTU with different precipitation times and different seed concentrations:

After preparing the water and adding the leaf extract, the characteristics of the treated water in terms of pH, TDS and conductivity are shown in Table (3)



	0.5	1	1.5	2	2.5	3	3.5	4
0.1	63.018	73.236	78.909	84.164	87.636	89.055	89.636	91.091
0.2	63.8	70.527	75.818	82.164	83.818	85.982	88.582	89.636
0.3	53.073	58.327	63.982	71.073	77.618	80.345	83.818	86.164
0.4	50.527	57.564	61.964	66.182	70.473	74	77.273	81.818

Figure (2) Variation of removal efficiency of raw water with initial turbidity of 55NTU by changing moringa seed extract concentration and sedimentation times

From Tables (1, 2) and Figures (1, 2) we observe the following:

.1 The three parameters (pH, TDS and electrical conductivity) continued to decrease as the concentration of seed extract increased, as the addition of seed extract led to a decrease in pH values where the pH value became pH=7.5 at 0.1g/L seed extract concentration, this is because Moringa seeds release cationic proteins and these cations can accept additional hydrogen electrolytes which leads to an increase in the concentration of hydrogen ions and thus decreasing the pH values.

.2 TDS and electrical conductivity decreased with increasing the dose of seed extract, where the TDS value became =252mg/L at a seed extract concentration of 0.1g/L due to the union of anionic colloids suspended in solution with cationic proteins from Moringa seeds leading to the formation of precipitated flakes, which reduces the electrical charges present in the solution and thus decreases the electrical conductivity and TDS.

.3 The turbidity continued to decrease with increasing sedimentation time for the four concentrations of coagulant from Moringa seed extract and the water became potable in terms of turbidity after sedimentation for 4 hours at a concentration of 0.1g/L, since during the sedimentation period the solid particles in the water move by gravity towards the bot-

Table (3) Effect of different concentrations of Moringa leaf extract on pH, TDS and electrical conductivity of raw water with initial turbidity of 55NTU and after precipitation for four hours

	Raw water	Added concentration of leaf extract(g/l)			
		0.1	0.2	0.3	0.4
pH	8.6	7.4	7.38	7.25	7.21
TDS(ppm)	319	296.1	293.3	291.9	288.2
الناقلية(µs)	446	423	419	417	412

The turbidity results during the different deposition times are shown in Table (4) and Figures (3,4) illustrate the results obtained:

Table (4) Effect of different concentrations of Moringa leaf extract on reducing the turbidity of raw water with initial turbidity of 55NTU with varying settling times.

Sedimentation times (hour)	Added concentration of leaf extract(g/l)							
	0.1		0.2		0.3		0.4	
	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%
0.5	18.2	66.9	18.9	65.6	19.4	64.7	19.3	65
1	13.2	76.1	14.5	73.6	15.7	71.4	16.0	71.0
1.5	9.1	83.5	9.3	83.2	10.0	81.7	11.5	79.0
2	8.5	84.5	9.1	83.4	10.0	81.8	10.9	80.1
2.5	6.0	89.1	7.2	86.9	7.9	85.6	7.3	86.7
3	5.9	89.3	7.1	87.2	7.2	86.8	7.6	86.3
3.5	5.1	90.7	6.8	87.6	6.9	87.4	7.0	87.2
4	4.87	91.14	5.5	89.9	6.3	88.5	7.4	86.5

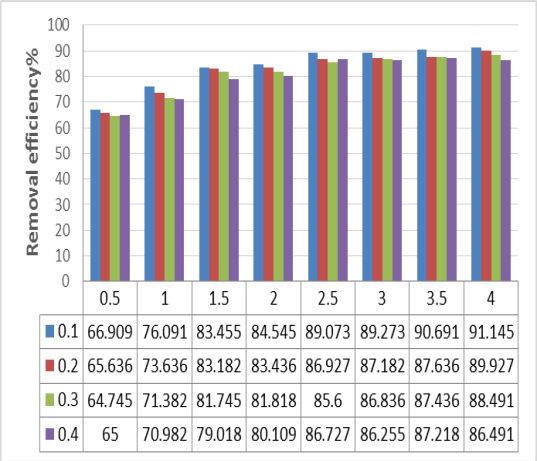


Figure (4) Change of removal efficiency of raw water with initial turbidity of 55NTU by changing the concentration of Moringa leaf extract and changing the settling times.

From Tables (3,4) and Figures (3,4) we observe the following:

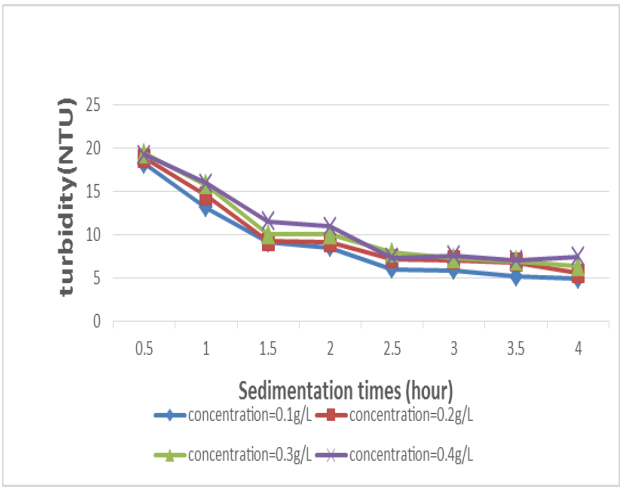


Figure (3) Change of turbidity values of raw water with initial turbidity of 55NTU by changing the concentration of Moringa leaf extract and changing the settling times.

rating the polymer bridge sites and causing a re-stabilisation of the electric charge due to insufficient anions to form further binding between the colloid and the polymer bridge, thus leading to a slight increase in the turbidity values of the water.

4-3- study the effect of Moringa leaf and seed extract in removing the turbidity of a sample of water with initial turbidity of 55NTU with different settling times and different seed concentrations:

After preparing the water and adding Moringa seed and leaf extract, the characteristics of the treated water in terms of pH, TDS and transmissivity are shown in Table (5)

Table (5) Effect of different concentrations of Moringa leaf and seed extract on pH, TDS and electrical conductivity of raw water with initial turbidity of 55NTU and after precipitation for 4 hours.

	Raw water	Added concentration of seed and leaf extract(g/l)			
		0.1	0.2	0.3	0.4
pH	8.6	7.61	7.59	7.54	7.48
TDS(ppm)	319	261.8	257.6	255.5	252.7
الناقلية(µs)	446	374	368	365	361

The turbidity results during the different deposition times are shown in Table (6) and Figures (5,6) illustrate the results obtained:

.1 The three parameters (pH, TDS and electrical conductivity) continued to decrease with increasing the concentration of the leaf extract as in the seed extract, where the addition of the leaf extract led to a decrease in the pH values where the pH value became pH=7.4 at a seed extract concentration of 0.1g/L, this is because Moringa leaves also release cationic proteins and these cations can accept additional hydrogen electrolytes which leads to an increase in the concentration of hydrogen ions and thus decreasing the pH values.

.2 The TDS and electrical conductivity decreased with increasing the dose of leaf extract, where the TDS value became 296.1mg/L at a leaf extract concentration of 0.1g/L due to the combination of anionic colloids suspended in solution with cationic proteins from Moringa leaves leading to the formation of precipitated flakes, which reduces the electrical charges present in the solution and thus decreases the electrical conductivity and TDS.

.3 The turbidity continued to decrease with increasing precipitation time for the four concentrations of coagulant from Moringa leaf extract and the water became potable in terms of turbidity after precipitation for 4 hours at 0.1g/L.

.4 The turbidity removal efficiency decreases as the concentration of the leaf extract increases, as the concentration of 0.1g/L gave the highest removal efficiency where the turbidity became 4.87NTU and the removal efficiency reached 91.14%, which is the same value obtained when the seed extract was added, and the water became potable as the turbidity values were within the permissible limits according to the Syrian standard which allows a turbidity value of 5NTU. The removal efficiency then started to decrease but less than it was when the seed extract was added. Applying a high dose of Moringa leaf extract also has negative consequences, because Moringa leaves also release cationic proteins and these cations will combine with anions in water through a series of electrostatic reactions, neutralising this electrical charge and thus forming precipitable flakes, By increasing the concentration of Moringa leaf extract, an excess fraction of the cations that did not combine with anions remained, satu-

Table (6) Effect of different concentrations of Moringa seed and leaf extract on reducing the turbidity of raw water with initial turbidity of 55NTU with varying settling times

Sedimentation times (hour)	Added concentration of seed and leaf extract(g/l)							
	0.1		0.2		0.3		0.4	
	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%	Turbidity (NTU)	Removal efficiency%
0.5	19.3	64.9	19.0	65.5	21.2	61.5	23	58.2
1	17.6	68.0	16.3	70.4	19.1	65.3	19.9	63.8
1.5	13.2	75.9	13.9	74.8	16.0	71.0	17.2	68.7
2	9.7	82.4	8.7	84.1	12.3	77.6	15.5	71.8
2.5	7.6	86.1	7.9	85.7	9.7	82.5	12.3	77.6
3	7.0	87.3	7.0	87.2	8.5	84.5	9.6	82.5
3.5	5.6	89.8	6.3	88.6	7.2	86.9	8.6	84.4
4	4.3	92.2	5.1	90.8	6.0	89.1	6.9	87.5

following:

.1 The three parameters (pH, TDS and electrical conductivity) continued to decrease with increasing the concentration of seed and leaf extract as in the seed extract and leaf extract, as the addition of Moringa seed and leaf extract led to a decrease in pH values as the pH value became pH=7.61 at 0.1g/L Moringa seed and leaf extract concentration, for the same reason mentioned in the previous two paragraphs.

.2 The TDS and electrical conductivity decreased with increasing the dose of Moringa seed and leaf extract, as the TDS value became 261.8mg/L at 0.1g/L concentration of Moringa seed and leaf extract

.3 Turbidity continued to decrease with increasing precipitation time for the four concentrations of coagulant from Moringa leaf and seed extract and the water became potable in terms of turbidity after precipitation for 4 hours at 0.1g/L.

.4 The turbidity removal efficiency decreases with increasing the concentration of Moringa seed and leaf extract, where the concentration of 0.1g/L gave the highest removal efficiency where the turbidity became 4.3NTU and the removal efficiency reached 92.2%, which is lower than the value ob-

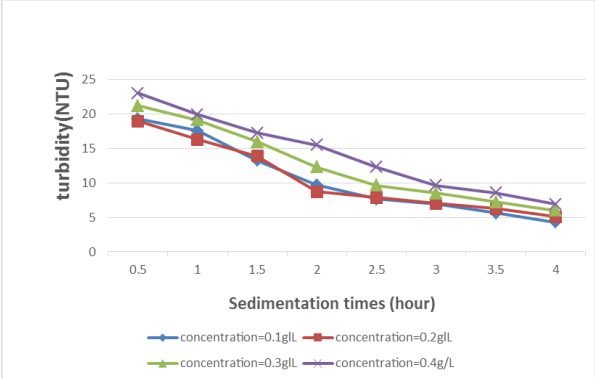


Figure (5) Change of turbidity values of raw water with initial turbidity of 55NTU by changing the concentration of Moringa seed and leaf extract and changing the settling times.

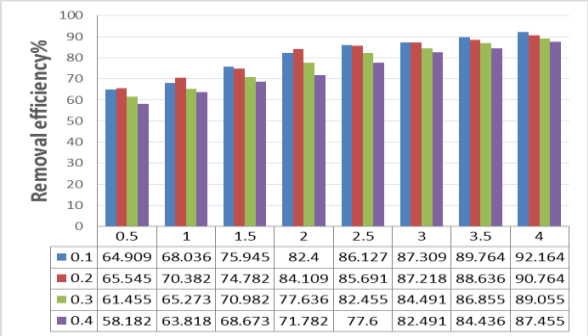


Figure (6) Variation of removal efficiency of raw water with initial turbidity of 55NTU by varying the concentration of Moringa seed and leaf extract and varying the settling times.

From Tables (5, 6) and Figures (5,6) we observe the

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dose of Moringa seed and leaf extract also has negative consequences, for the same reason mentioned in the previous two paragraphs.

To compare the three extracts, the results are listed as shown in Table (7).

tained when adding the seed and leaf extract independently, and the water became potable as the turbidity values were within the permissible limits according to the Syrian standard which allows a turbidity value of 5NTU. The removal efficiency then started to decrease but less than when adding the seed and leaf extract. In other words, applying a high

Table (7) shows the comparison between the three extracts at a concentration of 0.1g/L and after a precipitation time of four hours

	concentration0.1g/L after four hours sedimentation time			
	raw water	seed extract	leaf extract	Seed extract with leaves
pH	8.6	7.5	7.4	7.61
TDS(ppm)	319	252	296.1	261.8
الناقلية(µs)	446	360	423	374
Turbidity(NTU)	55	4.9	4.87	4.3
Turbidity removal efficiency (%)		91.09	91.14	92.2

while when using the seed extract with the leaves (55 to 4.3) NTU, the best was when using the combination (leaf and seed extract) followed by the leaf extract and then the seed extract and this is what was found by Alam where they found that using the combination of leaf and seed extract gave higher efficiency to remove turbidity as in reference (Alam et al, 2020,7)

4- We recommend studying the change of pH values on the final turbidity.

5-We recommend studying the effect of other parts of the tree such as seed husks and tree roots on the turbidity removal efficiency.

6- We recommend studying the effect of powder particle size on treatment efficiency.

7- We recommend studying the effect of using organic solvents other than hexane on the extraction of oil from Moringa and its effect on processing efficiency.

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5- Conclusions and recommendations:

1- In terms of pH, the three extracts used in this research showed good effectiveness in reducing the pH to a more neutral pH, as using the seed extract, the pH value decreased (8.6 to 7.5) and when adding the leaf extract (8.6 to 7.4) and when adding the leaf extract (8.6 to 7. 4) When the leaf extract was added with the seeds, the values were (8.6 to 7.6) at a concentration of 0.1g/L for all three types of extracts, i.e. the use of extracts of Moringa tree parts is able to reduce the pH of treated water and this agrees with the reference (Aho et al, 2014,45) where they reached the same result.

2- Dissolved solids clearly decreased when using the three extracts at a concentration of 0.1g/L for the three types of extracts, the values of dissolved solids when using the seed extract (319 to 252)mg/L, when using the leaf extract (319 to 296.1)mg/L, while when using the seed and leaf extract (319 to 261.8)mg/L, that is, the three types of extracts have a good effectiveness in reducing dissolved solids.

3- For turbidity, the three types of extracts also had a good effect in reducing turbidity at a concentration of 0.1g/L for the three types of extracts, the turbidity values when using the seed extract (55 to 4.9)NTU and when using the leaf extract (55 to 4.9)NTU,

6- references:

1. Aho, I. M., & Agunwamba, J. C. (2014). USE OF WATER EXTRACT OF MORINGA OLEIFERA SEEDS (WEMOS) IN RAW WATER TREATMENT IN MAKURDI, NIGERIA. GLOBAL JOURNAL OF ENGINEERING RESEARCH VOL 13, 13(1596-292x), 41–45.

2. Al-Mokhalelati, K., Al-Bakri, I. ., & AlShibeh AlWattar, N. . (2021). Experimental and theoretical investigations for the removal of chromium (III) from aqueous solutions using sugarcane bagasse. Damascus University Journal, 37(February), 0–13.

3. Alam, M. W., Pandey, P., Khan, F., Souayeh, B., & Farhan, M. (2020). Study to investigate the potential of combined extract of leaves and seeds of moringa oleifera in groundwater purification. International Journal of Environmental Research and Public Health, 17(20), 1–13. https://doi.org/10.3390/ijerph17207468.

4. Alhajali, O., & Ali-Nizam, A. (2022). Microbiological Treatment of Domestic Wastewater Using Pistacia atlantica Plant Leaves Powder. Damascus University Journal, 38, 129–158.

5. Bichi, M. H. (2013). A Review of the Applications of Moringa oleifera Seeds Extract in Water Treatment. Civil and Environmental Research, 3(8), 1–11.

6. Farghaly, A., El-hamied, E. M. A., & Gad, A. A. M. (2021). Sponge-Mediated Moringa Oleifera Seeds as A Natural Coagulant in Surface Water Treatment. Journal of Engineering Sciences Assiut University Faculty of Engineering, 49(5), 597–619.

7. Ganjo, A. R., Adham, A. N., Al-bustany, H. A., & Aka, S. T. (2023). Phytochemical analysis and evaluation of antibacterial activity of Moringa oleifera extracts against gram-negative bacteria : an in vitro and molecular docking studies. Formerly ANNALES UNIVERSITATIS MARIAE CURIE-SKLODOWSKA, SECTIO DDD, PHARMACIA, 35(December 2022), 4. https://doi.org/10.2478/cipms-2022-0035.

8. Nkalane, A., Oyewo, O. A., Leswifi, T., & Onyango, M. S. (2019). Application of coagulant obtained through charge reversal of sawdust-derived cellulose nanocrystals in the enhancement of water turbidity removal. Materials Research Express, 6(10), 3. https://doi.org/10.1088/2053-1591/ab3b49.

9. Rasheed, F. A., Alkaradaghi, K., & Al-Ansari, N. (2023). The Potential of Moringa oleifera Seed in Water Coagulation-Flocculation Technique to Reduce Water Turbidity. Water, Air, and Soil Pollution, 234(4). https://doi.org/10.1007/s11270-023-06238-3

10. Shabaa, G. J., Al-Jboory, W. S. H., Sabre, H. M., Alazmi, A., Kareem, M. M., & AlKhayyat, A. (2021). Plant-based coagulants for water treatment. IOP Conference Series: Materials Science and Engineering, 1058(1), 012001. https://doi.org/10.1088/1757-899x/1058/1/012001.

11. Zaid, A. Q., Ghazali, S. B., Mutamim, N. S. A., & Olalere, O. A. (2019). Experimental optimization of Moringa oleifera seed powder as bio-coagulants in water treatment process. SN Applied Sciences, 1(5), 1–5. https://doi.org/10.1007/s42452-019-0518-0.