

## Coagulant potentials of *Moringa oleifera* seeds in water purification

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### ABSTRACT

The main objective of this study is to confirm the potentials of *Moringa oleifera* seeds over alum for water purification. Various doses of *Moringa* seed powder 4, 8, 12 g/l were taken and checked for treatment of river and sewage water. After treatment of seed powder with water samples were analyzed for physico-chemical parameters like pH, Absorbance, TDS, TSS, Hardness, Chlorides, Conductivity, Turbidity, MPN and DO. Almost all parameters showed reduction with increasing dosage of *Moringa* seed powder. Similar doses of alum were checked with river water sample and were analyzed for above mentioned parameters. The results obtained showed that seed powder (natural coagulant) is more effective than conventional chemical coagulant, alum. The seed of *Moringa oleifera* is cheap, eco-friendly and non-toxic, can be effectively used as a coagulant for river and sewage water purification.

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KEY WORDS : Coagulant potentials, *Moringa oleifera*, Purification

### Introduction

Potable water is one of the basic needs of all living organisms including humans. About 71% of the Earth's surface is water-covered. Out of this, only 2 ppm (0.0002%) of water is found in rivers across the world. Waste water is also generated from the river water which contains bodily wastes (faeces and urine), washing water, laundry wastes, etc. It is mainly termed as sewage water. Pollution of river water can lead to various water borne diseases like diarrhea, amoebiasis, typhoid, etc. Safe drinking water is essential to the health and welfare of a community and so water should be purified before consumption<sup>4</sup>.

Various water treatment methods are used at small scale level like coagulation-flocculation, sedimentation, filtration and disinfection, often by chlorine, before distribution of treated water to consumers<sup>9</sup>. Nowadays aqua-technology containing RO water purifiers is widely used for water purification. But this technique is quite expensive for the common consumers.

The study is primarily focusing on *Moringa oleifera* seeds as a natural polyelectrolyte which can be used as a coagulant to clarify turbid river and sewage waters. *M. oleifera* is among the 14 species of trees that belong to the family Moringaceae<sup>5</sup>. The conventional method of using high levels of chemical coagulant alum (aluminium sulphate) is a risk factor for Alzheimer's disease<sup>3</sup>. The use of *M. oleifera* seeds has an advantage over the chemical treatment methods as it is herbal and less expensive.

This work was carried out to study the coagulant potentials of *M. oleifera* powder extracted from mature and dried *Moringa oleifera* seeds against the alum available from the market.

### Materials and Methodology

#### Coagulants used

Dry *Moringa oleifera* (drumstick) seeds used in this study were collected from local fields of Karad town, Maharashtra. The shells covering the seeds were removed and fine powder was prepared using mortar and pestle. This dried powder was kept in hot air oven at 40°C for one hour and was directly used as a natural coagulant. The aluminium sulphate (alum) crystal powder used in this study was obtained from local grocery store in Karad, Maharashtra.

#### Sample Collection

Ten liters of river water samples were collected from Krishna River, Karad and five liters of sewage water samples were collected from Krishna Canal, Karad. The water samples were collected in containers which were cleaned priorly by detergent to avoid impurities.

The untreated river and sewage water samples were immediately used for the study and before treatment various parameters were analyzed. These physico-chemical parameters include pH, Absorbance, Total Dissolved Solids (TDS), Hardness (total and permanent), Total Suspended Solids (TSS), Chlorides, Conductivity, Turbidity, Most Probable Number (MPN) and Dissolved Oxygen (DO). Before treatment characteristics of the



**Fig.1: *Moringa oleifera* seeds**

untreated river and sewage samples (Table-1).

**Treatment of river and sewage water with *Moringa oleifera* seed powder**

Three different concentrations of doses of *M. oleifera* seed powder i.e. 4, 8 and 12g/l each of river and sewage water were selected for treatment. The *M. oleifera* seed powder was mixed in both river and sewage water and allowed to settle for 1-1.5 hours. After sedimentation, the treated water was filtered using



**Fig.2 : *Moringa oleifera* shelled seeds.**

Whatman filter paper (42 pore size). The water quality parameters were studied for understanding physico-chemical characteristics as given in standard APHA methods<sup>2</sup>.

**TABLE-1 : Characteristics of river and sewage water samples before treatment.**

S. No.	Parameter	River water sample value	Sewage water sample value
1.	pH	8	10.5
2.	Absorbance (at 450 nm)	0.13	0.21
3.	Total Dissolved Solids[TDS] (mg/l)	0.4	0.3
4.	Hardness(mg/l) Total Permanent	140.6 132	601.2 412
5.	Total Suspended Solids [TSS] (mg/l)	1400	1540
6.	Chlorides(mg/l)	212.7	177.25
7.	Conductivity(S/m)	2500	1910
8.	Turbidity (NTU)	168	105
9.	Most Probable Number(MPN)	129.56	84.61
10.	Dissolved Oxygen [DO] (mg/l)	3.42	4.42

### Treatment of river water with Alum (aluminium sulphate)

Similarly, three different concentrations of doses of alum crystal powder *i.e.* 4, 8, 12g/l, each of river water were selected for treatment. The alum powder was mixed in river water and allowed to settle for 1 hour. After sedimentation, the treated water was filtered using Muslin cloth and water quality parameters were checked.

A 1000ml of distilled water with no *M. oleifera* powder or alum was kept as a control.

### Laboratory Analysis

#### pH and Absorbance measurement

The pH of the water samples was found out using pH paper indicator (Litmus paper). The change in color indicated the pH of the water samples. Absorbance was measured using a digital colorimeter at 450 nm as the water samples contained coloured impurities<sup>2</sup>.

#### TDS, Hardness and TSS

These parameters were analyzed using the procedure as described by the standard APHA methods

**TABLE-2 : Treatment of river and sewage water samples by *M. oleifera* seed powder at different concentrations**

S. No.	Parameter	D/w (Control)	Treatment with <i>M. oleifera</i> seed powder (in grams)					
			River water samples			Sewage water samples		
			4g/l	8g/l	12g/l	4g/l	8g/l	12g/l
1	pH	7	6	5.5	6.8	9.5	9	7.5
2	Absorbance(at 450 nm)	0.11	0.13	0.12	0.11	0.2	0.14	0.11
3	Total Dissolved Solids [TDS] (mg/l)	0.1	0.6	0.3	0.15	0.3	0.2	0.1
4	Hardness(mg/l) Total Permanent	24.6 15.2	86.6	63.2	52	244.6	106.6	61.2
			61.2	49.2	44	183.2	64.6	42
5	Total Suspended Solids [TSS] (mg/l)	550	880	350	150	1420	1285	500
6	Chlorides(mg/l)	106.35	184.34	155.98	127.62	141.8	141.8	113.4
7	Conductivity(S/m)	300	2500	1600	800	1500	560	270
8	Turbidity (NTU)	1.00	85	26	4	90	20	3
9	Most Probable Number (MPN)	50.25	110.25	76.33	25.64	112.30	80.45	67.96
10	Dissolved Oxygen [DO] (mg/l)	2	3.20	3.10	2.80	4.42	3.38	1.12

of examination of water purity.

### Chloride Test

Chloride content in the untreated and treated samples was estimated by using Mohr's method of titration<sup>2</sup>.

### Conductivity and Turbidity measurement-

Conductivity of water samples were determined using digital conductivity meter. The reading was recorded from the LCD display after stabilization. While turbidity measurements were carried out using INSIF digital turbidity meter. The turbidity of the water samples was displayed on the LCD panel in Nephelometric Turbidity Units (NTU). After each reading, both the instruments were calibrated with distilled water prior to using the next sample.

### Most Probable Number (MPN) and Dissolved Oxygen (DO)-

Total coli form count of before and after treatment

water samples was carried out using Mac Conkey's broth. Double and single strength tubes containing Mac Conkey's broth with Durham's tubes were used. After incubation for 24 h at 37°C, the coli form count was analyzed.

Dissolved Oxygen was estimated by Winkler method following the standard guidelines recommended by APHA standards.

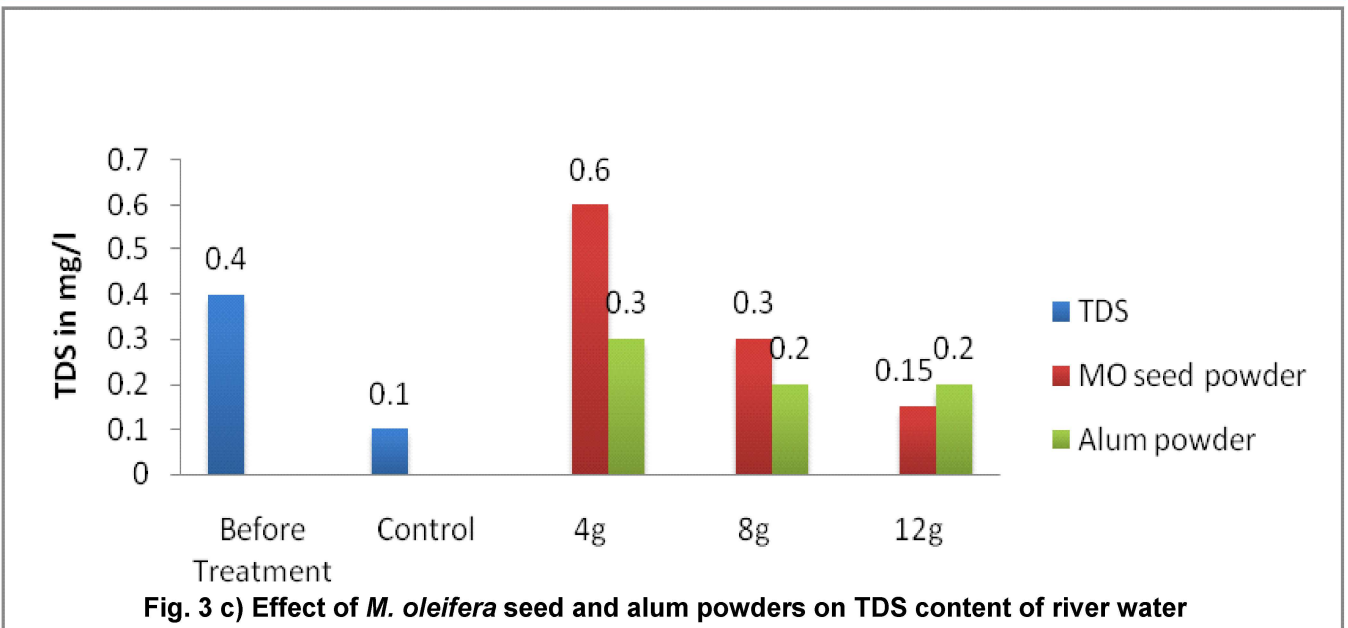
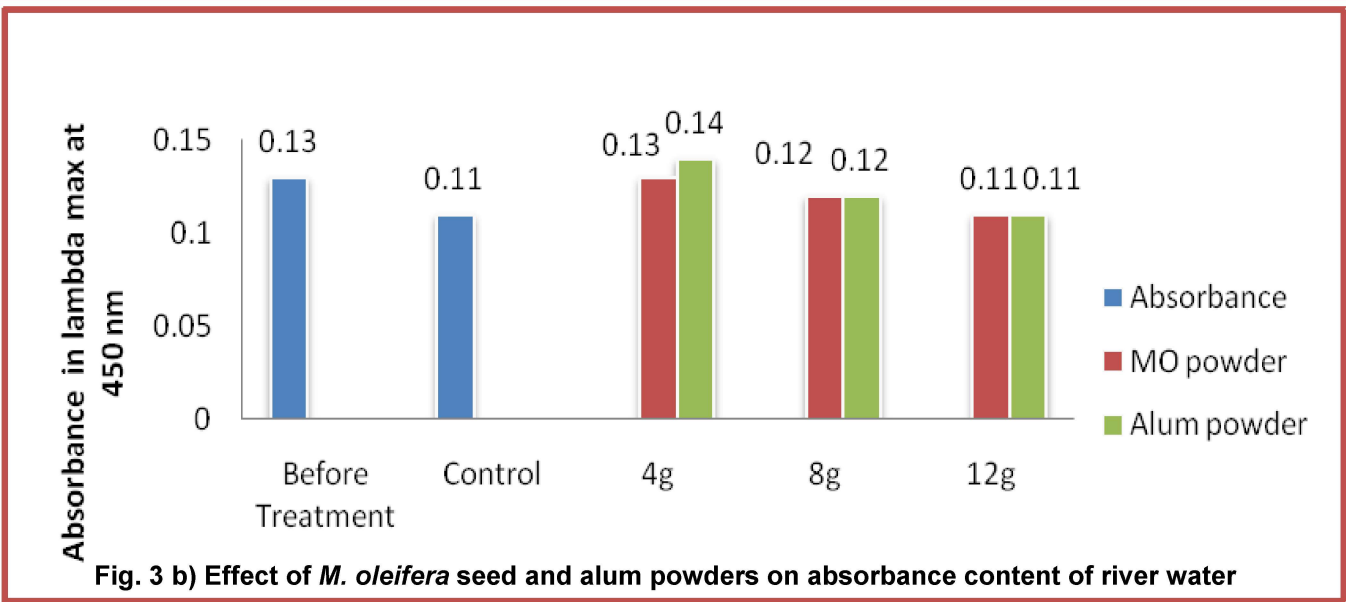
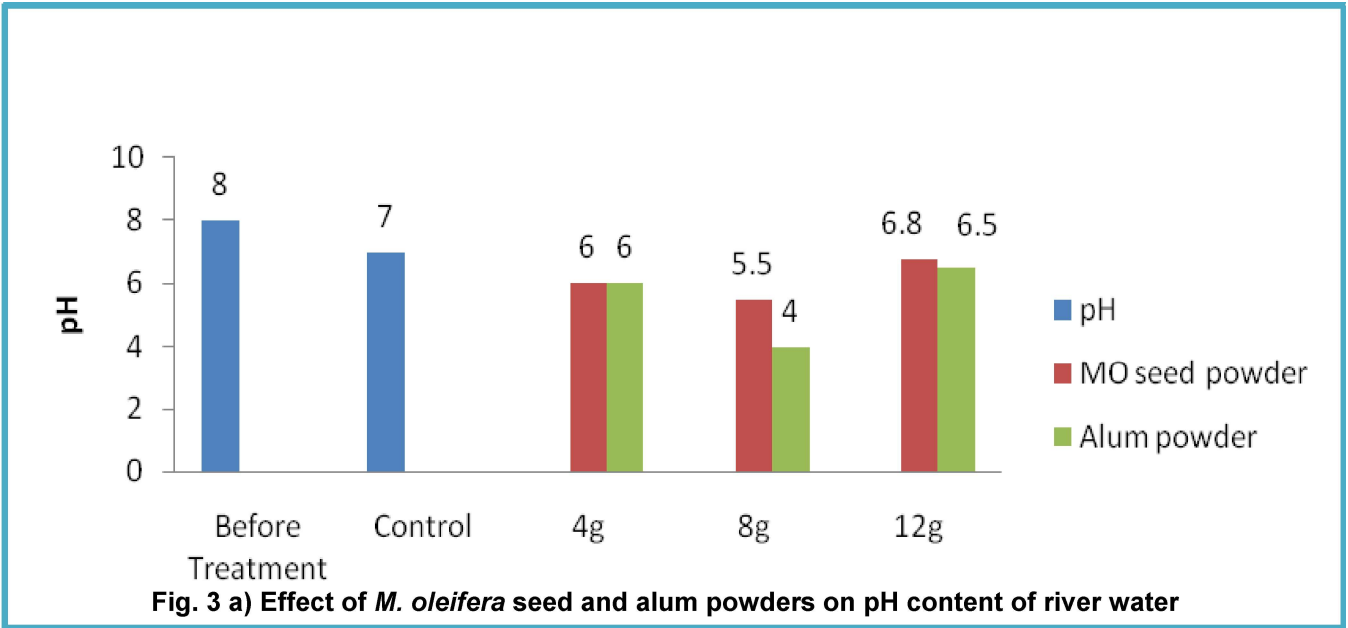
## Results and Discussion

The treatment with *Moringa oleifera* shows better results than alum for the water treatment.

In order to determine the adequate condition for the activity of the coagulants, the concentrations were taken as 4g, 8g and 12g and the results obtained are presented (Tables 2 and 3). The comparative study of some important physico- chemical characters of river water with *Moringa* seed and alum powders at various concentrations. Optimum results were obtained for water

**TABLE-3 : Treatment of river and sewage water samples by Alum powder at different concentrations**

S. No.	Parameter	Distilled water (Control)	Treatment with Alum powder (in grams)		
			4g/l	8g/l	12g/l
			<b>River water samples</b>		
1	pH	7	6	4	6.5
2	Absorbance(at 450 nm)	0.11	0.14	0.12	0.11
3	Total Dissolved Solids[TDS] (mg/l)	0.1	0.3	0.2	0.2
4	Hardness(mg/l) Total Permanent	24.6 15.2	128.6 115.2	108 101.2	92 73.2
5	Total Suspended Solids[TSS] (mg/l)	550	1330	1285	990
6	Chlorides(mg/l)	106.35	248.15	212.7	170.16
7	Conductivity(S/m)	300	2000	1700	1000
8	Turbidity (NTU)	1.00	150	95	6
9	Most Probable Number(MPN)	50.25	290.10	150.15	113.50
10	Dissolved Oxygen [DO] (mg/l)	2	4.4	4.2	3.6



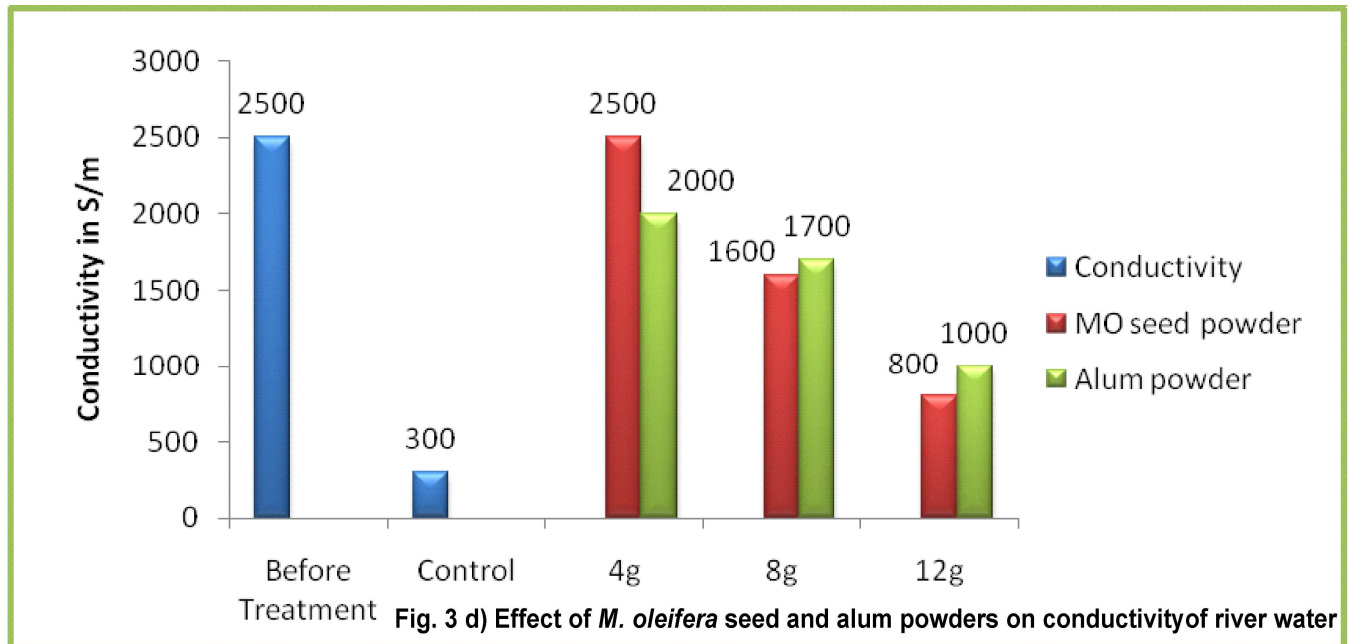


Fig. 3 d) Effect of *M. oleifera* seed and alum powders on conductivity of river water

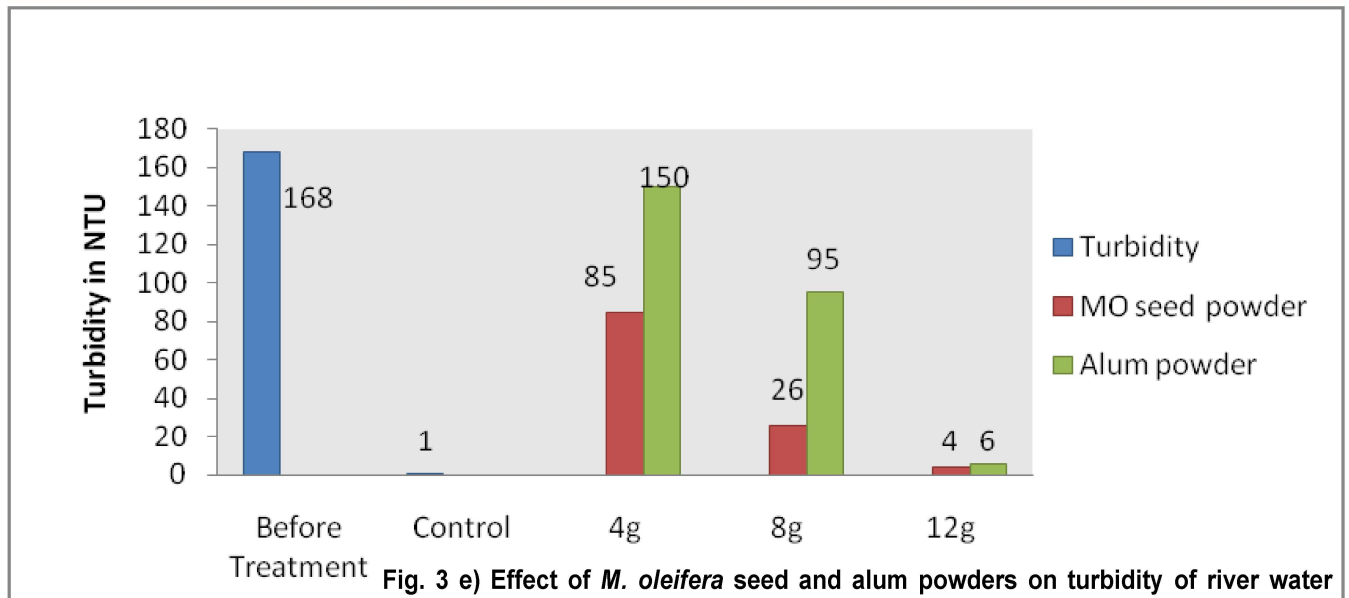


Fig. 3 e) Effect of *M. oleifera* seed and alum powders on turbidity of river water

**Fig. 3 : Comparative study of some physico-chemical characters of river water before and after treatment with *M. oleifera* O seed powder and Alum powder at Different concentration.**

samples with both *M. oleifera* seed and alum powders at 12 g concentration.

The pH of sewage sample before and after treatment shows decrease in value with increasing dosage of *M. oleifera* seed powder. In comparative study, river water treated with *M. oleifera* seeds shows better results than alum powder. This could be explained by the fact that the solutions were becoming acidic due to sulphuric acids produced by alum in river water. This reduced its pH<sup>6</sup> (Fig.- 3a). Absorbance of sewage sample as seen in Table-2, reduces by increasing the concentration of *Moringa* seed powder. It has a relationship with colour. Initial brownish green colour of sewage water lessened after treatment with natural coagulant with 12g

concentration. Both *M. oleifera* and alum coagulants show similar absorbance as presented (Fig 3b). The initial TDS content of sewage water was 0.3mg/l. But after treatment with *Moringa* seed powder with 12g dosage, it was found to be 0.1 mg/l which is equal to control (d/w). *Moringa oleifera* is known to be a natural cationic polyelectrolyte containing up to six amino acids of mainly glutamic acid, methionine and arginine<sup>8</sup>. After treatment, initially the TDS count increased with addition of *M. oleifera* seed powder than alum powder at 4g dosage. But later on it decreased with increasing concentration (Fig. 3c).

Initially the total and permanent hardness of both sewage and river water was more. But after the treatment with high doses of the respective coagulants, it decreased.

*M. oleifera* seed powder removes hardness in water through adsorption and inter-particle bridging mechanism<sup>8</sup>. The initial TSS count of sewage water was 1540mg/l. But it decreased upto 500mg/l at 12g of dosage of *M. oleifera* seed powder. Also the initial TSS count of river water was 1400mg/l and it decreased upto 150mg/l at 12 g dosage when treated with *M. oleifera* seed powder. While in case of alum treatment, TSS count decreased upto 990 mg/l at 12g dosage. The chloride content of sewage water initially was 177.25 mg/l which after *M. oleifera* seed powder treatment at higher concentration decreased to 113.4 mg/l. Chlorides in river water before treatment were 212.7mg/l which decreased to 127.62mg/l at 12 g of *M. oleifera* seed powder concentration. While it decreased to 170.16 mg/l at 12 g of alum powder concentration. It is because cations from *Moringa* seed attract the negatively charged chloride ions present in water and neutralize it<sup>7</sup>.

Conductivity is directly linked to the concentration of ions in the water and determines purity of water<sup>1</sup>. In this study, the initial conductivity of sewage and river water was 1910 S/m and 2500S/m respectively. After treatment of sewage water with *M. oleifera* seed powder, it decreased to 270mg/l at 12g dosage. Also after treatment of river water with *M. oleifera* seed and alum powders, at high concentration (12g), the conductivity decreased upto 800 S/m and 1000S/m. *M. oleifera* seed powder showed better results than alum powder (Fig. 3d). The degree of turbidity depends upon the concentration or dispersion of the suspended matter and the light absorption

properties of the suspension<sup>1</sup>. Tables 1 and 2 show that turbidity of untreated sewage water decreased tremendously after treatment with high dosage of *M. oleifera* seed powder, (Fig. 3e) shows better results of *M. oleifera* seed powder than alum powder at various concentrations.

The MPN count of coli forms according to Mc Cardy's chart of sewage and river water initially were 84.61 and 129.56 respectively. After treatment of sewage water with *M. oleifera* seed powder at 4g dosage, the MPN count was 112.30 which decreased to 67.96 at 12 g dosage. The results showed decreasing MPN count in treated river water samples with increasing concentrations of natural and chemical coagulants respectively. The study shows that the dissolved oxygen of treated sewage water decreased at higher concentrations 12 g than DO at other concentrations. The DO content of pre-treated river water was 3.42. Tables 2 and 3 show the DO contents of river water with *M. oleifera* seed and alum powders at various concentrations.

### Conclusion

The results obtained show that *M. oleifera* seed powder has coagulant potentials and is better than the chemical coagulant, alum. Also, it shows good results at high dosage while checking various parameters like pH, Absorbance, TDS, Hardness, TSS, Chlorides, Conductivity, Turbidity, MPN and DO. Therefore, it is concluded that the seeds of *Moringa oleifera* which is easily available, eco-friendly and non-toxic can be used in water purification treatments.

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