Comparative Studies of Aloe Vera Powder and Alum to Remove Turbidity in Raw Water

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Abstract

Coagulation plays a very crucial role in the treatment of potable water, especially in consumption of drinking water for human kind. Aluminium sulfate is the most common chemical coagulant. Aloe vera is widely acknowledged as a plant with numerous uses. It is useful in medicine, but utilization of Aloe Vera using in various water and waste water treatments can be used as a low cost adsorbent instead of high cost adsorbent. In this study, some natural coagulants have been explained for the coagulation process. Water is an important resource for the survival of life. This study focused on developing an efficient and cost-effective processing technique by using Aloe Vera gel to produce natural coagulant for use in raw water treatment. The turbidity removal efficiency of alum and aloe vera powder are 89.65% at coagulant dose 40mg/l and 77.68% at coagulant dose 150mg/l respectively. The results showed that the alum is more effective than aloe vera but some drawbacks have been seen in using alum, as it induces Alzheimer's disease because of its carcinogenic properties. So aloe vera powder is reduced the Alzheimer's disease.

Keywords
Turbidity, Alum, Aloe vera powder, Coagulant, Coagulation, Coagulants dose, Water

1. Introduction
Portable water is indispensable in terms of sustaining life; clean drinking water is a basic human need. Water is a precious and essential natural resource, unevenly distributed on our planet. Freshwater represents only 2.5% of global supplies of water. About 70% of this freshwater quantity are either trapped under ice caps, or disseminated in the form of humidity or steam. Less than 1% of fresh water, about 0.007% of the planet's water, is easily accessible to the various uses for development (Irma, et al. 2016). The scarcity of drinking water is now becoming a global matter of concern in urban as well as rural areas of several countries.
In the 1980s, these studied were based on surface water and the estimate of a number of factors, such as coagulant kind, coagulant dose, pH and raw water characteristics (Wiley 1989). Next introduction in the coagulation technology was streaming current detector (SCD), which was extensively used along with jar test in regulating coagulant dosage and therefore process (Dentel, Thomas and Kingery 1989).
In chemical coagulants, alum is generally used in water treatment. The use of alum as a coagulant increase the aluminum concentration in treated water (Altaher and Alghamdi 2011). Alum has various negative effects on human health, including Alzheimer's disease.

The use of natural resources in the process of water treatment, thus constitutes a potential promising ways to reduce on one hand, the high costs and environmental impacts due to the use of synthetic products used previously (Amruta and Munavalli 2017). Native to the Indian subcontinent is the Aloe Vera (Aloe barbadensis) family Asphodelaceae. Aloe Vera's positive uses in the food business, pharmaceutical industry, cosmetics industry, etc. are attributed to its

original makeup, which includes enzymes, vitamins, carbohydrates, proteins, and inorganic compounds (Katubi , et al. 2021).

1.1 Objectives

The aim of this study is the use of natural coagulant and their benefits in comprises to chemical coagulant. The objectives of this study are as follows.

1. To study on the turbidity removal efficiency for raw water with Aloe vera and alum at the different dosage.
2. To calculate the optimum coagulant dosage of aloe vera and alum.
3. To evaluate the dose effect of cactus powder on coagulation activities; and to compare the effectiveness of natural and chemical coagulants (Alum).

2. Literature Review

(Altaher and Alghamdi 2011) has investigated the enhancement of the treatment process to reduce the turbidity with ferric chloride, ferrous sulfate, alum and polymers. The highest removal efficiency was found at higher pH. Ferrous sulfate and polymer were found to be the best polymers. Ferrous sulfate and polymer reduced the final turbidity to acceptable values with very low doses compared with other coagulant.

(Irma, et al. 2016) focused on the evaluation of the aloe vera leaf gel as a natural flocculant phytochemical screening and turbidity removal trials of water by coagulation flocculation. By the use of aloe vera, 72% reduction in turbidity and 91% reduction in suspended matter at the optimum doses. It concludes that the aloe vera can be promoted as a good natural flocculant in surface water clarification.

(Srikanth 2020) has done an experimental study on replacement of alum with aloe vera gel in turbidity removal. It was get the optimum coagulant dosage at 30ppm with alum and reduce alum with add aloe vera at same coagulant dosage. It concludes that the amount of alum required was high for effective removal of turbidity but use of aloe vera gel coagulant aid with alum can effectively reduce the amount of alum required.

3. Methods

3.1 Preparation of Aloe vera

Aloe Vera leaves were collected from Hostel No.6 NIT Kurukshetra, Haryana. The leaves were washed under running water for remove dirt. The gel portion would be carefully removed from the thick green coat, or epidermis. Then the gel part was mixed in a mixer and preserved in glass bottles in the oven at 100-105°C for 24 hours. 1% dilution of aloe vera is made using 1 gm aloe vera powder in 100 ml distilled water similarly different percentages of aloe vera. Introduce 1 gm of aloe vera gel powder was mixed with 100 milliliters of distilled water, stirred with a magnetic stirrer, and then strained through a filter with a 25 mm screen. Similarly, various concentrations of aloe vera solutions were produced. Jar tests were performed for various percentages of dilution of aloe vera, including 1%, 2%, 3% and 5% respectively.

3.2 Alum Solution

Alum is water-soluble, it is mostly utilised as a coagulating agent in wastewater treatment plants and paper manufacture. Aluminum sulphate can be found in a variety of hydrates, the most prevalent form. The alum used for experiment was aluminum sulphate ($Al_2(SO_4)_3.18H_2O$). Introduce 1% dilution of alum was made by using 1 gm of alum was added to 100ml of distilled water for preparation of 1% stock solution. The solution was mixed slowly with glass rods and left it to complete mix. Jar tests were performed for various percentages of dilution of alum, including 1%, 2%, 3% and 5% respectively (Amruta and Munavalli 2017).

3.3 Jar test Experiments

The jar test is the most commonly used method for evaluating and optimizing the coagulation-flocculation processes. Three stages—rapid mixing, gradual mixing, and sedimentation—of three simultaneous batch tests make up this research. The surface water was poured into 1-liter beakers. The equipment made it possible to stir six glasses at once. In a typical run beakers were filled with one litre of turbid water and were agitated at the preselected vehemence of rapid mixing (George and K 2018).

The coagulant doses were put into each cup using pipettes of the desired capacity while the rapid mixing phase was in progress (Table 1).

Table 1. Coagulation process

Variable	**Speed (RPM)**	**Time (min.)**
Rapid Mixing	200-250	2
Slow Mixing	25-35	20
Sedimentation	-	30

4. Data Collection

4.1 Sample collection

The raw water sample was collected from Baan Ganga. It is located in Dayalpur village near NIT Kurukshetra, Kurukshetra, Haryana, India. This is the spot where the Ganges water sprouted from under the ground when Arjun shot an arrow to bring forth water to quench the thirst of Bhishma Pithamaha. The name of the spot is derived from this episode. Baan means Arrow and Ganga means Ganges. It serves water for fishes and also used for bathing purpose. The source of water is rain water and underground water. The sample was collected on daily basis. Daily 15 liter sample was collected for testing in a 20 liter drum.

5. Results and Discussion

In this study we explained the effect of natural coagulant within the coagulation process and their efficiency then it absolutely was compared with different water quality parameters and located that each natural coagulant has some specific efficiency and better leads to terms of turbidity removal. At that time the optimum dose of chemical coagulant and natural coagulants were determine.

5.1 Numerical Results

The turbidity was determined by the Turbidity meter. The turbidity of the raw water samples was 34.35. The turbidity was found at the different proportion such that 1%, 2%, 3%, and 5%Turbidity determined using of the both coagulants like alum and aloe vera.

From Figure 1 it was observed that the maximum turbidity removal efficiency of alum and aloe vera at 1% were 83% and 67.19 % respectively at the optimum doses of 30 mg/l and 40 mg/l respectively. It was observed that the maximum turbidity removal efficiency of alum and aloe vera at 2% were 87.62% and 70.19 % respectively at the optimum doses of 40 mg/l and 80 mg/l respectively. It was observed that the maximum turbidity removal efficiency of alum and aloe vera at 3% were 80.9% and 72.6 % respectively at the optimum doses of 60 mg/l and 120 mg/l respectively. It was observed that the maximum turbidity removal efficiency of alum and aloe vera at 5% were 79.38% and 78.48 % respectively at the optimum doses of 200 mg/l and 200 mg/l respectively.

Table 2 is showing that the variation in turbidity after use alum.

Table 2. Variations in Turbidity at different percentages of alum

Initial Turbidity (NTU)	34.35 S 1%	34.35 S 2%	34.35 S 3%	34.35 S 5%
Jar 1 (1ml)	21.13	14.65	11.94	8.75
Jar 2 (2ml)	10.37	3.55	6.56	8.03
Jar 3 (3ml)	5.83	5.03	7.58	7.24
Jar 4 (4ml)	8.24	5.88	7.98	7.08
jar 5 (5ml)	9.54	6.71	8.30	7.69
jar 6 (6ml)	7.54	7.03	13.82	8.51

Table 3 is showing that the variation in turbidity after use aloe vera.

Table 3: Variations in Turbidity at different percentages of aloe vera

Initial Turbidity (NTU)	34.35 S 1%	34.35 S 2%	34.35 S 3%	34.35 S 5%
Jar 1 (1ml)	25.40	17.87	16.21	10.95
Jar 2 (2ml)	22.90	14.80	15.12	10.10
Jar 3 (3ml)	21.25	13.90	13.57	7.66
Jar 4 (4ml)	17.21	13.13	11.88	7.76
jar 5 (5ml)	11.27	13.54	11.59	8.40
jar 6 (6ml)	11.92	11.86	10.90	9.21

5.2 Graphical Results

Experiments were carried out using alum as coagulant for raw water. Alum and aloe vera doses were varied in the range of 10- 300mg/l. In results it was found that for effective turbidity removal alum dose required was high. The maximum removal efficiency was found 89.65% with alum and 77.68% with aloe vera for doses of 40 mg/l and 150mg/l respectively. Fig 5.1 shows the effect of alum and aloe vera at 1% on raw water.

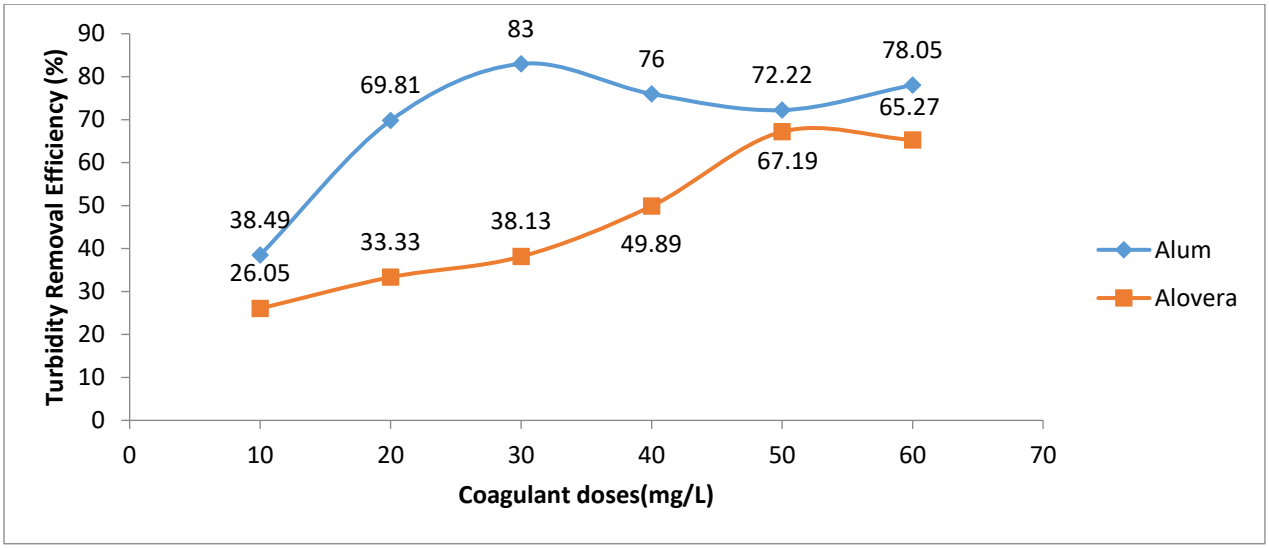

Figure 1. Turbidity removal efficiency (%) after using 1 % alum and 1 % aloe vera

From the above results it was shown that 1% dilution of Aloe Vera was found to be effective. Jar tests were performed for the 10-60 mg/l of constant alum dose and various doses of Aloe Vera for raw water. In results it was found that for 30mg/l of alum dose and 50ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. It varied between range of 38.49- 83% with alum and it varies between 26.05-67.19% with aloe vera.

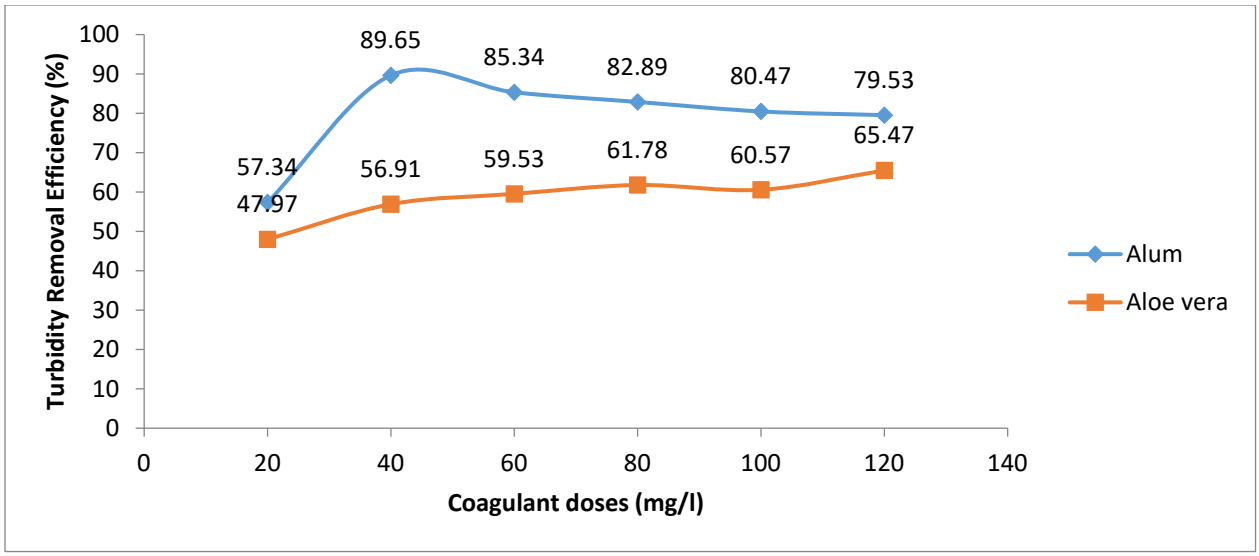

Figure 2. Turbidity removal efficiency (%) after using 2 % alum and 2 % aloe vera

From the above results it was shown that 2% dilution of Aloe Vera was found to be effective. Jar tests were performed for the 20-120 mg/l of constant alum dose and various doses of Aloe Vera for raw water. In results it was found that for 40mg/l of alum dose and 120ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. It varied between range of 57.34- 89.65% with alum and it varies between 47.97-65.47% with aloe vera.

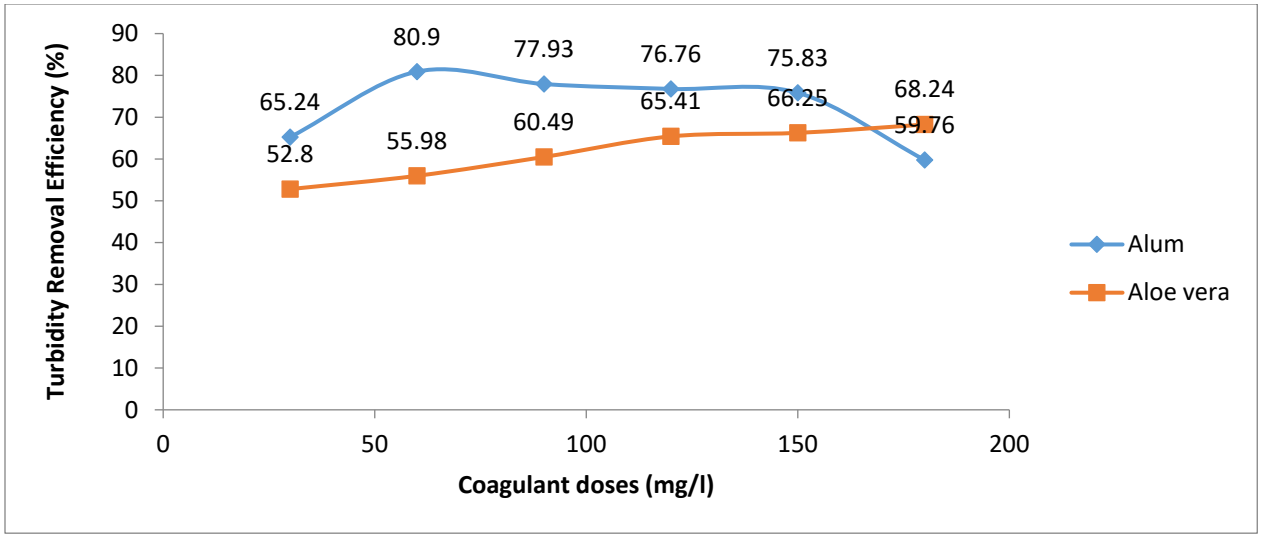

Figure 3: Turbidity removal efficiency (%) after using 3 % alum and 3 % aloe vera

From the above results it was shown that 3% dilution of Aloe Vera was found to be effective. Jar tests were performed for the 30-180 mg/l of constant alum dose and various doses of Aloe Vera for raw water. In results it was found that for 60mg/l of alum dose and 180ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. It varied between range of 65.24- 80.9% with alum and it varies between 52.8-68.24% with aloe vera.

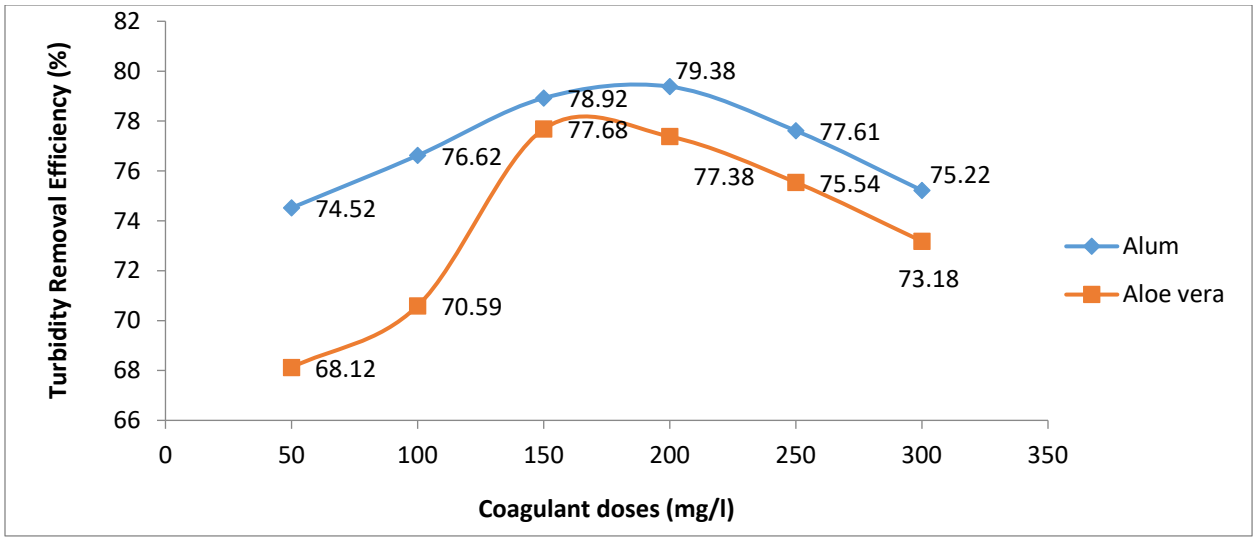

Figure 4: Turbidity removal efficiency (%) after using 5 % alum and 5 % aloe vera

From the above results it was shown that 5% dilution of Aloe Vera was found to be effective. Jar tests were performed for the 50-300 mg/l of constant alum dose and various doses of Aloe Vera for raw water. In results it was found that for 200mg/l of alum dose and 150ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. It varied between range of 74.52- 79.38% with alum and it varies between 68.12-77.68% with aloe vera.

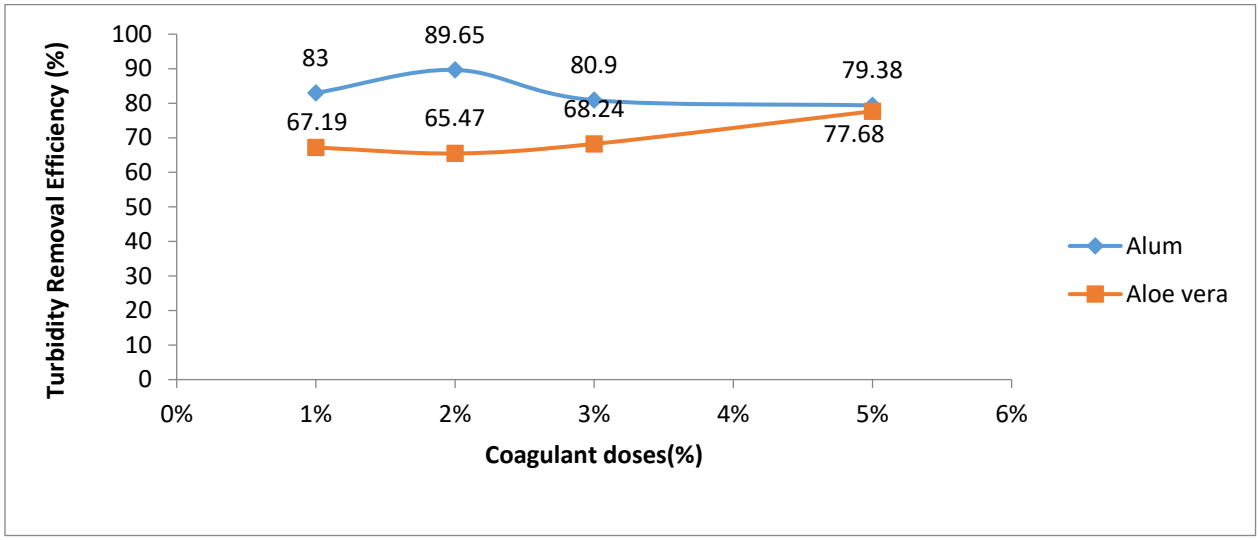

Figure 5: Comparison of Turbidity removal efficiency (%) of alum and aloe vera

After performed the test it is clear that aloe vera have less turbidity removal efficiency as compared to alum. In Figure 5 it was observed that the maximum turbidity removal efficiency of alum at the 2% was 89.65% and aloe vera at 5% was 77.68 % respectively.
The obtained results show that the Aloe vera was responsible for turbidity reduction of 77.68% as shown in Figure 5. More aloe vera is to be required to get more turbidity removal efficiency.

5.3 Proposed Improvements

More study is needed to determine how to reuse or dispose of the sludge produced while using a natural coagulant to clean water. Future studies should focus on streamlining workable extraction and purification techniques,

characterising potential local resources (plant- and/or animal-based) that could be used as natural coagulants, optimising extraction process conditions, and assessing other types of wastewater with various characteristics. In conclusion, taking into account all the benefits, the use and development of natural coagulants have promising futures as a green technology with a workable, long-term solution for reducing water pollution.

6. Conclusion

This study was mainly focused on the preparation of Aloe vera; study on its performance and effectiveness as a coagulant in the water. Alum was give better result compared to Aloe vera. The turbidity of raw water is reduced by 87.62% with Alum; and 78.48% with Aloe vera powder as the coagulant. Hence, it is better to use the natural coagulant aloe vera during raw water treatment. This is also effective in terms of cost and environmentally friendly and coagulation-flocculation activities. Aloe vera may be effectively employed as a natural coagulant for the treatment of raw water, according to this experimental investigation. As a result, natural coagulants may substitute alum without affecting how well the procedure works.

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Biography

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