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## Original Article

# *Plantago ovata* Medicinal Plant and Water Treatment

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## Abstract

*Plantago ovata* is a medicinal plant of plantain, Plantaginaceae, family used to treat intestinal disorders and stomach diseases. *P. ovata* grain has relieving effects and healing inflammation and irritation of the mucous layer of stomach and duodenal ulcer. Beside the medicinal benefits, this plant is useful for water turbidity removal. Coagulation and flocculation are important processes in water treatment. Artificial coagulants are not useful from economic and health point of view. The objective of this study is to compare performance of chloroferric coagulant (alone) and with *P. ovata* coagulant aid in water turbidity removal. The experiments were done in turbidity of 50 NTU. In all experiments the amount of chloroferric was 10 ppm and optimum dose of *P. ovata* was 0.1 ppm at optimum pH of 7. *P. ovata* at 50 NTU turbidity, reduced turbidity up to 94.5% whereas chloroferric alone could reduce 85.16% of turbidity. Having been contained mucilage, protein and starch, *P. ovata* would reduce consumption of coagulants and be effective in water turbidity removal as a coagulant aid.

**Key words:** Water treatment, Flocculation, Coagulation, Turbidity, *Plantago ovata*

## Introduction

The approximate population of one billion has no access to healthy drinking water around the world. [1]. Surface water has different suspended particles which lead to turbidity and color [2]. Flocculation and coagulation are the processes in which very fine particles, causing turbidity and color, appear in the form of thick mass and finally removed by physical methods such as settling, filtration or floatation. Usually salt metals like alum, chloroferric, organic anionic, cationic and non-ion polymers act as coagulant [3]. Performance of non-organic salt metals is to unsterilized the particles which occurred by compaction of additional electric layers surrounding colloidal particles. Polymers compounds do their function by being adsorbed at the surface of particles and by making joint particles-polymer-particle bridge [4].

In 1930 the function of active silica was announced coagulant aid. Later in 1960 artificial polyelectrolyte released to the market. Many countries use natural polyelectrolyte such as Chitosan [5-7]. It is prohibited to use artificial polymer in many countries because of its side effect on human health [5, 8, 9]. *Plantago ovata* is an indigenous plant in Iran. *Plantago* is a Latin word which means talon indicating the form of leaf and *ovata* is related to the form of leaves. *P. ovata* is a one-year-old plan with very low stem coated by soft fibers which is of plantain, Plantaginaceae, family with 7 to 30 cm high [10-13]. The leaves are long and thin, this plant has root of 20 to 30 cm long seen with many sidelong roots [10]. *P. ovata* grain is 2 to 3.5 cm high [10, 14] and 1-1.5 mm wide with light brown and rather dark brown color , every one hundred seeds weight 0.15-0.19 g.

*P.ovata* grain contains mucilage, protein, cellulose and starch [10]. Mucilage can not be deposited in the water and appear in the form of mass [12]. In addition to mucilage, this grain contains tannin [12, 15]. The nature of this grain is cold and tensionless used to treat inflation and Xanthus disorders [10-12, 16]. Boiled *P. ovata* is prescribed for cough treatment [11]. The recent researches show that regular use of *P. ovata* will reduce blood cholesterol [17]. Mucilage within the *P. ovata* acts very much like liquid paraffin healing Irritable bowel syndrome malignant diseases and eczema [11, 12] mucilage also used in beauty mask and relieving dermal inflation and irritated eyelid [17].

Research objective

Proper treatment gets done by using coagulants and polymers. Artificial polymers have vast applications all over the world because of their efficiency as a coagulant and coagulant aid, however, they are not used in some countries due to being harmful for human health. Recent studies show that *P. ovata*

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could act as a natural polyelectrolyte in flocculation and be positive for turbidity reduction, meanwhile, it can be analyzed biologically and its residue will not have any side effect on the users ‘body. Thus, it has priority over artificial polymers.

The objective of this study is evaluating the performance of flocculation and coagulation processes in turbidity removal by *P. ovata* plant as coagulant aid.

## Materials and Methods

Due to instability it is impossible to keep water with natural turbidity in laboratory, therefore; some clay added to water so that artificial turbidity of 50 NTU be achieved. Also chloroferric, manufactured by Merck Co., added as coagulant and concentrated *P. ovata* extract used as coagulant aid.

In this investigation, five samples,500-mililiter, of raw water whose turbidity and pH were already measured containing 50 NTU turbidity, poured in a jar (500 ml) and then the chloroferric coagulant of a certain volume added initially alone and then along with *P. ovata* coagulant aid.

Samples were mixed rapidly 100 rpm for one minute and then slowly 30 rpm for 25 minutes in order to form flocs. During this process, the formation of flocs was observed and then flocs had 30 minutes time to be deposited. Then containers were sampled for analysis, turbidity and pH measurement, finally the remained turbidity was compared with the first one. To make pH effective on efficiency of coagulant aid, 1N Sulfuric acid was used and then after the experiment was over the rate of pH changes and final turbidity of the samples was compared with the initial rate.

## Results

● By using 10 ppm chloroferric and 0.1 ppm *P. ovata* at pH 7 and 8 the percent of reduction is 94.5% and 89.3%, respectively.

● Using chloroferric as the only coagulant at optimum pH of 7 and 8 could reduce the turbidity up to 85.1% and 77.56%, respectively.

Figs. 1 and 2 indicate that the use of *P. ovata* extract has effective role in turbidity reduction.

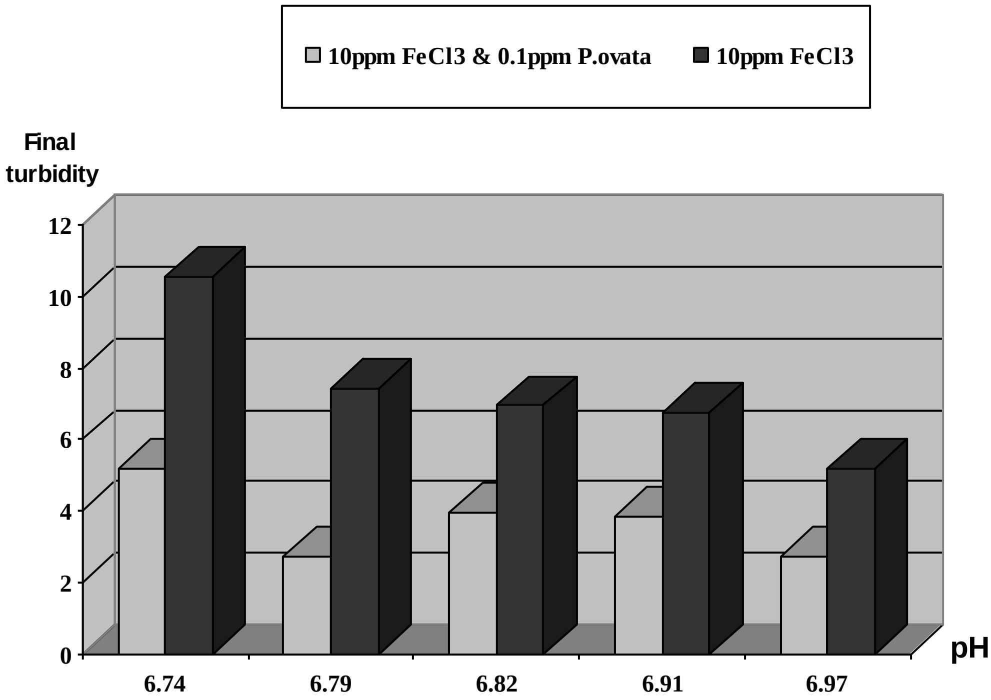


**Fig 1.** Comparison of final turbidity in two following conditions: using chloroferric coagulant alone and using chloroferric coagulant together with *P. ovata* coagulant aid in turbidity of 50 and pH 7.

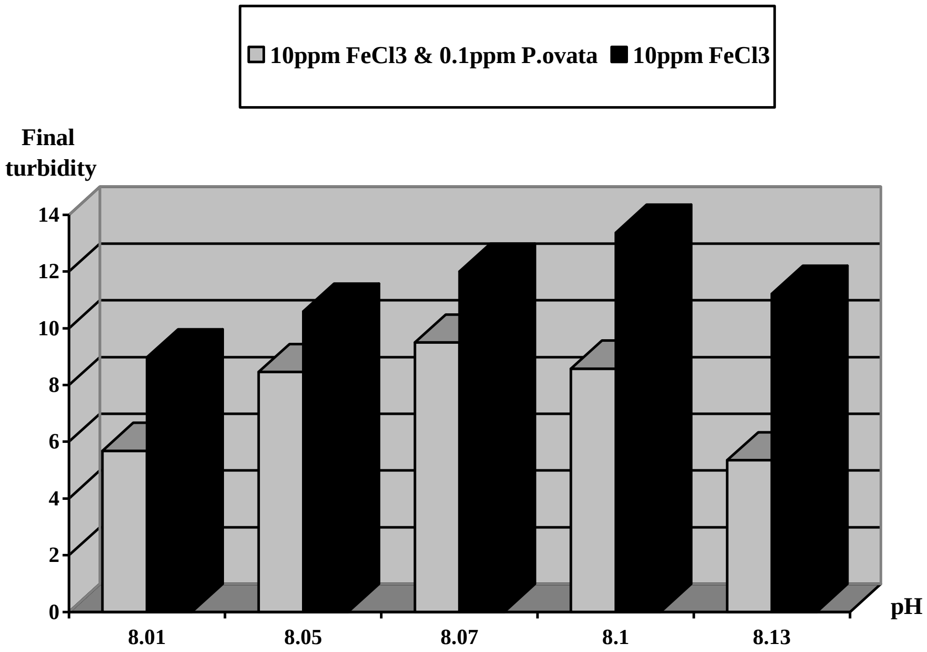


**Fig 2.** Comparison of final turbidity in two following conditions: using chloroferric coagulant alone and using chloroferric coagulant together with *P. ovata* coagulant aid in turbidity of 50 and pH 8.

## Discussion

In this study, with the aim of coagulation and fluctuation, the effect of adding *P. ovata* to the chloroferric coagulant for the purpose of water turbidity removal was investigated. To reduce the amount of chloroferric, *P. ovata* coagulant aid was used and optimization amount and optimum pH were determined. Table 1 represents pH 7 for chloroferric alone and chloroferric with *P. ovata* coagulant aid. Table 2 shows this result for pH 8. Obtained results from these tables show desirable turbidity removal for pH 7 and chloroferric used along with *P. ovata*.

**Table 1** Comparision between final and primary turbidity (50 NTU) in two different condition: using chloroferric coagulant together with *P.ovata* coagulant aid (first stage), using chloroferric coagulant alone in pH 7 (Second stage)

| The amount of materials | | Primary turbidity (NTU) | | Final turbidity (NTU) | | Removal percentage (%) | | Primary pH | |
|---|---|---|---|---|---|---|---|---|---|
| First stage | Second stage | First stage | Second stage | First stage | Second stage | First stage | Second stage | First stage | Second stage |
| 10 ppm $FeCl_3$ & 0.1 ppm *P. ovata* | 10 ppm $FeCl_3$ | 50 | 50 | 2.75 | 7.42 | 94.5 | 85.16 | 7 | 7 |

**Table 2** Comparison between final and primary turbidity (50 NTU) in two different condition: using chloroferric coagulant together with *P. ovata* coagulant aid (first stage), using chloroferric coagulant alone in pH 8 (Second stage)

| The amount of materials | | Primary turbidity (NTU) | | Final turbidity (NTU) | | Removal percentage (%) | | Primary pH | |
|---|---|---|---|---|---|---|---|---|---|
| First stage | Second stage | First stage | Second stage | First stage | Second stage | First stage | Second stage | First stage | Second stage |
| 10ppm $FeCl_3$ & 0.1ppm *P. ovata* | 10ppm $FeCl_3$ | 50 | 50 | 5.35 | 11.22 | 89.3 | 75.56 | 8 | 8 |

## Final conclusion

The main results of this experiment are as follows:
● The efficiency of *P. ovata* extract influenced by pH and optimum pH lead to improvement of its performance.
● Reduction in pH leads to improvement in choloroferric efficiency as well as choloroferric-*P. ovata*.
● Using coagulant aid leads to improvement in choloroferric efficiency and much more turbidity reduction in comparison with single application of coagulant mode.
● The cost of supplying this plant is relatively low in comparison with artificial coagulant and it is possible to culture this plant in Iran and it is available.
● From health point of view, using this plant has no side effects in comparison with artificial coagulant aid and it has considered as an medicinal plan.

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