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Evaluation of *Moringa oleifera* seed extract coagulation in removal of some dyes in textile wastewater

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Abstract : The purpose of this paper is to irradiate the dyes by biologically through utilization involve the use of ***Moreinga oleifera*** seed extract , the ability of *Moringa oleifera* seed extract– among other natural coagulants–to remove several different types of dyes has been investigated. *Moringa oleifera* has been demonstrated to have a high removal ability for anionic dyes. The study confirms the potentially of the *Moringa oleifera* in decolourization of dyes and thus opens up a scope for future analysis pertaining to their performance in treatment of textile effluent. In this paper the ability of natural products as *Moringa oleifera* seeds in removing dyes has been tested using two reactive and one acid dyes. After a preliminary screening for dye removal capacity, The influences of several parameters such as pH, temperature or initial dye concentration have been tested and the behavior of coagulants has been compared. The results show that pH values changed according to the kind of dye used, and dye removal decreases as pH increases. The ability of *moeringa oelifera* in removing dyes has been studied. At various concentrations of the dye ,the absorbance value is noted using a double beam UV spectrophotometer. Experiments were carried out for determining the dye removal capacity using a powder derived from *Moringo oleifera* seed. The results show that the color removal efficiency is attained maximum up to 90% using *moringa* as coagulant.
Keywords : *Moreingaoleifera*– decolourization- waste water- reactive dyes- acid dyes.

1. Introduction :

Dyes are considered the most important pollutants [1] in textile waste water. The textile industry is one of the industries that produce a high volume of waste water and cause water pollution. Dyes in waste water from textile and dyestuff industries are difficult to remove. This is because dyes usually synthetic and have complex aromatic structures which make them more stable consequently they are difficult to biodegrade[2]. There are some biological methods to removal dyes involve the use of microorganisms such as fungi, bacteria and algae to convert dyes into non-toxic harmless compounds**.** [3] Organic compounds can convert to water and carbon dioxide through biological methods. The removal of dyes from textile waste water is one of the most environmental problems.[4]

There are several researches involve the methods of removing dyes from waste water and different methods have been developed; for example, adsorption onto materials as activated carbon[1,5] and physical and chemical degradation[4,6]. There are other techniques such as Fenton's oxidation, electrochemical degradation, ionization, etc.[7,8,9]. *Moreinga. oleifera* is used as a water treatment agent. It is a tropical multipurpose plant. *M. oleifera* is very important for future applications, as it is easily available water treatment method.

The powder of *Moringa oleifera* seeds is also used as coagulant/flocculent agent for drinking water clarification due to its high content of a water soluble cationic protein which able to reduce turbidity[7]. *Moringaoleifera* oil extraction can be used for water treatment, for drinking water clarification, and it is also for textile waste water treatment[8,9]. The use of natural coagulant is used in developing countries, as substitution of external chemical coagulants as (aluminum sulfate, ferric chloride. [10,11]The water -soluble extract of the dry seeds of Moringa oleifera is ne of the natural coagulants , which is a tropical plant from the family of Moringa ceae.[12] *Moringaoleifera* is used for water treatment in two different methods, one as a primary source of activated carbon [11,13] and the second method through seed extraction, and produce a product working as a coagulant / flocculant agent[14,15].

In industrial wastewater treatment, these natural coagulant/flocculants can be applied in textile dyeing and finishing processes[13]. The valorization of natural waste as low-cost materials for the treatment of textile effluents has important interest in recent years, some researches also have been published about the treatment of acid dyes (anionic dyes) with Moringa oleifera seeds. In textile industry a large volume and variability of wastewater produced in dyeing and finishing processes. World wide, 280,000 tons of textile dyes are removed in industrial effluents every year, azo dyes are the most widely used with more than 60% of the total dye synthesis[16]. Azo dyes can be degraded by reduction reactions of the azo group, producing aromatic amines. Which can be harmful and some of them are carcinogenic and genotoxic according to the International Agency for Research on Cancer. The presence of toxic and carcinogenic products in textile dyeing effluents is a problem [17]. Reactive dyes are widely used for dyeing cotton and other cellulosic fibers since they characterized by high washing fastness and brilliant colors. It represents 25% of the total world market. On the other hand, these dyes have a relatively low degree of exhaustion and fixation values ranges, from 70% to 90%[17]. The unfixed dyes are hydrolyzed and cannot be reused since they are not covalently fixed to the cellulosic fibers. Consequently, large quantities of these unfixed dyes are found in the wastewater. Another environmental problem associated to dyeing with reactive dyes is the generation of highly saline effluents due to the amount of electrolyte, generally NaCl, used to increase the dye exhaustion and fixation about 50–80 $g \cdot L^{-1}$ [17]. This salt is almost completely discharged into the wastewater after the dyeing process. The presence of high concentration of salts is considered very harmful for aquatic ecosystems. Also its elimination is only possible through application of costly treatments as reverse osmosis [18]or electro dialysis[19]. These cause environmental problems which draw attention to residual reactive dyebath discoloration. Also the reuse of discolored salt-containing effluents in new dyeing processes is possible. This approach provide a significant saving of water and electrolyte[20].

In this work, the use of *Moringa oleifera* seed extraction is proposed for the removal of reactive and acid dyes from textile wastewater in substitution of more expensive decolonization, methods which require the use of chemical reagents or higher operation and maintenance technologies

1- Materials and methods :

2.1.Materials

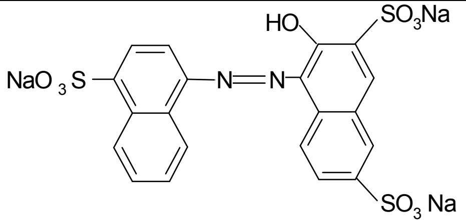
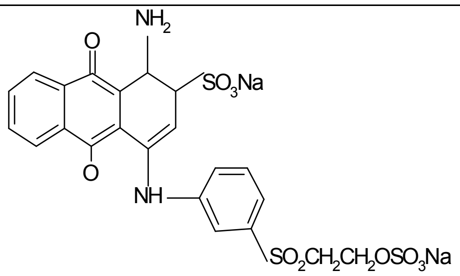
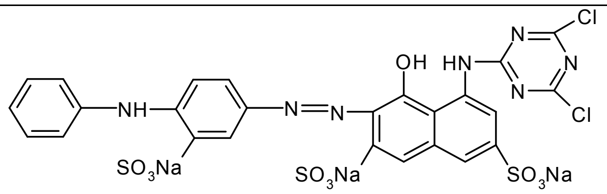
2.1.1.Source of dyes and Moreinga olefera:

This study was carried out at National Research Center, Egypt. Seeds of *Moringa oleifera* Lamarck (moringa) family Moringa cease were kindly obtained from Egyptian Scientific Society of Moringa (ESSM), National Research Center, Dokki, Cairo, Egypt.

2.1.2. Dyes:

The dyes used in this study were C.I Reactive Blue 19, C.I Reactive Blue 81, Acid Red27. The chemical structures of these dyes and the maximum wave length (λ max) are illustrated in Table (1)

Table (1): The commercial names, the maximum wave length and the chemical structures of the dyes under investigation.

The chemical structure	maxλ	The commercial names
	520	CI Acid Red 27
	583	C.I Reactive Blue 19
 Reactive Blue 81	590	C.I Reactive Blue 81

2.2. Methods:

2.2.1. Preparation of dye solution

The dye stock solution were prepared by dissolving accurately weighed dyes in distilled water to the concentration of 500 mg/L. Different concentrations were prepared from the stock solution.(50, 100, 150, 200, 250 mg/L).

2.2.2. Moringa oleifera seed extraction

The extraction process was carried out as follows. First, the shelled seeds were reduced to powder using a domestic mill (Braun,Spain). A 100 mL solution of 1 mol L^{-1} NaCl was prepared and 5 g of *Moringa oleifera* seed powder was added (a stock solution, 5% w/w). The NaCl solution containing the powder was vigorously stirred at pH 7 for 30 min at room temperature using magnetic agitation. The extract was then filtered twice: once through commercial filter paper on a B¨uchner funnel and once again through a fine-filtering *Millipore* system (0.45 µmglass fibre). The result was a clear, milk-like liquid. *Moringa* stock solution prepared in this way was used the same day it was produced, although there are references that record the stability of the extract [21, 22,17].

2.2.3. Preparation of coagulant

The husk covering the M. oleifera seeds were manually removed, good quality seeds were selected, and the kernel was ground to a fine powder using an ordinary electric blender. The active component from coagulant was extracted using sodium chloride (NaCl)or potassium chloride (KCl) salt solution. A concentration of 4% (4 g of powder in 100ml salt solution) was used throughout the study after several trials. The whole mixture was stirred for 30 min at room temperature using a magnetic stirrer. The suspension was filtered using whatman filter paper. The resultant filtrate solution was used as a coagulant.

2. 2.4. Coagulation Studies

The coagulation studies were performed using Jar test apparatus which allowedfor six 1 liter beakers to be agitated simultaneously and rotational speed could be variedbetween 0 and 100 rotations per minute (RPM).

The beakers were filled with 1000ml dye sample. During rapid mixing at 100RPM for 2 min coagulant dosage was added into eachbeaker and was followed by slow mixing at 40RPM for 30min. The duration of sedimentation was kept constant at 30 min. The supernatant after sedimentation was filtered using whatman filter paper. The filtrate was analyzed for absorbance using UV spectrophotometer at a maximum wavelength 526.5 nm. Color removal efficiency was measured as a decrease in optical density measurement at 475 nm. The readings were takenin triplicate for each individual solution to check repeatability. The dyes were added to moringa solution of concentrated stock solutions.

Decolourization was measured spectrrophotometrically at the wave length of peak absorbance of each dye using UV. Vis recording spectrophotometer. Different concentrations such as 50, 100, 150, 200 and 250 mg *Moringa oleifera* seed powder was added to a 1000 ml textile waste water sample. After rapid mixing for 5 `minutes at 200 rpm and slow mixing for 55 min at 60 rpm, the sample was withdrawn by using a plastic syringe from a point about 2 cm below the top of liquid level at the beaker in order to determine the color, so that the effect of coagulant dose on coagulation could be studied. For the purpose of coagulation, pH was adjusted to 8 by addition of Ca(OH)2.

3- Results and discussion

3.1. Effect of coagulant dose on coagulation:

The percent of color removal of Reactive Blue 19 and Reactive Blue 81) increase as the concentration of coagulant dose increase (figures 2,3,4) and reaches to 90% for reactive dyes.

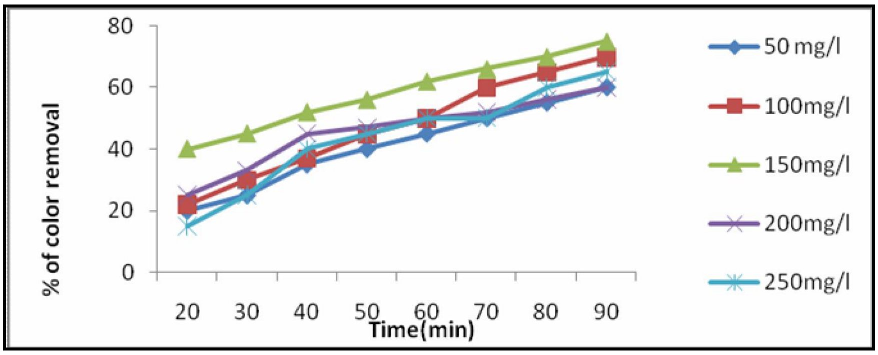


Figure1. Effect of coagulant dose on coagulation for reactive dye 1

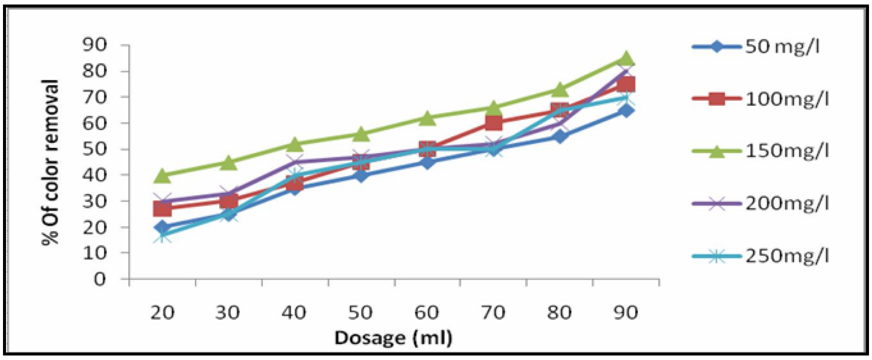


Figure. 2. Effect of coagulant dose on coagulation for reactive dye 2

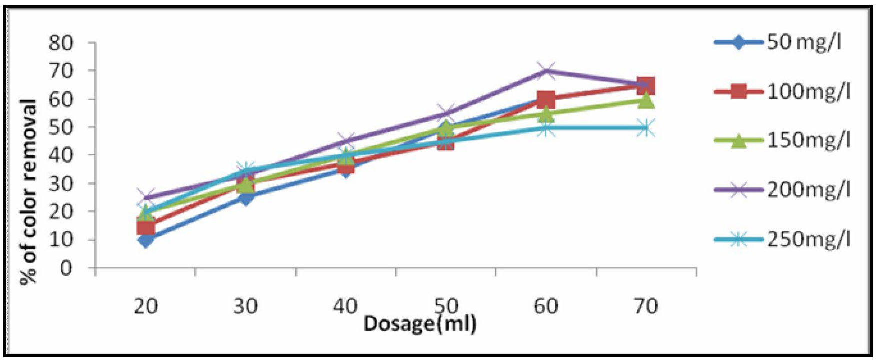


Figure.3. Effect of coagulant dose on coagulation for acid dye 3

3.2. Effect of contact time :

The results obtained indicated that, decolourization efficiency of acid and reactive dyes(acid red 27, Reactive Blue 19 and Reactive Blue 81) reaches maximum at 90 min. The nature of the subsistent on the aromatic ring has been shown to influence enzymatic oxidation. Electron donating substituent as methyl and methoxy and amino groups enhance enzymatic degradation of azo phenols while electron withdrawing substituent as chloro, nitro and hydroxyl inhibited oxidation [23]. Hydroxy and amino groups enhance decolourization.The preceding section discussed the effect of contact time on the degradation of acid dye (figure 5, 6,7).

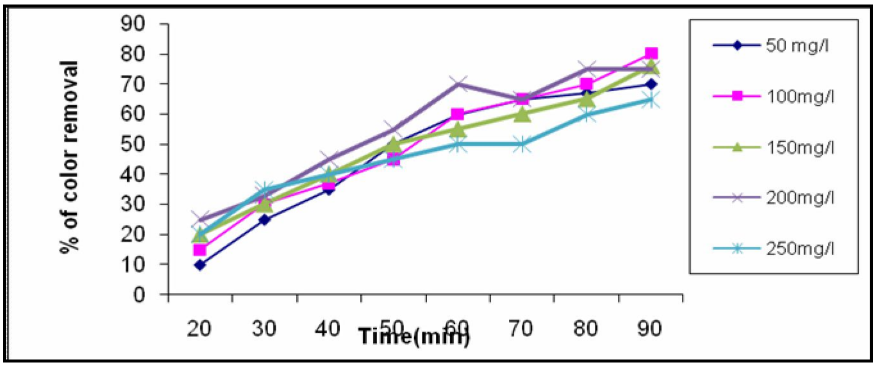


Figure. 4:Effect of contact time on the efficiency of color removal for reactive dye 1

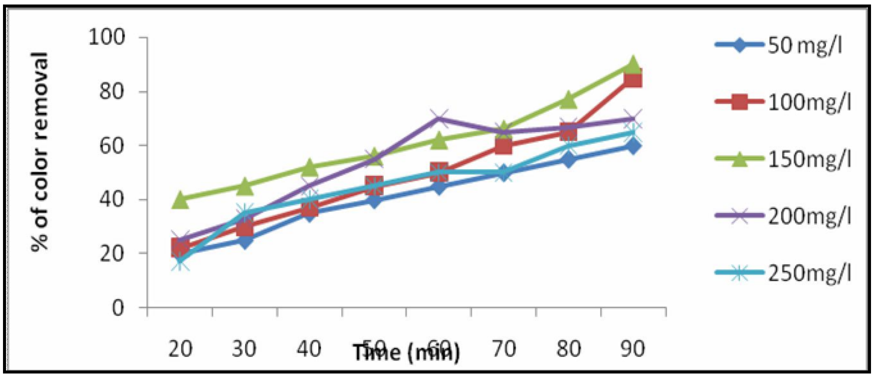


Figure. 5 :Effect of contact time on the efficiency of color removal for reactive dye 2

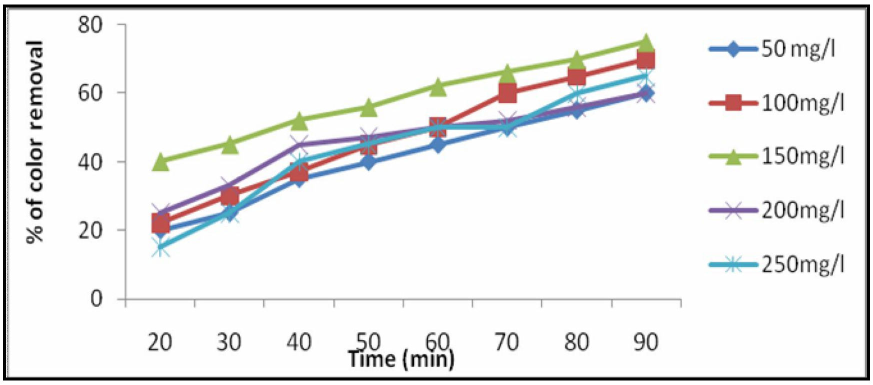


Figure. 6 :Effect of contact time on the efficiency of color removal for acid dye 3

3.3. Effect of pH on the efficiency of color removal for acid dye 3:

The aqueous solution of dyes having concentration of 100 mg/L were treated by varying concentrations of 0.20 g dose of adsorbent for half an hour with varying pH (2 -10).The pH was maintained with the help of 0.1 N-HCl and 0.1 N-NaOH solutions.Fig.(8,9,10) show the effect of pH of the dye solution on the decolourization % within the range of (2-10). The results showed that the decolourization reached maximum at pH 8-10 for acid and reactive dyes for all dosage. The Effect of pH was one of the parameters was crucial to determine the optimum levelin order to minimize the dosing cost and obtain the optimum performance in treatment. pH variation in comparison had a significant effect on the decolorization of Reactive and acid dyes by *Moreinga oleifera.*

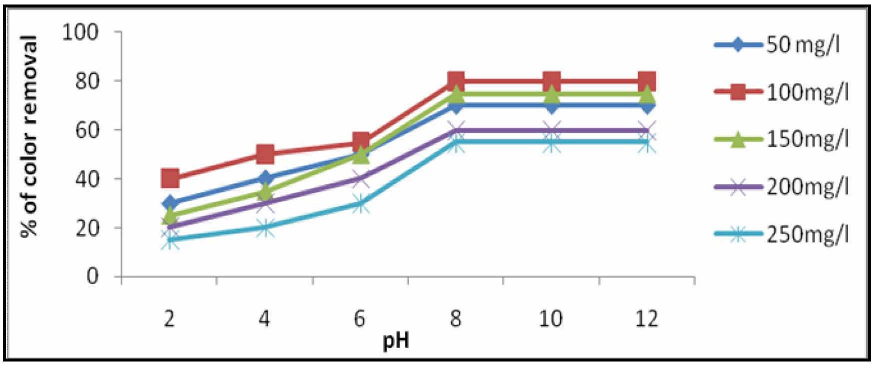


Figure.7:Effect of pH on the efficiency of color removal for reactive dye 1

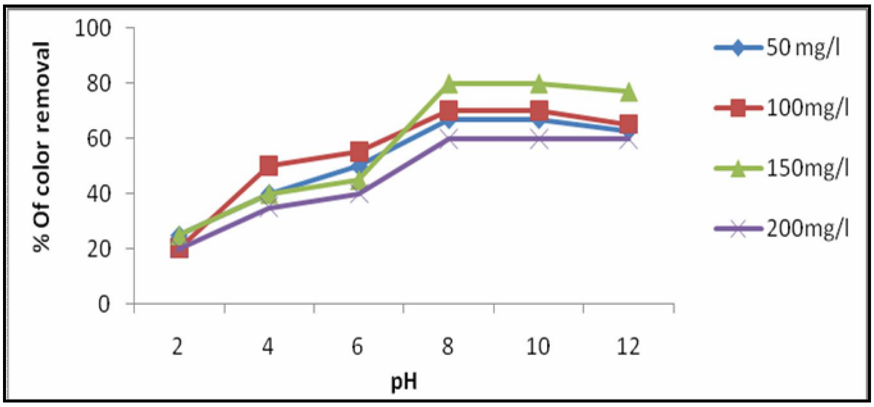


Figure.8 :Effect of pH on the efficiency of color removal for reactive dye 2

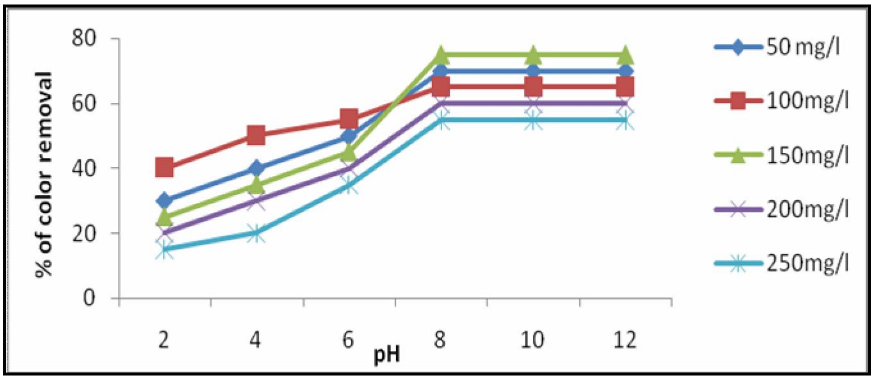


Figure. 9:Effect of pH on the efficiency of color removal for acid dye 3

Figure. 9 shows that the highest color removal was detected at pH 10(85%). The removal of dyes are more at higher pH, because the surface of activated coagulants are negatively charged, the decrease in adsorption capacity at the low pH values would be expected as the acidic medium would lead to an increase in hydrogen ion concentration which would then neutralize the negatively charged coagulant surface thereby decreasing the adsorption of the positively charged ions because of reduction in the force of attraction between adsorb ate and adsorbent

4- Conclusion

Decolourization of reactive dyes could be successfully achieved by treating with *Moringa oleifera*. Coagulation process was used to treat textile dye effluent. Results of the experiments revealed the following: 100mg *Moringa oleifera* reduces color by 90% respectively. The pH range of 8-10 was found to be effective for the coagulation process. Increasing dosage increases the enhancement of removal of contaminants.. 1000mg coagulant enhances efficient removal of color in the coagulation process Removing approximately 90% dye color was achieved. The most efficient removal was observed with the reactive dye 2 athigh concentrations. The results revealed also that the decolourization reached maximum at pH 8 with respect to the three dyes used. It was also noticed that dye 2 exhibited the highest percent as compared to dye1 and dye 3.

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