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Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 13
Issue: 05

Res. Jr. of Agril. Sci. (2022) 13: 1465–1472

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2022)
13(5): 1465–1472

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

www.rjas.org

Full Length Research Article

Adsorption of Basic Fuchsin Dye Through Fresh Water Hycinth (*Eichhornia crassipes* L.)

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Received: 19 Jun 2022 | Revised accepted: 01 Sep 2022 | Published online: 23 Sep 2022

A B S T R A C T

Dye effluents release from textile industry and discharge in to water bodies and create ecological problems as they are more toxic. Filtering of dye from colour polluted water is a critical problem. Biosorption through water hyacinth is an alternative and cost-effective technology for textile dye effluents treatment. In present, Laboratory investigation of the strength of fresh bulk biomass of water hyacinth to remove basic fuchsin dye from aqueous solution were conducted. Parameters studied on the bases of different biomass dosage and different concentration. The Langmuir and freundlich isotherm were found to represent the measured sorption data well. Maximum 30.43% adsorption capacities of water hyacinth for basic fuchsin dye were calculated at 20ppm. In FTIR study, C=N (Very Strong- VS), C=S (Strong- S) and C=C (Very Strong- VS) play important role in adsorption process. Water hyacinth biomass could represent a cost-effective biosorbent and cheap source for Biosorption of basic fuchsin dye.

***Key words*:** Dye effluents, Industry, Biosorption, Water hyacinth, *Eichhornia crassipes* L., Biomass, FTIR, Cost-effective

Today industries are the backbone of economy in many developed as well as developing countries. In India, it contributes to about 25% of total export Earning and providing employment to almost one fourth of the total labour force but high volumes of aqueous effluents contaminated with dyes are generated by different industries [1]. These industries discharge variety of toxic pollutant in different processes and affected the water resources, soil productivity, aquatic organisms and ecosystem integrity. The presence of effluents discharges from different industries is a major problems of the textile dye industrial sector. The characteristics of textile wastewater can be difficult to predict by the reported values in the literature, as every industry uses different production methods, technology, and chemicals. The textile industry produces the most polluting wastewater [2]. One of the world's most polluting industries is the textile-dyeing industry. It releases a lot of harmful chemicals into the water, which can hazardous for the environment [3].

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In the world annually, more than 700 thousand tons of synthetic dyes are produced with more than 10,000 different types of dyes and pigments used in various industries such as textile, paper, plastic, leather tanning. These dyestuff industries discharge variety of pollutants in different processes [4].

Water resource polluted by toxic organic chemical compounds which is a major contributor to global environmental pollution. The presence of dyes pollutants in aquatic environments are of major concern due to their potential health hazards associated with their toxicity, allergenic, mutagenic, carcinogenic and genotoxic character. The adverse effects of these chemicals can have a negative impact on the natural balance of aquatic ecosystems, as well as the photosynthesis and viability of aquatic plants [5].

Dyes cannot be completely removed by conventional wastewater treatment systems. There are a lot of treatment methods traditionally used at industrial scale for dye effluent treatment that are broadly classified as chemical, physical and biological. The physical and chemical techniques are numerous including anion exchange resins [6], coagulation, floatation, adsorption, oxidation, hyper filtration [7-8] and photolytic process is well known for removing dye effluent from wastewater. However, the processes are expensive because a lot of chemicals are required and they are complicated to dispose of. Therefore, according to research, adsorption is best way to remove to dye effluents because it is easy handling, high efficiency, low energy input and availability of adsorbent [9].

Adsorption is one of the most common methods for the removal dyes from wastewaters. The environment is contaminated by many hazardous chemical species, especially with chemical dyes. Environmental protection requires

conscientiousness regarding the use of dyes with respect to regulations and the treatment of effluent discharge because many industries use chemical dyes to treat their finished products. Chemical dyes reduce the light penetration in water, interfering with photosynthesis, and most of them contain suspected carcinogens. Therefore, it is necessary to reduce or eliminate these life-threatening compounds from wastewater before it is discharged [10].

Biosorption is a physiochemical process in which the biomass used which allows it to passively concentrate and bind though the using biomass in environmental clean-up has been practice are hopping this phenomenon will provide an economic alternate for removing toxic dyes and metals from industrial waste water and aid in environmental remediation [11]. Biosorption is a low-cost technology for the removal of textile dye effluents from wastewater, biosorption based on the binding capacities of various biosorbent materials like as waste plant materials, algae, fungi, bacteria and agricultural wastes. Biosorption is a continuous process by which metal or dye can be sequestered by the living or dead biomass [12].

Aquatic plants are using as a biosorbents. The use of aquatic plants for the removal of heavy metals from wastewater gained more interest. Some freshwater macrophytes including *Potamogeton lucens, Salvinia herzogoi, Eichhornia crassipes, Myriophyllum brasillensis, M. spicatum, Cabomba* sp., *Ceratophyllum demersum* have recently been investigated for the removal of heavy metals [13].

Among these above-mentioned aquatic plants *E. crassipes* (Water hyacinth) that belongs to the family Pontederiaceae stands as a challenging, highly growing invasive aquatic plant on planet. The utilization and importance of the water hyacinth in various above-mentioned concepts, its play important role in textile effluent treatment is recently undergoing higher attention to find an alternative for the currently available textile effluent treatment techniques. The water hyacinth decreases the soluble pH to neutral and this decrease might be because of the adsorption of nutrients or by concurrent arrival of H+ particles with the take-up of metal particles [14].

E. crassipes being one of the worst weeds on the planet as a vigorous grower which is known to double its population within two weeks was worked out as a cheap and easily available adsorbent for dye and effluent treatment. Water hyacinth was found to be highly impossible to eradicate from the water ways, though its quest for nutrients has given a possible way for its usage in phytoremediation. *E. crassipes* can remove dye effluents from aquatic systems because of the functional groups present on the cell wall and their high binding efficiency, rapid growth and high abundance around the world [15].

MATERIALS AND METHODS

Biosorbent collection

Fresh plants of water hyacinth were collected from the pond at village Maithana Inder Singh Meerut Uttar Pradesh. The plants were cut fresh bulk disk with the help of steel T shape pipe.

Preparation of dye solution

Basic fuchsin dye ($C_{20}H_{19}N_3$.HCl, molecular weight=337.86 g/mol was used for the experiment of 100ppm. Stock solution was prepared by dissolving the dye in double distilled water. Working solution different concentration (10 ppm, 20ppm, 30ppm and 40ppm) of dye solution were prepared by diluting the stock solution.

Preparation of standard calibration curve

A standard mixture of dye was obtained from textile industry and stock solution prepared from it. Dye solution of different concentration were prepared from stock solution of dye by 0.1 ml, 0.2 ml, 0.3 ml, 0.4 ml, 0.5 ml, 0.6 ml, 0.7 ml, 0.8 ml, and 0.9 ml with sufficient water so that the volume of each mixture was 10ml. The O.D. of these solution were measured and plotted on a graph paper to obtain the best fit. 100ml dye 10ppm dye solution were taken in 24 flasks and different amounts (50mg and 400mg) of fresh bulk biomass were added separately (3 flasks for each dose). A set of 3 flasks servedar control.

Kinetic biosorption experimental procedure

Borocilicate conical flasks (250 ml) were used for adsorption experiments. A total of volume of different concentrations (10 ppm, 20ppm, 30ppm and 40ppm) of dye solution were taken in flasks separately, with different eight doses (50 mg to 400 mg) of fresh bulk disk plant biomass. All the flasks were kept on rotary shaker for 10 minutes at 150 revolutions per minute. The biosorption process was performed at room temperature. After 10minutes of continuous shaking all the reaction mixture were filtered through Whatman filter No. 40 separately. All the reaction mixtures were estimated through visible spectrophotometer.

Calculate of q value and adsorption capacity

The specific uptake (q-value) of dye was determine such as:

$$q = V (C_i - C_f)/ W$$

where, q = dye uptake (mg dye/ g biosorbent); V = the volume of liquid sample (ml); C_i = the initial concentration of the dye in solution (mg/l); C_f = the final concentration of the dye in solution (mg/l); W = the mass of biosorbent added to sample fresh basis (mg).

Adsorption isotherm

The observational models viz., Freundlich (1915) and Langmuir (1918) for single solute structure were utilized to explain the biosorption equilibria of the experimental plant biomass:

$$\text{Freundlich equation: } q_e = K_F C_e^{1/n} \ldots\ldots (1)$$

$$\text{Langmuir equation: } q_e = \frac{q_{max} K_L C_e}{1 + K_L C_e} \ldots\ldots (2)$$

where, q_e = dye molecule adsorbed per unit quantity of adsorbent at equilibrium (mg/g), q_{max} = maximum amount of the dyeic ions adsorbed per unit amount of adsorbent (mg/g), C_e = residual concentration at equilibrium point(mg/L), n = Freundlich characteristic constant of system, including parameters such as result of concentration on the capacity of adsorption and represents the adsorption intensity (dimensionless quantity), K_L = constant related to the attraction of binding sites for ions of the dye (L/mg), K_F = Freundlich characteristic constant of the system, including parameters that effects the process of adsorption, such as capacity of adsorption.

Statistical data calculation

Standard deviation and correlation coefficient (R^2) were determined through Freundlich and Langmuir isotherm equation by using Microsoft-Excel 2011.

FT-IR study of plant biomass

FT-IR study of the selected the plant biomass samples (unloaded and loaded biomass with dye) were observed the relationship between the functional groups before and after adsorption of dye. Each sample 2mg of fresh bulk biomass was mixed with 98 mg of FT-IR grade (merck) potassium bromide

(KBr) and grounded. The material welt to prepare pellets applied to the mixture for this, a pressure of 10,000−15,000 psi. IR spectra of these pellets were observed on FT−IR spectrophotometer at high resolution (≤ 0.001 cm^{-1}).

RESULTS AND DISCUSSION

The result of laboratory investigation let out that plant biomass is high strength for the biosorption of basic fuchsin dye effluents come out from different type of textile industry at different (10, 20, 30 and 40ppm) dye solution. The contact time of ten minutes was picked since prior investigations did by various researchers including Bhole *et al*. [16], Kumar [17], According to research, The best time for effluents take-up by biosorbent is 10 minutes. Biosorption of Basic Fuchsin Dye Colorants through Living Disk of *Eichhornia Crassipes.* After the investigation of the graph observed that the strength of plant biomass is more effective for the biosorption of Basic Fuchsin Dye Colorants delivered by textile dye industry whereas the water hyacinth is easily available and cost-effective. Different doses of fresh bulk Plant biomass as biosorbents i.e., eight different doses (50mg to 400mg) were allowed to biosorption from tested dyes effluents solution. The maximum adsorption percentage of tested dye was found 27.86% with high dose of biosorbent (i.e., 400mg) and followed by 19.32% with 350mg, 20.15% with 300mg, 19.43% with 250mg, 17.72% with 200mg, 18.28% with 150mg, 12.72% with 100mg and minimum uptake of dye (6.43%) was found with 50mg of biosorbent at 10ppm dye solution (Table 1, Fig 1a). The maximum adsorption percentage of tested dye was found 30.43% with high dose of biosorbent (i.e., 400mg) and followed by 24.04% with 350mg, 26.64% with 300mg, 23.87% with 250mg, 20.36% with 200mg, 16.33% with 150mg, 17.19% with 100mg and minimum uptake of dye (15.93%) was found with 50mg of biosorbent at 20ppm dye solution (Table 1, Fig 1b). The maximum adsorption percentage of tested dye was found 29.38% with high dose of biosorbent (i.e., 400mg) and followed by 27.09% with 350mg, 27.39% with 300mg, 23.50% with 250mg, 20.12% with 200mg, 20.32% with 150mg, 16.35% with 100mg and minimum uptake of dye (14.30%) was found with 50mg of biosorbent at 30ppm dye solution (Table 1, Fig 1c). The maximum adsorption percentage of tested dye was found 24.39% with high dose of biosorbent (i.e., 400mg) and followed by 17.69% with 350mg, 19.12% with 300mg, 17.89% with 250mg, 16.08% with 200mg, 14.36% with 150mg, 13.46% with 100mg and minimum uptake of dye (11.78%) was found with 50mg of biosorbent at 40ppm dye solution (Table 1, Fig 1d).

Table 1 Biosorption of basic fuchsin dye from its solution of different concentrations by living biomass of *Eichhornia crassipes* after 10 minutes

Initial concentration of dye solution (ppm)	Amount of plant biomass doses (mg)	Final concentration of dye in solution (ppm)	Amount of dye adsorption (ppm)	Percentage (%) of dye adsorbed	Q Value (Dye uptake mg/g biomass)
10	50	93.57	0.64± 0.07	6.43	1.286
	100	87.28	01.27 ± 0.03	12.72	1.272
	150	81.71	01.82 ± 0.04	18.28	1.218
	200	82.28	01.77 ± 0.06	17.72	0.886
	250	80.57	01.94 ± 0.03	19.43	0.777
	300	79.85	02.05 ± 0.02	20.15	0.671
	350	80.68	01.93 ± 0.06	19.32	0.552
	400	72.14	02.78 ± 0.04	27.86	0.696
20	50	84.07	03.18 ± 0.03	15.93	6.372
	100	82.81	03.43 ± 0.02	17.19	3.438
	150	83.67	03.26 ± 0.05	16.33	2.177
	200	79.64	04.07 ± 0.07	20.36	2.036
	250	76.13	04.76 ± 0.04	23.87	1.904
	300	73.36	05.32 ± 0.03	26.64	1.776
	350	74.96	05.00 ± 0.04	25.04	1.430
	400	69.57	06.08 ± 0.05	30.43	1.521
30	50	85.70	04.29 ± 0.06	14.30	8.580
	100	83.65	04.90 ± 0.04	16.35	4.905
	150	79.68	06.09 ± 0.03	20.32	4.064
	200	79.88	06.03 ± 0.02	20.12	3.181
	250	76.50	07.05 ± 0.06	23.50	2.820
	300	72.61	08.21 ± 0.07	27.39	2.739
	350	72.91	08.12 ± 0.04	27.09	2.322
	400	70.62	08.81 ± 0.03	29.38	2.203
40	50	88.22	04.71 ± 0.02	11.78	9.424
	100	86.54	05.38 ± 0.04	13.46	5.384
	150	85.64	05.74 ± 0.03	14.36	3.829
	200	83.92	06.43 ± 0.03	16.08	3.216
	250	82.11	07.15 ± 0.02	17.89	2.862
	300	80.88	07.64 ± 0.05	19.12	2.546
	350	82.31	07.07 ± 0.03	17.69	2.021
	400	75.61	09.75 ± 0.02	24.39	2.439

On the basis of overall observation of the biosorption reaction, it was found that maximum biosorption of tested dye (up to 20ppm dye concentration) was found at lowest dye concentration i.e., 10ppm (27.86%). Interestingly, at high concentration of dye (20ppm), a rapid increase was found in biosorption and as high as 30.43% of dye uptake was detected

by 400mg of biosorbent dose and followed by 24.04% with 350mg, 26.64% with 300mg, 23.87% with 250mg and 20.36% with 200mg dose. The increase in adsorption showed a characteristic feature of fluid chemistry that involved the role of stress of molecules on biosorbent surface. The excess load of dye molecules on a binding site caused stress on the biosorbent and released different binding groups on the surface of biosorbent. These groups might be involved in more and more adsorption of dye molecules from the aqueous solutions of different dye concentrations.

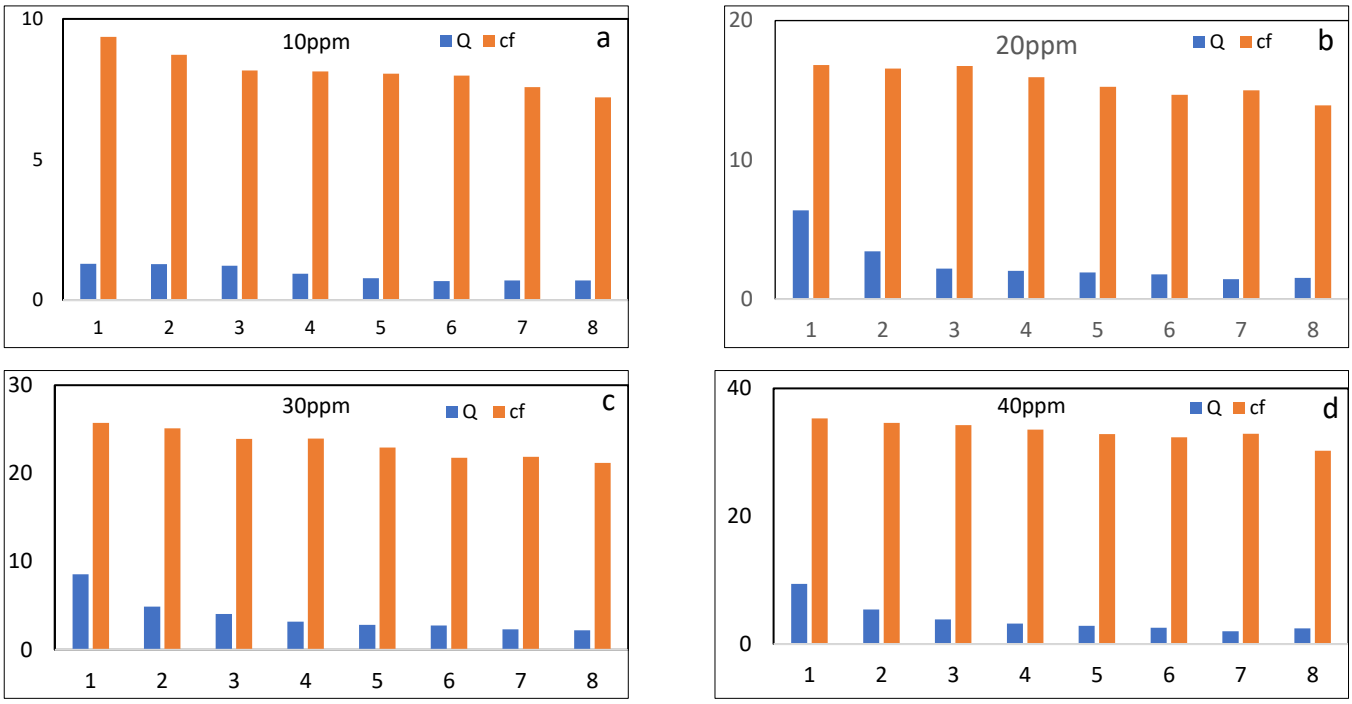


Fig 1(a-d) C_f and Q-values of basic fuchsin dye fresh plant biomass doses (10, 20, 30, 40ppm dye solution)

Table 2 Langmuir's isotherm: Basic fuchsin dye sorption profile of *Eichhornia crassipes* (10,20,30 and 40ppm)

a	b	1/ab	R^2
0.1593	1.436781609	4.369114878	0.4859
0.1051	0.657462196	14.47193149	0.5657
0.1419	0.453926464	15.52501761	0.8414
0.0735	0.410041004	33.18068691	0.5878

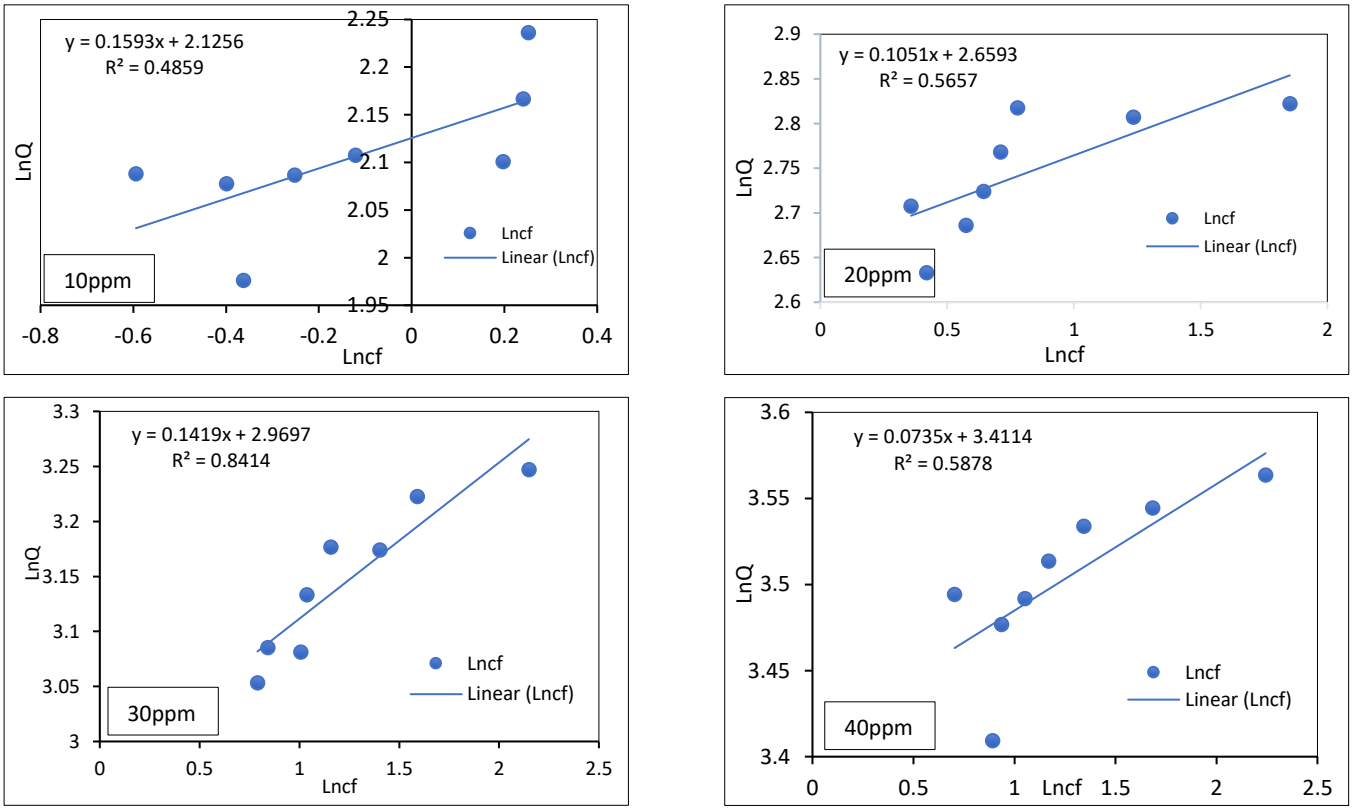
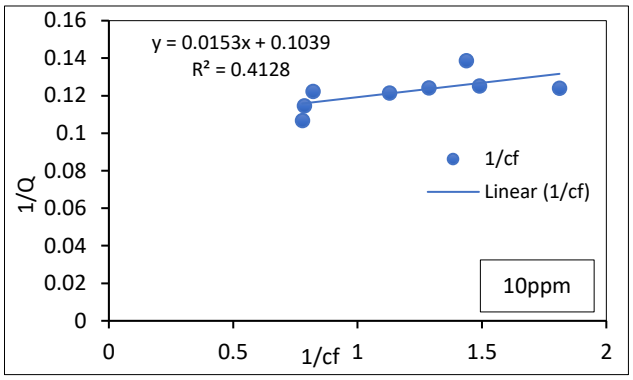
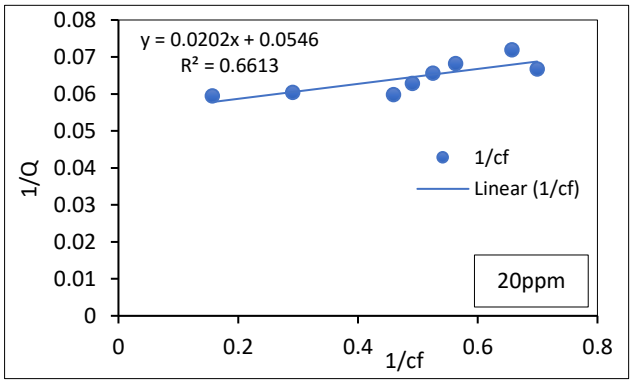
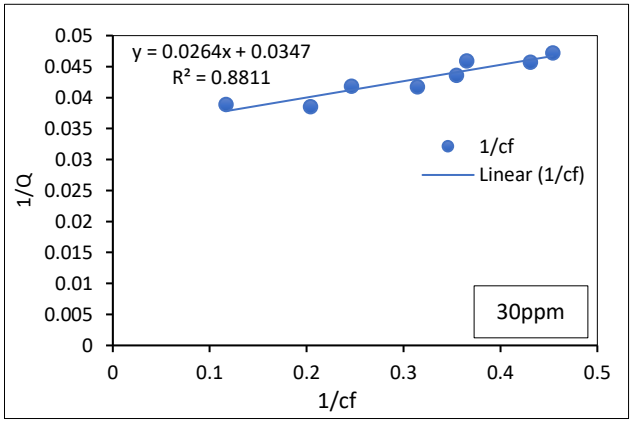


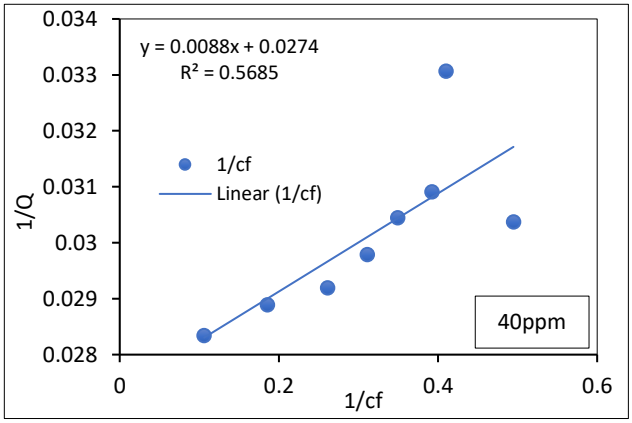
Table 3 Freundlich's isotherm: Basic fuchsin dye sorption profile of *Eichhornia crassipes* (10,20,30 and 40ppm)

n	1/n	Kf	R^2
65.359477	0.0153	1.1094895	0.4128
49.504950	0.0202	1.0204054	0.6613
37.878787	0.0264	1.0353090	0.8811
113.636363	0.0088	1.0277788	0.5685









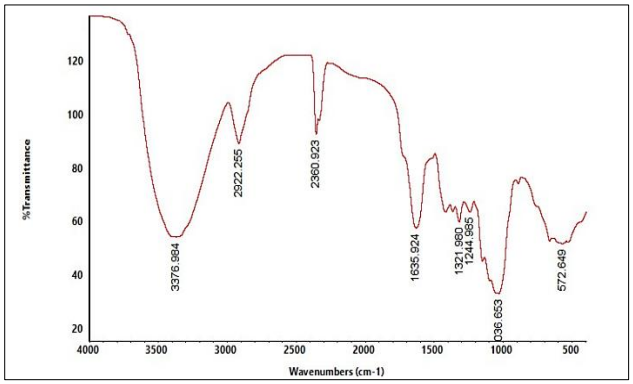


Fig 4 Functional groups of *Eichhornia crassipes* (unloaded dye) control biomass with corresponding infrared absorption peaks

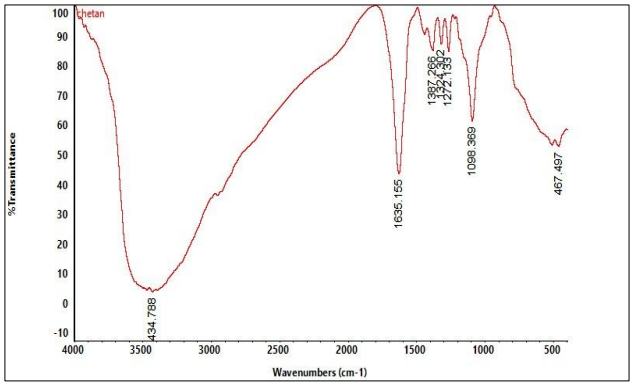


Fig 5 Functional groups of *Eichhornia crassipes* (loaded 10ppm dye) biomass with corresponding infrared absorption peaks

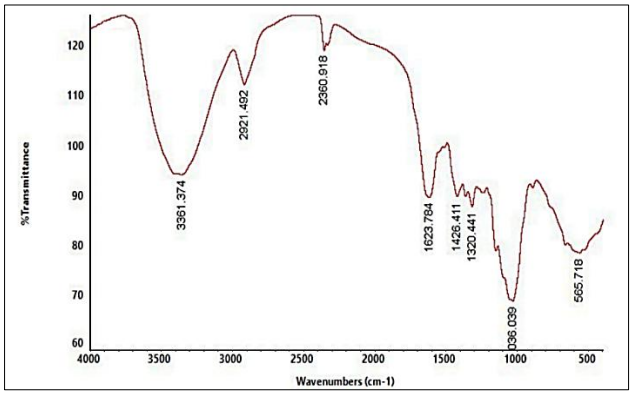


Fig 6 Functional groups of *Eichhornia crassipes* (loaded 20ppm dye) biomass with corresponding infrared absorption Peaks

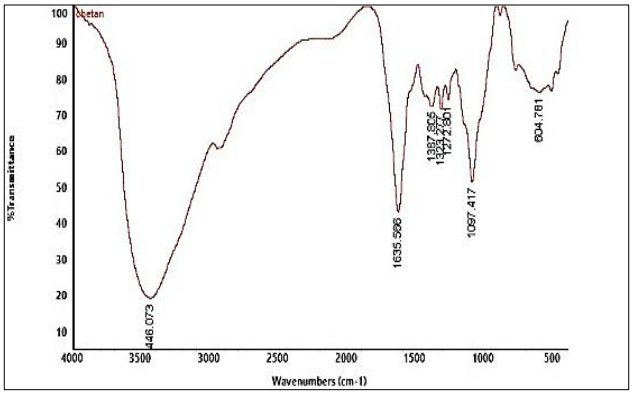


Fig 7 Functional groups of *Eichhornia crassipes* (loaded 30ppm dye) biomass with corresponding infrared absorption Peaks

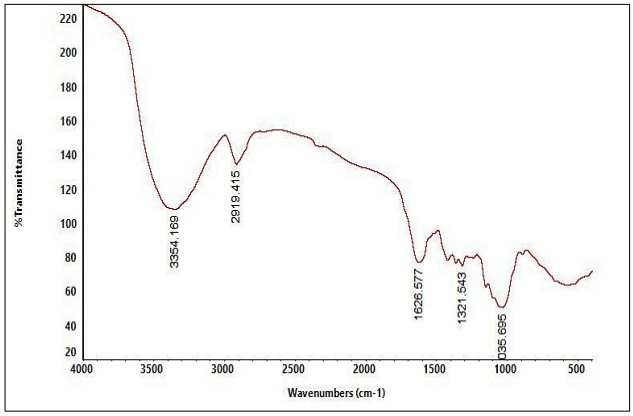


Fig 8 Functional groups of *Eichhornia crassipes* (loaded 40ppm dye) biomass with corresponding infrared absorption peaks

The Q value were observed a pattern of increase to decrease values (0.69 to 1.28 at 10ppm and 6.37 to 1.52 at 20ppm and 8.58 to 2.20 at 30ppm and 9.42 to 2.43 at 40ppm dye concentration) with different type of plant biomass dose (Table 1, Fig 1a-d). According to research was observed that increase the biomass concentration had a positive impact on biosorption of dye solution and again increase biomass concentration had a positive impact on biosorption [18]. Increase the biomass amount (50mg, 100mg,) in the same way the biosorption of dye also increase as increase 15.93% on 50mg, 17.19% on 100mg. After that as soon as the amount of biomass is extended again, then percentage of biosorption such as decrease 16.33% on 150mg biomass but once again increase the biomass amount then biosorption increase again such as 20.36% on 200mg, 23.87% on 250mg, 26.64% on 300mg plant biomass. After that as soon as the amount of biomass is extended again, then percentage of biosorption such as decrease 25.04% on 350mg biomass. but once again increase the biomass amount then biosorption increase again such as 30.43% on 400mg plant biomass. So, the maximum increasing percentage biosorption of dye 400mg of biomass at 20ppm concentration. Whereas the maximum adsorption was found in 20ppm (30.43%).

The analysis of the FTIR spectra of the unloaded and biosorbent loaded with different concentrations of the tested dye showed the change in the surface chemistry of the biosorbent (Fig 1-5). The sorption of dye effluents on the biomass is a reversible interaction both adsorption and desorption process are probably going to happen. At first, the high concentration of test dye in the solution mixture and the particles of test dye possess the limiting locales of the biosorbent. The higher portion of biomass in the response combination brings about decrease of distance between the adsorbent particles. Because of this, the dye molecules tie with the binding groups present at closest area. Although, subsequent to arriving at a saturation point, the color particles are delivered once more into the solution followed by conceivable resorption [19]. Freundlich condition expects a logarithmic decline in the adsorption enthalpy with a rising number of involved adsorption destinations of a fairly vivaciously heterogeneous adsorbent surface [20]. The probability of existence of such a situation is more only when a multi-layered structure exists [21-22]. Much better correlation coefficients were obtained using Freundlich's isotherm model as compare to Langmuir's isotherm model. The Freundlich's model is describe heterogenous adsorption process [23] and assumes the presence of multi-layer structure [24]. The values of correlation coefficients (R^2) finding that the Freundlich's model was the better fit for the adsorption of basic fuchsin dye onto fresh *E. crassipes* as comparison to Langmur's model (Tables 2-3; Fig 2-6).

Table 4 Wave numbers and F.W.H.M (in brackets) of various peaks obtained in FT-IR spectral analysis of fresh *Eichhornia crassipes* biomass

Unloaded	3376.984 (2.3 cm)	2922.255 (1.4 cm)	2360.923 (0.3 cm)	1635.924 (1.4 cm)	1321.980 (1.3 cm)	1244.985 (2.1 cm)	1036.653 (1.4 cm)	572.649 (2.2 cm)
Loaded with 10 ppm	3434.788 (2.2 cm)	1635.155 (1.6 cm)	1387.266 (0.7 cm)	1324.302 (1.4 cm)	1272.133 (1.8 cm)	1098.396 (2.2 cm)	467.497 (2.1 cm)	
Loaded with 20 ppm	3361.374 (1.9 cm)	2921.492 (0.8 cm)	2360.918 (0.3 cm)	1623.784 (1.0 cm)	1426.411 (1.2 cm)	1320.441 (1.1 cm)	1036.039 (1.8 cm)	565.718 (3.7 cm)
Loaded with 30 ppm	3446.073 (2.1 cm)	1635.566 (0.5 cm)	1387.805 (0.7 cm)	1323.277 (0.5 cm)	1272.801 (0.8 cm)	1097.417 (0.7 cm)	604.781 (1.9 cm)	
Loaded with 40 ppm	3354.169 (2.3 cm)	2919.415 (2.0 cm)	1626.577 (1.9 cm)	1321.543 (1.7 cm)	1035.695 (2.1 cm)			

FTIR spectra of dry water hyacinth (E. crassipes) biomass before and after dye loading

FTIR fresh biomass of water hyacinth with before and after loading basic fuchsin dye are show in the Figures. FTIR spectra of *Eichhornia crassipes* control biomass (unloaded) showed eight Peaks at wave numbers 572.649 cm^{-1}, 1036.653 cm^{-1}, 1244.985 cm^{-1}, 1321.980 cm^{-1}, 1635.924 cm^{-1}, 2360.923 cm^{-1}, 2922.255 cm^{-1}, 3376.984 cm^{-1} (Fig 4). The fresh plant biomass loaded with 10ppm of basic fuchsin dye showed a total of seven peaks at wave numbers 467.497 cm^{-1}, 1098.369 cm^{-1}, 1272.133 cm^{-1}, 1324.302 cm^{-1}, 1387.266 cm^{-1}, 1635.155cm^{-1} and 3434.788 cm^{-1}. Treatment of 10 ppm dye showed only five new peaks at wave number 467.497 cm^{-1}, 1098.369 cm^{-1}, 1272.133 cm^{-1}, 1387.266 cm^{-1} and 3376.984 cm^{-1} while slight shifting was observed in rest of the two peaks (Fig 5) in comparison to unloaded biomass spectra (Fig 4). The fresh plant biomass loaded with 20ppm of basic fuchsin dye showed a total of eight peaks at wave numbers 565.718 cm^{-1}, 1036.039 cm^{-1}, 1320.441 cm^{-1}, 1426.411 cm^{-1}, 1623.784 cm^{-1}, 2360.918 cm^{-1}, 2921.492 cm^{-1} and 3361.374 cm^{-1} (Fig 6). Treatment of 10 ppm dye showed only one new peak at wave number 1426.411 cm^{-1} while slight shifting was observed in rest of the seven peaks (Fig 6) in comparison to unloaded biomass spectra (Fig 4). The fresh plant biomass loaded with 30ppm of basic fuchsin dye showed a total of seven peaks at wave numbers 604.781 cm^{-1}, 1097.417 cm^{-1}, 1272.801 cm^{-1}, 1323.277 cm^{-1}, 1387.805 cm^{-1}, 1635.566 cm^{-1} and 3446.073 cm^{-1} (Fig 7), Treatment of 30 ppm dye showed only four new peaks at wave number 604.781 cm^{-}

[1],1097.417 cm^{-1}, 1272.801 cm^{-1} and 1387.805 cm^{-1} while slight shifting was observed in rest of the three peaks (Fig 7) in comparison to unloaded biomass spectra (Fig 4). The fresh plant biomass loaded with 40ppm of basic fuchsin dye showed a total of five peaks at wave numbers 1035.695 cm^{-1}, 1321.543 cm^{-1}, 1626.577 cm^{-1}, 2919.415 cm^{-1} and 3354.169 cm^{-1} (Fig 8), Treatment of 40 ppm dye showed only two new peaks at wave number 2919.415 cm^{-1} and 3354.169 cm^{-1} while slight shifting was observed in rest of the three peaks (Fig 8) in comparison to unloaded biomass spectra (Fig 4). F.W.H.M of the peaks of treated (loaded)plant biomass was more to untreated (unloaded) (Table 4).

In the present study of FTIR spectra analysis of the fresh plant biomass unloaded and loaded with 10ppm of dye solution showed disappearance of C=C (Very Strong- VS), C=N (Strong- S), C-I (Strong-S) and Aromatic ring (Strong- S)), In case of 20ppm of dye solution showed disappearance of C=N (Very Strong). The FTIR spectra analysis of the plant biomass unloaded and loaded with 30ppm of dye solution showed disappearance of C=N (Very Strong- VS), C=C (Strong- S), Nitro (Very strong-VS) Sulfonamide and Sulfone (Moderate), In case of 40ppm of dye solution showed disappearance of C=N (Very Strong- VS), C=S (Strong- S), C-CI (Strong-S), C-I (Strong- S) and C-C Aliphatic chain (Moderate).

In the present study FTIR observed that the fresh plant biomass is more effective as a biosorbent. After the data observed, obtained was found to better fit into the Freundlich's model in comparison to Langmur's model which assume that the adsorption was found to be multilayer and heterogenous adsorption process. In FTIR study, C=N (Very Strong- VS), C=S (Strong- S), C=C (Very Strong- VS), Nitro (Very Strong- VS), C-I (Strong- S), C-CI (Strong- S) Aromatic ring (Strong- S), Sulfonamide and Sulfone (Moderate) play important role in adsorption process. The hydrogen-bonded groups like -OH and -NH groups correspond to the expansive assimilation band showed by the all the native biosorbents in FTIR examination [25]. The different types biomolecules such as fats, proteins, crude fiber, etc., in which different functional groups are present (-COOH, $-NH_2$, -NH, -OH and/or others) in *E. crassipes* plant and its vegetative organs. A similar truth is referenced in the chemical compound analysis [26]. Thus, after examination it was found that the *E. crassipes* plant biomass use as a coast viable biosorbent.

CONCLUSION

Present study explored the biosorption performance of water hyacinth plant biomass. It is an easily available and cost-effective adsorbent to remove of dye effluents from aqueous solutions. This study was investigated in terms of Langmuir and Freundlich isotherms. The adsorption was found to be monolayer because the values of Freundlich's model was better fit for the adsorption of basic fuchsin dye onto fresh plant biomass in comparison to Langmuir's model (which assumes multilayer and heterogenous adsorption). The maximum adsorption percentage of tested dye was found 30.43% with high dose of biosorbent (i.e., 400mg) at 20ppm dye concentration. In FTIR study, C=N (Very Strong- VS), C=S (Strong- S), C=C (Very Strong- VS), Nitro (Very Strong- VS), C-I (Strong- S), C-CI (Strong- S) Aromatic ring (Strong- S), Sulfonamide and Sulfone (Moderate) play important role in adsorption of basic fuschin dye. It was additionally accepted that further detailed study is expected to confirm the better utilization of water hyacinth as bisorbent and improvement of appropriate biotraps units according to the dye effluents discharged from various textile units.

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