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Research Article

APPLICATIONS OF BIOWASTE AND THEIR ACTIVATED CARBON AS AN ADSORBENT OF CONGO RED DYE

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ABSTRACT

In this study seeds of bitter gourd (*Momordica charantia*) and peels of Chickoo (*Manilkara zapota*), Ridge gourd (*Luffa acutangula*), yellow cucumber (*Cucumis sativus*) and also the activated carbon derived from these seeds and peels is used as effective biosorbents of Congo red dye from its aqueous solution. The Freundlich and Langmuir adsorption isotherms have been verified by the experimental data. Different concentration of adsorbate is used for the study. The effect of pH, amount of adsorbent dosage and effective time of adsorption is also studied.

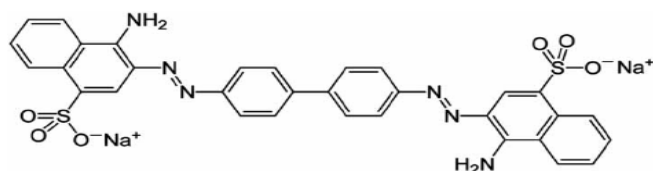
Key Words:

Congo red, Adsorption, Adsorption isotherms, biowaste, peels and seeds

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INTRODUCTION

Vegetables and fruits peels/shells/wastes^{1,2,3,4,5,6,7} is a biowaste and can be used as adsorbent of synthetic dyes, other plant products like leaves⁸, roots^{9,10} and biomaterials like Agricultural waste^{11,12}, forestry waste¹³, microorganisms¹⁴, natural coagulants¹⁵ are also being used as environmental friendly adsorbents. In this study a synthetic dye Congo red is removed from its aqueous solution by using selected vegetables and fruits peels and seeds. These are found to be environmental friendly and cost effective biosorbents.



Structure of congo red dye

MATERIALS AND METHODS

Adsorbate Preparation

4×10^{-5} M aqueous solution of Congo red is prepared as stock

solution. This stock solution is made into various dilutions and then used for adsorption studies.

Adsorbent Preparation

The vegetable and fruits waste that is bitter gourd seeds, Chickoo peels, Ridge gourd peels, yellow cucumber peels are collected, washed, dried, finely powdered and sieved for uniformity and are stored in separate air tight containers and the activated carbon of bitter gourd seeds, Chickoo peels, Ridge gourd peels, yellow cucumber peels are derived by heating each of them separately at 300°C in a muffle furnace.

Experiment

In this study different dilutions of Congo red were prepared using its stock solution for testing the adsorption characteristics of adsorbents. The amount of adsorbent used was 0.1 gms/50 ml of adsorbate. A constant time of 60 min. was maintained for every adsorption and the adsorbate is filtered and filtrate is collected and its optical density values were determined to check the discoloration. Chemicals used in this study were of analytical grade.

RESULT AND DISCUSSION

The adsorption properties of the bitter gourd seeds, Chickoo

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peels, Ridge gourd peels, yellow cucumber peels have been studied by using Freundlich and Langmuir adsorption isotherms. Langmuir adsorption isotherms equation is valid for monolayered sorption onto a surface with a finite number of identical sites. Langmuir adsorption isotherms equation is $C_e/x/m = ab * C_e/1+ab$ where a and b are Langmuir constants. Freundlich adsorption isotherms equation is $\ln x/m = \ln k + 1/n * \ln C_e$

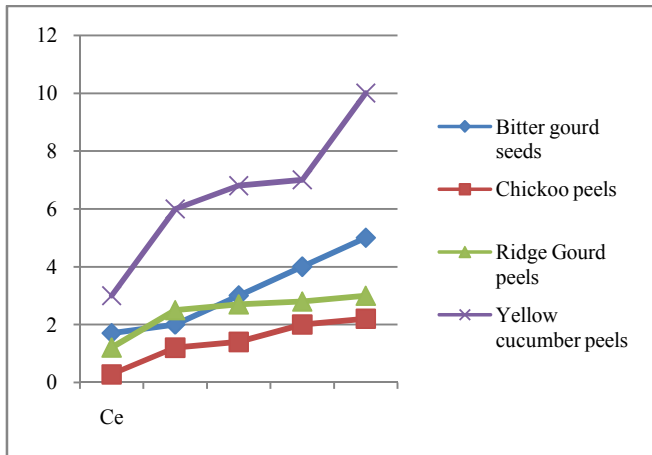
Table 1 Adsorption constants for Congo red with peels and seeds Langmuir isotherm parameters

Adsorbent	a	b	KL
Bitter gourd seeds	9433.96	1.06×10^{-4}	1
Chickoo peels	396825.3	1.01×10^{-5}	4
Ridge Gourd peels	119047.6	1.2×10^{-5}	1.4
Yellow cucumber peels	113636.36	7.10×10^{-6}	0.8

Table 2 Adsorption constants for Congo Red with activated carbon extracted from following peels and seeds Langmuir isotherm parameters

Adsorbent	a	b	KL
Bitter gourd seeds activated carbon	29411.1	2×10^{-5}	0.59
Chickoo peels activated carbon	500000	1.1×10^{-5}	5.5
Ridge Gourd peels activated carbon	50505.05	1.8×10^{-5}	0.90
Yellow cucumber peels activated carbon	72463.7	9.2×10^{-6}	0.66

Langmuir Adsorption Isotherm graph for Congo Red



Langmuir Adsorption Isotherm graph for Congo Red

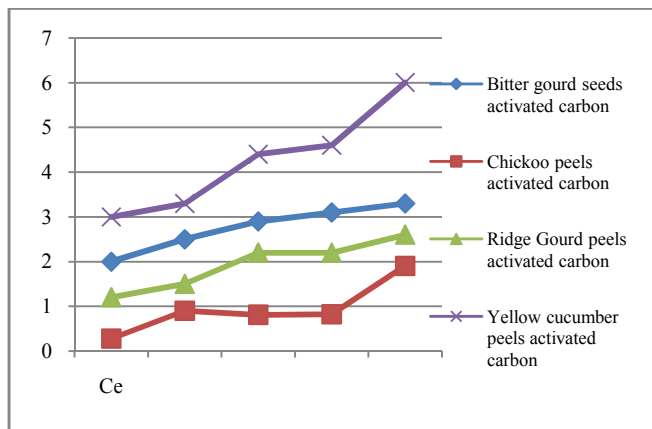


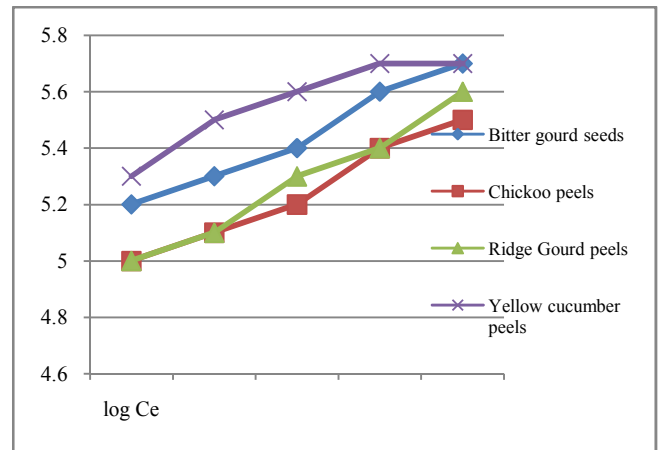
Table 3 Adsorption constants for Congo Red with peels and seed Freundlich isotherm parameters

Adsorbent	k	n
Bitter gourd seeds	7.9×10^{-3}	1.8
Chickoo peels	3.2×10^{-4}	3.5
Ridge Gourd peels	6.3×10^{-3}	1.5
Yellow cucumber peels	3.162×10^{-3}	2.3

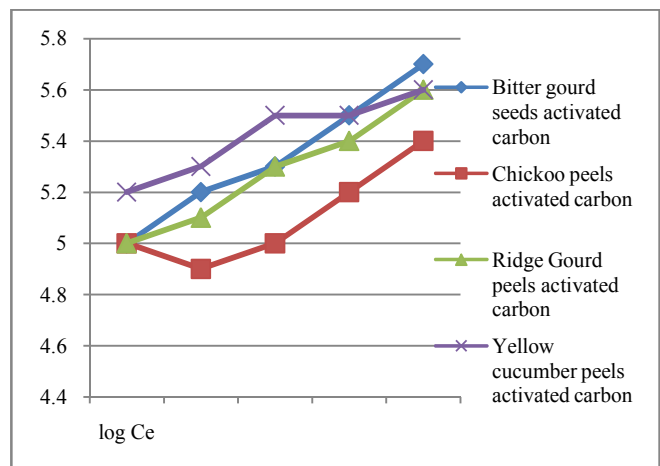
Table 4 Adsorption constants for Congo red with activated carbon extracted from following peels and seeds Freundlich isotherm parameters

Adsorbent	k	n
Bitter gourd seeds activated carbon	5×10^{-2}	1.3
Chickoo peels activated carbon	5×10^{-4}	3.3
Ridge Gourd peels activated carbon	1.5×10^{-2}	1.5
Yellow cucumber peels activated carbon	1.3×10^{-2}	1.8

Freundlich Adsorption Isotherm graph for Congo Red



Freundlich Adsorption Isotherm graph for Congo Red



Percentage removal of dye is calculated as follows
 $\% \text{ removal} = (C_0 - C_e) \times 100 / C_0$ Where C_0 is the initial concentration of dye that is before adsorption and C_e is the final concentration of dye that is after adsorption

Adsorbent	% removal of Congo red
Bitter gourd seeds	32.5
Chickoo peels	52.5
Ridge Gourd peels	40

Adsorbent	% removal of Congo red
Yellow cucumber peels	25
Bitter gourd seeds activated carbon	45
Chickoo peels activated carbon	60
Ridge Gourd peels activated carbon	50
Yellow cucumber peels activated carbon	30

CONCLUSION

The results obtained for the study of adsorption properties of *Bitter gourd seeds*, *Chickoo peels*, *Ridge Gourd peels* and *Yellow cucumber peels* are in agreement with Langmuir and Freundlich adsorption isotherms. The maximum value of kL from Langmuir adsorption isotherms suggest that the chickoo peels having maximum adsorption potential for Congo red dye. The activated carbon derived from these biosorbents is found to be more effective adsorbent than their original forms. Maximum adsorption is found at PH 4-5. With increase in adsorbent dosage adsorption also increases. Time of adsorption is effective till 90 minutes.

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