Low cost adsorbents for the removal of pharmaceutical pollutants from aqueous solution: Thymine drug as a model

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Abstract

With the permanent rise of pollutants environmental, the threat to life human, fauna and flora too increasing. Removal of toxic pollutants by adsorption on Activated Carbon (Apricot stone) has shown immense potential. The experiments were carried out to drug uptake by Apricot stone activated by H₂SO₄. Deferent physiochemical parameters for example, contact time, initial Thymine drug concentration, weight of (AC) and temp. were investigated in system batch-adsorption. The equilibrium time at normal pH was found 2h. Result showed that the adsorption of Thymine drug increase with increase in primary concentration Thymine drug, and egestion time but decreases with the mass of AC, temp. of the method. The equilibrium data were estimated utilizing Freundlich, Langmuir isotherms. Langmuir, model best describes the uptake of Thymine drug. Study the adsorption of drug from aqueous solution detect the potential of AC to be used as an substitutional, cheap, and benign environmentally adsorbent for purification water. The concentration of Thymine drug was measured before and after adsorption via utilizing UV-Visible spectrophotometer at 360 nm.

Keyword: Adsorption, Pharmaceutical, Activated carbon, Removal, Thymine drug isotherm models.
Introduction

In last years, personal care products and pharmaceuticals (PCPs) have been repeatedly revealed in environment aqueous with varying concentrations from ng/L to μg/L due to their wide path use [1]. Generally utilized in human's life daily and industry, are released to several water methods [2, 3]. Virtually pharmaceuticals like antiepileptic, antibiotics analgesics exhibit false persistence [4, 5]. The appearance of PPCPs in water cause is an emerging worry, as PPCPs can happen disruption endocrine and toxicity chronic to human beings and aqueous microorganisms [6-8]. Activity biological and toxicity chronic therefore posing possible harmful effects to both aqueous organisms [9, 10]. Several treatment ways are obtainable to eliminate the pollutants. Amongst the treatment ways, adsorption consider one of the simple and greatest active ways. Maximum commercial adsorption treatment technologies usage activated carbon [11, 12]. Activated carbons trait a group of very rise fabricated material porous for functions specialized in vivid applications technological. The elastic carbon coordination chemistry and capability to chemically bond with several heteroatoms appear an edge through other materials porous. Activated carbons are collected of micro crystallites including sp2 hybridized carbon atoms arranged in hexagonal rings randomly stacked in planes parallel via Van der Waals interactions[13-15].

MATERIALS AND METHODS

Preparation solutions Thymine drug and Linearity of Calibration Curve.

Thymine stock solution (1000 ppm) were prepared freshly from aqueous solution of the drug pure in a volumetric flask of 1000 mL through dissolving 1 gm of Thymine drug in D.W. The law Beer's found to hold over the 10–90 ppm Thymine range concentration studied. Figure 1. presents a linear analysis regression of information attained from calibration graphs of the Thymine utilized from the relation A=a +bc, where A is the absorbance at the related peak in a 1.0 cm cell quartz, b and a are the slope and the intercept of the calibration graph, at the same order, and C is the conc. of Thymine drug (ppm).

Figure 1: Calibration curve of Thymine drug.
Effect of adsorption parameters

Preparation of Activated Carbon

Apricot stone, acquired Market Hilla in (Babylon/Iraq), crushed, washed with D.W to Polluted removal, after that activation by H₂SO₄ (20%) and dried via oven at 90°C for 6 hr. Then, it is activated in air hot oven at 300°C (3 hr), until pH reached 6.6–6.8 of activated carbon can be remove the free acid via washing the material with distilled water and dried at 102°C. The clean bio-mass are ground mechanically and sieved to obtain a powder low particle size[15].

Effect of Thymine drug concentration [10-90ppm]

About 0.05 gm from AC added to (10, 20, 30, 40, 50, 60, 70, 80 and 90 ppm) from drug putted in 100ml conical flask and utilizing shaker water bath at 30°C with stirrer constant for 2 hr.

Effect of temperature solution [10-50°C]

Study effect of temperature solution through stirring of variants temperatures solution (10, 30 and 50) °C, adsorbent amount 0.05 gm of AC and Thymine drug concentration 30ppm, 100ml utilizing water bath. The experiment was showed at pH 6.5, contact time at 2h a constant contact speed of 120 rpm.

The Effect of Weight Activated Carbon [0.001-0.1]

The effect of adsorbent amount was studied through agitating of several weight (0.01, 0.03, 0.05, 0.075 and 0.1,) gm, drug concentration (30 ppm) in 100 mL utilizing shaker water-bath at 30 °C. The experiment was showed at pH 6.5, contact time at 2h a constant contact speed of 120 rpm.

Result and Dictation

Effect of initial drug concentration

Fig. 2 appear effects of the several primary Thymine drug concentrations on the removal efficiency and adsorption capacity of AC. As appear, the adsorption capacity (Qₑ) decrease with decreasing primary concentration of Thymine drug, whereas the removal percentage(%) increasing with decrease primary concentrations drug. [16]. The removal of Thymine drug via adsorption on activated Carbon was create low rapid of the drug concentrations and then to down slow with increasing the concentration drug [17]. the removal of Thymine drug solution on to activated Carbon through adsorption rose quickly at the start and then gradually reduce speed at
equilibrium was reached. It might be explained that a great number of available active sites surface was obtainable for adsorption through the primary stage [18, 19].

![Figure 2: Effect of primary concentration on the amount of adsorbed and percent removal Thymine drug on to activated carbon (Exp. Con.: contact time 2 h, Temp. = 30°C, and pH 6.5).](image1)

**Effect the mass Activated Carbone**

study the effect of Activated Carbone amount on the Thymine drug removal at 30°C. Figure 3, shows the removal percentage(%) of Thymine drug increased with an increase in the activated Carbone amount (0.001–0.1g).It is apparent that through increasing weight of activated Carbone the amount of adsorbed Thymine drug increases but decreases adsorption efficiency, when increase the weight of adsorbent,. It is willingly agreed the number of obtainable adsorption active sites increases through increasing the activated Carbone amount and it, thus, data in an increase the mass of adsorbed drug [20-22].

![Figure 3: Effect of mass dosage on the adsorption of drug (Thymine) by the surface of AC. (pH of solution 6, Temp. 30 C, drug concentration 30 ppm).](image2)

**The Effect of solution temperature**
Study effect of temperature solution through stirring of variants temperatures solution (10, 30 and 50) °C, adsorbent amount 0.05 gm of AC and concentration Thymine drug (30ppm)in 100ml utilizing shaker water bath . appear in (Fig. 4). The results show percentage removal E% and the adsorption efficiency of Thymine drug on the surface adsorbent of AC depended of the solution temperature. it is appear adsorption efficiency and the percentage removal E% increased because the temperature solution increased. That removal percentage E% (24.48 -89.74%) , (55.1-95.91%) and (77.34-97.95%) adsorption efficiency (17.95-44.08mg·g$^{-1}$) , (19.18-99.18 mg·g$^{-1}$) and (19.59-139.22 mg·g$^{-1}$) at temperature (10-50) at the same order [21, 23].

![Figure 4](image_url)

**Figure 4**: Influence of resolution temperature on adsorption (Thymine drug) utilizing AC (a)Temp 10°C (b) Temp 30°C (C) Temp 50°C

**Models of Adsorption Isotherm**

To study the factors dependence of the adsorption efficiency, two equilibrium isotherm were analyzed, counting Freundlich and Langmuir. The models imitation utilizing an iterative procedure founded on a nonlinear leastsquares algorithm. The Langmuir adsorption model equation,: [24, 25]

$$q_e = \frac{q_\text{max}KLC_e}{1+KLC_e}$$

where $q_e$, application at equilibrium (mg /g), $KL$ the constant Langmuir (L mg$^{-1}$), $q_{\text{max}}$ the monolayer adsorption efficiency (mg /g) and $C_e$ the concentration solution.
at equilibrium (mg L\(^{-1}\)). equation of the Freundlich is related for multi component adsorption. The Freundlich model is expressed through[26, 27]:

\[
q_e = K_f C_e^{1/n}
\]  

(2)

where \(K_f\) : Empirical constant Freundlich or factor capacity (L.g\(^{-1}\)) and n is the Freundlich exponent.

The Results of this model are appear in Fig. (5), and constants Langmuir are illustrated in Tables (1).

![Figure 5: The adsorption isotherm of Thymine drug (pH 6, Temp. 30 °C, mass dosage 0.05 gm/100 ml, t = 2 h, agitation speed = 120 rpm)](image)

### Table 1: model of Langmuir and Freundlich, models factors for Thymine drug on the of Apricot stone (AC) at 30 oC.

| Isotherm models | Parameters | Thymine drug |
|-----------------|------------|--------------|
| Langmuir        | qm (mg·g\(^{-1}\)) | 129.26 ± 3.7511 |
|                 | KL (L·mg\(^{-1}\)) | 0.3386 ± 0.03308 |
|                 | \(R^2\)     | 0.9902       |
| Freundlich      | Kf          | 41.177 ± 4.1648 |
|                 | 1/n         | 0.3543 ± 0.04212 |
|                 | \(R^2\)     | 0.9408       |

### Conclusion

The equilibrium adsorption of the Thymine drug onto Apricot stone (AC) surface was studied in a batch mode process for the factors primary concentration of the drug, temperature solution, and amount of adsorbent. The results appeared that adsorbent mass inversely affected the adsorption capacity of activated carbon, while
the adsorption capacity increased with increasing primary concentration of the drug. The adsorption equilibrium model was investigated via Langmuir, Freundlich, model equations. All the parameters effective give good fitting of Langmuir isotherm better than Freundlich models because suggests that adsorption is heterogeneous in nature.

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