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REMOVAL OF PHENYLEPHRINE HYDROCHLORIDE AS A MODEL OF PHARMACEUTICAL COMPOUNDS BY USING ULTRASONICATED ADSORPTION TECHNIQUE IN THE PRESENCE OF NANO COMPOSITES

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Abstract

Pharmaceuticals are significant type of contaminants and cannot equable be special through the human eye. elimination of Phenylephrine hydrochloride (PHE) drug in invaluable water exchequer must be evade, however, that different treatment technologies are in utilize. different adsorption process consider eminent place to removal drug. The rising request for effective and low-cost treatment procedures and the meaning of adsorption has given rise to low-cost substitute adsorbents (one type of Carbon Sugar (Sucrose) decorated Bentonite clay supported Fe_2O_3 Micro/Nanocomposite). The effect of various factors for example premier concentration Phenylephrine hydrochloride (PHE) drug (2-100 mg L-1), primary pH 2-11 of aqueous solution and mass (0.001-0.15 g) on the adsorption of Phenylephrine hydrochloride (PHE) drug were investigated.

Key word : Adsorption, Pharmaceuticals, Phenylephrine hydrochloride (PHE) drug, Ultrasound, Bentonite clay.

Introduction

Provision water to save the planet and to make the future of mankind unscathed is what we requirement at present With the development of mankind, community, technology, science, our world is arrive to new, rise horizons but the cost which we are paid or will paid in future is certainly also very high (Fazelirad, Ranjbar *et al*. 2015). through result of this immediate growth is ecological defect with a large contamination problematic. Besides other necessarily the request for water (''Water for Life Water for People'' United Nations World Water Development Report UNESCO) (Baskaralingam, Pulikesi *et al*. 2006; Ruwaida A Raheem 2016; del Mar Orta, Martn *et al*. 2019). Adsorption method is in general utilized for removal of oil, odor, organic contaminants and colors, chiefly from a phase liquid system, in order to it is considered an active path to remove drug from wastewater, since it is not devastating and simple to stratify (Alkaim, Zainab *et al*., 2015). The method cost for removal drug by adsorption lies fundamentally on the cost of the regeneration of adsorbent and adsorbent. Clays are very good replace for costly mercantile activated carbon utilized in adsorption processes (Aljeboree and Alshirifi, 2012; Alkaim, 2017; Enas M. Alrobayi, 2017) usually the low-cost adsorbents consider a low removal of drug. In organization these clay minerals have many advantage over other low cost adsorbents such as archaically, high adsorption capacity, ion exchange capability, surface area, surface characteristics, mechanical and chemical stabilization and various structural (Aljeboree and ALSHIRIFI, 2018; Aljeboree, Alkaim *et al.*, 2015).

In opinion of this study, we will describe and locate key method parameters: adsorbent mass, solution of pH and primary drug concentration,. The experimental data will be appraised by Langmuir and Freundlich adsorption isotherms.

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Materials and Methods

Adsorption experimental procedures and measurements

The effects of experimental parameters, primary (PHE) drug concentration (2-100 $mg.L^{-1}$), pH solution (2-11), adsorbent mass(0.001-0.15 g), on the drug adsorption was investigation in a batch mode of process

for a contact time of 1h. The impact of pH was calculated by adjusting the pH of the drug PHE solution via adding 0.1 N HCl or 0.1 N NaOH. using centrifugation the solution and solid phase were separated at 2000 rpm for 15 min in a Hettich EB 21 centrifuge, reiterated two times to assure there is no particles dispersed the absorbance measurements and analyzed utilize a UV-vis spectrophotometer at a wavelength of 272 nm. The conc. retained in the adsorbent phase (qe/ $mg.g^{-1}$) was calculated through by utilizing equation (1):

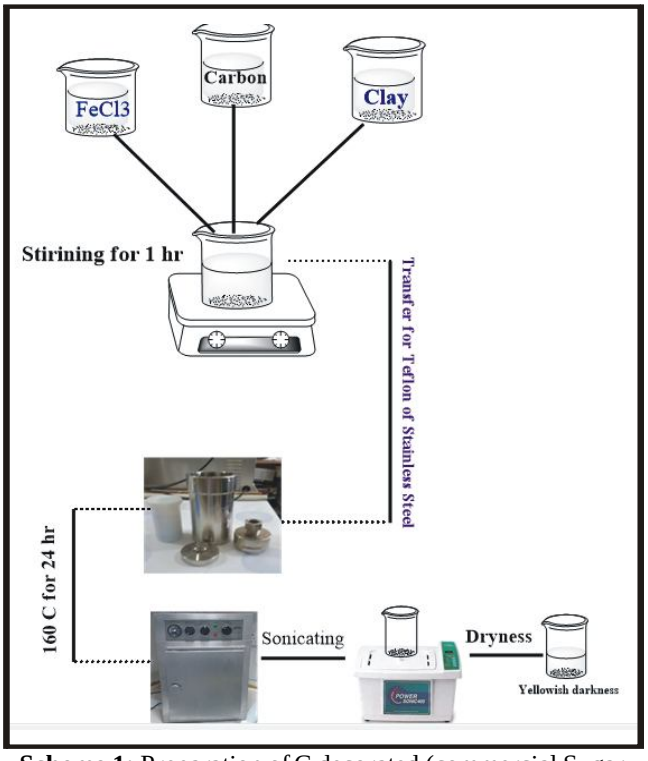
$$qe = (Co - Ce) V / W \quad (1)$$

Co the concentration of the primary drug and Ce the concentration of the equilibrium drug ($mg.L^{-1}$), W weight of the adsorbent (g), also the percentage of drug removed (E%) from solution was calculated using the following equation:

$$(E\%) = (Co - Ce) / Co \times 100 \quad (2)$$

Preparation of C Decorated (commercial Sugar (Sucrose) commercial Sucrose; Clay(Bentonite) / Fe_2O_3 Micro/Nanocomposite

Nanocomposite (C decorated / Clay(Bentonite) supported by Fe_2O_3) were prepared by using hydrothermal process (Scheme (1)). 5 g of clay (Bentonite) and 1g of commercial Sugar (Sucrose) were maxed. The mixture was added to basic solution of $FeCl_3$ (0.2 mol/L). then complete to 100mL with distilled water then mixed for 1hr to get slurry solution. The resultant mixtures were kept at 160oC for 24 hr., in an autoclave. The obtained dark brown precipitate was filtered, washed with distilled water and ethanol then sonicated in 10 min. intervals then dried at 80°C for 24 hr. to get a fine powder.



Scheme 1: Preparation of C decorated (commercial Sugar (Sucrose)) Clay (Bentonite) /Fe_2O_3 Micro Nanocomposite

Table 1:XRF analysis of Bentonite Clay.

524-4	L.O.I.	MgO	Al2O3	SiO2	P2O5	SO3	Cl
(%)	81.97	0.033	0.099	16.379	0.026	0.351	0.046

K2O	CaO	Fe2O3	Ni	Zn
0.099	0.188	0.755	0.007	0.046

Traces: Sr Pd

Table 2: XRF analysis of commercial Sugar (Sucrose) decorated/Bentonite clay supported Fe_2O_3.

524-2	L.O.I.	Na2O	MgO	Al2O3	SiO2	P2O5	SO3
(%)	41.51	0.064	2.813	8.744	34.361	0.497	0.091

Cl	K2O	CaO	TiO2	MnO	Fe2O3	Ni	Zn
0.012	0.436	6.836	0.591	0.011	3.943	0.01	0.069

Sr	Zr
0.008	0.005

Traces: Cu Rb

Results and Discussion

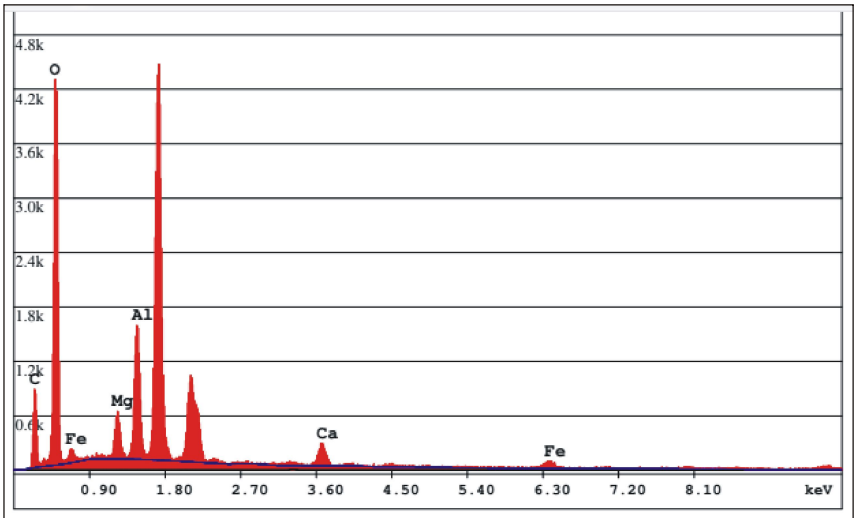
Characterization of The Preparation C /Decorated /Clay(Bentonite) / Fe_2O_3 Micro/Nanocomposites

- **Chemical Composition (XRF) Analysis :**

XRF analysis consider a very important technique for determination percentage of oxide in a mixture, results are shown in table 1. An evident increase in Fe_2O_3 content indicates Fe species had been loaded on bentonite for all sample were decorated by C substrate, the highest value

Table 3: Langmuir and Freundlich, isotherms factors for PHE drugs adsorbed onto (Clay(Bentonite) / commercial Sugar (Sucrose) at 25°C.

Phenylephrine hydrochloride		
Clay /sugar	**Parameters**	**Isotherm models**
96.3423±8.4535	qm (mg/g)	Langmuir
0.07688±0.01434	KL(L/mg)	
0.9817	R^2	
11.86336±0.50554	K_F	Freundlich
0.5240±0.01499	1/n	
0.99704	R^2	



EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	19.04	28.62	0.0498	1.0440	0.2506	1.0006
O K	48.96	55.25	0.1653	1.0266	0.3286	1.0005
FeL	12.01	3.88	0.0327	0.8801	0.3095	1.0004
MgK	4.04	3.00	0.0180	0.9850	0.4508	1.0024
AlK	10.88	7.28	0.0585	0.9561	0.5623	1.0003
CaK	2.63	1.18	0.0249	0.9549	0.9807	1.0112
FeK	2.45	0.79	0.0215	0.8673	1.0113	1.0000
Total	100.00	100.00				

Fig 1: EDX analysis of commercial Sugar (Sucrose) /Clay (Bentonite) /Fe_2O_3.

of Fe_2O_3 (3.943%) percentage is shown in table 2 this attributed to exist of a higher percentage if the pristine of Sugar (Sucrose) sample (Ahmed, Raheem *et al*., 2017).

Energy Dispersion X-ray

EDX is a versatile technique used for qualitative and semi-quantitative analysis, it was noted that the iron in the clay (Bentonite) was increased in the presence of carbon and Fe_2O_3 impetration. For pristine clay (Bentonite), it showed larger particle size and unequal particles due to stacking of flaky materials in comparison to the treatment with hydrochloric acid and sodium chloride where these particles were disaggregated to smaller flakes and a clear microstructures difference distinction (Fig. 1).

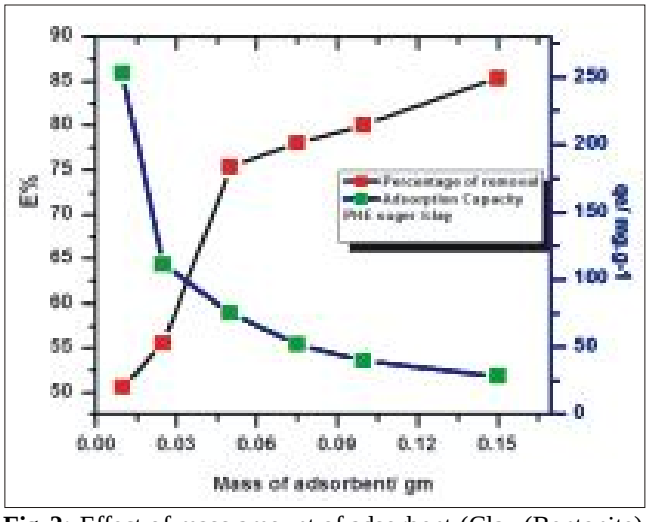


Fig. 2: Effect of mass amount of adsorbent (Clay (Bentonite) / commercial Sugar (Sucrose)) nanoparticles.

Applications of Prepared Nanocomposites

• Effect of adsorbent dosage:

Adsorbent dose variation showed that although increasing of weight of mass composite in aqueous solution lead to increase drug removal. The plot of percentage removal (E%) of PHE drug against the weight of C decorated (commercial Sugar (Sucrose)) Clay (Bentonite)/Fe_2O_3 Micro/ Nanocomposite. From fig. 2, it is observed the percentage of adsorption is rises with increasing the mass. This might be reflected to surface area increase of the Micro/Nanocomposites, that increases the binding sites. There is a very large adsorption at higher dosage on the adsorbent surface that improved drug uptake. (Aljeboree, 2019; Aljeboree and Abbas, 2019; Yazidi, Atrous *et al*., 2020).

Effect of Initial Drug Concentration

In this study, the initial concentrations of the (PHE)

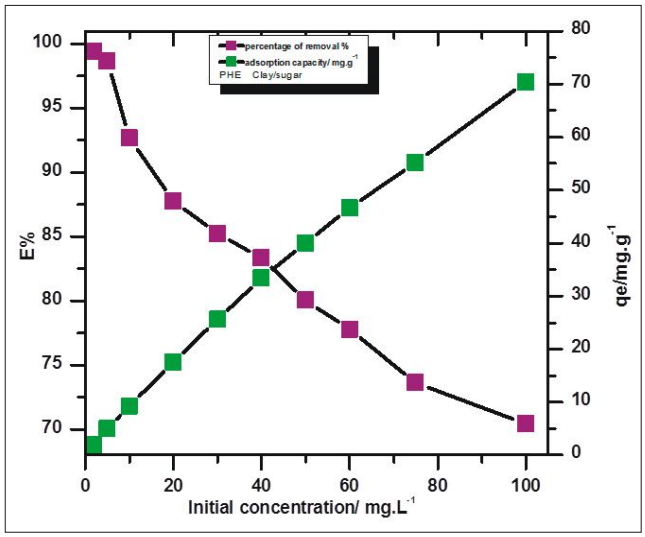


Fig. 3: Effect of primary concentration on the amount of adsorbed and percent removal PHE drug onto *Clay(Bentonite) / commercial Sugar (Sucrose)* (Exp. Condition: agitation time 1 h ,Temp. = 25°C,pH 6).

drug were removed by using surfaces Clay (Bentonite) / commercial Sugar (Sucrose) nanoparticles. The adsorption amount for removal of drug depends on the initial concentration of drug and the adsorbent surface available sites. The effect of initial drug concentration on the removal of drug by Micro/ Nanoparticles is fig. 3 presents the removal efficiency versus drug concentration. The drug removal percentage decreases with drug concentration increase due to reduction in adsorption for the lack of available active sites. The adsorption capacity ((qe) mg/g) is proportional with initial drug concentration as the drug uptake resistance decreases with the increase in drug concentration. The adsorption rate also increases with the increase in the drug initial concentration due to driving force increase (Cardoso, N.F., 2011; Alkaim and Alqaragully, 2013; Ahmed M. Kamil, 2016; Aljeboree, 2019).

Effect of pH solution on PHE drug:

Effect the solution pH onto adsorption of PHE *via* the Clay (Bentonite) / commercial Sugar (Sucrose) is found in fig. 4. The solution pH onto adsorption of PHE drug was studied in solution pH choice 2-11. The pH solution would affect both surface binding-sites and aqueous chemistry of the adsorbent. The equilibrium sorption capacity was minimum at pH 2 (11.5 mg/g) and up to pH 6 increase, to reached maximum (41.34 mg/g). The absence of sorption at low pH can be explained by the fact that at this acidic pH, H+ may compete with PHE drug ions for the adsorption sites of adsorbent, thereby inhibiting the adsorption of drug. At higher pH solution, the Clay (Bentonite) / commercial Sugar (Sucrose) may get negatively charged, which improves the positively charged drug cations through electrostatic

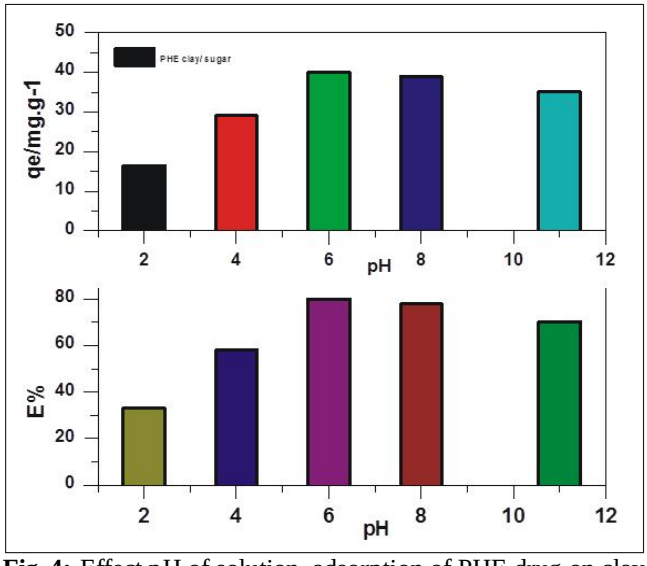


Fig. 4: Effect pH of solution adsorption of PHE drug on clay (Bentonite) / commercial Sugar (Sucrose).

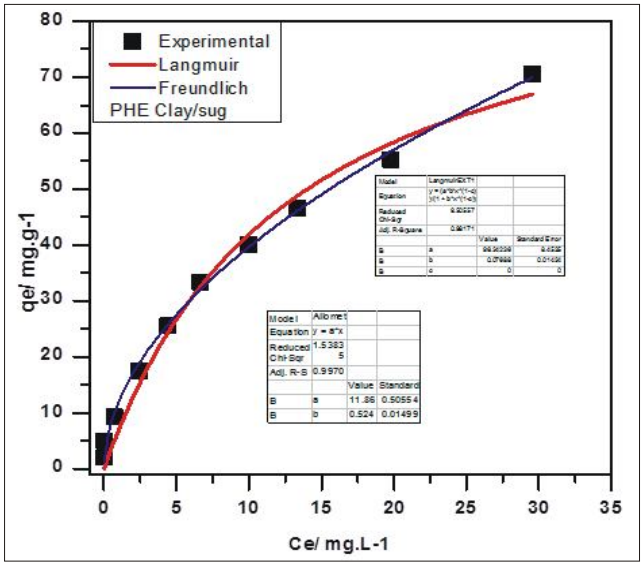


Fig. 5: Nonlinear fit of several adsorption isotherm for adsorption of pHE drug on (Clay(Bentonite) / commercial Sugar (Sucrose)) primary conc. = 50 mg/L, Temp. = 25°C, agitation time 1 h, and adsorbent mass 0.1 g/L.

forces of attraction (Alkaim and Alqaragully, 2013; Aljeboree, 2019; Aljeboree, 2019).

Adsorption Isotherms

• Freundlich Isotherm:

The Freundlich isotherm is defined through the follows equation 3 (Freundlich H 1939).

$$q_i e = K_i f\, C_i e^{\uparrow}(1/n) \quad (3)$$

Kf: capacity factor (L/g) or Experiential Freundlich constant or the drug quantity adsorbed for unit equilibrium concentration, 1/n: Freundlich exponent, if the value of n is like to unity, the adsorption is linear; if under to unity, then adsorption method is chemical and if the value is above unity, then adsorption is a physical method (Kim and Kim, 2019).

Langmuir Isotherm:

The isotherm Langmuir mostly utilizer for pollutants adsorption from liquid solution. The nature of the adsorption method was derived by Langmuir alternative equation 4 (Langmuir, 1918).

$$q_e = \frac{q_m K_L C_e}{1 + K_L C_e} \quad (4)$$

qe: amount adsorbed per unit weight of adsorbent at equilibrium (mg/g), Ce: concentration equilibrium of adsorbent in solution after adsorption (mg/L), qm: Empirical Langmuir constant which represents maximum adsorption capacity (mg/g) KL: empiricial Langmuir constant (L/mg) or the equilibrium constant of the adsorption reaction (Zaheer, Al-Asfar *et al.*, 2019).

A plot of qe versus Ce (Fig. 5) where the values of KF and 1/n are obtained from the intercept and slope of the linear regressions (Table 3).

Conclusion

The adsorption equilibrium of the PHE drug onto (Clay (Bentonite) / commercial Sugar (Sucrose) investigation in a batch mode process of the factors premier the concentration drug PHE, solution of pH, mass dosage. The data appeared the adsorption of PHE drug give good removal increased with increase in premier PHE drug concentrations, The isotherms equilibrium was analyzed via Freundleich, Langmuir model equilibrium. The Freundlich (R2 = 0.99704) is the best isotherm that described the adsorption process and then followed Langmuir isotherms. Isothermal results showed that PHE drug adsorption was favorable on (Clay (Bentonite) / commercial Sugar (Sucrose) and followed multilayer adsorption.

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