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Evaluation of Adsorption Isotherms of Freundlich, Temkin and Langmuir of Loratadine Drug on Multi-walled Carbon Nanotube

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ABSTRACT

This research has studied equilibrium adsorption isotherms of Loratadine as a drug on carbon nano-tube. And also results of experiments through Freundlich, Temkin and Langmuir models have been studied and it has found different parameters of these models for carbon nano-tube absorbent. According to the error rate for each model, we obtained a good agreement between these data which it showed the best agreement by Langmuir model. With the spectrophotometer (UvVis); it obtained the adsorption diagram based on wavelength for Loratadine. Experimental result showed that by increasing concentrations of Loratadine therefore adsorption rate will increase too. The highest adsorption rate is for 5 ppm concentration of Loratadine.

Key words: Isotherm, Adsorption, Multi – Walled Carbon nano-tubes, Loratadine.

INTRODUCTION

Carbon nanotubes (CNT) discovery by Iijima in 1991[1]. Carbon nanotubes (CNTs) are hollow cylinders of graphite carbon atoms. These tubes are on the nanoscale (10^{-9} m), which is so small that 10,000 of them could fit within the diameter of one human hair. Carbon nano-tubes are a new form of carbon with unique electrical and mechanical properties. They can be considered as the result of folding graphite layers into carbon cylinders. These cylinders may be composed of single shell single wall carbon nanotubes (SWCNTs), or of several shells multi-wall carbon nanotubes (MWCNTs). CNTs can be thought of as a rolled-up sheet of hexagonal ordered graphite formed to give a seamless cylinder. Due to the variety of extraordinary properties exhibited by CNTs, a large number of possible applications have been proposed[2-3]. Recent discoveries of various forms of CNTs have stimulated research on their applications in diverse fields[4]. The nature of bonding in carbon nanotubes (CNTs) is described by applied quantum chemistry, specifically, orbital hybridization. This chemical bonding is composed entirely of sp2 bonds, similar to those of graphite. This bonding structure, which is stronger than the sp3 bonds found in diamond, provides the

molecules with their unique strength. CNTs are the strongest and stiffest materials on earth, in terms of tensile strength and elastic modulus respectively. This strength results from the covalent sp^2 bonds formed between the individual carbon atoms. As for thermal conduction, the CNT surpasses even that of diamond, reaching almost double the value diamond[5]. Carbon nanotubes (CNT) possess many unique characteristics that promise to revolutionize the world of structural materials resulting in significant impact on our capability to build lighter, smaller and higher performance structures for aerospace and many other industrial applications. Based on its unique properties, many applications of CNT have been proposed including quantum wires, tiny electronic devices[6-8]. Loratadine is a white to off-white powder not soluble in water, but very soluble in acetone, alcohol, and chloroform. It has a molecular weight of 382.89, and empirical formula of $C_{22}H_{23}ClN_2O_2$. Loratadine is a second-generation H_1 histamine antagonist drug used to treat allergies. Structurally, it is closely related to tricyclic antidepressants, such as imipramine, and is distantly related to the atypical antipsychotic quetiapine[9].

MATERIAL AND METHODS

Substances

Ethanol (Purity %96) as solvent , Loratadine and adsorbent carbon nano-tubes with a diameter of the outer surface 5-10 nm space 40-600 m^2/gr and high purity merck 95% of the company .

Devices used

Spectrophotometer (Uv-Vis) model Lambda 25 perkin elmer

Methods

At first, stock solution of Loratadine was prepared in ethanol (50 mg/l). Then , from stock solution of Loratadine, four standard solutions in concentration of 2,3,4,and 5ppm were prepared . Certain quantities of carbon nano-tube
(0.01 g) have been added as absorbent to 100 mL glasses containing 10 mL Loratadine solution, then it was stirred by mixer for 24 hours (optimal time).After mixing process then the solution should be put into 10000 rpm speed for 20 minutes until the solid and liquid phases are separated. Loratadine concentration was measured before and also after adsorption by spectrophotometer and calibration curve was plotted. All tests have been performed at the lab with the temperature of(C° 2 ± 22).

RESULTS AND DISCUSSION

Table (1) shows the amount of Loratadine in the absence of carbon nano-tubes on the solvent ethanol at wavelengths 257(λ_{max}=257nm) on the ethanol solvent. Figure (1) shows the amount of adsorption of Loratadine with different concentrations without the presence of carbon nano-tubes with some walls. As was shown with increasing concentrations of Loratadine adsorption rate increases so that so that we see the most

Table 1: The adsorption of Loratadine in absent of carbon nanotube

Concentration	Adsorption
2	0.396
3	0.557
4	0.679
5	0.847

Table 2: The amount of Loratadine on 0.01 grams of carbon nano-tubes

Concentration	Adsorption on0.01 gr carbon nanotube ($mg.g^{-1}$)
2	1.94
3	2.83
4	3.42
5	4.13

Table 3: Experimental results obtained from the isotherm data

	Temkin	Langmuir	Freundlich
Ketotifen	R^2=0.968	R^2=0.984	R^2=0.964
	1/n=0.259	$1/q_m$=0.228	B=0.744
	lnk_f=1.431	$1/q_{mb}$=0.021	BlnA=4.066

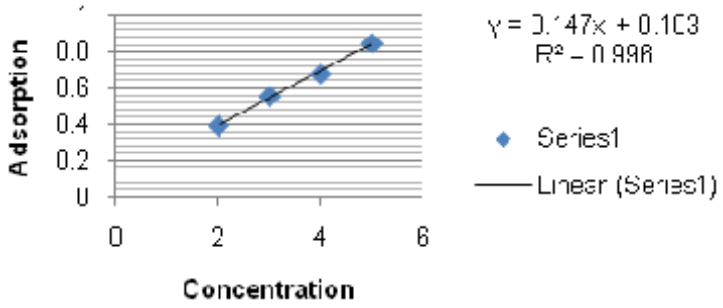

Fig. 1: Adsorption rate without nano-tube Loratadine

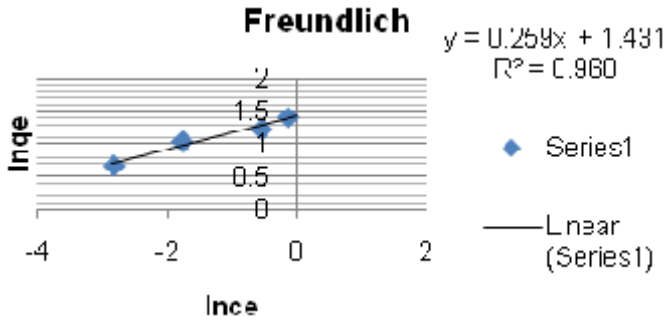

Fig. 2: Loratadine adsorption diagram based on Freundlich

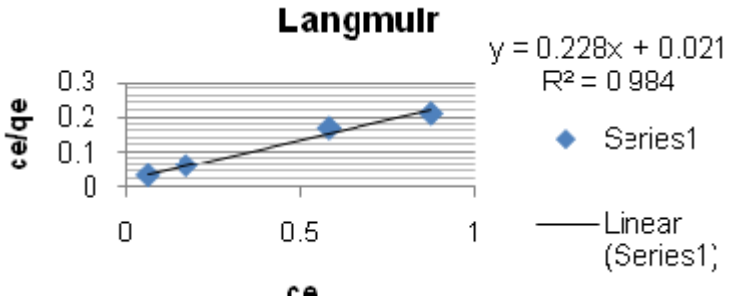

Fig. 3: Adsorption diagram of Loratadine based on Langmuir model

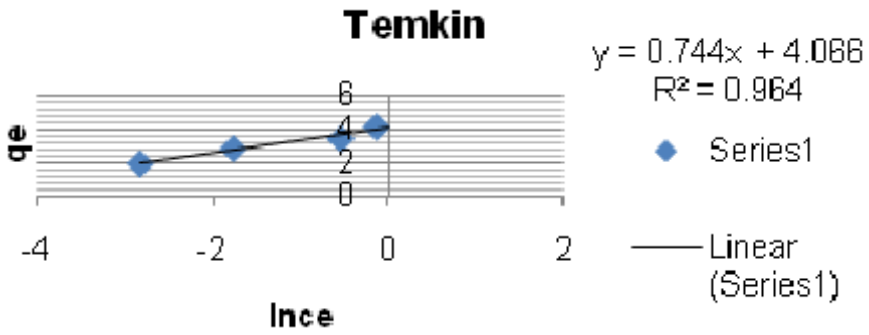

Fig. 4: Adsorption diagram of Loratadine based on Temkin model

adsorption in 5 ppm by using the figure (1) and Table (1) kit can be calculated the adsorbed Loratadine (0.01 g) on that carbon nano-tubes in table (2) **.**

Freundlich adsorption isotherms

This model often shows homogeneous absorbent non-adapted hub with experimental data[10-12]. Freundlich adsorption isotherms equation is described below:

$$q_e=k_f c_e^{1/2} \quad ...(1)$$

q is adsorbate rate in term of mgg^{-1} and ceq,1/n & kf are adsorbate concentration into solution at the balance moment, from Freundlich constants respectively. These constants are the adsorption severity and adsorption capacity respectively .The following part shows the linear equation:

$$\ln qe=\ln kf+1/n \ \ln ce \quad ...(2)$$

To calculate the constants of Freundlich equation, we draw (lnqe) curve in term of(lnce) according to the presented equation (eq.2) .It is found that if its value (slope of this curve -1/n – is greater therefore the adsorption amount is more too. Here are the related diagram in figure 2 and 1/ n- kf parameters at the table 3.

Langmuir model

This model is identical with the energy being adsorbed all the sites on the adsorbent surface obtained [9]. with the following equation

$$q=\frac{q_m bCeq}{1+bC_{eq}} \quad ...(3)$$

Here q is the amount of dissolved adsorbate (mgg-1),Ceq,qe is dissolved concentration in the balance moment b and qm are Langmuir constants.qm is adsorption balance constant and b is also adsorption capacity and a saturated respectively. We can obtain the following relation by rearranging of equation(3):

$$\frac{1}{q}=\frac{1}{q_m}+\frac{1}{q_m bc_{eq}} \quad ...(4)$$

To calculate Lagmuir relation constants; we draw Ce/qe curve in term of Ce which here 1/ qm,1/ qmb are slop and width of origin respectively Corresponding graph (Fig. 3) and parameters KL and qm, respectively, represent the maximum energy adsorption and is absorbed in the Table 3.

Temkin isotherm

This model is considered to interact with the adsorbent material by self adsorption which is obtained[8]. With the following equation:

$$qe = RT/b \ \ln(ACe) \quad ...(5)$$

By Considering RT/b=B A linear form of Temkin isotherm will be as following

$$Qe=B1\ln A+B1\ln Ce \quad ...(6)$$

In this relation, A (L / mg) is equal bond constant relate to mlent maximum bond energy. B (J / mol) is Temkin isotherm constant and proportional adsorption therm. Adsorption data can be derived form equation (6).

CONCLUSION

In this study we obtained the adsorption isotherms of Loratadine by carbon nanotube. The present research showed that the concentration of carbon nano-tubes of 0.01 grams to adsorb Loratadine has higher efficiency .The parameter that includes Loratadine concentration and type absorber has a strong impact on the efficiency of adsorption. 5ppm concentration reaches its maximum and the constants associated with this isotherm and the correlation coefficient R2 in a linear form in three Tables 3 is given. Based on the correlation coefficient, the Langmuir isotherm has the highest value so Loratadine obeys the Langmuir isotherms.

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