Study of Thermodynamic Variables to Adsorption of Aldomete Drug (Methyldopa) from its Water Solution on the Nano Zinc Oxide Surface

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ABSTRACT
The experiment was carried out to study the adsorption of aldomete on the surface of nano zinc oxide and its effectiveness in drug adsorption which causes poisoning in the case of doses exceeding the usual doses. UV spectroscopy technique was used to follow the concentration of the drug in the water solution after mixing it with 0.1 g of nano zinc oxide, and different solutions of the drug were used to obtain the adsorption isotherm and tested the applicability of the Langmuir and Freundlich equation for isotherm of the adsorption. The effect of temperature was investigated within the range (298 - 328) Kelvin and the best temperature was 298 Kelvin. The effect of time was also investigated within the range (30-180), and it was found that the largest amount of adsorption at time was 180 minutes. The adsorption was studied at pH = 1 and the thermodynamic functions (ΔG, ΔH, ΔS) were calculated, and the effect of ionic intensity on adsorption was studied by adding (0.1 M) of potassium chloride, it was found that the amount of adsorption of the drug on the surface of the nano zinc oxide increased with the presence of salt and showed the study of the ability of nano zinc oxide to adsorption the drug with high efficiency.


INTRODUCTION
The state of drug poisoning is produced when the drug is taken in a quantity above the dose or for long periods which sometimes leads to death1, and an effective way to treat cases of poisoning caused by excessive medication is the adsorption on the nano surfaces as a modern and effective means as these nanoparticles have distinct properties including high susceptibility to ion exchange2-5 and high surface area which increase the pore size6,7 which gives them the potential and high efficiency of adsorption of large molecules8,9, high absorption10 and the lack of toxicity11, so we absorbed Aldomete drug on the surface of nano zinc oxide and It is a white powder to Insoluble in water12. It has a high stability in its physical and chemical properties13. So, it is used in many fields, including the ceramic industry14, pharmaceutical and cosmetic industries15, sensor industry16, electronics17, absorption of radiation and adsorption18 and a catalyst as well as a non-toxic nature19. Aldomete drug is a scientific name is Methyldopa and it is one of the most common medications for lowering blood pressure, it is an antihypertensive medication and alpha-adrenergic receptor inhibitor, It is also an alpha-2-adrenergic receptor catalyst, and it works by stimulating the alpha receptors in the brain making it send nerve signals in the blood vessels which works to widen and relaxed it, leading to lower blood pressure, blood can flow easily through the body.

The chemical formula of the drug is (C10H13NO4), and its molecular weight (211.21g / mol). The structural formula as in figure (1), it is a crystalline powder of white to yellowish white or sometimes colorless crystals, it is odorless and tasteless, often dissolved in water20,21.

Practical part
Devices used
The visible-UV spectrometer, type: Apple (PD-303 U.V.) Spectrophotometer Germany in Karbala University
PH-Meter –WTW-720-Ionlab Germany.
Themostated Shaker Bath has a temperature controlled: Themostated Shaker Bath, GFL (D-3006) Germany.
Centrifuge: Megafuge 1.0, Herouse Sepatech, Germany.
Electric sensitive balance with four decimal places: Electric Sensitive Balance, Sartorius medeian, Lab. BL 210 S, Germany.

Materials used
Potassium chloride: KCl Fluka - Garantie, Switzerland
Hydrochloric acid HCl: BDH Chemical, ltd. poole, England
Aldomete drug: Iraq SDI
Nano zinc Oxides: Mknano, Mississauga, Canada.

Work methods
Determination of the wavelength of the aldomete and calibration curve: To determine the maximum wavelength at which the highest absorption occurs. (λmax) The absorption spectrum of Aldomete was taken using the
UV-visible spectrometer within the range (250 - 1100) nm, and the maximum wavelength (280) nm as in Fig (2).

The calibration curve, which represents the relationship between absorption and concentration, was determined by preparing five consecutive concentrations within the range of 10 - 50 ppm of the Aldomet solution used in the study. The absorption of these concentrations was measured at the maximum wavelength (λ_{max}) Between

Figure 1: Structural formula of Aldomet drug.

Figure 2: UV spectrum of the Aldomet drug at λ_{max}=280nm.

Figure 3: Curved calibration of Aldomet solution at λ_{max}=280nm.
absorption and concentration as shown in Figure (3).

**Determination of the equilibrium time**

To determine the equilibrium time between the solvent surface and the absorbent material, 0.1 g of nano oxide was put in contact with 25 mL of aldomet solution at a concentration of 10 bermalon at 303 kV and the absorbance was followed at different times (30, 60, 90, 120, 150, 180 minutes) and found that the equilibrium time of the drug 180 minutes.

**Adsorption isotherm**

The adsorption isotherms were determined by taking (0.1) g of nano zinc oxide surface in contact with 25 mL of the water solution of the drug for each concentration within the range (10-50 ppm) and then placed in a water bath.
Table 5: Values of ΔH, ΔG and ΔS of aldomete on the surface of nano ZnO at a temperature of 298 K.

<table>
<thead>
<tr>
<th></th>
<th>ΔH  (KJ.mol(^{-1}))</th>
<th>ΔG  (KJ.mol(^{-1}))</th>
<th>ΔS  (J. mol(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.02</td>
<td>4.87</td>
<td>-3.72</td>
</tr>
</tbody>
</table>

with shaker and stabilized temperature at 298k. Upon reaching the pre-determined equilibrium time, the solution was then placed in the centrifuge at 3000 cycles per minute. The solutions were then filtered and measured using UV spectrometer. The quantity of the absorbent substance (Qe / mg / g) was calculated according to the following relationship:\(^{22}\):

\[
Qe = \frac{(c_0 - c_e)v_{sol}}{m}
\]

Effect of temperature: For the purpose of studying the effect of temperature in adsorption isotherm study of drug adsorption isotherm in successive temperatures is (328, 318, 308, 298) Kelvin.

Figure 6: shows the effect of temperature on adsorption of aldomete drug on the surface of nano ZnO in experimental range (298 -328) K at PH=1.

Figure 7: Log Xm vs. 1 / Tk of nano aldomete on ZnO surface

To study the effect of ionic intensity on adsorption, a concentration of potassium chloride (0.1M) was prepared and the isotherm adsorption study of the drug solution and compare them with the pharmaceutical solution that free of potassium chloride.

**RESULTS AND DISCUSSION**

*Isotherms of the adsorption*

A study of the adsorption of the aldomete drug from water solution on the surface of nano zinc oxide was conducted, and the corresponding absorbed quantity was calculated for each value of equilibrium concentrations at different concentrations and PH = 1, which represents the value of the optimal acid function of the stomach and a temperature of 298 K as adsorption of different forces on different parts of the surface. The adsorption capacity is also reduced by increasing the covered portion of the surface. We observe that adsorption increases with increasing concentration of equilibrium\(^{23}\) of the results.
shown in Table (1) and Figure (4), it is observed that it follows the Freundlich equation to give it a linear image by drawing values (logQe) against (logCe)And follow the Langmuir equation to give it a linear relationship when drawing (Ce / Qe) against (Ce) As in Figure (5).

**Effect of temperature**

A study of the effect of temperature in adsorption of aldomete drug on the surface of nano zinc oxide was conducted in the experimental thermal range (298-328) K. The results in Table (2) and Figure (6) indicate that the adsorption of the drug decreases by increasing the temperature and this applies with the thermodynamic properties. The highest absorption was found at 298 K, and through the negative ΔΗ value, we find that the process is exothermic, this indicates that the process is only adsorption and it indicate that the adsorbed molecules that are diffused on the surface and are reduced the speed their diffusion, resulting in reduced interaction between the surface and the absorbed molecule.

As the temperature increases, the bonds will be separated. HH is calculated from the log xm logarithm versus the inverted temperature of 1 / T as in Table 3 and Figure 7 according to the following equation:

\[
\log \text{xm} = -\frac{\Delta H}{(2.303 RT)} + \text{conc} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ ld
catalyst gives additional stability to the effective site versus the electrostatic interference.

CONCLUSIONS
Can benefit from the Nano zinc oxide to treat the poisoning of aldomete. It was found that the adsorption isotherm on the Nano zinc oxide followed Freundlich formula. The drug adsorption is exothermic and non-automatic. Adding salt increases the adsorption of the drug on the surface.

REFERENCES

Figure 9: Effect of ionic intensity of aldomete drug adsorption on the surface of nano ZnO at 298 k and at pH = 1.
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