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International Journal of Current Research
Vol. 6, Issue, 03, pp.5399-5402, March, 2014

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

ADSORPTION OF SOME ALBUMINS ON CHARCOAL DERIVED FROM OLEASTERSEED

***Abbas Hmood Al-Khafajy**

Chemistry Department, Faculty of Education for Women, Kufa University, Al-najaf al-ashraf, Iraq

ARTICLE INFO

Article History:
Received 12th December, 2013
Received in revised form
19th January, 2014
Accepted 03rd February, 2014
Published online 25th March, 2014

Key words:

BSA, EWA, Adsorption, Isotherms, Thermodynamic, Parameters.

ABSTRACT

The In recent years many researchers has been focused on the use of biomass residues as low cost and locally available adsorbents for the removal of different organic and inorganic chemicals by the adsorption process. In this study the powder of Oleaster Seed were used in their charcoal form for the removal of Bovine serum Albumin (BSA)and Egg white Albumin(EWA)from aqueous solution. Various experimental parameters such as BSA and EWA concentrations, contact time, adsorbent dose, pH and temperature were studied to establish the conditions for the removal of BSA and EWA. Isotherm data were fitted to the Langmuir and Freundlich adsorption isotherm equations. Results showed that the maximum extent of adsorption occurs in pH=5 and pH=3 at a temperature of 302K for Oleaster Seed charcoal respectively. Thermodynamic data ΔG, ΔH and ΔS showed that the adsorption process is exothermic on the surface of Oleaster Seed.

INTRODUCTION

Water plays important roles in several fields of science and technology including physics, chemistry, biology, medicine and engineering. When life is concerned this importance increase. In fact, it is difficult to find a single phenomenon of biological relevance that is not related somehow with water (Denny 1993). A real understanding of life processes requires and understanding of how proteins and other endogenous macro molecules perform their actions. Proteins can be viewed as copolymers consisting of different amino acids, connected though the so-called peptide bond, and can be studied at various levels of detail, from the quantum mechanical to the statistical mechanical, the choice depending on the type of investigation . The simplest amino acid characterization is in terms of their hydrophobic or hydrophilic nature (Roberto 2008). Bovine serum albumin is very interesting biophysical and biochemical systems and has been quite studied over the last 40 years. Its primary structure is very well known consisting of 585 amino acid residues, whereas its secondary structure contain 67% of alpha helix and 17 disulfide bridges that confer to the protein a remarkable stability (Marcel *et al.,* 2006), and (BSA) is a large globular protein (66KDa) containing amino acid residues in a single chain with a known sequence, the tree dimension al conformation of BSA is composed of three homologous domain specific for metals and fatty acids (Hirofum 2008). BSA possess two tryptophan's Try-134 and Try-214: Try 134 located in proximity of the protein surface. Eggs are used in dared cereal products because of their nutritional and functional properties. Egg white has been successful used in the food industry as the major foaming protein, this is possible due to the ability of the egg white to have homogenous foams of great volume, while improvement of the foam stability in the presence of the other compounds or heating, therefore the use of egg white in ceramics shape forming has many advantages in the porous ceramic processing, egg white is non toxic, biodegradable, cheap and widely available. Different conventional and non-conventional type of adsorbents have been tried for removal of various metal ions viz, activated carbon (Krishnan 2008), Bentonite (Kubilay *et al.,* 2007), cellulose (Tang *et al.,* 2008), red mud (Gupta *et al.,* 2001), zeolite (Wingenfelder *et al.,* 2005), and rice husk (Tarley *et al.,* 2004). In this work the adsorption of EWA, BSA from aqueous solution on charcoal derived from were evaluated by UV.-Visible spectrophotometer.

Corresponding author:** **Abbas Hmood Al-Khafajy,
Chemistry Department, Faculty of Education for Women, Kufa University, Al-najaf al-ashraf, Iraq.

MATERIALS AND INSTRUMENTS

1. Bovine and egg white Serum Albumins were Supplied by Sigma Chemical Co.
2. Pectrophotometer T604, pg, Instruments, LTD
3. Blance sensitive –W-Germany
4. pH-meter HANNA, Portugal
5. Oven memmert, Edelstahi, Germany
6. Shaker Bath, Indicator GCA, Chicago
7. Centrifugal, Herouse, septch

Preparation of Charcoal Derived

The charcoal derived used in this study was prepared by pulverizing the Oleaster seed into the powder in the laboratory pulverizing, washed and dried in oven. It was then kept in furnace up to 600C° for two hours (Gailkwad 2004).

Preparation of albumins solutions

The stock solution of BSA and EWA was made by dissolving 0.04gm, albumins in 250ml double distilled water which was contained 200mg/L of BSA and EWA solutions of different concentration were prepared by serial dilutions for between (10-100mg/L).

METHODS

The adsorption rate data at different temperaturesand initials pH values have been obtained by allowing the commercial optimum charcoal derived solute (0.005, 0.05gm) of charcoal derived from Oleaster Seedwith 20ml of BSA and EWA respectively, to be mixed in the shaker water bath at 160min of charcoal derived from Oleaster Seed, then was filtered and the residual amount of albumin were determined spectrophotometry by depending on Beer-Lambert law. The amount of albumins retained by charcoal derived was calculated from the relation (CH 2001).

$$\left[Qe=\frac{(Co-Ce)V}{m}\right]$$

Where :-
Co is the initial concentration (mg/L)
Ce is the equilibrium concentration (mg/L)
V is the total volume of albumin (L)
m is the weight of charcoal derived (gm)
Qe is the amount of Adsorption (mg/g)

RESULTS AND DISCUSSION

Contact time effect

Figure (1) shows the effect of contact time on removal of albumins by charcoal derived from Oleaster Seed. The removal efficiency increase with time and attains equilibrium within 120min of albumins, the removal of albumins with time curves are monotonously increase to saturation, since then, the removal efficiency has no change with contact time, which are required for interaction with anions cations, significantly improved the binding capacity and the process proceeded rapidly (Viraji *et al.*, 2001; Al-Khafajy 2013).

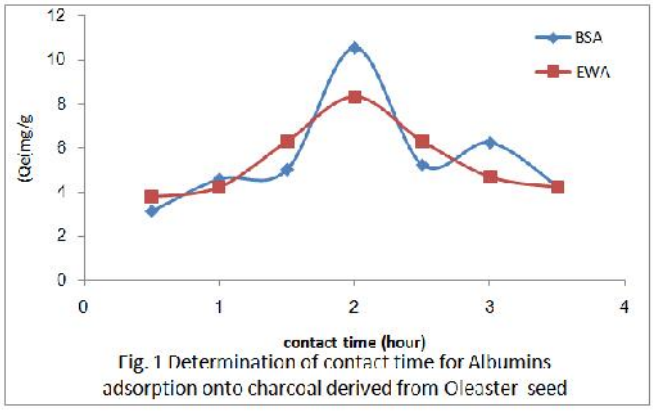

Fig. 1 Determination of contact time for Albumins adsorption onto charcoal derived from Oleaster seed

Adsorption dosage effect

To investigate the effect of adsorbent dosage, the adsorption of BSA, EWA on charcoal derived from Oleaster Seed was measured at four different adsorption (0.005,0.01,0.05,0.1, 0.15,0.2gm) for initial albumin concentration of 100mg/L, Fig.(2). When the adsorbent dosage optimum of albumin 0.005, 0,05gm of BSA and EWA respectively on charcoal derived from Oleaster Seed.

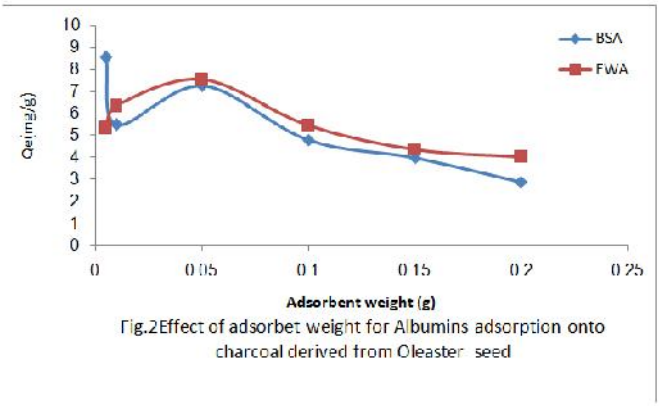

Fig.2Effect of adsorbet weight for Albumins adsorption onto charcoal derived from Oleaster seed

Adsorption isotherm

To study the relationship between sorbed (Qe) and aqueous concentration Ce at equilibrium (Fig.3), calceiform adsorption isotherms for albumins removal by charcoal derived. The experimental data were analyzed according to the linearity of the Langmuir and Freundlich isotherm. The Langmuir isotherm is represented by the following equation (Ho 2002).

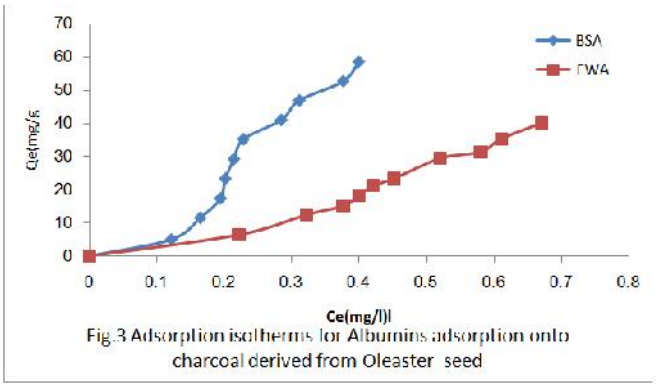

Fig.3 Adsorption isotherms for Albumins adsorption onto charcoal derived from Oleaster seed

$$\frac{Ce}{Qe}=\frac{1}{K_LK_L}+\frac{a}{K_L}.Ce$$

Where :- Ce is the equilibrium concentration (mg/L) ,

Qe is the amount adsorbed at equilibrium (mg/g),

and K_L and a are Langmiur constants related to adsorption efficiency and energy of adsorption, respectively. The linear plots of Ce/Qe versus Ce suggest the applicability of the Langmiur isotherms. Values of k_l and a were determined from the slope and intercepts of the plots and are presented (Fig.4). The Freundlich equation has also been employed for the adsorption of albumin on charcoal derived. The Freundlich isotherm was represented as (Erdem 2004).

$$\text{Log Qe} = \log K_f + \frac{1}{n}\log C_{eq}$$

where :- Qe is the amount of albumins (mg/g),

Ce is the equilibrium concentration of albumin in solution (mg/L), and $K_f$and n are constants incorporating all factors affecting the adsorption capacity and intensity of adsorption, respectively. The linear plot of Log Qe versus Log Ce shows that the adsorption of Albumines follows the Freundlich isotherm (Fig.5). Values of equation constants were found and were compiled in Table (1).

Table 1. Freundlich and Langmuir isotherms for ions using charcoal derived at 302K

Albumins	$\log K_f$	n	R^2	a	k	R^2
BSA	2.9078	-0.4356	0.9654	-2.264	45.66	0.8196
EWA	1.8542	-0.5057	0.8563	-1.901	17.76	0.8351

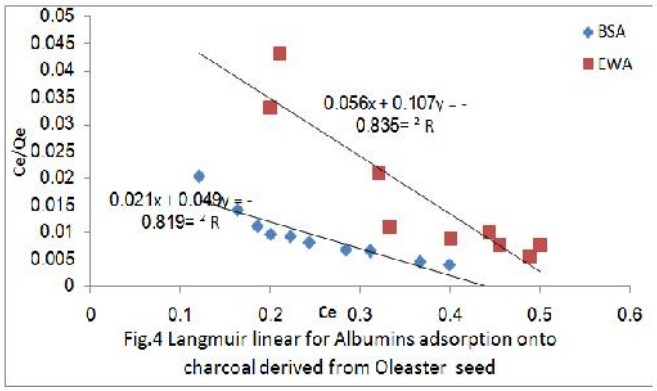

Fig.4 Langmuir linear for Albumins adsorption onto charcoal derived from Oleaster seed

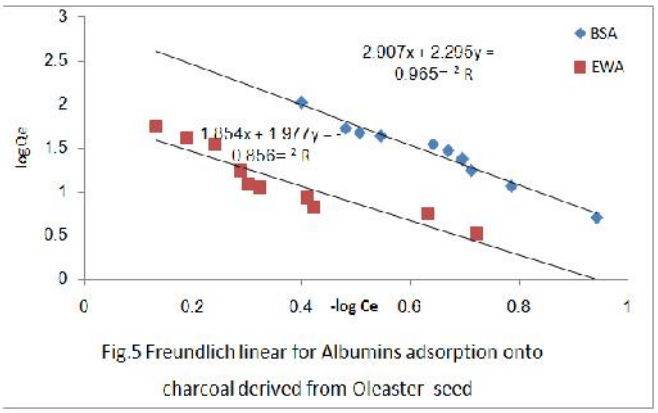

Fig.5 Freundlich linear for Albumins adsorption onto charcoal derived from Oleaster seed

Temperature Effect

The effect of temperature on the adsorption extent of albumines on two surface has been studied Fig. (6) illustrate data and general shapes of BSA,EWA adsorption at (302 , 312, 322, 332 K). The results showed and an decrease in the amount of albumin adsorbed on charcoal derived from Oleaster Seedwith increasing temperature (lekaa and Nadia 2013; Al-Khafagy 2012).

Table 2. Thermodynamic values and constant of vantHoff"s equation for ions using charcoal derived at 302K

Albumins	ΔH(Kj.mol^{-1})	ΔG(Kj.mol^{-1})	ΔS(j.mol^{-1}.k^{-1})
BSA	14.144–	13.909	-92.258
EWA	-18.912	13.765	-108.201

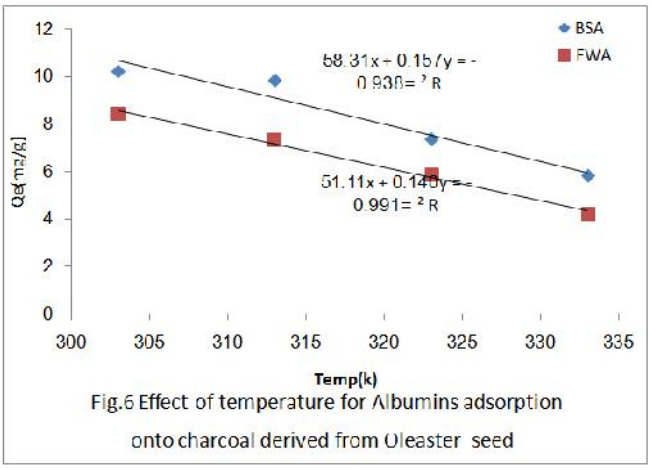

Fig.6 Effect of temperature for Albumins adsorption onto charcoal derived from Oleaster seed

Thermodynamic parameter

The thermodynamic parameters for the adsorption of albumins on charcoal derived such as. The change in free energy (ΔG) could be determined from the equation (Kapoor 1994).

$$\Delta G = -RT \ln \frac{Ce}{Qe}$$

Where :- R is the gas constant (8.314 J. mol^{-1} . k^{-1}), T is the temperature (K)

The heat of adsorption (ΔH) may be obtained from the Vant Hoff's equation (Panday 1985) :

$$\text{Log Xm} = \frac{-\Delta H}{2.303RT} + \text{Constant}$$

Where :- Xm is the maximum value of adsorption. The plotting log Xmversus (l/T) should produce a straight line with a slope

$$\frac{-\Delta H}{2.303RT}$$ as shown in Fig. (7).

The change in entropy ΔS was calculated from Gibbs equation (Atkins 2006).

$$\Delta G = \Delta H - T\Delta S$$

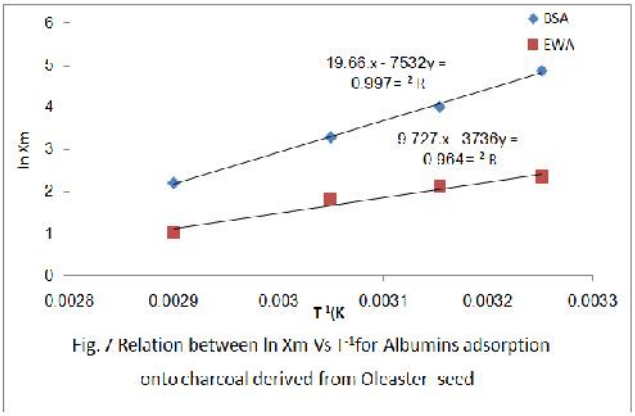

Fig. 7 Relation between ln Xm Vs $T^{-1}$for Albumins adsorption onto charcoal derived from Oleaster seed

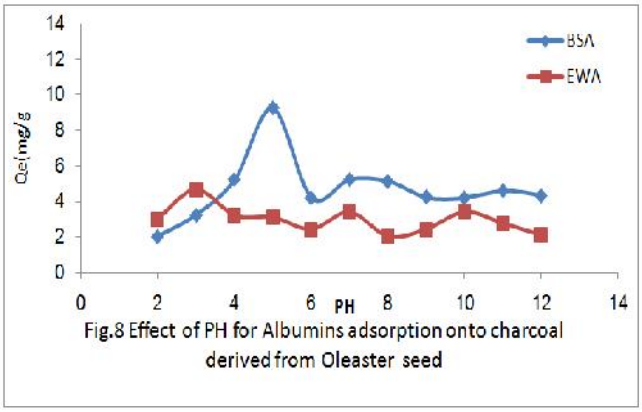

Fig.8 Effect of PH for Albumins adsorption onto charcoal derived from Oleaster seed

pH effect

Fig. (8) shows the effect of PH on the adsorption of BSA, EWA on charcoal derived from Oleaster Seed by rang (2-14). The amount of adsorption is maximum at pH=3 of EWA, and pH=5 of BSA. The system is strongly pH dependent, because the properties of both the charcoal derived and the solution composition of albumin changes with PH (Gonzalez 1990).

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