ISOTHERM STUDY *OF OPUNTIA FRAGALIS* ADSORPTION OF LEAD

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INTRODUCTION

- Pollution by heavy metals has been and still in focus of attention worldwide (Wang *et al.,* 2013). Detoxification of heavy metals is one of the most widely used treatments and concepts in alternative medicine (Raskin *et al.,*1997).

- The identification of plants capable of accumulating extraordinary high metal levels, demonstrate that plants have the genetic potential to clean up contaminated solutions(Oboh et al., 2008)

- The use of natural biomaterials for heavy metal detoxification is a promising alternative due to their relative abundance and their low commercial value (Bhattia *et al.,* 1998)

INTRODUCTION CONTD

- Blood is a circulating tissue composed of fluid and cells.
- Blood composition is made of a fluid called “plasma” and three additional types of cells which include:
- Red blood cell: picks up oxygen from the lungs and carries it to the organs in the body
- White blood cell: assist the body in fighting infections and other diseases)
- Platelets: assist in forming blood clots to control bleeding
- Plasma: aids the transportation of toxic substances (Peter *et al.,* 2013).

AIM

- The aim of the present study was to assess the capacity of *opuntia fragalis* biomass in the removal of lead (II) ions from human plasma and study the biosorption isotherms.

Objectives

- To prepare blood plasma from Human blood sample collected from non infected patient prior to screening

- To perform screening investigation and distribution of Heavy metals in blood plasma prior to batch experiment

- To optimize different parameters such as contact time, pH, biosorbent dose and initial concentration of heavy metals on biosorption process performance by *opuntia fragalis*.

- To investigate the appropriate biosorption isotherms of heavy metals removal from blood plasma by *opuntia fragalis* using Langmuir, Freundlich and temkins adsorption isotherms.

MATERIALS AND METHOD

Sample collection

- Fresh leaves of *opuntia fragili* was collected from the botanical garden of Biological Science Department, Ahmadu Bello University (ABU), Zaria.

- Blood sample was collected from Ahmadu Bello University Teaching Hospital (ABUTH) Zaria.

- Fresh leaves of *opuntia fragilis* washed repeatedly with tap water and rewashed with deionised water to remove dirt particles, cut into pieces, dried, ground, sieved and stored in a plastic bottle for further use without any pre-treatment.

- Human plasma was prepared as recommended Berthold *et al.,* 1998

- The effects of various parameters on the rate of biosorption process were optimized by varying biosorbent dose (0.5, 1.0, 1.5, 2.0 and 2.5 g), initial metal concentration (10, 20, 30, 40 and 50 mg/L), pH of solution (2.0, 4.0, 6.0, 8.0 and 10), contact time (20, 40, 60, 80 and 100 minutes) José *et al.,* 2014.

METHOD CONTD

- The solution volume was kept constant at 20.00 cm^3 and sorption studies were carried out at 25°C. Solution pH was adjusted with HCl or NaOH to pH of interest.

- The effect of initial metal concentration was studied by varying the initial metal concentration of the human plasma used for biosorption. The experiment was conducted by measuring 20.00 cm^3 of human plasma at pH 6 containing 20.00 mg/L of metal ion concentration and 1.50 g of biomass was transferred into conical flask at 25 ^{0}C and agitated for 60.00 min.

- The mixture was filtered immediately through Whatman filter paper. The filtrate was then digested and used for spectrophotometric test (Memon *et al.,* 2007)

METHOD CONTD

- Finally, the concentration of the residual metal ions remaining in the solution after digestion was determined using AAS. Thus, the optimum biosorbate concentration was determined.

- Therefore, the amount of metal ion biosorbed per biomass is given in equation 1.

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

- The % of metal ion removal from blood plasma at any instant of time was determined with equation 2.

$$\% \text{ Metal ions removal} = (Co - Ce)/Co \times 100 \quad \ldots\ldots\ldots\ldots 2$$

Where, Co and Ce are the concentration of metal ion at initial condition and at any instant of time, respectively.

RESULTS AND DISCUSION

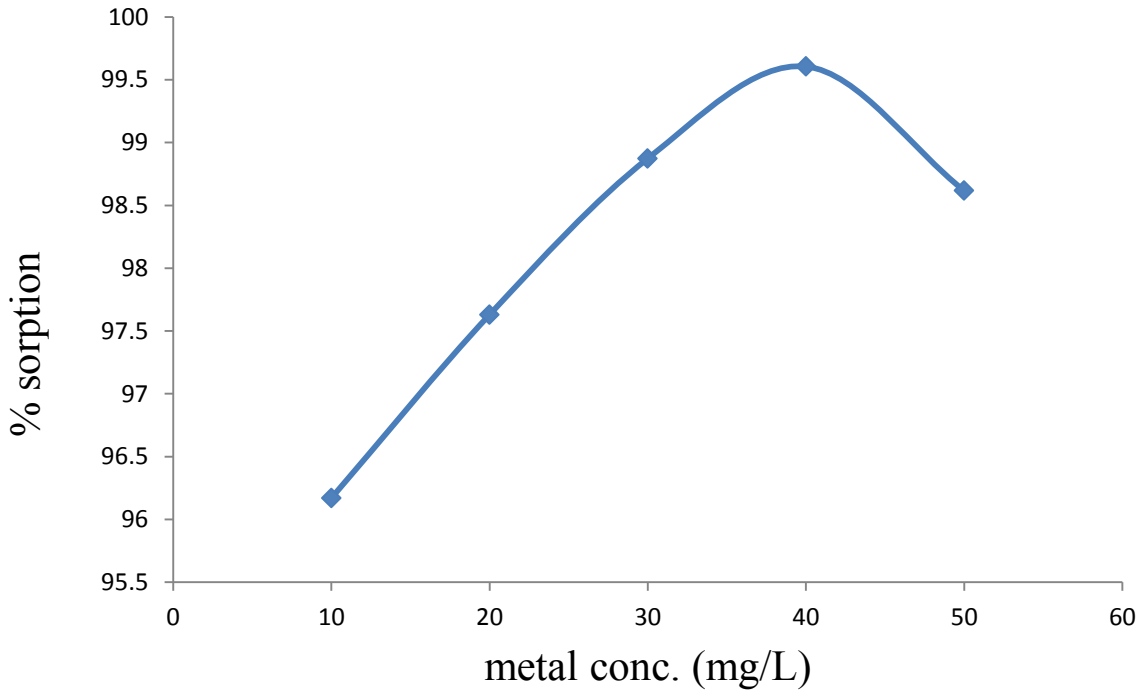


Figure 1: Variation of lead concentration with % sorption

RESULTS AND DISCUSION CONTD

- As presented in Figure 1 there was an increase in % sorption from 96.17 - 99.605% as initial concentration increased indicating optimal concentration of 40.0 mg/L.

- The increase in the amount of metal ion uptake per unit mass of the biosorbent observed as initial lead concentration increased was as a result of two main factors namely; high probability of collision between metal ions with the biosorbent surface and high rate of lead ions diffusion onto biosorbent surface due to the availability of vacant site for the biosorption of metal ions (Wang *et al.,* 2013).

- Thereafter, decrease in % sorption from 99.605 - 98.617% as initial concentration was increased which is explained by the fact that the active sites of biosorbent attained saturation point with no further lead adsorption. This is in agreement with the result of other researchers (Hashem *et al.,* 2007)

RESULTS AND DISCUSION CONTD

Table1: Langmuir isotherm constants and correlation coefficient for lead adsorption			
Q_m (mg/g)	K_L (L/m)	R_L	R^2
0.1462	-8.9534	-0.0028	0.8932

- The result implies that this model is suitable to explain the biosorption process, since these constants are indicative of the surface binding energy and monolayer coverage (Kiurski *et al.,* 2011).

- This also suggests that some heterogeneity in the surface or pores of the *opuntia fragalis* will play a role in toxic metals biosorption from human plasma. R_L value indicated that the equilibrium sorption is favourable

RESULTS AND DISCUSSION CONTD

Table 2: Freundlich isotherm constants and correlation coefficient for lead adsorption

n	K_f (mg/g)	R^2
-1.3682	0.4328	0.2916

- Freundlich isotherm constants and correlation coefficient is as presented in Table 2. The n value (-1.3682) indicates normal biosorption signifying higher adsorption of lead, n value indicated favourable biosorption (since $n<1$) and R^2 value indicated that sorption data didn't fit into Freundlich isotherm (Goldberg *et al.,* 2005)

RESULTS AND DISCUSSION CONTD

Table 3: Temkins isotherm constants and correlation coefficient for lead adsorption

A_T (L/m)	b_T	R^2
0.3836	-37.5011	0.112

- Temkins isotherm constants and correlation coefficient for lead adsorption is as presented in Table 3. A_T value indicated low binding energy, b_T value indicated low heat of biosorption and R^2 value entails that sorption data didn't fit into Temkins isotherm (Feng *et al.,* 2004).

CONCLUSION

- The biosorbent exhibited good surface chemistry suitable for enhancing the activity in the biosorption process .The condition for biosorption of the toxic metal was optimized and evaluation of the performance of the biosorbent using selected isotherm models.

- Thus, equilibrium isotherm studies demonstrated that sorption data fit into Langmuir Isotherm model more than Freundlich and Temkins.

THANK YOU FOR LISTENING