



## Design and Application of Biosorbent (*Opuntia fragalis* Leaves) for the Removal of Heavy Metal from Human Blood Plasma

Abuchi Elebo<sup>a\*</sup>, Elaoyi David Paul<sup>a</sup>, Victor Udoka Jibunor<sup>a</sup>, Sheba Maaji Paul<sup>b</sup>, Patricia Adamma Ekwumemgbo<sup>a</sup>

<sup>a</sup>Department of Chemistry, Ahmadu Bello University, Nigeria

<sup>b</sup>Department of Chemical Science, Federal University Wukari, Nigeria

### ARTICLE INFO

#### Article history:

Received 10 July 2022

Received in revised form 15 August 2022

Accepted 1 September 2022

Available online 8 September 2022

#### Keywords:

Biosorption,  
 Human Plasma,  
 Central Composite Design,  
 Kinetics, Isotherm.

### ABSTRACT

Environmental pollution is a potential threat to human health mainly because of the non-biodegradable and hazardous heavy metals. Among these heavy metals, lead is of considerable concern. Various methods adopted for removal of heavy metals include chemical precipitation, membrane separation, ion exchange and adsorption. In case of adsorption, the generally used adsorbents like activated carbon, silica, alumina, etc. are expensive. This has prompted the use of natural materials as biosorbents in order to develop cheaper alternatives, which can be disposed of without regeneration due to their lower cost. This study seeks to investigate the efficiency of *Opuntia fragalis* leaves as biosorbents for the removal of Pb (II) ions from Human plasma using Response Surface Methodology (RSM). The effect of adsorption factors; adsorbent dose (A), concentration of Pb (II) ions (B), pH of solution (C) and contact time (D) was optimized. The percentage removal of Pb (II) ions increased as the biosorption factors increased. The optimal removal of Pb (II) ions was attained at 95%. The surface chemistry of the biosorbent was analyzed using Scanning Electron Microscope, revealed an appreciable level of porosity and ability of biosorbent to adsorb Pb (II) ions from human plasma. The FTIR results showed that -C-Br, -C-N, -C-O, -C-C, -N-H and -OH functional groups were responsible for Pb (II) ions adsorption from human plasma. The lack of fit model have p-value greater than 0.05 with F-value of 0.27, implies non-significant lack of fit relatively due to the pure error and 97% lack of fit is caused by noise. The kinetics of the adsorption processes were investigated and data were subjected to Pseudo first order, Pseudo second order and Elovich models. The adsorption process fits into Pseudo second order model with  $R^2 = 0.9991$ . The equilibrium data was analyzed using isotherm models and Langmuir isotherm model with  $R^2 = 0.8932$  indicated Pb (II) ions uptake from human plasma occurred on the same pore space without having interactions amongst themselves thereby exhibiting monolayer adsorption.

\* Corresponding author. Tel.: +2347068381492; e-mail: abuchielebo@yahoo.com