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EFFECT OF pH ON DIENESTROL ADSORPTION BY COCONUT SHELL BIOCHAR

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ABSTRACT

The effect of solution pH on adsorption of dienestrol (DS) by coconut shell biochar (CSB) was investigated. The optimum solution pH was 5. This suggested that the strong chemical interaction of DS with the CSB. Therefore, CSB, as a green, environmental-friendly adsorbent, can be applied to the adsorption of contaminants in environment.

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INTRODUCTION

Dienestrol (DS), as one of the most used endocrine disruptors (EDCs), regulates the development and growth of animals and humans (Feng *et al.* 2020). Due to the tremendous influences on human health, especiallyon endocrine system, DShas obtained growing attention. Therefore, the analysis of the DS became crucial to environment monitoring. In recent years, biomass contains product, byproducts, residues and waste from agriculture, forestry and industrial processesare undertaking efforts for the utilization of sorbents for various contaminants (Lehmann *et al.* 2011).Coconut shell biochar (CSB)can also be used as an inexpensive adsorbent for various pollutants. In this study, CSBwas applied to adsorbDS. The effect of solution pH on adsorption of DS by CSB were investigated. The results were analyzed by high performance liquid chromatography (HPLC).

EXPERIMENTAL

Chemicals and Materials: DS was purchased from Sigma-Aldrich (Steinheim, Germany), high performance liquid chromatography-grade methanol (MeOH) and acetonitrile (ACN) were provided by J&K Chemical (Beijing, China). H_3PO_4, NaOH, and other affiliated chemicals were all obtained from Sinopharm Chemical Reagent Co. Ltd. (Shanghai, China). All solvents and chemicals were of analytical grade and used without further purification unless otherwise specified. HPLC-grade water was obtained by purifying demineralized water in a Milli-Q system (Millipore, Bedford, MA, USA), and was used throughout the work.

Apparatus and software: For chromatographic separation, an Agilent 1260 HPLC system (Agilent Technologies, CA, USA), equipped with a quaternary pump, a degasser, a column compartment, and a UV detector were used. Separation was performed on a Pursuit 5 C18, 5 µm, 4.6 mm ×150 mm column. The injection volume was 20 µL and the ultraviolet (UV) detector was set at 228 nm. The mobile phase consisted of ACN and water with a ratio of 80:20 (v:v) at a flow rate of 1.0 mL/min. All the samples were passed through microporous nylon filters of 0.22µm pore sizes in diameter (Pall Corporation, USA). An Ion 510 pH meter (Ayer Rajah Crescent, Singapore) was used to monitor pH adjustment.

Preparation of standard: Standard stock solution containing 1000µg/mL of DSwas prepared by dissolving the required amounts of DS in MeOH. It was stored in a refrigerator at 4 °C. Working solutions were prepared from the stock solutions by dilution with appropriate amounts of Milli-Q water.

Effect of pH on adsorption: The impact of initial solution pH on DS adsorption efficiency were conducted by adding 10 mg CSBinto each DS solution (200μg/mL, 5 mL) with ultrasonic bath assisting for 0.5 h. The pH value was adjusted by NaOH or H_3PO_4 solution (0.1 M) ranged from 2.0 to 10.0. The adsorption capacity (Q, mg/g) of CSB for DS was calculated by the following formula (Wang *et al.* 2017):

$$Q = \frac{(C_0 - C_e) \times V}{m} \quad \text{..... (1)}$$

where C_o and C_e are the initial and equilibrium concentrations of each DS (μg/mL),

RESULTS AND DISCUSSION

Effect of pH: Figure 1 illustrates the effect of initial pH on DS uptake by CSB with pH ranging from 2.0 to 10.0.

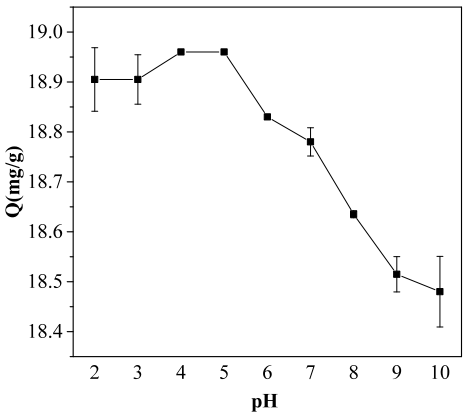

Figure 1. Effect of solution pH on adsorption capacity

It could be found that $Q$of DS increased as pH value increased from 2 to 5 and decreased as pH value increased from 5 to 10, and the Q value was biggest when pH was 5 for DS.

These phenomena may be resultant from the surface charge of CSB and the speciation of DSat different pH values.

CONCLUSION

In conclusion, a green, environmental-friendly adsorbent was supplied to the DS adsorption. The solution pH had a great effect on the adsorption efficiency. The data showed that when the solution pH was 5 the adsorption is strong. As a highly efficient adsorbent for DS, CSB could be a candidate to adsorb contaminants in environment in the future.

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