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Removal of pharmaceutical compounds by activated carbon prepared from agricultural by-product

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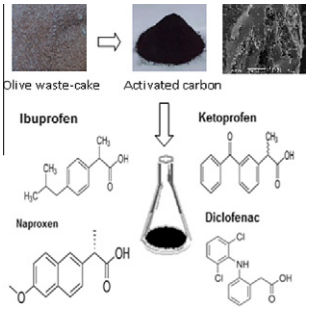
HIGHLIGHTS

- Adsorption of four pharmaceuticals present in surface water was investigated.
- The adsorbent was an activated carbon prepared from olive waste cakes.
- Capacities were essentially linked to p*K*a and octanol/water coefficient of the drugs.
- pH increase disadvantages gradually the uptake of the tested drugs.
- The temperature had no significant effect on the adsorption of the adsorbates.

GRAPHICAL ABSTRACT



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ABSTRACT

Adsorption of ibuprofen, ketoprofen, naproxen and diclofenac onto a low-cost activated carbon, prepared at the laboratory scale from olive-waste cakes, has been investigated. Single and mixture drug solutions were considered. The equilibrium adsorption data obtained at 25 °C were analyzed by Langmuir and Freundlich models. The former provides the best fit of the experimental data. The adsorption capacities of the carbon for the four drugs were quite different and were linked essentially to their p*K*a and their octanol/water coefficient. The adsorption kinetics of these adsorbates have been investigated and the results indicated that the adsorption process followed the pseudo-second-order kinetic model for the four tested drugs. The effect of pH and temperature on the drugs uptake by the adsorbent was also investigated. Increasing pH gradually reduced the uptake of the four drugs, and this effect was more perceptible when the pH became alkaline. The increase of temperature in the range 4–40 °C does not have a perceptible effect on the adsorption process for all the studied drugs.

1. Introduction

Pharmaceuticals are compounds with biological activity developed to promote human health and well being. Nevertheless, because a considerable amount of the dose taken is not adsorbed by the body, a variety of these chemicals – including painkillers, tranquilizers, anti-depressants, antibiotics, birth control pills and chemotherapy agents – are finding their way into the environment via human and animal excreta from disposal into the sewage system and from landfill leachate that may impact groundwater supplies [1]. Most substances of pharmaceutical origins are not biodegradable and often not completely eliminated due to their ability to escape to conventional wastewater treatments [2,3]. Therefore, residual quantities remain in treated water, or have been found in drinking water [1]. According to a survey in German

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