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Competitive study of pharmaceutical adsorption onto novel biochar

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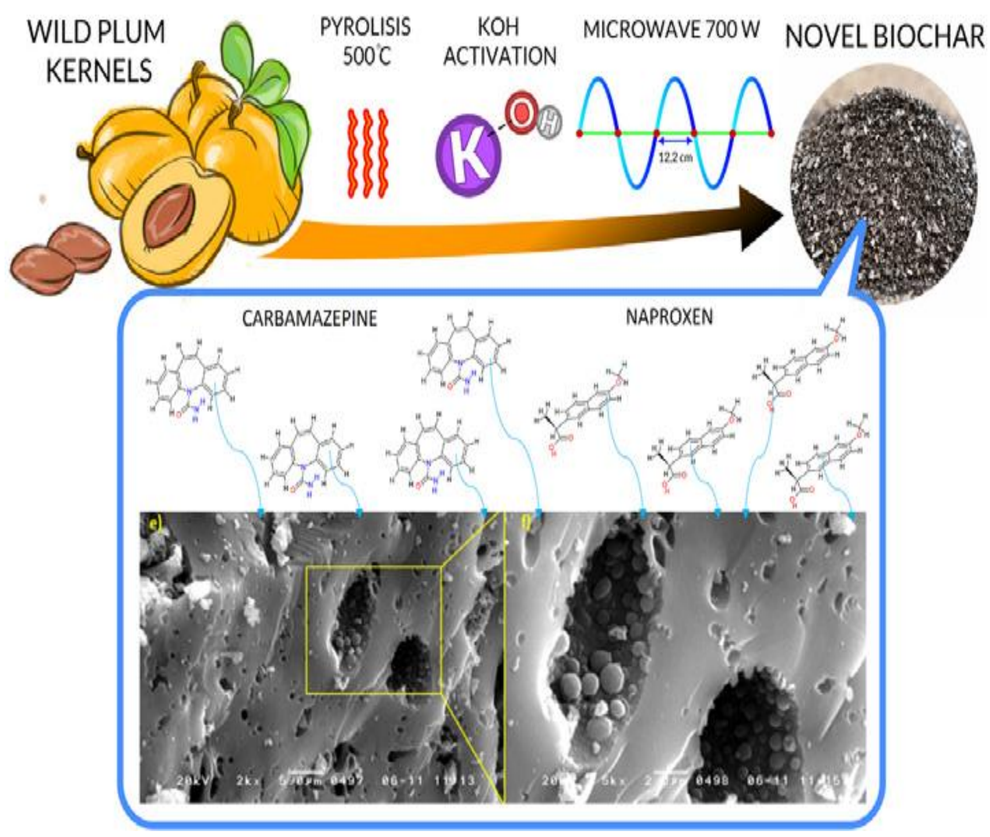
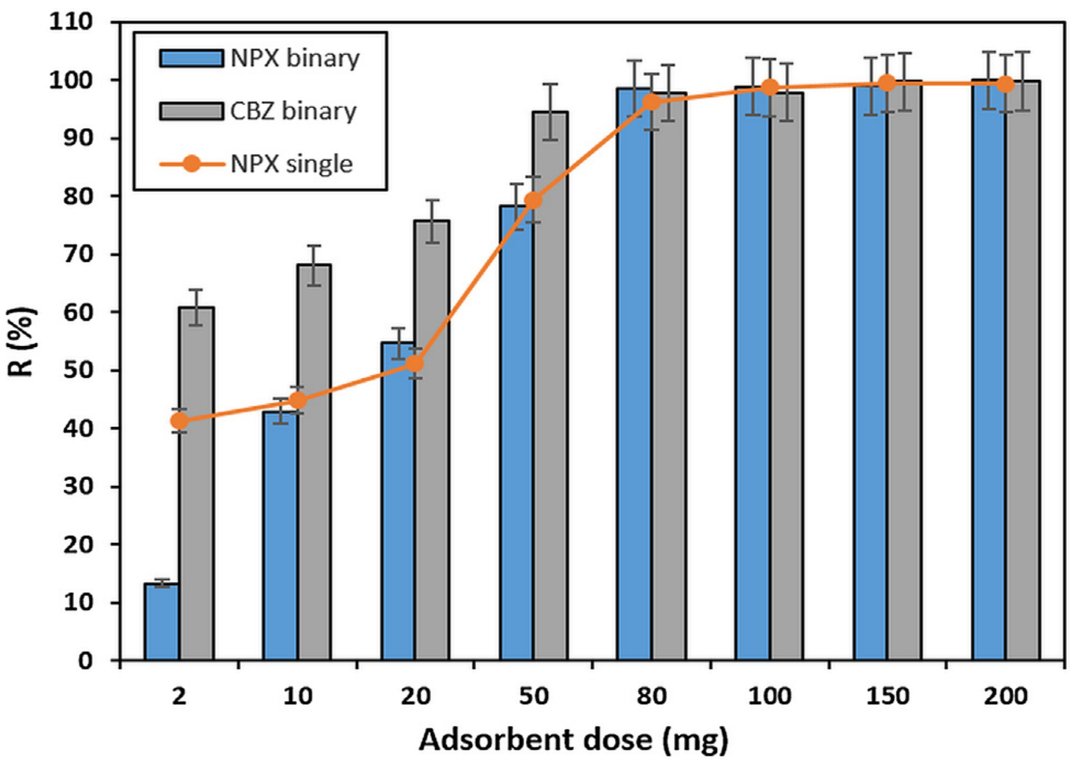
Emerging pollutants, usually present in trace concentrations in industrial and municipal wastewater effluent, commonly are not removed in wastewater plants. Adsorbents synthesized from lignocellulosic waste material are available, economical and effective for removal of various pollutants from water.

Novel low-cost biochar (WpOH) was sintetized from wild plum kernels, using combined processes of pyrolisis such as conventional heating and microwave with chemical activation that was done with potassium hydroxide (KOH) (Fig. 1). Developed adsorbent was applied in a competitive study of a basic/amphoteric drug carbamazepine (CBZ) and ionizable naproxen (NPX) removal from water. The study showed that at lower WpOH dose CBZ shows higher removal, comparing to NPX, while at a higher dose of adsorbent there is very small difference, which may be explained the smaller molecular size of CBZ (Fig. 2).



The adsorption mechanism in the mixed system may be explained as follows: Under the investigated pH (6), zwitterionic CBZ molecules existed in their uncharged form, while molecules of NPX are negatively charged. Consequently, the possibility of electrostatic interaction can be almost completely excluded for CBZ, in favour of EDA interactions and H-bonding. It plays a part, as well as structure/configuration of the molecules.



Here, both NPX and CBZ had planar configurations, however, the more planar structure and smaller molecular size of the CBZ comes to the fore when low WpOH dosing is used, i.e., during the competitive study, which resulted in higher adsorption and faster kinetic characteristics.

This study showed that two different compounds (i.e., basic vs amphoteric drug) can be adsorbed in the same time. It may be concluded that adsorbent, sintetized wild plum kernels, combined with potassium hydroxide and microwave activation is a high quality microporus biochar. These results are very important because it is a step to implementation of syntetized biochar in large-scale/complex treatment systems.

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