Removal of coccidiostats from aqueous solutions using biochar

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Abstract

The coccidiostat compounds are widely used in animal husbandry worldwide in poultry and pig farming and they enter the environment through farming waste. Their presence in the environment poses a risk to the environment and to human health and their removal from water samples needs to be investigated. The adsorption method is generally regarded as a simple process for the removal of veterinary medicinal products (VMP) from aqueous samples. The removal process has a low operating cost and depends mainly on the versatile use of the adsorbent material in terms of its recyclability, large surface area, and adsorption capacities. Biochar produced from biomass waste serves as a sustainable and a cost-effective adsorbent for the removal of organic contaminants from liquid samples. For the experiments, three biochar sorbent materials were produced via pyrolysis. The adsorption experiments were conducted at room temperature, 25° C, in the dark using a ratio of 0.2g biochar to 20 ml of coccidiostat mixture solution (Diaveridine, Nequinate, Clazuril and Diclazuril) (concentration 250 ug/L). The adsorption process was achieved using a platform shaker at 170 rpm. Water aliquots, 100 ul, were collected at each of the following intervals 5 - 300 min. The samples were centrifuged at 13000 rpm at 4o C, diluted with equal volume of the mobile phase and transferred to an autosampler vial. Control experiments were conducted (no sorbent, at three different concentrations). The chromatographic separation, analyte detection, and quantification were performed on a Waters Xevo Absolute system using a Phenomenex pre-column UPLC C18, 2.1 mm , a Luna Omega Polar C18 Column 2.1 x 100mm, particle size 1.6 um, and the mobile phases were: A, 2 mM ammonium formate, 0.01 % formic acid in water and B, 0.01% formic acid in methanol. The percentage (%) removal efficiency was calculated. It was found that Manure biochar can effectively remove all studied compounds with better results in clazuril (100% removal). Additionally, from the first 30-45 minutes more than 90% of the compounds is removed. Sludge biochar has shown the lowest efficiency, probably due to its complex matrix. SCG biochar is more effective for the removal of Diaveridine and Nequinate and less effective for Clazuril and Diclazuril. Finally, the removal of the compounds when treated with the different biochar depends on their physicochemical properties which is determined by the resource material used. For example, same groups of coccidiostat showed similar trends of removal.