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ABSORPTION OF *BACILLUS CEREUS, BACILLUS SUBTILIS AND PSEUDOMONAS FLUORESCENS* BACTERIA ON ACTIVATED CHARCOAL OBTAINED FROM APRICOT HUSKS

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Introduction

The microrganisms pollution is one of the dangerous contaminants in the water and removing them is very important to human and animal health. Adsorption is often used at the end of a treatment sequence for pollution control due to a high degree of purification that can be achieved. Activated carbon is the most popular adsorbent used for the the application of adsorption technique. The adsorption process can be described as the ability of certain solid called adsorbent to concentrate a specific substance called adsorbate from solution onto their surfaces, and the most widely used adsorbents are activated carbon. Activated carbon is favored for water supplies because adsorbs a wide range of microorganisms and natural carcinogenic compounds. Activated carbons are complex and heterogenous material and can be obtained from different vegetal sources with unique adsorptive characteristics mainly influenced by the porous structure, surface area and chemical structure of the surface. Granular activated carbon has an extremely large amount of adsorption surface area, that offers an exceptional ability to adsorb many kinds of materials on to its surface. Activated carbon has a high efficiency of adsorption depending on the pore size, small pores increasing the surface area of them and thus increasing the efficiency of adsorption. The present study was conducted to test the ability of activated charcoal obtained from apricot husks to adsorb bacteria from gram-positive and gram negative groups.

Materials and methods

Three bacterial strains *Bacillus cereus, Bacillus subtilis* and *Pseudomonas fluorescens* were cultivated on peptone agar solid medium to assess the bacterial adsoption properties of the activated carbons. Subsequently, 3 different bacterial sollutions with the intial optical densities of 1,5 were prepared after McFarland. It was made the dillution of the tested bacteria in 10 different flasks, so in the end it were obtained 10 solutions with different concentrations of bacteria, so that the calibration curve was possible to be established. In the prepared solutions was put the same amount of activated carbon obtained from apricot husks, around 100 mg. The contact time of carbon and bacteria varied from 30-120 min. The experiments were performed at 2 different temperatures (27 and 37ºC degrees). After each measurement the adsorption isotherms for each selected bacteria were established.

Results and conclusions

The activated carbons used have a specific area of about 1500 m^2/g and a total sorption volume of the pores equal to 1,05 cm^3/g. The study of the kinetics of the adsorption processes of the bacteria within the above mentioned species showed that the value of the maximum adsorption of the bacteria is established within 2-2,5 hours, depending of the bacteria used in the sorption. After 2-2,5 hours of mechanical stirring, the concentration of bacteria begins to increase exponentially. After 12-13,5 hours of contact, the concentration of bacteria increases so rapidly that the bacteria coagulate forming microfuges in solution. The obtained results allow us to conclude that the bacteria in the first 2-2,5 hours are adsorbed in the macropores of the activated carbon. After the saturation of the macropores, the activated carbon has the role of mechanical surface, which allows the rapid multiplication of bacteria. This fact is also confirmed by the research results, which are related to the study of the behavior of bacteria when stirring in aqueous solutions in the absence of activated carbon, especially the linear decrease in the concentration of bacteria depending on the contact time. The influence of temperature on the adsorption processes of different species of bacteria on activated carbons obtained from plant sources was studied. The adsorption processes were studied at 27ºC and 37ºC temperatures. The results obtained are presented in the Table 1.

Table.1 The maximum value of adsorption of different species of bacteria on activated carbon at different temperatures, determined according to the stirring time

Bacterial species	The maximum value of the adsorption of bacteria on carbon adsorbents at the temperature of 27°C established at different contact time between phases (McF*10^8/g)				The maximum value of the adsorption of bacteria on carbon adsorbents at the temperature of 37ºC established at different contact time between phases (McF*10^8/g)			
	30 min	60 min	90 min	120 min	30 min	60 min	90 min	120 min
B. cereus	0,225	0,330	0,450	0,46	0,075	0,100	0,145	0,165
P. fluorescens	0,290	0,555	0,560	0,660	0,300	0,540	0,560	0,625
B.subtilis	0,325	0,375	0,385	0,460	0,225	0,250	0,260	0,275

The analysis of the results presented in the table allow us to conclude that temperature influences the adsorption process differently. With the increase of the temperature by 10ºC the value of adsorption for the bacterial species *B.cereus* decreases on average 3 times. In the case of *Ps.fluorescens*, the increase in temperature practically does not influence the adsorption process. Increasing the temperature in the case of *B.subtilis* species leads to a decrease of the adsorption value on average by 1.5 times.

Temperature specifically influences the adsorption process of bacteria on activated carbon. In the case of *Ps. fluorescens* temperature practically does not influence the adsorption process, while in the case of *B.subtilis* and *B.cereus* the increase in temperature leads to a decrease in the value of adsorption of bacteria on charcoal of vegetal origin.

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