

UDC 544.723

COMPARATIVE STUDY OF THE SPECIFIC ACTIVITY OF CARBON AND LIGNIN ENTEROSORBENTS

M.G. Ismailova¹, A. Nabiev², P.L. Ismailova¹

¹*Uzbek Scientific Research Chemical-Pharmaceutical Institute
40 Do'rmon yo'li Street, Tashkent 100125, Uzbekistan*

²*Head Department of drug and medical equipment quality control
16 Usmanhodjaev Street, Tashkent 100002, Uzbekistan*

The technology of obtaining was designed and comparative tests of the medical enterosorbents, activated coal (AU-K) and lignin enterosorbents (LE) were carried out. AU-K possesses by mainly developed micro- and media-porous structure, lignin enterosorbent – by macro-porous structure. However, significant set of the oxygen-containing functional groups on LE surfaces conditions its high activity at the treatment of the lacto-dependent diarrhoea.

INTRODUCTION

The unfavourable ecological situation in some regions of the Central Asia leads to significant deterioration of the environment, quality of drinking water and food. It causes the growth of the number of patients with a sharp and chronic poisoning accompanied by diarrhoea. One of the perspective methods of the treatment of the given pathology is enterosorption [1–3].

The sorbents developed by us – activated coal AU-K (on the basis of fruit shells) and a natural enterosorbent obtained from hydrolytic cotton lignin [4, 5] were approved as medical enterosorbents.

EXPERIMENTAL

Carbonization (thermal decomposition, pyrolysis) and activation- the main technological stages of obtaining activated coal AU-K – were carried out in a revolving stove with external gas heating. Carbonization was carried out at the temperature (T_{carb}) = 600–800°C and the activation - at the temperature (T_{act}) = 800–900°C, water steam was used as an activating agent ($H_2O:carbonizat = 5:1$). The technical coal obtained herewith was subjected to the acid demineralization by 10% solutions of hydrochloric or nitric acids and the further neutralization to pH 6–8 with the aim to reduce the sorbent ash content and achieve the cleanness criteria claimed to medical sorbent [6].

The technology of lignin enterosorbent obtaining includes alkaline processing of the source hydrolytic lignin from cotton seeds husk at the temperature of 60–70°C followed by cleaning from alkali and dissolved compounds by water, neutralization of the remaining alkali by acid and cleaning lignin from the acid and salts.

The determination of the maximum adsorption value and of the parameters of enterosorbent micro-porous structure were carried out on basis of benzene and water steam standard vapors adsorption isotherms received at 20°C on adsorptive high-vacuum apparatus by weighting method.

The absorbabilities of the sorbents were defined by blue methylene indicator by spectrophotometrical method on a spectrophotometer PYE UNICAM SP-8-500 by the wavelength of 400 nm.

The raster electronic-microscopic (REM) researches on an electronic microscope REM-200 (scanning) were carried out to get an obvious picture of the activated coal AU-K surfaces [7].

The study of the specific antidiarrhoea activity of enterosorbents was conducted on rat-males of mass 180–220 g divided into 3 groups with 6 animals in each. Diarrhoea have been caused by inclusion the lactose in amount 40% on Mc Ckung H.J. in ration of the nutrition. Enterosorbent in the form of water suspension is entered to the rats inside by means of probe once at day. The antidiarrhoea activities of the enterosorbents were judged by the decrease of the mass and amount of the moisture of the animal faeces.

RESULTS AND DISCUSSION

In order to choose the optimum samples of the activated coal AU-K, suitable for medical purposes, the sorbents with different activation degrees were explored. Herewith, the sample with degree of the activations 70% was found as the most optimum. The comparative features of the AU-K and LE enterosorbents are presented in Table 1.

Table 1. Physical-chemical features of enterosorbents

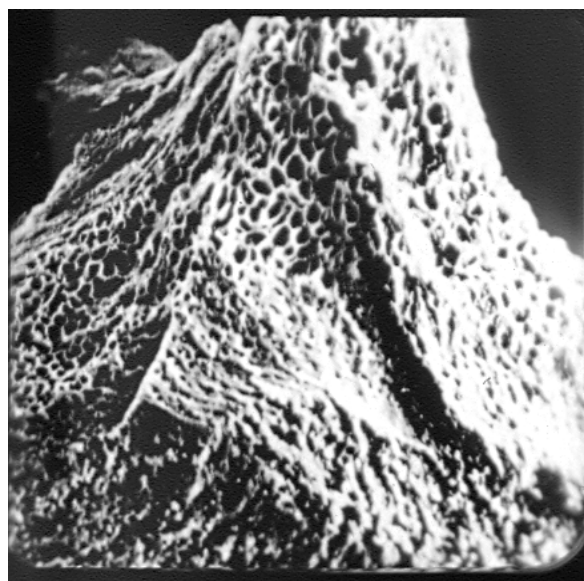
| Sorbent | Exterior | Total volume of the porous, cm ³ /g | Specific surface, m ² /g | Adsorptive ability, mg/g | |
|-----------------------|--|--|-------------------------------------|--------------------------|-------------------|
| | | | | by methylene blue | by thylene orange |
| actuated coal | granules of the wrong form of the black colour | 1.2 | 1250 | 220.25 | 177.42 |
| lignin enterosorbents | amorphous powder of the brown colour | 0.8 | 62 | 85.09 | 3.01 |

The absorbability of the sorbents is conditioned in a considerable extent by the characteristics of their surfaces. Data of IR spectroscopic analysis has shown that in sample LE the set of the bands of the absorption exists in interval 3800–500 cm⁻¹.

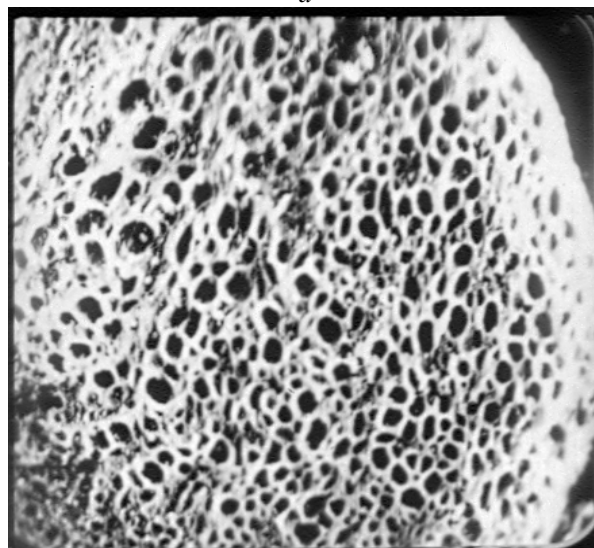
The most expressing bands in the field of 1700–1600 sm⁻¹, typical of the vibrations (C=O), point out the presence of the carbonyl groups in composition of the aldehydes and acids, in interval 1420–1350 cm⁻¹ the expressed bands characterizing for carboxyl also exist. Bands of the absorption in the field of 3500–3300 cm⁻¹ refer to valent vibrations of (O–H) in alcohols, phenols, carbon acids and adsorbed water molecules. The presence of quite a considerable number of oxygen-containing and hydrogen functional groups in LE sorbent is conditioned the sorption of different toxic metabolities by this enterosorbent.

Under IR spectroscopic study of AU-K expressed bands of the absorption were not discovered that indicate the absence or quite small quantity of functional groups, however, in this case high adsorptive ability of the preparation is conditioned by developed porous structure of the sorbent.

The microphotographies of the surfaces AU-K and AU-L sorbets were received by raster electronic microscopy (Fig.1, 2).



a



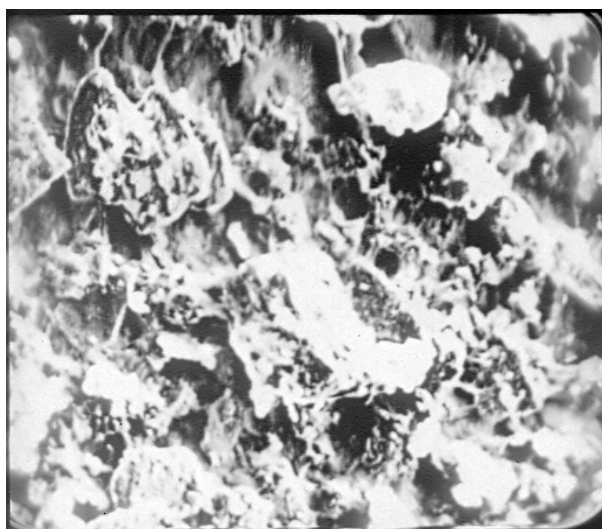
b

Fig. 1. The pictures of actuated coal from raster electronic microscope in scale 1:200 (*a*), 1:250 (*b*)

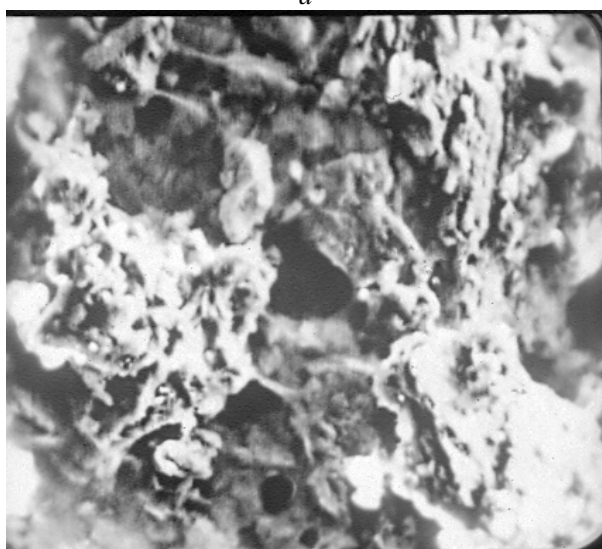
The results of the studies of specific antidiarrhoea activity of the enterosorbents showed that under action of the LE sorbent depending on dose (50 mg/g and 100 mg/g) the discharge of the fecal masses, which have formed 55% and 33% to control, respectively, decreases. In that time, under 500 mg/g receiving AU-K the amount of the fecal masses was 62% (Table 2). Consequently, the anti-diarrheal effect of the LE is 3 times more than AU-K.

Table 2. Enterosorbents influence on rats stool indicators under a diarrhea

| Experimental conditions | The researched indicator | | |
|--|--------------------------|---------------------|-------------------------|
| | lump of excrements | the dry residue, mg | the moisture, mg |
| intact | 850±22.0 | 400±34.9 | 450±6.4 53.0±.8 |
| the control (diarrhoea) | 2300.6±28.0 | 650.3±32.5 | 1650.3±20.5 71.8±5.0 |
| after taking the lignin enterosorbent 50 mg/g | 1268.0±35.7 | 900±210.0 | 368.0±21.0 29.0±2.3 |
| after taking the lignin enterosorbent 100 mg/g | 760.0±47.0 | 445.6±204 | 157.9±20.5 20.6±4.1 |
| after taking the enterosorbent AU-K 500 mg/g | 1445.8±140.0 | 502.7±47.0 | 943.0±74.0 65.2±4.7 |



a



b

Fig. 2. The pictures of lignin enterosorbent from raster electronic microscope in scale 1:200 (a), 1:250 (b)

The results of the studies are the basis for using the tested enterosorbents in the case of poisoning by lactose- dependent intestine infection.

CONCLUSIONS

Activated coal AU-K is a sorbent with a developed micro- and media-porous structure, enterosorbent LE is a natural nonselective macroporous sorbent with a set of oxygen-containing functional groups.

Pharmacological studies of the enterosorbent showed that their using removes the syndrome of "watery diarrhea" on models of the diet with lactose content, moreover antidiarrheal effect of the lignin enterosorbent is 3 times more than that of coal.

REFERENCES

1. *Remmert H.P., Olling M., Slob W. et al.* Comparative antidotal efficacy of activated charcoal tablets, capsules and suspension in healthy volunteers // *Europ. J. Clin. Pharmacol.* – 1990. – V. 39, N 5. – P. 501–505.
2. *Enterosorption / Ed. N.A. Belyakov.* – Leningrad: Center of Sorption Technologies, 1991. – 340 p. (in Russian).
3. *Levanova V.P., Korolkova S.V., Artemeva I.S.* The use of lignosorb enterosorbent in a complex therapy of various pathological conditions // *J. Efferent Therapy.* – 2006 – V. 12, N 3. – P. 12–18.
4. *Ismailova M.G., Ismailova P.L.* Natural sorbents from cotton hydrolytic lignin // 8th International symposium on the Chemistry of Natural Compounds (15–17 June, 2009, Anadolu University, Turkey). – 41 p.

5. *Ismailova M.G.* Modification of coal sorbents on fruit-stone shells basis and lignin by oxidation by air oxygen // 8th International symposium on the Chemistry of Natural Compounds (15–17 June, 2009, Anadolu University, Turkey). – 41 p.
6. *Ismailova M.G., Mahkamov H.M., Ismailova P.L.* High-performance coal sorbent obtained from cotton lignin for medical purposes // *Chemical-Pharmacological J.* – 2000. – V. 12. – P. 38–40. (in Russian).
7. *Raster Electronic Microscopy and X-ray (Radiography) Microanalysis / Ed. V.I. Petrova.* – Moscow: Mir, 1984. – 108 p. (in Russian).

Received 02.07.2010, accepted 17.08.2010

Порівняльне вивчення специфічної активності вуглецевого та лігнінового ентеросорбентів

М.Г. Ісмаїлова, А.Н. Набієв, П.Л. Ісмаїлова

Узбецький науково-дослідний хіміко-фармацевтичний інститут
вул. Дурмен йули 40, Ташкент 100125, Узбекистан, uzkfiti@rambler.ru
Головне управління контролю якості лікарських засобів і медичної техніки
вул. Усманходжаєва 16, Ташкент 100002, Узбекистан

Розроблено технологію одержання та проведено порівняльні випробування медичних ентеросорбентів – активованого вугілля (АУ-К) і лігнінового ентеросорбента (ЛЕ). АУ-К має переважно розвинену мікро- та мезопористу структуру, ЛЕ – макропористу структуру. Проте значна кількість кисеньвмісних функціональних груп на поверхні ЛЕ обумовлює його високу активність при лікуванні лактозалежної діареї.

Сравнительное изучение специфической активности углеродного и лигнинового энтеросорбентов

М.Г. Исмаилова, А.Н. Набиев, П.Л. Исмаилова

Узбекский научно-исследовательский химико-фармацевтический институт
ул. Дурмен йули 40, Ташкент 100125, Узбекистан, uzkfiti@rambler.ru
Главное управление по контролю качества лекарственных средств и медицинской техники
ул. Усманходжаева 16, Ташкент 100002, Узбекистан

Разработана технология получения и проведены сравнительные испытания медицинских энтеросорбентов – активированного угля (АУ-К) и лигнинового энтеросорбента (ЛЕ). АУ-К обладает преимущественно развитой микро- и мезопористой структурой, ЛЕ - макропористой структурой. Однако значительный набор кислородсодержащих функциональных групп на поверхности ЛЕ обуславливает его высокую активность при лечении лактозависимой диареи.