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SORPTION PROPERTIES OF LIGNINS AND PROSPECTS OF THEIR USE AS MEDICINAL AGENTS

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Hydrolysis lignin (HL) is a multitonnage byproduct of the hydrolysis industry and forms a solid water-insoluble granular material. In its chemical structure it is a high-molecular-mass polyfunctional organic compound with a condensed system of phenylpropane structural units. The functional composition of lignin is characterized by the presence of reactive groups: OH_{alip}, OH_{arom}, COOH. All this permits it to be regarded as a possible sorbent for studying sorption processes.

The literature gives experimental material on the study of the sorption capacity of HL and of phosphorylated HL in relation to various metal ions [1, 2, 3], but we have found no information on the use of lignin for binding lead ions.

We have now investigated the sorption capacities of HLs obtained from cottonseed husks, wood chips, and rice husks and also of modified cottonseed husk HLs obtained by demethylation, oxidation, chlorination, piperidinomethylation, phosphorylation, and nitration [4] in relation to lead salts with the aim of creating medicinal preparations that can be used in cases of lead poisoning.

The hydrolysis lignins considered differed in physicochemical structure: different levels of functional groups and different adsorption capacities for the polar components of plant oils [5]. They had the following compositions, %: wood HL – C 55.7, H 7.0, OCH_3 6.72, OH_{tot} 7.21, CO 3.85; rice husk HL – C 61.85, H 6.28, OCH_3 4.48, OH_{tot} 5.28, CO 4.62; cottonseed husk HL – C 57.3, H 6.14, OCH_3 4.83, OH_{tot} 5.41, CO 7.85.

We used a standard method for a sorption experiment [6]. We studied the sorption capacity of the HLs for lead in the form of $Pb(NO_3)_2$ under static conditions. The initial concentrations of metal in the aqueous phase and the residual concentrations after sorption were determined by atomic absorption spectroscopy. The results of the investigation of the sorption capacities of the lignins, in mg Pb/g of lignin, are given below:

Cottonseed husk HL	1.72
Wood HL	0.63
Rice husk HL	0.78
Nitrolignin	1.77
Chlorolignin	0.57
PMHL	0.67
PhPMHL	0.69
Oxidized lignin	0.47
Demethylated lignin	0.77
PMDemHL	1.01
Polifepan	0.57

PMHL represents piperidinomethylated hydrolysis lignin, PhPMHL phosphorylated piperidinomethylated lignin, and PMDemHL piperidinomethylated demethylated lignin.

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The sorption capacities of the samples of lignin shown in relation to lead salts were subject to considerable variation, at 0.47-1.77 mg Pb/g of lignin. The activity of cottonseed husk hydrolysis lignin considerably exceeded that of rice husk HL and wood HL, including the medicinal preparation polifepan obtained from wood [7].

Lignins act more effectively than other carbohydrate-containing sorbents such as cellulose, pectin, and hemicellulose. They are not metabolized in the organism by the intestinal flora, thanks to which the sorption activity of lignins is retained in the gastrointestinal tract.

It was established in experiments on animals that the administration of lignin to mice protected the animals from death with a toxic dose of lead. The results obtained and those given in the literature show the promising nature of the investigation of lignin for the creation of preparations ensuring the sorption detoxification of the organism.

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