

The Selectivity of Carbohydrate Conversion into the Levulinic Acid and 5-Hydroxymethylfurfural Derivatives

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Hexose carbohydrates, like cellulose, sucrose and fructose are known to produce levulinic acid (LA) and 5-hydroxymethylfurfural (HMF) in the acid media. The low yield of the products is the great problem of the processes, and the main aim of this paper is to study the mechanism of byproduct, humic substance, formation and to increase the selectivity of the acid-catalyzed conversion of carbohydrates applying the alcohols as extractants of the products.

Hydrochloric acid as the catalyst was found to be twelve times more active, than sulfuric acid at the same $H^0 -2.7$, but the selectivities of the LA formation from glucose were practically the same in both cases (35 – 38 mol. %). Phosphoric acid is too weak to catalyze the process. The comparison of the results obtained indicates that the water activity, but not Hammett acidity function, is responsible for the selectivity of the levulinic acid formation.

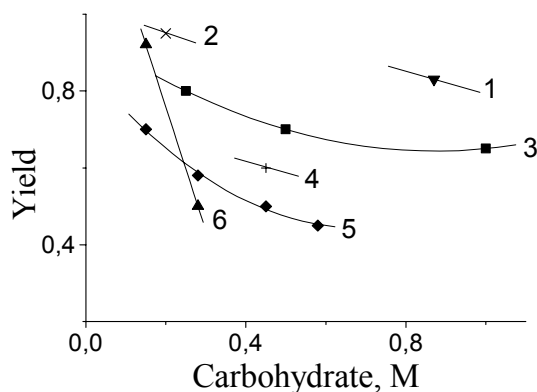


Fig.1. The influences of the carbohydrate concentration on the product yields (mol/mol of carbohydrate) (1-butanol-water-2:1, fructose; 2-DMSO, fructose; 3-water, fructose; 4-butanol-water 2:1, sucrose; 5-water, sucrose; 6-butanol, fructose).

The main products of the acid-catalyzed fructose and sucrose conversion in the butanol solution or in the two-phase system butanol - water are butyl levulinate and 5-butoxymethylfurfural. Under optimum conditions the total yield of the products attains 60 mol. % from sucrose and 83 mol. % from fructose in the two-phase system butanol - water, and these results show the best selectivity described before (see Fig. 1).

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