HiT 2025 HUMIC INNOVATIVE TECHNOLOGIES

Humic substances and plant raw materials in the context of a closed-loop economy

Tenth International Conference of the CIS IHSS

on Humic Innovative Technologies

September 25-27, 2025
Syktyvkar, Russia

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Book of abstracts

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This book contains abstracts of reports from the Tenth International Conference of the CIS IHSS on Humic Innovative Technologies “Humic substances and plant raw materials in the context of a closed-loop economy”. The conference covers a wide range of topics, from the theoretical foundations of the molecular analysis of humic substances and plant raw materials using modern analytical methods, to new applications of artificial humification products and the processing of plant biopolymers within the bioeconomy and circular economy. It also discusses the role of humic substances and soil organic matter components in the carbon cycle in terrestrial and aquatic ecosystems. Particular attention is paid to the use of humic preparations and plant raw materials in nature conservation and biomedical technologies. **Abstracts published in the author's edition.**

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CONTENTS

Study of furan derivatives formation from the carbohydrate raw material under thermal conditions using PY-MS and FTIR spectroscopy methods

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The results of furan structural fragment's formation in *D*-maltose (as model carbohydrate system) thermodestruction products study are presented. Using derivative IR Fourier transform spectroscopy and pyrolysis-mass spectrometry (PY-MS) methods It has been shown that in processes of alkaline cleavage and dry caramelization of the initial carbohydrate the polymeric structures, containing furan heterocycles of varying substitution degree, form as a result of intramolecular condensations.

Formation of furan derivatives from carbohydrate may be presented as scheme Figure 1, **A**, illustrating intramolecular activation by the attack of O(C_2)-atom on the anomeric C_1-centre [1]. Cleavage of glycoside bond provides the monosaccharides and furfural (peaks at m/z = 68, 82, 96 in PY-MS spectra), further condensations lead to polymeric products, which structure depends on reaction conditions and our earlier investigation assume formation of α- and β-furan humic-like systems [2].

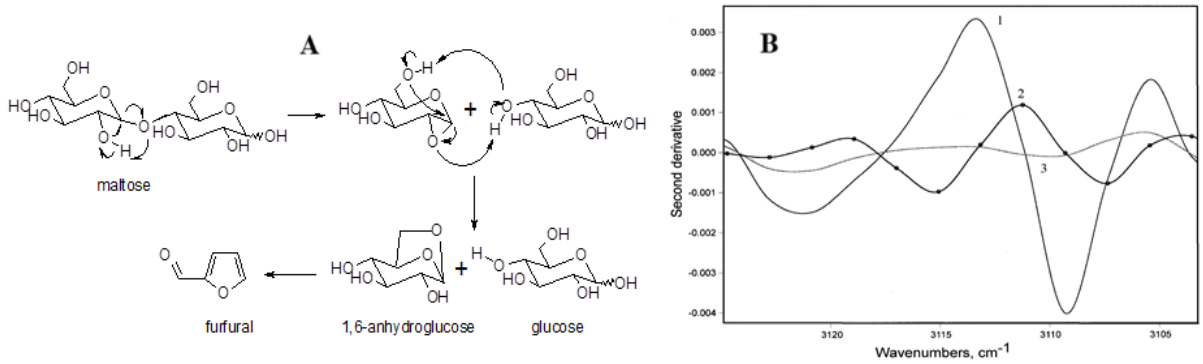

Figure 1. **A**, Proposed furfural formation mechanism; **B,** second derivative FTIR-spectra of solid phases: 1. – maltose alkaline cleavage products; 2. – maltose dry thermodestruction products; 3. – alkaline cleavage products after dry thermodestruction.

Analysis of 3150-3100 cm^{-1} FTIR spectral area of solid phases of various maltose thermodestruction products allows to estimate furan cycles substitution degree [2]. Second derivative FTIR spectra (Figure 1, **B**) show difference between α/β-[=C-H] content in various polymeric furans: alkaline cleavage products (intensive doublet at 3109 and 3122 cm^{-1} in spectrum 1) contain significant part of non-substituted rings (free =C-H bonds), as soon as dry thermodestruction solid phases of initial disaccharide and its alkaline cleavage products (spectra 2 and 3) are more condensed (no sharp signals). It is also postulated, that the [=$C_α$-H]-fragments react by the electrophilic substitution mechanism, but the [=$C_β$-H]-centers transform via oxidative condensation pathway. These experimental facts are in agreement with the literature data obtained [1] and may be used in biotechnologies, perspective as a synthetic platform for biomass transformation to heterocyclic compounds.

References

1. Maliekkal V. et al. Activation of cellulose via cooperative hydroxyl-catalyzed transglycosilation of glycosidic bonds. *ACS Catal*. 2019, 9, 1943–1955.

2. Cherepanov I.S. Carbonization products in *D*-glucose-*p*-toluidin system as sorbents of carbohydrate caramels from aqueous solutions. *IOP Conf. Ser.: Earth Envir. Sci.* 2019, 315(6), 062001.

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