Kyrylov S.K.[1,2], *Bida I.O.*[1], *Havryliuk O.A.*[1],
Hovorukha V.M.[1], *Tashyrev O.B.*[1]
[1]Zabolotny Institute of Microbiology and
Virology of the NAS of Ukraine, Kyiv
[2]National Aviation University, Ukraine, Kyiv

The detoxification of Cr(VI) by methanogens during the fermentation of environmentally hazardous *Solidago canadensis* plant

The spread of harmful weeds in bio- and agrocenoses is a significant environmental hazard. In particular, plants of the *Solidago canadensis* species (Canadian goldenrod) can cause allergic reactions, etc [1]. Another environmental problem is the accumulation of toxic metals in the environment, particularly Cr(VI) compounds [2]. The application of biotechnological approaches is a promising way to solve both problems. The plant biomass of *S. canadensis* can be a useful substrate for the growth of methanogens and biogas synthesis as well as for CrO_4^{2-} detoxification due to it's reduction to insoluble $Cr(OH)_3{\cdot}nH_2O\downarrow$.

In this regard, the aim of the work was to study the effective pathway of Cr(VI) detoxification by the methanogenic microbiome with the simultaneous degradation of *S. canadensis* biomass and CH_4 synthesis.

Thermodynamic prediction was used to justify the optimal pathways of the detoxification of Cr(VI) by methanogenic microbiome. Plant biomass of *S. canadensis* was used as a substrate for the fermentation and as the electron donor for the chromate reduction. As the source of microbiome, the sludge from methane tanks (Bortnytsia aeration station in Kyiv, Ukraine) was used. Fermentation was carried out for 102 days at 30°C. The Cr(VI) solution was added to the bioreactors to final concentrations of 100, 200, and 500 mg/L. The concentration of Cr(VI) was determined spectrophotometrically via the reaction with 1,5-diphenylcarbazide (0.5 % solution).

The efficiency of Cr(VI) detoxification was the highest at a concentration of 100 mg/L and was 100 % with a duration of 5 min. An increase in the concentration of Cr(VI) to 200 mg/L led to the inhibition of the metabolic activity of microorganisms. Under these conditions, Cr(VI) was completely reduced and precipitated in the form of $Cr(OH)_3{\cdot}nH_2O\downarrow$ within 5 days. At a concentration of 500 mg/L, Cr(VI) expectedly significantly inhibited the growth of methanogens. Hence, Cr(VI) precipitation lasted as long as 48 days. Despite the presence of toxic chromium, microorganisms adapted to such extreme conditions, completely reduced and precipitated Cr(VI) and synthesized methane.

Thus, the possibility of the effective detoxification of toxic chromium simultaneously with methanogenic fermentation of *S. canadensis* biomass was experimentally confirmed. The obtained results are promising for the

development of environmental and energy biotechnologies.

1. *Benelli G., et al.* Evaluation of two invasive plant invaders in Europe (*S. canadensis* and *S. gigantea*) as possible sources of botanical insecticides // J. Pest Sci. — 2019. — Vol. 92, — P.805–821.
https://doi.org/10.1007/s10340-018-1034-5
2. *Ishchenko V.* Environment contamination with heavy metals contained in waste // Environmental problems. — 2018. — Vol. 3, 1.
http://ir.lib.vntu.edu.ua//handle/123456789/22840