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

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

Solidago canadensis plants are a promising, cheap and renewable substrate for methane production. In this way, it is possible to solve two global problems: the lack of efficient energy carriers and the disposal of environmentally dangerous plants [1]. In addition, the process of anaerobic fermentation of *S. canadensis* in the presence of an anaerobic microorganisms is promising for the detoxification of heavy metals, in particular Cu^{2+}.

In this regard, the aim of the work was to study the efficient pathway of Cu^{2+} detoxification by the methanogenic microbiome with simultaneous degradation of *S. canadensis* biomass and CH_4 synthesis.

Thermodynamic prediction was used to substantiate the optimal pathways of Cu^{2+} detoxification by the methanogenic microbiome. As a substrate for fermentation and as an electron donor for the reduction of copper compounds the plant biomass of *S. canadensis* was used. As a source of microorganisms the sludge from methane tanks (Bortnytska aeration station, Kyiv, Ukraine) was used. Fermentation was carried out for 102 days at 30°C. The solution of Cu^{2+} was added to the bioreactors to final concentrations of 100, 200, 500 and 1000 mg/L. The concentration of Cu^{2+} was determined titrometrically via the reaction with solutions of surfactant (0.1 %) and EDTA [2].

It was determined that the effective degradation of *S. canadensis* by the methanogenic microbiome occurs with a high methane yield of up to 40 %. The input of Cu^{2+} inhibited the fermentation process, but despite extremely high concentrations of Cu^{2+} up to 500 mg/L, anaerobic microorganisms adapted and continued to grow and produce methane after complete copper immobilization. It was established that during the fermentation of *S. canadensis* by the methanogenic microbiome, the input of Cu^{2+} in concentrations 100, 200 and 500 mg/L Cu^{2+} leads to its 100 % precipitation within 6, 18 and 24 days, respectively. At 1000 mg/l Cu^{2+} concentration complete inhibition of microbiome growth was observed.

Thus, the possibility of effective detoxification of toxic copper simultaneously with methanogenic fermentation of *S. canadensis* biomass has been experimentally confirmed. The obtained results are promising for the development of new ecological and energy biotechnologies.

References

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