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

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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

2. Ishchenko V. Environment contamination with heavy metals contained in waste //