IRON IMMOBILIZATION VIA METHANE FERMENTATION OF *SOLIDAGO CANADENSIS* INVASIVE PLANT

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The accumulation of toxic metals in the environment, particularly iron, is a significant environmental problem. The spread of harmful weeds, in particular *Solidago canadensis* (Canadian goldenrod), in bio- and agrocenoses is another ecological problem. We consider *Solidago* plants to be a promising and free renewable substrate for the production of methane gas and iron detoxification. In this way, we solve three problems of a global level, the lack of energy carriers, metals detoxification as well as the utilization of ecologically hazardous *S. canadensis* plant.

In this regard, the aim of the work was to study the microbial methods of iron immobilization by methanogenic microorganisms and methane production.

The optimal pathways of iron detoxification by methanogenic microbiome were substantiated by the thermodynamic prognosis method. Dried plant material of *S. canadensis* weed was used as a substrate for the methane fermentation and iron immobilization. The methane tank sludge was used as the inoculum to ferment. Fermentation was carried out for 3,5 months at 30 °C. The Fe(III) solution was added to the bioreactor during the fermentation process to final concentrations of 100 and 200 mg/L. The concentration of Fe(II) and Fe(III) was determined spectrophotometrically via the reaction with *o*-phenanthroline for Fe(II) and potassium rhodanide under acidic conditions for Fe(III).

According to the thermodynamic prognosis, anaerobic methanogenic microorganisms are able to immobilize toxic iron compounds with high effectiveness due to the precipitation of Fe(III) as a result of increasing the pH of the medium during methanogenesis as well as due to the precipitation of iron ions by S^{2-} formed during microbial sulphate reduction that accompanies methanogenesis.

The high efficiency of iron immobilization was substantiated theoretically and confirmed experimentally. The effectiveness of iron immobilization at the concentration of 100 mg/L was 100 % within 7 days. An increase of Fe(III) concentration to 200 mg/L inhibited the metabolic activity of microorganisms. Despite this, the effectiveness of Fe(III) immobilization was also 100% with the duration of 50 days. Microorganisms adapted to such extreme conditions, completely immobilized soluble iron compounds and synthesized methane, the concentration of which was 50-60% in the gas phase.

Thus, the high efficiency of toxic iron immobilization and methane production by methanogenic microorganisms during the fermentation of *S. canadensis* plant was experimentally confirmed. The obtained results are promising for the development of environmental and energy biotechnologies.