ABSTRACT

Understanding the differences between the meso- and thermophilic anaerobic digestion process, as well as the factors that affect the shape of the microbiota and its subsequent stability, is crucial in terms of process control and maintenance. Many sciencists are trying to interpret the observed phenomena, but some aspects remain unknown. Therefore, the presented research aimed to determine the effect of methane fermentation temperature on the process dynamics, the direction of the ongoing metabolic changes, and the differentiation of the fermentation reactor microflora.

Dried, powdered maize silage suspended in Hungate buffer with the addition of microelements was used for the study. The inoculation was the post-fermentation pulp from two properly functioning biogas plants – without a history of either instability and the second – dysfunctional, chronically elevated VFA concentration and microelements deficiency. The research was conducted in a batch culture and quasi-continuous feeding system with variable OLR and constant HRT. The structure of the microflora was determined by performing sequence analysis of the hypervariable regions of the 16S rRNA gene using the Ion Torrent platform (Life Technologies, USA).

Process temperature increase did not affect the bioavailability or gas yield of the corn silage, however, it was observed that thermophilic fermentation was characterized by higher dynamics of biomass decomposition and biogas production by up to 24%. Additionally, it has been proven that the temperature and the heating rate significantly affected the microbiota composition, leading to SAO pathway dominance at 52°C, while in mesophilic conditions the majority were hydrolytic-fermenting bacteria. Previous inoculum dysfunction may be critical for process stability and adaptability to changing OLR conditions and temperature due to the depletion of microflora, and an increase in stability can be ensured by supplementing with highly biodiverse inoculum.

05.07.2023
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