MONITORING THE ANAEROBIC DIGESTION OF MEAT INDUSTRY SLUDGE WITH DIELECTRIC PARAMETERS

Zsófia Gréta Sánta[1,2], Balázs Lemmer[2], Zoltán Péter Jákói[1,], Juhász Blanka[2] Sándor Beszédes[1]

[1]Department of Biosystems Engineering, Faculty of Engineering, University of Szeged, Moszkvai krt. 9, H-6725 Szeged, Hungary
[2]Department of Food Engineering, Faculty of Engineering, University of Szeged, Moszkvai krt. 5-7, H-6725 Szeged, Hungary
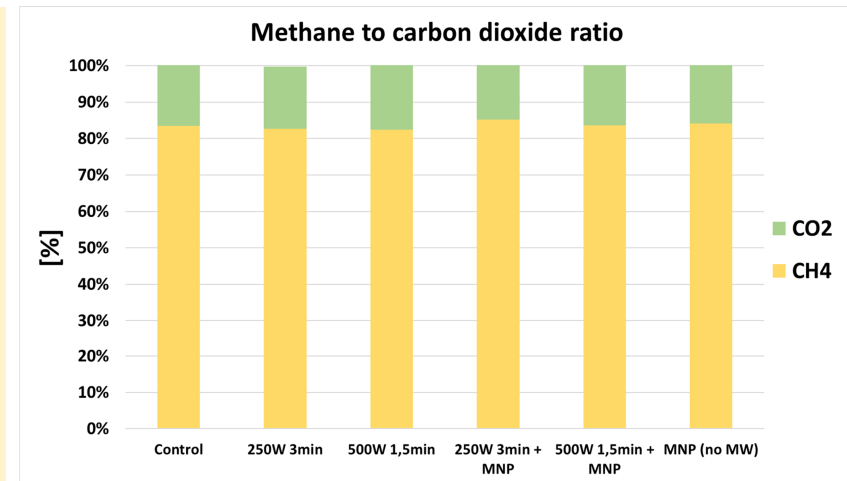*e-mail: zsofiasanta71@gmail.com*

Abstract

Our goal was to investigate the effect of different pretreatment methods on the quantity and methane content of biogas produced during the anaerobic digestion of sewage sludge from meat processing plants, while also monitoring the fermentation process. Before the fermentation we added magnetite nanoparticles (MNP) to the sludge and then irradiated it with microwaves at different power levels to enhance digestibility. We monitored the progress by measuring the dielectric properties of the sludge samples.
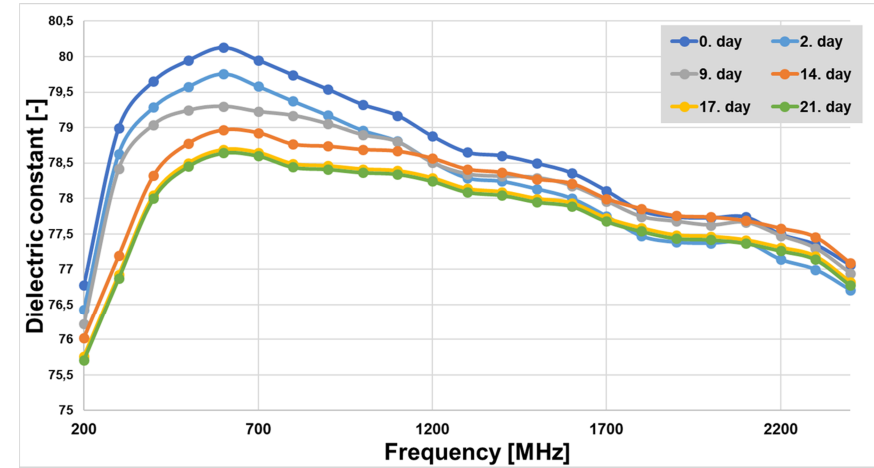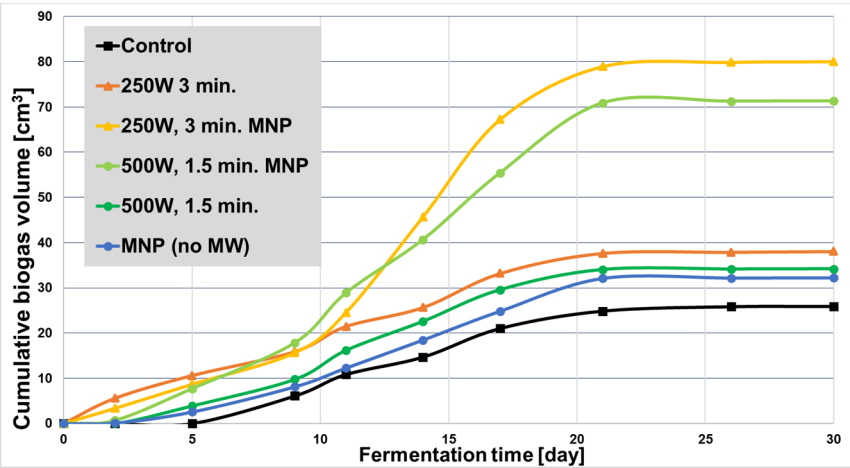
Results and discussion

Our results demonstrate that the most effective pre-treatment was the one combined with magnetite particles at 250 W for 3 minutes, which produced more than three times as much gas as the control sample. The two pre-treatments together were more effective than either microwave treatment or nanoparticle treatment alone. This suggests that the effects of the two pre-treatments are additive. One form of this is likely to be that the magnetite nanoparticles act as hotspots during heating and successfully eliminate the temperature inhomogeneities. Regardless, the presence of metal nanoparticles stimulated gas production even without microwave heating, suggesting that the presence of iron plays a role in microbial metabolism. Not only did the treatments have a beneficial effect on the volume of gas produced, but they also catalyzed the initiation of gas production: gas production started several days earlier in treated samples than in untreated ones. The CH_4-CO_2 ratio determined across all samples averaged 83%±2.7% in favor of methane, so there was no significant difference between the gas quality of the treated samples and the control. In other words, the applied pretreatments increased the volume of gas produced without having a negative effect on its methane content, so the amount of CH_4 produced increased notably as a result of these treatments. It can also be seen from the results that the maximum value of the dielectric constant decreases steadily as the fermentation proceeds. This decrease is present regardless of the pre-treatment and follows a second order trend. This means that we can consider the measurement of dielectric properties. a non-destructive and real-time monitoring method for sewage sludge fermentation monitoring.

Methane to carbon dioxide ratio

```
Enhancing the             Microwave irradiation
biodegradability of the   with magnetite
sewege sludge      →      nanoparticles
```

```
Monitoring of the         Observation of
fermentation       →      dielectric properties
```