AQUAFIX
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Impact of Ana-Zyme P on the Anaerobic Digestion of Dairy Farm Manure

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Study Summary

- Ana-Zyme P is a product designed for anaerobic systems to break down complex proteins into free amino acids
- This study was designed to evaluate the impacts of Ana-Zyme P on biogas generation in a mesophilic dairy manure digester supplemented with fats, oils, and greases (FOG)
- Testing was a BMP style test at 97°F (36°C) run for 56 days. Biogas generation was tracked throughout the study
- This study compared a 5-ppm, one-time addition of Ana-Zyme P to a control (no additive)
- The sample containing Ana-Zyme P reached a peak methane generation of 13 (mL CH_4/g VS) after the 56-day period which was a 3.3x increase in gas generation versus the control (diagram above)

333%

Increase in methane generation with Ana-Zyme P

VS. The Control

Methane generation with and without Ana-Zyme P

Background

A dairy farm in Oregon was interested in anaerobic digestion in order to use dairy manure to produce biogas. This plant commissioned "Digester Doctor Laboratories" to run a methane optimization study to maximize methane yield from the manure. Dairy cow food, which is often predominantly composed of grasses and corn silage feed, is often supplemented with high protein additives, like soybeans, to improve milk production. However, this leads to excess proteins being released in cow manure which are often difficult to degrade in anaerobic digesters.

Proteins can be a valuable food substrate in anaerobic digestion due to their amino acid content. In anaerobic digesters, free amino acids can help to stimulate enzyme production leading to more complete degradation of anaerobic substrates, such as dairy manure and FOG. However, the proteins that contain these amino acids are difficult to degrade. These proteins are also relatively low in carbon content. This means anaerobic bacteria typically favor the degradation of other substrates, such as fats or sugars, because of their high energy yield over proteins.

Production of enzymes is more efficient from free amino acids than other nitrogen sources like urea. Urea and ammonia are needed to synthesize free amino acids for producing proteins, adding an extra step for enzyme production which can limit anaerobic digester efficiency.

These concepts led us to perform this study on Ana-Zyme P to see if its ability to degrade proteins could help improve methane production in a dairy manure facility. Ana-Zyme P is a biocatalyst product designed specifically for breaking down complex proteins to improve the availability of free amino acids.

Objective

To determine the effects of Ana-Zyme P on biogas generation in a dairy manure digester supplemented with FOG.

Methods

In this study, we used a BMP style test to measure methane generation with Ana-Zyme P compared to a control. The BMP test was performed by "Digester Doctor Laboratories." The samples used in the study were high-solids dairy manure that was supplemented with FOG at a 4:1 ratio with 4 parts FOG to 1 part manure. BMP tests were run in 500 mL bottles maintained from pH 6.8-7.2 in all reactors throughout the duration of the experiment. The temperature in the reactors was kept at 97°F (36°C). Ana-Zyme P was added to the test reactors with a 1-time dose of 5 ppm at the beginning of the test run. All reactors were run in triplicate to ensure consistency. Results were analyzed by Aquafix Inc. Laboratories.

Discussion and Conclusions

Overall, we did observe increased methane production with the addition of Ana-Zyme P versus our control. We also observed better-sustained methane production. This suggests that Ana-Zyme P contributed to the greater bioavailability of nutrients, likely due to the improved degradation of proteins into free amino acids. However, increased availability of nutrients may have led to a longer lag period before the first large methane generation spike around 27 days with Ana-Zyme P (figure 1). This spike is most likely because anaerobic bacteria generally need a greater acclimation time to deal with higher loading rates. It should also be noted that the reactor was seeded with cow manure as its inoculum. Cow manure is not as well acclimated for a BMP test as a sample collected from a mixed mesophilic digester which accounts for the limited total methane production in this trial.

Another interesting note was the peak of methane production in our control reactor that occurred quite early in the test and then all production of methane ceased. This suggests the feed substrate may have been missing some key nutrients for the production of methane. Missing specific nutrients could potentially cause anaerobic bacteria to be unable to produce enzymes necessary for the degradation of food substrates such as FOG.

In our reactors with Ana-Zyme P, we also saw a somewhat unusual production of methane. After the initial lag period of the study, we noticed a large spike in methane production around 26-30 days and 36-40 days. During other periods, the production of methane appeared slow and steady. This likely suggests that while our Ana-Zyme P reactors may have also been hindered by nutrient deficiencies, the anaerobic bacteria present were able to overcome this hurdle and develop other pathways for the production of methane. We are currently planning future trials of this test in which micronutrients are supplemented to more directly monitor the effects of Ana-Zyme P on methane production rates.

Methane Accumulation in Dairy Manure Reactors

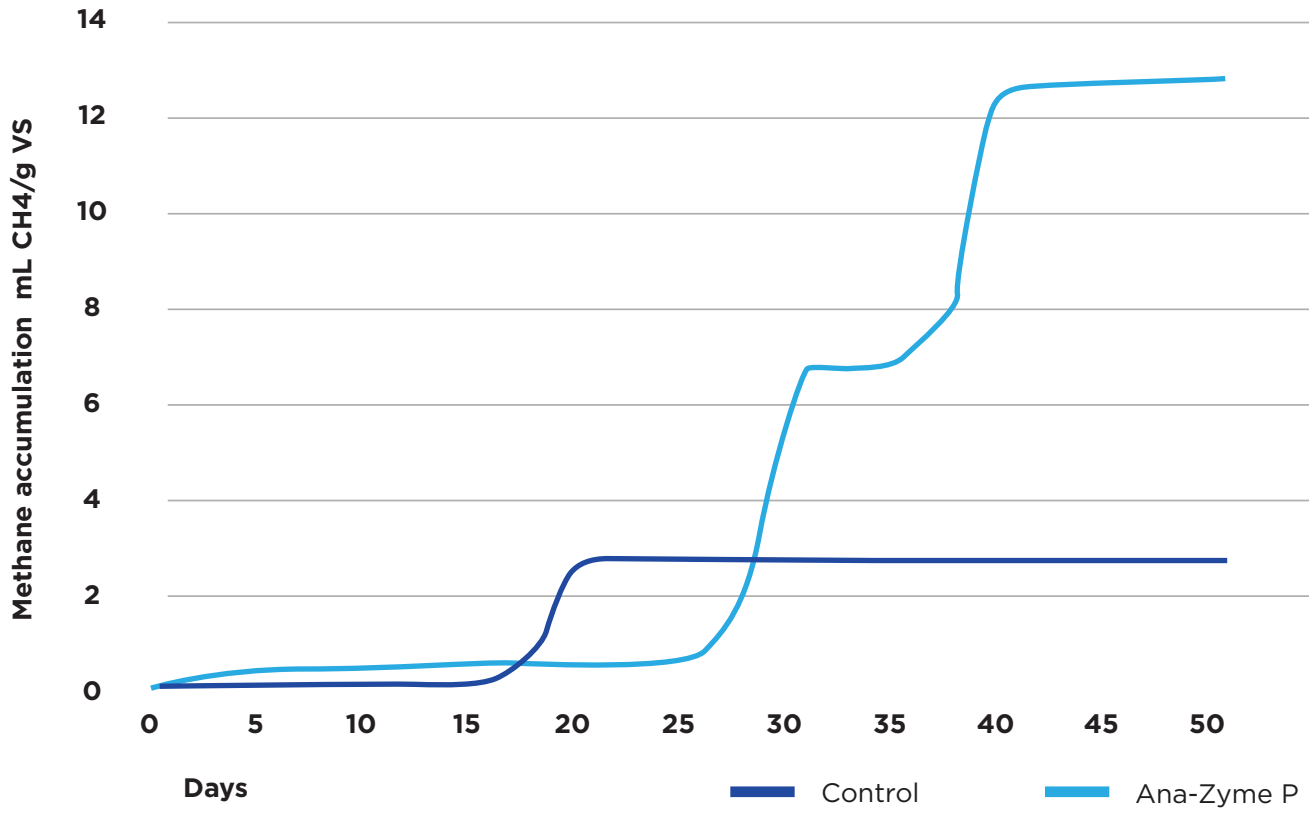

Figure 1. We observed cumulative methane generation of 3 mL CH4/g VS with our control verses 13 mL CH4/g VS with Ana-Zyme P. This reflects a 3.3x increase in methane production in our reactors with the addition of Ana-Zyme P. The reactor with Ana-Zyme P did have a somewhat longer acclimation period before its first methane production spike versus the control. However, methane production was sustained for 56 days with Ana-Zyme P versus 21 days with the control. It is possible that methane production would have continued with Ana-Zyme P past the 56-day duration of the test.

Notes

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