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Effect of domestication on microorganism diversity and anaerobic digestion of food waste

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ABSTRACT. To accomplish the rapid start-up and stable operation of biogas digesters, an efficient inoculum is required. To obtain such an inoculum for food waste anaerobic digestion, we domesticated dairy manure anaerobic digestion residue by adding food waste every day. After 36 days, the pH and biogas yield stabilized signifying the completion of domestication. During domestication, the microbial communities in the inocula were investigated by constructing 16S rDNA clone libraries. We evaluated the effect of the domesticated inoculum by testing batch food waste anaerobic digestion with a non-domesticated inoculum as a control. The pH and methane yield of the digestion systems were determined as measurement indices. Domestication changed the composition and proportion of bacteria and archaea in the inocula. Of the bacteria, Clostridia (49.3%), Bacteroidales (19.5%),

and Anaerolinaceae (8.1%) species were dominant in the seed sludge; Anaerolinaceae (49.0%), Clostridia (28.4%), and Bacteroidales (9.1%), in domestication sludge. *Methanosaeta* was the dominant genus in both of the seed (94.3%) and domestication (74.3%) sludge. However, the diversity of methanogenic archaea was higher in the domestication than in seed sludge. *Methanoculleus*, which was absent from the seed sludge, appeared in the domestication sludge (21.7%). When the domesticated inoculum was used, the digestion system worked stably (organic loading rate: 20 gVS/L; methane yield: 292.2 ± 9.8 mL/gVS; VS = volatile solids), whereas the digestion system inoculated with seed sludge failed to generate biogas. The results indicate that inoculum domestication ensures efficient and stable anaerobic digestion by enriching the methanogenic strains.

Key words: Food waste; Biogas; Inoculum; Domesticated inoculum