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Short Communication

Batch anaerobic co-digestion of Kimchi factory waste silage and swine manure under mesophilic conditions

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HIGHLIGHTS

- Kimchi factory waste silage (KFWS) was prepared by mixing Chinese cabbage (CC) and rice bran (RB).
- The KFWS produced significantly higher ($p < 0.01$) biogas and methane than CC.
- The biogas and methane yield was higher using a mixture of KFWS and swine manure (SM) than SM alone.
- The volatile solids (VS) removal was higher using a mixture of KFWS and SM than SM alone.
- Co-digestion of KFWS with SM could be promising to improve biogas production from SM digesters.

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ABSTRACT

The objective of this study was to investigate the feasibility of anaerobic co-digestion of Kimchi factory waste silage (KFWS) with swine manure (SM). Chinese cabbage (CC) is the major waste generated by a Kimchi factory and KFWS was prepared by mixing CC and rice bran (RB) (70:30 on a dry matter basis). In Experiment I, the biogas potential of CC and RB were measured and, in Experiment II, the test was conducted with different ratios of KFWS and SM (KFWS: SM = 0:100; 33:67; 67:33; 100:0 by% volatile solids (VS) basis). KFWS produced a 27% higher biogas yield and a 59% higher methane yield compared to CC. The specific biogas yields increased by 19, 40 and 57% with KFWS-33%, KFWS-67% and KFWS-100%, respectively compared to SM-100% (394 mL/g VS). Similarly, VS removal increased by 37, 51 and 74% with KFWS-33%, KFWS-67% and KFWS-100%, respectively compared to SM-100%. These results suggested that Kimchi factory waste could be effectively treated by making silage, and the silage could be used as a potential co-substrate to enhance biogas production from SM digesters.

1. Introduction

Kimchi is prepared by fermenting Chinese cabbage (CC). There are many Kimchi factories in Korea and a large quantity of waste is generated from each factory during the trimming processes. Choi and Park (2003) reported that the total annual production of CC is approximately three million tons in Korea and up to 30% of the total production is discarded as waste. Anaerobic digestion could be a good approach for CC waste utilization and energy generation; however, CC waste is seasonal and it may accumulate in quantities larger than needed for immediate use. The high moisture content (>95%) in CC causes fast spoilage, thus ensiling has been envisioned for storage before biogas production (Herrmann et al., 2011; Zubr, 1986). Since CC has too high of a moisture content (>95%) for ensiling, its moisture content needs to be reduced by drying or maceration or mixing with the other feed materials with a low moisture content. Like CC, rice bran (RB) is an agricultural byproduct, which is produced in large quantities by rice processing industries. RB has a low moisture contents (10–15% w.b.), can be preserved for a long time, and could be mixed with CC in order to maintain a suitable range of moisture contents for silage preparation.

Anaerobic digestion tends to fail without the addition of external nutrients and buffering agents (Demirel and Scherer, 2008); therefore, co-digestion with substrates having a high buffering capacity (alkalinity) such as manure can be a good alternative for effective treatment of highly biodegradable materials. Therefore, the objective of the present study was to determine the feasibility of anaerobic co-digestion of Kimchi factory waste silage (KFWS) with swine manure (SM). The biogas potential of CC, RB, and KFWS and of KFWS mixed at different ratios with SM was determined for mesophilic conditions.

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