**Assessing the fate of nitrogen in a novel food waste anaerobic digestion process: Production of digestate with reduced ammonia content.**

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**Highlights**

* Conversion of food waste to biogas and eco-friendly digestate
* SBO addition enhanced biomethane production reducing the content of NH3
* Effects of temperature and assessment of nitrogen’s fate in the process

**1. Introduction**

Food waste (FW) is a valuable feedstock utilized as a renewable substrate for obtaining a wide variety of bio-based products [1]. However, the conversion of FW into biogas requires secondary treatment, since the process produces high contents of NH3 in the digestate, constituting a common inhibitor in bio-waste anaerobic digestion (AD) systems. Excess NH3 can be reduced through the use of SBO isolated from compost of gardening residues [2]. Many studies have shown promising applications of SBO as chemical auxiliary in the chemical industry and in agriculture. Some existing examples in the relevant literature comprise the use of SBO for textile dyeing [3], detergents manufacturing [3] and hydrocarbons contaminated soil washing [4].

The present study has been carried out within the LIFECAB project funded under the 2016 LIFE program. It aims to evaluate at pilot-scale a novel FW fermentation technology that involves four-steps, including: 1) use of FW as feedstock in two pilot anaerobic digesters, 2) co-composting of the digestate produced with green waste, 3) chemical hydrolysis of the compost generated to produce SBO, and 4) implementation of SBO in AD for enhanced biogas formation and production of digestate with reduced NH3. The technology will be tested in 3 EU countries (Italy, Greece and Cyprus) through the production of eco-friendly cost-effective biogas and agricultural products. The study will assess the fate of NH3 removed with the use of SBO in lab-scale experiments and to present preliminary data obtained from the pilot system.

**2. Methods**

*Composting:* Green waste was used for composting comprising grass clippings, dry leaves, wood sawdust, tree prunings and soil. The analytical methods applied included monitoring of the organic carbon content, pH, TS, VSS, ash, temperature, phytotoxicity, conductivity and moisture content, water holding capacity, phosphorus content and heavy metals.

*AD experiments:* Lab-scale experiments were conducted for FW fermentation to produce biogas and digestate with low NH3 content. SBO was provided from Acea Pinerolese Industriale (Pinerolo, Italy). Four treatments were tested: A) Anaerobic sludge (AS) as control, B) AS with SBO, C) AS with FW, and D) AS with FW and SBO. The amount of SBO used in each treatment was 0.2% (w/w) and the temperatures applied were 30 °C and 55 oC. Gas samples were analysed for CH4, CO2, H2, N2, O2 and N2O using Gas Chromatography. Furthermore, the samples were passed through sorbent tubes (DRAGER tubes) for the determination of NO, NO2 and NH3.

**3. Results and discussion**

Lab-scale experiments were conducted under anaerobic conditions for evaluation of nitrogen’s fate in the novel SBO-based process. Four treatments were tested as described above and the gas samples collected were analysed for CH4, CO2, H2, N2, O2, N2O, NO, NO2 and NH3. The data obtained from these experiments (Figure 1) demonstrated higher production of biogas and CH4 in SBO assisted fermentations. Moreover, the GC analysis performed showed a small production of N2O at the initial stages of experiments and small concentrations of N2 at the final stages of experiments fed with FW. However, no detection of NO, NO2 and NH3 was observed in the gas phase, excluding the formation of the specific molecules due to the addition of SBO. Results from preliminary composting trials in three different countries will be also presented.

**Figure 1.** Cumulative volume analysis of CH4 during lab-scale experiments. Coloured symbols correspond to: (I) control (blue), (II) AS and SBO (red), (III) AS and FW (green), and (IV) AS, FW and SBO (purple).

**4. Conclusions**

Based on the findings obtained, the fermentation of FW coupled to SBO is capable of significantly reducing the ammonia content of the digestate, producing elevated quantities of methane. Thus, the proposed technology improves both energy efficiency and the environmental footprint of AD.

**References**

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