

Biogas production from pressure sterilized organic wastes having a low- or high-lipid content

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Organic wastes with a low (cattle blood, crabs, grape marc, pomegranate peels) or high lipid content (slaughterhouse wastes category 2 and 3, animal fat and vegetable oils) were digested in batch anaerobic reactors. The waste samples were obtained from a full-scale waste processing facility implementing pressure sterilization at 135 °C, 3-4 bar and 30 min reaction time. The anaerobic degradability of the samples was assessed at mesophilic conditions under organic loading of $0.7 \pm 0.2 \text{ gCOD g}^{-1} \text{ MLSS}$. The seed sludge originated from a full-scale anaerobic digester treating animal wastes and it was characterized in terms of acetic, propionic, butyric and valeric acid degradation (see Figure 1a). The biogas yield of all pressure sterilized wastes was on average $0.50 \pm 0.07 \text{ L g}^{-1} \text{ COD}$ with a methane content between 65 – 75%. Wastes having a low lipid content (Figure 1b) recorded the maximum biogas production rate equal to $230 \pm 5 \text{ mL g}^{-1} \text{ COD d}^{-1}$ which decreased to $23 \pm 6 \text{ mL g}^{-1} \text{ COD d}^{-1}$ when animal fat and vegetable oils were used as the sole substrates (Figure 1c). Indeed, animal fats and vegetable oils display low solubility and thus bioavailability as demonstrated in the study of Long et al. (2012) and Fernandez et al. (2005). Co-digestion of animal fat with slaughterhouse wastes resulted in a significant increase of the maximum biogas production rate ($133 \pm 15 \text{ mL g}^{-1} \text{ COD d}^{-1}$) similar to the slaughterhouse wastes alone (Figure 1c and d).

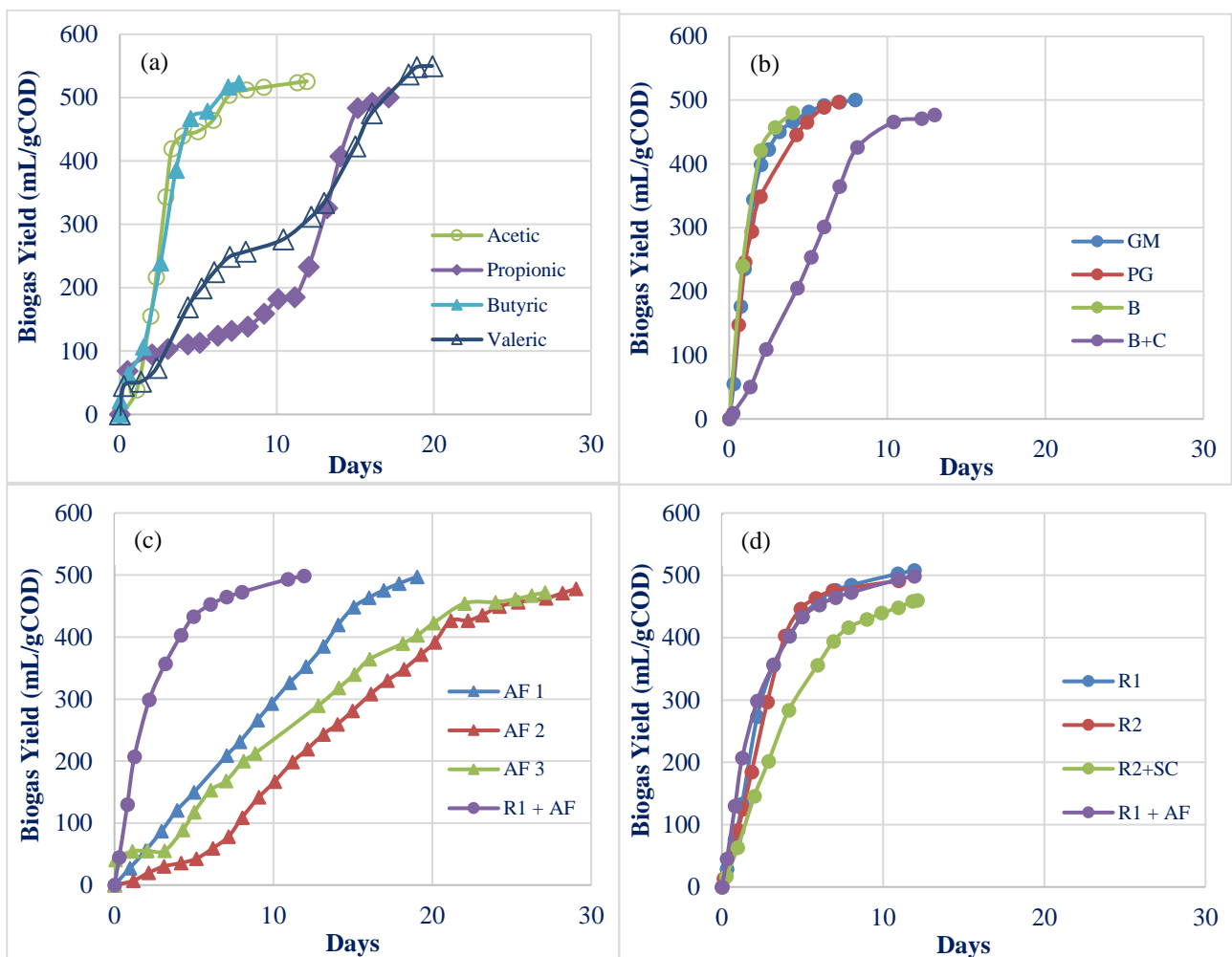


Figure 1. Biogas yield values during the anaerobic digestion of (a) volatile fatty acids (acetic, propionic, butyric and valeric acid), and organic wastes with (b) low and (c and d) high lipid content (GM – grape marc, PG – pomegranate peels, B – Blood from cattle, C – crabs, AF – Animal fat, R – Slaughterhouse wastes, SC – stomach content).

Based on the results of this study it can be concluded that:

- (1) Pressure sterilized organic wastes resulted in high biogas yield values.
- (2) Pomegranate peels, grape marc (carbohydrate-rich substrates) and cattle blood (protein-rich substrate) were characterized by a low lipid content and displayed the highest biogas production rate.
- (3) Animal fat and vegetable oil were characterized by extremely low biogas production rate due to their low solubility and bioavailability.
- (5) When crabs and stomach content were digested the maximum biogas production rates decreased significantly.
- (6) Co-digestion of animal fat and slaughterhouse wastes resulted in high biogas production rates, compared to animal fat alone, indicating the importance of lipid emulsification in the anaerobic digestion process.

References

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