Effect of $NaHCO_3$ addition on the anaerobic co-digestion of fruit and vegetable waste and sewage sludge performance

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HIGHLIGHTS

- Digestion of FVW residues with sewage sludge is feasible as long as the FVW to sludge ratio fed to the batch digester is not too large.
- The pH is the main variable determining the reactor performance and can be controlled by $NaHCO_3$ addition.

Keywords
Anaerobic co-digestion; fruit and vegetable wastes; sewage sludge alkalinity addition; waste management

INTRODUCTION

Fruit and vegetable solid wastes (FVSWs) are generated in large quantities around the world. These residues are sometimes accumulated at the vicinities of greenhouses leading to serious problems such as pests, foul odour and other unhealthy conditions due to their high biodegradability (Bouallagui et al., 2005). The digestion for the production of biogas is one of the best alternative management procedures since it simultaneously allows energy recovery and material recycling if the digestate can be used for soil amendment. Nevertheless, the generation of this kind of residues is frequently concentrated in only few weeks per year, imposing a serious economic limitation. Thus, co-digestion with the sewage sludge at the wastewater treatment plant can represent a very interesting alternative (Arhoun et al., 2013).

In this sense, the aim of the present study was to evaluate the feasibility of the anaerobic co-digestion of fruit and vegetable waste and sewage sludge and determine the optimum ratio of FVSW to sludge and alkalinity with varying $NaHCO_3$ dose.

METHODS

In this study, all the experiments were carried out in duplicates and performed in 60 mL glass vials, which were placed in a Gallenkamp orbital incubator at 30 rpm and 35 ºC. A mass of 25 g of the desired ratio of sludge to FVSW was introduced in the vials. In a first series of experiments the influence of the ratio of sludge to FVSW was studied. Another series of experiments was performed in order to analyze the effect $NaHCO_3$ dose on the production of methane.

RESULTS AND DISCUSSION

The results from batch anaerobic digestion tests, shown on Figure 1, indicate that no methane production is obtained when the initial composition consists of 50% or more FVSW. All the pH values are between 3.5 and 6.5. An increase of this value is observed as the amount of sludge increases. Most probably, the very little methane production for the larger ratios of FVSWs is related to these acidic values since the ideal pH range for anaerobic digestion is between 6.8 and 7.2.

When the pH drops below 6.6 the growth rate of these bacteria is greatly impaired (Ward et al., 2008).

Therefore, the pH value should be controlled in order to optimize the conditions for the methane production. To achieve this pH control $NaHCO_3$ was selected. The results for a ratio of 50% sludge together with 10 g $NaHCO_3$/kg of residue are among the best obtained, with a total methane production (TMP) of about 90 L/kgSV, and a methane concentration of 40% (v/v) of the biogas. In this conditions it was achieved a 50% reduction of the total solids, 21% reduction of the volatile solids (in terms of total solids), and 6.9 pH value of the sludge.

Finally, we can conclude that the ratio of FVW to sludge and the pH control are the main variables determining the methane production and concentration.

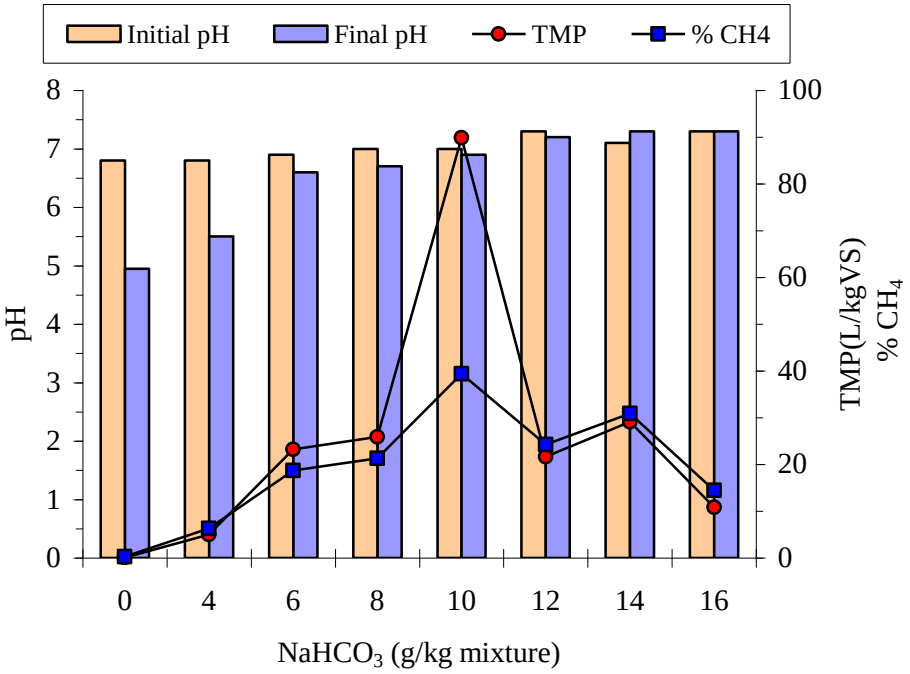

Figure 1. Effect of different alkali doses addition (50 % Sludge)

ACKNOWLEDGEMENTS

The authors acknowledge the economic support from the Agencia Española de Cooperación Internacional para el Desarrollo (AECID), through the Proyect: "Aprovechamiento de residuos vegetales generados en invernaderos de la zona de Tanger A/023239/09".

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