ENERGY RECOVERY OF WASTE FROM THE FOOD INDUSTRY

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INTRODUCTION

Currently, alternative energy sources are required to those already conventional, motivated to the need to protect the environment. One of those alternatives is using waste for the production of biofuels within the so-called circular economy. The food industries, such as dairy and bakery industries, generate large quantities of by-products. Thus, approximately 90% of the amount of milk destined for cheese production is converted to whey, reaching up to 78,000-100,000 m /year in the Canary Islands, therefor uncontrolled dumping can cause serious pollution problems. Likewise, 2-3% of the mass of bread produced becomes waste, and considering that in Spain 34.12 kg of bread/person/year are produced, approximately 32,000 t/year of waste are generated. In addition, 4,850,000t of cereals are transformed into flour [1], of which 25% is converted into waste (bran) that is currently sent to farmers through specific agreements [2].

OBJECTIVES

Study of biogas production from the anaerobic fermentation of the different wastes from these food industries.

EXPERIMENTAL

Wastes food industries

- Whey
- Bread
- Wheat bran

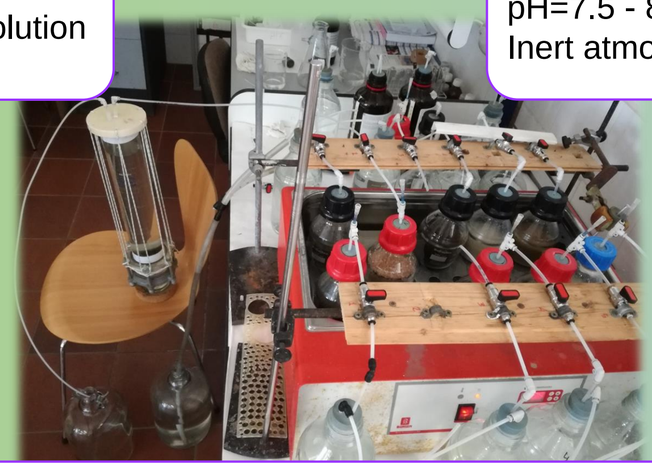
Inoculum

- Sludge

Anaerobic fermentation

Distilled water
NH_4Cl
Buffer solution
$CaCO_3$

T= 32 ºC
pH=7.5 - 8.5 (NaOH)
Inert atmosphere (N_2)



Biogas production finished → pH reduction →reactivated with NaOH

Biogas analysis

- Volume
- Composition → Gas chromatograph (Agilent Technologies 7820A)

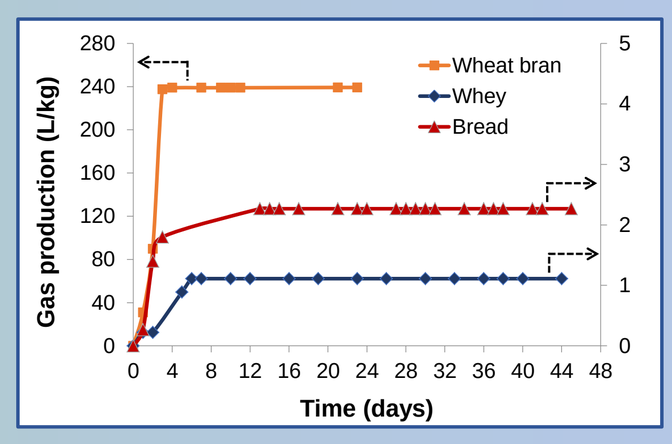
RESULTS AND DISCUSSION

Digestate characteristics				
Waste	Initial		After Digestion	
	Total Solid (TS),%	Volatile Solid (VS),%	Total Solid (TS),%	Volatile Solid (VS),%
Wheat bran	89.3	91.0	6.1	62.7
Whey	7.8	81.0	---	---
Bread	59.9	96.3	15.3	65.2
Sluge	3.8	72.0	3.3	63.6
Wheat bran + Sludge	44.0	90.0	8.7	59.1
Whey + Sludge	4.8	74.1	5.6	42.1
Bread + Sludge	39.8	95.1	15.5	75.2

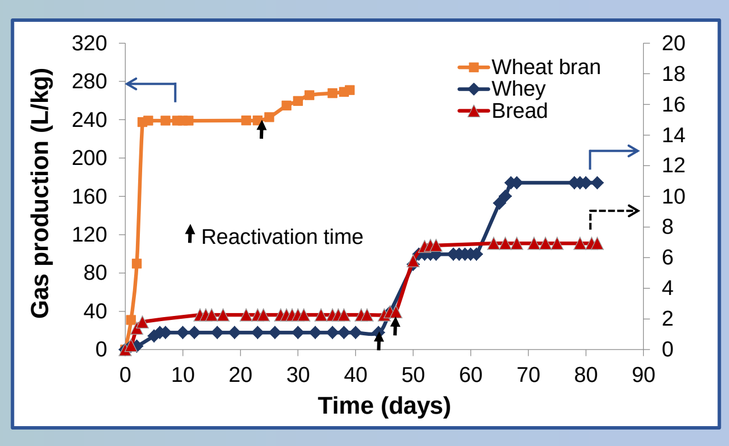
- A decrease in both total solids and volatile solids is observed, but the concentration of volatile solid in the digestate resultant from the process indicates that they still have solid to be digested.

Biogas Production

Digestion without inoculum

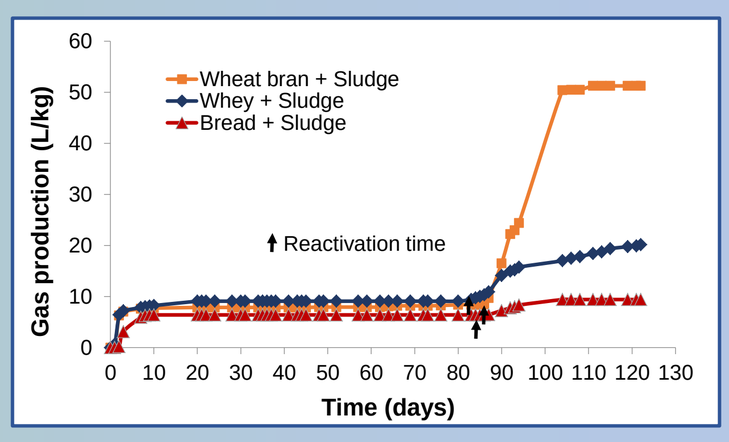


- The highest gas production without reactivation is obtained for the wheat bran, 240 L/kg in 4 days.



- The reactivation doubles/triples gas production for bread /whey.
- For the wheat bran the increase is only 10%, 280 L / kg.

Digestion with inoculum



- The presence of the inoculum stimulates the production of gas, for the whey and bread, almost doubling the production obtained without inoculum for the whey.
- When wheat bran is studied, the inoculum inhibits the digestion to a fifth of the one that is obtained with only wheat bran.

Biogas Composition

- Inoculum digestion produces some methane, the rest of the biodigesters generate only CO_2 that could be used for BioDME production.

CONCLUSIONS

The high production of CO_2 by the wheat bran is of great interest for bioDME production. It seems appropriate to carry out a more in-depth study by changing the inoculum to promote methane production in order to obtain biogas.

References

[1] D. Manzanares, La Industria harinera en España. Asociación de Fabricantes de harina y sémola de España. 24 de Mayo 2016.

[2] I. Dupuis, (2015). Instituto Canario de Investigaciones Agrarias. Evaluación de subproductos agroalimentarios para la alimentación animal en Canarias, 2015.

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