Anaerobic digestion of tuna waste to produce volatile fatty acids

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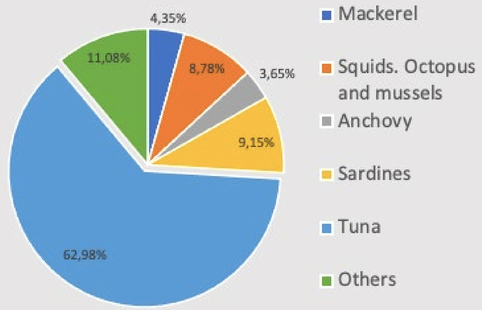
INTRODUCTION

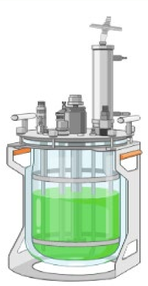
- Spain is the second largest world producer and the largest producer in EU of canned tuna.



- The solid waste produced during the manufacturing process consists of offal, tails, heads and guts. This is a good candidate for anaerobic digestion (AD) because it contains high levels of potentially biodegradable materials.
- In recent years, the Volatile Fatty Acids (VFA) generated during the AD have gained attention due to their possible use in many industries. For example, for biodegradable polymers production, nutrient removal in wastewater treatment plants (WWTP) or as a substrate for microbial fuel cells (MFC).
- VFA production through acidogenic fermentation of organic wastes can be affected by several factors, such as the nature of the substrate and its concentration, hydraulic retention time (HRT), temperature or pH.

OBJETIVE

The aim of this research was to study the effect of various **pHs**, ranging from 5.0 to 10.0, and percentage of **total solids** on the anaerobic digestión (AD) of tuna waste into VFA, both in batch assays and continuous reactor



MATERIAL AND METHODS

➢ Substrates and inoculum

- The **waste** used came from a tuna cannery industry in Galicia (Spain).
- The **inoculum** used in the batch assays and for the acidogenic reactor was collected from an anaerobic digester fed tuna waste and operated to produce biogas.

1. The residue was dried in an oven at 100ºC 24-48 h.
2. Tuna waste was triturated to a size < 2mm. The composition is shown in Table 1.

	Tuna waste
g COD/g waste	1,29
g TS/g waste	0,96
g VS/g waste	0,84
g N/g waste	0,10
g C/g waste	0,51
g fat/g waste	0,29
g Protein/g waste	0,63
C/N	5,10

Table 1. Composition of the dried and grounded tuna residue

➢ Batch assays

The batch assays were performed in glass flasks of 120 ml with a working volume of 50 ml by triplicate.

- The initial pH values were adjusted from 5 to 10 by adding NaOH or HCl.
- After introducing the medium, the grounded waste and the inoculum in the vials, the headspace was flushed with N_2/CO_2 (80/20, v/v) and Na_2S was added as reducing agent (1mM).
- The vials were then incubated at 37ºC and a blank test.

➢ Lab-scale reactor

- The reactor (2 L) was inoculated with 26,41 g VS/L of anaerobic sludge. The temperature was maintained constant at 37ºC.
- Acidogenic fermentation was conducted at different pHs (5-10). The pH was controlled through the addition of NaOH sol. and it was maintained with continuous stirring at 120 rpm.
- The reactor was started up with an OLR of 2 g COD/L d, which was maintained for 40 d. Then increased to 4 g COD/L d.

RESULTS AND DISCUSSION

➢ Batch experiments

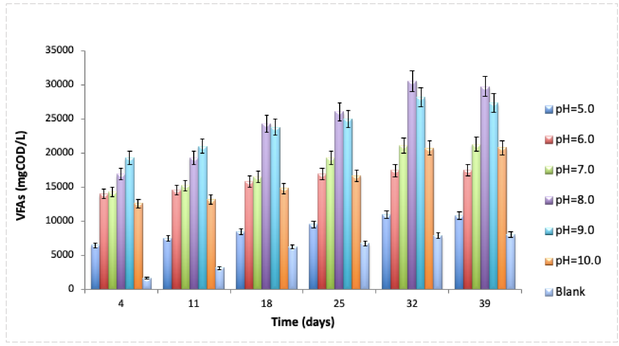


Figure 1. Evolution of VFA production over time

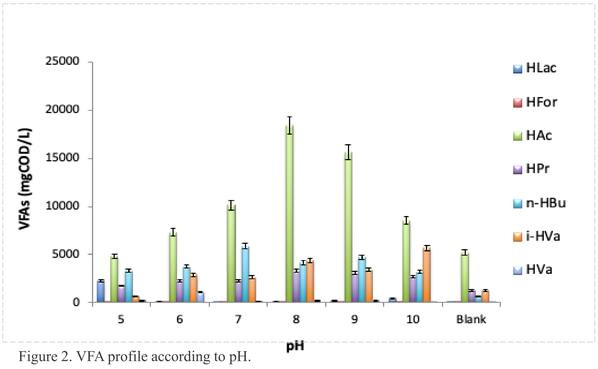


Figure 2. VFA profile according to pH.

✓ Higher % of acidification at **alkaline pH**.
✓ VFA concentrations **greater than 25000 mg DQO/L** (Fig. 1).
✓ The maximum acidification was achieved at the **lowest TS content**, reaching 0,73 g COD-VFA/g COD waste.

✓ The maximum concentration of VFA as COD was achieved at **pH 8** (30611 mg VFA_COD/L).
✓The VFA profile under these conditions was dominated by **acetic acid** (Fig. 2).

➢ Lab-scale reactor

- A semi-continuos reactor was used to compare the results in continuous mode with the results obtained in the previous bach experiment.

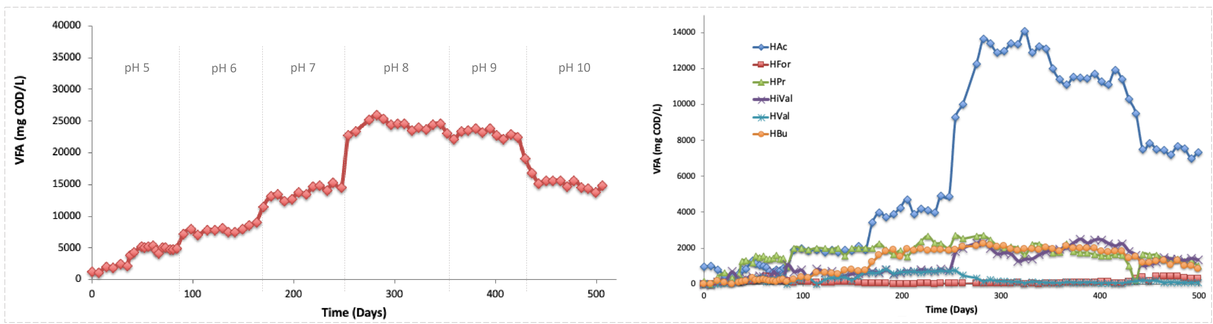


Figure 3. Effect of pH (5-10) on the concentration of VFA in a acidogenic reactor.

✓The VFA production increased gradually with the pH, with the **same trend** as observed in the batch assays and the máximum acidification was obtained at **pH 8.**
✓The VFA profile was dominated during all the experiment by acetic acid (Fig 3).

CONCLUSIONS

❖ Tuna waste is a **suitable feedstock** for the production of VFA.
❖ Higher VFA production was obtained under **alkaline conditions**.
❖ **Acetic acid** was the prevalent VFA at any pH.
❖ The **highest VFA production** was obtained at **2.5%TS** waste.

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