Influence of cow dung storage on methane production by anaerobic digestion and enhancement using the ligninolytic fungus *P. ostreatus*

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INTRODUCTION

The management of agricultural wastes is considered a key concern because of the enormous quantities produced, but at the same time it is an inexhaustible source of nutrients and energy which should not be wasted. For a long time, anaerobic digestion has been an optimal strategy to handle those organic wastes [1] becoming an alternative to waste disposal as well as a renewable energy source [2].

Although cattle manure sometimes shows the suitable C/N ratio for the biomethanization process, they are usually mixed with the straw used as animal bedding, increasing the amount of lignin. This fact is considered a problem since lignin hinders the hydrolysis stage of the process[3]. In this work, the presence of lignin was faced with two different strategies: the storage of the cow manure and a pre-treatment with ligninolytic fungi (*Pleurotus ostreatus*)

OBJECTIVES

The objective of this work is to improve methane production by enhancing the hydrolysis stage in the anaerobic digestion of lignin-rich manure by either storing the manure before digestion or pre-treating the manure with *P. ostreatus*.

MATERIALS AND METHODS

The manure and sludge from a WWTP were obtained from a livestock farm located in Burgos (Spain)

Storage of the manure

The cattle manure mixed with the bedding material was stored in a stored in a closed container of 1 m^3 with non-favoured leaching conditions for 8 weeks inside an umbraculum at temperature ranged between 2-17 ºC minimum to 10-31 ºC maximum

Pre-treatment with *P. ostreatus*

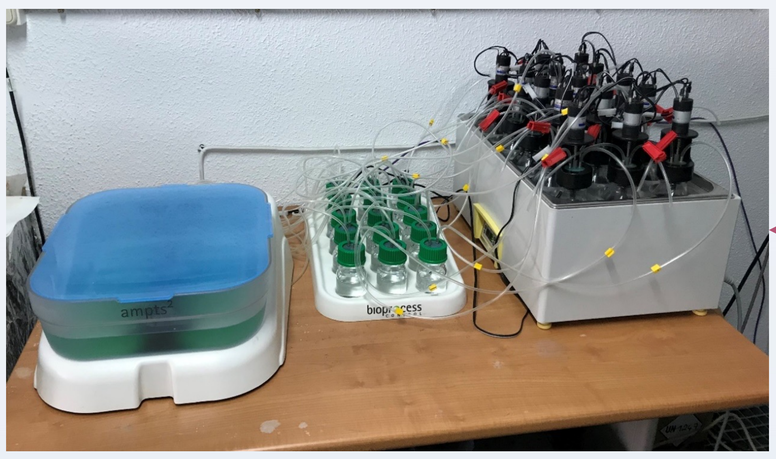
Pleurotus ostreatus

P. ostreatus mycelium embedded in wheat grains

A: cow manure and B: cow manure inoculated with *P. ostreatus*

Manure with and without fungi was stored in darkness at room temperature for 2 weeks

Anaerobic digestion



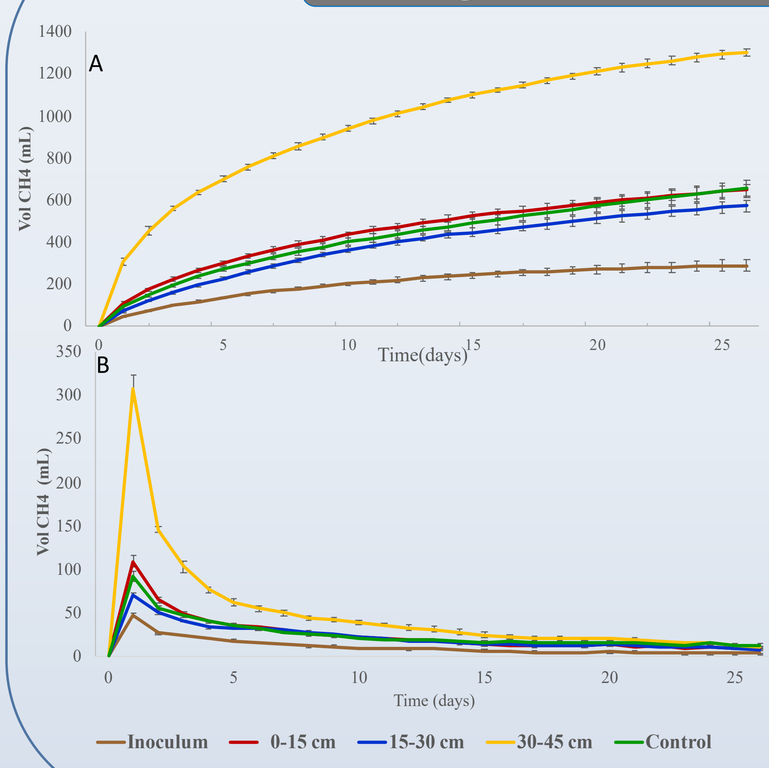
Control parameters

- VS (APHA, 2005)
- Chemical Oxygen Demand (COD) by spectrophotometer of Hanna instruments (Smithfield, RI 02917 USA) (James W. O'Dell, 1993)
- Total Kjeldhal nitrogen, ammonia nitrogen and volatile acids by titration using KjelFlex K-360 coupled with TitrinoPlus (Büchi Labortechnik, Flawil, Suiza),
- Total, partial and intermediate alkalinity (Ripley L. E., 1986).

The anaerobic digestion took place in micro digestors (500 mL) in batch on continuous basis in triplicate at 37 ºC. The ratio Inoculum/substrate was 2:1.The volume of methane was daily measured using an equipment AMPTS II (Bioprocess Control, Lund, Sweden). The digestions were finished when the daily methane production was lower than 1% of the production of the day before.

RESULTS

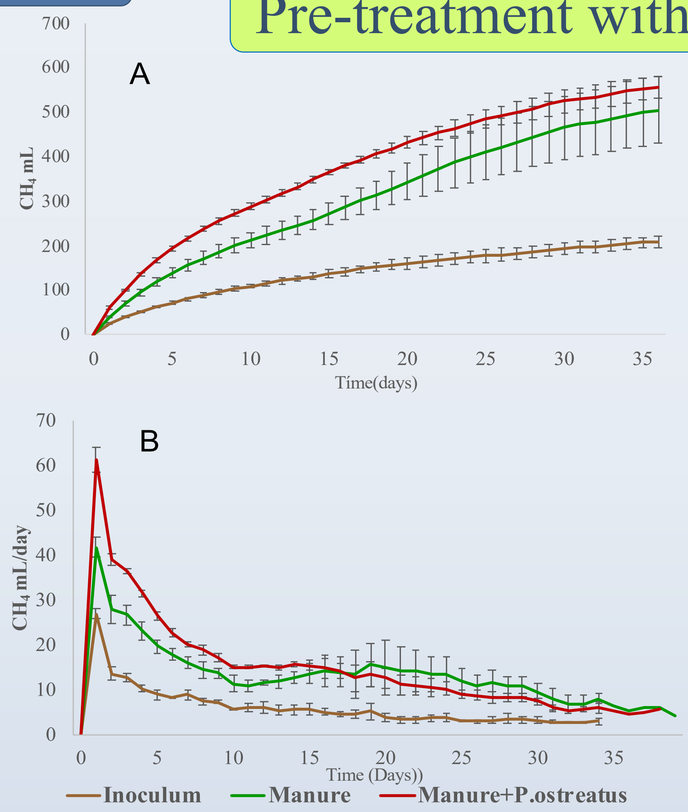
Storage of the manure assay



- Biomethane yield varied with the depth level of the storage.
- The lower level (30-45 cm) produced 50% more methane than the other two levels and control. (A)
- The conditions in the lower level might have enhanced the hydrolysis stage by means of anaerobic environment of that depth.
- The highest production peak occurred around day 3 (B)

A: Cumulated Methane production (mL)
B: Daily Methane production (mL/day)

Pre-treatment with *P. ostreatus* assay



- Pre-treated cow manure with *P. ostreatus* before anaerobic digestion yielded higher cumulated production of biomethane than the non-pre-treated manure
- The fungal treatment improved the methane yielding 9,34%
- The peak of methane production occurred at day 1, and the pre-treated manure produced 32 % more than the manure itself

A: Cumulated Methane production (mL)
B: Daily Methane production (mL/day)

CONCLUSIONS

- ❑ Both strategies improved the hydrolysis stage of the anaerobic digestion yielding higher volumes of methane
- ❑ The storage without leaching conditions allow the manure to produce 50 % more methane.
- ❑ The fungal pre-treatment of the manure with *P. ostreatus* for two weeks yielded 9,34 % more methane.

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