CO_2 EMISSIONS DURING CO-COMPOSTING OF THE SOLID FRACTION OF PIG SLURRY

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1. Introduction

Nowadays, the intensive systems for pig production cause a huge accumulation of pig slurry in the farms, which need to be recycled or treated adequately to reduce the environmental impact. Composting of pig slurry can be a feasible method for its management to produce an organic material with high fertilising properties. But due to the high water content, a solid-liquid separation is needed for composting. Composting of organic wastes is a biooxidative process involving the mineralisation and partial humification of the organic matter, leading to a stabilised final product, free of phytotoxicity and pathogens and with certain humic properties (Zucconi and de Bertoldi, 1987). In the composting process, CO_2 is produced, one of the main contributors to the greenhouse effect during composting. According to Song Qiu et al.(2005), temperature and CO_2 concentrations are directly related with microbial activity. During composting, organic matter is stabilised and easily degradable compounds are mineralised to CO_2 by microorganisms. The aim of this study is to relate temperature profile with CO_2 production rate for defining the bulking agent for co-composting of solid phase of pig slurry.

2. Materials and methods

Solid phase of pig slurry (SPS) was obtained from a sows and piglets farm after separation of the pig slurry with a screw-press. Four different materials were selected as bulking agents for the co-composting of the solid fraction of pig slurry: maize straw, barley straw, cotton gin waste and a garden pruning waste. All the materials were fully characterised. The solid fraction had a low C/N ratio for composting (14.3), and the mixtures were elaborated in order to have a C/N ratio around 25, optimum for composting. The batch reactors used as composting simulators were insulated cylindrical columns with 14 cm inner-diameter and 40 cm height. The solid pig slurry+bulking agent mixtures were run in duplicates, and weight, height, volume and density of the mixtures inside the batch reactors is shown in Table 1. The trials lasted for 15 days and a data logger with temperature sensors was used to collect the temperatures inside the batch reactor, while the maximum and minimum ambient temperatures were collected daily with an external thermometer. Samples from the initial and final mixtures were kept, to determine microbial respiration as CO_2 emission in 10 days. The measurement of the CO_2 emission was performed using hermetic jars, with 5g of material and the CO_2 released from the microorganism's activity was trapped in a vial with 10mL of NaOH 0.5M. The jars were placed in an incubator for 10 days. The vials were changed with 2-3 days of interval and titrated with HCl 0.5M to evaluate the C-CO_2 released from the mixtures before and after the 15 days laboratory composting.

3. Results and discussion

Analysing the thermal profile of the biodegradation curves (Fig.1), it can be observed that the cotton gin and the pruning wastes are easily degradable materials, due to the high temperatures observed, around 24-26ºC, and a quick temperature development, indicating a high microbial activity. This observation is supported by the results showed in Table 2, where a reduction in the C-CO_2 production on the samples analysed at the end of the experiment occurred. The reduction of the CO_2 emission was more significant in the pruning mixture, with a reduction of 57%, indicating that microbial activity was still going in the cotton gin mixture. As observed in the C-CO_2 values, mixtures with cotton gin waste and garden pruning waste had the highest values of C-CO_2 emissions when comparing with other materials, the maize straw having the lowest values. The results are in agreement with the temperature profile. The increased values for C-CO_2 production in the maize and barley mixtures after 15-d composting may indicate that these mixtures are more difficult to be degraded. Maybe the internal part of the particles cannot be physical accessible for the microbial attack, and the 15-days composting acted as a pre-treatment for breaking down the surface of the straw particles.

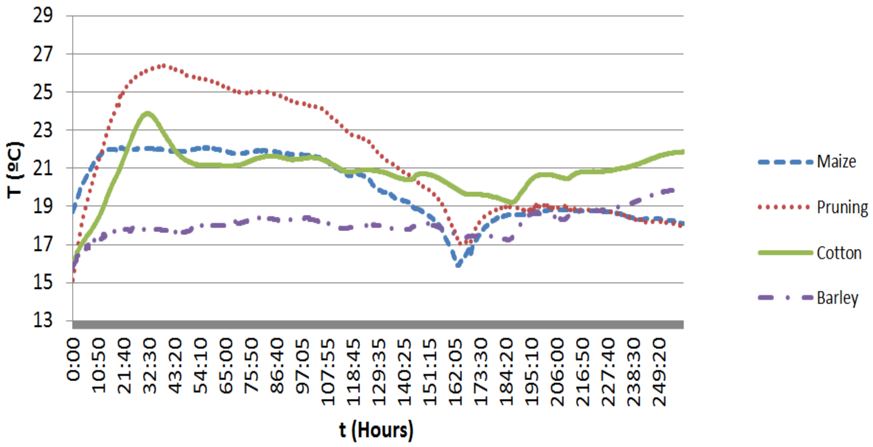

Fig 1. Temperature evolution from the composting simulator test of SPS with several bulking agents.

Table 1. Weight, height, and density of the mixtures inside the batch reactors.

	SPS+Cotton gin	*SPS+Barley straw*	*SPS+Maize straw*	*SPS+Pruning*
Weight (Kg)	2,3	2,3	3,0	3,0
Height (m)	0,31	0,31	0,30	0,31
Density (Kg/m^3)	479	479	652	625

Table 2. C-CO_2 emission values from microbial activity of the mixtures before and after 14 days laboratory composting (mgC-CO_2/gDM in 10-d).

	SPS+Cotton gin	*SPS+Barley straw*	*SPS+Maize traw*	*SPS+Pruning*
Before	24,08	15,19	8,65	22,38
After	21,72	18,79	13,13	9,62

4. Conclusions

Thermal profile of composting materials at laboratory scale together with the microbial degradation measured by C-CO_2 emissions in 10-d are adequate parameters to define the feasible mixtures for composting of solid pig slurry at laboratory level. It can be concluded that pruning waste or cotton gin can be considered adequate bulking agents for composting the solid phase of pig slurry.

References

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