Effects of biological additives (EU200® and Bio-buster®) on the characteristics of cattle whole slurry and its liquid fraction during anaerobic storage

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Biological processes are usually considered as an alternative to improve manure management due to their impact on the N, C and P cycles. A number of biological additives have been produced commercially and used widely by farmers for manure treatment all over the world. Recently, two new biological additives (EU 200® and Bio-buster®) have been produced and currently available on the commercial market. The manufacturer of the additives claim the microbes present supersedes those originally in manure, because they are better adapted, ensures rapid degradation of organic materials and work best at slightly acidified conditions (pH 6). In order to protect the interest of farmers, it is important to test the efficacy of these additives to perform as claimed and to provide information to help understand the mode of action of the additives. In this study, the effect of the above additives on the characteristics of two effluent types (cattle whole slurry and its liquid fraction) during anaerobic storage at 20°C was investigated.

The main characteristics of the effluent used are summarised in Table 1. Each effluent type initially had 2 treatments, one with acidification (pH 6) and one without acidification (pH 8.0 for the whole slurry and pH 8.5 for the liquid fraction). The acidified and non-acidified effluents were further amended with 3 treatments each: control, Bio-buster® (BB) and EU200® (EU200). BB (a liquid formulation of enzymes and micro-organisms) was applied at a rate of 0.40 L m^{-3} effluent and EU200 (a powder formulation of micro-organisms) was applied at a rate of 0.17 k gm^{-3}. The experiment was repeated for a total of 4 replicates making a total of 48 experimental units. The experiment was conducted at a constant temperature of 20°C for 105days. The characteristics of the effluents were analysed at the beginning (day 0) and at the end (day 105) of the experiment. Effluents were analysed for the following parameters using standard laboratory protocols: dry matter, total nitrogen, total carbon, pH value and electrical conductivity (EC). We are currently analysing samples for mineral-N, other mineral elements (P, Ca, Mg, Cu, Fe, Mn, Zn, Co), structural carbohydrates (lignin, cellulose and hemicellulose) and the particle size distribution of the effluents.

Table 1: Some initial characteristics of the effluents at the beginning of the experiment

Effluent	pH	%DM	Total-C (g/kg)	Total-N (g/kg)	Electrical conductivity(mS)
Whole slurry	8.0	5.5	39.5	4.6	2.18
Liquid fraction*	8.5	1.7	16.5	2.8	1.90

*The liquid fraction was separated from the whole slurry by hand using 0.5mm sieve

After 105 days, the use of biological additives only showed a statistical significant effect on the total-N but the result was reliant on the acidification factor. The highest total-N content (4.71 mg N kg^{-1}, average for both effluents) was observed when the materials were acidified and no biological additive was used. Although, when no acidification of the effluents were done, the application of BB and EU200 increased the total N-content of the effluents, respectively, by 25 and 30% compared to the Control (not acidified).

Furthermore, the C/N ratio value was affected significantly ($p<0.05$) by the interaction between effluents and acidification. We observed an increase (17%) and a decrease (25%) in total-C/N ratio of the whole slurry and liquid fraction (both effluents with acidification) respectively compared to their controls. There was a significant reduction in dry matter at the end of storage ($p<0.05$) and acidification leads to DM values, in average, 0.3 percentual points higher than no acidification. Relatively to the pH value results, a significant interaction between the type of effluent and the addition of biological additives was observed. Addition of EU200 to the whole slurry leads to a higher pH value than BB. A positive correlation ($r^2=0.92$) between pH and electrical conductivity of effluents was found.

Some studies have shown that, the degradation intensity of organic matter by microbes during anerobic storage of slurry is dependent on the dry matter content. Subsequently, the differences in behaviour of biological additives due to the effect of effluent type may partly be explained by the differences in dry matter content in the effluents. Acidification showed to affect the behavior of biological additives in both effluents, confirming that microbes are sensitive to the concentration of hydrogen ions. Some studies on biological additives showed no significant effect on the chemical characteristics of slurry. The variation in results may partly be attributed to differences in the effluent type (dry matter content), composition of biological additives, storage time and storage conditions.

Eventhough, we are still in the process of analysing the rest of the parameters in the laboratory, we have made two interesting observations from the analysed results so far: 1. The type of effluent had a significant effect on the behaviour of biological additives at the end of storage and 2. The pH of effluents also had a significant effect on the performance of biological additives. This may suggest that, dry matter content and pH of effluents are important parameters to consider in understanding the mode of action of these additives.