Effects of Silage Preparation and Microbial Silage Additives on Biogas Production from Whole Crop Maize Silage

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The XX International Grassland Congress took place in Ireland and the UK in June-July 2005. The main congress took place in Dublin from 26 June to 1 July and was followed by post congress satellite workshops in Aberystwyth, Belfast, Cork, Glasgow and Oxford. The meeting was hosted by the Irish Grassland Association and the British Grassland Society.

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Introduction Biogas applications based on the production of energy from renewable resources have emerged in the past years due to several countries setting quotas for bioenergy thus promoting anaerobic digestion for heat and electricity generation. Maize is one of the most common substrates for biogas production based on energy crops because of the high yields per hectare with ensiling as the preferred method for storage. Experiments were performed to investigate whether conditions during the silage fermentation and the addition of starter cultures can affect the biogas yields.

Materials and methods Laboratory silage experiments were performed as described by Danner *et al*. (2003) with whole crop maize as raw material. Six treatments were tested; improperly compressed material, inoculation with homofermentative lactic acid bacteria (LAB), inoculation with homo- and heterofermentative LAB, addition of amylase, and inoculation with *Clostridium tyrobutyricum* after adjusting the dry matter contents to a lower level (29%) and adding $CaCO_3$ as a buffer. All experiments were made in triplicate. After 44 d the silages were chemically analysed and a portion was used as a substrate for anaerobic batch fermentation tests. Methane production was measured over a period of three weeks.

Results The chemical analyses of the silages are shown in Figure 1. Well ensiled silages exhibited high lactic acid concentrations in a comparable range, with the exception of the silage inoculated with heterofermentative lactic acid bacteria that showed lower lactic acid and elevated acetic acid formation. The silages prepared under unfavourable conditions showed lower lactic acid concentrations. High concentrations of butyric acid were only detected in the silage that was inoculated with *Clostridium tyrobutyricum*.

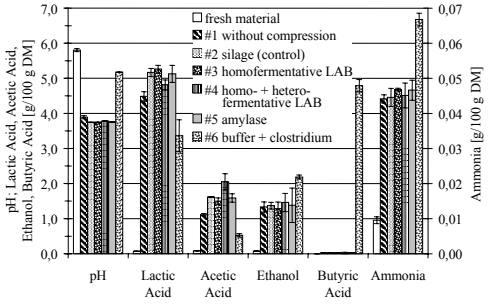

Figure 1 pH and concentration of metabolites in fresh and ensiled whole crop maize

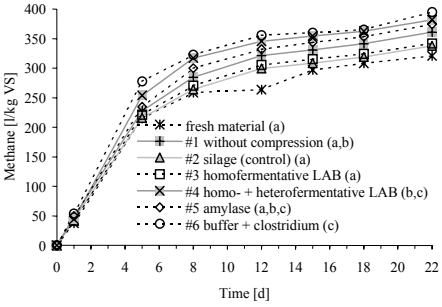

Figure 2 Methane production from fresh and ensiled whole crop maize

Methane production based on volatile solids (VS) obtained during labscale batch tests is shown in Figure 2. Treatments that do not differ significantly (P<0.05, LSD) in their methane yields after 22 d are marked with same letters in parentheses. The silages generally show higher methane production from VS compared with fresh substrate. The highest productions after 22 d were obtained with addition of *Clostridium tyrobutyricum* (395 l/kg VS) and with the starter containing both homo- and heterofermentative LAB (389 l/kg VS).

Conclusions The results of the present study show that ensiling generally can improve methane production from whole crop maize. Obviously spoiled silages also showed good methane yields with respect to volatile solids. The highest methane productions were obtained by inoculating with *Clostridium tyrobutyricum* and with a starter culture containing both homo- and heterofermentative lactic acid bacteria, however differences in methane yield are not very distinct. Fermentation losses during the ensiling process may lower the overall yield from spoiled silages after longer storage periods.

References

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