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Introduction

Aerobic deterioration is the result of aerobic microorganisms metabolizing components of the silage using oxygen. Most often lactate assimilating yeasts utilize lactic acid and raise pH allowing other aerobic microorganisms such as bacilli to flourish (Pahlow and Muck, 2009).

Microbial additives containing heterolactic bacteria raise acetic and propionic acids production of silages and are used to minimize silage degradation when exposed to oxygen (Nkosi *et al.*, 2009).

The increase in forage temperature and accumulate temperature have been used as indicator of aerobic deterioration of silages (Kung Jr. *et al.*, 2000). However, other authors (Ashbell *et al.*, 1991) have proposed the use of carbon dioxide (CO₂) produced as an indicator of silage degradations under aerobic conditions.

This study aimed to evaluate the aerobic stability of whole plant corn silage inoculated with microbial additives, by monitoring temperature and CO₂ production.

Materials and Methods

The test was conducted at the Paraná Federal University (UFPR) Animal Science Department, in Curitiba, PR, Brazil. Two treatments were tested: Control – with no use of additives; Combo – additives containing strains of *Lactobacillus plantarum*, *Lactobacillus brevis* and *Enterococcus faecium* (1x10⁵CFU g⁻¹).

Silages were produced in experimental silos which were opened after 60 days to evaluate aerobic stability, using five replicates per each treatment, in a temperature-controlled room at 23°C. The temperature of the silage was measured for 140 hours, at intervals of 30 minutes, using data loggers buried on the forage. The CO₂ production was measured for 140 hours, at intervals of 60 minutes, using the IRGA (Infrared Gas Analyzer) equipment. The system consists of 18 channels, an air pump, two bottles of acid water washing gas, with a flow controller with a needle valve for each channel, a mass flow meter, an infrared gas analyzer and a computer for data storage. It was used 30 g of silage per replicate with 297 g of dry matter (DM) kg⁻¹. The results were expressed in µL of CO₂ produced per g of DM per hour.

It was used a completely randomized design and the treatment means were compared by F test. Correlations were established between all variables using the PROC CORR of SAS.

Results and Discussion

The accumulated temperature and CO₂ production in 140 hours showed similar performance (Fig. 1). The use of the Combo additive on silage influenced only the accumulated temperature in 140 hours, with a small reduction on this variable. The average stability time observed in this study (30.4 hours) were similar to those reported by Kung Jr. *et al.* (2000) in corn silage (36 hours).

Table 1. Aerobic stability of whole plant corn without additives (Control) or with microbial additive (Combo)

Variables	Treatments ¹		CV (%)
	Control	Combo	
Aerobic Stability, hours to increase 2 °C	30.4	30.4	10.5
Maximum temperature, °C	37.2	37.0	1.86
Hours to maximum temperature, hours	43.2	43.8	15.3
Accumulated temp. after 140 hours, °C	1,277.9 ^a	1,120.8 ^b	8.26
Dry matter losses, g kg ⁻¹ DM	89.8	96.4	13.3
Max. CO ₂ production, µL CO ₂ h ⁻¹ g ⁻¹ DM	50.2	48.7	14.5
Hours to maximum CO ₂ production, hours	34.0	31.8	17.3
Accumulated CO ₂ prod. after 140 hours, µL CO ₂ g ⁻¹ DM	3,199.8	3,267.8	8.83

¹Control – no additives; Combo - combination of *Lactobacillus plantarum*, *Lactobacillus brevis* and *Enterococcus faecium* (1x10⁵ CFU g⁻¹).

The additive used was not effective in increasing the aerobic stability of silage and reduce CO₂ emission, possibly due to the predominance of homolactic fermentation mediated by *L. plantarum* and *E. faecium*.

A positive correlation coefficient of 0.60 was observed between the number of hours to the peak temperature and the number of hours to the peak of CO₂ (P=0.06). This means that CO₂ production can be a good parameter to estimate aerobic deterioration of silages, as proposed by Ashbell *et al.* (1991). There was a strong positive correlation (r = 0.78) between the number of hours to the peak of CO₂ and the aerobic stability of silages (P<0.01). The correlation between DM losses and accumulated CO₂ production in 140 hours was positive (r = 0.52), although not significant (P = 0.12).

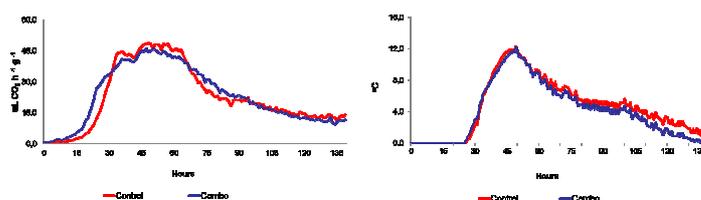


Figure 1. Productions of CO₂ and temperature curves (difference to the room temperature) of aerobic exposed silages by 140 hours of whole plant corn without additives (Control) or with microbial additive (Combo).

Conclusion

The additive used was not effective in improving corn silage stability, probably due to the predominance of homolactic fermentation. The CO₂ production evaluated by Infrared Gas Analyzer was well correlated to the increase of the silages temperature, being a good indicator of losses under aerobic conditions.

References

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