Chemical composition and aerobic stability across the storage period of corn silages

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Introduction Although the silage pH quickly reduce and stabilize for about three to seven days after harvest (Bolsen et al. 1992), a period of 21 to 30 days has been widely recommended as adequate for silage fermentation and stabilization. However, some studies have reported alterations in silage quality throughout storage period (Hallada et al., 2008; Der Bedrosian et al., 2012). Thus, the objective of this study was to evaluate the influence of storage period and microbial inoculants on chemical composition, microbiology, and aerobic stability of corn silages.

Materials and Methods Whole corn plants were harvested at 40% dry matter (DM), chopped, and packed in lab-scale silos. Microbial inoculants were applied as follows: Control – no additives, LB – *Lactobacillus buchneri* (application rate of 1×10^5 cfu/g fresh forage), and LP+EF – *Lactobacillus plantarum* + *Enterococcus faecium* (application rate of 1×10^5 cfu/g of fresh forage). Silos were stored for 3, 7, 15, 30, 60, 210, 390, 480, and 570 d. At opening, silages were evaluated for chemical composition, fermentation end-products, lactic acid bacteria and yeasts counts, and aerobic stability. The experimental design was completely randomized with factorial arrangement (3x9) and three replicates per treatment. Data were analyzed using the Mixed procedure of SAS version 9.3.

Results and Discussion Due to the lack of responses to additives, only the fact of storage length will be discussed. Contents of neutral detergent fiber (45.5%), acid detergent fiber (23.0%), lignin (2.1%), and ash (3.8%) were not significantly altered across the storage period ($P>0.05$). Crude protein (CP) fluctuated among opening dates (6.2 to 7.1%; $P<0.01$), but without biological significance. The proportion of nitrogen as ammonia (N-NH_3/N) increased with the storage length ($P<0.01$), from 1.3% at d-3 to 4.4% at d-570 (Figure 1). According to Kung Jr. (2001), NH_3-N/N contents ranging from 5 to 7% are acceptable for corn silage, and increased values are likely due to the long storage periods (Der Bedrosian et al., 2012). In the same way, DM losses increased with prolonged storage time (Figure 1) and periods exceeding one year further enlarged nutrient losses ($P<0.01$). As expected, soluble carbohydrates were metabolized during the fermentation and decreased from 1.8% at d-3 to 0.9% at d-570 ($P<0.01$). Lactic acid bacteria and yeast counts decayed exponentially ($P<0.01$) over the corn silage storage (Figure 2). Seven days after ensiling, silage pH stabilized at 3.9.

Accordingly, lactic acid accumulated until d-7 and reached 5.3% DM. On the other hand, acetic acid reached the maximum value of 3.1% DM at d-60. Because of yeast counts decreased and acetic acid content increased over time, aerobic stability was greatly improved (Driehuis et al., 1999), especially for corn silages stored for more than 60 d. Likewise, thermal accumulation during 5 d and 10 d after silage exposure to the air were also decreased ($P<0.01$), indicating lower nutrient oxidation at air exposure for silages stored for more than 60 d.

Conclusions The nutritional value of corn silage increases along the storage period, whereas the main changes occur during the first 60 d. Nonetheless, periods exceeding one year would increase the risk of increased DM losses and reduction of nutritional value.

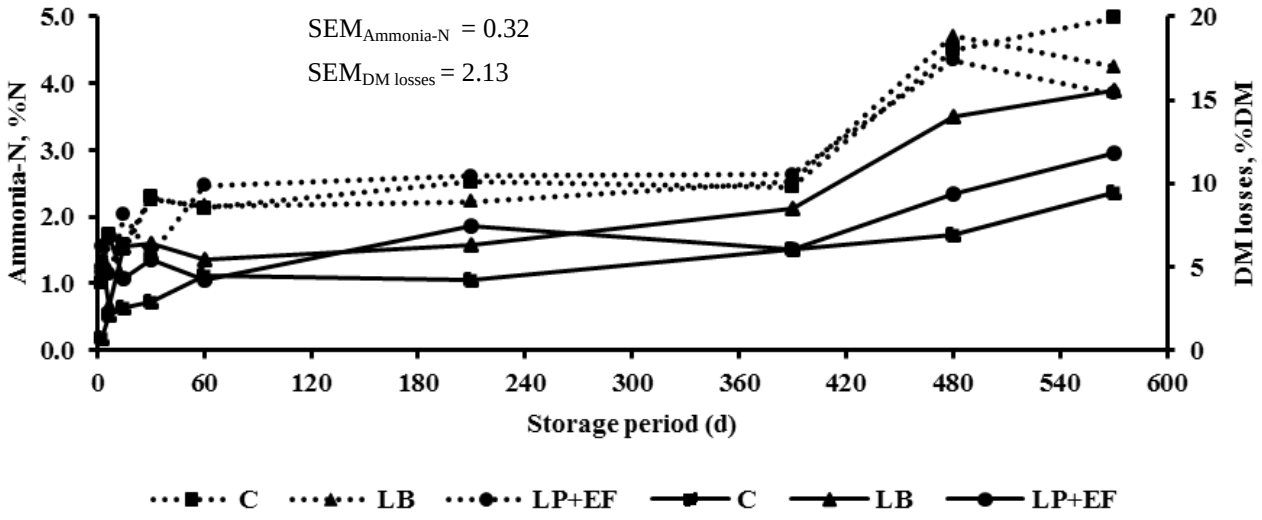

Figure 1 Content of N-NH_3 (···) and DM losses (−) in corn silages across the storage period.

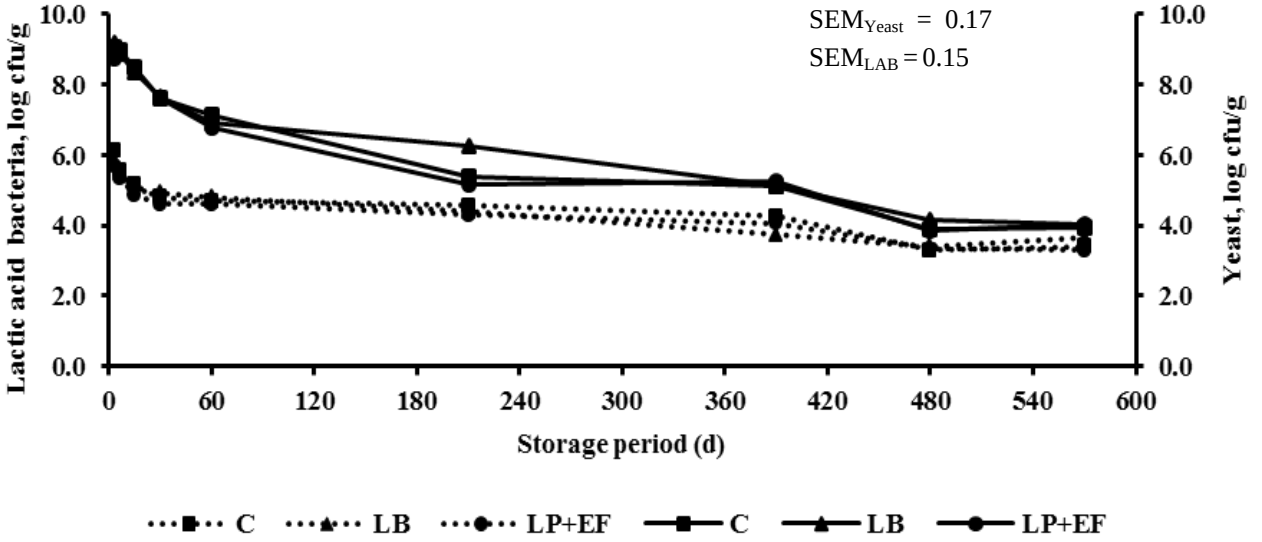

Figure 2 Lactic acid bacteria (−) and yeast (···) counts in corn silages across the storage period.

References

Bolsen, K.K., Lin, C., Brent, B.E., Feyerherm, A.M., Urban, J.E., Aimutis, W.R. 1992. Effect of silage additives on the microbial succession and fermentation process of alfalfa and corn silage. J. Dairy Sci. 75:3066-3083,

Der Bedrosian, M.C., Nestor, K.E., Kung Jr., L. 2012. The effects of hybrid, maturity, and length of storage on the composition and nutritive value of corn silage. J. Dairy Sci. 95:5115-5126.

Driehuis, F., Elferink, S. J. W. H. O., Spoelstra, S. F. 1999. Anaerobic lactic acid degradation during ensilage of whole crop maize inoculated with *Lactobacillus buchneri* inhibits yeast growth and improves aerobic stability. J. Appl. Microbiol. 87:583-594.

Hallada, C.M., Sapienza, D.A., Taysom, D. 2008. Effect of length of time ensiled on dry matter, starch and fiber digestibility in whole plant corn silage. J. Dairy Sci. 91:30 (Suppl. 1).

Kung Jr. L. 2001. Silage fermentation and additives. Science and technology in the feed industry. In: 17th Proceedings of Alltech's Annual Symposium, Nottingham, p. 145-159.