Nitrogen fertilization and inclusion of inoculants in maize silage production

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Introduction The maize silage is one of the most used products for ruminants feeding. However, productive and qualitative characteristics are dependent on the handling used in its confection. The expression of plant potential is related to nutrients availability, as nitrogen (N). This nutrient is important for tissue growth and proteins composition (Brouwer and Flood, 1995). However, the technology used in maize production can be impracticable if the fermentation process after ensiling is not adequate. Therefore, the use of microbial inoculants in the ensiling becomes an interesting characteristic, because according to Henderson (1993), these additives contribute to the reduction of enzymatic proteolysis, due to the fast pH drop inside the silo, what favors the production of great amounts of lactic acid, and represents, therefore, the possibility of higher dry matter recovery. This paper was conducted with the aim to evaluate chemical and fermentation characteristics of maize silage managed with different levels of nitrogen fertilization and ensiled with or without the inclusion of inoculant.

Materials and Methods The trial was carried out in Palmeira das Missões (27°53'58"S, 53°18'49"W), RS, Brazil. The treatments evaluated consisted of two factors: nitrogen fertilization as urea (N = 45%) (0, 100, 200 and 300 kg urea/ha) and inoculant (mini-silos with or without inclusion of inoculant). We used a 2 x 4 factorial arrangement (four levels of nitrogen fertilization x silage with or without inoculant), in a complete randomized design, with three replications. Twelve plots were made with 15 m^2 each. When the grains were at half milky half dough kernel stage, the plants were harvested manually (discarding 50 cm borders) at 20 cm height, chopped in a stationary chopper (adjusted to 2 cm mean particle size) and weighed. Mini-silos were composed of 20 L buckets, coated by black plastic bags, with 2 mini-silos per plot (one with and one without inoculante addition). The inoculant consisted of the following components: *Lactobacillus plantarum* (8 x 10^9 cfu/g), *Lactobacillus buchneri* (10^{11} cfu/g) and *Enterococcus faecium* (2 x 10^9 cfu/g). The mini-silos had been weighed soon after its confection and later in the opening day, being the differences between the weights multiplied by its respective dry matter content, and transformed into percentage of the initial mass. Silage samples were collected for the determination of DM, CP, NDF, ADF and TDN content, metabolizable energy (ME), net energy for lactation (NEL), net energy for gain (NEG), net energy for maintenance (NEM) digestible energy (DE, %DM), according to procedures described by Silva and Queiroz (2002). Two kilograms of silage of each silo were removed and conditioned in styrofoam boxes with 2 L capacity. Temperatures were recorded at 0 (immediately after the allocation of the material in the styrofoam boxes), 12, 24, 48, 72, 96 and 120 hours for aerobic stability determination. The results of the analyzed temperatures were calculated as the rate of temperature rise, using the maximum temperature observed divided by the time necessary to reach the maximum temperature (Ruppel et al., 1995). The results were submitted to the analysis of variance and the means compared by the Tukey test (5% probability). The statistical program Assistat (2011) was used for the statistical analyses.

Results and Discussion With exception for the CP, for the other studied variables it was not observed effect (P>0.05) of inoculant and fertilization. The nitrogen fertilization increased CP, TDN, ME, NEL, NEM, NEG, and decreased the ADF content (Table 1). The inclusion of inoculant did not affect the chemical quality of silage. The highest CP content for the groups that had received fertilization with urea were due to protein deposition in the grain, related to the N content in the plant mainly at the beginning of the flowering. Therefore, the urea inclusion increased the available N in the soil for plant absorption (Brouwer and Flood, 1995). In relation to the percentage of dry matter loss and the aerobic stability differences had not been verified (P>0.05) between the treatments with nitrogen fertilization or the use or not of inoculant. This fact possibly occurred due to the handling adopted in the silage confection. Probably there was an ideal condition and the storage time was enough to provide good fermentation.

Conclusion The nitrogen fertilization affects positively the silage quality. The correct procedures in the ensiling process do not require the use of inoculant to improve quality.

References

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Table 1. Chemical composition of maize silage treated with different levels of urea, and ensiled with (WI) or without (WHI) inclusion of inoculant

	Urea (kg/ha)								
	0		100		200		300		
Variable	WI	WHI	WI	WHI	WI	WHI	WI	WHI	CV (%)
DM, %	30.43aA	29.97aA	30.53aA	32.53aA	29.13aA	32.87aA	30.49aA	28.67aA	6.64
CP, %	6.32aA	6.38Ca	7.02bA	7.18bA	7.99aA	8.04aA	7.72aA	7.82abA	3.94
NDF, %	60.08aA	58.18aA	59.43aA	60.63aA	59.28aA	61.07aA	57.31aA	58.02aA	4.87
ADF, %	28.37aA	28.68aA	27.63bA	27.12bA	26.44bA	26.78bA	26.33bA	27.03bA	3.92
TDN, %	66.98bA	66.76bA	67.5abA	67.86abA	68.33aA	68.10aA	68.41aA	67.91aA	1.10
ME, Mcal/kg	2.42bA	2.41bA	2.44abA	2.45abA	2.47aA	2.46aA	2.47aA	2.45aA	1.10
NEL, Mcal/kg	1.52bA	1.52bA	1.54abA	1.55abA	1.56aA	1.55aA	1.56aA	1.55aA	1.15
NEM, Mcal/kg	1.65bA	1.65bA	1.67abA	1.68abA	1.70aA	1.70aA	1.69abA	1.68abA	1.32
NEG, Mcal/kg	0.93bA	0.93bA	0.95abA	0.96abA	0.98aA	0.97aA	0.97abA	0.96abA	2.3
DE, %	66.8bA	66.56bA	67.37abA	67.78abA	68.30aA	68.05aA	68.39aA	67.84aA	1.23

Means followed by the same capital letters (inoculant effect) and lowercase letters (nitrogen fertilization effect) do not differ (P>0.05) by Tukey test.