Effect of particle size and storage length on fermentative profile of rehydrated corn grain silage

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Introduction The ensiling and grinding of the grain contribute to increasing the availability of starch in the diet. There are changes in the fermentation profile of rehydrated corn grain silage (RCGS) as a function of silage storage length (Silva et al., 2018). The effects of different particle sizes in fermentation profile in RCGS are not well defined. Smaller particle sizes can increase surface contact facilitating the action of lactic acid bacteria improves the fermentation profile (Jacobs et al., 2016; Vermeulen et al., 2017). The aim of this study is to evaluate the effect of processing on different particle sizes over storage length on the fermentative profile of RCGS. We hypothesized that silages with smaller particle sizes and longer storage length will presents better fermentative profile.

Materials and Methods The dried corn kernels were processed in hammer mill (Model 4/360º, Cirelli Industria e Comercio Ltda., São Paulo, BR), and rehydrated to achieve around 35% of moisture. The treatments were: corn ground in the sieve with 3 mm (P3), 5 mm (P5), 8 mm (P8), 10 mm (P10), 12 mm (P12), and 15 mm (P15). The ensiling was performed in 20 L buckets, which were stored for 15, 30, 60, 120 and 240 days (with five replicates each, totaling 150 buckets). An aqueous extract prepared with 30 g of sample and 270 g of distilled water was obtained, homogenized in the Stomacher (400 Circulator, West Sussex, UK) for four minutes to obtain pH and NH_3-N. After each storage period, silos were weighted to compute fermentative dry matter losses (DML) and gas losses by fermentation (GLF). The model included the fixed effects of processing (particle size) and length of storage (0 to 240 d), and their interactions. Mean separation was performed using the Tukey test at $P < 0.05$.

Results and Discussion There was no interaction effect for the pH variable. The values decreased with the increase of storage length, being the lowest at 240 days. Treatments P5 and P15 had lower pH than the others. The reduction in pH over time is related to the increased lactic acid concentration (Silva et al 2018). The pH has been within the recommended range (3.8 to 4.2) since 15 days of ensiling. There was an interaction effect for the variable NH_3-N; the highest values were observed at 240 days of storage. NH_3-N was lower for P3 treatment compared to the others. Increase in NH3-N during storage length has been associated with decrease in prolamin concentration by lactic acid solubility (Lawton, 2002). For the DML and GLF was an interaction effect with only particle size effect, the results from different particle sizes are not clear.

Conclusion The storage length improved the fermentation parameters of silage without changing losses. Larger particle sizes did not negatively influence the fermentative profile, but their effects need further investigation.

Table 1 Fermentative profile of RCGS with different particle sizes and storage length.

Particle size	Storage length (d)	pH	NH_3-N (% DM)	DML (%)	FGL (% DM)
P3	15	$4.18^{A,a}$	$0.043^{B,d}$	1.11^{BC}	1.73^{BC}
	30	$4.16^{A,a}$	$0.052^{B,c}$	0.80^{A}	1.28^{B}
	60	$4.03^{A,b}$	$0.049^{C,cd}$	0.72^{B}	1.12^{B}
	120	$3.87^{A,c}$	$0.061^{B,b}$	0.88^{C}	1.40^{C}
	240	$3.74^{A,d}$	$0.081^{BC,a}$	0.91^{B}	1.44^{B}
P5	15	$4.12^{B,a}$	$0.050^{A,b}$	0.76^{C}	1.24^{C}
	30	$4.03^{B,a}$	$0.053^{B,b}$	1.21^{A}	1.90^{AB}
	60	$3.92^{B,b}$	$0.051^{BC,b}$	1.17^{AB}	1.88^{AB}
	120	$3.74^{B,c}$	$0.073^{A,a}$	0.92^{C}	1.43^{C}
	240	$3.77^{B,d}$	$0.086^{BC,a}$	0.91^{B}	1.44^{B}
P8	15	$4.13^{A,a}$	$0.047^{AB,c}$	0.89^{BC}	1.41^{BC}
	30	$4.11^{A,a}$	$0.052^{B,c}$	1.07^{A}	1.75^{AB}
	60	$4.02^{A,b}$	$0.052^{BC,c}$	1.62^{A}	2.52^{A}
	120	$3.88^{A,c}$	$0.073^{A,b}$	1.14^{BC}	1.83^{BC}
	240	$3.78^{A,d}$	$0.085^{BC,a}$	1.11^{AB}	1.74^{AB}
P10	15	$4.12^{AB,a}$	$0.045^{AB,e}$	1.02^{BC}	1.62^{BC}
	30	$4.12^{AB,a}$	$0.060^{A,c}$	0.97^{A}	1.54^{AB}
	60	$4.00^{AB,b}$	$0.052^{BC,d}$	1.11^{AB}	1.81^{AB}
	120	$3.8^{AB,c}$	$0.077^{A,b}$	2.22^{A}	3.46^{A}
	240	$3.68^{AB,d}$	$0.087^{B,a}$	1.01^{B}	1.63^{B}
P12	15	$4.07^{AB,a}$	$0.046^{AB,c}$	1.45^{AB}	2.25^{AB}
	30	$4.09^{AB,a}$	$0.059^{A,b}$	1.41^{A}	2.23^{A}
	60	$3.99^{AB,b}$	$0.056^{A,a}$	1.16^{AB}	1.84^{AB}
	120	$3.87^{AB,c}$	$0.078^{A,b}$	1.55^{AB}	2.53^{AB}
	240	$3.5^{AB,d}$	$0.08^{C,a}$	1.67^{A}	2.60^{A}
P15	15	$4.07^{B,a}$	$0.047^{AB,d}$	1.97^{A}	3.17^{A}
	30	$4.08^{B,a}$	$0.063^{A,c}$	1.40^{A}	2.18^{AB}
	60	$4.03^{B,b}$	$0.065^{A,c}$	1.44^{A}	2.28^{A}
	120	$3.72^{B,c}$	$0.076^{A,b}$	1.33^{BC}	2.11^{BC}
	240	$3.70^{B,d}$	$0.097^{A,a}$	1.45^{AB}	2.36^{AB}
P-value					
PS		0.004	0.001	<0.0001	<0.0001
SL		<0.001	<0.001	0.582	0.568
PSxSL		0.07	0.001	0.008	0.012
SEM		0.015	0.002	0.306	0.444

$^{A-C}$Means within a row (among particle size) with different uppercase letters differ ($P < 0.05$). $^{a-e}$Means within a row (among storage length) with different lowercase letters differ ($P < 0.05$).