Aerobic stability of silage black oat *(Avena strigosa Schreb.)* in different densities and particle sizes

S.L. Silva[1], T.T. Tres[2], C.C. Jobim[3], C. Feitosa[4], M.R. Oliveira[4] and J.P. Oliveira[4]

[1]State University of Maringá, Maringá, Paraná 87020-900, Brazil, email: samuel@unemat.br, [2]State University of Maringá, Maringá, Paraná 87020-900, Brazil, email: tamaratais@zootecnista.com.br, [3]State University of Maringá, Maringá, Paraná 87020-900, Brazil, email: ccjobim@uem.br, [4]State University of Maringá, Maringá, Paraná 87020-900, Brazil.

Introduction Many factors are important in the fermentation process to ensure quality silage. Among them, the oxygen removal is of great importance in order to provide a rapid production of lactic acid and pH drop to maintain the material conservation (Kung Jr., 2001). The silage density has influence on this aspect, since higher densities decrease the porosity of the silage. Yet, the smallest particle size favors compression and provides a greater surface area for contact with microorganisms. This study was carried out with the purpose of evaluating the effect of different densities and particle sizes in the aerobic stability of black oat *(Avena strigosa Schreb.)* silage.

Materials and methods The field experiment was conducted at the State University of Maringa Experimental Farm of Iguatemi, located in the Northwest of Paraná. The aerobic stability of the black oat (Avena strigosa Schreb) silage was evaluated in a factorial scheme (3X3), being three particle sizes: 5, 8 and 12 mm and three densities: 550, 600 and 650 kg/m^3. At the time of ensiling the commercial inoculant based on *Lactobacillus plantarum, Pediococcus acidilactici, cellulase and sucrase (Lallemand®)* was used in all treatments. The silos were opened after 90 days of ensiling and uncompressed samples were taken to assess the aerobic stability as described by Kung Jr. et al. (2000). Temperature measurements were taken at 8 h and 16 h with the use of a Gulterm 1001digital thermometer and the pH reading was done at 8 h with digital potentiometer according to Cherney & Cherney (2003).

Results and discussion Over the time of exposure to air there was an increase in the pH for all silages at all densities, which is an indicative of deteriorative microorganisms' activity (Table 1). According to Kung Jr. (2001), yeasts are the main microorganisms that initiate aerobic deterioration, using lactic acid for metabolism. The microbiological activity causes silage warming and increases silage pH, allowing bacteria previously inhibited by the acidity to develop and continue with the process of aerobic deterioration.

It was found that the silage with average particle size of 12 mm showed lower pH values to time exposure to air. It was also observed that these silages tend to have lower temperatures, showing high aerobic stability (Table 2).

The silage with 8 mm particle size showed a break in stability with 42 hours of exposure to air, t is observed that in these treatments there was a time and peak of higher temperature that can be related to a higher fermentation standard of silages, which generated a higher substrate concentration and thus higher microbial activity.

Table 1 Average values for oat silages pH in different densities and particle sizes during 192 hours of exposure to air

Time (h)	550 kg/m³			600 kg/m³			650 kg/m³				
	5 mm	8 mm	12 mm	5 mm	8 mm	12 mm	5 mm	8 mm	12 mm	Average	VC(%)
0	4.13a	4.22ab	4.31b	4.12a	4.18a	4.28a	4.10a	4.16a	4.23a	4.19	2.2
18	4.07a	4.21ab	4.34b	4.05a	4.21a	4.38b	4.04a	4.15ab	4.27b	4.19	2.1
42	4.21a	4.31a	4.38a	4.06a	4.29b	4.46b	4.10a	4.31b	4.38b	4.28	2.54
66	4.21a	4.53b	4.43ab	4.12a	4.54b	4.58b	4.15a	5.03b	4.47a	4.46	4.28
90	5.26a	5.18a	4.47a	4.97a	5.72a	4.50a	5.97ab	7.03b	4.43a	5.28	17.89
114	6.93b	6.54ab	4.66a	6.63b	7.31b	4.39a	6.28ab	7.87b	5.35a	6.22	19.34
138	8.31b	7.89b	5.33a	7.44b	8.15b	4.58a	7.60b	8.80b	5.64a	7.08	14.59
162	8.43b	8.26b	6.35a	8.56b	8.54b	4.78a	8.57b	8.75b	6.92a	7.69	10.69
186	8.87a	8.51a	7.99a	8.83b	9.06b	5.61a	8.99b	9.06b	7.49a	8.27	6.42

Averages followed by different lowercase letters in the column differ at 5% error by Tukey test.

Table 2 Changes in temperature of the oat silage during the 98 hours of exposure to air

	550 kg/m³			600 kg/m³			650 kg/m³		
	5 mm	8 mm	12 mm	5 mm	8 mm	12 mm	5 mm	8 mm	12 mm
Temperature peak (°C)	30	30	28	28	32	29	33	33	29
Time to reach maximum temperature (h)	74	74	26	74	74	26	74	74	26
Aerobic stability (h)[1]	50	42	50	66	42	46	50	42	90

[1]Time (hours) to break aerobic stability (2 °C above ambient temperature).

Conclusion There was no clear effect of the density of ensiling on the aerobic stability of silages. The silages of average particle size of 12 mm showed smaller changes in pH during exposure to air.

References

Cherney, J.H., and D.J.R Cherney. 2003. Assessing silage quality. Page 141-198 in: Buxton *et al.* Silage Science and Technology. Madison, Wisconsin, USA.

Kung Jr., L.2001. Silage fermentation and additives. Page 145-159 in: Science and technology in the feed industry. Nottingham: Nottingham UniversityPress.Minnetonka.

Kung Jr., L., J.R. Robinson, K. Ranjit, J.H. Chen, C.M. Golt, and J.D. Pesek. 2000. Microbial Populations, fermentation and-products, and aerobic stability of corn silage treated with ammonia or a propionic acid-based preservative. J. Dairy Sci. 83:1479–1486.