Aerobic stability of winter cereal silage under different storage periods

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Introduction As any fermentation process, ensiling is a set of biochemical reactions, including oxireductions which are intrinsically mediated by enzymes and/or other metabolic products of microorganisms. In this way, storage period begins after the ensiled mass reaches the pH required to cause a reduction in microbiological activity (Muck, 2010). However, there are several evidences of alterations on nutritional quality during storage, since there is also the presence of pH-tolerant enzymes. Nevertheless, focus of research on this topic has been mainly on corn (Der Bedrosian et al., 2012, Young et al., 2012), and for winter forages, there is a lack of research reported in literature. Winter cereals have great importance due to their nutritional value, digestibility and as being an alternative ingredient in the nutritional management. Therefore, the study goal was to evaluate five winter cereals silages submitted to different storage periods and their effects on aerobic stability.

Materials and methods Experimental material was wheat (*Triticum aestivum* cv. BRS Gralha Azul), barley (*Hordeum vulgare* cv. BRS Brau), white oat (*Avena sativa* cv. URS Guará), black oat (*Avena strigosa* cv. Embrapa 139) and triticale (*X Triticosecale* cv. IPR 11). The experimental field consisted of a total area of 225 m², distributed in five plots of 45 m² for each cereal. At the period of ensiling, plants of each plot were harvested at 8 cm from the ground, according to Fontaneli et al. (2009), and later the materials were processed in stationary forage chopper (Nogueira® EM 6400) to an average particle size of 3.7 cm, according to the methodology proposed by Jobim et al. (2007). After this process, samples of 1.0 kg of each cereal were vacuum ensiled in plastic bags (mini bags) with welds (nylon poly, 150 microns, 25 cm wide x 35 cm long) using vacuum packer (TM-280 Tecmaq). Treatments consisted of five cereals and different storage periods (60, 120, and 180 days). The experimental design was completely randomized, in a 5×3 factorial arrangement of five forage species and three storage periods, with five replications each. Aerobic stability evaluation was obtained by temperature and pH means, which started after opening the silos. In each silo, silage was decompressed to facilitate exposure of ensiled material to air, as described by Kung Jr. et al (2000), and a sample of approximately 400 g of the material was placed in buckets with a capacity of 4.0 kg. The experimental period for aerobic stability lasted 168 hours (7 days after opening the silos). Buckets were placed in an environment with temperature control at 25°C, throughout the period. To determine the aerobic stability of the silages, temperature of the silages was measured directly in the buckets, using a long rod digital thermometer Gulterm 1001 inserted at the center of the forage mass. Temperature and pH were measured daily at 6, 12 and 18 hours. The pH readings were made using a digital potentiometer, according to Jobim et al. (2007). Aerobic stability break was considered when the temperature of the ensiled material exceeded environment temperature by 2ºC, as recommended by Taylor and Kung Jr. (2002), or when the pH increased above 0.5 units in up to five days, as mentioned by Weinberg et al. (2008). The

results were tested by analysis of variance and compared using the Tukey's test at 5% level of significance, using SAS statistical software.

Results and discussion Storage period influenced ($P < 0.05$) only black oat where higher stability was observed for long storage periods (Figure 1). Higher aerobic stability was observed for barley, wheat and triticale. Justification could be precisely in the epiphytic flora of these cereals. In wheat, Li et al. (2015) detected a high number of heterofermentative microorganisms, contributing with 66.7% of the total lactic acid bacteria. Heterofermentative microorganisms have a distinct fermentation pattern, leading to the formation of different compounds, such as acetic acid and 1,2-propanediol. Besides, Kleinschmit and Kung Jr. (2006) argued that these microorganisms, even under low pH can remain active, performing the previously mentioned biochemical cycle. We hypothesized that the higher aerobic stability of these silages, in this way, may be associated with a possible higher concentration of organic acids, such as acetic and propionic, although not determined in the present study. These compounds have an antifungal effect, acting on yeast, the main spoilage microorganisms of silage, thus increasing aerobic stability (Muck, 2010).

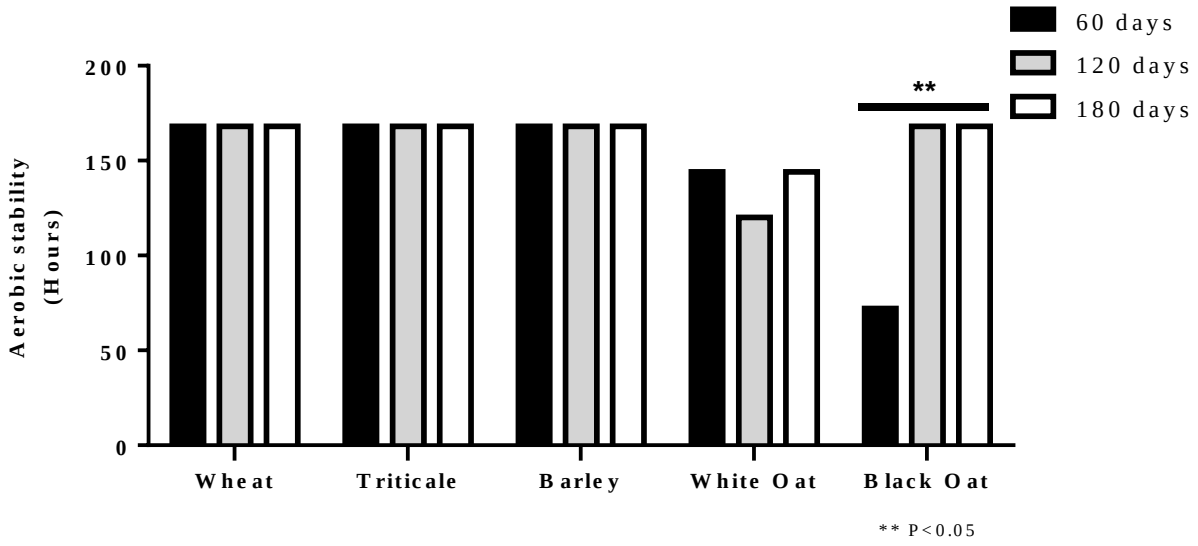

Figure 1 Aerobic stability (hours) of winter cereals silages subjected to different storage periods.

Conclusions Storage periods over 60 days provide benefits for black oat.