Effect of sodium benzoate, relocation and storage time on microbiology during sugarcane silage stability test

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Keywords: chemical additive, reensiling, yeast, molds

Introduction Sugarcane silages are naturally prone to alcoholic fermentation due the high concentration of sugars and a high epiphytic microflora of yeast in sugarcane. Thus, under aerobic conditions (silo opening), lactate assimilating yeasts cause a decrease in lactic acid concentrations, lower the pH, and leave the environment favorable for the multiplication of spoilage microorganisms (Schmdit et al.,2014). The use of chemical additives, such as sodium benzoate (SB), can be efficient in reducing these microorganisms, especially when silages are subjected to adverse) conditions such as relocation processes. Thus, this study aimed to determine the effects of sodium benzoate, relocation, and storage time on microbiology during sugarcane silage stability test.

Materials and Methods The experimental trial was conducted in UFRA, Brazil (at 01°07'S, 47 °36'W). Sugarcane was harvested with a traction harvester with a theoretical cut length of 20mm. The silages were made in experimental silos (15 L). The density was 476 ± 35 kg of FM (fresh matter) / m³. A completely randomized experimental design in a 2 × 4 × 2 factorial arrangement with four replications was used. The treatments included the addition of additive: without sodium benzoate (WB) and sodium benzoate (SB) at 2g kg^{-1} FM, relocation (no relocation (NR), 12, 48 or 72 hours of relocation), and silage storage time after relocation (ST; 10 or 60 days).The silage was subjected to the aerobic stability test. In the stability test samples were taken at times (0; 48; 96; 168 hours) and microbiological composition (yeast and molds) were performed. For microbiology analysis during stability, the time factor was analyzed separately. Data were analyzed as a 2 × 4 factorial arrangement with repeated measures over time (0; 48; 96; and 168 hours) by the SAS® program MIXED procedure observing the effects of additive (A), relocation (R), evaluation during the stability test (ST) and their interaction (A × R × ST). The averages were compared using the Tukey test at 5% probability level.

Results and Discussion The mold population ($P < 0.05$) of sugarcane silage stored for 10 days after relocation was higher at 48h and 96h (5.67 and 5.49 log.ufc g^{-1}) exposure at stability test and was smaller (4.87 log.ufc g^{-1}) at 0h exposure time. There was an A × ST interaction on the mold population in sugarcane silages stored for 60 days (Table 1). The BS showed its fungicidal effect ($P < 0.05$) when we observed that silages exposed by 96h and 168h presented lower mold counts ($P < 0.05$) compared to WB silages. The increase in exposure time allowed higher ($P < 0.05$) mold counts. In general, mold growth is strongly influenced by silage pH, and its optimum growth at pH above 5 (Pallow et al., 2003), which explains the growth of these microorganisms after aerobic

exposure in silages without additives, where yeasts consumes the lactic acid produced, increasing the silage pH. Sugarcane silages (P <0.05) stored for 10 or 60d after relocation suffered A × R × ST interaction. Yeast population increases with aerobic exposure of silage in the stability test. When silages are exposed to air, it favors the growth of yeasts and molds (Tabacco et al., 2011). Silages stored for 60d had smaller yeast populations compared to 10d, which shows that silages stored for longer periods stabilize yeast counts (Evangelista et al., 2009). It was possible to observe the effect of sodium benzoate on silages relocated at both storage times. The fungistatic action of this additive is the result of the action of benzoic acid on cell membrane passage in dissociated form causing the death of these microorganisms (Lambert and Stratford, 1999).

Table 1 Interaction of sodium benzoate use and time in the stability test under the mold population (log.ufc g^{-1}) of sugarcane silages stored for 60 days after relocation.

	0h	48h	96h	168h
Without S. Benzoate (BW)	4,13Ad	4,51Ac	4,99Ab	6,32Aa
Sodium Benzoate (SB)	4,3Aab	4,54Aa	4,64Ba	4,71Ba

[a–d]Means within a row with different superscripts differ (P < 0.05).

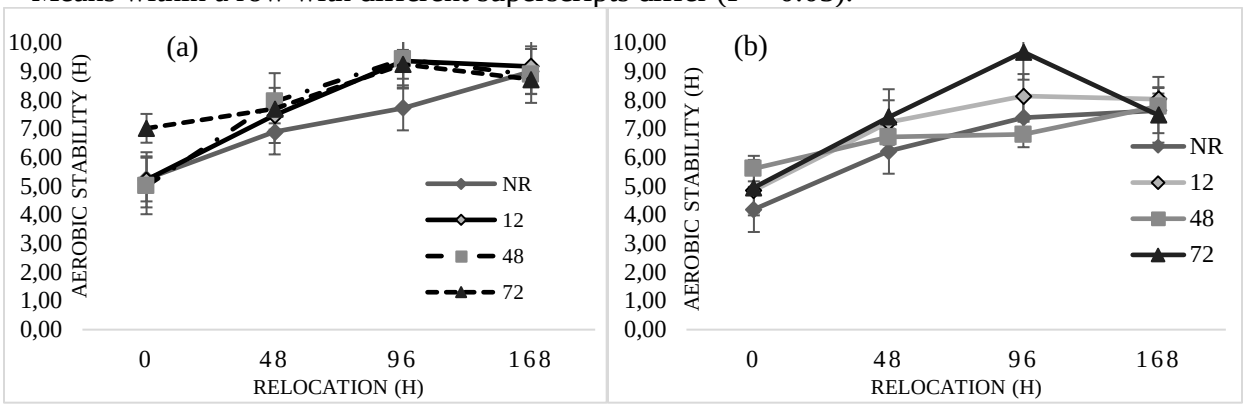

Figure 1 Interaction of additive use (no benzoate (a); sodium benzoate (b) (2g kg^{-1} FM), relocation time and stability test (A × R × ST) on yeast population of sugarcane silage stored for 10d.

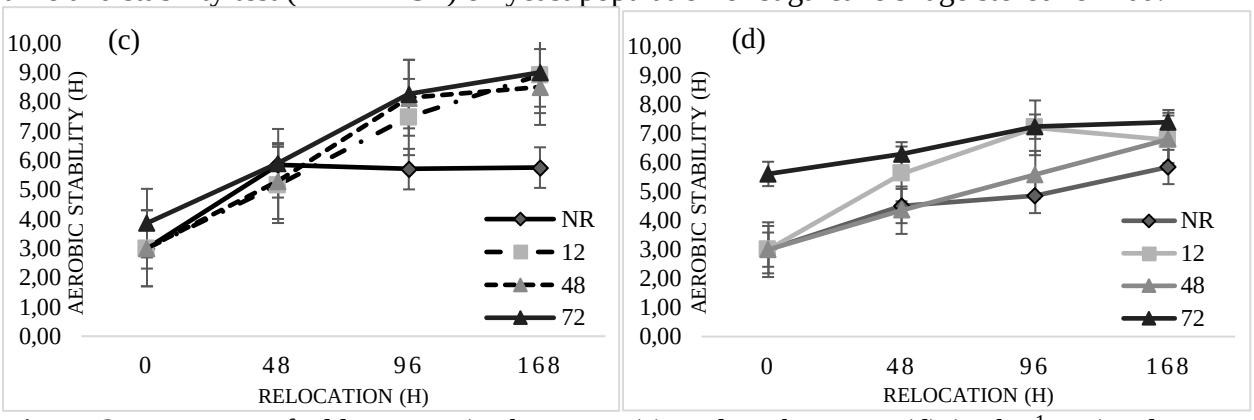

Figure 2 Interaction of additive use (no benzoate (c); sodium benzoate (d) (2g kg^{-1} FM), relocation time and stability test (A × R × ST) on yeast population of sugarcane silage stored for 60d.

Conclusion SB (2g kg^{-1} FM) is effective in inhibiting the population of spoilage microorganisms in relocated sugarcane silages. Especially when stored for 60 days after relocation.