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A new approach to assess feed-out rate in maize silage bunker

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Introduction There is an increasing recognition that many of the problems associated with feeding silage arise during the unloading phase. Thus, it is imperative to identify a correct feed-out rate (FR), which can mitigate aerobic deterioration in this phase. To date, all proposed FR are based on linear feed-out (cm/d or m/week), which were developed through empirical observations and mathematical models (Pitt and Muck 1993). However, this recommendation may fail, since silage densities vary among silos. We hypothesised that a parameter, which consider the silage density, can be more suitable. The aim of this study was to identify an unloading rate based on daily silage consumption per face area to reduce spoilage in farm maize silages.

Materials and Methods Forty-four dairy farms in South, Southeast, and Midwest of Brazil and 44 dairy farms in North of Italy, agreed to participate in this project. Farm size ranged from 6 to 1,800 lactating cows. Farms performing well, moderately well, and poorly in terms of silage management were selected. On the day of sampling, one maize silage bunker that had been open for at least 20 d was assessed in detail on each farm. Three samples from the peripheral area and one sample from the central core were taken from the face to determine microbial counts and fermentation profile. Before coring, the temperatures were measured at the same four locations. The temperature and pH of silages located in the central core were used as references. The difference between the silage sample and the reference temperature and pH were used as indices of aerobic deterioration (dT and dpH, respectively). The silage density profile was characterised according to D'Amours and Savoie (2005). The width and height of both entire face and visibly spoiled layer were recorded in order to calculate face area (m^2) and spoiled area (%; area visibly spoiled/face area). The silage consumption was recorded to determine the FR (kg/m^2/d; kg of daily silage/face area). The daily length of silage removed was also assessed. To identify silage spoilage, the following parameters were considered: dT ≥ 5°C, dpH ≥ 0.25, spoiled area ≥ 2%, and yeast and mould counts at the top ≥ 5 log colony-forming units (cfu)/g and ≥ 2 log cfu/g, respectively (described as dT5, dpH25, SA2, Y5, and M2, respectively). Each parameter was tested within four ranges of FR, as follows: < 125, 125-250, 250-375, and > 375 kg/m^2/d (described as FR1, FR2, FR3, and FR4, respectively). The statistical analyses were conducted using the PROC FREQ of SAS (2004). The Fisher's exact test was used to calculate *P*-values of the tested parameter. Significance was declared when the *P*-value was < 0.05. The mean and standard deviation for the linear removal were calculated using the PROC MEANS procedure of SAS (2004).

Results The daily FR and length of silage ranged from 29 to 990 kg/m^2 and from 0.05 to 1.4 m, respectively. The occurrence of Y5 was in 47.1, 44.1, 27.3, and 0% of silages for FR1, FR2, FR3, and FR4, respectively (Figure 1; $P = 0.03$). The occurrence of M2 was in 58.8, 44.1, 18.2, and 0% of silages for FR1, FR2, FR3, and FR4, respectively ($P = 0.03$). The dT5 was found in 67.7, 42.4, 15.2, and 0% of silages for FR1, FR2, FR3, and FR4, respectively ($P < 0.01$). The dpH25 was found in 47.1, 35.3, 9.1, and 0% of silages for FR1, FR2, FR3, and FR4, respectively ($P = 0.01$). The SA2 was found in 69.7, 33.3, 45.5, and 22.2% of silages for FR1, FR2, FR3, and FR4, respectively ($P = 0.01$). The number of farms for each FR was of 34, 34, 11, and 9 for FR1, FR2, FR3, and FR4, respectively, for all parameters tested. The mean linear removal (± SD) for FR1, FR2, FR3, and FR4 was 0.13 ± 0.05, 0.3 ± 0.09, 0.47 ± 0.11, and 0.8 ± 0.3 m/d, respectively.

Discussion Losses during unloading depend on the silage density, the aerobic stability of the silage (i.e. fermentation end-products and microbial count), the ambient temperature, the feed-out rate, and other management practices (Muck et al. 2003, Borreani and Tabacco 2010). Although the ambient temperature has been pointed out as a factor that affect silage deterioration during unloading, in our study there was a negative relationship between the ambient temperature and the parameters, which indicate spoilage silage (data not shown). Thus, the data from Brazil and Italy were combined. Conversely, the fermentation profile, the density, and the removal rate decisively affected losses during the feed-out phase. The five parameters used in this study to identify silage spoilage occurred mainly when the FR was lower than 250 kg of silage/m^2/d. There was no spoiled silage when the FR was greater than 375 kg silage/m^2/d. Several silages had FR lower than 250 kg silage/m^2/d and did not presented signals of deterioration (Figure 1). Most of these silages had good management practices such as materials weighing down silage cover and high concentration of organic acids and/or 1,2 propanediol. Therefore, these factors attenuated the effects of aerobic deterioration when silages had lower FR (250 kg of silage/m^2/d).

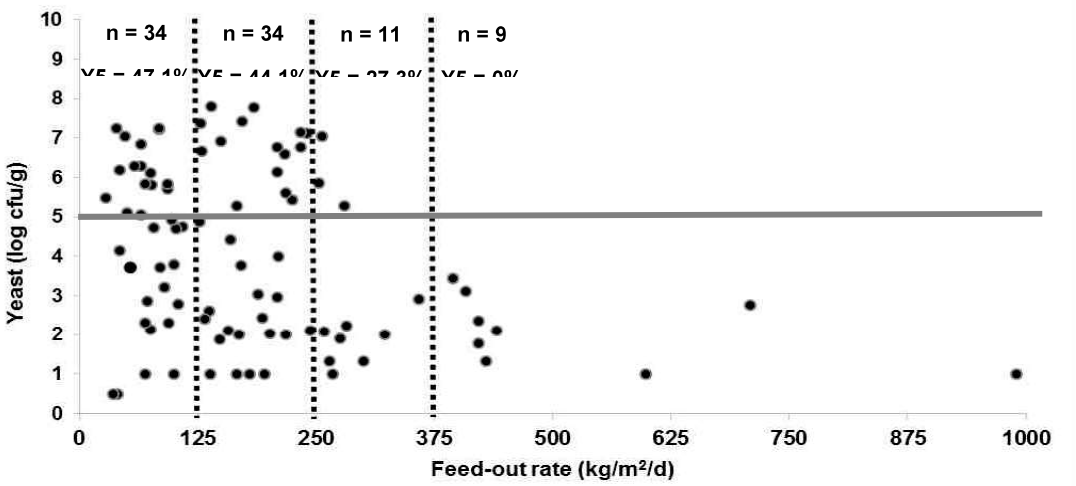

Figure 1 Yeast counts in maize silages (n = 88) located at the top of the bunkers as influenced by feed-out rates. The dotted lines divide four ranges of feed-out rates. Y5 = silages with yeast counts ≥ 5 log cfu/g. The statistical significance was obtained using the Fisher's exact test. $P = 0.03$.

Conclusions The feed-out rate recommendation based on daily amount of silage per square meter is more reliable, since it considers silage density. A removal rate between 250−375 kg of silage/m^2/d reduces the risk of spoilage in maize silages. Removing more than 375 kg of silage/m^2/d the farm can guarantee unspoiled silage in the ration.

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References

Borreani G. & Tabacco, E. (2010) The relationship of silage temperature with the microbiological status of the face of corn silage bunkers. Journal of Dairy Science, 93, 2620-2629.

D'Amours, L. & Savoie P. (2005) Density profile of corn silage in bunker silos. Canadian Biosystems Engineering. 47, 2.21-2.28.

Muck, R.E., Moser, L.E. & Pitt, R.E. (2003) Postharvest factors affecting ensiling. In: Buxton, D.R. Muck, R.E. & Harrison J.H. (ed). Silage Science and Technology. ASA, CSSA., and SSSA, Madison, WI. p. 251-304.

Pitt, R.E. & R.E. Muck. (1993) A diffusion model of aerobic deterioration at the exposed face of bunker silos. Journal of Agricultural Engineering Research, 55, 11-26.

SAS Institute Inc. 2004. SAS/STAT 9.1 User's Guide. Version 9.1 ed. SAS Inst. Inc., Cary, NC.