CHR HANSEN

Improving food & health

XVIII ISC 2018

WE-118

First estimation and validation of a new model to predict dry matter loss based on temperature changes - II. Validation of maize mini silo and big scale silage.

K.L. Witt[1] , J. N. Joergensen[1], N. G. Nielsen[1], K. A. Bryan[1], G. Copani[1], S. Pires[1], V. Vrotniakiene[2], J. Jatkauskas[2]

[1] Chr. Hansen - Boege Alle 10/12 - 2970 Hoersholm – Denmark, dkgico@chr-hansen.com

[2] Institute of Animal Science of Lithuanian University of Health Sciences, Baisogala, 82317, Lithuania

Keywords: Aerobic stability, dry matter loss estimation, spoilage control, temperature increase, *Lactobacillus buchneri, Lactococcus lactis*

INTRODUCTION

It was recently demonstrated that a linear correlation between dry matter (DM) loss and temperature exists (Pires et al. 2018). The model is, however, based on a meta-analysis study and should be validated on real time temperature tracking during aerobic exposure of silage.

"The purpose of this study was to **validate the model** on **continued temperature recording** in a crop (maize) typically associated with aerobic stability challenges. In addition, the model was **tested with different storage structures** (mini silos and big bales) to examine if mini silos can be used to predict silage fermentation and aerobic stability just as well as big bales."

MATERIAL AND METHODS

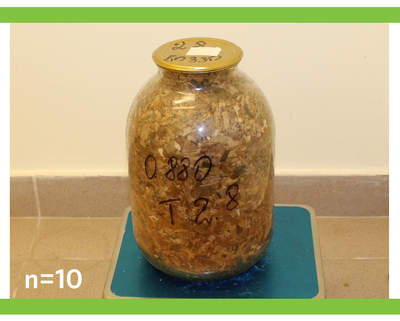
Maize (38.7% DM)

Mini silo
3 l, (1.8-1.9 kg forage)/silo

Fermented 90 days

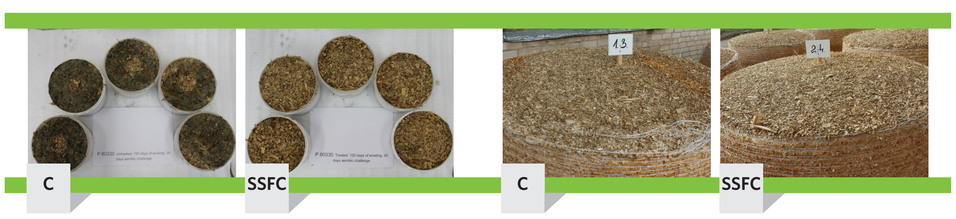
Big bales
wrapped in 6 layers of 0.025 mm white stretch film, width 750 mm, (872 kg forage)/bale

Fermented 120 days



n=5	**Untreated control (C)**	**Untreated control (C)**	n=5
n=5	**SiloSolve® FC (SSFC)** 150,000 cfu/g of forage *Lactobacillus buchneri* DSM22501 *Lactococcus lactis* O224 DSM11037	**SiloSolve® FC (SSFC)** 150,000 cfu/g of forage *Lactobacillus buchneri* DSM22501 *Lactococcus lactis* O224 DSM11037	n=5

Aerobic stability (AS) test after fermentation



Total yeast and mold counts were measured prior to ensiling, when the silos were opened (before aerobic exposure) and at the end of AS test. DM losses were also recorded after AS test.

RESULTS

Table 1. DM loss recorded vs. predicted using 2 different models based on temperature (T) in the easy to ensile maize crop, comparing 2 different structures (mini silos or big bales) and 2 different treatments (TRT) (untreated [C] and SiloSolve® FC [SSFC]), AS: Aerobic stability

Structure	Ambient T at max T during AS test (°C)	Max T (°C) reached after [hours] of AS test		DM loss (%) recorded after AS test (Std. dev.)		DM loss (%) using delta vs. ambient T according to McDonald (1991)		DM loss (%) using linear regression model according to Pires et al. (2018) (Std. dev.)	
TRT		C	SSFC	C	SSFC	C	SSFC	C	SSFC
Big bales	3.7	34.7 [828]	15.3 [948]	3.4 (+/-0.17)	1.2 (+/-0.17)	15	15	7.1 (+/-0.4)	-2.3 (+/-0.4)
Mini silos	20.4	28.7 [276]	24.3 [390]	8.2 (+/-0.12)	5.6 (+/-0.12)	15	10	4.2 (+/-0.4)	2.1 (+/-0.4)

Table 2. Yeast and mold counts in the easy to ensile maize crop, comparing 2 different structures (mini silos or big bales) and 2 different treatments (TRT) (untreated [C] and SiloSolve® FC [SSFC]) **(*P*<0.01)

Structure	Before ensiling		After ensiling				After AS test			
	Yeast (log cfu/g)	Mold (log cfu/g)	Yeast (log cfu/g)		Mold (log cfu/g)		Yeast (log cfu/g)		Mold (log cfu/g)	
TRT			C	SSFC	C	SSFC	C	SSFC	C	SSFC
Big bales	4.72	4.64	3.96	1.12**	1.70	1.0**	5.65	1.16**	4.44	1.97**
Mini silos			3.65	1.06**	1.59	1.0**	7.63	4.25**	9.38	3.33**

Adapting the linear correlation model (Pires et al. 2018) to temperature scores in mini silos and big bale silages (maize), showed a vast improvement in the estimation of dry matter loss during aerobic challenge compared to the previous model (McDonald et al. 1991), using a step logic approach of temperature delta versus ambient temperature (Table 1). In addition, it was demonstrated that compared to the untreated control, ensiling with SSFC reduced DM loss after aerobic challenge. Yeast and mold were reduced (*P*<0.01) with SSFC treated silages irrespectively of storage structure (Table 2). The response to aerobic challenge was delayed in big bales compared to mini silos, which most likely reflects the difference in mass, yet the differences between treatments were observed irrespectively of storage structure.

DISCUSSION

Submitting real time temperature recordings to the newly established model led to a significantly (*P*<0.001) better prediction of DM loss vs. the stepwise delta to ambient T logic (McDonald et al. 1991) previously used. The model was robust disregarding structure (mini silos or big bales [*P*<0.001]) and also disregarding treatment (C or SSFC [*P*<0.001]). Interestingly it was also observed that there was no interaction between neither structure nor treatment on the model (*P*=0.1901).

CONCLUSION

Based on the recently developed model we found a **better fit** to the **DM loss** when estimating this **from real time temperature recording** of maize silage during aerobic exposure in both mini silos and big bales. **For maize silages** it can be concluded that **mini silos may be used equally well as big bales** to discriminate treatments (inoculated vs. untreated).

REFERENCES

- EFSA Scientific Opinion (2018). Guidance on the assessment of the efficacy of feed additives, EFSA Journal, 16(5):5274, 6-7.
- Henderson, A. R., Matthew Ewart, J., & Robertson, G. M. (1979) Studies on the aerobic stability of commercial silages. Journal of the Science of Food and Agriculture, 30(3), 223-228.
- McDonald, P., Henderson, A. R., & Heron, S. J. E. eds. (1991) The biochemistry of silage, 2nd edition, Chalcombe Publications, 340 p.
- Pires, S, Joergensen, J. N., Groenlund Nielsen, N., Bryan, K., Copani, G., & Witt, K.L. (2018) First estimation and validation of a new model to predict dry matter loss based on temperature changes – I. A meta-analysis study. In Proceedings of the XVIII International Silage Conference in press
- Woolford, M.K. 1984. The Silage Fermentation. Microbiology Series vol. 14. New York: Marcel Dekker, Inc. 350 p