ORIGINAL PAPER

THE INFLUENCE OF SILAGE ADDITIVES FOR QUALITATIVE PARAMETERS OF CLOVER-GRASS SILAGES

VLIV ADITIV NA VYBRANÉ KVALITATIVNÍ UKAZATELE JETELOTRAVNÍCH SILÁŽÍ

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Manuscript received: May 1, 2005; Reviewed: July 10, 2005; Accepted for publication: August 13, 2006

ABSTRACT

We observed the influence of silage additives for choice qualitative parameters at 109 samples of clovergrass silages in working conditions. We evaluated total classification and categorization to quality classes according to fermentation process.

It has been found out positive effect of the silage additives for fermentation class and for total silage quality of silages. This positive effec t has been more considerable at classification to the fermentation classes at clover-grass silages. The high content of crude fibre decreased fermentation results and total silage quality at test clover-grass silages. The greatest (deterioration) influence for clasification to total quality class has crude fibre content. It is see from correlation coeficient at clover-grass silages – r = 0,75 (P < 0,05). The weak dependence r = 0,37 (P < 0,05) was detected between fermentation class and acetic acid content. It was detected large dependence between fermentation class and butyric acid content r = 0,73 (P < 0,05).

KEY WORDS: clover-grass silages, qualitative parameters, silage additives

ABSTRAKT

U 109 vzorků jetelotravních siláží byl v provozních podmínkách sledován vliv silážních aditiv na kvalitativní ukazatele. Posuzováno bylo jednak celkové zatřídění a zařazení do tříd jakosti podle fermentačního procesu. U silážovaných krmiv bylo potvrzeno, že aditiva mají pozitivní vliv na fermentační proces a tím i na celkovou kvalitu siláží. Tento pozitivní vliv byl ještě více patrný na zatřídění do třídy fermentace. Vysoký obsah vlákniny u sledovaných silážovaných krmiv zhoršoval fermentační výsledky i celkovou jakost siláží. Z korelačních koeficientů hodnotící jetelotravní siláže je patrné, že největší (zhoršující) vliv na zařazení do celkové třídy jakosti má množství vlákniny r 0,75 (P < 0,05). Mírná závislost r 0,37 (P < 0,05) byla zjištěna mezi třídou fermentace a obsahem kyseliny octové. Mezi třídou fermentace a obsahem kyseliny máselné byla zjištěna velká závislost r 0,73 (P < 0,05).

KLÍČOVÁ SLOVA: jetelotravní siláže, kvalitativní ukazatele, aditiva

INTRODUCTION

Ideal fermetation process reduces fermentation losses and preserves good aerobe stability during animal feeding. Right siling and suitable silage additives are the most important for silage quality. We know examples very bad silages but with good aerobe stability (high content of nonprotein nitrogen or high content of acetic acid or butyric acid) and very good prepare silages can be aerobe unstable (Woolford, 1998).

They are known two reasons why to use silage additives for better aerobe stability of silages. We must prevent to silage warming with following loss of dry matter. We must stop reducing of animal production in consequence of poor-quality silage (Bolsen et al., 1996). The effective silage additives remove one or both problems (Kung, et al., 1998). The silage additives improve fermentation process and reduce aerobe degradability (Honig, 1995). These additives stimulate quick acidification of silage matter with help of higher production of acid lactic and obstruct growth and increasing of bad microorganisms.

MATERIALS AND METHODS

We evaluated the influence of silage additives for quality parameters according to categorization to total classes and fermentation process in working conditions. We have evaluated 109 samples of clover-grass silages in co-operation with Agriculture district laboratory in České Budějovice.

The samples of silages have been evaluated by silage evaluation EKO-LAB Žamberk (Mikyska et Šeda, 2000). The samples have been classification to quality classes according to share of acids contents in silage, pH, dry matter and crude protein. The quality of silages has been evaluated according to sensory evaluation and fermentation procees too.

The nutritive values were analysed by Laboratory Methods for Feed Analyses in Appendix No. 9 – 13 Announcement of Ministry of Agriculture Czech Republic No. 124/2001 Digest. Crude proteins were analysed by Kjehdal method at apparatus KJELTEC TECATOR and crude fibre was analysed by acidalkaline method at apparatus ANKOM. The silage acids were analysed by izotachoforetic analyser IONOSEP 2001.

They are calculated points for dry matter, crude fibre, crude protein and fermentation process according to analytic values. There is assign total class Ist – IVth to table and word comment – excelent, good, worse, bad (Mikyska et Šeda, 2000).

It was not dressed 46 samples of clover-grass silages (42,2 %) by silage additives and 67 samples (57,8 %) was dressed from total number of tested clover-grass silages. The share of bacterial-ferment additives was 50,1 % and bacterial additives 49,9 % from total number of used additives.

We tested seven kinds of silage supplements in clover-grass silages – GOLDZYM (20,8 %), BACTOZYM (20,8 %), FEEDTECH F 3000 (13,9 %), MICROSIL (11,1 %), BONSILAGE PLUS (8,4 %), SILLA-BAC (6,9 %), SILL-ALL 4x4 (5,6 %) and KEM LAC DRY (2,8 %). Graph No. 1.A

RESULTS AND DISCUSSION

The categorization of the clover-grass silages to total classes: class excelent 27,5 % of samples, class good 30,3 %, class worse 23,9 % and class bad 18,3 %. The clover-grass silages with silage additives have been classification to class excelent – 30,2 % of samples and to class good – 34,9 %, class worse 23,8 % and class bad 11,1 %. The clover-grass silages without silage additives have been classification to class excelent – 23,9 % of samples, class good – 23,9 %, class worse – 23,9 % and class bad – 28,3 %. The values in table No. 3.

The categorization of the clover-grass silages to class according to fermentation process: 56,9% of samples in Ist class, 22,9 % in IInd class, 10,1 % in IIIrd class, 3,7 % in IVth and 6,4 % in Vth class of fermentation. The categorization of the clover-grass silages with fermentation additives to class according to fermentation process is better: 71,4 % of samples in Ist class and 19 % in IInd class, 3,2 % in IIIrd class, 3,2 % in IVth and 3,2 % in Vth class. The categorization of silages without fermentation additives to class according to fermentation process: 37 % of samples in Ist class, 28,3 % in IInd class, 19,6 % in IIIrd class, 4,3 % in IVth and 10,8 % in Vth class of fermentation. The fermentation additives have very positive influence for fermentation process. The values in table No. 4.

There are cited percentage shares of clovergrass silage samples in single total classes that unmatched to silage evaluation EKO-LAB Žamberk (Mikyska et Šeda, 2000) in nuriments dry matter, crude fibre and crude proteins in table No. 5. These nutriments are important for eveluation of silages. The clover-grass silages categorization to class excelent: 10 % of samples with high dry matter and 6,7 % with low dry matter, class good: 18,2 % of samples with high dry matter and 9,1 % with low dry matter, class worse 15,4 % of samples with high dry matter and 23,1 % with low dry matter and to class bad: 20 % of samples with high dry matter and 25 % with low dry matter. The share of all samples with high content of dry matter was 15,6 % and 14,7 % with low dry matter. The share of unmatched samples in content of crude proteins in class

Table No.1: Composition of bacterial-enzymatic additives for preservation of roughages (clover-grass)

Name of additive	Species (strains) of microbes and their minimum quantity in additive (CFU/g)		Enzymes and their minimum activity in additive (nkat/g, nkat/ml)		Other components
Bactozym	*L. plantarum* (CCM 3769), *L. casei* (CCM 3775), *E. faecium* (CCM 6226), *P. pentosaceus* (CCM 3770)	$1,5 \times 10^{10}$	cellulase and hemicellulase glukosaoxidase	31 000 4 800	dry whey, sacharose, laktose
Goldzym	*L. plantarum* (CCM 3769), *L. casei* (CCM 3775), *E. faecium* (CCM 6226), *P. pentosaceus* (CCM 3770)	$1,5 \times 10^{10}$	cellulase a hemicellulase glukózaoxidase	28 000	dry whey, sacharose
Kemlac Dry	*L. acidophilus* ATCC 4 356, *L. delbrueckii ssp. Bulgaricus* ATCC 11 842, *L. plantarum* ATCC 4 008	1×10^{9}	endo-1,2(4)- ß glukanase endo-1,4-ß glukanase amylase	16 700 16 700 16 700	laktose
Sill-All 4 x 4	*L. plantarum, E. faecium, P. acidilactici, L. salivarius*	1×10^{11}	cellulase, hemicellulase, amylase, pentozanase		dextrose

Table No. 2: Composition of bacterial additives for preservation of roughages (clover-grass)

Name of additive	Species (strains) of microbes and their minimum quantity in additive (CFU/g)		Other components
Bonsilage	*L. rhamnosus* (NCIMB 30121), *E. faecium* (NCIMB 30122)	R: 1×10^{11} G: 2×10^{8}	R: dry whey G: calcium carbonate
Bonsilage plus	*L. rhamnosus* (NCIMB 30121), *L. plantarum* (DSM 12836), *L. brevis* (DSM 12835), *L. buchneri* (DSM 12856), *P. acidilactici* (*P. pentosaceus*) (DSM 12834)	R: 1×10^{11} G: 2×10^{8}	R: dry whey G: calcium carbonate
Feedtech F3000	*L. plantarum Milab*, *P. acidilactici*, *E. faecium*, *Lactococcus lactis*	5×10^{5}	
Microsil	*L. plantarum* (CCM 3769), *L. casei* (CCM 3775), *E. faecium* (CCM 6226), *P. pentosaceus* (CCM 3770)	1×10^{10}	dry whey, sacharose, laktose
Sila-Bac	*L. plantarum* (DSM 4784, DSM 4785, DSM 4786, DSM 4787), *E. faecium* (DSM 4788, DSM 4789)	R: $1,35 \times 10^{11}$ G: 2×10^{8}	R: maltodextrin, sodium aluminium silicate, sodium thiosulfate, color E133 G: calcium carbonate

L = *Lactobacillus*, *E* = *Enterococcus*, *P* = *Pediococcus*, CFU = colony forming unit,
R = soluble, G = granulated

excelent 90 %, in class good 39,4 %, in class worse 30,8 % and in class bad 55 %. The share of all samples with unmatched content of crude proteins was 54,1 %. The share of samples with high content of crude fibre in class excelent 36,7 %, in class good 81,8 %, in class worse 96,2 % and in class bad 100 %. The share of all samples with high content of crude fibre was 76,1 %.

The greatest (deterioration) influence for clasification to total quality class has crude fibre content. It is see from correlation coeficient at clover-grass silages $r = 0,75$ ($P < 0,05$). The weak dependence $r = 0,37$ ($P < 0,05$) was detected between fermentation class and acetic acid content. It was detected large dependence between fermentation class and butyric acid content $r = 0,73$ ($P < 0,05$).

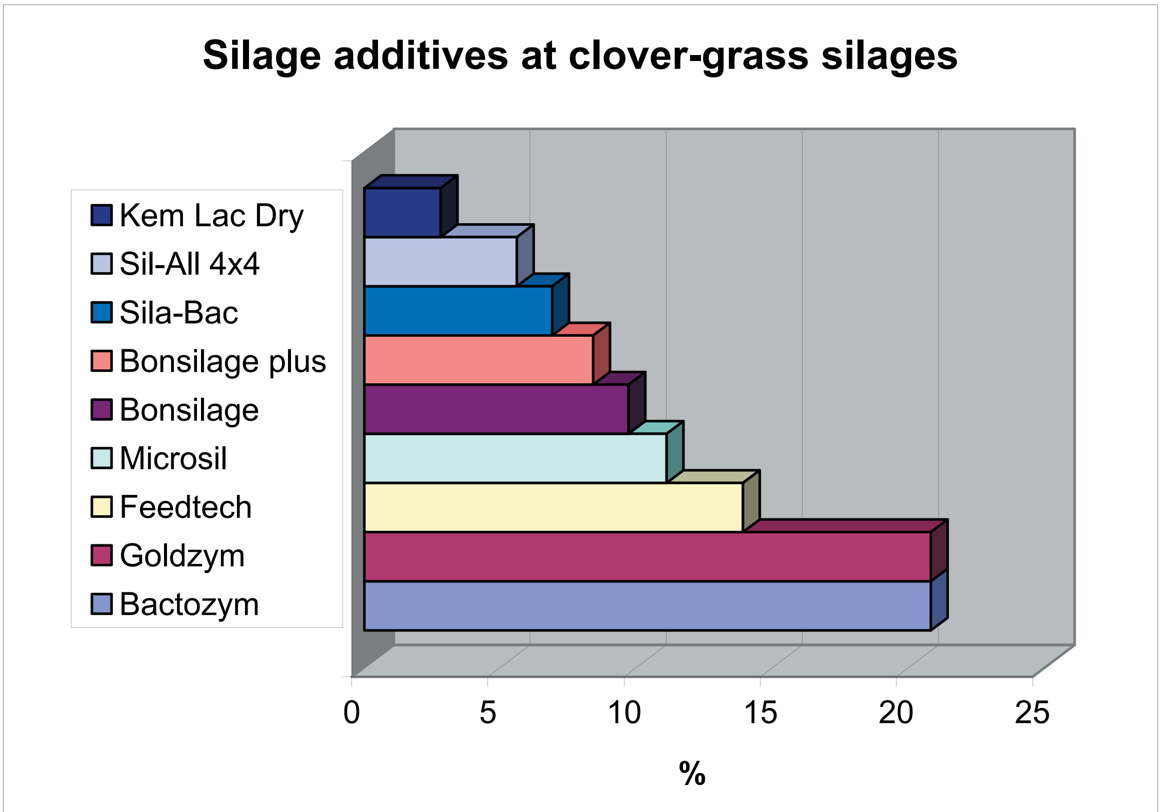
The using of silage additives improves qualitative parameters of silages (LOUČKA et al., 1999; LÁD et al., 2004). WEDDELL, (2001) writes results of silages from working conditions in years 1998, 1999 and 2001. Statistical significant differences were not detected. They exist explicit suggestions the using of silage additives improves quality of fermentation process. WILKINS et al., (1999) estimate the share of silage additives for increase of ensilage profitability since 5 % at ensilages with high content of dry mater to 9 % at silages with low content of dry mater. DOLEŽAL, (2001) writes the ensilage quality is influenced by available silage additives but must be observed all technological requirements.

We have found out high contents of crude fibre and crude proteins at clover-grass silages. Optimum values: dry matter 280 - 450 g/kg, crude fibre to 250 g/kg of dry matter and crude protein to 150 g/kg of dry matter. The 76,5 % of clover-grass silages from experiment did not reach of optimal content of fibre.

silage additives are given to feedstuffs. The silage additives have positive effect for lactic acid fermentation, for aerobe stability and for feed value of ensilages. The silage additives do not compensate mistakes in ensilage technology but they used for preparation of high quality silages (LOUČKA et al., 1998, Doležal et al., (2001).

CONCLUSIONS

We observed the positive influence of silage additives for the fermentation process and quality of ensilages. This positive effect has been more considerable at classification



Graph No. 1

Table No. 3: The percentage categorization of clover-grass silages to total class

Total class	Total	With silage additives	Without silage additives
I	27,5	30,2	23,9
II	30,3	34,9	23,9
III	23,9	23,8	23,9
IV	18,3	11,1	28,3

Table No. 4: The percentage categorization of clover-grass silages to fermentation class

Fermentation class	Total	With silage additives	Without silage additives
I	56,9	71,4	37
II	22,9	19	28,3
III	10,1	3,2	19,6
IV	3,7	3,2	4,3
V	6,4	3,2	10,8

Table No. 5: The percentage share of cloverg-rass silage samples unmatched to silage evaluation, EKO-LAB Žamberk (Mikyska et Šeda, 2000)

Total class	Parameters			
	Dry matter (g/kg)		Crude fibre (g/kg DM)	Crude proteins (g/kg DM)
	to 280	Above 450	Above 250	above 150
I	6,7	10	36,7	90
II	9,1	18,2	81,8	39,4
III	23,1	15,4	96,2	30,8
IV	25	20	100	55
Total	14,7	15,6	76,1	54,1

to the fermentation class.

The high content of crude fibre decreased of fermentation results and total quality of examinated fodder silages. They have been evaluated correlation coefficients at clover-grass silages. The greatest (deterioration) influence for clasification to total quality class has crude fibre content. It is see from correlation coeficient at clover-grass silages – $r = 0{,}75$ ($P < 0{,}05$). Optimal content of crude fibre in clover-grass silages matches to the value 250 g/kg DM. The 76,5 % of clover-grass silages from experiment did not reach of optimal content of fibre. The high content of crude fibre is big problem in practice. This insufficiency is caused by later harvest of fodder. The silage additives have positive influence for fermentative process and for total quality of silages too.

ACKNOWLEDGEMENTS

Supported by grant MSM 6007665806

REFERENCES

[1.] Bolsen, K.K., Bonilla, D.R., Huck, G.L., Young, M.A., Hart-Thakur, R.A, Joyeaux, A. (1996). Effect of a propionic acid bacterial inoculant on fermantation and aerobic stability of whole-plant corn silage. J. Anim. Sci 74 (Suppl. 1), 274-279.

[2.] Doležal, P., Dvořáček, J., Zeman, L. (2001). Problematika kvality siláží a silážních aditiv. Krmivářství č. 1, s. 16-20.

[3.] Honig, H., Pahlow, G. (1995). Principles to produce high quality silage from grass. Paper Presented to Ulster Grassland Society, February 22, 6 -9.

[4.] Kung, J. L., Sheperd, A.C., Smagala, A.M., Endres, K.M., Bessett, C.A., Ranjit, N.K., Glancey, J.L. (1998). The effect of preservatives based on propionic acid on the fermentatoin and aerobic stability of corn silage and total mixed tation. J. Dairy Sci. 81, 1322-1330.

[5.] Lád, F., Jančík, F., Čermák, B., Kadlec, J. (2004).

Faktory ovlivňující kvalitativní ukazatele silážovaných krmiv (The influence of factors for qualitative parameters of silages). In: Collection of Scientific Paper, Faculty of Agriculture in České Budějovice, Series for Animal Sciences, volume XXI., Č.Budějovice, 1 Special Issue: 129 – 132.

[6.] Loučka, R., Machačová, E. (1998). Zajištění vysoké kvality krmiv z víceletých pícnin. Metodika pro zemědělskou praxi. ÚZPI ve spolupráci s MZe. Praha, 51 s.

[7.] Loučka, R., Machačová, E., Moravcová, J., Čeřovský, M., Voldřich, M. (1999). Effect of cellulase, hemicellulase and glucose oxidase mixture in probiotic-enzymatic additive on fermentation of alfalfa. Czech J. Anim. Sci., 44, 87-92.

[8.] Mikyska, F., Šeda, J. (2000). Laboratorní hodnocení kvality silážovaných krmiv. AgroKonzulta Žamberk, 6 s.

[9.] Weddell, J.R. (2001). Silage Additive Approval Schemes in Europe – Aims, Developments and Benefits. X International symposium. Forage conservation, Brno, 37-44.

[10.] Wilkins, R., Syrjala-Qvist, L., Bolsen, K.K. (1999). The future of silage in sustainable animal production. Process. XII International Silage Conference, Uppsala, 23-40.

[11.] Woolford, M. K. (1998). Bacterial developments their implications for silage production and aerobic stability. In: Biotechnology in the Feed Industry, Proceedings of the 14"' Annual Symposium. Nottingham University Press, Nottingham, UK, 181-184.