COMPARISON OF THE EFFECT OF SILAGE ADDITIVES ON THE FERMENTATION PROCESS OF THE LATTE SORGHUM VARIETY IN SINGLE-CUT USE

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ABSTRACT

Sorghum of the LATTE variety was harvested at the milky-wax maturity stage, with an average dry matter of 26% for minisilage production. Using a silage hydraulic press, the mass was pressed into tubes (diameter 160 mm, length 65 cm), weighed, and closed with a rubber lid equipped with a gas outlet valve. Sorghum forage was preserved with various additives: control without additives (C), organic acid-based additives (OA), and acid salt-based additives (AS), with each variant replicated 6 times. After 5 months of fermentation, the minisilos were opened, and silage samples were analyzed. The highest pH was found in OA (4.09) and was higher than in AS (3.86) and C (3.9, $P<0.05$). The acidity of the aqueous extract was lowest in OA (703 mg KOH) compared to C (1301 mg KOH) and AS (1462 mg KOH) ($P<0.05$). Compared to C silages, OA and AS silages had significantly ($P<0.05$) higher contents of all silage acids (85.3, 87.3, and 64 g/kg DM) and especially acetic acid (25.9, 29.1, and 16.6 g/kg DM in OA, AS, and C silages, respectively). In addition, OA silages had significantly higher propionic acid content (2.71 g/kg DM). The higher content of silage acids in silages with additives not only improved their quality but also increased their stability under aerobic conditions.

Keywords: modelsilage, sorghum silage, LATTE variety, silage additives, silage acids

INTRODUCTION

With the progressing climate change and the increasingly frequent problems with a lack of moisture during vegetation and the associated deterioration of yields of the main fodder crops (silage corn, alfalfa), the task arises of ensuring the fodder base with drought-resistant crops. One such crop is sorghum bicolor [*Sorghum bicolor* (L.) Moench.], which, thanks to breeding for a lower content of anti-nutritional substances (tannins, dhurrin), also appears to be a suitable crop for the production of silage for cattle. Despite its lower content of nitrogenous substances and starch, it can be a suitable supplement to feed rations and also a suitable reserve in case of a shortage of corn and alfalfa silage. The NDF content in sorghum forage is also interesting. With a suitable crop rotation, it can be included after winter crop harvests, yielding one additional harvest in a given year. It is also advantageous to use some sorghum varieties in two cuts, as plants harvested earlier have higher crude protein content. Various preservatives are used for ensiling, both chemical and biological, and their selection is often guided by the dry matter content of the preserved forage. When preserving sorghum, especially with a single-cut harvest, it is often a problem to achieve a higher dry matter content of the forage.

MATERIAL AND METHODS

Sorghum forage of the LATTE variety was grown on the lands of the Mendel University in Brno school agricultural enterprise, which are located in South Moravia in the village of Žabčice (Czech Republic). Plants were harvested at the milky-wax maturity stage of the grain. Harvesting took place in September, and due to adverse weather conditions, it was not possible to wither the plants to a higher dry matter content. The average dry matter content of the ensiled forage was 260 g/kg. The sorghum cut was treated with preservatives based on organic acids (OA) and acid salts (AS); the control group was ensiled without additives (C). The fodder was pressed into cylindrical tubes (diameter 160 mm, length 65 cm), using a silage hydraulic press. Tubes were loaded with a 10 kg weight, closed with a rubber lid equipped with a gas outlet valve, and weighed. Each variant was ensiled in 6 replicates. The tubes were left to ferment for 5 months at ambient temperatures of 20–25°C. After the fermentation period, silage samples were taken for analysis. Essential nutrients were analyzed in the laboratory according to methodologies in accordance with COMMISSION REGULATION (EC) No. 152/2009. Furthermore, according to Mertens (2002) and ISO 16472 (2012), acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined. Acid detergent lignin (ADL) was determined from the ADF fraction after 3-hour maceration in 72% sulfuric acid, and cellulose was determined by subtracting ADL from the ADF fraction (ADF – ADL). Fatty acids were measured in silage extract by capillary isotachophoresis according to Kvasnička (2000). The determination was performed using the IONOSEP 2001 analyzer (RECMAN–laboratory systems, Ostrava, Czech Republic). Statistical evaluation was performed using the STATISTICA 14 program (TIBCO Software Inc.). The significance of differences was evaluated using a one-factor Analysis of Variance using the Tukey HSD test.

RESULTS AND DISCUSSION

The results of the fermentation process evaluation are shown in Table 1. Despite the low dry matter of the ensiled material, the resulting silages were of acceptable quality. Silages treated with OA and AS showed significantly higher total organic acid and acetic acid contents compared to the control silage. The pH value corresponded to the dry matter of the silages. As for the percentage of lactic acid, the treated silages were relatively balanced, but their values were inconclusively lower than those of the control silage. SHAVER (2003) states that the proportion of lactic acid from the total fermentable acids should reach at least 65-70%. The control silages were closer to the higher value, but the differences were not significant. Nutrient values after laboratory analysis are shown in Table 2.

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Tab. 1: Composition of tested TMR (kg/head/day; % of total fresh matter)

Experimental group		Control (C)		Organic acids (OA)		Acid salts (AS)	
n		6		6		6	
Parameter	**Units**	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
pH		3.90[a]	0.03	4.09[b]	0.08	3.86[a]	0.02
Acidity of the aq. extract	mg KOH	1300[b]	71.26	703[a]	106.65	1462c	66.23
Ammonia (NH_3)	g/kg of silage	0.26	0.07	0.21	0.03	0.28	0.05
Lactic acid	g/kg DM	46.60	12.35	56.40	12.09	57.70	5.00
Acetic acid	g/kg DM	16.61[a]	3.56	25.85[b]	2.81	29.09[b]	1.81
Propionic acid	g/kg DM	0.82[a]	1.39	2.71[b]	0.83	0.45[a]	0.46
Butyric acid	g/kg DM	0.00	0.00	0.32	0.79	0.00	0.00
Sum of acids	g/kg DM	64.03[a]	14.53	85.29[b]	11.73	87.28[b]	5.46
LA/VFA		2.71	0.76	1.98	0.49	1.96	0.21
LA/AA		2.84[b]	0.81	2.22[ab]	0.54	1.99[b]	0.21
% of LA out of total FA	%	71.77	7.02	65.55	7.05	66.09	2.51

n - number of cases; S.D. - standard deviation; LA - lactic acid; VFA - volatile fatty acids; AA - acetic acid; FA - fatty acids. Means in a row marked with different letters are significantly ($P<0.05$) different.

Tab. 2: Nutritional value of sorghum silages (nutrients in g/kg of dry matter)

Experimental group	Control (C)		Organic acids (OA)		Acid salts (AS)	
n	6		6		6	
Nutrients in g/kg of DM	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Dry matter	260	7.61	268	17.10	264	10.43
Crude Ash	74[b]	1.90	68[a]	2.03	72[b]	0.97
Crude Protein	83[b]	2.69	79[a]	2.90	83[b]	1.90
Ether Extract	23	3.69	23	2.89	24	1.39
Crude Fibre	306[b]	7.08	284[a]	8.42	309[b]	8.19
ADF	375	13.24	377	28.58	379	6.78
aNDF	606[b]	15.19	582[a]	15.97	598[ab]	15.43
ADL	44[a]	2.28	53.6[b]	13.41	43.5[ab]	1.08
Cellulose	331	11.53	323	16.68	336	5.79

n - number of cases; S.D. - standard deviation; ADF - Acid detergent fiber; aNDF - Neutral detergent fiber after sample treatment with amylase; ADL - acid detergent lignin; DM - dry matter. Means in a row marked with different letters are significantly ($P<0.05$) different.

CONCLUSION

Good quality was found for sorghum silages despite the low dry matter content of the ensiled material. The higher content of silage acids in silages with additives not only improved the quality of silages, but also improved their stability after exposure to aerobic conditions. Sorghum silage should be a suitable supplement to cattle feed rations and a feed reserve in times of climate change with a lack of moisture during the vegetation period.

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