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QUALITY OF SILAGE FROM BROWN MIDRIB SORGHUM x SUDANGRASS FORAGE

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Abstract

Sorghum x sudangrass hybrid has as feed for cattle a lower nutritive value than maize silage. The BMR hybrid has a higher value and a less indigestible lignin and a higher organic matter digestibility. In trial was hybrid Sorghum x sudangrass harvested in optimal stand height for forage and ensilaged in laboratory silos and on farm. In model trial the silage was made of green matter quality and subsequently of the quality of silages produced from the second cut. In the experiment, the effect of additives supplementation on the fermentation quality of Sorghum x sudangrass silage was examined and compared with the untreated control. In the production of silages from the forage we used chemical ingredient Kemisile 3 L/t (formic acid, propionic acid, ammonium formate) and biological additive Microsil 15 g/t (4 stems of lactic acid bacteria – *Enterococcus faecium* (CCM 6226), *Lacotobacillus plantarum* (CCM 3769), *Lacotobacillus casei (*CCM 3775*)*, *Pediococcus pentosaceus* (CCM 3770) and *Lacotobacillus buchneri* (CCM 1819) in total concentration $1.5*10^5.*g^{-1}$ silage. Silages sampled 60 days after the beginning of conservation were assessed for DM, pH, titrable acidity, contents of organic acids and ethanol. The silage with Kemisile supplementation had the the highest ($P<0.01$) content of lactic acid, howewer ($P<0.05$) pH value and acetic acid content. The lowest average content of ethanol was in untreated control silage. The treatment with chemical conservation had a favourable effect on the titration acidity ($P<0.05$). Silage inoculated with Microsil had the higher ($P<0.05$) content of lactic acid than untreated silage, but lower as the silage with Kemisile.

Keywords: Sorghum x sudangrass hybrid, quality of silages, Kemisile, biological additive Microsil

Introduction

Traditional hybrids of sorghum are not widespread due to their lower nutritive value as compared with maize silage. On the other hand, sorghum x sudangrass hybrids (BMR) are for their multi-cut harvest interesting fodder crops for direct feeding to cattle but also for ensilaging (*Kilcer et al*, 2005). These BMR hybrids can be used in cow ration for milk production at a similar level as maize silage. *Miller and Stroup* (2003), but also *Oliver et al* (2004) and other authors state that BMR hybrids are characterized by higher NDF digestibility, higher protein quality and better palatability, too. For an optimum use, biomass for silage must be harvested at a correct growing stage when the concentration of digestible energy and organic matter is optimal (*Dickerson et al*, 1995; *Sonon et al*, 1991 and others). The lignification is low at that time. Main energy nutrients in the feedstuff are soluble sugars, which positively affect sappiness and dry matter intake. Higher concentration of sugars provides for rapid and good fermentation.

Materials and Methods

The work objective was to study silage additives on fermentation process quality in silage made of the multi-cut hybrid of sorghum.

In model trial, we used green matter of multi-cut sorghum hybrid harvested at the stage of ear formation. Mown sorghum biomass with the original dry matter content of 195.06 $g.kg^{-1}$ was for a short time (1 day) wilted in the laboratory of the Department of Animal nutrition and forage production, Mendel University of Agriculture and Forestry Brno to DM = 229.61 $g.kg^{-1}$, treated with additives and ensilaged in experimental vessels. The model trial included three variants: A (untreated variant as negative control), B (variant treated with the addition of biological inoculant at a dose of 15 $g.t^{-1}$), and C (variant treated with a mixture of organic acids at a dose 3 $L.t^{-1}$). The treatment of sorghum green matter prior to silaging was in all experimental variants homogeneous. The biomass was subsequently ensilaged into experimental vessels at an amount of 7 kg in three replications. Each experimental vessel contained the identical amount of biomass pressed down to converted average weight of 600 $kg.m^{-3}$. The experimental vessels for anaerobic fermentation were enclosed with a lid and stored at room temperature of 20-25 °C. After six months, the vessels were opened and representative samples (6) were taken from each variant for the analysis of the fermentation process. At the same time, a sensoric assessment was made of the model silages.

Analytical methods used

Dry matter content was established by desiccation at 103±2 °C to constant weight. Analytical procedures including aqueous extract preparation were described in one of our earlier works (*Doležal*, 2002). The samples were analyzed for the content of volatile fatty acids, lactic acid, ammonia, pH value and titration acidity. Alcohol content was ascertained by using the method described by *Hartman* (1974). Results were statistically processed by using one-factor analysis of variance.

Results and discussion

Due to the low dry matter content of ensiled matter, silage fluids flowed off during the storage. The amount of silage fluids from control silages converted to 1 ton of ensiled matter was 35.4 L while the highest amount was detected to flow out from silages treated with the chemical preparation (52.9 L/t). Silages inoculated with the biological additive (B) exhibited the lowest reduction of silage matter due to the flowing out silage fluids (31.1 L/t). The findings are in a good agreement with data published by other authors. Average fermentation characteristics of the fermentation process in model sorghum silages are presented in *Table 1*.

Table 1: **The fermentation characteristics of sorghum silages**

Variant	DM	pH	AWE	LA	AA	PA	Sume acids in DM	Ethanol	NH_3
	g.kg^{-1}		mg KOH	%				%	%
A	190.4	4.482	1255.0	0.455	1.798	0.062	12.159	0.365	0.045
B	199.6	4.482	1277.8	0.675	1.898	0.115	13.465	0.490	0.055
C	214.1	3.932	1480.7	1.922	0.902	0.20	13.287	0.675	0.045

DM – dry matter; AWE – acidity water extract; La – lactic acid; AA – acetic acid; PA – propionic acid

The results indicate that due to the different release of fluids, changes occurred also in the dry matter content of delivered silages. Average dry matter content of untreated control silage was 190.40 g.kg^{-1} and did not significantly differ from the dry matter content of inoculated silage (199.63 g.kg^{-1}). On the other hand, the highest loss in the form of silage fluids in the chemically treated sorghum silage resulted in a significant ($P \leq 0.05$) increase of dry matter content (214.05 g.kg^{-1}) as compared with both groups of silages. Total loss of dry matter (DM) in silages due to fermentation process was the highest in the untreated silage (303.48 g) while the lowest loss was found in the chemically treated silage (14.24 g).

DM loss in the inoculated silage was 252.99 g. These findings correspond with tendencies detected in other silages. Significant differences were found in pH value, too. The lowest pH value ($P \leq 0.05$) was detected in the chemically treated silage (3.93) while no significant differences were found between the remaining variants. Differences that were more significant were found in the AWE characteristic whose value relates to the total content of acids, resp. lactic acid (LA). A mutual comparison of the contents of fermentation acids revealed differences in the laboratory sorghum silages not only in the contents of lactic acid and acetic acid but also in the sum of fermentation acids in the dry matter content of the silages. As compared with both the inoculated and control silages, the addition of the mixture of organic acids had a positive influence ($P \leq 0.05$) not only on the increased level of lactic acid but also on the reduction of acetic acid content (0.902% vs. 1.798 resp. 1.893% in silage DM). The total content of acids as well as the total content of lactic acid corresponded with the behaviour of titration acidity in silages (AWE). The highest titration acidity was found in the silage with the addition of chemical agent (1480.7 mg KOH) while the control silage showed free titration at a level of 1225.0 mg KOH/100 g). With respect to the low DM content, the addition of microbial inoculant increased the level of free titration only insignificantly (1277.8 mg KOH/100 g silage). The tendency of these silages to produce ethanol is different from earlier published results. Contrary to expectations, the ethanol content in the control silage made of the tested hybrid was the lowest (0.365%) as compared with that in the inoculated silage (0.490% in DM) as well as in the chemically conserved sorghum silage (0.675% in DM) in spite of worse fermentation values.

The regression relation between the content of lactic acid and ethanol content was not corroborated because we did not succeed to demonstrate unambiguously that ethanol content is decreasing with the increasing lactic acid content as it was formerly demonstrated in other silages. *Driehuis et al* (1999) can see prevention against alcohol fermentation in the restriction of the activity of enterobacteria and particularly in the stimulation of the fermentation process. On the other hand, *Seija et al* (1999), *Chri et al* (1999) and other authors detected reduced alcohol production but also reduced production of fermentation acids including lactic acid upon the application of active chemical preservatives based on organic acids, which we failed to corroborate in our trial. No significant differences were found between the respective model silages in the content of ammonia.

Conclusion

The season of harvesting is important for the production of high-quality forage with maximum levels of nutrients. Harvesting in the later vegetation phase with a lower content of DM has a negative influence on the level of fermentation process. The addition of chemical preservative increased the amount and the discharge of silage fluids from the ensiled sorghum biomass, significantly reduced the production of acetate, boosted the production of lactic acid, increased the value of free titration in silage but did not prevent the reduced production of alcohol in the silages.

References

Cited sources are available at the authors.

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