Ensiling of Tannin-Containing Sorghum Grain

E. M. Ott
University of Rostock, Germany

Y. Acosta Aragón
University of Rostock, Germany

M. Gabel
University of Rostock, Germany

The XX International Grassland Congress took place in Ireland and the UK in June-July 2005. The main congress took place in Dublin from 26 June to 1 July and was followed by post congress satellite workshops in Aberystwyth, Belfast, Cork, Glasgow and Oxford. The meeting was hosted by the Irish Grassland Association and the British Grassland Society.

Proceedings Editor: D. A. McGilloway

Publisher: Wageningen Academic Publishers, The Netherlands

Ensiling of tannin-containing sorghum grain

E.M. Ott, Y. Acosta Aragón and M. Gabel
University of Rostock, Faculty of Agricultural and Environmental Sciences, Institute of Farm Animal Sciences and Technology, Justus-von-Liebig-Weg 8, D-18059 Rostock, Germany, Email: edda.ott@uni-rostock.de

Keywords: sorghum, grain silage, tannin

Introduction Sorghum is known as important feed-stuff in tropical regions where rainfall is insufficient for the cultivation of maize. Furthermore, those sorghum cultivars rich in tannins are naturally protected to a certain extent against bird damage, insect pests and moulds. Nevertheless, tannins impair the feed quality. Thus, the objectives of this study were to investigate whether ensiling could be a suitable preservation method for sorghum grain originally rich in tannins and if it is possible to reduce tannin content during fermentation.

Materials and methods Bruised grain of sorghum variety CIAP 2E (with red coloured grain) was used for an ensiling study. After adjusting the DM content of the grist to 70% (using aqua dest.), 600 g of this material were filled in plastic bags (3 per treatment on opening) either pure or inoculated with lactic acid bacteria (LAB; $3x10^5$ cfu/g fresh matter (FM)) and molasses (2% of FM). Air was evacuated. Bags were sealed and stored at 30°C for 1, 2, 7, 14 and 56 d. After incubation fermentation parameters (pH; lactic acid: HPLC; acetic acid, propionic acid, butyric acid, i-valeric acid, ethyl alcohol, 2,3 - butandiol: GC), content of condensed tannins (CT; extraction with butanol/HCl by Porter *et al.*, 1986), total phenol amount (TPA; staining with Folin-Ciocalteus-solution by Julkunen-Tiito, 1985) and content of non-tannin-phenols (NTP; Polyvinyl polypyrrolidone by Laurent, 1975 and Waterson & Butler, 1983) were analysed. The content of tannin-phenols (TP) was calculated by subtraction (TP=TPA-NTP). A t-test (Duncan) was performed to compare the results of treatments and control.

Table 1 pH-values, lactic acid contents and tannin fractions in silage from sorghum grain depending on additives and time of storage (means, n=3)

	Parameter after time of storage (days)					
	0	1	2	7	14	56
Variants	PH-value					
Control	6.45	5.84	5.97	5.71	5.48	4.74
LAB+mol	6.45	4.73	4.12	3.93	3.99	3.93
	Lactic acid (g/kg DM)					
Control	0.00	0.00	0.30	2.10	3.30	8.20
LAB+mol	0.00	7.20	14.20	14.60	14.20	16.70
	Condensed tannins (g/kg DM)					
Control	11.91[a]	3.02[a]	1.53[a]	0.80[a]	0.72[a]	0.41[a]
LAB+mol	11.91[a]	3.92[b]	3.14[b]	1.23[b]	0.96[b]	0.65[b]
	Total phenol amount (g/kg DM)					
Control	19.55	9.45	8.54	8.82	9.20	9.83
LAB+mol	19.55	11.41	12.22	12.12	9.14	11.23
	Non-tannin-phenols (g/kg DM)					
Control	6.43	2.26	2.17	1.91	2.36	2.94
LAB+mol	6.43	3.04	3.12	2.58	2.64	2.93
	Tannin-phenols (g/kg DM)					
Control	13.17	7.22	6.46	7.05	6.83	6.94
LAB+mol	13.17	8.44	9.12	9.56	6.67	8.31

Control: without additives
LAB+mol: addition of lactic acid bacteria (*Lb. plantarum*) and molasses
[ab]: different letters show significant differences between variants

Results Organoleptic evaluation of the silages showed good quality in all variants tested, even in those variants exhibiting pH-values above 5. This could be approved by analytical determination of the fermentation parameters (e.g. no occurrence of butyric acid). Inoculation with LAB led to a rapid acidification and had a positive influence on silage quality (Table 1). Contents of acetic acid were low in all variants (0.08-0.10% of DM). Amounts of CT, TPA, NTP and TP decreased during storage, with the greatest decline after 1 d storage. Decrease was most evident for the fraction of CT, with a reduction to 25% after 1 d and to 3.5% after 56 d of storage (control, Table 1).

Conclusions Ensiling of bruised grain of sorghum (70% DM) results in anaerobically stable silages of good quality with lower contents of tannins than observed in the original material. To verify mechanisms of tannin-reduction further investigations are necessary. Conceivable explanations are, for instance:
- degradation of tannins during moist storage
- enzymatic degradation by LAB (Nishitani *et al.*, 2004)

References

Julkunen-Tiito, R. (1985). Phenolic constituents of leaves of Northern Willows: methods of analysis of certain phenolics. *Journal of the Science of Food and Agriculture*, 33, 213-217.

Laurent, S. (1975). Etude comparative de differentes methodes d`extraction et de dosage des tanins chez quelques pteridhytes. *Archive International Physiology and Biochemistry*, 83, 735-752.

Nishitani, Y., E. Sasaki, T. Fujisawa & R. Osawa (2004). Genotypic analyses of lactobacilli with a range of tannase activities isolated from human faeces and fermented foods. *Systematical Applied Microbiology*, 1, 109-117.

Porter, L.J., R.Y. Wong, H.F. Benson, B.G. Chang, V.N. Viswanadhan, R.E. Gandour & W.L. Mattice (1986). Conformational analysis of flavan. *Journal of Chemistry Research,* 86, 830.

Waterson, J.J. & G.L. Butler (1983). Occurrence of an unusual leucoanthocyanidin and absence of proanthocyanidins in sorghum leaves. *Journal of Agriculture and Food Chemistry*, 31, 41-45.