Perennial ryegrasses bred for contrasting sugar contents: manipulating fermentation and aerobic stability of wilted silage using additives (3) (EU-Project 'SweetGrass')

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Introduction Rapid field-drying of grass prior to successful ensilage restricts fermentation and can assist preservation, but can consequently result in silages that are prone to aerobic deterioration at feedout. Additives that directly (e.g. potassium sorbate or sodium benzoate) or indirectly (e.g. formic acid or *Lactobacillus plantarum*, via manipulation of fermentation) alter yeast activity at feedout could modify silage aerobic stability. This experiment evaluated the fermentation and aerobic stability of wilted silages made from perennial ryegrass cultivars of high or normal water soluble carbohydrate (WSC) genotype that differed in additive use.

Materials and methods Aberdart (Ab; bred for high WSC) and Fennema (Fn; normal WSC) perennial ryegrasses were mown on 17 June, 2003, and field dried for 24 h. Each was then precision-chopped and ensiled in laboratory silos (5 kg/silo). The additives applied to grass, using three silos per treatment, were (1) no additive, (2) and (3) Add-SafeR (85% ammonium tetraformate salt; Trouw Nutrition UK Ltd.) at 3 and 6 ml/kg, (4) Biomax SI (*Lactobacillus plantarum*; Chr. Hansen UK Ltd.) at 5 ml/kg, (5) Biomax SI at 5 ml/kg + potassium sorbate (KSor; 30g/l) at 5 ml/kg, (6) Biomax SI at 5 ml/kg + sodium benzoate (NaBe; 30 g/l) at 5 ml/kg, and (7), (8) and (9) Bio-Sil (*Lactobacillus plantarum;* Dr. Pieper Technologie- und Produktentwicklung Gmbh) at 5 ml/kg alone or with KSor or NaBe at 5 ml/kg, (10) KSor at 5 ml/kg, and (11) NaBe at 5 ml/kg. Silos were filled, sealed and stored (15^{0}C) for >100 days. Silage composition and aerobic stability measurements were made on every silage and the results subjected to 2-way analysis of variance.

Results

Mean (s.d.) grass dry matter (DM), WSC and buffering capacity for wilted Ab were 372 (26.4) g/kg, 165 (4.8) g/kg DM and 208 (11.0) mEq/kg DM, respectively, with corresponding values for Fn of 383 (27.4) g/kg, 144 (4.8) g/kg DM and 235 (16.0) mEq/kg DM. Lactic acid bacteria on Ab and Fn at harvesting were 7.1 and 7.2 $\log_{10}$ colony forming units/g, respectively. All silages were well preserved and were aerobically very stable. Cultivar had relatively little effect on the variables measured (Table 1), although Ab resulted in lower (P<0.05) lactic acid/fermentation products (653 vs. 678 g/kg) and duration to temperature rise (136 vs. 158 h). Add-SafeR increased final pH and NH_3-N values. Even though it decreased the content of lactic and acetic acids it increased ethanol content. Treatments containing Bio-Sil increased ethanol and reduced acetic acid and the duration to temperature rise. Neither of the bacterial inoculants and neither of the salts altered pH, total fermentation products or the content of lactic acid.

Table 1 Chemical composition and aerobic stability of wilted silages

	pH		Lactic acid g/kg FP[1]		NH_3-N g/kgN		Hours to temp. rise		ATR to day 5[2]	
Additive (A)	Ab	Fn	Ab	Fn	Ab	Fn	Ab	Fn	Ab	Fn
No additive	4.00	4.03	669	702	52	61	139	165	5	2
Add-SafeR low	4.10	4.13	613	623	75	88	192	158	2	4
Add-SafeR high	4.23	4.27	459	466	96	80	192	192	3	2
Biomax SI	4.00	4.00	696	716	59	66	110	145	5	4
Biomax SI + KSor	4.03	4.00	672	733	65	89	107	192	5	2
Biomax SI + NaBe	4.00	4.00	702	695	59	58	129	176	5	3
Bio-Sil	4.00	4.00	665	690	50	54	82	109	9	8
Bio-Sil + KSor	4.03	4.00	645	729	52	63	103	159	6	1
Bio-Sil + NaBe	4.00	4.00	673	710	51	58	78	133	12	4
KSor	4.00	4.00	719	705	63	60	171	124	2	8
NaBe	4.00	4.03	666	692	59	56	192	187	2	1
s.e.m. (CxA)	0.019		23.0		8.1		19.8		2.1	
Sig. C (cultivar)	ns		*		ns		*		P=0.089	
A	***		***		***		***		*	
CxA	ns		ns		ns		*		ns	

[1]FP=fermentation products (lactic+VFA+ethanol); [2]accumulated temp. rise to day 5

Conclusions The higher WSC and lower buffering capacity of Ab at harvesting gave it an apparent ensilability advantage over Fn. However, preservation was quite similar for both cultivars. The high rate of the formic acid-containing additive had the largest effect on fermentation and improving aerobic stability. The rates of inclusion of sorbate or benzoate salts did not improve aerobic stability under the test conditions prevailing.