Perennial Ryegrasses Bred for Contrasting Sugar Contents: Manipulating Fermentation and Aerobic Stability of Unwilted Silage using Additives (2) (EU-Project 'SweetGrass')

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Perennial ryegrasses bred for contrasting sugar contents: manipulating fermentation and aerobic stability of unwilted silage using additives (2) (EU-Project 'SweetGrass')

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Introduction Grass cultivars bred for elevated concentrations of water-soluble carbohydrate (WSC) could have improved silage preservation but possibly disimproved aerobic stability. Additives can be used to manipulate fermentation and thereby increase silage WSC. They can also influence aerobic stability. This experiment evaluated the fermentation and aerobic stability of unwilted silages made from perennial ryegrass cultivars of high or normal 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. Each was precision-chopped and ensiled in laboratory silos (6 kg/silo) without wilting. 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; 30 g/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 unwilted Ab were 143 (12.6) g/kg, 180 (4.8) g/kg DM and 226 (19.7) mEq/kg DM, respectively, with corresponding values for Fn of 141 (12.8) g/kg, 154 (11.6) g/kg DM and 242 (24.4) mEq/kg DM. Lactic acid bacteria on Ab and Fn at harvesting were 6.1 and 6.2 $\log_{10}$ colony forming units/g, respectively. All silages were well preserved. Ab silages had lower NH_3-N (68 vs. 77 g/kg N) and lactic acid/fermentation products (616 vs. 702 g/kg) values and a higher accumulated temperature rise to day 5 (ATR; 27 vs. 23^{O}C) than Fn silages (Table 1). Incremental additions of Add-SafeR restricted (P<0.05) fermentation, improved (P<0.05) aerobic stability (i.e. duration to temp. rise) and reduced (P<0.05) aerobic deterioration (i.e. ATR). Neither of the bacterial inoculants and neither of the salts (KSor or NaBe) altered (P>0.05) fermentation, aerobic stability or aerobic deterioration indices.

Table 1 Chemical composition and aerobic stability of unwilted 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	3.73	3.83	636	732	59	66	28	25	34	27
Add-SafeR low	3.80	3.87	633	653	104	105	69	79	24	19
Add-SafeR high	4.20	3.97	379	527	146	140	94	128	14	9
Biomax SI	3.70	3.87	683	686	58	72	51	25	25	27
Biomax SI + KSor	3.97	3.93	491	664	52	69	34	22	29	26
Biomax SI + NaBe	3.80	3.90	594	690	56	64	27	34	31	22
Bio-Sil	3.73	3.80	680	739	53	76	22	38	29	24
Bio-Sil + KSor	3.67	3.73	720	764	62	62	32	32	31	24
Bio-Sil + NaBe	3.67	3.80	702	759	53	61	25	29	30	24
KSor	3.70	3.83	662	740	53	67	24	25	26	28
NaBe	3.77	3.73	597	772	51	65	24	21	27	29
s.e.m. (CxA)	0.072		34.0		8.2		14.7		4.9	
Sig. C (cultivar)	ns		***		*		ns		P=0.076	
A	***		***		***		***		P=0.051	
CxA	ns		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 for Ab compared to Fn indicate that Ab had better ensilability indices. The higher lactic acid/fermentation products for Fn silage reflects its higher concentration of lactic acid and lower concentration of both acetic acid and ethanol. The formic acid-based additive had the largest impact on fermentation and was the only additive to consistently and significantly improve aerobic stability and reduce aerobic deterioration.