Inoculant type affects fermentation characteristics, dry matter losses and aerobic stability of baled grass silage

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Introduction Aerobic instability is a common problem in well-fermented grass silage containing high lactic acid concentrations but only small amounts of acetic acid, which is normally observed in silage treated with homofermentative lactic acid bacteria (LAB_{ho}; Conaghan *et al*., 2010). The use of heterofermentative lactic acid bacteria (LAB_{he}) promotes acetic acid production, which improves aerobic stability (AS; Kleinschmidt and Kung, 2006). The use of a dual-purpose microbial inoculant (LAB_{ho+he}) was shown to improve fermentation characteristics and AS of grass silage (Driehuis *et al.*, 2001). However, most of these experiments have been conducted in small scale silos. This experiment aimed at investigating the effects of different types of inoculants on fermentation characteristics, dry matter (DM) losses and AS of chopped grass silage pressed in large round bales.

Material and methods The grass sward was mowed on June 4, 2012 as a first cut and wilted to an average DM content of 31% (10.5% CP, 22% water-soluble carbohydrats (WSC), 49% NDF of DM) before being precision chopped to 25 mm length and pressed into round bales with a stationary baler (Orkel MP 2000) on June 5, 2012 at Götala Research Station, Swedish University of Agricultural Sciences, Skara, south-west Sweden. The following inoculants (ADDCON EUROPE GmbH) were applied at chopping of the forage; KOFASIL LAC (KLAC) containing LAB_{ho} (*Lactobacillus plantarum* DSM 3676, 3677), $1x10^5$ cfu/g, KOFASIL S, (KS) containing LAB_{he} (*Lactobacillus buchneri* DSM 13573), $1x10^5$ cfu/g and KOFASIL DUO (KDUO), a combination of KLAC and KS, $2x10^5$ cfu/g. The bales were stored outside for 91 days before drilled samples were taken from five bales per treatment used as replicates. The treatments were compared with an untreated control (CON). Fermentation characteristics and WSC were determined by routine analytical procedures. The DM losses during fermentation were calculated (Weissbach, 2005) and the AS was determined as the number of days for the silage to reach a temperature of 2°C above ambient temperature. Data were statistically evaluated by using the procedures GLM and REG of SAS (version 9.3). When a significant *F*-test was detected ($P<0.05$), a pair-wise comparison between LSMEANS was performed by using the Tukey´s test and significance declared at $P<0.05$.

Results and discussion There was an overall treatment effect on all the variables studied in the grass silage (Table 1). KLAC showed a homolactic fermentation pattern and aerobic instability. The DM losses were lowest for KLAC although it had the highest ethanol content. Contents of acetic acid and 1,2-propanediol increased from KLAC to KDUO and KS, indicating anaerobic lactate degradation by *Lactobacillus buchneri*. As a result, AS increased from KLAC to KDUO and KS, which did not differ from CON. The AS was highly correlated with the acetic acid/lactic acid ratio in the silages (Figure 1). No butyric acid was detected in the silages. The WSC content was highest for KLAC and KDUO. All inoculants decreased proteolysis in the silages (Table 1).

Table 1 Effects of inoculants on fermentation characteristics, water-soluble carbohydrate (WSC) content, DM losses and aerobic stability of grass silage after 91 days of storage (n=5).

Parameter	CON[1]	KLAC[1]	KDUO[1]	KS[1]	SEM	*P*-value
pH	3.90[a]	3.89[a]	3.78[b]	3.91[a]	0.012	<0.0001
Lactic acid (g/kg DM)	51.2[c]	71.8[a]	63.6[ab]	59.5[bc]	2.12	<0.0001
Acetic acid (g/kg DM)	27.9[b]	15.6[c]	25.7[b]	33.2[a]	1.02	<0.0001
Ethanol (g/kg DM)	10.4[b]	15.2[a]	10.6[b]	10.8[b]	0.55	<0.0001
1,2-Propanediol (g/kg DM)	11.5[b]	0.1[d]	7.4[c]	16.5[a]	0.92	<0.0001
WSC (g/kg DM)	25.5[b]	49.6[a]	42.0[a]	25.8[b]	3.14	<0.0001
NH_3-N (% total N)	11.3[a]	10.0[b]	9.9[b]	10.4[b]	0.16	<0.0001
DM losses (%)	5.4[a]	4.0[b]	5.2[a]	5.6[a]	0.16	<0.0001
Aerobic stability (days)	10.0[a]	2.4[c]	6.3[b]	9.7[a]	0.53	<0.0001

[1]for description see Material and methods, [a-c]LSMEANS in rows with unlike superscripts differ (*P*<0.05)

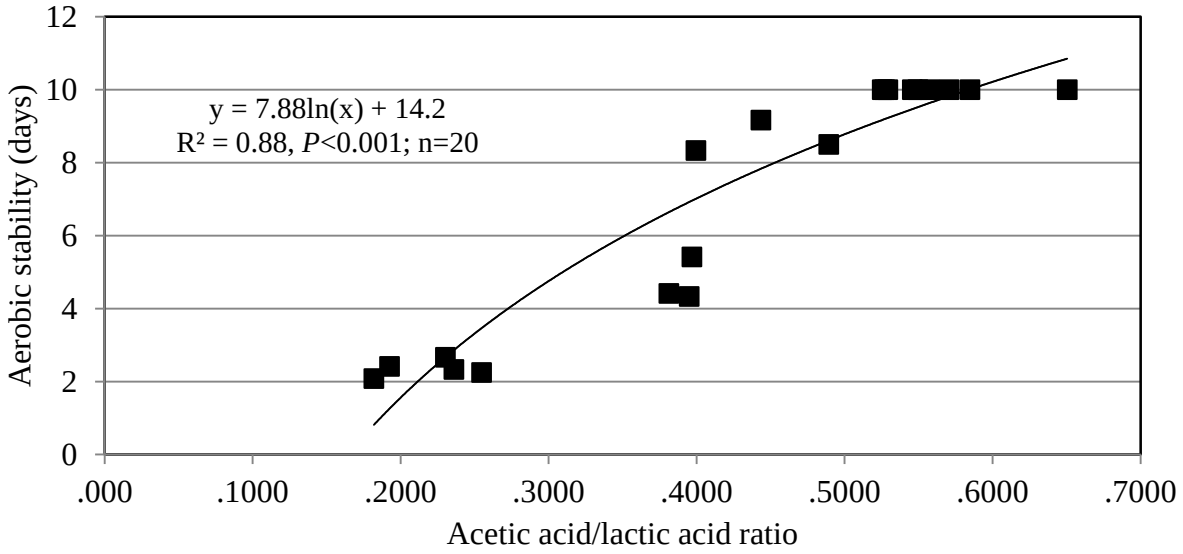

Figure 1 Relationship between acetic acid/lactic acid ratio and aerobic stability of grass silage.

Conclusions The dual-purpose inoculant containing LAB_{ho} and LAB_{he} improved the fermentation of chopped grass silage in bales and alleviated the negative effect of the sole LAB_{ho} use on aerobic stability.

References

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