Effects of bacterial and enzyme inoculation on the fermentation quality of ensiled whole crop sweet sorghum

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Introduction Although sweet sorghum (*Sorghum bicolor L. Moench*) is usually grown for the production of fuel in many developed countries, it can be used as forage for livestock production. For improving the feed quality of whole crop sweet sorghum (WCSS), ensiling is one of important methods. This method includes the use of bacterial inoculants to improve the fermentation dynamics of ensiled forages by accelerating the decline in pH and improving dry matter (DM) and nutrient retention (Muck, 2010). However, the effects of bacterial inoculants on fibre degradation is not consistent and lactic acid bacteria (LAB) cannot use fibre as an energy source to make lactic acid, and enzymes are added to silage for this reason (Xing et al., 2009). In addition, their effects on aerobic stability of silage are inconsistent due to low levels of acetic acids. As a result, *Lactobacillus buchneri* (LB) has been used to improve the aerobic stability of silage. The present study aimed to evaluate the effect of LB in combination with an enzyme on the fermentation and aerobic stability of ensiled WCSS.

Materials and Methods The WCSS (345g DM/kg, 5.6 pH, 255g WSC/kg DM, 38g CP/kg DM, 439 g NDF/kg DM and 282g ADF/kg DM) was treated with: no inoculant (control), *Lactobacillus buchneri* (LB), *Lactobacillus plantarum* (LP), and a combination of LB and cellulase enzyme (LB+E). Inoculants were applied to obtain 3 x 10^5 CFU/g of fresh forage. Treatments were ensiled in 48 x 1 liter jars (12 jars/treatment), kept at room temperature of 24-28^0C. Three jars per treatment were opened on d 0, 3, 4, 15 and 25 of ensiling, and samples were analyzed for nutrient composition and fermentation characteristics. Data was analyzed by ANOVA using the mixed procedure of SAS software (SAS Institute, Inc., 1991) and significance was declared at a 5 % probability level.

Results and discussions Inoculation reduced the pH and ammonia-N of WCSS silage compared to the control (Table 1), consistent with Fellner et al., (2001), but contrasted Xing et al (2009). High ($P<0.05$) lactic acid concentration was obtained with inoculation, but was highest with LP inoculation. The concentration of acetic acid was increased ($P<0.05$) with the LB and the LB+E treatments, suggesting that the aerobic stability of the silage may be improved with LB even with the presence of an enzyme. The fibre fractions (aNDF and ADF) of the silage were reduced ($P<0.05$) with inoculation compared to the control. However, the LB+E and LP treatments were more effective than the other treatments, consistent to Nadeau et al., (2000) but contrasted Meeske et al., (1993). Inoculation with LB and LP increased ($P<0.05$) the CP content of WCSS silage compared to the other treatments.

Conclusions It was concluded that inoculation improved the nutritive value and fermentation of ensiled WCSS. Further, the addition of enzyme reduced the fibre content of silage and did not restrict the production of acetic acid in the presence of LB.

References

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Table 1. Effects of microbial inoculation on the nutrient composition and fermentation characteristics of sweet sorghum after 25 days of ensiling (n=9)

	Treatments					Significance (*P*)		
	Control	LB	LB+E	LP	SEM	Trt	Day	Trt X Day
Nutrient composition (%, of DM unless stated otherwise)								
DM	32	30	30	30	84.5	3.01	1.22	3.31
Ash	43^{b}	46^{a}	44^{b}	42^{b}	3.3	0.001	0.001	0.019
CP	4.0^{b}	4.1^{a}	3.9^{b}	4.2^{a}	0.9	0.001	0.001	0.001
EE	1.4^{c}	1.5^{b}	1.6^{a}	1.5^{b}	0.03	0.006	0.009	0.001
aNDF	49^{a}	47^{b}	44^{c}	44^{c}	6.11	0.001	0.001	0.001
ADF	33^{a}	31^{b}	30^{c}	30^{c}	3.01	0.001	0.001	0.001
Fermentation characteristics (%, of DM unless stated otherwise)								
pH	3.9^{a}	3.6^{b}	3.6^{b}	3.6^{b}	0.02	0.001	0.001	0.073
WSC	36^{b}	55^{a}	74^{a}	22^{b}	14.3	0.001	0.002	0.432
LA	48^{c}	84^{b}	84^{b}	99^{a}	26.1	0.001	0.001	0.053
AA	24^{b}	39^{a}	40^{a}	6^{c}	17.1	0.001	0.001	0.001
PA	0.04	0.05	0.06	0.33	0.1	0.185	0.510	0.525
BA	0.5^{b}	0.7^{a}	0.9^{a}	0.5^{b}	0.9	0.014	0.927	0.959
NH_3-N (g/kg TN)	15.1^{a}	11.2^{b}	9.6^{b}	10.2^{b}	1.38	0.001	0.016	0.233

$^{a\text{-}c}$ Means with different letters in a row differ significantly (*P*<0.05)

DM, dry matter; CP, crude protein; EE, ether extract; aNDF, amylase treated neutral detergent fibre; ADF, acid detergent fibre; WSC, water-soluble carbohydrate; LA, lactic acid, AA, acetic acid; PA, propionic acid; BA, butyric acid; NH_3-N, ammonia nitrogen