Ensiling Characteristics of Sudangrass Silage Treated with Green Tea Leaf Waste or Green Tea Polyphenols

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Introduction Green tea waste (GTW), emitted from beverage companies manufacturing tea drinks, contains high crude protein (CP) and polyphenols. Kondo *et al*. (2004) showed that GTW addition to forage ensiling enhanced lactic acid fermentation and decreased pH value. Ishihara *et al*. (2001) showed that high counts of *Lactobacillus* species were maintained and the counts of clostridia were decreased in the intestinal microflora of animals fed the diet containing green tea polyphenols (GTP). It is hypothesised that GTP might activate lactic acid bacteria and enhance silage fermentation. This study was conducted to evaluate the potential of GTW and GTP as silage additives and explored the mechanisms of enhanced lactic acid fermentation by GTW.

Materials and methods Silages were made from sudangrass (*Sorghum sudanese*) harvested at heading stage on 2 August 2001. Soon after the harvest, the forages were chopped into about 2 to 3 cm in length using a forage cutter and then 400 g of the forages were mixed with fresh GTW, GTP, *Lactobacillus rhamnosus* or cell-wall degrading enzymes prior to ensiling. Silages were prepared in triplicates and stored at 25^{o}C for 30 days.

Results Dry matter (DM) contents of sudangrass and GTW at ensiling were 312 and 184 g/kg respectively. Water soluble carbohydrate contents of sudangrass and GTW were respectively 102.0 g/kg DM and 7.0 g/kg DM. The number of lactic acid bacteria associated with the grass and GTW were 5.90 and 7.96 log^{10} cfu/g fresh matter (FM) respectively. GTW contained 91.4 g/kg DM of polyphenols. Silages treated with GTW at 50 and 200 g/kg FM and *L. rhamnosus* decreased pH and increased lactic acid content (P<0.05) (Table 1). GTP and cell-wall degrading enzyme treatments did not increase lactic acid content compared with the control silage.

Table 1 Chemical composition of Sudangrass silage after 30 days of ensiling

Treatment	Rate (g/kg FM)	pH	DM (g/kg)	Lactic acid (g/kg DM)	Acetic acid (g/kg DM)	Butyric acid (g/kg DM)
Control		5.04a	298abc	22.4d	1.7c	8.3b
GTW	50	3.99d	298abc	75.7c	8.6b	0.0d
	200	3.86e	277dc	89.0b	10.5a	0.0d
GTP	0.2	4.90c	290bdc	24.1d	1.4c	11.3a
	1	4.94bc	291bdc	24.5d	1.6c	7.4b
	4	5.11a	288d	20.4d	1.3c	6.5b
L. rhamnosus		3.67f	304ab	107.8a	2.2c	0.0d
Enzyme		4.99b	303a	27.2d	1.6c	5.5c
s.e.m.		0.02	0.41	3.4	0.5	2.5

GTW: green tea waste, GTP: green tea polyphenols. Values in the same column with different letters are significantly different (P<0.05)

Conclusions GTW addition to grass at ensiling increased lactic acid content by a similar amount as *L. rhamnosus* inoculation. GTP treatment had no affect on lactic acid production. Enhancement of lactic acid fermentation by GTW would not be caused by its polyphenol content.

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