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Effect of Addition of Dried Mao Pomace on Fermentative Quality and Nutritive Value of Napiergrass Silages

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The effect of different rates of dried Mao (*A. thwaitesianum* Müll. Arg.) pomace (DMP) which are abundance sources of organic acid, sugar and polyphenols on the fermentative quality and antioxidant activity of napiergrass (*Pennisetum purpureum*) silages were studied. The addition rate of DMP was 0%, 1%, 3%, 5% and 10% of fresh matter. Three replicates of silages were kept at room temperature and opened on 1, 7, 14 and 30 days of ensiling for chemical analysis. The pH value, butyric acid and NH_3-N contents of the silages were decreased with the increasing of DMP rates. The pH value of 10% DMP treatment was lower than the others over the ensiling period. The NH_3-N content of 10%DMP addition silage was significantly ($p<0.05$) lower than the others after 30 days of ensiling. Addition more than 3% DMP increased the residual water soluble carbohydrate (WSC). The concentration of inhibit free-radical DPPH was increased when increasing the addition of DMP. The experimental results indicated that addition of DMP inhibited the use of protein and WSC of undesirable bacteria during the ensiling period and improved the fermentative quality and increased the antioxidant activity of napiergrass silage.

Key Words: Dried Mao pomace, Antioxidant activity, Fermentative quality, Napiergrass, Silage

INTRODUCCTION

The characteristics of higher moisture content and low dry matter in napiergrass is required the addition of additives at ensiling (Bureenok et al., 2006). The likelihood for the time span to obtain the required optimum dry matter for wilting is too low during rainy season. However, under poor wilting condition, restricting respiration and fermentation intensity can be achieved by adding acid and organic acid. Direct acidification through an acid additive result in an immediate drop in pH, the fermentation and growth of undesirable bacteria is restricted. A wide range of chemicals has been used as silage additives but the information of using it in tropical forages is limited. However, using the strong acid is unsafe in handling and corrosive to equipment. Therefore, the research need to create the applying of some organic acid with weakly acidic for initial fall in pH, after that the lactic acid bacteria which suitable for this condition will develop to fermentation, resulting in a low pH and high lactic acid content.

Ma mao, mao or mak mao is classified in the family *Stilaginaceae*, genus *Antidesma*. Ma mao grows well over variety of soil types especially in the upper part of northeastern Thailand. Products of mao luang (*A. thwaitesianum* Müll. Arg.) such as mao juice and mao wine, have become increasingly popular in northeastern Thailand. As a result, waste products from the mao plant such as seeds (20% of total material) and pomace (30% of total material) are plentiful. Samappito and Butkhup (2008) categorized the organic acids of Ma mao according to the available amounts into 2 groups as a major which including oxalic, tartaric, malic and ascorbic acids, whilst the minor group were lactic, acetic, critic and benzoic acids. After making juice, the leftover (pomace) may contain these organic acids which can use as animal feed. Moreover, Puangpronpitag et al. (2008) found the abundance source of polyphenols to be 97.32-130 mg GAE (gallic acid equivalents)/g and proanthocyanidins (PA) content in both parts of mao after partial purification and its exhibited antioxidant activity. Thus, the strong antioxidant properties of mao seed and pomace extracts may applying as natural antioxidant through diets improve the antioxidative activity of animal product.

Mao contains many kinds of organic acid, amino acid, mineral, vitamin and sugar. Therefore, mao pomace may have potential as silage additive by stimulating the LAB growth on the ensiling process. Therefore, in this study was aimed to investigate of applying of mao pomace as a silage additive on the fermentative quality, chemical composition and antioxidant of tropical crop silages.

MATERIALS AND METHODS

Silage preparing

Napier grass was harvested at 40 days regrowth and its silages were made with DMP at 0%, 1%, 3%, 5% and 10% of fresh matter. Napiergrass was chopped by a chopper into 2-3 cm lengths and mixed with the silage additives. This mixture was then carefully packed tightly in a 100-g plastic pouches, kept at 30°C and opened on 1, 7, 14 and 30 day of ensiling for chemical analysis. Three replicates per treatment were prepared and used for the chemical analysis.

Chemical Analysis

The dry matter (DM) content of the grass and silages were determined by oven drying at 70°C for 48 h. The dried sample was milled to pass through a 1.0 mm sieve. The samples were extracted with ethanol, and the concentration of water-soluble carbohydrates (WSC) was estimated as described by Dubois et al. (1956). The concentration of total nitrogen (N) was determined by the Kjeldahl procedure. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations in forage and feces were determined by methods as described by Van Soest et al. (1991).

Fermentation quality

At 1, 7, 14 and 30 days of fermentation, silage samples in each treatment were collected. Subsamples (20 g) were macerated with 70 ml of distilled water and stored in a refrigerator at 4°C for 12 h. The extract was filtered using No.5 filter paper (Whatman, England). The pH of silage was determined with a pH meter (Lab 860, Schott). Lactic acid and volatile fatty acid was determined by HPLC (Aminex® HPX-87H, 300 mm x 7.8 mm i.d; column temperature, 40°C; flow rate, 0.60ml/min, Shimzu Co., Ltd., Kyoto, Japn). The NH_3-N content was determined using a steam distillation technique. The lactic acid bacteria (LAB) were plated out onto MRS agar and incubated at 35°C for 3 d, after which viable colony-forming units (cfu) were determined.

DPPH assay

To measure the antioxidant activity of a biological material, DPPH method given by Brand-Williams et al. (1995) were used. Briefly, extract solution (0.5 ml) was added to 0.25 ml of DPPH in 80% ethanol and left to react for 30 min at room temperature, after which the absorbance at 517 nm was recorded. A control with no added extract was also analyzed. The

radical scavenging activity of the samples (antioxidant) was expressed as % inhibition of DPPH absorbance which was calculated with following formula;
% Inhibition = [(A control – A sample) / A control] × 100, where
A control = Absorbance of control (containing only DPPH), A test = Absorbance of test sample.

Statistical Analysis

Data was statistically analyzed according to CRD using the PROC GLM procedure by SAS program. Significant differences among treatments were determined using Duncan's News Multiple Range test.

RESULTS AND DISCUSSION

Chemical compositions of the material grass before used as silage additive are shown in Table 1. The pH value silage treated with 10% DMP resulted in lower pH ($p < 0.05$) compared with the other silages at all ensiling periods (Table 2). The LA content of DMP addition was significantly ($p<0.05$) higher than the control on 14th day and 30th day except for 1% addition. The butyric acid content in the treated silages was lower than the control silages (0%). The value of NH_3-N/TN increased gradually during ensiling and the NH_3-N/TN of DMP addition silage was significantly ($p<0.05$) lower than the control. It is generally accepted that in silage pH values should be <4.5, lactate >30 g/kg DM (McDonald et al., 1991) and NH_3-N content should not exceed 100 g/kg total nitrogen (Umana et al., 1991). Clearly, the 10% DMP silages met these criteria. The silage treated with addition of DMP more than 3% showed higher value of residual WSC ($p < 0.05$) compared with the control. The LAB counts of 10% DMP addition tended to be lower than the others in all ensiling periods. The percentage of inhibition free-radical DPPH of DMP addition was higher than that the control. The 10% DMP silage had higher % inhibition DPPH than the other levels at first day, however, the values of the % inhibition among treatments were similar (except 1% addition) after 30 days of ensiling. This may cause by the antioxidant properties of DMP. Thus, addition of DMP at 10 % would be beneficial effect for improving of fermentative quality and high antioxidant activity of napiergrass silage.

Table 1 The chemical composition of material grass and dried mao pomace prior ensiling

Item	Napiergrass	Dried mao pomace
pH	5.76	3.70
DM (g/kg)	158.5	883.23
CP (g/kg DM)	73.35	69.87
NDF (g/kg DM)	715.38	494.57
ADF (g/kg DM)	397.95	327.59
WSC (g/kg DM)	112.98	188.25
Inhibition DPPH (%)	41.38	66.65

Table 2 The fermentative quality, chemical composition and the percent inhibition of free radical by DPPH method of napiergrass silages

Item	Ensiling (days)	Treatments (dried mao pomace) 0		1%		3%		5%		10%		SEM
pH	1	5.28	a	5.16	a	4.80	b	4.69	b	4.39	c	0.07
	7	5.34	a	5.18	a	4.64	b	4.64	b	4.23	c	0.07
	14	4.93	a	4.86	a	4.45	b	4.29	b	3.95	c	0.09
	30	5.16	a	5.00	b	4.85	c	4.75	c	4.35	d	0.05
DM (g/kg)	1	154.32	d	165.74	cd	173.65	c	197.43	b	223.70	a	5.35
	7	150.02	c	156.37	c	163.43	c	190.06	b	234.00	a	6.76
	14	155.46	c	156.42	c	164.1	c	188.85	b	223.06	a	3.59
	30	151.70	c	152.14	c	177.75	b	187.68	b	221.25	a	4.11
LA	1	18.27		25.58		16.46		13.56		27.59		8.11
(g/kg DM)	7	13.99		18.24		21.90		16.77		5.94		6.41
	14	27.09	c	44.93	b	62.25	a	58.46	ab	58.25	ab	4.90
	30	21.79	b	27.43	b	89.96	a	51.36	ab	90.03	a	12.36
BA	1	3.78		4.53		2.17		1.08		1.22		1.05
(g/kg DM)	7	2.79	a	1.02	b	0.71	b	0.17	b	0.00	b	0.47
	14	12.25	a	1.32	c	4.91	b	3.01	bc	1.49	c	0.91
	30	8.45	a	3.99	b	2.15	bc	0.5	c	1.79	bc	1.04
NH_3-N	1	54.36	a	45.05	ab	37.75	bc	33.00	cd	25.94	d	3.54
(g/kg TN)	7	198.52	a	141.30	b	89.28	c	69.37	c	57.96	c	11.57
	14	185.05	a	148.45	b	108.9	c	90.76	d	63.7	e	3.83
	30	213.74	a	171.73	b	125.3	c	105.54	c	67.6	d	8.63
WSC	1	57.17	b	76.30	ab	86.52	ab	92.16	a	98.50	a	9.91
(g/kg DM)	7	48.61		43.03		46.38		49.16		69.07		8.78
	14	16.99	c	32.08	c	34.66	c	66.35	b	87.10	a	6.19
	30	16.26	b	20.09	b	37.77	a	47.37	a	48.99	a	5.44
LAB	1	7.76	a	7.70	a	6.74	b	6.79	b	6.65	b	0.21
(log_{10} cfu/g FW)	7	7.52	a	7.35	a	6.99	b	7.33	a	6.83	b	0.09
	14	6.66	a	6.51	a	6.61	a	6.57	a	5.79	b	0.10
	30	6.88	ab	6.90	ab	7.09	a	6.68	ab	6.53	b	0.12
Inhibition (%)	1	19.81	c	26.8	bc	27.27	bc	33.08	b	46.39	a	3.06
	7	38.98	ab	34.6	b	42.11	ab	39.2	ab	46.49	a	3.17
	14	24.08	c	28.92	bc	38.62	ab	34.43	ab	45.14	a	3.35
	30	22.68	c	37.36	bc	47.48	ab	48.88	ab	57.08	a	3.60

Means followed by a different letter within the same row are significant different ($P < 0.05$), SEM: Standard error of mean. DM = Dry matter, LA = Lactic acid, BA = Butyric acid, WSC = Water soluble carbohydrate, NH_3-N = ammonia- nitrogen, TN = Total nitrogen, LAB = Lactic acid bacteria.

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REFERENCES

Bureenok, S., T. Namihira, S. Mizumachi, Y. Kawamoto and T. Nakada. 2006. The effect of epiphytic lactic acid bacteria with or without different byproduct from defatted rice bran and green tea waste on napiergrass (*Pennisetum purpureum* Schumach) silage. J. Sci. Food Agric. 86:1073-1077.

Brand-Williams, W., Cuvelier, M.E. and Berset, C. 1995. Use of free radical method to evaluate antioxidant activity. Lebensmittel Wissenschaft and Technologie 28, 25-30.

Dubois, M., K. A. Gilles, J. K. Hamilton, P. A. Rebers and F. Smith. 1956. Calorimetric method for determination of sugars and related substances. Anal. Chem. 28:350-356.

McDonald, P., A. R. Henderson and S. J. E. Heron. 1991. The Biochemistry of silage (2nd Ed.) Chalcombe Publications, Marlow Bucks, UK.

Puangpronpitag, D., P. Areejitranusorn, P. Boonsiri, M. Suttajit and P. Yongvanit. 2008. Antioxidant activities of Polyphenolic compounds isolated from Antidesma *thwaitesianum*M¨ull. Arg. Seeds and Marcs. J. Food Sci. 73: 648-653.

Samappito, S. and L. Butkhup. 2008. An Analysis on organic acids contents in ripe fruits of fifteen Mao Luang (Antidesma bunius) cultivars, harvested from dipterocarp forest of Phupan valley in Northeast Thailand. Pakistan J. Biol. Sci. 11: 974-981

Van Soest, P. J., J. B. Robertson and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3597.

Umana, R., C. R. Staples, C. B. Bates, C. J. Wilcox and W. C. Mahanna. 1991. Effects of a microbial inoculant and (or) sugarcane molasses on the fermentation, aerobic stability, and digestibility of bermudagrass ensiled at two moisture contents. J. Anim. Sci. 69:4588-4601.