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Fermentation Quality and Chemical Composition of Napier Pakchong 1 Silage Supplemented with Lactic Acid Bacteria

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Abstract

The objective of this study were to evaluate effect of lactic acid bacteria supplementation on fermentation quality and chemical composition of Napier Pakchong 1 silage. Lactic acid bacteria (LAB) were extracted from corn silage. The isolates was grow in MRS agar plate at 37°C for 48 hours in anaerobic condition. The effect of LAB supplementation on fermentation quality and chemical composition of Napier Pakchong 1 silage were evaluated using in a completely randomised design (CRD). Napier Pakchong 1 Silage were divided 2 groups (control and supplemented with LAB with 1×10^5 cfu/ml concentration). One kilogram of LAB Napier Pakchong 1 grass was supplemented with 10 ml of LAB. Silage was collected at the day of 14, 21, 28 and 35 days of fermentation. Samples were collected for pH value, lactic acid concentration, chemical composition by proximate analysis and detergent method. It was found that pH value of Napier Pakchong 1 silage supplemented with LAB were lower than control group. Lactic acid concentration was higher in Napier Pakchong1 silage supplemented with LAB. The CP and ADF concentration of Napier Pakchong 1 silage declined as the increasing of ensiling time. The CP and EE concentration of Napier Pakchong 1 silage supplemented with LAB were higher than control group (8.57 vs 7.98% and 2.5 vs 2.31 %) The CF concentration of Napier Pakchong 1 silage supplemented with LAB were higher than control group. It can be concluded that LAB supplementation increase fermentation of Napier Pakchong 1 silage and decrease the nutrient deterioration of Napier Pakchong 1 silage.

Keywords: Chemical composition, fermentation quality, lactic acid bacteria, Napier Pakchong 1, silage

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Introduction

Ruminant production of Thailand are currently being developed continuously, so demand for animal feed, which is the source of roughage while can produce only half of the demand only. Therefore, Napier Pakchong 1 grass (*Pennisetum purpureum* x *P. americanum* cv. Pakchong 1) has been developed by the Nakhonratchasima Animal Nutrition Research and Development Center, Thailand (Sarian 2013).Napier Pakchong 1 grass is one of the most promising grasses available for ruminant production because of its high yield and high nutritional value (Cherdthong et al. 2015). However, forage is abundant during the rainy season, which grows well and there is more than enough for a cattle. While, in dry season is scarce. Preserving forage yield during the rainy season should be made in form silage. Silage is forage products of fermentation fodder full of water in plant in a anaerobic container to prevent outside air until the fermentation process microbial activity preserved, the forage to remain value of plants. The preservative the nutrients in the silage can be achieved by speeding up the process of fermentation plants earlier than usual by causing anaerobic conditions faster. This can be done by adding the bacteria that can live in anaerobic conditions and has the ability to inhibit and destroy microbes that use oxygen to decrease such as lactic acid bacteria. Therefore, used of starter cultures such as lactic acid bacteria (LAB) can be increase the fermentation process faster. Silage quality after 60 days of fermentation indicate increased lactic acid, a reduced acetic acid concentration and improved lactic to acetic acid ratio in silage treated with LAB inoculant. It was expected that inoculants containing LAB would lower pH more quickly and more effectively than naturally occurring epiphytic bacteria, which low pH inhibits the growth of many detrimental microorganisms and helps reduce proteolysis and other plant enzyme activity (Kleinmans et al., 2011). Therefore, the objective of this study were to evaluate effect of lactic acid bacteria supplementation on fermentation quality and chemical composition of Napier Pakchong 1 silage.

Material and Methods

Isolation lactic acid bacteria

Approximately 10 grams of corn silage were collected at 21 days of fermentation in replicated three times. 3 replicate. Lactic acid bacteria was screened. The isolates was grown in MRS agar plate at 37°C for 48 hours in anaerobic condition, then divide for 1 ml to ten-fold serial dilution used 10^7 cfu to spread in MRS agar plate at 37° C for 48 hours in anaerobic condition and keep single of colony to check lactic acid bacteria by microscopy. Lactic acid bacteria was cultivated in MRS broth.

Silage preparation

Napier Pakchong 1 grass was grown at Mae Hia Agricultural Research Demonstrative and Training Center, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand. The grass was harvested at 45 days of maturity and chopped at 3–8-cm length. The experimental design was a completely randomised design. Napier Pakchong 1 Silage were divided 2 groups (control and supplemented with LAB with 1×105 cfu/ml concentration). One kilogram of LAB Napier Pakchong 1 grass was supplemented with 10 ml of LAB. All experimental silages were replicated three times. The experimental silages were packed tightly in two-layered plastic bags and vacuumed. Silage was collected at 14, 21, 28, 35 days of ensiled times.

Feed sample analyses

A 5 g sample of fresh silage was blended in 50 mL of water for pH determination. A 50 g of sample of each silage was used for determination of lactic acid by high performance liquid chormatography (HPLC) (Madrid et al., 1999) and volatile fatty acids by gas chromatograph (GC) (Cao et al., 2009). The silage samples were dried at 60˚C for 48 h. Dry matter (DM), crude protein (CP), ether extract (EE) and crude fiber (CF) were analyzed according to AOAC Methods (AOAC, 2000). The neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were analysed by detergent methods (Van Soest et al. 1991).

Results and Discussion

Table 1. The pH, volatile fatty acid, lactic acid and chemical composition (%DM basis) of Napier Pakchong 1 silage at different ensiling period

Item	Treatment	Ensiling period					*P-value*		
		14	21	28	35	**Avg**	Time	LAB	T*L
pH	control	4.16	4.26	4.31	4.29	**4.31^{b}**	0.14	<0.01	0.23
	LAB	4.38	4.13	4.15	4.21	**4.17^{a}**			
	average	**4.27**	**4.20**	**4.23**	**4.25**				
Acetic acid	control	0	0.50	0.06	0.35	**0.23**	0.09	0.60	0.01
	LAB	0	0	0.97	0.22	**0.30**			
	average	**0^{a}**	**0.25^{ab}**	**0.51^{b}**	**0.28^{ab}**				
Butyric acid	control	0	0	0	0	**0**	0.41	0.33	0.41
	LAB	0.003	0	0	0	**0.0006**			
	average	0.001	0	0	0				
Propionic acid	control	0.03	0.01	0.06	0.03	**0.03**	0.04	0.42	0.03
	LAB	0.01	0.04	0.03	0.04	**0.03**			
	average	**0.02^{a}**	**0.03^{ab}**	**0.05^{b}**	**0.03^{ab}**				
Lactic acid	control	2.10	1.58	2.61	1.31	**1.90^{a}**	<0.01	0.03	0.03
	LAB	4.07	1.20	2.12	1.37	**2.19^{b}**			
	average	**3.09^{b}**	**1.39^{a}**	**2.37^{b}**	**1.34^{a}**				
Chemical composition									
DM	control	22.18	23.74	20.48	21.34	**22.04^{b}**	0.67	0.01	0.23
	LAB	18.94	18.88	20.17	19.85	**19.73^{a}**			
	average	**20.56**	**21.31**	**20.33**	**20.59**				
OM	control	81.75	82.85	81.82	82.22	**81.91**	0.07	0.27	0.74
	LAB	81.51	83.78	83.54	82.22	**82.47**			
	average	**81.10**	**83.32**	**82.68**	**82.22**				
CP	control	8.36	7.96	7.96	7.67	**7.98^{a}**	<0.01	<0.01	0.18
	LAB	8.70	8.57	8.31	8.14	**8.57^{b}**			
	average	**8.52^{c}**	**8.26^{b}**	**8.14^{b}**	**7.91^{a}**				
EE	control	2.33	2.26	2.73	2.72	**2.50^{a}**	<0.01	<0.01	0.09
	LAB	2.53	2.44	2.84	2.78	**2.31^{b}**			
	average	**2.43^{a}**	**2.35^{a}**	**2.79^{b}**	**2.75^{b}**				
CF	control	28.74	28.18	30.67	28.71	**28.66^{a}**	0.20	0.03	0.80
	LAB	31.28	29.31	30.64	31.03	**30.28^{b}**			
	average	**30.01**	**28.74**	**30.65**	**29.87**				
NDF	control	60.03	57.61	58.30	58.89	**59.22**	0.08	0.43	<0.01
	LAB	58.04	61.92	56.82	58.34	**58.76**			
	average	**59.03**	**59.77**	**57.56**	**58.61**				
ADF	control	40.67	39.17	35.67	40.38	**39.27**	<0.01	0.47	0.15
	LAB	43.93	43.01	35.57	37.05	**39.99**			
	average	**40.43^{c}**	**41.09^{bc}**	**35.62^{a}**	**38.72^{ab}**				
ADL	control	7.11	6.64	7.18	7.74	**7.19**	0.23	0.49	0.56
	LAB	7.67	7.19	6.89	7.52	**7.34**			
	average	**7.39**	**6.92**	**7.03**	**7.63**				

[a,b] Means in the same row with different superscripts differ significant (P<0.01), DM loss = Dry matter loss, LAB = Lactic acid bacteria, T*L =Time × Lactic acid bacteria

It was found that pH value of Napier Pakchong 1 silage supplemented with LAB were lower than control group. Lactic acid concentration was higher in Napier Pakchong1 silage supplemented with LAB. The DM content of Napier Pakchong 1 silage supplemented with LAB were lower than control group, presumably reflecting the increased water production due to greater fermentative activity (McDonald et al., 1991). The CP and ADF concentration of Napier Pakchong 1 silage declined as the increasing of ensiling time. The CP and EE concentration of Napier Pakchong 1 silage supplemented with LAB were higher than control group (8.57 vs 7.98% and 2.50 vs 2.31 %). The CF concentration of Napier Pakchong 1 silage supplemented with LAB were higher than control group. A significant interaction of the effects of the inoculants and periods of fermentation ($P<0.01$) was observed on the acetic acid, propionic acid, lactic acid and NDF. The result of this research claimed that the addition of LAB stimulated the early growth of LAB and caused a more rapid decline in silage pH and also enhances aerobic deterioration of silages and inhibit the growth of fungi. Indeed, acetic acid is known to play an important role in the aerobic stability of silages. The simultaneous production of lactic acid and acetic acid by the LAB maintain the aerobic stability in silages (Ashbell et al., 2002).

Conclusions and Outlook

It can be concluded that LAB supplementation increase fermentation of Napier Pakchong 1 silage and decrease the nutrient deterioration of Napier Pakchong 1 silage.

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