

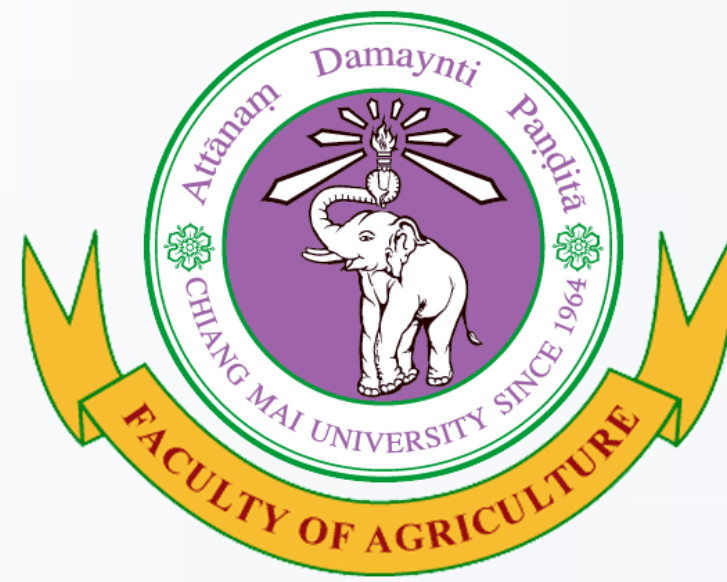
# Effect of *Lactobacillus rhamnosus* C6 Inoculation on Fermentation Quality and Rumen Degradability of Maize Cob and Hush Silage

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## Introduction

- Chiang Mai Province is the biggest area of maize production (157,000 rai) with an estimated annual cob and husk production of 42,000 tons.
  - Because of the huge amount of crop residues, therefore the preservation is necessary. Silage is the feed preservation by ensiling method
  - Lactic acid bacteria can change water-soluble carbohydrate to lactic acid. The accumulation of lactic acid leads to reduction of pH. The low pH condition inhibits the growth and nutrient utilization of desirable microorganism which results in reducing loss of nutrient. (McDonald et al., 1991)
  - Lactobacillus rhamnosus* was able to ferment various carbohydrates substrates.
  - L. rhamnosus* AT195 showed a good survival performance in the silage fermentation process of both maize and sorghum and improved the fermentation quality of the forages by reducing the ammonia nitrogen content (Salime et al., 2007)
- Therefore, the objective of this study were to evaluate effect of *Lactobacillus rhamnosus* C6 inoculation on fermentation quality and rumen degradability of maize cob and hush silage.

## Material and Methods

- L. rhamnosus* C6 was isolated from rumen fluid of Thai native cattle
- The isolates was grown in MRS agar plate at 37°C for 48 hours in anaerobic condition



- Maize cob and hush silage were divided into 2 groups
  - control
  - supplemented with *L. rhamnosus* C6 with 10<sup>6</sup> cfu/g
- The silage were ensiled for 21 days for later analysis
- The fermentation quality was evaluated by pH measurement and VFA analysis



- A pH meter was immediately used to test the pH of silage extract (Bal et al., 1997). High-performance liquid chromatography was used to examine the volatile fatty acids of silage, which included acetic acid, propionic acid, butyric acid, and lactic acid (adapted from Scherer et al., 2012). Ammonia nitrogen was measured by method of Chaney and Marbach (1962).
- 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).
- Ruminal fluid was obtained from 4 rumen fistulated Thai native cattle.
- Each sample of 230 ± 5 mg was accurately weighed out in 3 replicates and placed into 100 mL glass syringes that were fitted with plungers. They were then incubated in a shaking water bath at 39°C.
- Gas production was recorded after incubation at 2, 4, 8, 10, 12, 24, 48, 72 and 96 hr.
- The fermentation kinetic parameters were established using the exponential model that had been proposed by Ørskov and McDonald (1979).

## Results and Discussion

- The pH value of maize cob and hush silage inoculated with *L. rhamnosus* C6 were lower than control group.
- Lactic acid concentration was higher in inoculated groups

Table 1 Fermentation quality of fermented maize cob and husk with (LAB.) or without (CON.) *L. rhamnosus* C6 at 21 day of ensiling time.

Item	Treatment		SEM	P-value
	Control	<i>L. rhamnosus</i> C6		
pH	4.48	4.30	0.47	0.01
Acetic (%DM)	5.65	7.99	0.68	<0.001
Propionic (%DM)	0.14	0.13	0.01	0.67
Butyric (%DM)	1.19	0.64	0.16	<0.001
Lactic (%DM)	0.12	0.28	0.04	0.04
Total acid (%DM)	8.97	11.48	0.73	<0.001

SEM= standard error of the mean, DM= Dry matter

- Maize cob and hush silage inoculated with *L. rhamnosus* C6 showed significantly lower DM but significantly higher OM contents than control group.
- Maize cob and hush silage inoculated with *L. rhamnosus* C6 showed significantly lower NDF, cellulose and hemicellulose contents than control group.
- LAB inoculation triggered reducing of pH, values led to inhabitation of bacterial ligninolytic enzymes, including the three main lignin-degrading enzymes: lignin peroxidase, manganese peroxidase, and laccase, functioning at pH values around 8 (Rahman et al., 2013), causing fiber to be higher in *L. rhamnosus* C6 inoculation than control.

Table 2. Chemical composition (DM basic %) of maize cob and husk inoculated *L. rhamnosus* C6 at 21 day

Chemical composition	Treatment		SEM	P-value
	Control	<i>L. rhamnosus</i> C6		
Dry matter (DM)	43.59	42.73	0.24	<0.001
Organic matter (OM)	96.33	96.76	0.12	<0.001
Crude protein (CP)	2.97	2.95	0.01	0.39
Ether extract (EE)	1.75	1.82	0.05	0.35
Crude fiber (CF)	85.18	90.02	3.88	0.39
Neutral detergent fiber (NDF)	80.87	78.62	0.68	<0.001
Acid detergent fiber (ADF)	44.41	44.86	0.25	0.22
Acid detergent lignin (ADL)	8.22	7.88	0.14	0.07
Hemicellulose	36.45	33.75	0.79	<0.001
Cellulose	72.64	70.74	0.57	<0.001

- Gas production at 48 and 72 hr after incubation was significantly greater in inoculated groups.
- The inoculated groups revealed the gas production rate (c) and the potential extent of gas production (|a|+b) were significantly higher than in inoculated groups

Table 3. *In vitro* gas production and estimated parameters of maize cob and husk inoculated *L. rhamnosus* C6

Item	Treatment		SEM	P-value
	Control	<i>L. rhamnosus</i> C6		
<b>In vitro gas production (ml/0.2g DM)</b>				
2 hours	1.63	1.96	0.34	0.03
4 hours	2.33	3.29	0.47	0.53
8 hours	5.62	7.53	0.70	0.05
10 hours	9.59	11.05	0.49	0.53
12 hours	13.57	14.89	0.57	0.16
16 hours	20.82	22.65	0.65	0.16
24 hours	31.00	32.41	0.63	0.49
48 hours	34.94	42.87	3.18	0.002
72 hours	43.35	50.71	3.00	0.02
96 hours	48.50	55.10	2.84	0.06
<b>Kinetic of gas production</b>				
a(ml)	-3.28	-5.41	0.56	0.04
b (ml/0.2g DM)	64.0	104.34	9.93	0.10
c (% hr.)	.04	.07	0.01	0.01
IaI+b	67.31	109.76	10.46	0.03
<b>Estimated parameters</b>				
OMD (%)	43.07	44.27	0.54	0.48
ME (Mj/Kg DM)	5.80	6.02	0.09	0.48
SCFA (mol)	0.68	0.71	0.01	0.54
NE <sub>L</sub> (Mj/Kg DM)	3.03	3.04	0.01	0.21

## Conclusions

- Maize cob and hush silage inoculated with *L. rhamnosus* C6 had better quality fermentation than natural fermentation
- L. rhamnosus* C6 stimulated the fermentation process and accelerated lactic acid production, resulting in a sharp drop in pH and faster ruminal degradability after 48 hr of incubation

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