Replacing soybean meal by *Mimosa pigra* (L.) meal on nutrient digestibility and rumen fermentation in growing goats

Walailuck Kaewwongsa[1*]

Abstract: The aim of this study was to determine the effect of replacing soybean meal (SBM) with *Mimosa pigra* (L.) meal in the diet of meat goats. Growing goats were randomly assigned to four dietary treatments according to replicated 4x4 Latin square design. Dietary treatments were four levels of replacement SBM with Mimosa pigra (L.) meal at 0, 33, 67, and 100 % of crude protein (CP) in concentrates. The results showed that there were no significant different on production performance of animal fed the experimental diets. The highest for body weight change was found in 33% replacement SBM (P>0.05). Data on rumen fermentation have indicated that ammonia (NH_3) concentrate, pH, and microbial population were non significantly. The results suggested that *Mimosa pigra* (L.) meal could replace up to 100% of SBM in concentrate of growing goats fed rice straw as roughage. Based on this result, using 100% *Mimosa pigra* (L.) meal as the main source of protein to completely replace soybean meal was beneficial to grow goats in terms of nutrient digestibility and rumen fermentation.

Keywords: *Mimosa pigra* (L.) meal, replacing, digestibility, fermentation

Introduction

In situations where concentrate feed supplements are expensive, farmers should be capable of formulating their own feeds based on available farm resources and their economic viability (Wanapat, 1999). *Minosa pigra* meal was weed that can be used as a feedstuff to the animals. The chemical composition was similar to *Leuceana leucocephala*. Dried leaves of *M. pigra* can be included in the diets of quail, broiler, laying hen and pigs (Devendra, 1989). The above information obviously reflects that *M. pigra* meal is promising alternative protein source in animal diets. *M. pigra* leaves have a high protein content of 20 to 23% in DM according to Vearasilp et al (1981). Therefore, the present study evaluated productive performance of growing goats fed diets containing various CP replacement levels of *M. pigra* meal. In general, cassava pulp is very wet. However, dry it is the best way of stored *M. pigra* because it can easily store. Because the protein source for animal feed is getting expensive. So, research has found that *M. pigra* is one of good alternative for replaced of SBM. Therefore, *M. pigra* is replaced of SBM for protein enrichment before it is used as the high quality animal feed material. The main objective of this study therefore sought investigate the effect of soybean meal by *M. pigra* meal on nutrient digestibility and rumen fermentation in growing goats on feed intake and goat productivity.

[1] Program in Animal Production Technology Faculty of Technology Udon Thani Rajabhat University Udon Thani, 41000

[*] Corresponding author: kaewwongsa@hotmail.co.th

Material and Methods

Animals and management

Eight growing crossbreed (Thai native x Anglo-Nubian) male meat goats of 7-8 months old were used in this study. The goats were kept in individual pens and received free choice of clean fresh water and mineral block.

Experimental design and treatments

The experiment was taken according in replicated 4x4 Latin square design. Dietary treatments were four levels of replacement SBM with *M. pigra* meal at 0, 33, 67, and 100 % of crude protein (CP) in concentrates. The dietary treatments with T1: control diet with soybean meal (SBM) based, T2: replacing SBM by 33.3% of *M. pigra* meal, T3: replacing SBM by 66.7% of *M. pigra* meal and T4: replacing SBM by 100% of *M. pigra* meal. All diets were isonitrogenous and formulated to meet or exceed the NRC (1988) recommendations for all nutrients, regardless of treatment. Animals were fed concentrate 1.5% BW. The experiment was conducted for four periods, each period lasted 21 days. During the first 14 days, all animals were fed their respective dietary treatments at 1.5% BW of concentrate and fed with rice straw ad libitum divided between two daily feeds (07.00 and 16.00), whereas during the last 7 days, they were moved to metabolism crates for total collection. Refusal was weighed daily prior to the morning feeding to determine daily dry matter intake (DMI). Body weight of each animal was measured weekly immediately before morning feeding. During the feeding trail, samples of feed refusal were collected, before new feed was given each morning. Representative samples of feed and faeces were analyzed according to AOAC (1990). All data obtained from the experiment were subjected to analysis of variance using Microsoft Excel (2003).

Sampling methods and chemical analysis

Rice straw and concentrate diets were sampled weekly and dried at 60~65°C in hot air oven for dry matter determination and ground through a 1 mm sieve and then kept in tightly covered plastic containers to make a pool respectively for further approximate analysis. Feeds, orts and feces samples were analyzed for DM, ash, nitrogen content (AOAC, 1990), NDF and ADF (Goering and Van Soest, 1970). During the total collection, feces and urine samples were quantitatively collected and urine sample was acidified with 10% H_2SO_4. Subsequently, 15% of the total amounts were sub-sampled from each animal and then sample was kept at -20°C for nitrogen utilization (Schneider and Flatt, 1975).

Rumen fluid samples from all goats were taken at 0, 3, and 6 hour post feeding by stomach tube connecting with pump. The samples were strained through three layers of muslin cloth and then were followed by immediately measuring of pH with pH meter. Thereafter, 1 ml of the samples wase measured and truly with a pipette into the tubes containing 9 ml 10% formalin (v:v, 9:1) as a preserving reagent and then wase closed tightly with screw caps for checking the counts of ruminal protozoa and bacteria counts using the hematocytometer according to Hungate (1966). And, 20 ml of the samples were measured and then put into small plastic bottles containing 5 ml 6 N HCl as a preserving reagent, and then the bottles were closed tightly with screw caps, cen-

trifuged at 3,000 rpm for 10 minutes. Subsequently the ruminal fluid was collected, and then it was stored at -20°C for subsequent analyses of ruminal ammonia N (Bremner and Keeney, 1965). With that, all samples were kept at -20°C until further analysis. The supernatant fluid was analyzed for ammonia N by Kjeldahl method.

The blood samples from all goats which were taken at preliminary feeding 3 and 6 hours post feeding during the digestibility trail of each period were collected from jugular veins into EDTA containing vacuum tubes and were centrifuged at 3,000 rpm for 10 minutes. Subsequently the plasma was collected, and then it was stored at -20°C for subsequent analyses of plasma urea nitrogen determined using a Spectronic R Genesys 5 spectrophotometer according to Mackay and Mackay (1972) (Adapted from Preston, Schnakenberg Andw, and Pfander, 1964).

Statistical methods

All data were subjected to analysis of variance using Proc ANOVA (SAS, 1996) and treatment means were statistically compared by Duncan's New Multiple Range Test (Steel & Torrie, 1980).

Results and Discussion

Ingredients and chemical composition of the feed were showed in **Table 1**. The DM, Ash, CP, NDF, and ADF contents were similar in all treatments. The analyzed protein contents were slightly higher than calculation.

Table 1 Chemical composition of the experimental diets (% DM basis).

Ingredient	*M. pigra* (L.) meal replacement of SBM				RS
	0:100	33.3:66.7	66.7:33.3	100:0	
Analyzed chemical composition (% DM basis)					
DM	99.07	99.77	98.04	98.93	96.34
Ash	8.43	7.70	6.81	6.85	11.98
CP	18.52	18.27	18.24	18.23	2.73
NDF	41.75	44.82	48.87	45.60	84.69
ADF	25.26	29.25	29.14	27.92	68.72
Bath/1 kg of feed[1]	8.99	7.77	6.55	5.34	2.00

RS=Rice straw, DM=dry matter, OM=organic matter, CP=crude protein, NDF=neutral detergent fiber, ADF=acid detergent fiber, [1]the price of feedstuff recorded on 21 March 2014.

The concentration and total intake of the meat goats were showed in **Table 2**. Concentrate dry matter intakes expressed as g/day were decreased and total dry matter intakes expressed as g/day were increased as increasing the level of replacing soybean meal (SBM) with *M. pigra* meal ($P>0.05$). Body weight change, whereas those fed *M. pigra* meal replacement of soybean meal 33.3% were higher than other diets, but they were not significantly different with increasing proportion of *M. pigra* meal replacement of SBM. Body weight change, whereas those fed

fermented the *M. pigra* meal replacement of soybean meal 33.3-100 % were higher than basal diets, but they were not significantly different with increasing proportion of *M. pigra* meal replacement of SBM. (Dawson et al., 1990; Oeztuerk et al., 2005); decreased ruminal lactate concentrations (Williams et al., 1991; Callaway and Martin, 1997).

Table 2 Effects of *Mimosa pigra* (L.) meal replacement of SBM in dietary meat goats.

Items	*M. pigra* (L.) meal replacement of SBM				SEM	Contrast[1]	
	0:100	33.3:66.7	66.7:33.3	100:0		L	Q
Concentrate dry matter intake							
g/day	210.13	210.00	210.38	208.50	7.58	ns	ns
%BW	1.50	1.50	1.50	1.50	0.0003	ns	ns
gDM/kgBW$^{0.75}$	7.63	7.63	7.63	7.63	0.0017	ns	ns
Total dry matter intake							
g/day	511.22	516.1	523.4	525.79	11.69	ns	ns
%BW	3.82	4.05	3.81	3.61	0.09	ns	ns
gDM/kgBW$^{0.75}$	72.91	76.21	73.01	70.42	1.28	ns	ns
Digestibility (%)							
DM	71.48	70.67	71.82	68.79	1.34	ns	ns
OM	76.23	75.80	76.86	74.44	1.16	ns	ns
CP	79.94^{a}	70.53^{ab}	70.26^{ab}	65.02^{b}	1.74	*	ns
Body weight change (g/d)	0.21	1.00	0.74	0.63	0.14	ns	ns

[1]contrast effect (L=Linear and Q=Quadratic), SEM= Standard error of means, ns=not significantly different (P>0.05), $^{a, b, c}$ Value on the same row under each main effect with different superscripts differ significantly (P<0.05), *Value on the same row under each main effect with different superscripts differ significantly (P<0.05), DM=Dry matter, OM=Organic matter, CP=Crude protein

Ruminal pH and NH_3-N concentration at preliminary feeding 3 and 6 hr post-feeding are presented in **Table 3**. Average rumen pH across treatments prior to feeding was ranged 6.83 to 6.96. Ruminal pH before feeding of goats fed with 100% *M. pigra* meal replacement of SBM diet was highest (P>0.05); however, there are not significantly different with 0, 33.3, and 66.7%. Ruminal pH at 3 and 6 post-feeding was not significantly different among treatments. Ruminal pH ranged from 6.5 to 7.03 across treatments (P>0.05). Concentrations of ruminal NH_3-N were ranged from 9.52 to 9.90 mg/dl (P>0.05). Similarly, the number of protozoa ranged from 1.17 to 1.75 x 10^5 cells/ml rumen fluid with increasing proportion of *M. pigra* meal replacement of SBM was not significant different (P>0.05). In addition, number of bacteria population in rumen fluid of goats fed *M. pigra* meal replacement of SBM in dietary ranged from 1.11 to 1.45 x 10^{12} cells /ml rumen fluid. The number of bacteria population in rumen fluid of goats fed 33.3% *M. pigra* meal replacement of SBM diet was higher than 0, 66.7, and 100%; however, there are not significantly different (P>0.05).

The pattern of PUN concentration decreased linearly (P<0.01) as a consequence of feeding the level of replacing soybean meal (SBM) with *M. pigra* meal at 3 h post feeding increased and peaked at 6 hour post feeding then decreased. Thereafter, when fed *M. pigra* meal replacement SBM in concentrate diets feeding level increasing was significant difference (P<0.05) is presented in Table.

Table 3 Effect of diets on rumen and blood parameters.

Items	*M. pigra* (L.) meal replacement of SBM				SEM	Contrast[1]	
	0:100	33.3:66.7	66.7:33.3	100:0		L	Q
Rumen							
pH	6.90	6.90	6.83	6.96	0.02	ns	ns
Ammonia-N (mg%), mg/dl							
0 h post feeding	9.72	9.99	10.07	9.11	0.25	ns	ns
3 h post feeding	9.20	10.07	9.37	10.61	0.34	ns	ns
6 h post feeding	9.81	9.64	9.11	8.91	0.25	ns	ns
Ruminal microbial population							
Protozoa count (cells x 10^5)	1.17	1.23	1.19	1.75	1.26	ns	ns
Bacteria count (cells x 10^{12})	1.15	1.45	1.14.	1.11	3.44	ns	ns
Plasma urea nitrogen (PUN, mg%)							
0 h post feeding	13.50^{a}	11.88^{ab}	9.00^{c}	9.71^{bc}	0.63	**	ns
3 h post feeding	15.63^{a}	15.00^{ab}	11.63^{c}	12.57^{bc}	0.63	*	ns
6 h post feeding	14.13^{a}	13.63^{a}	9.25^{b}	10.29^{b}	0.66	**	ns

[1]contrast effect (L=Linear and Q=Quadratic), SEM= Standard error of means, ns=not significantly different (P>0.05) *Value on the same row under each main effect with different superscripts differ significantly (P<0.05)

Conclusions

The results obtained from this experiment could have a great impact on animal feed, especially using local resources-based diets. The present results indicate that *M. pigra* meal can improve CP content and can be made that using *M. pigra* meal replacement SBM in concentrate diets as the main source of protein to completely replace SBM was beneficial to meat goats in terms of feed intake (100% in concentrate).

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