

EFFECTS OF DIETARY PROTEIN SOURCES ON FEED AND NUTRIENT INTAKE, DIGESTIBILITY AND RUMEN PARAMETERS OF GROWING BACH THAO GOATS

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ABSTRACT

Four Bach Thao male goats at 5 months of age (10.5 ± 0.711 kg) were arranged in a Latin square design with 4 treatments and 4 periods to evaluate feed and nutrient takes, digestibility and rumen environment. This experiment was carried out from Feb to June 2018 at laboratory and experimental farm of Can Tho University. Four treatments were coconut meal (CM), soybean extraction meal (SEM), soya waste (SW) and *Psophocarpus scandens* (PS) corresponding to CM, SEM, SW and PS treatments, respectively. There was an adjustment for the CP intake of experimental goats, which were around 6.0 gCP/kg live weight by urea supplementation. Each experimental period last 14 days with 7 days for adaptation and then 7 days for collecting samples.

The results showed that daily DM intake was significantly different ($P < 0.05$) among the treatments with the highest value for the PS treatment (482 g/goat/day) and the lowest for the CM one. The daily NDF intake of for the PS treatment was significantly higher ($P < 0.05$) than the others, however daily CP intake was numerically higher ($P > 0.05$) for the SEM (99.7g) and PS treatment (87.9g). However, the ME intake (MJ) was significantly higher ($P < 0.05$) for the PS, SEM and SW treatment. The digestible DM and NDF were significantly different among the treatments with the higher values for the PS treatment. Numerically, the nitrogen retention was higher ($P > 0.05$) for the SEM and PS treatment, while daily weight gain was not significantly different ($P > 0.05$) among treatments, however the higher value for the PS treatment (120 g/day). The conclusion was that supplementing the CP sources for goats with *Psophocarpus scandens*, soybean extraction meal and soya waste gave better feed nutrient intakes and digestibility compared to the coconut meal.

Keywords: *Small ruminants, feeds, nitrogen sources, rumen parameters, growth*

INTRODUCTION

Bach Thao goat is an indigenous breed in Vietnam for the dual purpose of meat and milk. They have black color coat with white spots, big and pendulous ears and their average body weight from 75 to 80 kg for the males and 40-45 kg for the females. Their milk yield is about 1.1 to 1.4 kg/day with lactation period of 148 to 150 days and produce 1.7-1.8 liters of kid per year (Nguyen Van Thu, 2010). In the Mekong Delta in Vietnam, Bach Thao goats are mainly raised due to their well adaptation to climatic conditions, low quality diets and investment costs. The goats are able to utilize locally available roughages, because their rumen microbes can effectively digest fibrous feeds into energy sources. Natural forages and agricultural by-products are often used for goat feeding. The low nutrients intake is the main problem for goat production in the Mekong Delta. While protein is needed to meet for cell repair and synthetic processes in the body. The transformation of feed protein into body protein is an important process of nutrition and metabolism (NRC, 1981).

Coconut meal and soybean extraction meal are common protein sources used for supplying goats in the Mekong Delta region. Also soya waste, the by-product and *Psophocarpus scandens* are widely used as protein supplementation sources for goats. However, studies of these protein sources for goats are still lacking. Therefore the objective of this study was to evaluate effects of different crude protein sources in the diets on feed intake, nutrient digestibility and nitrogen retention of growing Bach Thao goat for further research and applications.

MATERIALS AND METHODS

Location and experimental design

The study was carried out at the experimental farm and the laboratory E205 of College of Agriculture, Can Tho University from Feb to June 2018. Four growing Bach Thao male goats with the average live weight of 10.5 ± 0.711 kg at 5 months of age were arranged in a Latin Square design with 4 treatments and 4 periods. The four treatments were different crude protein sources including coconut meal (CM), soybean extraction meal (SEM), soya waste (SW) and *Psophocarpus scandens* (PS) corresponding to CM, SEM, SW and PS treatments, respectively. The goats were individually raised in the wood cages with the nets and plastics below the floor to collect feces and urine.

Feeds and feeding

Para grass and *Brassica oleracea* waste were offered to the goats as the basal diets. Urea was supplied in the diets in such a way that to ensure the CP intakes of experimental goats being around 6.0 gCP/kg live weight. Each experimental period was 14 days including 7 days for adaptation and 7 days for samples collection. The chemical composition of feeds and formulation of experimental diets were showed in Table 1 and Table 2.

Table 1. Chemical composition (%DM) of feeds used in the experiment

Feed	DM	OM	CP	EE	NDF	ADF	Ash
Para grass	16.2	90.6	11.1	3.50	61.9	35.4	9.38
<i>Brassica oleracea</i> waste	7.50	88.8	15.1	4.44	25.5	17.2	11.2
Soya waste	12.5	90.5	21.5	9.23	32.4	27.8	10.5
<i>Psophocarpus stem and leaves</i>	15.3	89.8	18.7	7.39	52.3	36.8	10.2
Coconut meal	93.0	94.5	18.9	8.20	55.8	33.0	5.50
Soybean extraction meal	87.8	93.4	43.2	3.60	18.4	11.3	6.60
Urea	100.0	-	288	-	-	-	-

Note: DM: Dry matter, OM: Organic matter, CP: Crude protein, EE: Ether extraction, NDF: Neutral detergent fiber, ADF: Acid detergent fiber.

Table 2. Dietary formula and nutrients in different diets of the experiment (%DM)

	Treatment			
	PS	SW	CM	SEM
Para grass	47.0	35.8	24.4	41.0
<i>Brassica oleracea</i>	13.0	28.0	20.2	30.0
Coconut meal	-	-	54.0	-
Soybean extraction meal	-	-	-	29.0
Soya waste	-	35.0	-	-
<i>Psophocarpus scandens</i>	39.0	-	-	-
Urea	1.00	1.20	1.40	-
Total	100	100	100	100

Note: PS, SW, CM and SEM were the treatments containing crude protein supplementation feeds from *Psophocarpus scandens*, soya waste, coconut meal and soybean extraction meal, respectively

Para grass and *Psophocarpus scandens* were collected daily from the areas surrounding Can Tho University. Coconut meal, soybean extraction meal and urea were purchased from a local feed company in one occasion during experiment in Can Tho City. Soya waste and *Brassica oleracea* waste were bought from soya producer and vegetable market everyday. The animals were fed three times a day at 7:30, 11:00 and 17:00h. Para grass was offered *ad libitum* after goats completely consumed the protein feeds and *Brassica oleracea* waste. Fresh drinking water was available for the goats throughout a day.

Measurements taken

Daily feed, nutrient and metabolizable energy (ME) intakes

Feeds and refusal were measured daily and analyzed of DM, OM, CP, EE, NDF, ADF and Ash following procedure of AOAC (1990) and Van Soest et al. (1991), and metabolizable energy (ME) determined according to Bruinenberg et al. (2002).

Feeds and nutrient digestibility

Apparent DM, OM, CP, EE, NDF and ADF digestibility were done according to McDonald et al. (2002).

Rumen parameters

In the morning of the last day of each period, rumen fluid of experimental goats were taken at 0h (before feeding) and 3h after feeding through esophagus by using stomach tube for determination of pH, total volatile fatty acids (VFAs) and ammonia (N-NH₃). Rumen pH was measured by using pH meter. Rumen VFAs was determined by the procedure of Barnet and Reid (1957). Rumen ammonia concentration was determined by distillation and titration with the Kjeldahl method.

Daily weight gain

Goats were weighed individually in two consecutive days in early mornings before feeding at the end of each experimental period.

Statistical analysis

The data were analyzed by analysis of variance using the ANOVA of General linear model of Minitab Reference Manual Release 16.0 (Minitab, 2016), while the Tukey test was used for paired comparison between 2 treatments.

RESULTS AND DISCUSSION

Feed, nutrient and ME intakes of experimental goats

Feed, nutrient and ME intakes were presented in Table 3.

The DM intake of experimental goats was significantly different ($P < 0.05$) among treatments with the highest value for the PS treatment (482 g/head/day) and the lowest value for the CM treatment (360 g/head/day). The DM intake of growing Bach Thao goats fed different CP levels stated by Nguyen Thi Kim Dong and Nguyen Van Thu (2018) ranged 619-726 g/head/day. The DM intake per kg live weight of experimental goats in this study was similar to the result of Nguyen Dong Hai (2008). The CP intake of goats in this experiment was similar ($P > 0.05$) among treatments and ranged 74.9-99.7 g/head/day. Due to higher fiber

content, NDF and ADF intakes of goats for PS treatment (236 and 152 g/day, respectively) were significantly higher ($P < 0.05$) than those of the others. The ME consumption (MJ/head and $\text{MJ/W}^{0.75}$) of goats in this experiment was significantly different ($P < 0.05$) among treatment and the significantly higher values for the SEM, PS and CM treatments. The ME values ($\text{MJ/W}^{0.75}$) of goats in this experiment were similar to those reported by Nguyen Thi Kim Dong and Nguyen Van Thu (2018) studied on growing Bach Thao goats being 0.451-0.574.

Table 3. Feed, nutrient and metabolism energy intake of experimental goats

	Treatment				SE	P
	PS	SW	CM	SEM		
Feed intake, gDM/head/day						
Para grass	179 ^a	133 ^a	79.4 ^b	180 ^a	13.1	0.005
<i>Brassica oleracea</i> waste	111	116	80.1	140	12.6	0.077
Soya waste	-	137	-	-	-	-
<i>Psophocarpus scandens</i>	187	-	-	-	-	-
Coconut meal	-	-	196	-	-	-
Soybean extraction meal	-	-	-	133	-	-
Urea	5.25	4.79	5.10	-	0.46	-
Nutrient intake, g/head/day						
DM	482 ^a	391 ^{ab}	360 ^b	453 ^{ab}	22.9	0.023
OM	427	350	332	410	28.8	0.447
CP	87.9	77.1	74.9	99.7	9.50	0.324
EE	25.0	22.5	22.4	17.6	3.76	0.153
NDF	236 ^a	155 ^b	177 ^b	172 ^b	9.91	0.005
ADF	152 ^a	105 ^b	107 ^b	103 ^b	5.44	0.002
Ash	48.6 ^a	39.8 ^a	26.9 ^b	41.1 ^a	2.74	0.006
Metabolizable energy (ME)						
ME, MJ/head/day	4.72 ^a	4.39 ^a	3.76 ^b	5.25 ^a	0.33	0.050
ME, $\text{MJ/W}^{0.75}$	0.495 ^a	0.446 ^a	0.370 ^b	0.509 ^a	0.03	0.038

Note: PS, SW, CM and SEM were the treatments containing crude protein supplementation sources from *Psophocarpus scandens*, soya waste, coconut meal and soybean extraction meal, respectively. The numbers with different superscript letters in the same row were significantly different ($P < 0.05$)

Apparent digestibility, nitrogen retention and daily weight gain

The Apparent nutrient digestibility, nitrogen retention and daily weight gain were showed in Table 4.

Table 4. Nutrient digestibility, digestible nutrient and daily weight gain of experimental goats

Item	Treatment				SE	P
	PS	SW	CM	SEM		
Nutrient digestibility, %						
DM	69.6 ^a	70.4 ^a	64.7 ^b	69.7 ^a	1.00	0.023
OM	70.1	72.0	67.6	71.1	2.73	0.245
CP	87.5	87.2	85.0	85.4	2.00	0.767
NDF	66.3	65.7	59.7	59.9	1.70	0.054
Digestible nutrient, g/head/day						
DM	337 ^a	277 ^{ab}	235 ^b	331 ^{ab}	19.8	0.033
OM	298	254	225	289	25.7	0.461
CP	77.1	67.5	63.5	88.7	9.60	0.340
NDF	159 ^a	103 ^b	107 ^b	103 ^b	9.40	0.014
Nitrogen balance, g/head/day						
N intake	14.1	12.4	12.0	16.0	1.52	0.324
N in feces	1.72	1.54	1.83	1.76	0.23	0.824
N in urine	3.18	2.80	1.83	2.29	0.36	0.148
N retention, g/head/day	9.16	7.80	8.28	11.9	1.67	0.409
N retention g/W ^{0.75} /day	0.90	0.80	0.80	1.10	0.14	0.501
Initial live weight, kg	13.3	13.5	13.4	13.6	0.18	0.615
Final live weight, kg	15.0	14.5	14.9	15.0	0.21	0.433
Daily weight gain (g/day)	120	71.0	107	98.2	17.6	0.344

Note: PS, SW, CM and SEM were the treatments containing crude protein supplementation feeds from *Psophocarpus scandens*, soya waste, coconut meal and soybean extraction meal, respectively. The numbers with different superscript letters in the same row were significantly different ($P < 0.05$)

The DM digestibility for CM treatment (64.7%) was significantly lower ($P < 0.05$) than that of the others. The OM, CP and NDF digestibility values were similar ($P > 0.05$) among treatments. Phengvilaysouk and Kaensombath (2006) reported the DM digestibility from 54.5 to 67.6% and the digestibility of NDF ranged from 62.8 to 63.9%, which was similar to those reported by Aregheore (2005) being from 63.9 to 69.4%. Lam Phuoc Thanh and Le Trung Tin (2018) found that DM, OM, CP and NDF digestibility of growing Bach Thao goats fed different oil sources in the diet being 63.6-65.9%, 65.9-68.1%, 74.8-77.1% and 56.3-60.4%, respectively. The digestible DM and NDF values were significantly different ($P < 0.05$) among the treatments with the higher values for the PS treatment. The nitrogen retention was numerically higher ($P > 0.05$) for the SEM and PS treatment, while daily weight gain was not significantly different ($P > 0.05$) among treatments, however the higher value for the PS treatment (120 g/day). The nitrogen retention values (g/head/day) of experimental goats were similar to those found by Nguyen Dong Hai (2008) being from 5.57-10.1 g/head/day and it was also agreement with that presented by Phengvilaysouk and

Kaensombath (2006). The daily weight gain of goats in this experiment was from 71.0 to 120 g and it was similar to the findings of Nguyen Thi Kim Dong and Nguyen Van Thu (2018) ranged from 98.6-107 g/day.

Rumen environment

Table 5. Rumen pH, N-NH₃ and VFAs concentration of experimental goats

Item	Treatment				SE	P
	PS	SW	CM	SEM		
pH at 0 h	6.60	6.61	6.48	6.71	0.09	0.419
pH at 3 h after feeding	6.45	6.11	6.13	6.38	0.08	0.082
N-NH ₃ at 0 h, mg/100ml	19.5	24.0	26.4	23.0	1.43	0.070
N-NH ₃ at 3 h after feeding, mg/100ml	22.2	29.6	29.7	28.9	2.00	0.108
VFAs at 0 h, mmol/l	68.3	66.6	68.1	68.8	2.61	0.934
VFAs at 3 h after feeding, mmol/l	77.4	84.3	91.1	96.8	3.97	0.058

Note: PS, SW, CM and SEM were the treatments containing crude protein supplementation feeds from *Psophocarpus scandens*, soya waste, coconut meal and soybean extraction meal, respectively. The numbers with different superscript letters in the same row were significantly different ($P < 0.05$)

Rumen pH, N-NH₃ and VFAs concentration at 0h and 3h after feeding of experimental goats were similar ($P > 0.05$) among treatments. Thus supplementation of CP sources of *Psophocarpus scandens*, soya waste, coconut meal and soybean extraction meal in the diets was not highly effected on goat rumen environment. Due to VFAs at 3h after feeding was higher than those of VFAs at 0h, pH values at 3h after feeding was lower than those of pH at 0h. The rumen parameters of Bach Thao goats at 0h and after feeding in the present study were similar to these stated by Lam Phuoc Thanh and Le Trung Tin (2018), Nguyen Thi Kim Dong and Nguyen Van Thu (2018) and Nguyen Dong Hai (2008).

CONCLUSION

The conclusion was that supplementing the CP sources for goats with *Psophocarpus scandens*, soybean extraction meal and soya waste gave better feed nutrient and ME intakes and DM digestibility compared to the coconut meal. Promisingly, dietary CP supplementation of *Psophocarpus scandens* source for goats should be applied due to the availability and lower cost.

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