Study on ruminal degradability of *Leucaena leucocephala* pellet (LLP) by nylon bag technique

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Abstract: Two ruminally fistulated buffaloes of 369 ± 28 (kg) BW were used to evaluate the nutritive value of three protein resources: Leucaena leaf, Leucaena pellet with 5% urea (LLP5) and Leucaena pellet with 10% urea (LLP10) using the in sacco nylon bag technique. A Randomized complete block design (RCBD) was employed to determine ruminal degradability of DM, OM, CP and NDF. Approximately 5 g of feed samples were weighed into duplicated nylon bags (38 µm pore size) and incubated ruminally at 0, 2, 4, 8, 12, 24, 48, and 72 h-post feeding. The results showed that the mean values of ruminal pH (6.2) and temperature (38.8 ºC) were not different (P>0.05) among different times of incubation. The effective degradability of DM, OM and NDF of LLP5 and LLP10 were similar and significantly higher than that of Leucaena leaf. Moreover, the effective degradability of CP of LLP10 was highest among three feed resources and significantly differed from that of LLP5 and Leucaena leaf. Based on this experiment, it could be concluded that LLP10 can be used as strategic supplement for ruminants.

Keywords: Leucaena leaf, buffalo, rumen, nylon bag technique.

Introduction

Crop residues are the main source for ruminant diets in developing countries. These feeds are imbalanced particularly deficient in protein, minerals, vitamins, but are highly lignified. Efficient supplementation of locally mixed concentrate with grains or protein foliages has been demonstrated to improve rumen ecology, dry matter intake and subsequently meat and milk quantity and quality (Wanapat 1999). Local feed resources such as cassava hay, corn stovers, kapok meal, baby corn, cow-pea, cotton seed meal, sweet potatoes, sugarcane, sesbania seed/leaves, mulberry leaves, moringa seed, sapindus fruit, and leuceana leaves have potential as ruminant feeds to improve and increase the efficiency of the production system (Promkot and Wanapat 2003). Moreover, Leucaena leucocephala leave has high protein contents (23.7% crude protein) and condensed tannins can be used as alternative dietary strategic supplements to improve rumen digestibility and ecology. Therefore, the objective of this study was to determine on ruminal degradability of Leucaena Leucocephala Pellet (LLP) by using nylon bag technique.

Materials and methods

This experiment was conducted on station at the Tropical Feed Resources Research and Development Center (TROFREC), Department of Animal Science, Faculty of Agriculture, Khon Kaen University, Thailand. The experiment was implemented from 23rd of February to 20th of April. A randomized complete block design (RCBD) with three treatments and two replicates per treatments was used. Three samples were used as substrates in this experiment. These samples were as follows: Leucaena leaf meal; LLP5 (Leucaena pellet with 5% urea); LLP10 (Leucaena pellet with 10% urea).

All samples were dried in a forced air oven at 60^0C and ground to pass a 1 mm screen and stored for chemical analysis and the degradability

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study. The formula of leucaena pellets were content CP=35.9% (Leucaena powder 90.5% plus Urea5%) and CP=48.3% (Leucaena powder 81.5% plus Urea 10%). Two ruminally fistulated buffaloes with liveweight 369 ± 28kg BW were used as replicates to determine in sacco DM, OM, CP and NDF degradability of three samples. Buffaloes were housed in individual pens and fed ad libitum rice straw and concentrate (12% CP) at 70:30 ratio. Water and mineral block were available at all times. The diets were offered in two equal meals at 07.00h and 16.00h. The animals were adapted to the basal feed for two weeks prior to suspension of the bags. The DM, OM, CP and NDF disappearances in the rumen were estimated for each feed sample using the nylon bag technique (Ørskov and McDonald 1979). The samples were analyzed for DM, Ash, and CP according to AOAC (1985). Neutral-detergent fiber (NDF) and acid-detergent fiber (ADF) were determined using the method of Van Soest et al. (1970). Data for ruminal disappearance characteristics of DM, OM, CP and NDF were fitted to the exponential equation following the procedure described by Ørskov and McDonald (1979) and using the NEWAY program (Chen 1996). P = a+b (1-e-ct) where, P = disappearance rate at time t (%), a = the intercept of the degradation curve at time zero (%), b = the fraction of DM, OM, CP and NDF which were degraded when given sufficient time for digestion in the rumen (%), c = a rate constant of disappearance of fraction b (h-1), and t = time of incubation (h). The effective degradability (ED) of DM, OM, CP and NDF were calculated by using the following equation. EDDM or EDOM, EDCP, EDNDF = a+{(bc)/(c+k)} where, k = assuming the rate of particulate outflow from the rumen, k, is 0.05 h-1 by equation of Ørskov and McDonald (1979). Data were analyzed by Analysis of variance (ANOVA) according to a Randomized complete block design (RCBD). It was performed on the data of the same incubation time as a separate set following the ANOVA procedure of SAS (1998).

Treatment means were compared using Duncan's New Multiple Range Test (Steel and Torrie 1980). The statistical model was: Yij = m + δi+Tj +eij where; Yij = Observation in block i and treatment j, m = Over all sample mean, δi = Block i, Ti = Effect of treatment i, eij = Error.

Results and discussions

Chemical composition of feedstuffs

The chemical composition of feedstuffs is presented in **Table 1**.

All three samples had similar OM and DM contents. The CP content of Leucaena leaf, LLP5 and LLP10 were 23.7, 27,2 and 42.2% . On the contrary, Leucaena leaf contained highest NDF and ADF content of 28 and 18.1 respectively the NDF and ADF content of the LLP5 and LLP10 were lower. The chemical composition of Leucaena leaf in this study was similar to that reported by Wanapat et al. (2007) with DM: 95.1 % and CP: 22.3%.

Ruminal environment

Rumen environment expressed by the level of pH and temperature is shown in **Table 2.** The average ruminal pH and temperature was 6.2 and 38.85 °C, respectively. There were no differences of these values among different times of incubation.

In situ DM, OM, CP and NDF degradabilities of feeds

In situ DM, OM, CP and NDF degradabilities of feeds were shown in table 3. DM and OM degradation rate constants (c) of LLP5 and LLP10 were similar and significantly higher than that of Leucaena leaf ($p<0.05$). Meanwhile, the rapidly degraded fraction (a) of DM and OM was not different among samples. The insoluble degradability fractions (b) and the potential degradability (a+b) of DM and OM of LLP5 and LLP10 were the same and significantly higher than that of Leucaena leaf ($p<0.05$).

Therefore, effective degradability of DM and OM of LLP5 and LLP10 at outflow rate of passage of 0.05/h-1 were 74.86%; 72.93% and 75.04%; 72.32%, respectively and higher than that of Leucaena. The degradation rate constants (c) and the potential degradability (a+b)

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Table 1 Chemical composition of feedstuffs.

Feedstuffs	DM	OM	CP	NDF	ADF	Ash
	%	*% of dry matter*				
Leucaena leaf	92.2	91.1	23.7	28.01	18.10	8.9
LLP5	93.6	89.1	27.2	26.2	17.8	10.9
LLP10	92.9	89.5	42.2	25.5	15.6	10.5

LLP5: Leucaena pellet with 5% urea; LLP10: Leucaena pellet with 10% urea

DM: dry matter; OM: organic matter; CP: crude protein; NDF: neutral-detergent fiber; ADF: acid-detergent fiber

Table 2 Ruminal pH and temperature of buffaloes in incubation time

Incubation time (h)	Temperature, °C	pH
0	39.2	6.2
2	38.9	6.3
4	38.2	6.2
8	38.9	6.0
12	39.1	6.1
24	38.6	6.4
48	39.0	6.3
72	39.1	6.2
Mean±SD	38.85±0.3	6.2±0.1

degradability (a+b) of DM and OM of LLP5 and LLP10 were the same and significantly higher than that of Leucaena leaf ($p<0.05$). Therefore, effective degradability of DM and OM of LLP5 and LLP10 at outflow rate of passage of 0.05/h-1 were 74.86%; 72.93% and 75.04%; 72.32%, respectively and higher than that of Leucaena. The degradation rate constants (c) and the potential degradability (a+b) of DM of Leucaena leaf were similar to the report by Wanapat et al. (2007). The rapidly degraded fractions (a) of CP were significantly different among samples ($p<0.05$). The LLP10 had the highest

Table 3 Dry matter (DM), organic matter (OM), crude protein (CP) and neutral detergent fiber (NDF) disappearance in the rumen for LLP5, LLP10 and Leucaena leaf at various incubation times in buffaloes.

Item	Leucaena leaf	LLP5	LLP10	SEM
a	39.4[a]	38.0[a]	28.9[b]	0.21
b	30.4[b]	43.6[a]	50.6[a]	2.81
c	0.06[b]	0.11[a]	0.13[a]	0.003
a+b	69.8[b]	81.7[a]	79.5[a]	1.64
*EDDM,%	62.3[b]	74.9[a]	72.9[a]	2.39
a	42.1	37.1	35.6	2.63
b	32.0[b]	38.8[ab]	43.2[a]	4.70
c	0.07[b]	0.11[a]	0.12[a]	0.004
a+b	69.1[b]	80.9[a]	78.9[a]	2.05
*EDOM,%	61.6[b]	75.0[a]	72.3[a]	2.19
a	47.5[b]	35.8[c]	58.0[a]	1.53
b	29.3[b]	52.1[a]	31.9[b]	3.10
c	0.07	0.14	0.13	0.010
a+b	76.8[b]	87.9[a]	89.9[a]	0.29
*EDCP,%	70.1[c]	80.8[b]	85.3[a]	0.95
a	17.2[a]	14.0[b]	8.6[c]	0.32
b	47.3[c]	55.0[b]	61.1[a]	0.68
c	0.06[b]	0.11[a]	0.12[a]	0.0048
a+b	64.5[b]	69.0[ab]	69.7[a]	1.13
*EDNDF,%	52.4[b]	60.8[a]	60.9[a]	1.12

LLP5: Leucaena pellet with 5% urea, LLP10: Leucaena pellet with 10% urea

a, b, c Means within rows not sharing common superscripts are different at $P<0.05$

* Effective degradability in the rumen (assuming rate of passage of 0.05/h)

SEM: standard error of the mean; EDDM: effective degradability of dry matter

EDOM: effective degradability of organic matter; EDCP: effective degradability of crude protein; EDNDF: effective degradability of neutral-detergent fiber fraction (a) and then Leucaena leaf, LLP5, respectively. However, the rates of degradation of CP did not differ among samples. The potential degradability (a+b) of CP of LLP5 and LLP10 was similar and significantly higher than that of Leucaena leaf and effective degradability of CP at outflow rate of passage of 0.05/h-1 significantly differred among

samples. The LLP10 had highest effective degradability of 85.29% and then LLP5: 80.75%, Leucaena leaf: 70.09%, respectively. On the contrary, the rapidly degraded fraction (a) of NDF of Leucaena leaf was highest and then LLP5, LLP10, respectively. The rates degradation of NDF of LLP5 and LLP10 were similar and significantly higher than that of Leucaena leaf ($p<0.05$). The highest insoluble degradability fraction (b) of NDF was found in LLP10 and then LLP5, Leucaena leaf, respectively. Similarly, the potential degradability (a+b) and effective degradability of NDF was highest in LLP10 and the lowest of that in Leucaena leaf.

Conclusions and recommendation

All samples were tested in this experiment had shown good nutritive values. The effective degradability of DM, OM and NDF of LLP5 and LLP10 were similar and significantly higher than that of Leucanea leaf. Additionally, LLP10 had the highest effective degradability of CP and significantly different compared with that of LLP5 and Leucaena leaf. In conclusion, Leucaena pellets are improved significantly with nutritive values compared with Leucaena leaf and LLP10 could be a good protein resource for ruminants with high protein content in comparison with soybean meal. However, further in vivo research needs to be conducted with different levels of LLP10.

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