Effects of Different Foliages and Sugar Cane in the Diet in Late Pregnancy on Ewe and Lamb Performance

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ABSTRACT : Thirty mature pregnant ewes of the Phan Rang breed with an initial live weight of 30 to 45 kg were used to compare the effects of three different diets in late pregnancy on ewe and lamb performance. All diets contained 20% of whole sugar cane, 16% rice bran, 26% cassava root and 6% molasses urea block. The remaining 32% of dry matter consisted of Jackfruit (JF diet), 16% each of Jackfruit and Cassava foliage (JF+CS diet) or Jackfruit and Flemingia foliage (JF+FM diet). The diets were fed at 3.5% of actual BW of the individual animal. The foliages were offered at 120% of the amount decided in the diets of the requirements. The JF+CS diet resulted in significantly higher feed intake than the JF diet, and also a higher feed intake than the JF+FM diet, but this difference was not significant. The ewe weight changes during the last 8 weeks of pregnancy, or from start to 24 h after lambing, were significantly different. The highest weight gain was obtained from the ewes fed the JF+CS diet. Diets had no effect on weight changes of ewes during 3 weeks after lambing but a significant effect on the litter birth weight, with the JF+CS diet giving the highest litter birth weight. There was, however, no effect on the litter weight at 21 days or litter growth rate from birth to 21 days due to the experimental diets. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 6 : 828-833)***

Key Words : Ewes, Late Pregnancy, Lambs, Foliage, Intake, Weight Change

INTRODUCTION

The feeding of ewes in late pregnancy has an important effect on ewe and lamb performance, especially for ewes in low body condition. Ledin (1995) found that ewes fed on a higher feeding level lost less weight during pregnancy. Low feeding levels resulted in low ewe body weights and low lamb birth weights. The milk production of the ewe is also affected negatively by low feeding levels during pregnancy (O'Doherty et al., 1997; Goodchild et al., 1999), which can cause high mortality rates and low growth rates of the lambs. In the last two months before lambing the foetus is growing rapidly and the energy requirement of the ewe is high. In late pregnancy voluntary food intake falls because the foetus is taking up more space (Gatenby, 1986) and giving more of a low quality feed will not be enough to meet the requirements. McNeill et al. (1997) and Charismiadou et al. (1999) observed that in the ewe in late pregnancy, mammary gland growth had priority over growth of carcass tissues, which also act as a protein reserve.

The conventional feed for sheep is grass or hay, often supplemented with a concentrate composed of cereal grains, protein meals and by-products. In tropical areas this feeding system has had little impact on smallholder farms because the grasses are difficult to grow in the dry season and purchasing concentrate is not an option for poor farmers, and in any case this would compete with the nutritional needs of people. There is a need to find new green feed resources that can improve the diet of ewes during the dry season in tropical areas especially for the pregnancy period, since this often occurs during the driest part of the year. The feeds should be easily available at low cost for the farmers.

Sugar cane *(Saccharum officinarum)* has characteristics which make it especially appropriate as a feed reserve for livestock in the tropics and superior to almost all other forage crops in bio-mass yield (Mui, 1994). Furthermore, the time of reaching maturity coincides with the dry season, which is when the sugar cane has its maximum nutritive value.

Protein-rich foliages from some multipurpose trees, which are available in the dry season, can be valuable components in livestock feeding systems in the tropics (Devendra and McLeroy, 1982). The use of tree foliages has a number of advantages: the foliages are sources of dietary protein, minerals and vitamins, and can provide variety in the diet, improve performance and reduce the cost of feeding (Devendra, 1988).

In northern Vietnam, foliage from Jackfruit *(Artocarpus heterophyllus)* trees is commonly available on farms in mountainous areas. Annual yield of leaves from 10 year old Jackfruit trees (defoliated at approximately 3 months intervals) was of the order of 150 to 250 kg/tree (Tien et al., 1996). *In vitro* (Keir et al., 1997) and *in vivo* studies (Mui et al., 2000) indicated that leaves of Jackfruit were of high nutritive value.

Flemingia *(Flemingia macrophylla)* was imported from the Philippines to Vietnam in 1994. Flemingia is a woody, deep-rooting shrub of the family Leguminosae, growing up

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Received August 27, 2001; Accepted January 24, 2002

to 2.5 m, with trifoliate leaves and papery leaflets. Flemingia is used for mulching, weed control and soil protection and the leaves have in addition high crude protein (CP) values, of approximately 14-18% (Mui et al., 2001). The annual yield of Flemingia foliage was reported to be about 55-64 tons/ha (Binh et al., 1998).

Cassava (*Manihot esculenta*) belongs to the family of rubber plants. It is a tropical shrubby perennial plant with a palmate leaf formation producing tubers at the base of the stem. Cassava thrives in sandy-loam soils with low organic matter, in areas receiving low rainfall and with high temperatures (Wanapat et al., 1997). Cassava is an important crop in the small-farm sector in tropical countries. Many researchers have shown that cassava leaves have a high protein content, with almost 85% of the CP fraction as true protein (Rogers and Milner, 1963; Ravindran, 1992; Phuc, 2000). According to Ravindran and Ravindran (1988), the CP content of cassava leaves decreased from 38.1% in very young leaves to 19.7% in mature leaves. Cassava leaves had an excellent storage quality because there was no mould or insect infestation even after 8 months of storage at room temperature and the cyanide content declined during storage (Ravindran, 1992). Cassava foliage is a readily available product at the time of harvesting of the root. Haryanto et al. (1982) found that dry matter (DM) intake over 14 days of sheep fed with cassava foliage alone was 540 g/$W^{0.75}$. Protein-rich foliages often contain limiting factors in the form of anti-nutritional substances. Phenolic compounds such as tannins are common in the foliages and are associated with lower voluntary feed intake and lower protein digestibility in the rumen (McDonald et al., 1995). Another limiting factor is HCN, which occurs in cassava foliages. According to Phuc (2000), the HCN content of fresh cassava foliages will be reduced by 90% by sun drying. Factors influencing toxicity of HCN are the size and type of animal consuming the plants, the type of food eaten at the same time and the rate of ingestion.

The overall objective of this research was to find locally available feed resources to use in sheep productions systems for small holders. In this study sugar cane and protein-rich foliages from Jackfruit, Flemingia and Cassava were tested in the diet of pregnant ewes.

MATERIALS AND METHODS

Location and climate of the study area

The study was conducted at the Goat and Rabbit Research Centre, Sontay, Hatay province in Northern Vietnam during the dry season. The centre is located in the zone between the mountainous area and the delta at E 105° 25 longitude and latitude N 21° 06, 220 m above sea level. The climate is tropical monsoon with a wet season between April and November and dry season from December to March. Average annual rainfall is 1,850 mm and the mean temperature ranges from 24 to 30°C.

Animals, feeds and management

Animals used in the experiment were 30 mature pregnant ewes of the Phan Rang breed, which is a local breed with a short thin tail. Mean live weights 9 weeks prior to expected lambing ranged from 30 to 45 kg. All the ewes were mated naturally with 2 different rams of the same breed and the time of mating was recorded.

Feeds used in the experiment were fresh Jackfruit foliage, Flemingia foliage, chopped dried Cassava foliage, whole sugar cane (WSC), dried cassava root slices, rice bran and molasses urea block (MUB).

Jackfruit and Flemingia foliages were harvested from the farms around the Centre daily in the morning. The foliage consisted of leaves, petioles and about 40 cm of stem. The cassava foliage was collected from farms in November and December when the roots were harvested and was chopped into 1 cm pieces, sun dried and stored in plastic bags in a shed. Slices of dried cassava root, rice bran, MUB and WSC were used as basal feeds. Sugar cane was collected at 12 months of age, twice a week from farmers around the Centre. Before feeding the sugar cane was chopped into slices (1 to 3 cm). Dried cassava root slices and rice bran were bought from the local market and stored in plastic bags and MUB were mixed twice a week (35% molasses, 10% minerals (70% stone meal, $Ca_3(PO_4)_2$ and 30% bone meal), 10% urea, 5% salt and 40% cassava root meal).

The ewes were fed individually twice per day (50% of the feeds at 08:30 h and 50% at 15:00 h). The foliages were given as small bunches hanging above the feeding trough. Sugar cane and other feed stuffs were given separately. Mineral lick blocks (73% minerals of the same composition as in the MUB, 17% cement as a binding agent and 10% salt) and water was available at all times. The animals were allowed to move freely for 1 hour in the yard daily. During the first three weeks the lambs were always with the ewes.

The first 2 weeks were an adaptation period. The experimental period was from the first day of week 12 in the pregnancy period to the day before lambing. Recording was continued until three weeks after lambing.

Experimental design

The pregnant ewes were allotted to a completely randomised design with three treatments:
i) Jackfruit foliage+basal diet (JF), ii) Jackfruit foliage +Flemingia foliage+basal diet (JF+FM), and iii) Jackfruit foliage + dried Cassava foliage+basal diet (JF+CS)

Experimental diets were formulated for a 50 kg ewe and were planned to give 176 g CP and 15.8 MJ metabolisable energy (ME) per ewe and day (McDonald et al., 1995) at a

DM intake of 3.5% of body weight (BW). The diets were calculated using CP and ME values for Jackfruit, Flemingia, MUB and sugar cane from Mui (1998) and for cassava foliage, cassava root slices and rice bran from McDonald et al. (1995). On a DM basis, the proportion of the ingredients was the same for all diets. Basal diet consisted of 20% WSC, 16% rice bran, 26% cassava root and 6% MUB. The JF diet contained the remaining 32% of DM as Jackfruit, the mixed diets 16% each of Jackfruit and Cassava foliage (JF+CS diet) or Jackfruit and Flemingia foliage (JF+FM diet).

Since the initial BW varied more than was anticipated, the planned intake was not achieved for all animals during the adaptation period. To minimise selection of the basal diet, it was decided to adjust the amount of feed offered to 3.5% of the actual BW of the individual animal and foliages were offered at 120% of the amount decided in the diets. The consumption was recorded daily and if the feed residuals were less than 25%, the offer was increased, but still with the feed stuffs in the same proportions as above. After lambing all ewes were fed the same diet, providing 1,550 g DM, 221 g CP and 15.9 MJ ME per day. The proportions of feed stuffs in the diet were the same as for the JF+CS diet but 6% of the cassava root was replaced by 6% of soybean meal to satisfy CP and ME requirement for lactating ewes.

Measurements and chemical analyses

The rations were weighed at each feeding and the feeds offered were sampled every week and pooled to give three samples for the whole experimental period. Feed residues were collected and weighed every day after the adaptation period. Residues of individual animals were sampled weekly and the samples were pooled to give one sample per animal and feed stuff. The samples were analysed for DM, CP, neutral detergent fibre (NDF), acid detergent fibre (ADF) and ash. DM and ash were analysed by standard methods of AOAC (1990), nitrogen (N) was determined by the Kjeldahl procedure and CP was calculated as N×6.25. NDF and ADF were determined by the methods of Van Soest et al. (1991). MUB was not analysed, and the DM, CP and ash are values from Mui (1998).

Body weight of ewes was recorded at the beginning of the experiment, at the 16th week, before lambing, after lambing and at 3 weeks after lambing, always in the morning before feeding. The lambs were weighed at birth and at 3 weeks of age. Litter weight at birth included dead born lambs.

Statistical analysis

Data were analysed statistically by using the GLM procedure of Minitab Software, version 12.0 (Minitab, 1998). The treatment means which showed significant differences at the probability level of $p<0.05$ were compared with each other using the Tukey's pairwise comparison procedures.

The data was corrected by using initial ewe weight as a covariate.

The statistical models used in the analysis were:

$Y_{ij}=\mu+T_i+\beta X_{ij}+e_{ij}$ (Feed consumed)

$Y_{ijk}=\mu+T_i+L_j+\beta X_{ijk}+e_{ijk}$ (Ewe weight and weight changes)

$Y_{ijk}=\mu+T_i+L_j+R_k+e_{ijk}$ (Litter weight and litter growth rate)

where Y is the dependent variable, μ is the overall mean, T_i is the effect of treatment (diets), L_j is the effect of litter size, R_k is effect of ram, the slope β describes the change in the response Y when the covariate X increases one unit, e_{ij} is the random error independent normally distributed.

RESULTS

The chemical composition of the feeds is shown in table 1. The foliages had high contents of CP, especially cassava foliage, which contained 20% of CP in DM. Flemingia had a higher content of NDF and ADF than Jackfruit or Cassava foliage. The WSC and cassava root had very low contents of CP.

Table 2 shows the intake of the experimental diets. Most of the MUB, the rice bran and the cassava root was consumed. However, Jackfruit, Cassava and Flemingia foliage and WSC were not consumed completely, but the true proportions of feed consumed were close to the planned amounts, except that WSC consumption was lower than planned. The JF+CS diet gave significantly higher feed intake (DM, CP, ME) than the JF diet. The JF+CS diet resulted in a higher feed intake than the JF+FM diet, but the difference was not significant. Daily feed intake was similar during the last eight weeks of pregnancy and was not influenced by the space occupied by the growing fetus.

Table 1. The chemical composition of the different experimental feeds (3 samples of each feed)

Components	DM	g/kg DM			
	(g/kg fresh)	CP	Ash	NDF	ADF
Jackfruit	350±26[1]	148±10	106±5	506±23	360±17
Flemingia	298±23	170±9	49±5	573±20	436±15
Cassava leaf	870±37	201±14	88±7	391±32	266±24
Sugar cane	237±30	25±1	23±6	411±26	253±20
Rice bran	889±37	111±14	96±7	337±32	131±24
Cassava root	900±40	35±1	16±6	114±26	33±2
MUB[2]	670	370	150	60	17

[1] Means±Standard error of means, [2]Not analysed. Values from Mui (1998).

DM=Dry matter, CP=Crude protein, NDF=Neutral detergent fiber, ADF=Acid detergent fiber.

Table 2. Feed offered and feed intake during the last 8 weeks of pregnancy[1]

Treatments	JF	JF+FM	JF+CS	SE
DM offered, g/ewe and day				
Jackfruit	547	312	318	15.6
Flemingia	-	276	-	6.5
Cassava	-	-	277	7.8
Sugar cane	253	265	271	11.6
MUB	70	71	73	4.0
Rice bran	189	197	213	9.0
Cassava root	304	330	334	16.2
Total, g	1,368	1,441	1,486	60.5
CP offered, total, g	143	156	172	6.3
ME offered, total, MJ[2]	13.5	14.2	14.7	0.6
DM intake, g/ewe and day				
Jackfruit	284^{a}	200^{b}	205^{b}	16.3
Flemingia	-	147	-	7.4
Cassava	-	-	167	6.0
Sugar cane	143	166	172	13.6
MUB	62	62	70	4.0
Rice bran	175	189	192	9.1
Cassava root	297	307	309	10.9
Total, g	966^{b}	1,068^{ab}	1,111^{a}	42.0
CP intake, total, g	112^{b}	125^{ab}	136^{a}	4.9
ME intake, total, MJ	9.8^{b}	10.9^{ab}	11.4^{a}	0.4

a,b Means within rows with different superscripts differ significantly ($p<0.05$).

[1] Least square means, [2] McDonald et al. (1995); Mui (1998).

JF=Jackfruit diet, JF+FM=Jackfruit+Flemingia diet, JF+CS=Jackfruit and Cassava diet, SE=Standard error of means, MUB=Molasses-urea block.

Table 3. Litter weight and weight changes in lambs and ewes[1]

Treatments	JF	JF+FM	JF+CS	SE
Ewe weight at start, kg	34.6	32.0	33.4	5.5
Changes in ewe live weight, kg				
Day 92-the day before lambing	4.9^{b}	5.8^{ab}	7.1^{a}	1.8
Day 92-24 h after lambing	-1.9^{b}	0.2^{ab}	2.4^{a}	1.1
24 h after lambing-21 days	-1.7	-0.9	-1.0	0.1
Live weight gain of the lambs				
Litter birth weight, kg	3.5^{b}	3.8^{b}	4.3^{a}	0.2
Litter weight at 21 days, kg	9.6	10.3	10.0	0.6
Litter growth rate, g/day (birth to 21 days)	290	309	275	30.3
Litter size, lambs/litter	1.3	1.3	1.4	0.2

a,b Means within rows with different superscripts significantly ($p<0.05$). [1] Least square means, JF=Jackfruit diet, JF+FM=Jackfruit+Flemingia diet, JF+CS=Jackfruit and Cassava diet, SE=Standard error of means.

The effect of diets on BW changes of the ewes and litter weight of lambs is shown in table 3. There was no difference in live weight of ewes at the start of experiment. The weight changes of ewes from start to the day before lambing and from start to 24 h after lambing were significantly different. The highest weight gain during the last 8 weeks of pregnancy was obtained from ewes fed JF+CS diet.

During 21 days after lambing, ewes fed the JF+CS and JF+FM diets lost less weight than ewes fed the JF diet, but the differences were not significant. The diets had a significant effect on the litter birth weight but had no effect on the litter weight at 21 days or litter growth rate from birth to 21 days. The highest litter birth weight was obtained from ewes fed JF+CS diet, while there was no difference in litter birth weight between JF and JF+FM diets.

The mortality during the experiment was low: 3 lambs died within 24 h after birth, one in each treatment group. The dead lambs were from twins, triplets and quadruplets. From 24 h to 3 weeks, there was no mortality and no health problems, neither with ewes nor lambs.

DISCUSSION

The present study showed that the foliages had high contents of CP, especially cassava foliage, which contained 20% of CP in DM. This was similar to the result reported by Ravindran and Ravindran (1988), where the CP content of cassava foliage ranged from 19.7-38.1%. However, this was lower than the percentage reported in a study by Phuc (2000), where CP contents of fresh cassava foliage were 23.9-34.7%. This difference can be due to variety and harvesting time, or whether it was fed fresh or dried. Jackfruit and Flemingia in this study had the same DM and CP contents as reported by Mui et al. (2000). In general, the standard errors of means, especially for DM, were quite high, but they were similar to results reported by Mui et al. (2000) under the same experimental conditions. This can be explained by the fact that the number of samples was low and the collecting time for each sample was long. The foliages consumed had higher contents of CP than the foliages offered. This was a result of the selection of leaves and petioles before stems. The intake of the diets with mixed foliages was higher than when Jackfruit was fed as the sole foliage, but only significantly so for the JF+CS diet. This was also shown by Jonasson (1999), and is probably an effect of lower levels of different anti-nutritional substances when feeding a mix of foliages.

The tannins and HCN were not analyzed in this study. However, according to Mui et al. (2000), the content of total tannins in Jackfruit varied between 1.9 and 3.6% of DM in the different plant parts. The Flemingia had a tannin content of around 2.4 to 3.3%. According to Phuc (2000), the HCN content in the dried cassava foliage was 17-86 mg/kg DM depending on plant variety. The quantity of tannins and HCN consumed in the diets was too low to be expected to cause any major intake or health problems.

The higher DM intake of the JF+CS diet resulted in higher ewe weight changes from start to the day before lambing, from start to 24 h after lambing, and higher litter birth weights. There was a positive relationship between ewe weight change during late pregnancy and litter birth weight, which agrees with the results of Ledin (1995) and Charismiadou et al. (1999). O'Doherty et al. (1997) found that DM intake during pregnancy had an effect on growth rate of lambs up to weaning at 14 weeks of age. In this study the pregnancy feeding had no effect on growth rate up to 21 days of age. This may be due to the fact that after lambing all ewes were fed a good quality diet, in which case the pregnancy feeding is less important. According to MAFF (1975), the ME requirement for pregnant ewes of 40 kg BW is 10.8 MJ and 121 g CP, so in this study ewes were able to consume enough to cover their requirements.

The conventional daily diet for pregnant ewes at the Goat and Rabbit Research Center, and the diet which is also recommended to farmers, is 3 kg of guinea grass, 200 g concentrate and 400 g cassava root. This diet gives a daily feed cost of around 2,700 VND (VND=Vietnamese Dong, 1 USD=14,800 VND) which is more expensive than the JF+CS; JF+FM and JF diets (1,800; 1,800 and 2,000 VND, respectively). According to Binh et al. (2000), the average litter birth weight of Phan Rang sheep is 3.2 kg, which is lower than the value in this study.

CONCLUSIONS

Foliage of Jackfruit, Flemingia and Cassava can be used together with other local feed stuffs to formulate diets for pregnant sheep.

The performance of the ewes and lambs was satisfactory and the prices of all experimental diets were lower than for the conventional grass-concentrate diet. The diets with two forage species gave the best results and the best combination in this study was Jackfruit and Cassava foliage.

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