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THE NUTRITIVE VALUE OF *LEUCAENA LEUCOCEPHALA* CV. PERU IN BALANCE AND GROWTH STUDIES WITH GOATS AND SHEEP

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Keywords: Nutritive value, *Leucaena*, Balance, Growth, Goats, Sheep.

RINGKASAN

Keputusan—keputusan mengenai nilai pemakanan *Leucaena leucocephala* (Lam) de Wit cv. Peru ada dibentangkan, hasil dari dua kajian imbangan yang dilakukan ke atas kambing dan biri-biri berserta dengan kajian tumbesaran selama 71 hari dengan menggunakan anak-anak kambing. Kandungan kimia leucaena adalah hampir sama dengan keputusan-keputusan yang telah diterbitkan di India dan Australia. Purata pengambilan bahan kering harian bagi kambing dan biri-biri adalah masing-masing 51.0 – 60.9 g/$W^{0.75}$ kg dan 39.4 – 53.7 g/$W^{0.75}$ kg. Daya hadzam bahan kering, bahan organik, protein kasar dan gentian kasar bagi kambing ialah masing-masing 53.9 – 56.4%, 54.1 – 57.0%, 44.3 – 45.0% dan 38.5 – 64.8% sementara bagi biri-biri pula nilai-nilai ini adalah 50.0 – 50.5%, 51.1%, 40.5 – 46.3% dan 31.2 – 60.2%. Perbezaan di antara spesis ini adalah berkesan ($P<0.05$) kecuali bagi daya hadzam protein kasar. Nilai retensi nitrogen sebagai peratus pengambilan makanan adalah 22.8 – 36.3% bagi kambing dan 8.7 – 18.4% bagi biri-biri. Perbezaan ini adalah berkesan secara statistik ($P<0.05$). Nilai DCP, TDN, DE and ME bagi kambing adalah masing-masing 9.3 – 11.0%, 46.9 – 67.8%, 8.66 – 12.62 MJ/kg dan 7.10 – 10.35 MJ/kg sementara bagi biri-biri pula adalah 9.1 – 10.1%, 46.7 – 54.2%, 8.62 – 10.00 MJ/kg dan 7.07 – 8.20 MJ/kg. Kemasukan 25, 50 dan 75% leucaena di dalam makanan-makanan rumput napier-kekacang merangsang pertambahan berat badan ($P<0.05$) masing-masing sebanyak 24.4, 32.9 dan 55.8 g/hari. Paras leucaena yang tertinggi memberikan pertambahan berat badan yang maksima. Kecekapan pengubahan makanan adalah berhubungan dengan pertambahan berat badan ($r = -0.481$, $P<0.01$). Adalah dicadangkan bahawa paras leucaena sehingga 50% adalah sangat sesuai untuk makanan kambing. Penggunaan yang lebih meluas bagi makanan ini untuk haiwan rumenen di Malaysia ada dibincangkan.

INTRODUCTION

Leucaena leucocephala (Lam) de Wit, commonly called Leucaena or ipil-ipil, is a valuable leguminous forage plant. In recent years it has been cultivated extensively in many parts of South East Asia, notably the Philippines, Latin America and also the West Indies. Its potential value as animal feed has recently been discussed (NATIONAL ACADEMY OF SCIENCES, 1977) with reference to ruminants to whom the forage serves to supply both energy and part of the dietary nitrogen requirements. Leucaena leaves which are rich in xanthophyll (a, pig—ment which colour egg yolks and broiler skins a bright yellow) is a valuable source of pigments for poultry. In Malawi leucaena leaf meal has been shown to induce depression of growth in young chicks (D'MELLO and THOMAS, 1979).

The growing importance of leucaena as an important feed source has prompted a programme of investigation into the introduction, performance and value of the forage to the ruminant in Malaysia. The programme which began in 1974, involved screening of some 76 cultivars from the Philippines. About six of the cultivars appear to be promising, one of which is cv. Peru (known as Peruvian leucaena).

This variety is slightly taller than the Hawaiian cultivar, with larger leaves, flower heads, longer broader pods and larger flatter seeds (SKERMAN, 1977). This cultivar has yielded an average of 5 tons/ha/year of dry matter forage under a bi-monthly cutting

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interval in Serdang, and also gave mean live weight gains of 305 to 351 g/head/day for Kedah-Kelantan cattle on rotational grazing for 40 weeks (WONG, IZHAM and DEVENDRA, 1982). Elsewhere, it is also extensively utilised by ruminants especially in the Philippines, for example as a supplement to rice straw (PEREZ, 1976), Malawi (THOMAS and ADDY, 1977), Mexico (ALVAREZ, WILSON and PRESTON, 1977) and Australia (BLUNT and JONES, 1977; FLORES, STOBBS and MINSON, 1979). With small ruminants however, there appears to be a paucity of effort to assess the comparative value in feeding systems. This paper presents studies on digestibility and growth concerning the intake and utilisation of *L. leucocephala* cv. Peru in goats and sheep.

Despite its growing importance, the fact remains however, that its value as a forage plant for ruminants is as yet, not widespread. The reasons for this are probably associated with the fact that only limited work has been done on its feeding value to ruminants, and secondly, the presence of mimosine, a toxic amino acid which occurs in all parts of the plant. Concentrations of mimosine in the growing tips of the plant may attain a level of up to 12 per cent of the dry matter, in young leaves 3 to 5 per cent, in seeds 4 to 5 per cent and in stems 1 to 2 per cent (JONES, 1979). It is now recognised however, that the toxicity is caused by DHP (3−hydroxy−4−1 (H)−pyridone), a breakdown product of mimosine in the rumen which is a potent goitrogen (HEGEARTY *et al.*, 1976), leading to goitre and reduced thyroxine secretion. The latter is believed to be associated with hair loss.

MATERIAL AND METHODS

(i) Goats and sheep

A total of 8 animals (4 goats and 4 sheep) and 12 animals (6 goats and 6 sheep) were used for the first and second balance trials respectively. The animals were all adult, with an average weight of about 25−26 kg. Indigenous Katjang goats and sheep of Malaysia were used. The techniques of the balance trial were as has been previously described (DEVENDRA, 1975). The animals were drenched regularly as part of normal flock management and were fed twice daily at 0830 and 1500 hours. Forage and water were made available *ad libitum*.

For the growth trial a total of 40 goats (16 males and 24 females) were used. The goats were Kambing Katjang x Etawah crossbreds and about one year of age with a live weight of about 20 to 22 kg. They were allocated to group feeding pens in a well ventilated stilted house which enabled the daily collection of the feed samples and residues. The animals were group-fed with 2 males and 3 females in each pen respectively.

(ii) Treatments

For the digestibility trials mature leucaena forage (leaves plus twigs) from four year old plants were used. The proportion of leaves to stems was approximately in the ratio 60:40. The required amount was harvested, during a two month routine harvesting cycle, dried and used for the duration of the trial (3 weeks each). This work was carried out in Serdang.

The growth trial which ran for 77 days had four treatments replicated twice for males and females in a randomised block design. The treatments were:−

(i) Napier *(Pennisetum purpureum)* grass (Control)
(ii) 75% grass + 25% leucaena
(iii) 50% grass + 50% leucaena
(iv) 25% grass + 75% leucaena

The treatments were designed to provide varying proportions of grass to leucaena ratios in the dry matter to satisfy appetite. No attempt was made to feed 100% leucaena as the sole feed in view of the toxic effects, and more particularly the fact that mixtures of leucaena and other roughages is likely to give better results. The grass was harvested at about 4 to 5 weeks of age. This was based on 3% daily dry matter intake (DMI). The experiment was done in Sungai Siput, Perak. *Table 1* gives the chemical composition of the leucaena used and also that of Napier grass.

TABLE 1: CHEMICAL COMPOSITION OF LEUCAENA FORAGE AND GRASS–LEUCAENA MIXTURES FED TO GOATS
(% dry matter basis)

Constituent	In Serdang		In Sungai Siput				
	Leucaena (Trial 1)	Leucaena (Trial 2)	Leucaena	100%G+	75%G + 25%L++	50%G + 50%L	25%G + 75%L
Dry matter	24.7	20.8	21.6	15.5	16.0	25.0	30.0
Crude protein (N x 6.25)	20.0	25.0	22.8	11.7	18.9	19.3	21.6
Crude fibre	25.3	16.9	18.1	27.9	23.6	22.8	20.0
Ether extract	4.7	5.2	4.2	8.0	6.0	8.0	8.1
Ash	4.1	5.2	9.8	10.9	9.0	8.9	8.0
Nitrogen-free extract	45.9	47.7	45.1	41.5	42.5	41.0	42.3
Gross energy (MJ/Kg)	23.51	18.50	18.5	–	–	–	–
Ca	0.64	0.74	2.6	0.1	0.3	0.9	0.9
P	0.24	0.15	0.6	0.3	0.2	0.5	0.2
Mg	0.18	0.29	0.1	–	–	–	–

+ G : Napier grass *Pennisetum purpureum*
++ L : Leucaena leaves + twigs (approximately 60:40 ratio)

(iii) Parameters

The balance trials were aimed at establishing nutritive value through an assessment of input – output data. The growth trial on the other hand was not only concerned with feed input – output data, but also the measurement of height at withers, body length and heart girth. The goats were also observed for any apparent effect of treatment on the hair covering.

(iv) Chemical analysis

The chemical analysis of feeds and faeces and the techniques employed were those recommended by A.O.A.C. (1971). Dry matter was determined by drying at 102°C for 24 hours, ash by firing at 600°C for 24 hours, protein by the microkjeldahl procedure and crude fibre was determined by successive boiling with alkali and acid. Unfortunately, it was not possible to determine ether extract on the diet and faeces samples. Ca and Mg was determined by titration and P was determined as mulybdate by colourimetry. Gross energy was determined by using an adiabatic bomb calorimeter (Gallenkamp, London). Urine was collected in polythene bottles containing 100 ml of 18N$-H_2SO_4$ to reduce N losses (MARTIN, 1966) and approximately 100 ml aliquots of the daily production was bulked for chemical analyses.

(v) Statistical analysis

The analysis of variance of the data was carried out as described by SNEDECOR (1965) and included the method of least significant difference between means.

RESULTS

(i) Chemical composition

The data on chemical composition indicates that the leucaena forage had between 20 to 25% crude protein and between 16.9 to 25.3% crude fibre. The relatively lower nutritive value of leucaena in the second trial was due to a higher proportion of leaves in the material. The chemical composition of Napier grass was comparable to other published values for the same grass (DEVENDRA 1979a).

(ii) Balance trials

Table 2 presents the voluntary feed

TABLE 2: VOLUNTARY FEED INTAKE OF LEUCAENA
(Digestibility trials)

Parameter	Goats	Sheep	t–value
Trial 1			
Mean fresh intake (g/day)	734.3	632.5	28.7*
Dry matter intake (g/day)	699.3	602.4	27.6*
DMI as % of L.W. (%)	2.7	2.4	3.1*
DMI/$W^{0.75}$kg (g/day)	60.9	53.7	5.7*
Relative intake+	73.1	65.6	8.7*
Trial 2			
Mean fresh intake (g/day)	603.4	476.7	2.1 N.S.
Dry matter intake (g/day)	570.3	450.6	2.1 N.S.
DMI as % of L.W. (%)	2.3	1.8	2.89*
DMI/$W^{0.75}$kg (g/day)	51.0	39.4	2.96*
Relative intake+	74.9	60.6	1.54*

+ Relative intake $= \dfrac{\text{Observed intake}}{80 \times W^{0.75}\text{kg}} \times 100$

* $P<0.05$

N.S. – Not statistically significant

intake data for Trial 1 and 2. There were statistically significant differences between goats and sheep in dry matter intake ($P<0.05$) only in trial 1. Goats ate more per unit metabolic weight compared to sheep in both trials. The DMI/$W^{0.75}$kg/day for goats and sheep were 51.0 to 60.9 and 39.4 to 53.9 g in trials 1 and 2 respectively.

Tables 3 and *4* presents the apparent digestibility coefficients for the forage for Trials 1 and 2. There were statistically significant differences in Trial 1 for the apparent digestibility of dry matter, organic matter, crude fibre and nitrogen-free extract. In trial 2, there were no differences between goats and sheep in apparent digestibility.

TABLE 3: MEAN APPARENT DIGESTIBILITY COEFFICIENTS BY GOATS AND SHEEP WHEN FED LEUCAENA (TRIAL I)
(Each value is the mean of 4 animals)

Constituent	Goats	Sheep	t–value
Dry matter	53.9	50.5	N.S
Organic matter	54.1	51.1	N.S
Crude protein	45.0	46.3	N.S
Crude fibre	38.5	31.2	N.S
Ether extract	14.8	11.6	N.S
Nitrogen-free extract	68.5	67.3	N.S
Ash	48.9	40.1	N.S
Energy	46.8	46.6	N.S

N.S – Not statistically significant.

TABLE 4: MEAN APPARENT DIGESTIBILITY COEFFICIENTS BY GOATS AND SHEEP WHEN FED LEUCAENA (TRIAL 2)
(Each value is the mean of 4 animals)

Constituent	Goats	Sheep	t–value
Dry matter	56.4	50.0	3.28*
Organic matter	57.0	51.1	3.29*
Crude protein	44.8	40.5	N.S
Crude fibre	64.8	60.2	1.22*
Ether extract	36.3	10.5	N.S
Nitrogen-free extract	59.5	50.1	5.37**
Ash	45.4	32.7	N.S
Energy	53.7	42.5	4.80

* – $P<0.05$
** – $P<0.11$
N.S – Not statistically significant

(iii) Nitrogen balance

The assessment of digestibility enabled nitrogen balance to be calculated *(Table 5)*. It was found that both trials, goats significantly ($P < 0.05$) utilised the nitrogen (N) in leucaena much better than sheep. This was reflected in relatively higher N retention values of between 22.8 and 36.3 for goats compared to 8.7 and 18.4 for sheep in Trials 1 and 2 respectively.

TABLE 5: NITROGEN BALANCE DATA

Parameter	Goats	Sheep	t–value
Trial 1			
Nitrogen intake (g/day)	23.2	20.6	6.88**
Nitrogen in faeces (g/day)	12.1	11.9	N.S
Nitrogen in urine (g/day)	5.8	6.9	N.S
Balance (g/day)	5.3	1.8	2.58*
Apparent digestibility (%)	47.8	42.2	N.S
N retention as % of intake	22.8	8.7	1.34**
Trial 2			
Nitrogen intake (g/day)	20.2	17.4	N.S
Nitrogen in faeces (g/day)	11.0	9.4	N.S
Nitrogen in urine (g/day)	1.9	4.8	1.45*
Balance (g/day)	7.3	3.2	2.42*
Apparent digestibility (%)	45.5	46.0	N.S
N retention as % of intake	36.3	18.4	2.34

* – P<0.05
** – P<0.11
N.S – Not statistically significant

(iv) Growth trial

Table 6 summarises the effect of dietary treatments on daily live weight gain and feed efficiency. The effect of increasing level of leucaena stimulated increased live weight gain consistently, and was highest (55.8g/day) for 25% grass + 75% leucaena. Treatments did not however exert any differences on sex and also on DMI. However, there were statistically significant effects on feed efficiency ($P<0.01$) between the control (grass) and leucaena diets, which improved with increasing level of leucaena. It was best for the 25% grass + 75% leucaena treatment. Between leucaena treatments however, there were no significant differences. *Figures 1* and *2* illustrate the growth rates and feed efficiencies by treatments.

Treatments did not have any effect on the body measurements namely, height at withers, heart girth and body length; the mean values for both sexes for each of these parameters is indicated in *Table 7.*

The opportunity was taken to correlate live weight change with feed efficiency, height at withers, heart girth and body length. It was found that only live weight change and feed efficiency were correlated ($r = -0.481$, $P<0.01$).

TABLE 6: EFFECT OF VARYING DIETARY LEVELS OF LEUCAENA ON GROWTH PERFORMANCE
(Each value is the mean of 10 goats)[+]

Parameter	100%G[+]	75%G + 25%L[+++]	50%G + 50%L	25%G + 75%L
Initial live weight (kg)	12.2	10.1	10.1	10.2
Final live weight (kg)	12.8	12.0	12.6	14.5
Live weight change (kg)	0.6	1.9	2.5	4.3
Mean live weight (kg)	12.5	11.1	11.4	12.4
Daily live weight gain (g/day)	11.7a*	24.4a	32.9ab	55.8c
DMI/day (g)	393.9	404.9	505.3	550.3
DMI/$W^{0.75}$kg/day (g)	59.7	66.4	44.3	83.4
DMI as % L.W. (%)	3.4	4.0	4.8	4.7
Feed efficiency (g DMI/g gain)	30.3a	17.1b	15.9b	11.5b

\+ – Results refer to the mean value for males and females
++ – Napier grass *P. purpureum*
+++ – *Leucaena leucocephala*
* – Means on the same line with different italicized letters differ significantly ($P<0.05$)

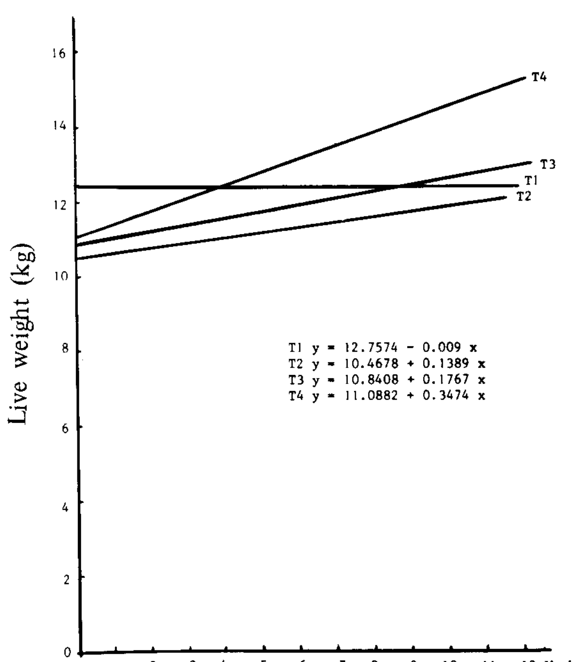

Figure 1: Weekly liveweight response to treatments (Males and females combined)

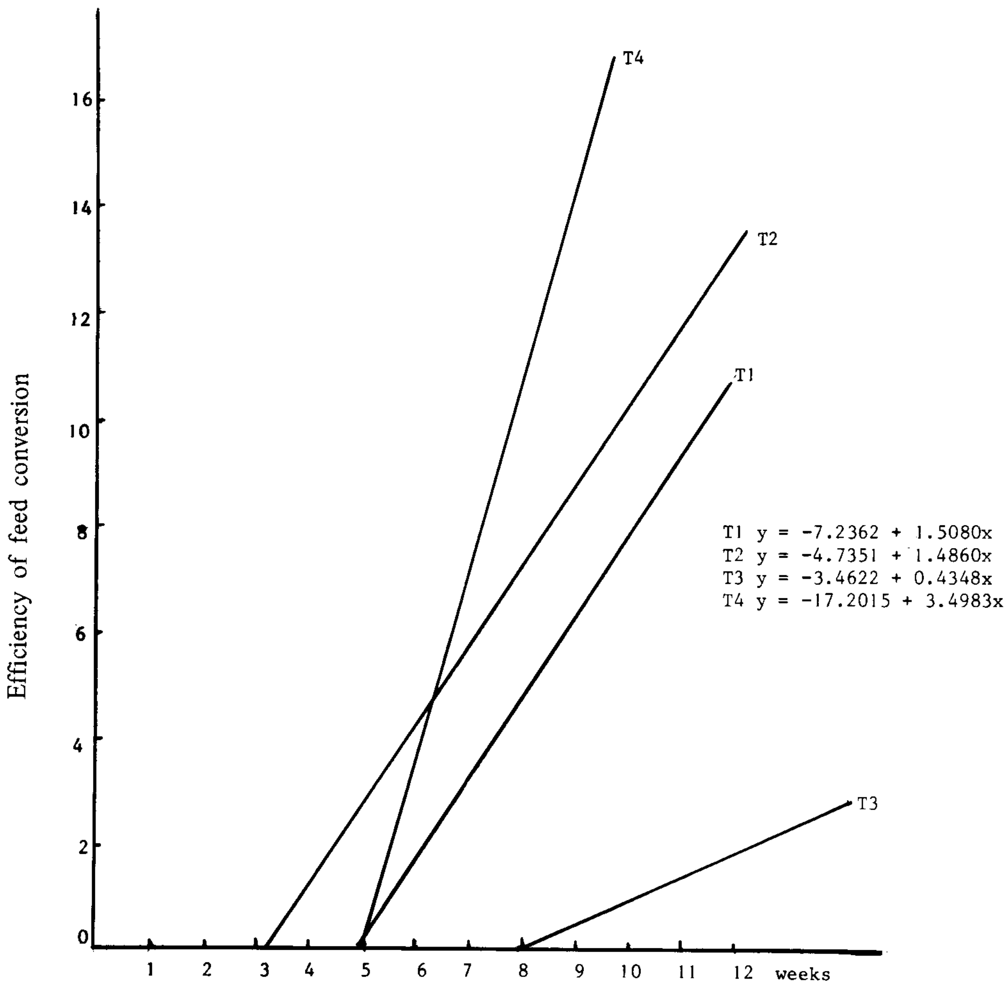

Figure 2: Effect of treatment on efficiency of feed conversion in goats

TABLE 7: EFFECT OF VARYING DIETARY LEVELS OF LEUCAENA ON BODY MEASUREMENTS
(Each value is the mean of 10 goats)$^{+}$

Parameter	100%G^{++}	75%G + 25%L^{+++}	50%G + 50%L	25%G + 75%L
Height at withers (cm)	5.89a*	5.65a	5.75a	6.01a
Heart girth (cm)	5.84a	9.02a	9.61a	10.79a
Body length (cm)	7.98a	7.78a	6.50a	7.65a

\+ – Results refer to the mean value for males and females
++ – Napier grass *P. purpureum*
+++ – *Leucaena leucocephala*
* – Means on the same line with different italicized letters differ significantly (P<0.05)

TABLE 8: NUTRITIVE VALUE OF LEUCAENA FORAGE

Parameter	Goats	Sheep
Trial 1		
Digestible crude protein (DCP, %)	9.3	9.1
Total digestible nutrients (TDN, %)	67.8	54.2
Digestible energy (MJ/Kg)	12.62	10.00
Metabolisable energy (MJ/Kg)	10.35	8.20
Trial 2		
Digestible crude protein (DCP, %)	11.0	10.1
Total digestible nutrients (TDN, %)	46.9	46.7
Digestible energy (MJ/Kg)	8.66	8.62
Metabolisable energy (MJ/Kg)	7.10	7.07

(v) **Nutritive value**

The nutritive value of the forage for goats and sheep *(Table 8)* indicates that, consistent with the balance data, the feed was of a higher value for goats. This is reflected in the DCP and ME values.

DISCUSSION

The chemical composition of leucaena reported here is approximately similar to data published elsewhere. The crude protein (20.0 to 25.0% in the dry matter value) for example is comparable to data published in India (UPADHAY, REKIB and PATHAK, 1974) and Australia (FLORES, STOBBS and MINSON, (1979). The mineral content was lower compared to the figures published by the latter.

The data on voluntary intake of leucaena and grass-leucaena mixtures are interesting. During the balance trials, the goats had an average DMI of between 51.0 to 60.9 g/$w^{0.75}$ kg compared to lower values of 39.4 to 53.7 g/$W^{0.75}$ kg for sheep. These corresponded to 2.3 to 2.7 and 1.8 and 2.4% DMI as percentage of body weight. The DMI values per unit metabolic live weight are smaller to the values of 58 to 85 g/$W^{0.75}$ kg reported by UPADHAY, REKIB and PATHAK (1974) and JONES, BLUNT and HOLMES (1976). The lower value for sheep is similar to values reported for *Centrosema pubescens* in Nigeria (MILLER and RAINS, 1963).

When leucaena was added to a grass diet in increasing levels, there was an increased intake in total DMI, the largest intake being recorded for the 25% grass + 75% leucaena mixture, equivalent to 83.4 g/$W^{0.75}$ kg *(Table 6)*. This increase in DMI compared to grass approximated to 39.7%. The increased DMI was brought about by the increased dietary protein supply since it is known that the protein content of tropical pastures is generally lower than that of temperate species (FRENCH, 1957; MINSON, 1976). Thus for example in Australia, Jersey cows grazing nitrogen-fertilized *Chloris gayana* cv. Pioneer regrowth pastures containing 18% crude protein and given 0, 2 or 4 kg/day fresh leucaena increased the intake of digestible organic matter from 5.7 kg/day to 6.0 and 6.5 kg/day with leucaena supplements. This in turn stimulated increased milk yield significantly ($P<0.001$).

The digestibility of leucaena forage was approximately similar for both trials. The digestibility of dry matter for goats was 53.9 to 56.4% and organic matter 54.1 to 57.0%.

The values for sheep were somewhat lower. The values for the digestibility of dry matter in the present study are however lower then the value of 71.4% reported by UPADHAY, REKIB and PATHAK (1974) in India. The organic matter digestibility reported here is also lower compared to 63% reported for leucaena in Australia (FLORES, STOBBS and MINSON, 1979). The lower values in the present study are due to the use in the Indian and Australian studies of a high proportion of leafy material. The high digestibility for cellulose is similar to results reported for pigeon pea forage (DEVENDRA and CHEE, 1979) and bagasse (DEVENDRA, 1979b). It is characteristic of the species (DEVENDRA, 1978).

The nitrogen balance data for both balance studies indicated that goats were significantly more efficient ($P<0.05$) in the retention of nitrogen than sheep *(Table 4).* The higher N retention capacity by goats in comparison to sheep, and ability by goats to retain between 22.8 to 36.3%, and sheep between 8.7 to 18.4% of N merit some comment. Firstly, it could well be that goats use the N in the forage move efficiently than do sheep, and similar evidence was also previously reported for pigeon pea forage (DEVENDRA and CHEE, 1979). The second point is speculative in that the capacity to retain feed N could be associated with reduced degradability in the rumen. This means that much more of the N, undegraded in the rumen by-pass it and is made available for more complete utilization posterior to the rumen. There is very little data or information to support this point, but this does serve to emphasize the need for a lot more investigations and research on how N in leucaena is utilized by the ruminant. This includes ammonia concentrations in rumen fluid, rate of uptake for microbial synthesis, and the amino acid profile. The issue is one of importance in that this understanding will go a long way to promote increased use of leucaena as a source of N in feeding system for ruminants.

The minimum protein requirements for maintenance of Katjang goats was determined to be 1.41 g DCP/$W^{0.75}$ kg (DEVENDRA, 1980a). For a goat with a body weight of 30 kg, this is equivalent to daily requirement of 18.2 g. Using the NRC data (N.R.C., 1981), the protein requirements of a goat weighing 30 kg, for maintenance plus medium activity and a growth rate of 50 g/day, is 62 g/day. Considering the balance data in *Table 5* and DMI values in *Tables 6,* this requirement will be achieved with 50% leucaena forage in the diet. This conclusion is also supported by the study of growth performance in goats *(Table 6).*

The nutritive value of leucaena forage in the present study can be comparable to data reported for the aerial part of the same plant by MCDOWELL *et al.*, (1974). The DCP value for goats in the present study (9.3 to 11.0%) are lower than the 17.2% for goats and 17.5% for sheep reported by them. The DE content of 7.07 to 8.20 MJ/kg for sheep found in the studies reported are also lower to the values of 9.21 MJ/kg reported by MCDOWELL *et al.*, (1974). The lower values are due to strain differences and also the fact that in the present study leaves plus twigs were used.

The growth studies indicated that increasing levels of dietary leucaena stimulated increased growth rate *(Table 6),* with a maximum inclusion of 75% in the diet. At this level, it was observed that the hair of goats were affected, with a distinct tendency for some, but not all of it, to fall. This point has also been noted for goats in Australia (JONES, 1979). On the other hand, there are some reports that goats are unaffected (KRANVELD and DJAENOEDIN, 1947; OWEN, 1958). No concurrent studies were made on possible effects on the reproductive system although BINDON and LAMOND (1966) reported that pregnant ewes fed *ad libitum* leucaena from 30 to 90 days post-coitus produced lambs of low birth weight and low vaibility. ABILAY and ARINTO (1981) has reported in feeding trials with leucaena that there were no deleterious effects on reproductive performance of goats fed up to 75% leucaena in the Philippines; this point confirms the data presented in this study. Both studies implicate high levels of leucaena utilisation by goats.

For practical feeding purposes therefore, based on the performance data as well as calculations of requirements, it is concluded that a level of up to 50% is suitable. There is no advantage in feeding levels higher than this. This level is higher than the 30% level advocated by JONES (1979) for steers, but is justified because of the greater apparent tolerance by goats. This is probably associated with the rumen micro-organisms of goats which have been shown to reduce the mimosine content in leucaena tips from 6.0 to 0.3 mg/g in 25 hours and, when pure mimosine was used 98% was degraded in five hours (SHIROMA and AKASHI, 1976). In Indonesia, WAHYUNI *et al.*, (1981) have shown that 60% dietary leucaena gave the best weight gain and feed efficiency in Ongole crossbred cattle.

Very much more needs to be known about the usefulness of leucaena forage as an energy and protein source, especially the latter. These can be achieved from continuing studies of intake and utilization especially in large scale feeding trials as well as from studies on metabolism. Associated with these, there is also a need for more information of the toxic compound mimosine, especially in relation to possible side effects. In view of this product, some caution is necessary in utilising high dietary levels for ruminants. It is also important to feed the leucaena gradually to encourage adaptation and minimise any toxic problems and side effects.

The results together demonstrate that leucaena represents an important forage potential for ruminants. Presently only limited amounts are being utilized for animals in Malaysia, partly for reason of small scale cultivation of the crop, and partly because of inadequate knowledge on its potential feeding value for ruminants. Clearly, much more can be done to encourage wider cultivation and concurrent utilization for ruminants especially in the rural areas where dietary proteins are often in short supply. With small ruminants, and as the results suggest, the more intensive utilization of leucaena is an attractive proposition in South East Asia (DEVENDRA, 1980b).

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SUMMARY

The results are presented on the feeding value of *Leucaena leucocephala* (Lam) de Wit cv. Peru based on two balance studies with goats and sheep, in addition to a growth study over 71 days with kids. The chemical composition of leucaena was similar to results published in India and Australia. Goats had an average daily DMI of 51.0 to 60.9 g/$W^{0.75}$ kg and sheep 39.4 to 53.7 g/$W^{0.75}$ kg. The digestibility of dry matter was 53.9 to 56.4%, organic matter 54.1 to 57.0%, crude protein 44.8 to 45.0% and crude fibre 38.5 to 64.8% for goats. The corresponding values for sheep were 50.0 to 50.5%, 51.1%, 40.5 to 46.3% and 31.2 to 60.2% respectively; excepting for the digestibility of crude protein, only in trial 1 were between species significant ($P<0.05$). Nitrogen retention data gave values of 22.8 to 36.3% as percentage of intake for goats and 8.7 to 18.4% for sheep; the differences were significant ($P<0.05$). The nutritive value was DCP 9.3 to 11.0 and 9.1 to 10.1%, TDN 46.9 to 67.8 and 46.7 to 54.2%, DE 8.66 to 12.62 and 8.62 to 10.00 MJ/Kg and ME 7.10 to 10.35 and 7.07 to 8.20 MJ/Kg for goats and sheep respectively. 25, 50 and 75% leucaena in Napier grass-legume diets significantly stimulated ($P<0.05$) 24.4, 32.9 and 55.8 g/day increased live weight gain; the highest dietary leucaena level gave maximum gain. Feed efficiency was correlated with increased live weight gain ($r = -0.481$, $P<0.01$). It is suggested that up to 50% dietary leucaena level is suitable for goats. The wider use of the forage for feeding ruminants in Malaysia is discussed.

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