



UNIVERSITI PUTRA MALAYSIA

**COMPARATIVE STUDIES ON DIGESTIVE EFFICIENCY
AND UREA KINETIC BETWEEN GOAT AND SHEEP**

DARLIS

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MASTER OF SCIENCE

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**COMPARATIVE STUDIES ON DIGESTIVE EFFICIENCY
AND UREA KINETIC BETWEEN GOAT AND SHEEP**

By

D A R L I S

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**COMPARATIVE STUDIES ON DIGESTIVE EFFICIENCY AND
UREA KINETIC BETWEEN GOAT AND SHEEP**

BY

DARLIS

SEPTEMBER, 1995

Chairman : Assoc. Prof. Dr. Norhani Abdullah

Faculty : Veterinary Medicine and Animal Science

A study was conducted to compare the digestive efficiency and urea kinetics between Malaysian indigenous goats and sheep fed rice straw + soybean meal (SSB) and rice straw + soybean meal + sago (SSG).

The Dry Matter (DM), Nitrogen (N), Organic Matter (OM) and Energy (E) intakes in goats and sheep were similar when fed SSB diet, but with SSG diet, DM intake of goats was higher than sheep, while no significant differences in N, OM and E intakes were observed.



With SSB diet, goats could digest ADF significantly ($P < 0.05$) more than sheep, but sheep showed higher ($P < 0.05$) digestibility values for Crude Protein (CP), OM and E than those of goats. However, with SSG diet only digestibility values for E were significantly different between the two animal species.

Potential degradability for DM and NDF of straw were higher ($P < 0.05$) in goats than sheep when fed SSB diet. However, goats had lower values ($P > 0.05$) in N potential degradability of Soybean Meal (SBM) than sheep.

Studies in rumen fluid parameters showed that ammonia concentration was higher in sheep (382.89 ± 33.76 mg N/l) than goats (363.24 ± 43.42 mg N/l), while pH and total Volatile Fatty Acid (VFA) concentrations were similar between the two species when fed SSB diet. The molar proportion of acetate in goats was higher ($79.13 \pm 2.95\%$) than that in sheep ($75.84 \pm 3.91\%$), but the reverse was true for molar proportion of propionate where the values obtained for sheep and goats were $15.57 \pm 2.40\%$ and $17.96 \pm 2.72\%$, respectively. No significant difference in molar proportion of butyrate was observed between the two animal species.



With SSG diet, a higher concentration of ammonia was exhibited by goats (310.97 ± 40.52 mg N/l) than by sheep (282.48 ± 28.42 mg N/l). Goats also had a higher proportion of acetate ($77.65 \pm 3.22\%$) than sheep ($73.96 \pm 2.43\%$), but the proportion of butyrate was lower in goats ($7.24 \pm 1.02\%$) than in sheep ($9.59 \pm 2.27\%$).

There were no significant differences in the dilution rate constant, rumen volume, pool size of small particles (based on bodyweight), mean retention time on both liquid and solid between the two animal species.

The bacterial population in the rumen of sheep was found to be higher than that of goats, but the protozoal population was observed to be similar between the two animal species fed SSB and SSG diets.

Concentration of plasma urea N, urea N synthesis rate, urea N degradation rate, fraction of urea C from blood to the rumen and urea excretion in the urine were found to be similar between the two species of animal fed both SSB and SSG diets.

The results of the present study indicate differences in digestion between goats and sheep. However, the results in the rumen fermentation, solid and liquid flow rate and urea metabolism could not explain fully why differences between the two species exist.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia
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**KAJIAN PERBANDINGAN MENGENAI KECEKAPAN
PENGHADAMAN SERTA KINETIK UREA
DI ANTARA KAMBING DAN BEBIRI**

OLEH

DARLIS

SEPTEMBER, 1995

Pengerusi : Prof. Madya. Dr. Norhani Abdullah

Fakulti : Kedokteran Veterinar dan Sains Peternakan

Kajian ini telah dijalankan untuk membandingkan kecekapan penghadaman dan kinetik urea antara kambing dan bebiri baka Malaysia yang diberi makan jerami padi + meal kacang soya (SSB) atau jerami padi + meal kacang soya + sagu (SSG).

Pengambilan bahan kering (DM), nitrogen (N), bahan organik (OM), dan tenaga (E) oleh kambing dan bebiri adalah sama bila diberi makan SSB, Bila diberi makan SSG pengambilan DM pada kambing lebih tinggi daripada bebiri manakala tidak ada perbezaan yang ketara untuk pengambilan N, OM dan E.



Dengan makanan SSB, kambing dapat menghadapi ADF lebih tinggi daripada bebiri, manakala bebiri lebih tinggi berbanding kambing dalam penghadaman protein kasar (CP), bahan organik (OM) dan tenaga (E). Manakala, dengan makanan SSG hanya penghadaman E nyata berbeza antara kedua spesies haiwan tersebut.

Potensi degradasi DM dan NDF jerami padi lebih tinggi daripada kambing berbanding bebiri bila diberi makan SSB. Manakala, kambing lebih rendah nilainya berbanding bebiri untuk potensi degradasi nitrogen dari meal kacang soya.

Kajian terhadap ciri cecair rumen memperlihatkan bahawa kepekatan amonia lebih tinggi daripada bebiri (382.89 ± 33.76 mg N/l) berbanding kambing (363.24 ± 43.42 mg N/l), manakala pH dan jumlah kepekatan asid lemak meruap (VFA) adalah sama di antara kedua spesies haiwan bila diberi makan SSB. Jumlah molar asetat lebih tinggi pada kambing ($79.13 \pm 2.95\%$) berbanding bebiri ($75.84 \pm 3.91\%$), tetapi sebaliknya dilihat untuk molar propionat di mana nilai yang diperolehi untuk kambing dan bebiri adalah ($15.57 \pm 2.40\%$) dan ($17.96 \pm 2.72\%$) masing-masing. Hasil kajian menunjukkan tidak ada perbezaan dalam jumlah molar butirata antara kedua spesies haiwan.

Dengan makanan SSG, kepekatan ammonia didapati lebih tinggi daripada kambing (310.97 ± 40.52 mg N/l) berbanding bebiri (282.48 ± 28.42 mg N/l). Kambing juga mengandungi peratusan molar asetat ($77.65 \pm 3.22\%$) lebih tinggi berbanding bebiri ($73.96 \pm 2.43\%$), tetapi nilai butirrat lebih rendah pada kambing ($7.24 \pm 1.02\%$) berbanding bebiri ($9.59 \pm 2.27\%$).

Tidak ada perbezaan di antara kedua spesies haiwan dalam kelajuan pengaliran cecair dan butir-butir kecil digesta daripada rumen, isi padu bendalir, saiz gembeleng (pool size) butir-butir kecil digesta rumen (berdasarkan pada berat badan), dan min waktu penyimpanan (MRT).

Populasi bakteria campuran pada rumen bebiri didapati lebih tinggi berbanding kambing, sedangkan populasi protozoa adalah sama di antara kedua spesies haiwan bila diberi makan SSB atau SSG.

Kepekatan N urea plasma, kadar sintesis N urea, kadar degradasi N urea, pemindahan C urea daripada darah ke rumen dan urea yang dikumuhkan pada urin didapati sama antara kedua spesies haiwan yang diberi makan SSB atau SSG.

Keputusan yang diperolehi daripada kajian ini menunjukkan adanya perbezaan dalam proses penghadaman di antara kambing dan bebiri. Tetapi,

data yang diperoleh dari fermentasi rumen, pengaliran cecair rumen dan butir-butir kecil digesta dari rumen dan metabolisme N urea tidak dapat memberi penerangan sepenuhnya terhadap perbedaan penghadaman di antara kedua spesies hewan tersebut.

CHAPTER I

INTRODUCTION

Goats and sheep are the most important groups of small ruminants in tropical agriculture. They produce meat, milk, wool and fiber. In the Asian countries the indigenous goats and sheep are valued for their meat (Devendra and Coop, 1982).

The indigenous goats and sheep in Malaysia are known as kambing katjang and Malin, respectively, and they are usually reared on small farms where the emphasis is on intensive crop production. Fibrous residues from the crops are important feed materials for goats and sheep. The animals provide a means of converting the residues into useful animal products.

Goats and sheep have distinct characteristics and grazing behaviour. Sheep are grazing animals whereas goats prefer to browse. The relative productivity of the two species depends upon the ecotypes involved (Wilson, 1982). Each species exhibits many different ecotypes, but only a few have been studied for their actual and potential productivity in all the relevant traits such as fertility, growth rate and carcass characteristics (Fitzhugh, 1987).



Several comparative studies between goats and sheep indicated that there are differences in the ability of these two species in digesting various feeds. Earlier studies using low-quality roughage have shown that goats are better than sheep in the digestibility of most nutrients including fiber (Devendra, 1977; Gihad *et al.*, 1980). The reason for the difference in the digestibility between these two species is not fully understood. There is thus a need to conduct comparative evaluation on the rumen activities of these two species in order to compare their digestive abilities.

The objective of this study is to determine whether goats and sheep differ in their digestive efficiencies. To achieve this objective, a series of experiments were carried out to measure nutrient intake, *in vivo* and *in situ* digestion rates, liquid and solid out flow rates, rumen liquid characteristics (ammonia, pH, total VFA, acetate, propionate and butyrate), microbial population (bacteria and protozoa) and urea kinetics of the two animal species.

CHAPTER II

LITERATURE REVIEW

Goat and Sheep Production

Goats and sheep belong to the tribe caprini of the family Bovidae in the suborder Ruminantia and the order Artiodactyla. They are typical cloven-hoofed ruminants of relatively small size. The tribe caprini comprises of five genera. The goats belong to two of these genera, the Capra and Hemitragus, the sheep belong to the genus Ovis, while the goat-like sheep or sheep-like goat belong to the other two genera, Ammotragus and Pseudois, respectively (Wilson, 1991). Goats and sheep have spread all over the continents and inhabit almost all climatic zones, from the arctic circle to the equator (Gall, 1981).

Devendra and Coop (1982) reported that, nearly 80% of all goats are found within the latitude 0-40⁰ N, in the arid tropical and sub tropical regions. The majority lives in the belt from Bangladesh through India, Iran and Turkey to the Mediterranean countries and in Africa around Ethiopia and the Sahel. Within the tropics, there are more sheep than goats in the highland ecozones of the semi arid areas in east and north



Africa, but they are of approximately equal number to the goats in the Sahel. Goats are more important in the humid tropics such as Southern India, South East Asia, West Africa and the Caribbean.

This indicates that goats are predominantly found in the drier areas, because these areas contain a wide variety of plants, shrubs and trees, which provide a diverse supply of feed for animals at different times of the year. Goats are adaptable; they graze when grasses are lush and abundant and browse the leaves and trees when the supply of grasses is sparse. This contrasts with sheep which graze almost exclusively on grasses (Wilkinson and Stark, 1987).

The goats and sheep are valued for their meat, milk, and fiber. Goats contribute 16.6%, 13.1% and 16.9% of the total world production of meat, milk and fresh skin respectively, while sheep produce 8.2%, 12.2% and 4.4% of the total world output of meat, milk and wool (Devendra, 1986). In the western countries, goats are mainly reared as dairy animals, but in most Asian and African countries, goats are considered almost exclusively as meat animals. In the developing countries the proportion of total income from goats coming from meat is very high, about 70 to 80%, with the remaining 20 to 30% from milk (Gall, 1981).



In Malaysia, goats and sheep production is mostly carried out by smallholders where the animals are kept in small flocks. They are reared primarily for mutton (Rajion *et al.*, 1993). On the average, sheep production (for mutton) has increased about four fold during the last 10 years. The production from goats and sheep are 283 and 125 tons per year, respectively (Table 1).

Table 1
Goats and Sheep Production in Malaysia

Year	Goat	Sheep
1981	309.22	64.78
1983	274.49	59.73
1985	273.59	78.31
1987	269.11	128.38
1989	283.24	181.00
1991	288.52	234.90

Source: Department of Veterinary Service (1992).

The goats reared in Malaysia are the indigenous kambing katjang. This breed is also found in Burma, Thailand, Indonesia, Philippines and

Taiwan (Mason, 1981). Devendra and McLeroy (1982) described the kambing katjang from Malaysia as follows: they have short horn, while the ears are short and erect. The colour is usually black, but sometimes with a few white patches. The average height of this small-built goat at withers is 56-65 cm. The average birthweight is 1.5 kg and the adult weights are 25 kg for males and 20 kg for females. This prolific breed is very hardy, well adapted to the humid environment and reared mainly for meat.

According to Rajion *et al.* (1993) the sheep population in Malaysia is made up of the indigenous breed, Malin. The Malin, which is small-built and has a mixture of hair and long wool in assorted colours of white, brown or black is considered indigenous to Malaysia, although it may have originated from the sheep in Tibet via the Yunan province in China. The average height at wither is 46.7 cm and the adult weight is 25-30 kg for males and 20-25 kg for females.

Agricultural By-Products as Feed Material for Ruminant Animals

Fibrous agricultural residues represent a valuable potential source of ruminant feed in many Asian countries. Kossila (1985) estimated that Asia produces approximately 1,628,882 tons of fibrous crop residues, which