UNIVERSITI PUTRA MALAYSIA

MORPHO-PHYSIOLOGICAL STUDIES ON THE DIGESTIVE TRACT OF THE MOUSEDEER (*Tragulus javanicus*)

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MORPHO-PHYSIOLOGICAL STUDIES ON THE DIGESTIVE SYSTEM OF THE MOUSEDEER

(Tragulus javanicus)

By

HAWA BT ISMAIL

Thesis Submitted in Fulfilment of the Requirements
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Dedicated to my daughter, Nasreen

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LIST OF ABBREVIATIONS

BL	body length
BW	body weight
cm	centimeter
Co	cobalt
Co-EDTA	Cobalt-ethylenediamine Tetraacetic Acid
CS	concentrate selectors/selective feeders
Cr	chromium
^0C	degrees centigrade
g	gram
GR	grazers/roughage eaters
h	hour
IM	intermediate feeders
kg	kilogram
L	liter
M	meter
mg	milligram
ml	milliliter
mm	millimeter
MRT	mean retention time
%	percent
SEM	scanning electron microscope
VFI	voluntary feed intake

Abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in fulfilment of the requirements for the degree of Master of Science.

MORPHO-PHYSIOLOGICAL STUDIES ON THE DIGESTIVE SYSTEM OF THE MOUSEDEER *(Tragulus javanicus)*

By

Hawa Bt Ismail

June 1995

Chairman : Assoc. Prof. Dr. Mohamad Hilmi Hj. Abdullah

Faculty : Veterinary Medicine and Animal Science

Although the mousedeer (*Tragulus javanicus*) is considered a ruminant, its stomach comprises of three compartments only namely, rumen, reticulum and abomasum. Few published work on the digestive system of this animal are in isolated areas. As it is becoming more important as a laboratory ruminant model, the present study will provide additional and more comprehensive information on the animal, particularly on the morpho-physiology of its digestive tract. This study assists in the comparison of mousedeer with other ruminants and attempts to classify it in the most appropriate category of ruminants.

Morphological study and distribution of lingual papillae showed that the mousedeer has a tongue similar to that of a pig which is a non-ruminant. However, it is still considered a ruminant because it has a compound stomach where the omasum is under developed.

Studies on the shape, weight and locations of the parotid and mandibular salivary glands showed that the glands were similar to those of ruminants which were concentrate selectors. The parotid gland weighed 3.0±0.5g and 2.6±0.2g in the males and females, respectively, whereas the mandibular gland weighed 1.6±0.3g in the males and 1.4±0.3g in the females. The mean surface area of the rumen was 77.7±1.0% of the stomach surface area, 11.4±0.5% for the reticulum and 10.9±0.9% for the abomasum. The mean volume of the rumino-reticulum was 96.2±0.2% of the stomach volume whereas for the abomasum it was 3.8±0.2%. The ratio of the length of the small intestine to body length was 5.8±0.7:1, the length of large intestine to body length was 2.4±0.2:1 and the total intestinal length to body length was 8.2±0.9:1

In another part of this study, the apparent digestibility coefficient of Lundai and a commercial pellet diet were found to be 77.4±2.6% and 65.5±3.4% respectively. The dry matter (DM) intake was 49.0±5.3g DM/kg body weight when Lundai was given and 52.0±1.4g DM/kg body weight when pellet was given. The mean retention times (MRT) of food particles were 48.3±1.6 h and 24.9±0.6 h when fed Lundai and pellet, respectively. The MRT for fluid food were 14.8±2.0 h when fed Lundai

and 12.3±0.9h when fed pellet.

Except for the tongue and food passage rate, the results of the study indicate that the mousedeer is a concentrate selector. However, the passage rate of food particle was slow, which is not typical of a ruminant of this small body size. Therefore, further studies on the rate of passage using a more reliable marker should be carried out.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi syarat keperluan penganugerahan ijazah Master Sains.

KAJIAN MORFO-FISIOLOGI TERHADAP SISTEM PENCERNAAN PELANDUK *(Tragulus javanicus)*

Oleh

Hawa Bt Ismail

Jun 1995

Pengerusi : Prof. Madya Dr. Mohamad Hilmi Hj. Abdullah
Fakulti : Kedoktoran Veterinar dan Sains Peternakan

Walaupun pelanduk dianggap ruminan perutnya terdiri daripada tiga bahagian, rumen, retikulum dan abomasum sahaja. Beberapa kajian yang diterbitkan mengenai sistem penghadaman haiwan ini terdapat dalam bahagian berasingan. Oleh kerana haiwan ini semakin mendapat perhatian sebagai model ruminan di makmal, kajian ini dapat memberi maklumat tambahan dan huraian terperinci mengenainya terutamanya mengenai morfo-fisiologi saluran penghadaman. Di samping itu kajian ini juga dapat membantu membandingkan pelanduk dengan ruminan lain serta mengkelaskannya ke dalam kumpulan ruminan yang sesuai.

Kajian morfologi termasuk taburan papila lidah menunjukkan lidah pelanduk mempunyai morfologi serupa lidah khinzir yang bukan ruminan. Walaupun demikian ia masih dianggap sebagai ruminan kerana mempunyai perut majmuk di mana omasumnya tidak terbentuk sepenuhnya.

Kajian mengenai bentuk, berat dan kedudukan kelenjar parotid dan mandibul menunjukkan ia mempunyai persamaan dengan ruminan pemilih konsentrat. Berat kelenjar parotid ialah 3.0 0.5g dan 2.6 0.2g masing-masing pada jantan dan betina, sedangkan berat kelenjar mandibul ialah 1.6 0.3g pada jantan dan 1.4 0.3g pada betina. Purata luas permukaan berbanding luas permukaan perut untuk rumen ialah 77.7 1.0%, retikulum 11.4 0.5% dan abomasum 10.9 0.9%. Purata isipadu rumen dan retikulum daripada isipadu perut ialah 96.2 0.2% sedangkan abomasum ialah 3.8 0.2%. Panjang usus kecil relatif kepada panjang badan ialah 5.8 0.7:1, usus besar relatif kepada panjang badan ialah 2.4 0.2:1 dan seluruh usus relatif kepada panjang badan ialah 8.2 0.9:1

Dalam sebahagian lain kajian ini, pekali kehadaman ketara Lundai dan pellet komersil masing-masing ialah 77.4 2.6% dan 65.5 3.4%. Pengambilan bahan kering ialah 49.0 5.3g DM/kg berat badan bila diberi Lundai dan 52.0 1.4g DM/kg berat badan bila diberi pellet. Bila memakan Lundai kadar purata simpanan (MRT) partikel makanan ialah 48.3 1.6 jam dan bila memakan pellet ialah 24.9 0.6 jam. MRT untuk cecair ialah 14.8 2.0 jam jika memakan Lundai dan 12.3 0.9 jam jika memakan pellet.

Selain daripada lidah dan kadar laluan makanan, kajian ini menunjukkan pelanduk adalah pemilih

konsentrat. Namun demikian, ia mempunyai kadar laluan partikel makanan yang perlahan untuk ruminan yang kecil saiz tubuhnya. Oleh yang demikian, kajian lanjut mengenai kadar laluan dengan penanda yang lebih sesuai patut dilakukan.

CHAPTER I

INTRODUCTION

The mousedeer was probably present during the Oligocene period, about 40 million years ago (Romer, 1980). It appears to have evolved from the Docatherium, a suoid like animal (Figure 1). Such early fossil forms existed in North America and Europe during that period

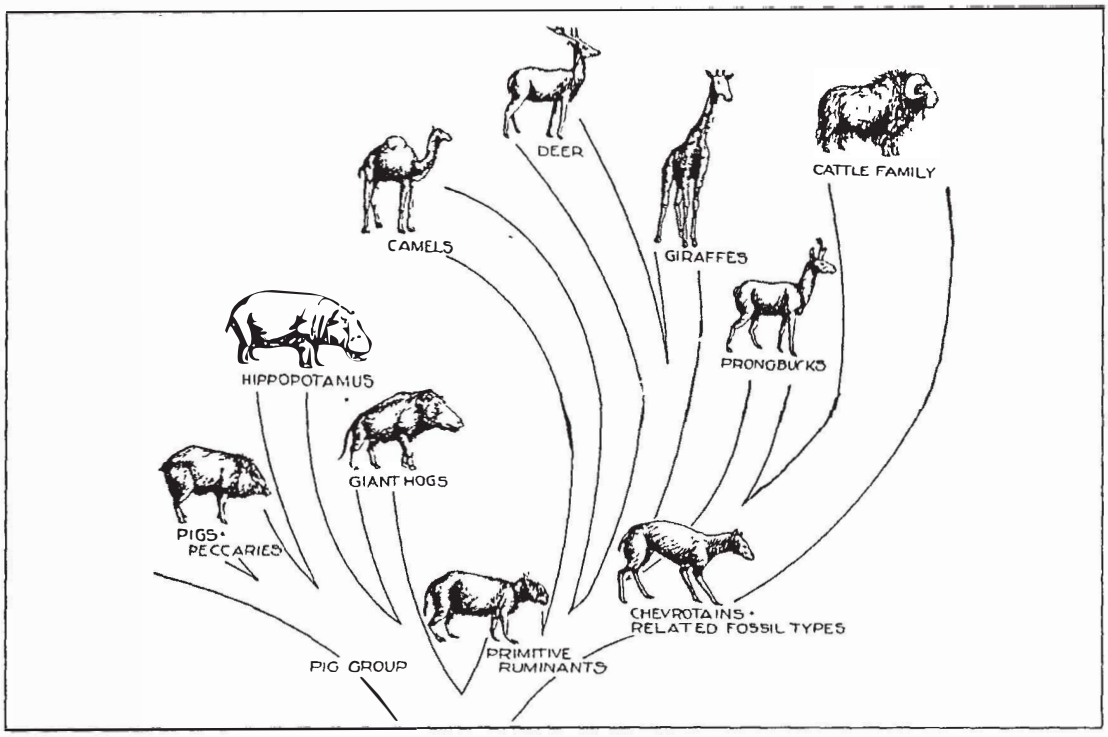

Figure 1. Pattern of *Artiodactyl* evolution (Romer, 1980)

but disappeared from these areas during the late Meiocene period when there was drastic climatic change (Janis,

1984). They migrated to warmer areas where food is available throughout the year.

The mousedeer belongs to the Order *Artiodactyla* (even toed animals), which also includes suids, deer, camels, bovids and giraffes, Suborder *Ruminantia* and Infraorder *Tragulina*. It is classified into the Family *Tragulidae* and Genus *Tragulus* with four existing species found in Africa and Asia (Janis, 1984; Cobert and Hill, 1991). *Haemoschus aquaticus* (water chevrotain) is found in west and central Africa (Figure 2). *Tragulus memina* is the only Indian species. According to Harrison, (1978) and Medway (1983), two species of the mousedeer

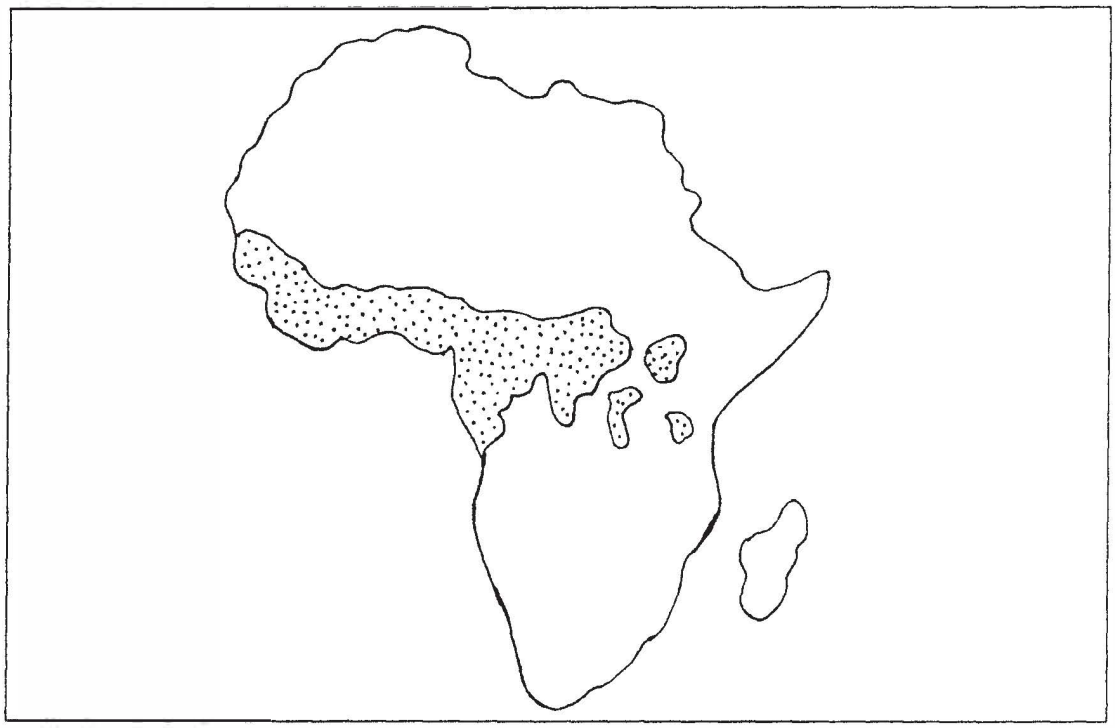

Figure 2. Map of Africa showing the distribution of water chevrotain (shaded portion)

are present in Malaysia, that is, *Tragulus javanicus*, the Malaysian lesser mousedeer and *Tragulus napu*, the Malaysian larger mousedeer. However, a number of sub species were also recognized, such as *Tragulus javanicus pumilus* (Medway, 1983) and *Tragulus javanicus klossi* (Payne *et al.*, 1985).

Of the Docatherium the suids were the least modified in their behaviour and anatomy. Since the mousedeer evolved from the Docatherium, it has retained most of the latter's primitive behaviour (Janis, 1984). For example, it uses the snout to search for food and are not able to rise on hind quarters when browsing. Another of its primitive traits is its solitary nature. It neither have a leader nor does it mark home ranges and adopts anti parallel stances when fighting (Whittow, 1983). The male finds the female by olfaction and tests her urine for estrus. The male detects receptive females by pressing its chin on the latter's hind quarters (Janis, 1984). They lie down in an intermediate, sitting-on-the-haunch position and sometimes with the back arched and the legs folded beneath the body (Whittow, 1983). Chevrotains rely on freezing and cryptic coat colouration to avoid predation (Kingdon, 1978).

The Malaysian lesser mousedeer (*Tragulus javanicus*) (Figure 3) is the smallest extant ruminant. The live weight of an adult animal ranges from 735 to 2,100 g

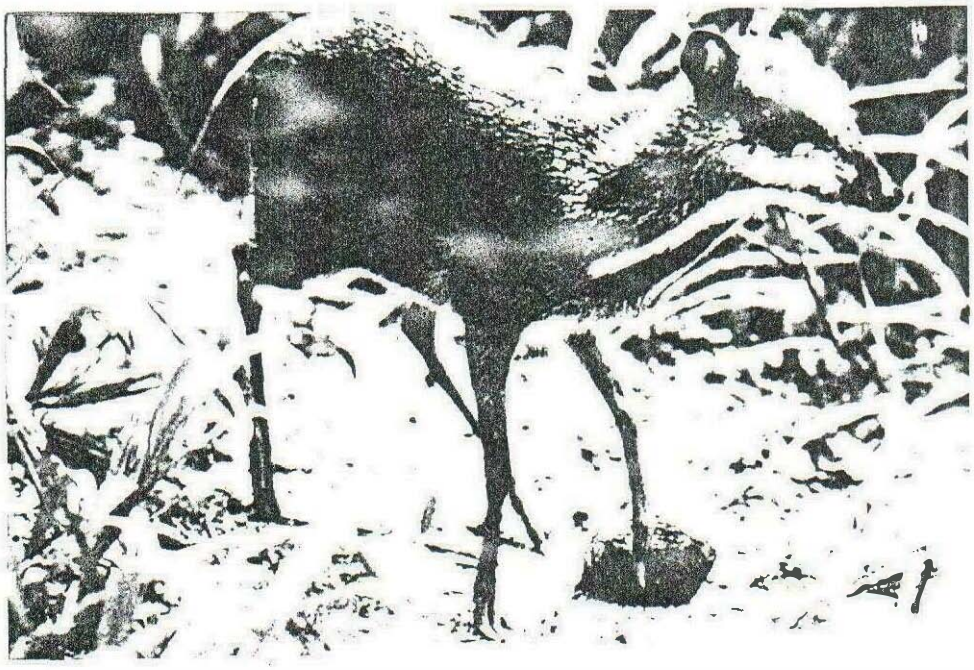

Figure 3. A picture showing the Malaysian lesser mousedeer (*Tragulus javanicus*)

(Medway, 1983). The adult body length from the back of the head to the base of the tail is 300-450 mm (Harrison, 1978). It is distinguished by a reddish brown colouration with an unbroken white line running laterally down the throat. It is mainly nocturnal but may sometimes become spontaneously active during the day (Ratnam, 1972; Davison, 1980). *Tragulus javanicus* is found in Southeast Asia, including Myanmar, Thailand, Kampuchea, Vietnam, Malaysia, Indonesia, Borneo and the Philippines (Figure 4)

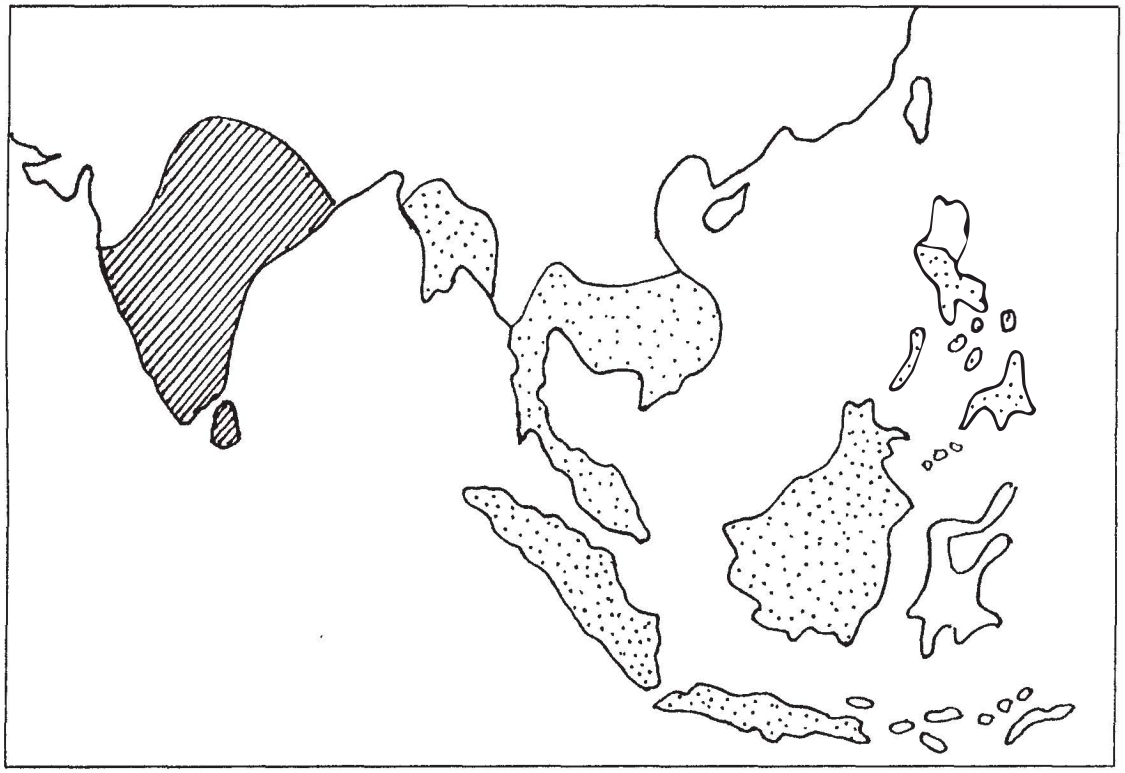

Figure 4. Map of Asia showing the distribution of Indian mousedeer and larger and lesser mousedeer

There is considerable interest in using this animal as a ruminant model for nutritional studies (Kudo *et al.*, 1991; Nolan *et al.*, 1994). From a meat production point of view, the mousedeer is an ideal animal since it has a high dressing percentage, high percentage of muscle and low percentage of bone. About 52% of the carcass is in the form of muscle (Vidyadaran *et al.*, 1983; Vidyadaran and Rosley, 1992). Fragmented information on many aspects of the mousedeer indicates that while the animal resembles a true ruminant, there are several features common to *Suidae*, such as the presence of a tusk-like