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The Gross Morphology of the Stomach of the Malaysian Lesser Mousedeer *(Tragulus javanicus)*

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Key words: Stomach; anatomy; lesser mousedeer; *Tragulus javanicus.*

RINGKASAN

Morfologi kasar perus pelanduk telah dihuraikan. Ciri rumen pelanduk adalah berbentuk S, belingkar sedikit dan mempunyai pundi-pundi ventral dan kaudo ventral yang besar. Omasumnya adalah vestigial dan merupakan kawasan seluas 2-3 cm³. Isipadu reticulo-rumen adalah lebih besar dari yang pada lembu atau biri-biri.

SUMMARY

The gross morphology of the stomach of the lesser mouse deer is described. Characteristically, the rumen is S-shaped spirally twisted and has large ventral and caudoventral sacs. The omasum is vestigeal and is represented by an area of about (2-3 cm²). Reticulo rumen volume is larger than for ox and sheep.

INTRODUCTION

Simpson (1945) estimated 180 genera of extinct and 68 genera of living ruminants and claimed that of the primitive ruminants only the family Tragulidae have survived to the present time. The Malaysian lesser mousedeer is included in the family Traguilidae in the Infra order Tragulina.

The anatomy of the domesticated ruminants is well described for the ox (Sisson and Grossman, 1975; Nickel *et al.,* 1973), the sheep (May, 1970) and the goat (Sisson and Grossman, 1975). However complete detailed information is lacking in the literature for most wild ruminants especially in the family Traguilidae. Available literature deals only with very general descriptions of the ruminant stomach (Webb *et al.,* 1972).

The present study was undertaken firstly to describe the detailed morphology of the stomach of the Malaysian lesser mousedeer. Secondly, it was hoped that the study would aid in establishing its relationship with other ruminants and whether feeding strategies have evolved in response to selection of different foods producing adaptations in the gastro-intestinal tract.

MATERIALS AND METHODS

Animals

Six adult *T. javanicus,* three males and three females aged between 2 to 3½ years (second generation offsprings bred in captivity) were housed at the Animal House Facilities at the Faculty of Veterinary Science. Two animals were placed in each cage measuring 2′ x 4′ x 8′. They were fed *ad libitum* on a diet consisting of *Ipomoea* leaves, long beans, raw peanuts and commercial rabbit pellets (Zuellig Feed Mill). The weights of the slaughtered animals ranged from 1.362 kg – 1.779 kg.

Dissection

The animals were killed by exsanguination of the neck. A midline incision was made on the skin extending from the base of the neck to the pubis. The skin was deflected and the sternum removed after disarticulating the costochondral joints of both sides. The abdominal muscles were incised and the gastro-intestinal tract exposed. The location of the various parts of the stomach was studied before ligatures were placed on the abdominal part of the oesophagus and at the proximal end of the duodenum. The stomach was then removed after cutting above and below the ligatures respectively.

Measurements

1. Weight

The live weight of the animals were taken prior to slaughter. The weights of the stomach and contents were also recorded. Each of the three compartments (rumen, reticulum, abomasum) was separated after placing ligatures and cutting at the rumino-reticulo and reticulo-abomosal junctions. The empty weights of the rumen, reticulum and

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abomasum respectively were obtained after emptying the stomach contents, washing and drying with tissue paper.

2. *Volume*

The volume of the three compartments were obtained by filling each compartment, to the brim with water and then emptying it into a measuring cylinder. Three readings were taken for each compartment.

3. *Surface Area*

The rumen, reticulum and abomasum were incised so that it flattened and spread out. Each compartment was placed on a polyethelene sheet and the circumference traced out. The traced polyethelene sheet was then placed on a graph paper and the area calculated. Four specimens (2 males and 2 females) were used in this study.

4. *Air-Dried Stomach Specimen*

The two air dried stomach specimens (1 male and 1 female) were prepared by the method of Church *(1973)*. The fresh stomach was trimmed of fat and the stomach flushed out with water. It was soaked in 95% ethanol to dehydrate the tissues and further extract some of the lipids. Finally, it was dried by passing air through the inflated stomach.

RESULTS AND DISCUSSIONS

Compound Stomach

The stomach consists of only three compartments (Fig. 1) namely the rumen, reticulum and abomasum. The omasum is absent for all purposes but a rudimentary area is represented. The stomach occupies almost the whole of the abdominal cavity and extends from the diaphragm to the pelvic inlet. Considerable portions of the rumen, reticulum and abomasum extend to the right of the median plane.

Dorsally the rumen extends from the seventh or eight intercostal space to the last lumbar vertebra and ventrally from the eleventh intercostal space to the pelvic inlet. Considerable portions of the dorsal sac lies to the left of the median plane whilst most of the ventral sac and caudo-ventral blind sac lie to the right of the median plane. The rumen resembles a three quarter-S-shape and differs markedly in shape from that of ox, sheep and goat *(Figs. 2* and *3)*. The dorsal sac overlies the ventral sac which is pushed more caudally. The caudoventral blind sac is extensive *(Fig. 2)* and is placed caudodorsal to the ventral sac. Both the right and left longitudinal grooves are present and they correspond to pillars internally. The left

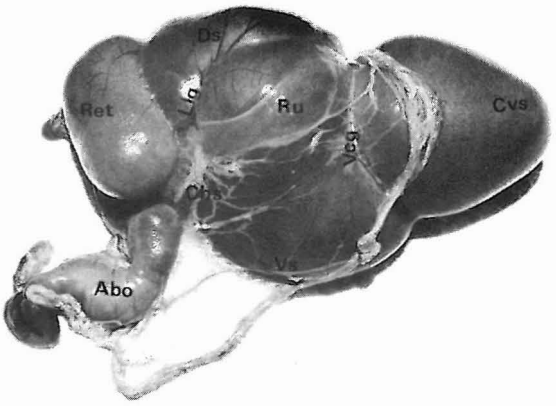

Fig. 1. Left view of the stomach of the Lesser mouse-deer.
Abo, Abomasum; Cbs, Cranial sac; Cvs, Caudo ventral sac; Ds, Dorsal sac; Llg, Left Longitudinal groove, Ret, Reticulum; Ru, Rumen; Vcg, Ventral coronary groove; Vs, Ventral sac.

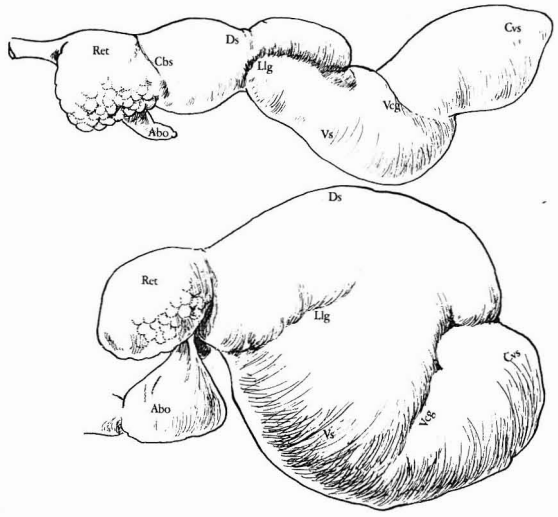

Fig. 2. External morphology of the Stomachs of the *Malaysian lesser mouse-deer and the **goat (left view).
Abo, Abomasum; Cbs, Cranial sac; Cvs, Caudo ventral sac; Ds, Dorsal sac; Llg, Left longitudinal groove; Ret, Reticulum; Vcg, Ventral coronary groove; Vs, Ventral sac.

a. Malaysian lesser mouse-deer (air dried specimen)

b. Goat (air dried specimen)

* actual size reduced by half.
** drawn to same scale as above.

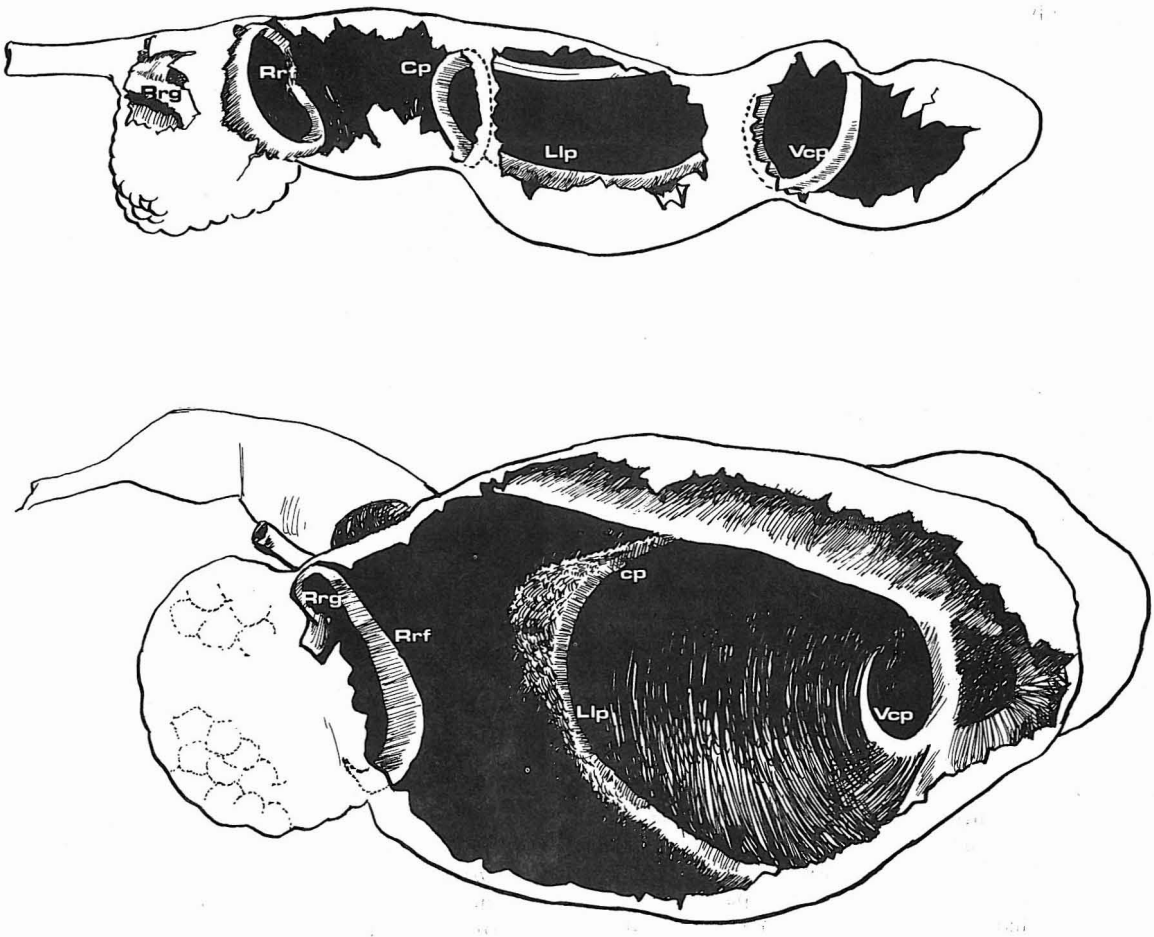

***Fig. 3. Internal morphology** of the stomachs of the *Malaysian lesser mouse-deer and the **goat (Dorsal view).*

Cp, Cranial pillar; Vcp, Ventral caudal pillar; Llp, Left longitudinal pillar; Rrf, Rumino-reticulo fold; Rrg, Rumino-reticulo groove.

a. Malaysian lesser mouse-deer (air dried specimen).

b. Goat (air dried specimen).

* size reduced by one-sixth.
** drawn to same scale as above.

longitudinal groove is prominent and extends from the cranial groove of the rumen, inclines dorsally, then ventrally and finally terminates caudally just anterior to the ventral coronary groove. No left accessory longitudinal groove is present. The right longitudinal groove is less distinct and extends from the cranial groove and fades out caudally. A right accessory groove is present dorsally. The ventral coronary groove is distinct, spiral in shape and very prominent on the left dorsal and ventral sides but less so on the right side. A dorsal coronary groove is not present.

At the cranial end of the cavity of the rumen is the rumino-reticular orifice, bounded by the rumino-reticular fold. The longitudinal and transverse diameters are 2-3 cm and 1-1.5 cm respectively. The ruminoreticular fold is very large and extensive. It extends from near the cranial pillar on the right side, passes dorsally, then to the left

and ventrally, and finally curves dorsally and ends near the ventral lip of the reticular groove on the right dorsolateral wall of the reticulum. The fold is smallest at its end and biggest ventrally. Both the reticular and ruminal sides of the fold are covered with short, flat papillae.

The left longitudinal pillar is large *(Fig. 3)*, it extends from the cranial pillar to the caudal pillar. The right longitudinal pillar is very small but a right accessory longitudinal pillar is present. The ventral coronary pillar does not meet the caudal pillar. It originates near the caudal pillar (on the dorsolateral part of right side) and ends caudally (on the ventro lateral part of the right side). The ventral coronary pillar separates the ventral sac from the caudo ventral blind sac. The dorsal coronary pillar is absent. The gastric groove is well defined but short. It lies on the dorsolateral part of the right side of the reticulum. The reticular groove is more obliquely directed rather than dorso-ventral (in ox, goat, sheep) so it is more appropriate to consider the lips as the dorsal lip (right) and the ventral lip (left). The dorsal lip is more extensive and more thickened near its termination. The groove is wide and the lips are covered with thick-globose type of papillae.

The mucous membrane is pale brown to almost yellow in colour. Large papillae are found on the dorsal, ventral and caudoventral blind sacs. Smaller papillae are distributed on the rumino-reticular fold, right and left longitudinal pillars and the regions surrounding it. The papillae are leaf like in shape and are variable in size even in the same area. The larger ones measure 0.3 mm in height and 0.1 mm in breadth.

The mean volume of the rumen is about 380 ml or 88% of the volume of the stomach. Ruminal contents averaged 51.8 ml or 76% of the stomach contents. Mean rumen surface area is 139.8 cm^2 or 78.3% of the surface area of the stomach.

Reticulum

The reticulum is large and its ventral relations extend from the diaphragm. Laterally it extends from the 8th to the 10th rib and although centrally located, considerable portions of the reticulum is on the right of the median plane.

The internal structure is honey-comb like and the mucosa is raised into folds. The honey-comb cells are four, five and six sided with the largest cells found ventrally. Unlike ox and goat, only primary crest are found. The cells are not sub-divided into smaller compartments and so secondary crests are absent *(Fig. 4)*. Long pointed papillae are found on the walls and at the center of the crests.

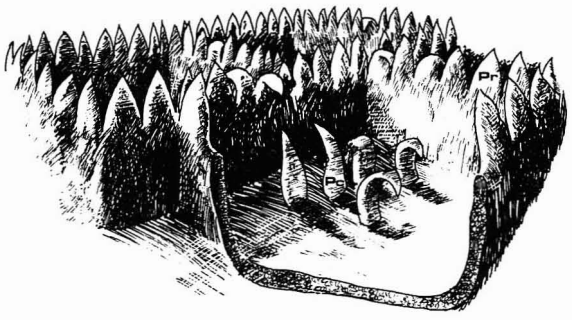

Fig. 4. Internal morphology of the 'honey comb' cells of the reticulum.
Pr, Papillae of the ridges; Pc, Papillae of the center.

The mean volume is 35 ml or 8.1% of the total stomach volume. Mean reticular surface area is 20 cm^2 or 11.27% of total stomach surface area.

Omasum

A small area (2-3 cm^2) lying between the reticulum and abomasum represents the vestigeal omasum. The mucosa is covered by irregular folds but no lamellae are seen. The omasal groove lies ventrally and leads directly into the abomasum.

Abomasum

The abomasum lies almost entirely on the right of the median plane and contacts the ventral sac of the rumen and liver. Internally, six longitudinal folds are present, and these extend to the pyloric region. Transverse folds connect the longitudinal folds.

The mean volume of abomasum is 17 ml or 3.9% of the total stomach volume. Mean abomasal surface area is 18.5 cm^2 or 10.42% of the total stomach surface area.

The domestic artiodactyl ruminants have a complex stomach consiting of four compartments although dietary habits or food preferences vary tremendously. How the variations in proportion of different parts of the stomach with certain structural pecularities can be related to different aspects of diet is not so easily understood.

Grossly, the stomach is S-shaped with large ventral and caudo ventral sacs. The sacs are spirally twisted, have large papillae and could be areas where food is not only stored but fermentative digestion and absorption occurs. The prominent

caudoventral sac may play a more prominent role in ruminant contraction.

Reticulo rumen volume (96.1%) was greater than that reported for adult ox and sheep (Warner and Flatt, 1965). Many of the structural and functional variations in the digestive tract can often be related to diet and feeding. The natural food is believed to consists of succulent grasses, fallen fruits and tubers. Vidydaran and Hilmi, (1981) studied teeth characteristics and reported that teeth types were not particularly suited for grinding. As for the physical reduction of food, Nordin (1978) reported that both in wild and captive animals food in the rumino-reticulo region was physically reduced well. The relatively large reticulo rumen volume provides increased storage capacity and with a longer retention time enables the animal to reduce the food well.

All true ruminants have a distinct omasum. It is not well developed in deer and antelope but reaches its full expression in the Girafidae and in the Bovidae (Moir, 1968). A functional omasum is absent in the mouse-deer. The reticulum and omasum are important structures for the mechanical separation of food (Hungate 1966 and Becker *et al.*, 1963) before passage into the obomasum. One can only speculate that the reticulum and possibly the reticulo abomasal opening in some way control the passage of fine particles into the abomasum.

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