Age-Related Anatomical and Morphological Development of the Ruminant Stomach in Kids

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SUMMARY

We observed the anatomical and morphological development of each compartment of the ruminant stomach in 3. 6. and 14 week old kids. Weaning from milk to roughage foraging, depending on the kids' ages, stimulated the development of the rumen and reticulum, and decreased the abomasum portion. A 3 week old kid's rumen has dense and thin papillas but, with advancing age and with roughage foraging, the number of the papillas on cm^2 decreases and their width increases. The omasum tertiary laminae and especially the quaternary laminae are observable only in the advanced age categories.

INTRODUCTION

At birth, the abomasum represents 60%, the rumen 30%, the reticulum 6%, and the omasum 4% of the ruminant stomach (Pop and Mireşan, 1991). During the period of feeding adaptation from milk to roughage, the proportion of rumen increases and, by the fully-developed ruminant stage, can reach 60-70% of the ruminant stomach (Dougherty, 1965). Crucial changes in the macroscopical structure of different compartments should be observed during the period of feeding adaptation from milk to roughage (Mgasa et al., 1994).

In this paper, we followed the anatomical and morphological development of several compartments of the ruminant stomach, dependent on the age of the kid.

MATERIAL AND METHODS

Research was conducted at Vultureni, Cluj county, between August 3rd and September 1st 1999, on a herd of Carpatina goats maintained on grassland. From this herd, we randomly selected:

- 6 kids, 3 weeks of age, fed mainly on suckling milk and with grass by grazing, both ad libitum;
- 6 kids, 6 weeks of age, fed with grass ad libitum, and suckling milk two times a day (in the morning and in the evening);
- 6 weaned kids, 14 weeks of age, fed with grass by grazing.

The slaughter of animals was made in an abattoir following normative slaughter procedures. After bleeding and skinning, the animals were eviscerated and the ruminant stomach removed. The stomach compartments were separated, washed and dried prior to all measurements.

The weight of the tissue of the stomach compartments was determined, and expressed as a percentage of total stomach tissue. From each compartment of the forestomach, several pieces were prelevated immediately after slaughter, and preserved in formaldehyde for further morphological study.

In order to determine rumen papillary development, papillas density was measured in cm^2 and length.

RESULTS AND DISCUSSION

The ruminoreticulum grows most rapidly in the initial weeks following birth, as shown in *Table 1*.

A percentage increase of rumen can be observed, from 37.5% at 3 weeks of age to 65% at 6 weeks of age. Assuming that kids started to consume grass from 10-12 days of age, at 5 weeks of age their digestive system starts to be prepared for roughage and the forestomach develops (Mgasa et al., 1994; Podar and Roman, 1992).

The morphological study of the kids' rumen from different ages showed that the 3 week old kids have less developed papillas in length and thickness, and that the rumen generally has a velvet – like aspect, with thin and dense papillas. The 6 and 14 week old kids' rumens have a well – developed papillary system. The age-related changes of the rumen papillary system are illustrated in *Table 2*.

At birth, the ruminal papillae are less than 1 mm in height (Mgasa et al., 1994; Podar and Roman, 1992); at 3 weeks of age 1.3 mm, at 6 weeks of age reach 3.3 mm, and at 14 weeks of age reach a normal size of 4.5 mm. The ruminal papillae density in cm^2 decreased proportionally with the kids' advancing in age, from 123 papillae/cm^2 at 3 weeks of age to 48 papillae/cm^2 for 14 week old kids.

At 6 weeks of age, the reticulum has doubled its weight (47.5 g) compared with its weight at 3 weeks of age (23.0 g), but reduced the relative amount of tissue, probably due to rumen overdevelopment. It attains full size at 14 weeks of age (10.3%) (*Table 1*). By analyzing the morphological aspects of the 3 week old kids' reticulum, the reticular hexagonal cells can be observed. Due to the soft firmness of the reticular folds, they often display a deforming tendency. The secondary folds of the reticulum are not very obvious. The conical papillas from the bottom of the honeycomb – shaped cells are easy visible. With the 6 and 14 week old kids, even the secondary reticular folds can be easily observed. The primary folds are taller and with strong firmness. Thus, the reticular cells are firmly emphasized (Mgasa and Arnbjerg, 1993). The conical papillas from the bottom of the cells are more developed than in the 3 week old kids' reticulum.

The omasum weight, almost doubles by 6 weeks of age (32.5 g) as compared to 3 weeks of age (17.0 g), but reduce its relative amount of tissue, 10.4% at 3 weeks of age to 6.6% at 6 weeks of age, and 6.5% at 14 weeks of age (*Table 1*). Similar values have been reported by previously in the secondary literature (Dougherty, 1965; Sărăndan, 1988).

By studying the morphological aspects of the omasum, all age categories with primary and secondary omasal laminae well developed, and the quaternary laminae better observed in a 14 week old kid's omasum, for which this organ plays an active part in squeezing the ruminoreticular content, can be observed. The conical papillas from the omasal laminae, are present at all the three age categories, but they are better developed at the 6 and 14 weeks of age (Green and Baker, 1996).

Considering the abomasum, however, a decrease with age was noted: at 3 weeks of age, this represents 38% from the total ruminant stomach, at 6 weeks 18.8%, and at 14 weeks only 15.2% (*Table 1*).

Table 1: **Weight and relative amount of tissue (expressed as percentage of total stomach tissue) of the total stomach and each compartment, for kids at various ages**

Age	Ruminant stomach		Rumen		Reticulum		Omasum		Abomasum	
(weeks)	Weight (g)	%	Weight (g)	%	Weight (g)	%	Weight (g)	%	Weight (g)	%
3	163.0	100	61.0	37.5	23.0	14.1	17.0	10.4	62.0	38.0
6	492.5	100	320.0	65.0	47.5	9.6	32.5	6.6	92.5	18.8
14	518.6	100	353.0	68.0	53.3	10.3	34.0	6.5	78.3	15.2

Table 2: **Rumen papillary development in kids at various**

Rumen	Age in weeks		
	3	6	14
Papillas density (nr/cm^2)	123	56	48
Papillas length (mm)	1.3	3.3	4.5

CONCLUSIONS

1. The kids fed adequately for their age category present a weight increase for all compartments of the ruminant stomach, but at different rates. The ratio between the compartments' weights is different, each having other dynamics of growth.
2. The proportion of the ruminoreticulum increased with age. However, the abomasum proportion decreased, due to weaning, which stimulates the development of the forestomach.
3. The ruminal papillary system is present from the youngest stage. The number of papillae on cm^2 decreases with the advancing in age, but the length and width of papillae increase with it.
4. The main reticular cells are obvious even in the youngest age category, but their folds show a deforming tendency which disappears in advanced age categories. The secondary cells of the reticulum can be easily observed in 6 and 14 week old kids. The conical papillas from the bottom of the reticulum cells increase with age.
5. The development of the tertiary and quaternary omasal laminae, and their conical papillas on the laminae are proportional with ageing. This ensures an active participation of the omasum in digestion.

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