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A NOTE ON THE SIMPLIFICATION OF PROCEDURE DETERMINING THE RATE OF RUMINAL PASSAGE OF DIGESTA

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Introduction

The rate of ruminal passage of digesta has been considered to be an important component of digestion in the rumen of ruminants[2,9,15]. Moreover, it has been shown that the passage rate of digesta through the rumen is positively related to the voluntary intake of diets[4,5,8]

GROVUM and WILLIAMS[6] developed a mathematical model determining the rate of ruminal passage of digesta. Their procedure involves the collection of feces samples at 4 h intervals up to 120 h after dosing a marker in the rumen, and costs considerable labor and time. The present study was purposed to verify whether there was any difference between the values of passage rate obtained when feces samples were collected at 4 h intervals and at longer intervals.

Materials and Methods

Data for passage rate were adopted from the feeding experiments carried out using 25 growing male calves and 19 sheep in this Institute. The calves were offered a mixed ration consisting of formula feed and orchardgrass hay with a ratio of 6 : 4 and sheep were fed ad libitum a roughage (hay, silage or straw) alone.

The rate of passage through the rumen was determined by using the model of the first order kinetics presented by GROVUM and WILLIAMS[6], in which chromium (Cr) was used as a marker. The details for determination have been described by OKUBO *et al.*[11]. The rate of passage through the

rumen was defined by the slope of descending portion of the excretion curve obtained by least squares regression of ln fecal Cr vs. time after administering chromium-mordanted cell wall constituents[14] in the rumen.

The point at which to start the regression analysis is usually selected as near the peak of the curve as possible not to bias the slope. In our study, the peak of ln fecal Cr ranged from 18 to 38 h postdosing, that is, the point to start regression analysis lied, at latest, at 38 h post-dosing. To find out the peak time, the collecting of feces sample was required at short interval up to 38 hours post-dosing. Since the descending portion of the excretion curve of fecal Cr was relatively linear, we consider that the determination of passage rate could not be affected by prolonging the interval of feces collection after 38 h post-dosing. Therefore we re-calculated the passage rate using those data obtained every 4 h for first 38 h, every 8 h for 38–72 h and every 16 h for 72–120 h. Regression analysis was done using the values of passage rate obtained at 4 h intervals (k) and at longer intervals (ks) of feces collection.

Statistical analyses were made using the methods described by SNEDECOR and COCHRAM[12] and STEEL and TORRIE[13].

Results and Discussion

Table 1 shows means and range of k and ks and the results for regression analyses. There was no significant difference between means of k and ks in both calves and sheep ($P>0.05$). From regression analyses of two variables, the highly significant regression equations ($P<0.001$) were obtained for both calves and sheep, as shown in Table 1. The difference in regression coefficients of the two equations revealed no statistical significance ($P>0.05$). Therefore, a pooled regression equation was made for all data, the regression coefficient being near 1.00. This indicates that k changes almost one unit with a change of one unit in ks. The coefficient of determination was calculated to be 0.97, which well speculates the relationship between the k and ks values[12].

The rate of passage of digesta through the gut has been shown to increase with increased intake of food[1,3,7,10]. Data in this study did not consist of all feeding level and of all kinds of ruminants. Our study, however, included the data from the animals fed straws alone, which were least ingested by animals in all diets. The passage rate of digesta through the reticulorumen of animals offered straw may be considered to be the slowest. The animals such as lactating cows always ingest feed more and have a faster passage rate than those animals fed straw. Thus the peak of the

TABLE 1. Mean and range of the rate of passage through the rumen of calves and sheep, obtained at two different intervals of feces collection, and regression equations

	No. of observation	Mean	Range	
			Minium	Maximum
		%/h		
Passage rate				
at 4 h intervals (k)				
Calves	25	4.23	2.65	5.83
Sheep	19	3.98	1.24	6.45
at longer intervals (ks)				
Calves	25	4.24	2.20	5.64
Sheep	19	3.92	0.97	6.81

Regression equation	n		r	se
Calves	25	k=0.974 (±0.055) ks+0.097	0.966	±0.042
Sheep	19	k=0.959 (±0.031) ks+0.220	0.991	±0.047
Pooled	44	k=0.959 (±0.027) ks+0.185	0.984	±0.031

excretion curve of fecal Cr in lactating cows should exist within 38 h postdosing. The measurement at a longer interval of feces collection after 38 h postdosing could not bias the value of passage rate determined at 4 h intervals in such animals as lactating cows.

Determination of passage rate by collecting the feces sample at longer interval, as made in the present study, allows to save considerable labor and time, while there was little difference between the values of the passage rate obtained when feces samples were collected at 4 h and at longer intervals.

Summary

The study was purposed to verify whether the collection interval of feces sample has any effect on the measurement of rate of passage of digesta through the rumen. Data were adopted from those obtained from growing calves offered a mixed ration containing of formula feed and hay, and from sheep fed ad libitum hay, silage or straw alone. There was little difference between the values of passage rate obtained when feces samples were collected at 4 h interval and at longer interval. It was concluded that passage

rate was able to determine by collecting the feces sample at longer interval than 4 h.

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