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Ann. Rech. Vét. 1979, **10** *(2/3)*, 163-165.

RATE OF PASSAGE OF DIGESTA IN SHEEP

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From a physiological and nutritional point of view, knowing the transit time of digesta through the whole gut and its different parts is very important.

The purpose of this paper is to show how this information may be derived by analysing the faecal concentration curves describing the excretion of a single dose of an unabsorbable marker.

Material and Methods

1. *Experiment I*

The purpose of this experiment was to compare the excretion curves of ^{144}Ce - ^{144}Pr and Cr_2O_3 - paper used as unabsorbable markers of the particulate phase of digesta.

Six sheep were fed chopped meadow hay. On the first day of the experiment, they received a single dose of doubly-labelled lucerne hay pellets (^{144}Ce - ^{144}Pr ; Cr_2O_3 - paper - chopped) before the hay meal.

2. *Experiment II*

This experiment was conducted in order to compare the rates of passage of liquid and solid digesta through the sheep alimentary tract.

Three sheep were given a daily diet of 0.5 l skimmed milk, 0.6 kg rolled barley and oats and 0.56 kg meadow hay at 9 a.m.

Six grams of chromium sesquioxide powder were mixed with the concentrate while ^{51}Cr-EDTA was added to the milk.

3. *Experiment III*

The purpose of this experiment was to compare the patterns of excretion of the dual phase markers ^{46}Sc and ^{51}Cr-EDTA administered into the abomasum and to study the closure of the œsophageal groove.

For this reason, we used ruminating sheep in which the reflex of the œsophageal groove had been maintained from birth. Thus, six sheep were given the same experimental ration as in experiment II, except that milk was given in a bottle and that 3 animals received in addition 50 g soybean oil mixed with the milk per day.

Chromium sesquioxide was mixed with the concentrate while ^{46}Sc and ^{51}Cr-EDTA were added to the milk.

4. *Chemical and radiochemical determinations*

Faeces were dried and finely ground before analysis.

Chromium sesquioxide was determined by a volumetric method in the nitroperchloric acid (François *et al.*, 1978).

A two-channel gamma spectrometer was used for counting the radioisotopes individually or together.

5. *Determination of mean retention times*

The mean retention time of the markers in the whole alimentary tract is calculated from the following equation (Thielemans *et al.*, 1978):

$$\bar{t} = \frac{\Sigma t_i C_i \Delta t_i}{\Sigma C_i \Delta t_i} \quad (1)$$

where

C_i is the marker concentration in faecal dry matter;

t_i is the time elapsed between dosing and the mid-point of the ith collection interval;

Δt_i is the collection interval.

The following equation gives the mean retention time of digesta in the reticulo-rumen (Thewis *et al.*, 1975):

$$T = \frac{T_c}{0.693} \quad (2)$$

where

T_c is the half-time derived from decreasing exponential excretion curve of marker in faeces.

The difference $\bar{t} - T$ is the mean retention time in the rest of the gut.

Results and Discussion

Our results show that chromium sesquioxide paper is a surprisingly good marker of the particulate phase of digesta. This is supported by the fact that Cr_2O_3 data correlates well with the ^{144}Ce-^{144}Pr excretion curve in most cases (fig. 1). Moreover, experiments to be published show that chromium sesquioxide powder produces even better curves which are almost indiscernible from the lanthanide curve.

The advantages of the concentration curves as compared to the cumulative ones are clear. The former do not require quantative collection of faeces and their mathematical treatment is much easier.

As for particulate markers, single doses of ^{51}Cr-EDTA are eliminated exponentially from the reticulo-rumen but the transit of water-soluble markers through the digestive tract

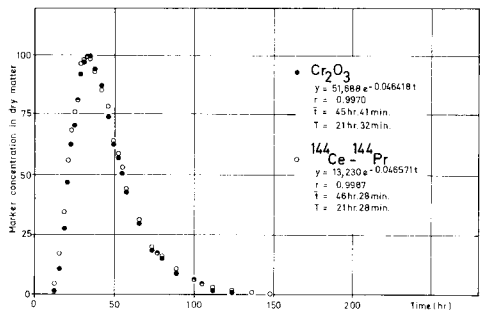

Fig. 1. — Excretion curves of ^{144}Ce-^{144}Pr and Cr_2O_3-paper in faeces of sheep following a single dose of markers into the rumen - Experiment I.

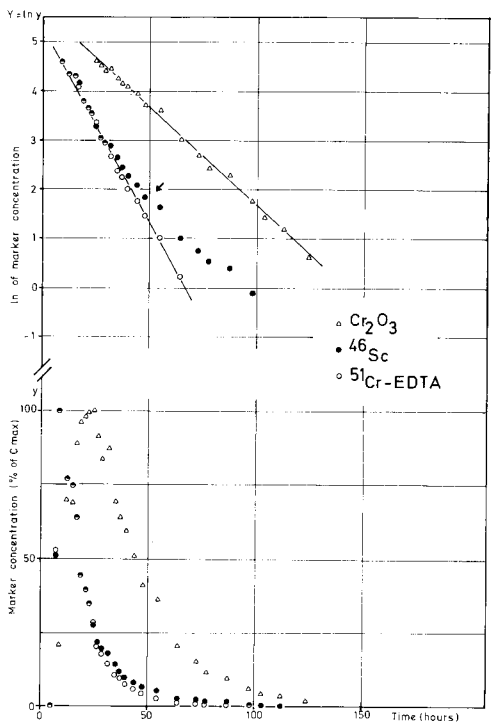

Fig. 2. — Excretion curves of Cr_2O_3-powder, ^{46}Sc and ^{51}Cr-EDTA in faeces of ruminating sheep in which the reflex of the œsophageal groove had been maintained - Experiment III.

^{51}Cr-EDTA:

$Y = -0.0809\ t + 5.3424$; $r = -0.9972$

Cr_2O_3 :

$Y = -0.0400\ t + 5.6549$; $r = -0.9985$

$\bar{t}$ (Cr_2O_3) = 38 h 44 min

$\bar{t}$ (^{46}Sc) = 23 h 26 min

$\bar{t}$ (^{51}Cr-EDTA) = 19 h 50 min

Table 1.— Mean retention times of Cr_2O_3-powder and ^{51}Cr-EDTA in the alimentary tract of sheep and half-times derived from the exponential curve - Experiment II.

Sheep no	t				Tc			
	Cr_2O_3		^{51}Cr-EDTA		Cr_2O_3		^{51}Cr-EDTA	
	h	min	h	min	h	min	h	min
187	54	08	34	40	24	19	10	50
188	40	56	27	29	14	14	9	03
189	35	49	32	29	11	46	10	44

of sheep was faster than particulate matter. Half-times derived from exponential curves (table 1) indicate that particulate matter spent more time in the reticulo-rumen than the liquid phase.

Finally, the pulse marker technique gives useful information on the efficiency of the closure of the œsophageal groove. So, a change in the slope of the straight line describing the excretion of the markers means that part of it — together with the milk — transits through the rumen (fig. 2-arrow).

Thus, by analysing the concentration curves of marker excretion in faecal dry matter, no surgical interference with an animal and no radiographs are required to obtain very precise information about gut function.

We thank Mr. F. Dupont and Mr. L. Lallemand for technical assistance.

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