The Estimation of Pasture Intake by the Grazing Sheep

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SUMMARY

This work depends on the theory that a mature wether whose weight is not varying appreciably will store nitrogen only in the wool. Accordingly

$$\underset{\text{intake}}{N} = \underset{\text{urine}}{N} + \underset{\text{faeces}}{N} + \underset{\text{wool}}{N}$$

An apparatus is described for the collection of excreta from the grazing sheep. Results are presented of estimations of nitrogen intake made with sheep on an improved pasture.

INTRODUCTION

The few estimates in the literature of the quantity of food eaten by the grazing sheep have involved calculations based on some component of the faeces. The "apparent digestibility" of this component was first calculated with sheep fed on known amounts of cut pasture. Faeces were then collected from grazing sheep and the amount of the particular component in the faeces was used to predict the intake. As Lancaster (1949) has pointed out, this technique involves two assumptions : (1) the material used in the pen experiments is similar to that selected by the sheep, and (2) the grazing animal digests the pasture material to the same extent as it does in the pens. As the first assumption is, from observation, almost certainly incorrect, the validity of the second must also be questioned.

The present paper describes a more direct measurement of the intake of nitrogen. This involves the assumption that a sheep which is not gaining weight will store nitrogen only in the wool. If this is so,

$$\underset{\text{intake}}{N} = \underset{\text{urine}}{N} + \underset{\text{faeces}}{N} + \underset{\text{wool}}{N}$$

The intake of nitrogen can thus be calculated from the three quantities on the right hand side of the equation. The nitrogen stored in the wool represents about l-2 g/day, which with sheep on good quality pastures, is not more than 5% of the nitrogen intake. The estimation of the intake of nitrogen thus depends on methods of estimating the output of urine and faeces.

Several devices for the collection of faeces from the grazing sheep have been described; the total collection of urine is more difficult. Collectors have been described by Cook et al, (1952), Puntriano (1955), Erwin et al. (1959) and Budtz-Olsen et al. (1959) for use with sheep in semi-arid regions; however the capacity of these units is too small for work with sheep on improved pastures. Sears and Goodall (1942) and Bassett (1952) developed collectors for sheep on New Zealand pastures, but in our experience this equipment caused too much fatigue and discomfort to the sheep. The collection device to be described below has proved satisfactory for the collection of up to 6.5 1. urine in 24 hours.

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MATERIAL AND METHODS

Apparatus.-The apparatus for collecting urine contains four components, a harness, a collecting cup, connecting tubing and a cart (Fig. 1). The harness basically comprises a saddle made from two pieces of half inch plywood backed by sponge rubber and joined by a piece of canvas fire hose. The plywood serves as a mounting for two three-eighth inch bolts to which the shafts of the cart are anchored. This saddle is held in place by a girth strap also made from fire hose and is prevented from slipping backwards by straps over the brisket.

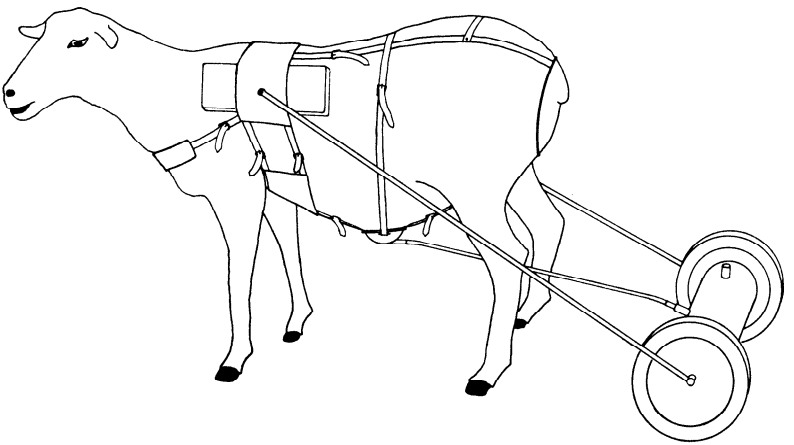

Figure 1.—Apparatus for the collection of urine from the grazing sheep. (The faecal collection bag described by McDonald (1958) has been omitted.)

The urine collecting cup is a hemisphere of 5" diameter spun from stainless steel. It is held in place under the prepuce by straps running forward to the canvas girth and back to the faecal collector. A webbing girth strap keeps the rolled rim of the collector in light contact with the sheep. The cup is connected to the urine cart by polyvinyl chloride tubing which is kept under light tension by a spring-loaded telescopic tube on the urine cart. This tube also contains a valve to prevent back flow of urine.

The cart is a stainless steel cylinder of about 3 1. capacity. Rubber tyred plastic wheels are fitted to stub axles welded to the ends of the cylinder. The shafts of the cart, made from light gauge solid drawn steel tubing, are bolted on to the axles; the other ends of the shafts pivot on the bolts in the harness saddle. The urine cart is fitted with a drain plug at the bottom and a non-spilling air-vent at the top.

Faeces were collected with equipment similar to that described by McDonald (1958).

The sheep used in these experiments were English Leicester X Merino crossbred wethers whose weights ranged from 45 to 55 kg. They were grazing a good subterranean clover — perennial rye grass pasture but from observation were choosing only the rye grass. The experiments were conducted in August-September, 1959.

Analytical.-Nitrogen was estimated by the method of McKenzie and Wallace (1954); dry matter was determined by drying overnight at 105°C.

RESULTS

Experiments were first conducted to see whether the urine collectors affected the sheep's grazing behaviour. Table 1 shows the mean daily faecal dry matter output of three sheep during four weeks. Collections were made from Tuesday to Friday of each week; the periods during which urine collections were also made are marked with asterisks. Although there was appreciable variation in the faecal dry matter output of individual sheep from week to week, the evidence indicated that the presence of the carts had no major effect on intake.

TABLE I.

	WEEK			
Sheep No.	1	2	3	4
MA88	306*	310	314*	336
MA93	177*	167	288*	308
MA97	221	287*	243*	293

Mean Faecal Dry Matter outputs (g. day) for three sheep at pasture on four days of four successive weeks. The asterisks denote urine collections.

In Table II results are presented of estimations of nitrogen intake on five sheep. The figures are the means of four day collections; the faecal samples were bulked for analysis, but the range of values for the volume and nitrogen content of the urine are shown in parentheses. These collections were made during different weeks and in some of them appreciable quantities of rain fell. This accounts for the fact that sheep MA93 had a high urine volume but a urine nitrogen output of the same order as the other sheep.

TABLE II.

Sheep No.	Urine Volume (ml/day)	Urine N (g/day)	Faecal N (g/day)	Estimated N Intake* (g/day)	Apparent N digestibility (%)
MA93	5320	40	11	52	79
	(4200–6350)	(35–44)			
MA88	2830	44	12	57	79
	(2200–3800)	(41–51)			
MA80	3375	39	7	47	87
	(2500–4900)	(35–45)			
MB1	3800	40	9	50	82
	(3200–5000)	(37–44)			
MA97	3500	26	8	35	77
	(2900–4300)	(17–37)			

* Estimated intake includes 1g N stored as wool.
The estimations of excretion by five grazing sheep. Each figure is the means of four successive days' collection, and the range of urine values is shown in parentheses.

DISCUSSION

The high apparent nitrogen digestibility found in these experiments indicates the importance of a direct measurement of nitrogen intake. In feed with an apparent digestibility of 80%, the intake would represent 5 times the faecal output; as Hutchinson (1956) indicated, small errors in estimating the apparent digestibility would lead to much greater errors in estimating food intake. Suppose for instance the apparent digestibility of nitrogen for a sheep on a 50 g

N-intake is really 80% whereas it is estimated to be 75%; the faecal-N output is 10 g; using the 75% apparent digestibility figure the intake would be calculated to be 40 g, i.e. a 20% error.

During this work tests were conducted on most of the urine collecting devices described in the literature, together with many others developed at this laboratory. All the devices failed to meet our requirements; either the weight of apparatus and urine was too heavy to be carried on the sheep's back or the collectors were too bulky to permit the animal to rest in a normal position. The urine cart withstands both these criticisms and provides a reliable means for long term collections involving large quantities of urine.

DISCUSSION

Mr. Beeston exhibited three slides which showed the various developments in the methods of collecting urine from sheep.

P. G. Schinckel (N.S.W.) referred to a urine-collecting apparatus being developed by Mr. Hutchinson of Roseworthy using an electrical principle.

W. H. Stephens (Tas.) asked how one could tell when the metal tank on the trailer would be full.

Answer.—They knew only by experience. A plastic type naturally would have the advantage that the urine could be seen but it lacked structural strength.

Dr. Hogan presented some figures in which the daily organic matter intakes of these sheep had been estimated from their Faecal —N outputs.

J. L. Lambourne (N.S.W.) asked whether the figures quoted showing organic matter intake variation were common or otherwise? Using chromic oxide he found a wide variation in dry matter intake up to 50%.

Dr. J. P. Hogan (N.S.W.).—One reason for this observed variation is that the sheep don't defaecate at any set times.

R. J. Moir (W.A.) also quoted wide variations from 1,000 to 400 gm. daily. He asked whether there was any information on the distance actually walked by the sheep carrying the urine carts?

Answer.-Sheep were grazing in quite a small paddock and they didn't have to walk far for their feed. The distance covered was about one half mile.

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