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Under certain dietary conditions, the intake of inorganic sulphur may limit microbial growth in the rumen. Inorganic sulphur entering the rumen is converted to sulphide which is taken up by the microbes. However, sulphide is absorbed rapidly from the rumen so that the fractional utilization of inorganic sulphur must be considerably less than unity. Beever *et al.* (1979) found that a value of 0.2 was required to simulate adequately the processes of digestion and microbial growth in the rumen of sheep given a sulphur deficient diet by Hume and Bird (1970). Under conditions in which sulphur supply is limiting microbial growth, the fractional utilization of inorganic sulphur would be expected to be maximal. However, Kennedy *et al.* (1976) reported that about 0.4 of the ^{35}S-sulphate infused into the rumen of sheep, given diets low in sulphur, was recovered as organically-bound ^{35}S in digesta flowing from the abomasum. This recovery, which is equivalent to the net fractional utilization of inorganic sulphur, is higher than expected from the simulation studies. Much lower values have been obtained in studies of rumen function in sheep in this laboratory and these, together with a simple method of calculation, are presented here.

Material and Methods

Animals and management

Corriedale ewes, fitted with self-retaining rumen catheters, were maintained in metabolism cages under continuous lighting and fed continuously by means of a conveyor belt. The diet consisted of a pelleted mixture of 3 parts lucerne hay and 2 parts oats (932 g organic matter and 29.9 g nitrogen/kg DM) given at the rates of 803 g DM/d to 3 ewes.

Experimental

A primed infusion of ^{51}Cr-EDTA, ^{103}Ru-phenanthroline and $Na_2{}^{35}SO_4$ was maintained for 5 days (Faichney, 1975). It was terminated by slaughter ; the rumen and abomasum were ligated, removed from the abdominal cavity and their contents removed, weighed and sampled within 10 minutes. Samples were taken of rumen and abomasal digesta, of fluid obtained by straining rumen and abomasal digesta through terylene cloth and of microbes obtained from rumen fluid by differential centrifugation.

Analyses

Organically-bound ^{35}S per g of digesta non-ammonia nitrogen (NAN) and microbial nitrogen was determined after hydrolysis, oxidation and treatment with $BaCl_2$. Other analyses were done using standard procedures.

Calculations

The flow of digesta and its constituents was calculated as described by Faichney (1975). Net microbial protein synthesis in the rumen

Organic matter intake g/d	Nitrogen intake g/d	NAN flow from stomach g/d	Microbial nitrogen flow g/d	Microbial yield[a]	Net fractional utilization of sulphur
749 (n = 6)	24.1	20.2 ± 0.8[b]	12.8 ± 1.2	33.9 ± 4.2	0.11 ± 0.01
417 (n = 3)	13.3	12.2 ± 1.0	7.7 ± 1.5	35.3 ± 8.1	0.13 ± 0.03

[a] Microbial yield = g nitrogen/kg organic matter apparently digested in the stomach.
[b] Standard error.

was estimated as the microbial component of NAN flow from the abomasum using the specific activity ratio calculation described by Beever *et al.* (1974). If all the inorganic sulphur entering the rumen was utilized by the microbes, microbial protein synthesis could be calculated by dividing the infusion rate of ^{35}S by the microbial specific activity. However, the 'apparent' microbial protein synthesis calculated in this way considerably overestimates the actual net microbial synthesis and the ratio of net synthesis to 'apparent' synthesis provides an estimate of the net fractional utilization of inorganic sulphur.

Results

The digestibility (± SE) of organic matter (OM) was 0.688 (± 0.009) at the higher intake and 0.713 (± 0.013) at the lower intake ; of the OM digested 0.746 (± 0.037) and 0.755 (± 0.044) was apparently digested in the stomach. The mean intakes of OM and nitrogen, the mean flows of NAN and microbial nitrogen from the stomach, the microbial yield and the net fractional utilization of inorganic sulphur are shown in the table. On average, about 0.12 of the inorganic sulphur entering the rumen was incorporated into microbial protein ; the values ranged between 0.09 - 0.13 at the higher intake and 0.08 - 0.17 at the lower intake.

Discussion

The values obtained for the digestion of OM in the rumen, the yield of microbial protein and the flow of NAN from the stomach are within the range expected for the diet given. The values for net fractional utilization of inorganic sulphur were of the same order as the values of 0.04 - 0.11 reported by Leibholz (1972) and were less than the value of 0.2 used by Beever *et al.* (1979). This is consistent with the suggestion that the value should be less for diets adequate in sulphur than for diets which are deficient. However, the value of 0.4 reported by Kennedy *et al.* (1976) for sheep given a low sulphur diet was more than three times that reported here and double that required to simulate rumen function for sheep given a sulphur deficient diet (Beever *et al.*, 1979). Although recycling of ^{35}S to the rumen would tend to cause an overestimation of actual net fractional utilization, this effect would apply to all the experimental results quoted ; the magnitude of sulphate recycling (Kennedy *et al.*, 1976) is not sufficient to reconcile the difference between the simulation studies and the results of Kennedy *et al.* (1976). The diet given by these workers was not only low in sulphur but virtually all the sulphur was inorganic. These factors may have been responsible for the high value for fractional utilization of inorganic sulphur observed in their work but no firm conclusions can be drawn. More information is needed on the interactions which control sulphur utilization in the rumen, particularly under conditions of dietary deficiency. It would be of value if authors, when reporting values for microbial synthesis obtained using ^{35}S, would record the net fractional utilization of inorganic sulphur as described here.

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