THE NUTRITIVE VALUE OF ROUGHAGES BEFORE AND AFTER MASTICATION BY OESOPHAGEALLY FISTULATED SHEEP

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SUMMARY

A range of roughage diets (1.5-5.2% nitrogen) were fed to 18 month old oesophageally fistulated sheep. Samples of each diet were analysed for digestible organic matter (DOM), neutral detergent fibre (NDF), nitrogen (N) and soluble carbohydrates (SC) before feeding and after mastication and collection through the fistulae.

The DOM in extrusa was not different (P>0.05) from that in the feed consumed but N and NDF levels were affected. The relationships were:

- Feed NDF = 1.24 (±0.05) NDF extrusa - 8.4 (±0.13) RSD 3.3 R² 97.2
- Feed N = 0.89 (±0.03) N extrusa - 0.11 (±0.03) RSD 0.15 R² 98.5

Soluble carbohydrate levels were 1.4% lower (P<0.05) in extrusa than in the feed consumed, but the regression equation developed was not different from y = x due to high variability. We conclude that while DOM, NDF and N may be accurately predicted from extrusa, SC levels are less reliable and this may be due to soluble material bypassing the fistula.

(Key words: oesophageal fistula, sheep, nutritive value).

INTRODUCTION

Animals fistulated at the oesophagus may be used to gather samples for estimation of the nutritive value of pastures. However, before the collection process, the material is chewed and saliva added. Incomplete sample recovery and leaching of nutrients may also lead to errors in the technique.

These effects on the nitrogen (N) content of extrusa have been well documented with cattle (Hoehne et al. 1967; Cundy and Rice 1968; Barth and Kazzal 1971; Little 1972; Scales et al. 1974; Cohen 1979) and sheep (McManus 1961; Lombard and Van Schalkwyk 1963; Arnold et al. 1964; Langlands 1966). However, of these authors, only Langlands (1966) has presented data on the relationship between the digestible organic matter (DOM) content of forages before and after mastication by sheep.

Neutral detergent fibre (NDF) and water soluble carbohydrate (SC) analyses indicate the potential voluntary intake of forages, but there are few reports in the literature where the effect of the collection procedures have been studied. Little (1972), using steers, found a strong relationship between neutral detergent soluble material (100-NDF) before and after collection, when results were expressed on a dry matter basis. Hoehne et al. (1967) found lower levels of SC in samples after collection but, as screen bottom bags were used, this loss may have been due to leaching of collected material.

In this experiment, we studied the nutritive value (N, DOM, NDF and SC) of a range of forages before and after mastication and collection by fistulated wethers.

MATERIALS AND METHODS

Six 18 month old Merino or Comeback wethers, fistulated at the oesophagus (OF), were held indoors in individual pens and fed a diet of either grass hay, fresh grass or fresh lucerne. After consuming each diet for 14 days, a comparison was made.
of the nutritional components of each feed was made, before and after each collection. Feed residues were removed at 0900 h but fresh feed was not provided. At 1300 h, samples of grass and lucerne were cut, coarsely chaffed using hand hedge clippers, and mixed. A random subsample of the feeds was frozen for analysis. After the fistula plugs were removed and collection bags fitted, samples of each herbage (30-70 g dry weight) were offered to two of the OF sheep. Hay samples were similarly chaffed, mixed and fed to two OF sheep.

Immediately all offered feeds were consumed (15-30 minutes) the extrusa samples (solid and liquid) were collected and frozen. Thirteen sets of samples (feed offered/extrusa collected) were obtained in this manner and five additional sample sets were obtained on the final day of the experiment when either fresh capeweed, Persian clover or sweet vernal was offered to the sheep. Previous analyses showed these feeds differed in composition from the lucerne and grass pastures. For these five samples the sheep were not introduced to the feeds over a 14 day period but all other procedures were identical.

Extrusa and feed samples were freeze dried and ground through a 0.5 mm screen and dry weight determined. Mean dry sample weight was 32.1±4.3 g. Samples were analysed for DOM using a pepsin-cellulase technique standardised with samples of known in vivo DOM (Clarke et al. 1982) and NDF was determined using Filtrex equipment under standardised conditions, a technique previously found to give identical values to the method of Van Soest and Wine (1967). Nitrogen was determined using a micro-kjeldahl digestion followed by automated colorimetric measurement of ammonia, based on the salicylate configuration of the Berthelot reaction. Soluble carbohydrates were determined spectrophotometrically as the anthrone complex following cold water extraction (Anon 1973).

RESULTS

Figures 1-4 show the relationships between feed offered and extrusa for DOM, SC, NDF and N, each point representing one OF wether. Comparisons were made on an organic matter basis because of a significant increase in the ash content of extrusa samples compared with the feeds offered (13.6 vs 8.8% respectively, P<0.01). The relationships between DOM and SC of feed and extrusa were:-

For equations 1 and 2, the slope of the line did not differ (P>0.05) from unity.

Relationships for NDF and N (equations 3 and 4) were both different (P<0.01) from Y = X

Feed DOM = 1.12 (±0.09) DOM extrusa - 9.17 (±0.26) RSD 3.3 R² 90.5 (1)
Feed SC = 1.26 (±0.14) SC extrusa - 0.36 (±0.32) RSD 1.5 R² 83.7 (2)

For DOM, SC and NDF, there was a closer relationship to Y=X when results were expressed on an organic matter basis rather than a dry matter basis, but the converse occurred with N (Fig. 4). When compared on a dry matter basis, the following equation was generated:

Feed N = 0.93 (±0.03) N extrusa - 0.05 (±0.03) RSD 0.1 R² 98.7 (5)

The function y = a+bx+c √x did not improve the precision of any equations.

Herbage dry matter recovered through the fistula per 100 g feed consumed was calculated from 12 samples. Mean recovery was 80.0 ± 4.7 g/100 g dry matter fed.
DISCUSSION

In our experiment, the DOM of extrusa samples was only 0.7% higher and not significantly different from that of the feed consumed, a finding similar to that of Cohen (1979). Langlands (1966), Barth and Kazzal (1971) and Scales et al. (1974) have all shown that the DOM of extrusa is higher than that of the feed consumed but the differences were often small and variable. The precision of our relationship between feed and total extrusa DOM was similar to that of Langlands (1966) where DOM was determined separately in solid and liquid fractions (RSD 3.3 and 3.4 respectively). When extrusa is freeze-dried, the sample preparation time and number of samples are reduced as separation of solid and liquid fractions is unnecessary. Also the risk of non-enzymic browning (Van Dyne and Torrell 1964) is avoided.
The regression equation (2) of SC data was not different from \( Y = X \) due to high variability (RSD 1.5, \( \pm 18.6\% \)). However, a paired 't' test of the data showed that the extrusa was lower in SC than the feed on offer (6.5 vs 7.9\%, \( P<0.01 \)). As leaching could not occur through the bag, the lower extrusa values may have been due to soluble material mixing with saliva and bypassing the fistula. Foam plugs fitted in the oesophagus (Hamilton and Hall 1975) may reduce this problem and improve the accuracy of SC estimation.

There was a significant relationship between NDF of extrusa and feed offered (equation 3) with the greatest divergence from \( Y = X \) occurring with feeds containing high fibre levels. Our results agree with those of Little (1972) and show that extrusa contains a higher ratio of cell contents to structural material than the feed eaten, and that equations may be developed to correct extrusa values.

Nitrogen levels in extrusa samples were higher than for the feed prior to collection. Therefore, when expressed on an organic matter basis, the difference was made larger due to the higher ash content of extrusa samples (equation 4 vs 5). However, as has been shown by Little (1972), there is a strong relationship between extrusa and feed N which is usually close to \( Y = X \) and equations may be developed to accurately correct extrusa N values.

We conclude that extrusa samples provide a reliable estimate of DOM and that N and NDF extrusa values may be corrected for collection effects using appropriate equations. Extrusa SC is less reliable and further investigation is necessary before extrusa samples may be used to accurately predict feed SC.

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REFERENCES