THE EFFECT OF SAMPLE PREPARATION ON THE DIGESTION OF CHOPPED, MASTICATED AND GROUND SIRATRO AND PANGOLA GRASS IN NYLON BAGS

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SUMMARY

Pangola grass and siratro were prepared as dried chopped hay and fed to 3 sheep over two 5 week periods. Samples of feed prepared as fresh frozen material or dried chopped hay were then either masticated or ground and these samples incubated in nylon bags. An equation of form $p = a + b(1 - e^{\frac{-t}{t}})$ (Orskov and McDonald 1979) described accurately ($r = 0.92 - 0.99$) the process of DM and N disappearance over time. The potential degradability of pangola grass (73.1 to 82.9%) DM was significantly higher than that of siratro (61.8 - 65.7%). Mastication increased potential degradability, solubility and degradation rate of DM and N for both species. Sample preparation was shown to affect the estimates of DM degradability rate constants, with fresh frozen samples significantly greater than that for dried samples and ground samples significantly greater than that for chopped and masticated samples.

INTRODUCTION

The use of nylon bags suspended in the rumen to determine rates of feed digestion was first reported by McAnally (1942), and this technique has since been used in many laboratories to rank feeds in nutritive value (Ayres et al. 1976). More recently, nylon bags have been used to determine the degradability of feed proteins in the rumen (Mathers et al. 1977, Orskov & Mehrez 1977) and it has been suggested that this information is useful in the formulation of dietary protein requirements for ruminants (ARC, 1980). However, variation in the techniques used makes meaningful collation of results between laboratories difficult, although some standardization of procedures is being developed in the U.K. (Minson 1982 pers. comm.). Bag size (Mehrez and Orskov 1977), pore size (Ail and Stobbs 1980, Mathers et al. 1977), sample preparation (Bailey 1962), and basal diet (Orskov et al. 1980) significantly affect the values for degradability obtained for any one feed. Furthermore, few studies have considered whether degradability determined in nylon bags is related to in vivo degradability by the ruminant animal. The following experiment was conducted to study the effects of sample preparation on dry matter and nitrogen degradability in nylon bag studies.

MATERIALS AND METHODS

Animals and diets

Three mature Border Leicester x Merino wethers fitted with rumen canulae (38 mm ID) were held in metabolism cages in a constant environment room. One of the following two diets was offered to these sheep in two separate experiments. Diets were offered ad lib from hourly feeders for five weeks during which an in vivo digestibility trial was carried out in the last 27 days. The diets used were: pangola grass (Digitaria decumbens, Stent) harvested after 5 weeks regrowth (16.6% crude protein), dried (65%) and chopped (2-2.5 cm). Siratro (Macroptilium atropurpureum) was harvested at 11 weeks (15.1% crude protein) and processed in a similar way to the pangola grass. At harvest a fresh sample of each pasture was collected and frozen.

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Experimental design

Pangola grass and siratro were prepared for use in nylon bags in the following forms - fresh and frozen, dried and chopped (diet fed to sheep), dried and ground (2mm screen), fresh frozen and masticated and dried, chopped and masticated. Masticated samples were prepared by feeding the appropriate samples to oesophageally fistulated sheep and collecting total extrusa which was then freeze dried for use. The digestibility of the above samples was determined by the nylon bag technique in 3 sheep per diet.

Analytical methods

Nylon screen (63u, Nyta1 screens - Swiss Screens, Sydney) was sewn with nylon thread to form 17x20cm bag. Feed samples (3-4g) were sealed in each bag, and after soaking in water (30 sec.), 6 bags were placed in the rumen, ensuring complete immersion. Bags were withdrawn at 3,6,12,24,36 and 48 h after placement washed and dried at 60°C (Nehrez and Orskov 1977). Dry matter (DM) disappearance was calculated from the residue weight after drying (60°C for 24 h). N content was determined on feed and residue after Kjeldahl digestion by an autoanalyser technique (Henzell et al. 1968).

The relationship between DM and N disappearance (g/100g) and t was described by an equation of the form:

\[ p = a + b \left(1 - e^{-ct}\right) \]

(from Orskov and McDonald 1979)

where 
- \( p \) = DM or N disappearance (g/100 g)
- \( c \) = Degradation rate (min^{-1})
- \( t \) = Time (min)
- \( a \) = Immediately soluble fraction (g/100 g) (p at t = 0)
- \( b \) = Fraction that disappears at rate c (g/100 g)
- \( a+b \) = Potential degradability (g/100 g) (p as t \to \infty)

Experimental data were fitted to the above curve by an interactive curve fitting computer program. From each data set, values for \( a+b, a \), and \( c \) were determined and subjected to analysis of variance to detect differences between treatment means.

RESULTS

The mean apparent in vivo digestibilities (%) of dry matter (±SE) in sheep given the pangola grass and siratro diets were 66.4±1.4 and 54.2±1.1 respectively. Mean values, with LSD, for the potential degradability, solubility and degradation rates in nylon bags of pangola grass and siratro prepared in different ways are shown in Table 1. The curve fitting program used accounted for 84 to 98% of the variation in experimentally determined values. The potential degradability of DM in dried pangola grass was significantly (P<0.05) greater than that of siratro, but N degradability was significantly (P<0.05) higher in dried siratro than in pangola grass. Drying the fresh feed significantly decreased the potential degradability of both DM and N.

The readily soluble fraction (solubility) represents that plant material which immediately disappears when feed enters the rumen. This value calculated from our data proved to be the most variable and caused most difficulty in the curve fitting procedure. Pangola grass contained significantly (P<0.05) more soluble N than did siratro, and mastication resulted in significant (P<0.05) increases in both DM and N solubility in the dried siratro. Drying the fresh pangola grass significantly (P<0.05) increased the solubility of N in masticated samples.
Degradation rate, as described in Table 1, is a rate constant, and may be used to calculate either instantaneous or total degradation that has occurred over a given time. Dried siratro was degraded at a significantly (P<0.05) faster rate than pangola grass, and was significantly (P<0.05) increased by mastication of pangola grass. The DM and N content of fresh frozen masticated samples were degraded significantly more than these components in the dried masticated samples. When siratro was ground, there was no significant effects on either the potential degradability or solubility of DM and N, however degradation rate was significantly increased in the ground material for both species. Fig. 1 shows the effects of sample preparation on the disappearance caused by mastication and grinding of the sample. The effects of sample preparation were similar for pangola grass.

<table>
<thead>
<tr>
<th>Component</th>
<th>Form</th>
<th>Pangola grass</th>
<th>Siratro</th>
<th>LSD (P&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Matter</td>
<td>Dried</td>
<td>82.9a</td>
<td>73.1b</td>
<td>61.8c</td>
</tr>
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<td></td>
<td>Frozen</td>
<td>80.4a</td>
<td>66.1b</td>
<td>1.7*</td>
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<tr>
<td>Nitrogen</td>
<td>Dried</td>
<td>68.3a</td>
<td>82.1b</td>
<td>79.1c</td>
</tr>
<tr>
<td></td>
<td>Frozen</td>
<td>87.7a</td>
<td>82.8b</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>LSD (P&lt;0.05)</td>
<td>7.3*</td>
<td>3.0*</td>
<td>2.4*</td>
</tr>
<tr>
<td>Dry Matter</td>
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<td>9.3a</td>
<td>11.3a</td>
<td>15.7a</td>
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<tr>
<td></td>
<td>LSD (P&lt;0.05)</td>
<td>6.3</td>
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<tr>
<td>Nitrogen</td>
<td>Dried</td>
<td>27.9a</td>
<td>5.7b</td>
<td>16.6c</td>
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<td>13.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSD (P&lt;0.05)</td>
<td>10.8*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

The higher potential degradability of frozen compared with dried samples agrees with previous studies (Beever et al. 1976) where drying depressed the apparent N digestibility and solubility of pasture samples. The trend of higher rates of degradation for masticated compared with chopped samples, agrees with earlier work (Bailey 1962) where masticated samples showed significantly greater degradation up to 13 hours incubation in the rumen. However in the present study, the effect of mastication differed for the two forages used. The degradation rate of pangola grass was significantly increased by mastication, but did not alter degradation rate, potential degradability or solubility of siratro samples.

The effect of grinding as shown by the siratro did not affect the potential degradability or solubility but significantly increased the degradation rate. It
would seem that estimates of degradability based on the use of ground hay samples (Kempton 1980) will over-estimate the degradation rates of feeds normally consumed in a chopped form. Chopping of forage samples appears to be the most suitable form as it would be easier to standardise than mastication of nylon bag samples. The successful application of the nylon bag technique to the prediction of feed degradability in the rumen will require more specific information on not only the form of sample preparation but also on the actual rate of digestion in the rumen and the water and particulate matter flow associated with the particular diets under study.

REFERENCES


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