# CRITICAL ASPECTS IN INTESTINAL DIGESTION ESTIMATES OBTAINED BY THE MOBILE BAG METHOD

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## Introduction

In the recent ruminant nutrition research, the *mobile bag technique has been suggested as a tool* in estimating the intestinal digestion of individual feed nutrients (Voigt et al., 1985; Hvelplund, 1985). The present study was designed to assess the influence of bag cloth characteristics and flow of intestinal non-feed N into the bags on the degradation values obtained for feeds of different nature.

## Materials and Methods

Experimental feeds used were ryegrass, barley and barley straw, all labelled with $^{15}N$ as described *by Varvikko and Lindberg (1985).* Milled (1 mm mesh) feeds (barley, 1,100 mg; roughages, 800 mg) were weighed into a 3.5 x 5.0 cm polyamide bag with a proportion of free (open) surface area (% of total surface)/pore size (μm) of 2/1, 2/10, 5/6, 5/16, 15/30 or 33/41. The bags were prepared and closed by heat sealing and introduced, through a t cannula, into the duodenum of non-lactating cow fed 4 kg grass hay and 1.75 kg of 1:1 mix of barley and oats. The bags were collected from the faeces approximately 21 hours later, washed for one hour in a rotating cylinder with running tap water (40 °C), and dried (60 °C/24 h). The bags were weighed, and 3-4 bags were randomly pooled to form one sample. Three samples were collected for each occasion (feeds, bag material) to be analysed for their DM, Kjeldahl-N, $^{15}N$ (*Varvikko and Lindberg, 1985*). NDF (Van Soest and Wine, 1967) and Kjeldahl-N in NDF (NDF-N).

The effect of bag cloth on the disappearance of feeds from the mobile bags was statistically analysed according to the analysis of variance.

## Results and discussion

The bag cloth significantly ($p < 0.05$) affected the disappearance of DM, NDF, N, NDF-N and $^{15}N$ from the bags within the intestine with barley, *DM and N with ryegrass, and* DM, NDF-N and $^{15}N$ with barley straw (table 1). In the following discussion, the methodological details involved in the bag technique rather than actual degradation values are emphasized, because the experimental feeds were not exposed to the rumen microbial degradation or abomasal digestion prior to the intestinal digestion.

Lowest disappearance values were usually measured with bags with a 2 % free surface (1 μm or 10 μm pore size). The maximal disappearance values for ryegrass and barley were often reached, irrespective of the pore size, with bags with a free surface of 5 % or more. With straw, differences between bags, if any, were more obvious between 1 and 10 μm pores, i.e. bags with a 2 % free surface. Disappearance of feeds from bags with a *free surface of 5 % or more was quite consistent,* even with a smaller pore size of 6 μm. These results should indicate that, within the given bag cloth margins of 2/1 to 33/41 %/μm, the free surface area rather than pore size is an important determinant of the degradation of feeds in the intestinal nylon bag.

It should be relevant to extent the importance of free surface area of bag cloth to the rumen degradation studies with the bag technique. Rumen bags usually have 30 to 45 μm pores and a free surface area varying, say, between 15 and 35 % (e.g. Polymon, Zurich, Switzerland). The closed bag surface area ranging 65-85 % is likely to reduce the microbial invasion into the bags and breakdown of feeds therein, compared to that of the free floating feeds in the rumen, because of *need for direct contant before microbial enzyme* action. Actually, lowered microbial polysaccharidase activity in the feed residues in nylon bags compared to respective free floating feeds has been found (Huhtanen and Khalili, 1989).



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TABLE 1. INTESTINAL DISAPPEARANCE (%; N=3) OF DRY MATTER (DM), NEUTRAL DETERGENT FIBRE (NDF), N, NDF-N AND $^{15}$N FROM FEEDS ENCLOSED IN BAGS WITH VARYING FREE SURFACE AREA/PORE SIZE (%/μm)

| Free surface/ bag pore... | 2/1 | 2/10 | 5/6 | 5/16 | 15/30 | 33/41 | SEM | Bag cloth effect |
|---|---|---|---|---|---|---|---|---|
| Ryegrass | | | | | | | | |
| DM | 48.2 | 52.9 | 55.5 | 55.1 | 54.8 | 56.3 | 1.32 | ** |
| NDF | 19.7 | 24.7 | 24.3 | 22.9 | 23.5 | 26.5 | 2.10 | NS |
| N | 68.5 | 75.4 | 80.4 | 81.3 | 81.0 | 81.0 | 2.75 | * |
| NDF-N | 81.4 | 82.2 | 85.7 | 86.0 | 86.8 | 85.1 | 1.25 | NS |
| $^{15}$N | 74.9 | 82.8 | 86.9 | 86.2 | 86.6 | 86.5 | 2.86 | NS |
| Barley | | | | | | | | |
| DM | 46.8 | 60.6 | 79.0 | 83.4 | 82.5 | 83.4 | 1.12 | *** |
| NDF | 34.7 | 36.5 | 44.4 | 50.9 | 48.9 | 49.8 | 1.03 | *** |
| N | 70.8 | 81.4 | 88.5 | 90.6 | 89.7 | 90.1 | 1.00 | *** |
| NDF-N | 63.0 | 62.9 | 73.4 | 75.2 | 75.0 | 71.8 | 1.36 | *** |
| $^{15}$N | 76.6 | 85.3 | 90.6 | 92.5 | 91.2 | 92.4 | 0.94 | *** |
| Barley straw | | | | | | | | |
| DM | 12.4 | 17.1 | 17.7 | 17.4 | 18.5 | 19.1 | 0.89 | ** |
| NDF | 7.4 | 7.7 | 8.3 | 7.0 | 7.8 | 8.3 | 0.53 | NS |
| N | 24.8 | 37.6 | 30.9 | 29.2 | 34.0 | 24.7 | 3.89 | NS |
| NDF-N | 32.0 | 19.6 | 29.0 | 17.2 | 25.5 | 14.0 | 3.65 | * |
| $^{15}$N | 58.6 | 67.5 | 68.6 | 71.1 | 67.7 | 68.4 | 1.00 | *** |

NS, $P > 0.05$; *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$.

Much higher nitrogen disappearance from the bags compared to the respective dry mass disappearance (N vs. DM, NDF-N vs. NDF) demonstrated the high activity of ruminant intestinal enzymes to release nitrogen even from fibrous feeds. Microbial feed N digestion in the lower gut should be small (Hvelplund, 1985; Voigt et al., 1985).

$^{15}$N, an internal feed N marker (Varvikko and Lindberg, 1985), disappeared from the bags always clearly more than N, the difference between these two being very dramatic with straw. The difference between apparent and true (i.e. N and $^{15}$N) feed N disappearance indicated intestinal non-feed N in the residual feeds. The difference was, on the average, 6.1, 2.9 and 36.8 %-units in ryegrass, barley and barley straw, respectively, and the respective proportions of non-feed N in the residues were calculated to be 27.4, 19.7 and 52.7 % of total N (table 1).

The present results suggest that disappearance of Kjeldahl-N from the mobile bag underestimates the feed N disappearance from the bag. This underestimate varies according to the nature of feed, and is more obvious with fibrous feeds with a low N content.

(Key Words: Mobile Bag, Intestinal Digestion, Ruminant)

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