

RUMINAL DISAPPEARANCE OF EXTRACTED SOYBEAN MEAL AND MEAT MEAL

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Story in Brief

Soybean meal (SBM and meat meal (MM) in original form, rinsed with buffer or following buffer extraction at pH 5 or 7, were ruminally incubated for various times up to 72 hours in the rumen of heifers fed 20 (R) or 80 (C) concentrate diets. In situ dry matter and nitrogen disappearances (DMD, ND) for SBM and MM tended to be greater for the roughage than the concentrate diet at shorter times of incubation but greater for the concentrate than the roughage diet for incubation times over 24 hr. For untreated SBM, disappearance at 4 hr of incubation was higher for the 20 percent than the 80 percent concentrate diet. Extraction reduced the extent of ND from SBM but not from MM. DMD and ND were not markedly altered by pH of extraction (5 vs 7). Differences in ND between C and R diets cannot be explained simply by loss of soluble protein since differences continued beyond the time for soluble protein to be removed.

Introduction

Ruminal pH has been suggested to be a primary factor which alters protein digestion in the rumen, presumably due to differences in solubility of protein at different pH. Removal of soluble protein should occur during the first few hours of ruminal incubation. Prolonged effects of ruminal pH on rate of substrate disappearance after rapidly solubilized materials are gone are not well defined, though treatment of protein with acetic acid may reduce in situ ND. Protein solubilization could theoretically alter subsequent protein disappearance, however, pH also could influence microbial degradation capacity. The objectives of this experiment were to detect and quantitate the effect of removal of soluble materials from soybean and meat meal on in situ dry matter and nitrogen disappearance in heifers fed a concentrate or a roughage diet.

Materials and Methods

Two Hereford heifers (482 lb), fitted with ruminal cannulas (10.2 cm i.d.), were used in a crossover experiment. Animals were fed diets at 1.7 percent body weight (dry matter basis) in four equal feedings per day. Diets were 20 and 80 percent roughage, made isonitrogenous by addition of soybean meal. Prairie hay was varied to achieve the different roughage levels. Periods lasted 15 days, with dacron bags being incubated the last three days of each period. Substrates tested and incubation times are presented in Table 1. SBM and MM were extracted with McDougalls buffer adjusted to pH 5.0 or 7.0 for six hours at 39 C in a shaking water bath. After extraction, samples were sieved

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Table 1. Substrates, preparation and incubation times.

Substrate	Preparation	Incubation times, hr
Soybean meal	None	4, 12, 24, 48
Meat meal	Extracted, pH 5	4, 12, 24
Soybean meal	Extracted, pH 5	4, 12, 24
Meat meal	Extracted, pH 7	4, 12, 24
Soybean meal	Extracted, pH 7	4, 12, 24
Meat meal	Rinsed, pH 6	4, 12, 24, 48, 72
Soybean meal	Rinsed, pH 6	4, 12, 24, 48
Meat meal plus soybean meal	Rinsed, pH 6	4, 12, 24, 48, 72

using dacron cloth to retain the insoluble residues. Residues were dried at 60 C for 10 hours and screened through a 2 mm sieve prior to placing into bags. On removal of bags from the rumen, bags were rinsed with tap water until rinsing water was clear. Bags were then dried at 100 C and residual dry matter was determined. Nitrogen contents of bag plus the residue were measured. Blank bags were similarly incubated to partially correct for influx of material from the rumen. Rates of DMD and ND were calculated by regressing amounts of residual material against time. Ruminal fluid samples were obtained at times at which bags were placed in the rumen and analyzed for pH and ammonia N ($\text{NH}_3\text{-N}$) concentration.

Results and Discussion

Ruminal pH was higher ($P < .05$) while ruminal $\text{NH}_3\text{-N}$ concentration was lower with the R diet (6.41 vs 6.90 and 12.0 vs 1.7 mg $\text{NH}_3\text{-N/dl}$ for C and R treatments, respectively). Ruminal pH has been observed to cause shifts in bacterial growth and species and has been recognized to affect protein solubility. DMD and ND for SBM (Figure 1) tended to be higher with heifers fed the R diet than with those fed the C diet at shorter incubation times, however the reverse was noted with longer incubation times with both MM and SBM (Figure 2).

SBM and MM were extracted at pH 5 or 7 to study effects of removal of the soluble proteins on in situ digestion. ND of SBM at 4 hr was reduced by extraction at pH 5 or pH 7 (Figure 3), presumably due to removal of soluble components. ND of untreated MM at 12 and 24 hr was intermediate to MM extracted at pH 7 and 5 (Figure 4). Animal protein sources may respond differently to ruminal pH conditions than vegetable protein feeds.

DMD and ND of SBM extracted at pH 5 and 7 did not greatly differ. Higher rates of DMD and ND averaged across feedstuffs, were observed for the R diet than for the C diet ($P < .05$) at all incubation times. Rates of SBM DMD and ND from 4 to 24 hr were greater for the R than the C diet. Since this was observed despite extraction, results suggest that differences in ND rates between C and R diets cannot be ascribed simply to removal of soluble protein. Rates of ND from 4 to 12 hours for the R diet were generally higher with the SBM that was extracted at pH 5.

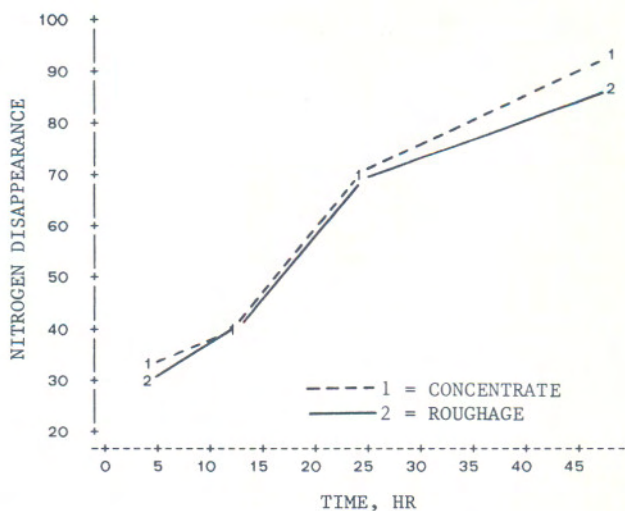


Figure 1. Nitrogen disappearance of rinsed soybean meal.

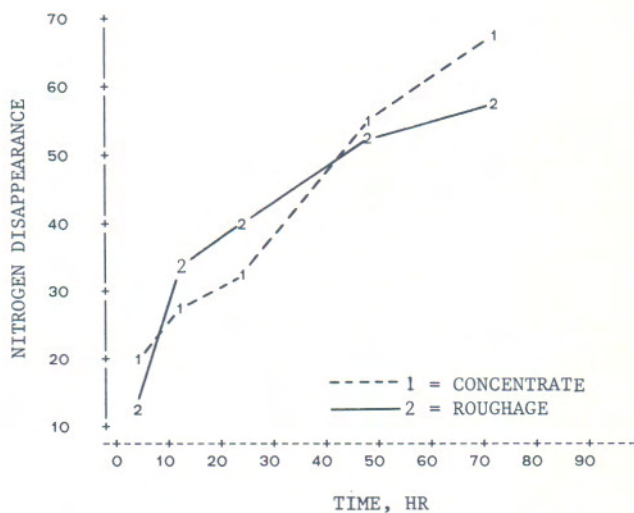


Figure 2. Nitrogen disappearance of rinsed meat meal.

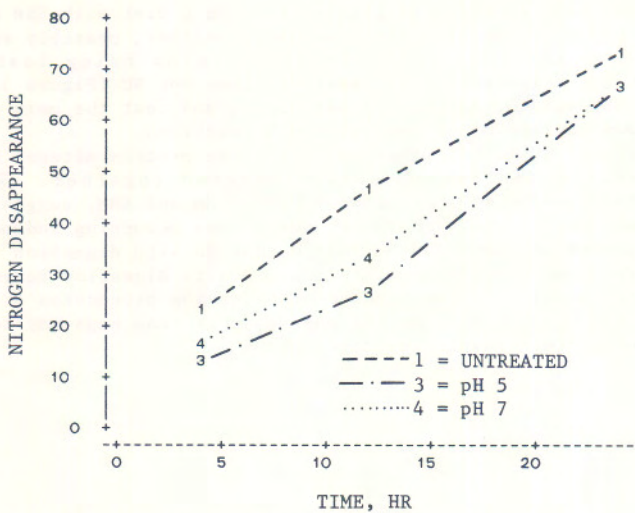


Figure 3. Nitrogen disappearance of soybean meal.

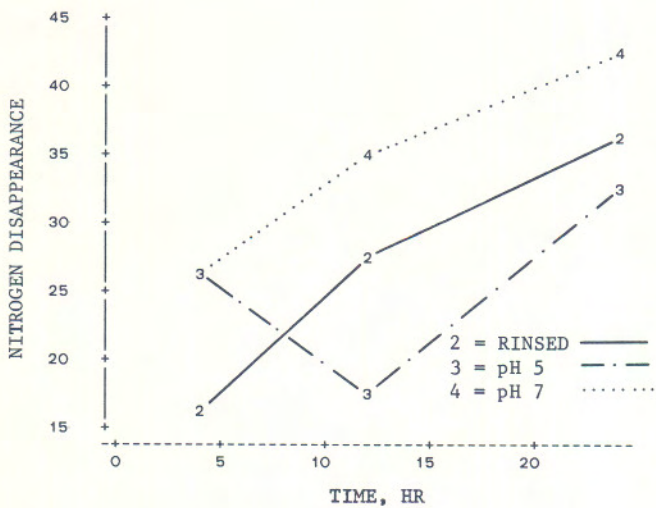


Figure 4. Nitrogen disappearance of meat meal.

Likewise, values tended to be greater for the C diet with SBM extracted at pH 7. Differences at later times were smaller, possibly reflecting different quantities or types of proteins being lost during preincubation treatment. The parallel lines for ND (Figure 3) suggest that ND of SBM was not altered by extraction and that the main effect of extraction was in removal of the soluble N fraction.

To determine whether presence of soluble protein altered DMD on ND in situ, rinsed SBM and MM were incubated together. Rates of disappearance were midway between rinsed MM and SBM, suggesting that degradation of the two protein sources was occurring independently. Previously, some workers have suggested that in situ digestion rates are not additive. Our results indicate that in situ digestion rates for SBM and MM were additive. Interference with washing procedures or problems with inoculation or removal of end products from bags may complicate incubation of certain substrates together.