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EFFECT OF PHYSICAL FORM OF DIET ON RUMINAL MICROBIAL AND METABOLIC DEVELOPMENT IN YOUNG CALVES

**A. A. Beharka, T. G. Nagaraja,
and J. L. Morrill**

Summary

Eight, ruminally cannulated, newborn, Holstein, bull calves were assigned to receive either finely ground or unground (chopped hay and normally ground grain) diet to study the effects of diet form on ruminal microbial and metabolic development. The difference in diet particle size caused a difference in ruminal pH and a shift in the bacterial population, as evidenced by decreased cellulolytic and increased amylolytic bacterial counts for the ground diet.

Introduction

Both the producer and the calf benefit by rapid development of the calf's ruminal function. Early ruminal development can lead to increased consumption of dry feed and early weaning, resulting in reduced labor and feed costs. Ruminal development is largely influenced by the consumption of dry feed and the products of its digestion. In addition, studies have shown that roughage is beneficial to ruminal development; however, calves are notoriously inconsistent consumers of roughage.

The feeding of a complete calf diet, in which ground roughage and concentrate are incorporated into a pellet, has become more common because it guarantees a constant roughage intake and facilitates feeding. However, limited research is available on how diet particle size influences ruminal metabolic and microbial development in the neonatal calf. This study was conducted to examine the effect of diet particle size on ruminal microbial numbers, fermentation characteristics, and liquid dilution rates in neonatal calves.

Procedures

Eight, ruminally cannulated, Holstein, bull calves were paired by birth date and birth weight, and calves of a pair were assigned randomly to receive either a finely ground or unground (chopped hay and grain) diet form. Diets varied in particle size but were identical in composition (75% grain mix : 25% alfalfa hay). Calves were fed milk at 8% of birth weight until weaning at 5 wk of age. Feed intake was equalized for each pair of calves. Calf health and fecal scores were recorded daily, and calf weight was recorded weekly.

When the calves were 2, 4, 6, 7, and 10 wk of age, ruminal fluid samples were collected 2-hr postfeeding on 3 consecutive days for determination of pH, VFA, L(+) lactate, ammonia,

and buffering capacity and for bacterial enumerations. During weeks 6, 8, and 10, calves were dosed with chromium EDTA to measure liquid flow rates.

Results and Discussion

Birth wt were similar for calves fed the ground and unground diets (mean = 86 lb), but calves fed the ground feed tended ($P=.12$) to be heavier at 10 wk of age than calves fed the unground feed, even though feed intakes were similar. However, calves fed the unground diet tended ($P=.13$) to be healthier, based on fecal scores and general appearance, than calves fed the ground diet.

Ruminal pH was affected by age ($P<.01$) and was lower ($P<.10$) in calves fed the ground diet than the unground diet (Figure 1). Total VFA concentration increased with age ($P<.01$) and appeared to be higher with the ground diet. Liquid flow rates (8.3%/hr) were not affected by diet form or calf age. Ammonia concentration decreased with age ($P<.01$) but did not differ between diets.

Calves fed the ground diet had lower numbers ($P<.10$) of cellulolytic bacteria and higher ($P<.10$) amylolytic counts (Figure 2) and tended to have higher total bacterial counts. Diet particle size did not influence number of proteolytic and lactate-utilizing bacteria.

Conclusion

Calves fed the ground diet tended to be heavier and have higher fecal scores (lower dry matter) than calves fed the unground diet. The smaller particle size of the ground diet caused a reduction in rumen pH. The lower rumen pH may have decreased cellulolytic bacteria because of their sensitivity to low pH. Amylolytic bacteria, which are pH tolerant, increased in number in calves fed the ground diet.

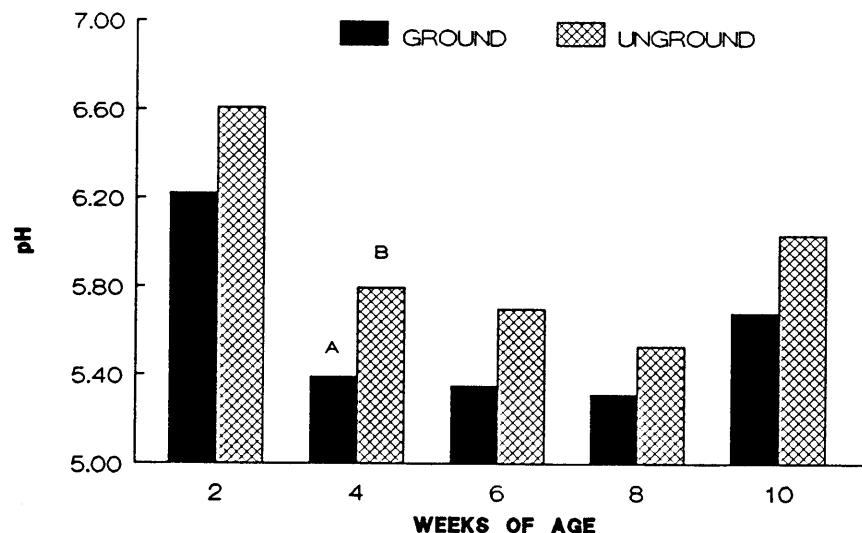


Figure 1. Ruminal pH (diet effect, $P<.05$; age effect, $P<.01$) in calves ($n=8$ per diet) fed ground and unground diet forms. Bars with different superscripts differ ($P<.05$).

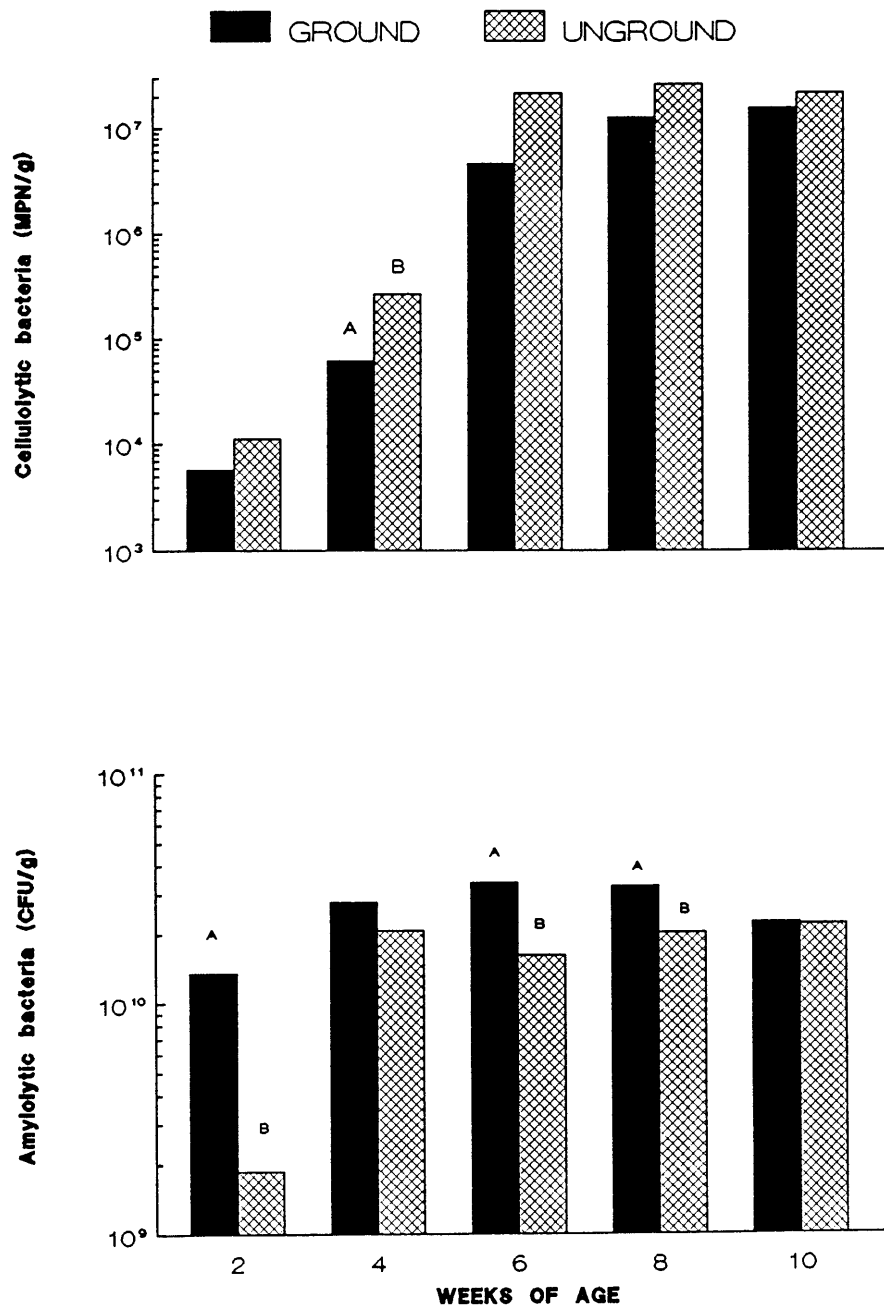


Figure 2. Semilog plots of cellulolytic (diet effect, $P < .10$) and amylolytic bacteria (diet effect, $P < .10$) in calves ($n=8$ per diet) fed ground and unground diet forms. Bars with different superscripts differ ($P < .05$).