Adaptation of the microflora in the rumen and caecum of the high arctic Svalbard reindeer

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The Svalbard reindeer relies on a highly active rumen microbial population of bacteria, fungi and protozoa for the utilization of cellulose and hemicellulose, the major components of growing plants (Rogers and Perkins, 1968). On Svalbard the availability and quality of food changes during the year, ranging from fresh young forage in summer (July - September), to a highly concentrated diet, including seedheads with a high content of protein and starch at the end of the summer, to a highly fibrous diet in the long, harsh winter (October-June).

The Svalbard reindeer have developed a large caecum constituting 12% and 7% by weight of the total intestinal tract in winter and summer respectively (Staaland *et al.*, 1979), but the nutritional importance of the caecum as a fermentation chamber is poorly understood in ruminants.

Optimal utilization of available plants in the rumen and caecum in summer, when body energy stores are deposited, as well as in winter, when food is in short supply, could be of crucial importance for the survival of these animals.

We have therefore presently characterized the dominant bacteria in the rumen and caecum of Svalbard reindeer, in summer (September) and winter (April) (Orpin *et al.*, 1985, Mathiesen *et al.*, unpublished data).

The population density of viable rumen bacteria was 181 $\pm$ 124 x 10^8 ml^{-1} in summer and 35 $\pm$ 29 x 10^8 ml^{-1} in winter. The winter experiments were conducted after a long period during which the vegetation had been covered with ice, and in spite of that, the winter population density was suprisingly high, with the percentage of cellulose digesting bacteria increasing from 15% in summer to 35% in winter. The percentage of bacteria utilizing hemicellulose constituted 30% and 58% of the viable bacterial population in summer and winter respectively.

The dominant cellulolytic bacterium in the rumen was *Butyrivibrio fibrisolvens* which constituted 10% of the viable population of rumen bacteria in summer and 18% in winter. Of the total *B. fibrisolvens* population 45% and 60% isolates showed cellulolytic capacity, in winter and summer.

The viable bacterial population density in the caecum was 8.9 $\pm$ 5.3 x 10^8 ml^{-1} in summer, but it decreased to 1.5 $\pm$ 0.7 x 10^8 ml^{-1} (17%) in winter, a similar percentage decrease to that shown by the rumen microbial population. Of the total caecal population, 10% of summer isolates had cellulolytic properties compared with 6% of winter isolates. The percentage of caecal bacteria utilizing hemicellulose was 33% of isolates in summer and 48% in winter.

The dominant cellulolytic caecal bacterium in summer was *B. fibrisolvens*, and in winter, *Ruminococcus albus*. These species represented 7% and 5% of the viable bacterial population density in each season, respectively (Mathiesen *et al.*, unpublished data).

The caecal bacterial population contained large numbers of species which have the potential to degrade plant material, including plant cell wall polysaccharides, which have escaped ruminal fermentation. While we have no data yet on particle flow rates from the rumen, we have observed large, relatively intact, plant tissues in the caecum of animals sampled in the summer. It is likely therefore that plant tissues entering the caecum are subject to extensive microbial fermentation.

The Svalbard reindeer clearly shows seasonal changes in the microflora of both the rumen and caecum. The adaption of these microbial populations helps to maximize the utilization of the diet in summer, when the nutritional demand and food intake of high quality forage is high, and during winter when, despite the poor nutritional conditions, the animal still needs to meet the bulk of its energy requirements from the diet.

References

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