show lower counts of palindromes than would be predicted from a random distribution. We suppose that the consistently low frequencies of 4-bp and 6-bp palindromes observed within the DNA of ruminal bacteria is probably a result of the variety and multiplicity of restriction systems found in bacteria from this ecological group. Possibly, there is a correlation between bacterial population density and the frequency of restriction endonucleases.

Bacterial counts in the rumen are higher than in any other environment. Together with the high bacterial counts, there are also unusually high concentrations of bacteriophages. If the protection of cells from bacteriophage infection is a primary role of restriction-modification systems, these systems should be more frequent in the rumen than in environments with lower populations of bacteriophages. In such a strongly competitive ecosystem as the rumen of herbivorous animals the possession of restriction activity can provide a selective advantage for survival of both the individual bacterial clone and the species as a whole.

1. Karlin S, Burge C, Campbell, AM (1992) *Nucleic Acids Res* 20, 1363-1370
2. Pristas P, Vanat I, Javorsky P (1997) *Folia Microbiol* 42, 121-124

Variability of endonucleolytic activity within natural population of *Selenomonas ruminantium.* P Pristas, I Vanat, N Kostrabova, P Javorsky (*Institute of Animal Physiology, Slovak Academy of Sciences, Soltesovej 4-6, 040 01 Kosice, Slovakia)*

The rumen is one of the most complex microbial ecosystems in nature. It is inhabited by a diverse community of bacteria, protozoa and fungi. Diversity in *S. ruminantium* strains isolated from the rumen was reported based on enzyme electrophoresis [1], as well as by DNA fingerprinting and DNA-DNA hybridization [2]. Usually, diversity was reported among bacterial isolates from different, sometimes extremely distant, sources. There is a comparative lack of data about variability within local populations.

On the basis of our previous study on the characterization of restriction activities in *S. ruminantium* [3] we analyzed a population of this species in the rumen of fallow-deer. Our analysis indicated high diversity of endonucleolytic activities within the population of *S. ruminantium.* At least 12 different restriction enzyme cleavage profiles, indicating the presence of nucleases with differing specificity, have been observed. Site-specific endonucleases were detected in 17 out of 45 strains tested; in other strains varying levels of non-specific activity were detected. Endonucleolytic activities seemed to be subspecies specific, since types of activity observed in subsp. *lactilytica* were not observed in subsp. *ruminantium* and vice versa. Plasmid DNAs ranging in size from 0.9 to more than 25 kbp were detected in 60% of strains analyzed. Little or no correlation was observed between endonuclease activity and plasmid content. The presence of endonucleases of differing specificity, as well as differences in the plasmid profiles of isolates possessing identical specific activity indicated that the population of *S. ruminantium* within the rumen of a single animal consisted of at least ten different clones.

Our results indicate a high diversity of endonucleolytic activities in *S. ruminantium* as well as high genetic variability

within *S. ruminantium* populations. The rumen of herbivorous animals is a strongly competitive ecosystem. If similar variability, as seen in *S. ruminantium*, is observed in other ruminal bacteria, competition between bacterial species will be markedly affected by competition and diversity within the competing species.

1. Flint HJ, Bisset J (1990) *FEMS Microbiol Ecol* 73, 351-360
2. Zhang N, Attwood GT, Lockington RA, Brooker JD (1991) *Curr Microbiol* 22, 279-284
3. Pristas P, Vanat I, Javorsky, P (1995) *Gene* 158, 139-140

Lack of surface receptors rather than possession of a restriction-modification system determines F4 phage resistance in *Streptococcus bovis* II/1. I Štyriak, P Pristaš, P Javorský *(Institute of Animal Physiology, Slovak Academy of Sciences, Šoltésovej 4-6, Košice, Slovakia)*

The resistance of *Streptococcus bovis* II/1 strain, which produces the *Sby*I restriction endonuclease, to F4 phage infection was demonstrated by the double agar layer method. Although restriction endonuclease *Sby*I is able to cleave F4 phage DNA to numerous fragments in vitro, evidence obtained from adhesion experiments in vivo suggests that inhibition of adsorption is the most important defence mechanism in phage resistance of *S. bovis* II/1. Electron microscopy of phage-host mixtures showed many phage particles to be present on the surface of a phage-sensitive control strain *S. bovis* 47/3, whereas no phage particles were seen on the surface of cells of the phage-resistant strain *S. bovis* II/1.

ANTI-NUTRITIONAL FACTORS

Biotransformation of toxic substances by rumen microbial ecosystem. P Javorský[1], P Pristaš[1], A Lauková[1] J Legáth[2] *([1]Institute of Animal Physiology, Slovak Academy of Sciences, Šoltésovej 4-6, 04001 Košice, Slovakia; [2]University of Veterinary Medicine, Komenského 73, 04001 Košice, Slovakia)*

The liver and kidney are generally regarded as main tissues for detoxification of toxic substances absorbed by animals. In ruminants, all potential poisonous substances enter the rumen before their passage to the lower parts of the digestive tract or before direct transport into the blood via the rumen wall or via the rumeno-hepatic circulation. The chemical composition of toxic substances following entry into the rumen can be very variable. Toxic substances which could enter the rumen through feedstuffs or by water include plant toxins and fungal or bacterial toxins which are a part of the natural microflora of grains. Farm and wild ruminants are, however, at the risk of exposure to inorganic and organic environmental pollutants, including pesticides, especially in countries with intensive industrial and agricultural production. The risk for exposure of wild ruminants to pesticides increases with the intensive chemical protection of forests.

We have paid particular attention to the mechanism of ruminant intoxication by the insecticide supermethrin, frequently used in agriculture against various species of insects, and the effect of PCBs presented in the silage pit coatings on the metabolism of silage lactogenic inoculants and, subsequently, on the mixed populations of