Near Infrared Spectroscopy for Measuring Purine Derivatives in Urine and Estimation of Microbial Protein Synthesis in the Rumen for Sheep

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The efficiency of the ruminal fermentation process influences overall efficiency of ruminal production, animal health and reproduction. Ruminant production systems have a significant impact on the global environment, as well. Animal wastes contribute to pollution of the environment as ammonia volatilized to the air and nitrate leached to ground water.

Microbial protein synthesis in the rumen satisfies a large proportion of the protein requirements of animals. Quantifying the microbial synthesis is possible by using markers for rumen bacteria and protozoa such as nucleic acids, purine bases, some specific amino acids, or by isotopic ^{15}N, ^{32}P, and ^{35}S labelled feeds. All those methods require cannulated animals, they are time-consuming and some methods are very expensive as well. Many attempts have been made to find an alternative method for indirect measurement of microbial synthesis in intact animals. The present investigations aimed to assess possibilities of NIRS for prediction of purine nitrogen excretion and ruminal microbial nitrogen synthesis by NIR spectra of urine.

Urine samples were collected from 12 growing sheep, 6 of them male, and 6 - female. The sheep were included in feeding experiment. The ration consisted of sorghum silage and protein supplements - 70:30 on dry matter basis. The protein supplements were chosen to differ in protein degradability. The urine samples were collected daily in a vessel containing 60ml 10% sulphuric acid to reduce pH below 3 and diluted with tap water to 4 liters. Samples were stored in plastic bottles and frozen at -20°C until chemical and NIRS analysis. The urine samples were analyzed for purine derivates - allantoin, uric acid, xantine and hypoxantine content. Microbial nitrogen synthesis in the rumen was calculated according to Chen and Gomes, 1995.

Transmittance urine spectra with sample thickness 1mm were obtained by NIRSystem 6500 spectrophotometer in the spectral range 1100-2500nm. The calibration was performed using ISI software and PLS regression, respectively.

The following statistical results of NIRS calibration for prediction of purine derivatives and microbial protein synthesis were obtained.

Parameter	SEC	R^2	SECV	CVR^2
Allantoin, mg/l	45.49	0.822	53.77	0.753
Total Purine Derivatives, mmol/d	1.42	0.843	1.68	0.776
Purine Derivatives Nitrogen, mg/d	105.17	0.821	121.72	0.760
Microbial Nitrogen, g/d	1.17	0.861	1.37	0.810

The result of estimation of purine nitrogen excretion and microbial protein synthesis by NIR spectra of urine showed accuracy, adequate for rapid evaluation of microbial protein synthesis for a large number of animals and different diets.

The results indicate that the advantages of the NIRS technology can be extended into animal physiological studies. The fast and low cost NIRS analyses could be used with no significant loss of accuracy when microbial protein synthesis in the rumen and the microbial protein flow in the duodenum are to be assessed by NIRS.