METABOLISM OF ^{15}N-UREA IN THE HINDGUT OF CATTLE

H. Bergner
Humboldt-University, Berlin, GDR

and

A. Sommer
Institute of Animal Production, Nitra, CS

Introduction

The general principle of microbial utilization of nitrogen derived from plasma urea in the hindgut of ruminants was shown from some authors. Furthermore, it is known that the urea inflow into the large intestine is mainly affected by the amount of fermentable material reaching this segment of the digestive tract (Nolan and Stachiw, 1979; Mason et al., 1981). The present study examined the effect of an additional supply of fermentable material to the hindgut on the inflow of plasma urea and its microbial utilization in young cattle and showed a comparison after intracaecal urea application.

Materials and Methods

The experiments were carried out on 3 bulls in experiment A (mean LW 198 kg), 3 bulls in experiment B (192 kg) and 2 heifers in experiment C (226 kg), equipped with ileo-caecal re-entrant cannulas and with catheters in the jugular vein. Ileal digesta was precollected and stored at - 20°C. During the course of the experiment (24 h) ^{15}N urea was infused intravenously (30 g urea with 75 atom-% ^{15}N-excess) in the experiments A and B or intracaecal (24 g urea with 10 % ^{15}N-excess) in experiment C. During this period and the following 6 hours the cannula was disconnected and out-flowing ileal digesta were removed quantitatively. While in group A precollected digesta only were reintroduced into the distal part of the cannula the reintroduced ileal digesta in the groups B and C was supplemented with partly hydrolysed straw meal at a rate of 10 % of the DM-intake. The precollected digesta (A), the digesta + straw meal (B) and the digesta + straw meal + 1 g ^{15}N-urea (C) were introduced hourly into the distal part of the cannula. N-fractions of faeces, ileal digesta and urine were analysed for ^{15}N-excess.

Results and Discussion

The average atom-% ^{15}N-excess of faecal NH_3-N during the urea application period (24 h), the next 6 hours with closed cannula and the later 36 hours (72 h after beginning) is shown in figure 1.

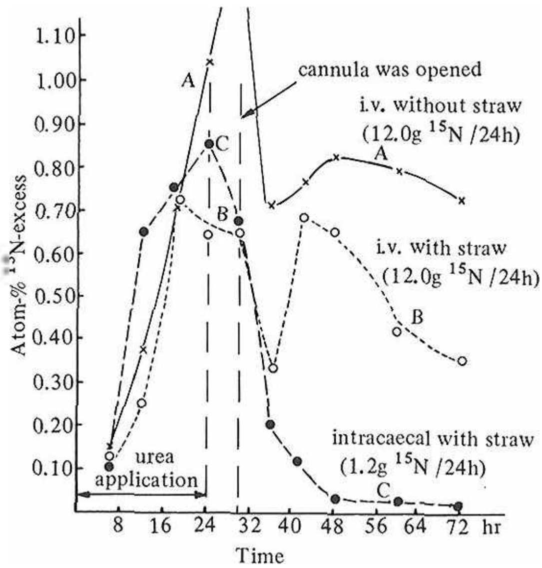

Figure 1. Atom-% ^{15}N-excess in NH_3-N of faeces.

The labelling of NH_3-N in faeces was the highest at the 24th to 30th hour after the start of the urea application. The atom-% ^{15}N-excess in group A (without an extra fermentable fibre source) was 2 to 3 times higher in comparison to group B with added partly hydrolysed straw meal to the reintroduced digesta. The ^{15}N-labelling of faecal bacteria-N is shown in figure 2.

The highest labelling was found in group C after intracaecal urea application. The added partly hydrolysed straw meal caused a doubled atom-% ^{15}N-excess during the i.v. urea infusion in group B in comparison to group A. The ^{15}N-labelling of bacterial nitrogen in the faeces increased sharply in the groups A and B after opening the cannula with a time lag of 6 hours. This is in following of the high ^{15}N-labelling of the ileal digesta. In figure 3 is shown the atom-% ^{15}N-excess of the faecal total-N

The curves represent the ^{15}N-labelling of bacterial-N in faeces in consideration of the amounts of non bacteria nitrogen in faeces. The added fermentable fibre source in group B caused a higher ^{15}N-incorporation after the influx of endogenous ^{15}N-labelled compounds from the ileal digesta also. The fermentable sources of the partly hydrolysed straw meal were utilized or left the large intestine 24 hours after the end of ^{15}N-administration. In figure 4 is shown the ^{15}N-excess excretion in faeces in percent of the applied ^{15}N-excess in urea.

The added fermentable fibre source in group B caused a 4 times higher ^{15}N-utilization in comparison to group A. The very high ^{15}N-labelling of ammonia-N (figure 1) in group A indicated a higher influx of ^{15}N-labelled urea as 0.17 % of the ^{15}N-application. The ^{15}N-excess excretion in faeces in group C was 3.28 % in average (3.31 %, 3.25 %) of the applied ^{15}N-excess. This measurement shows a two fold higher utilization rate in group C in comparison to group B. It seems that urease activities of microbes, associated with the gut wall, hydrolysed the main part of ^{15}N-labelled

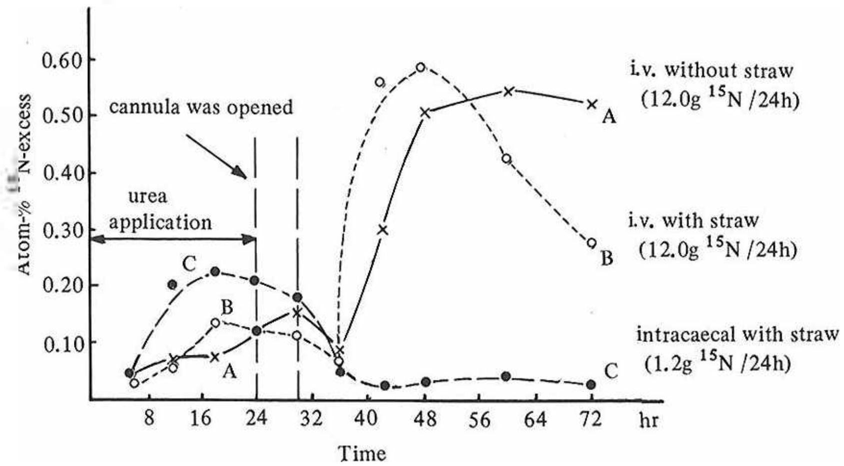

Figure 2. ^{15}N-excess in bacterial-N of faeces.

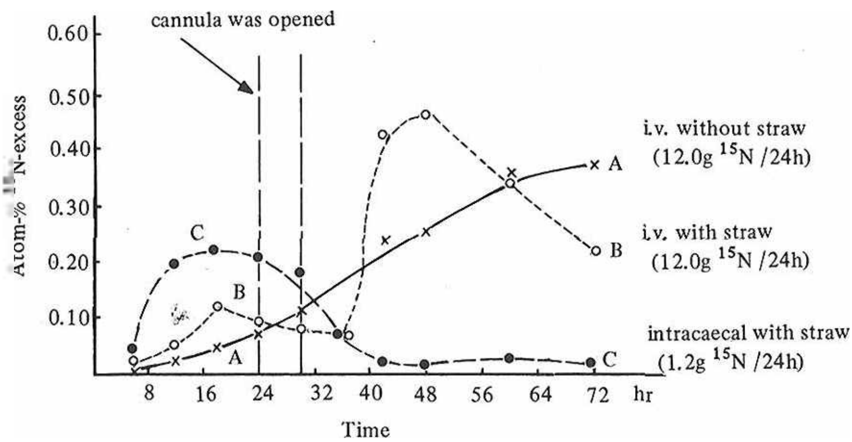

Figure 3. Atom-% ^{15}N-excess in total-N of faeces.

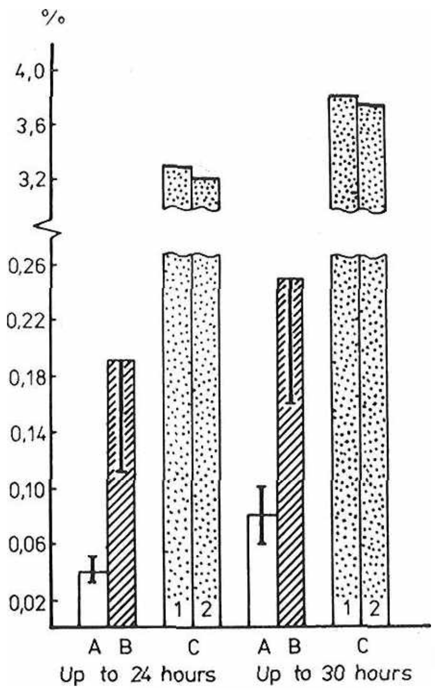

Figure 4. ^{15}N-excess excretion in faeces, % of the applied amount (Mean ± SE for groups A and B, in group C values of the individual animals).

urea entering the large intestine through the gut wall. A very fast absorption of ammonia near the gut wall reduced the utilization rate for this ^{15}N-labelled ammonia.

When the ^{15}N-labelled urea was mixed with digesta (group C) the urease activities of the whole digesta hydrolysed the urea, the NH_3-absorption rate through the gut wall was not so fast and the utilization rate of applied urea was higher.

(**Key Words:** Cattle, ^{15}N-urea, Hindgut)

Literature Cited

Mason, V.C. and Z. Tierphysiol. 1981. Tierernahr., Futtermittelkunde. 45:161.

Nolan, J.V. and S. Stachiw. 1979. Fermentation and nitrogen dynamics in Merino sheep given a low-quality-roughage diet. Brit. J. Nutr. 42:63.