

QUANTITATIVE ESTIMATION OF AMMONIA ABSORPTION BY GOATS FED HIGH STARCH DIETS WITH UREA SUPPLEMENT

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The determination of dietary balance cannot sufficiently estimate quantitatively and qualitatively the amount of nutrients supplied to ruminant blood from the digestive tract. The absorption of sugars and amino acids from the pig was assessed by Rerat (1977) through the simultaneous measurement of portal blood flow and arterial and portal blood concentrations. In the same way, Kedenburg and Hubner (1973) estimated the absorption into sheep blood of some nitrogenous components after a meal containing urea. In the present experiment, we estimated the absorption of ammonia into the blood of goats given feeds containing starch and urea, the diets differing in the nature of starch contained.

Materials and methods

Both pelleted diets contained 4% urea, 40% straw and 40% maize starch; they differed by the kind of starch. Diet A (starch) contained normal starch and Diet B (amylon), high amylose starch.

5 adult Alpine goats, averaging 47 kg body weight, were fitted with rumen cannula and permanent catheters in portal vein and mesenteric artery. To estimate the blood flow, they were also fitted with an electromagnetic probe surrounding the portal vein, according to the method previously described (Barry *et al.*

1979). The experiments began 2 weeks after surgical procedure.

On non-experimental days the animals were fed twice daily 500 g of chopped hay given in a bucket and once daily (morning meal) 500 g of crushed experimental ration introduced into the rumen through the cannula. 15 minutes before each of the fourteen experiments and after a 24 h fast, the goats were given 100 g chopped hay from a bucket. At the beginning of each experiment 400 g of the experimental meal were introduced into the rumen using the cannulae in order to control the feed intake rate and amount. Blood and rumen content samples were taken at different times during the 6 hours following feeding. At the end of each experiment the goats were given 900 g of hay.

pH, ammonia, acetic acid, propionic acid and butyric acid were determined in rumen contents. Ammonia was estimated in portal and arterial blood. Portal blood flow was continuously recorded, by linking the probe to an electromagnetic flowmeter Statham 2202. Ammonia absorption was calculated as follows:

$$Q = \int_{t_1}^{t_2} (PC - AC) \cdot F(t) \cdot dt$$

Where PC is portal blood ammonia concentration, AC is arterial blood ammonia concentration and F(t) portal blood flow.

Results and discussion

Rumen

Ammonia concentration was maximal about one hour after feeding. The peaks corresponding to the starch diet were a little higher than those corresponding to amylose diet (8.2 mM/100 ml vs 7.6 mM/100 ml). However, the NH₃ concentration decreased to a significantly lower level in the case of starch fed animals (1.0 mM/100 ml vs 2.7 mM/100 ml). The ruminal concentrations of VFA seemed to be lower, although not significantly, in the rumen of animals receiving the starch diets than in the others (8.5 mM/100 ml vs 10.6 mM/100 ml). These results disagree with those of Durand *et al* (1975) obtained *in vitro* and showing a 30% lower VFA production with amylose. In fact the rumen VFA concentrations *in vivo* may not truly reflect VFA production which would have been better measured by absorption and transit studies. The peak of ammonia production slightly increased the pH from about 6.8 to about 7 ; pH decreased from 7 to 6 at the end of the experimental period (6 hours).

Blood

Portal blood NH₃ was correlated to rumen pH ($r = 0.62$) and to rumen NH₃ ($r = 0.59$) ; the differences in the animals given the 2 diets were similar to those occurring in the rumen. Blood NH₃ increased more slowly in the arte-

rial than in the portal blood, and the difference in arterio-venous concentrations followed closely that of the portal values (fig. 1).

Portal blood flow was negatively correlated to rumen pH ($r = -0.37$) and to the portal blood NH₃ ($r = -0.48$). A decrease was observed during the first hour after feeding. This disagrees with the results of many authors who have recorded an increase in portal blood flow after feeding. However, it agrees with the results of Hogan (1961) who reported a decrease in ruminal vein blood flow due to NH₃ absorption. The average values, 1830 ml/m and 1940 ml/mn respectively for the animals given the starch and amylose diets, i.e. 40 ml/mn/kg et 40.5 ml/mn/kg, agree closely with published values.

Estimation of NH₃ absorption (fig. 2)

At the end of the experimental period (360 mn), the amounts of absorbed NH₃ became a

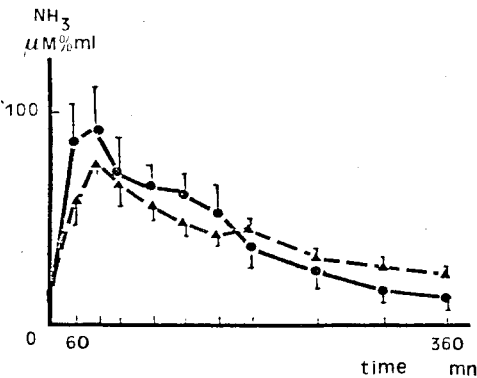


Fig. 1. - Arteriovenous differences in blood ammonia concentrations ● normal starch diet ; ▲ high amylose starch diet.

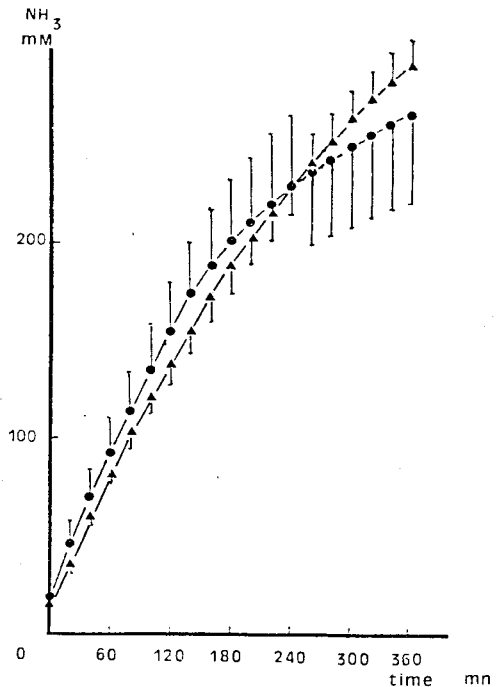


Fig. 2. - Ammonia absorbed after feeding ● normal starch diet ; ▲ high amylose starch diet.

little lower, but not significantly, in the animals given starch diet than in the others (263 mM vs 284 mM).

It may be inferred from the fasting values that, if the animals were not fed, the ammonia absorption would have been 120 mM and 145 mM respectively for the animals on the starch diet and the amydon diet. Thus the increase in NH_3 absorption, related to the amount of feed was about 140 mM i.e. about 30% of the NH_3 contained in the meal as urea (480 mM). As the duration of the NH_3 absorption peak was short, the fast absorption of NH_3 from dietary urea was not very important. This is related to the high starch content of the 2 diets which allows good utilization of urea by rumen microorganisms.

Conclusion

We were able to point out some differences in blood and rumen concentration and in NH_3 absorption between the animals given the 2 experimental diets. As the number of experimental animals was relatively low, few of these differences are significant. Nevertheless, they all seem to show that dietary urea is better utilized by the animals given the starch diet than by the others.

The method developed is interesting in that it allows an accurate estimation of the amount of NH_3 absorbed by animals; our results show that absorption of some nutrients may modify the portal blood flow making continuous measurement necessary for an accurate estimate of absorption.

References

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