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BRIEF COMMUNICATION

Blood plasma tryptophan concentration—a potentially useful indicator of feed intake in pasture-fed ruminants

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Tryptophan is not readily quantified by conventional amino acid analysis using ion-exchange chromatography. Most studies of amino acid metabolism/nutrition in ruminants have therefore not included tryptophan even though it is an essential amino acid (Black *et al.* 1957; Downs, 1961).

In the course of development of an automated fluorometric assay for tryptophan in blood plasma (based on the methods of Flentge *et al.* 1974 and Gaitonde *et al.* 1979) a statistically significant linear relationship was noted between plasma tryptophan and the reciprocal of plasma free fatty acid (FFA) concentration of ewes in late pregnancy (r = 0.80; n = 40). As plasma FFA concentration has been used as an indicator of energy status in ruminants (Bowden, 1971) the variation of plasma tryptophan concentration with feed intake was investigated in 3 trials involving grazing and housed sheep and housed cattle.

The response of plasma tryptophan concentration (TRYP; μg/ml) to daily feed intake (FI, g DM/kg live weight) in ewe lambs (ca. 35 kg live weight) and twin-pregnant ewes (120 days pregnant; ca. 60 kg live weight) housed indoors and offered fresh pasture once daily after bleeding (9 a.m.) was described by the following equations (figures in parentheses are standard errors):

Ewe lambs:

$$TRYP = \underset{(0.03)}{0.28}\,FI + \underset{(0.5)}{2.6} \quad (r = 0.89^{***},\ n = 20,\ RSD = 0.91)$$

Pregnant ewes:

$$TRYP = \underset{(0.05)}{0.26}\,FI + \underset{(0.9)}{1.1} \quad (r = 0.80^{***},\ n = 20,\ RSD = 1.1)$$

These equations were derived over the intake range of 200 to 1000 g DM for the ewe lambs (n = 20) and 700 to 1500 g DM for the ewes (n = 20). In both experiments the correlation of the reciprocal of plasma FFA concentration with feed intake (g/kg LW) was also significant (r = 0.79*** ewe lambs; r = 0.81*** ewes).

In further trials with grazing pregnant ewes, blood samples were taken by jugular venipuncture at 9 a.m. daily. Plasma tryptophan concentration varied according to pasture availability (Fig. 1). The range of plasma tryptophan concentration (ca. 3 to 11 μg/ml) was similar to the range seen with animals used in the indoor trials.

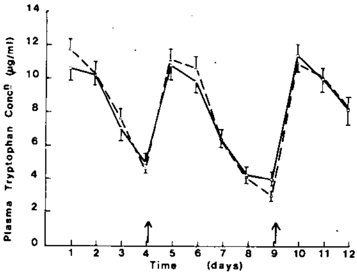

FIG. 1: Variation of plasma tryptophan concentration with time in 10 single-bearing (O————O) and 10 twin-bearing (Δ————Δ) ewes in late pregnancy. The ewes were offered a pasture allowance of 1.5 kg DM/ewe/d. Pasture yields at the start of a 'new' paddock (see arrows) were 1500 kg DM/ha, declining to 100 kg DM/ha over the grazing period.

Ten Friesian cows in early lactation (milk yield range 8.0 to 28.0 kg/d) were stall-fed fresh pasture *ad libitum* for 5 days. Five then received half of their *ad libitum* DM intake and 5 were starved for the next 2 days. Treatments were reversed in the second week of the experiment.

Plasma tryptophan concentration varied from 3 to 4 μg/ml in starved cows to 12 to 14 μg/ml in cows fed *ad libitum*. However, this relationship did not represent a simple linear response, there being a threshhold intake (related to milk yield) required before plasma tryptophan concentration began to increase.

Thus, the following model was derived to predict feed intake (FI, as DM, kg/d) from plasma tryptophan concentration (TRYP, μg/ml) milk tryptophan output (MITRYP, g/d) milk yield (MY, kg/d) and live weight (LW, kg). Figures in parentheses beneath major terms are standard errors.

$$FI = -14.31 - 0.5(MY) + 0.01\,(LW) + 25.0\,(\log_{10} MITRYP) + 5.0\,(\log_{10} TRYP)$$

(1.85) (0.07) (0.003) (2.0)

($n = 40$, $R^2 = 0.96$. RSO = 1.17)

Such a model is, as yet, only suitable for cows in early lactation further data being required from cows in late lactation to correctly weight the coefficients for MITRYP and TRYP. The latter cannot be achieved with the present data as these parameters are themselves highly correlated within cows (R^2 = 0.89).

Plasma tryptophan concentration and intra-duodenal tryptophan infusion rate over the range 0 to 6 g/d have been shown to be linearly related in preliminary experiments with sheep. These data suggest that variation in plasma tryptophan concentration reflects differences in duodenal protein flow and should be of value in assessing dietary protein availability in addition to its use as an indicator of feed intake in grazing ruminants.

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