AN ESTIMATE OF THE QUANTITY OF FEED PROTEIN ESCAPING DEGRADATION IN THE RUMEN OF STEERS FED CHOPPED SUGAR CANE, MOLASSES/UREA SUPPLEMENTED WITH VARYING QUANTITIES OF RICE POLISHINGS[1]

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3 Zebu cross steers each equipped with a rumen cannula and a T piece duodenal cannula were used to evaluate the extent that dietary protein escaped ruminal degradation in diets based on chopped sugar cane supplemented with three levels of rice polishings. Throughout a period of 3 days, 2 mCu of 35S labelled Na_2S0_4 were introduced into the rumen of each animal in order to label microbial cyst(e)ine. On the fourth day duodenal contents were collected from each animal. This was divided into two fractions, one for isolating the duodenal microbial fraction by differential centrifugation, the other left whole. The ratio of the specific activities of Cyst(e)ine-S in the whole duodenal digesta, to that in the microbial fraction isolated from whole duodenal digesta, was a measure of the proportion of microbial protein in the duodenal contents. It was found that by increasing the level of rice polishings in the diet from 0.4, 0.8 to 1.2 kg/24 hr the proportion of Sistine in the duodenal digesta of microbial origin fell from 0.710 to .603 to .524. These values were then used to calculate efficiency factors for bacterial growth in the rumen of each animal. Bacterial N levels produced (g/100 g OM actually digested in the rumen) were 3.02, 4.48 and 4.16 for the diets containing 0.4, 0.8 and 1.2 kg of rice polishings respectively.

Key words: Sugar cane, urea, 35S, microbial protein synthesis

It is well established that the maintenance protein requirements of ruminants can be met by rumen microbial protein synthesis from ammonia derived from NPN sources (0rskov 1970). However, the need for bypass proteins for rapid growth or milk production is equally well documented (Preston and Willis 1974; Hagemuster, Kaufmann and Pfeffer 1976). In such situations not only is the quantity of bypass protein important but also the quality. This was clearly shown by the work of Lopez and Preston (1977) who fed supplements of blood meal and rice polishings to growing steers. Increasing the level of rice polishings in the diet produced a linear increase in growth rate and feed efficiency, but increasing levels of blood meal caused a reduction. The authors attributed this phenomenon to the variable biological value of the blood meal proteins. Many estimations of biological value of proteins have been made and, assuming egg protein to have a value of 100, comparable values for rice proteins are 85, milk protein 90, beef muscle-73 and whole wheat 71 (Sterling and Lovatt Evans 1968). It would seem therefore that if a substantial quantity of protein in rice polishings were to bypass rumen degradation, it would be a useful source of balanced protein of high biological value to the animal.

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The purpose of this experiment was to determine the quantity of feed protein escaping degradation in the rumen of steers fed a diet of chopped sugar cane and molasses/urea with three levels of rice polishings.

Materials and Methods

Animals and Diets: A description of the animals, their management, diets and methods of feeding have been given by Elliott et al (1978).

Infusion of 35S and collection of samples: During the four days prior to the last duodenal collection of the experiment outlined by Elliott et al (1978), 2mCu of 35S-labelled sodium sulphate were introduced into the rumen of each steer. At the end of the collection period, the bulked digesta which had been collected was homogenized and approximately 2 litres removed for fractionation. The remaining digesta was homogenized again and sub-samples taken, placed in an oven at 80°C to dry, and finally ground to a fine powder.

The 2 litre sample removed for fractionation was strained through cheese cloth to remove large food particles and centrifuged at 2 500 g for 20 min to remove any remaining food particles. The microbial particles in suspension were then collected by centrifugation at 18 000 g for 30 min. The cells were dispersed and washed with isotonic saliva prior to recentrifugation. The microbial fraction was then dried at 80!;and ground to a fine powder in a pestle and mortar. The whole duodenal digesta and the microbial fraction isolated from whole duodenal digesta were then analysed for cyst(e)ine - S.

Determination of Cyst(e)ine-35S: The method used was that described by Elliott (1975). Approximately 80 mg of sample was weighed into a screw capped tube, 1 ml of hydrazine hydrate (99%) was added and the tubes flushed with nitrogen. The tubes were sealed with a teflon cap and placed in an oven at 120° for 18 hr. When cool, the tubes were attached to a unit which allowed them to be aerated with high purity nitrogen, so that the hydrogen sulphide produced by the addition of 6M H_2SO_4 (10 ml) could be carried into an absorbing solution of zinc acetate and sodium acetate (80 ml). During this stage the tube was placed in a water bath at 70° for 15 min. After this period, 1 ml of the absorbing solution was removed and mixed with 10 ml of liquid scintillant NE 260 (Nuclear Enterprises Ltd-Edinburgh Scotland UK) and the isotope measured in a Nuclear Enterprises NE 8312 gamma/beta counter for 1 hr.

To the remaining absorbing solution in the 100 ml volumetric flask, 10 ml of p-amino-dimethyl aniline sulphate solution was added plus 2 ml of a ferric ammonium sulphate solution. The solution was made up to 100 ml with glass distilled water. The methylene blue which develops in 5 min was read in a spectrophotometer at 670 nm.

A standard curve was obtained by taking suitable amounts of cystine through the procedure in the range 0.06 mg to 1.0 mg of cystine; the absorption was found to be linear.

In this way the ratio of the specific activities (SA) of cyst(e)ine35S in the whole and fractionated duodenal digesta could be calculated.

$$SA = \frac{\text{Total counts (CPM)}}{\mu\text{g of cyst(e)ine-S in sample}}$$

Table 1: The individual specific activities of cyst(e)ine -35S in the microbial fraction of duodenal digesta and in total duodena digesta of steers fed a chopped sugar cane, molasses/urea diet supplemented with rice polishings

	Rice polishings, g/d		
	400	800	1200
Specific activity of cyst(e)ine-35S			
Total duodenal cyst(e)ine (D)	79	94	116
Microbial fraction (M) isolated from whole duodenal digesta	111	156	223
Ratio D/M	0.71	0.60	0.52

Table 2: Efficiency factors for the utilization of energy for bacterial growth in the rumen of steers fed chopped sugar cane, molasses/urea diet supplemented rice polishings

Parameter	Rice polishings, g/d		
	400	800	1200
Microbial DM synthesised, kg/24 hr	1.16	1.47	1.66
Total organic matter actually digested in the rumen, kg/24 hr	2.42	2.17	2.15
Microbial N, kg/24 hr	0.073	0.095	0.116
Microbial synthesis, gN/100 g OM actually digested in the rumen	3.02	4.48	4.16
* rumen turnover/24 hr	0.78	1.70	1.61

* Data taken from paper by Elliott et al (1978)

If the specific activity of the microbial fraction of cyst(e)ine 35S is termed (M) and that of the total digesta (D), then the ratio D/M x 100 is the percent of cyst(e)ine in duodenal digesta that is of microbial origin. This is based on the work of Harrison et al (1972).

Results and Discussion

The individual results for the three animals are shown in table 1. The results would indicate (all be it from single observations at the different levels) that considerable quantities of cyst(e)ine, and therefore total protein, arriving at the duodenum are of feed and endogenous origin. These proportions have been used to calculate the efficiency of microbial protein production in the rumen of each animal The results are presented in table 2.

Method of computing efficiency factors: Microbial DM (kg/24 hr) = Proportion of cyst(e)ine-S in duodenal digesta of microbial origin (kg/24 hr)/ concentration of cyst(e)ine (g/100 g DM) in microorganisms.

Organic matter (OM) actually digested in the rumen (g/24 hr) = 0M apparently digested in the rumen (intake - duodenal flow) + microbial DM x proportion of OM in microbial DM.

Efficiency of microbial N synthesis = gN/100 g OM actually digested in rumen

It is interesting to note that at all levels of supplementation, the efficiency of microbial protein production was high, especially at the inclusion levels of 0.8 and 1.2 kg of rice polishings/head/day. At these two levels, rumen turnover rates were also greater, illustrating the relationship between microbial production and rumen turnover reported by Harrison al (1974).

The values for efficiency of rumen microbial production are similar to those reported for forage-based diets (McMiniman, Ben-Ghadalia and Armstrong 1976), and demonstrate the potential of sugar cane as a source of energy for microbial protein production, provided the other limitations in the diet such as fermentable sources of N and sulphur are met.

This limited study, together with the work reported by Ferreiro et al 1978), emphasises the suitability of rice polishings as a source of bypass protein for the animal. It is also interesting to note that the supplement appears to increase the efficiency of microbial protein production in the rumen by influencing changes in rumen turnover rate.

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