

THE EFFECT OF INTRAVENOUS UREA INFUSIONS ON DIGESTIBILITY AND RUMEN VFA AND AMMONIA IN CATTLE FED A LOW QUALITY DIET

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Summary

Urea was continuously infused intravenously at different levels over ten-day periods into two steers fed a fixed amount of a low quality tropical-pasture hay which contained 1.1 per cent nitrogen (N) and 35 per cent cellulose on a dry matter basis.

Dry matter and cellulose digestibility were not affected by the urea infusions. The apparent nitrogen digestibility, derived from the difference between feed and faecal N, and ignoring infused N, was slightly depressed by urea infusions of from 9 to 34 g N/day, but at the highest level of infusion (43.7 g N/day) it was equal to or greater than the control value.

Rumen pH and VFA concentrations were not affected by the urea infusions. Rumen ammonia increased rapidly with increased infusion level at the lower levels of infusion but, at the higher levels of infusion, it increased only slightly or not at all.

I. INTRODUCTION

There have been a number of observations made on the effect of urea on digestibility and rumen function when urea, sometimes with molasses, has been used to supplement low quality roughages (Clark and Quin 1951; Beames 1959; Williams et al. 1959; Campling, Freer and Balch 1962; Coombe and Tribe 1963; Hemsley 1964; Lesch and Pieterse 1966; Faichney 1968; Coombe and Christian 1969).

This paper reports studies on the effects of intravenously administered urea on digestibility and rumen function. The observations were part of a study of the transfer of nitrogen (N) from the blood to the rumen of cattle (Vercoe 1969).

II. MATERIALS AND METHODS

A Braham x Hereford (No. 19) and a Hereford (No. 24) steer, both with rumen fistulae and weighing approximately 420 and 396 kg respectively, were fed

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a **chaffed** pasture hay which had been cut from a sward of *Cenchrus ciliaris*, *Panicum maximum* and *Phaseolus astropurpureus* (Cv. Siratro). It contained approximately 1.1 per cent N (range 1.03 to 1.10 per cent) and 35 per cent cellulose (range, 33.8 to 34.9 per cent) on a dry matter basis. The steers were fed 7.12 kg of dry matter in eight equal portions at 3 h intervals, in an automatic feeding device (Vercoe 1969).

The experiment consisted of five periods, each separated by ten days. Sterilised urea solutions were infused continuously into the jugular vein over ten consecutive days during each of the final four periods. The amount of urea given each day throughout the experiment (shown in Table 1) was infused in 1700 ml of glass distilled water.

Faeces were bulked over the final eight days of each infusion period and were analyzed for dry matter, cellulose (Crampton and Maynard 1938) and nitrogen (Vercoe 1967). In the calculation of apparent nitrogen digestibility, only dietary nitrogen was included in the nitrogen intake.

Rumen contents were sampled every hour for five or six hours on the final day' of the infusion period and strained rumen liquor was analyzed for steam volatile fatty acids (VFA) (Annison 1954) and ammonia (Vercoe 1969) and its pH was measured.

III. RESULTS

Infusing urea intravenously at levels of from 0 to 43.7 g N/day had no effect on dry matter or cellulose digestibility and the variation between the animals was small (Table 1) .

The apparent nitrogen digestibility was depressed slightly from the control level by infusing up to 34 g N/day in steer 19 and up to 21.5 g N/day in steer 24. At the highest level of infusion (43.7 g N/day), steer 19 had a similar value to its control level and steer 24 had a higher value than its control level. At levels of infusion of 0, 9.3, and 21.5 g N/day, steer 24 had a lower apparent nitrogen digestibility than steer 19 but, at the two highest levels of infusion, both steers had similar values (Table 1) .

Rumen pH and the concentration of VFA in the rumen liquor were not affected by the urea infusions and the differences between the two animals were small (Table 1) . However, rumen ammonia concentrations (Table 1) were curvilinearly related to the infusions levels. Steer 19 showed a rapid increase in rumen ammonia at the two lower levels of infusion and little or no increase at the two higher levels. On the other hand, steer 24 showed a less rapid increase than steer 19 up to the second highest level (34.1 g N/day) and only a small increase, if any, at the highest level.

IV. DISCUSSION

Administering urea intravenously did not enhance dry matter or cellulose digestibility which agrees with findings for urea supplied orally (Clark and Quin 1951; Beames 1959; Williams et al. 1959; Coombe and Tribe 1963; Lesch and Pieterse 1966; Faichney 1968; Coombe and Christian 1969). It does not agree

TABLE 1
*Dry matter, cellulose, and apparent nitrogen digestibility, and rumen pH, VFA,
 and ammonia, for different levels of urea infused intravenously*

Animal No.	Infused urea-N (g/day)	Dry matter digestibility (%)	Cellulose Digestibility (%)	Apparent nitrogen digestibility (%)	Rumen		
					pH	VFA (mmoles/l)	Ammonia-N (mg/100 ml)
19	0	47.3	59.6	41.4	7.02 ± 0.01*	87.5 ± 2.8*	1.40 ± 0.32*
24	0	47.7	59.0	36.6	7.04 ± 0.03	88.4 ± 1.4	1.00 ± 0.32
24	9.3	47.6	59.9	39.6	7.04 ± 0.03	84.9 ± 2.0	3.84 ± 0.12
24	9.2	47.2	60.4	32.2	7.01 ± 0.02	92.6 ± 3.1	1.45 ± 0.13
19	21.5	47.9	61.4	38.4	7.10 ± 0.03	87.4 ± 2.4	6.14 ± 0.26
24	21.4	46.6	59.6	32.6	7.04 ± 0.02	89.7 ± 1.6	3.82 ± 0.25
19	33.9	46.9	61.1	36.2	7.08 ± 0.02	82.8 ± 2.0	5.79 ± 0.13
24	34.1	48.9	62.3	35.9	7.12 ± 0.02	83.3 ± 2.3	5.19 ± 0.15
19	43.7	47.3	61.0	40.7	7.03 ± 0.04	85.4 ± 2.0	6.50 ± 0.19
24	43.7	48.2	60.3	40.2	7.05 ± 0.02	87.2 ± 2.9	5.40 ± 0.36

* standard error

with the results of Campling, Freer and Balch (1962) who found that intraruminal infusions of urea in cows increased dry matter, organic matter and crude fibre digestibilities, nor with results for oaten straw and urea diets reported by Coombe and Christian (1969).

In many cases where urea has been supplied orally, an increase in apparent nitrogen digestibility has occurred (Clark and Quin 1951; Williams *et al.* 1959; Coombe and Tribe 1963; Lesch and Pieterse 1966; Faichney 1968; Coombe and Christian 1969). This effect could be due partly to the increased dry matter intakes of the urea-supplemented animals, because increased intake of a low quality roughage can increase markedly the apparent nitrogen digestibility (Vercoe 1967), and partly due to the high "digestibility" of urea. The decrease in apparent nitrogen digestibility over the first three (No. 24) or four (No. 19) periods in this experiment and the depression observed by Campling, Freer and Balch (1962) when 150 g of urea was infused intraruminally at a fixed food intake, may be the result of conversion of urea to bacterial protein in the rumen, some of which is not digested and appears in the faeces. However, no explanation is offered for the increase in apparent nitrogen digestibility at the highest levels of infusion (34.1 and 43.7 g N/day) or for the slightly different responses of the two steers.

Infusing urea intravenously had no effect on pH or VFA concentration which agrees with the findings of Waite and Wilson (1969) for urea administered as part of a hay/concentrate diet. Hemsley and Moir (1963) and Faichney (1968) found increased rumen VFA concentrations when urea was fed to sheep on a ground low quality roughage. However, these were associated with increased food intakes.

It has been shown (Vercoe 1969) that the highest level of intravenous infusion (43.7 g N/day) produced a similar level of rumen ammonia to an intraruminal infusion of urea of 17-20 g N/day. It seems likely therefore, that the increased rate of cellulose digestion, rate of passage of ingesta and food intake, which have been observed with urea feeding (Clark and Quin 1951; Campling, Freer and Balch 1962; Coombe and Tribe 1963; Lesch and Pieterse 1966), could also occur where urea was infused intravenously. This suggests the possibility that part of the variation in performance between animals grazing a low quality pasture may be due to differences in food intake associated with animal differences in plasma urea/rumen ammonia relations.

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