THE EFFECT OF DIETARY UREA ON THE GROWTH AND PLASMA UREA LEVELS IN CALVES

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Summary

Growth and digestibility trials were conducted with 24 male Friesian calves between 5 and 11 weeks of age. The control diet contained meat meal as the sole protein supplement and this was replaced by urea to supply 20.1, 39.2 or 55.6 per cent of the dietary nitrogen.

The growth rate of calves was not reduced by the addition of urea to the diets unless they were corrected for digestible dry matter intake. The nitrogen balance and the sulphur balance were reduced by feeding the 55.6 per cent urea N containing diet but the ratio of the nitrogen to sulphur balance remained constant.

There was a positive correlation between dietary urea nitrogen intake and urea nitrogen concentration in the blood plasma.

I. INTRODUCTION

The growth rate of calves between 5 and 11 weeks of age has been found to be similar with meat meal, dried skim milk, soyabean meal or fish meal as the sole protein supplement to grain diets (Whiting and Clark 1955; Pardue et *al.* 1962; Whitelaw and Preston 1963; Leibholz 1967). However, there have been few studies on the utilization of non-protein nitrogen by the young calf. Kay ***et al.*** (1967) found that the growth rate of calves between 50 and 110 kg liveweight was reduced by 30 per cent by the inclusion of 41 per cent of the dietary nitrogen as urea.

The present experiment was designed to determine the effect of replacing 33, ***66*** or 100 per cent of a meat meal protein supplement with urea on the growth of calves between 5 and 11 weeks of age.

II. MATERIALS AND METHODS

(a) Animals

Twenty-four 3 day old male Friesian calves were purchased in three groups of eight.

(b) Diets

All calves were reared on a synthetic milk replacer† for five weeks.

At two weeks of age, the calves were randomly allotted to one of the experimental diets shown in Table 1. In the formulation of the diets, the meat meal was replaced by sorghum and urea on an equal nitrogen basis while maintaining a constant ratio of nitrogen to sulphur.

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TABLE 1

Composition **of** *diets (%)*

Diets	1	2	3	4
Dietary ingredients				
Sorghum (ground)	62.3	68.9	74.5	77.8
Oats (crushed)	10.0	10.0	10.0	10.0
Meat meal	22.0	13.9	6.9	—
Urea	—	1.33	2.67	3.90
Molasses (dried)	5.0	5.0	5.0	5.0
Na_2SO_4	0.13	0.30	0.40	0.49
Ca_2HPO_4	—	—	—	1.70
$CaCO_3$	—	—	—	0.57
Salt	0.5	0.5	0.5	0.5
Antibiotics, Vitamins *	0.05	0.05	0.05	0.05
Trace minerals premix †	0.05	0.05	0.05	0.05
Total	100.03	100.03	100.07	100.06
Chemical composition				
Dry matter %	87.6	87.4	86.8	86.7
Nitrogen % of D.M.	3.42	3.41	3.53	3.64
Sulphur % of D.M.	0.308	0.302	0.325	0.294
N/S ratio	11.1	11.3	10.9	12.4
Urea N % of Total N	0	20.1	39.2	55.6

*Added to supply Vitamin A 4,000 I.U./kg, Vitamin D 400 I.U./kg, chlortetracycline 20 mg/kg.
†Added to supply Fe 100 p.p.m., Cu 10 p.p.m., Zn 50 p.p.m., Mn 30 p.p.m., Co 1 p.p.m.

The concentrate was offered ***ad libitum,*** with cottonseed hulls allowed to 17 per cent of the total feed intake in a separate bin.

(c) Management

Each calf was penned individually. During the fourth week, the calves were gradually weaned from the synthetic milk replacer.

Feed bins were filled daily. Feed intakes and calf weights were recorded weekly. At seven weeks of age, the calves were placed in metabolism cages for a one-day preliminary and two 3 day collection periods.

(d) Analytical Methods

Blood was collected once weekly by jugular puncture. The urea content of the blood plasma was determined by the method of Chaney and Marbach (1962). Dry matter and nitrogen were determined according to A.O.A.C. (1965) methods and sulphur according to Butters and Chenery (1959).

III. RESULTS

Calves on the urea-free diet gained less weight between 5 and 11 weeks of age than calves on diets containing 20.1 or 39.2 per cent of the dietary nitrogen as urea. When urea contributed 55.6 per cent of the dietary nitrogen weight, gains were similar to those obtained with the urea-free diet (Table 2). Weight gains were lower during the week in the metabolism cages.

Feed intakes (Table 2) and dry matter digestibility (Table 3) were lowest with the urea-free diet. When the weight gains of the calves were adjusted by covariance

TABLE 2

Average weight gains and feed intakes of calves between 5 and 11 weeks of age

Diets	1	2	3	4	Significance of difference between means ($P<0.05$)
Urea as % of dietary N	0	20.1	39.2	55.6	
Number of calves	6	6	6	6	
Initial weight (kg)	50.9	53.9	55.9	53.9	—
Weight gain (kg)	28.1	33.5	33.9	28.2	3 > 1 and 4
Grain intake (kg)	71.3	79.8	88.4	78.9	3 > 2 and 4 > 1
Total feed intake (kg)	84.5	95.5	102.7	93.3	2 and 3 > 1
Ratio feed intake/weight gain (kg/kg)	3.03	2.87	3.04	3.32	4 > 2
Weight gain adjusted for digestible D.M. intake	33.4	33.2	29.6	27.5	

for digestible dry matter intake then their liveweight gains decreased linearly with the increasing urea content of the diets.

Faecal nitrogen excretion decreased and urinary nitrogen excretion increased with increasing urea nitrogen intakes (Table 3). The nitrogen balance was significantly lower in the calves fed the meat meal free diet.

As occurred in nitrogen excretion, the faecal sulphur excretion was decreased and the urinary sulphur excretion increased with increasing urea intakes. The sulphur balance was significantly lower in the calves fed the meat meal free diet. The ratio of nitrogen to sulphur retained was similar for all diets (Table 3).

The plasma urea nitrogen concentration decreased with age (Table 4), and at 2 weeks of age the concentration was significantly greater than at 9, 10 and 11 weeks of age. The increased dietary urea intakes resulted in increased urea nitrogen concentrations in the plasma. These were correlated with increased urinary nitrogen excretion. Significant differences in the plasma urea concentrations occurred within one week of the initiation of the experiment.

IV. DISCUSSION

The experiment indicated that when 3.9 per cent urea was included in the diet of the calf to supply 55.6 per cent of the dietary nitrogen intake, weight gains between 5 and 11 weeks of age were similar to those on a meat meal control diet. However, when the weight gains were adjusted for digestible dry matter intake,

TABLE 3

Dry matter, nitrogen and sulphur excretion data

Diets	1	2	3	4	Significance of difference between means ($P<0.05$)
Urea as % of dietary N	0	20.1	39.2	55.6	
Faecal D.M. (g/day)	513	522	489	411	1 and 2 >4
D.M. Digestibility (%)	66.4	69.6	72.6	72.7	1 < 3 and 4
Faecal N (g/day)	16.8	16.3	15.4	12.4	4 < 1 and 2
Urine N (g/day)	15.2	18.6	23.6	26.0	3 and 4 > 1 and 2
N balance (g/day)	14.6	17.1	16.7	8.6	1, 2 and 3 > 4
Urine N as % of N intake	33.6	36.3	43.0	56.2	1 and 2 < 4, 1 < 3
Faeces S (g/day)	1.72	1.79	1.71	1.36	2 >4
Urine S (g/day)	1.20	1.53	1.80	1.67	3 and 4 > 1
S balance (g/day)	1.22	1.23	1.48	0.69	1, 2 and 3 > 4
Urine S as % of S intake	29.2	34.0	36.0	44.3	4 > 1
Ratio of N : S retained	12.2	14.2	11.9	9.4	—

TABLE 4

Effect of age and diet on plasma urea N concentrations (mg/100 ml)

Diets	Urea as % of dietary N	Age in weeks									Mean	Significance of difference between means ($P<0.05$)
		2	3	4	5	6	7	9	10	11		
1	0	20.5	13.3	17.3	15.9	12.0	11.0	9.6	8.8	9.4	13.1	
2	20.1	21.3	14.4	16.7	15.3	14.2	12.2	12.7	10.6	11.4	14.3	Diet 4 > 1 and 2
3	39.2	19.8	15.4	15.9	16.5	14.2	17.3	14.7	13.6	14.8	15.8	
4	55.6	20.4	18.5	18.9	20.4	16.7	19.5	16.6	18.4	17.3	18.6	
Means		20.5	15.4	17.0	17.0	14.3	15.0	13.4	12.9	13.2		
Significance of difference between means ($P<0.05$)		Week 2 > 9, 10 and 11										

growth rates were decreased by up to 18 per cent with increasing urea intakes. Kay ***et al.*** (1967) included 22 to 41 per cent of the dietary nitrogen as urea and found that growth rates were reduced by 10 to 30 per cent compared with the control fish meal diets. Similar results were obtained by Stobo, Roy and Gaston (1967) and Miron, Otterby and Purse1 (1968). One explanation of the difference between these results and those of the present experiment may be the low sulphur contents in the diets of the other workers.

In contrast, Brown ***et al.*** (1956) found that calves between 4 and 14 weeks of age gained weight as rapidly when urea supplied 54 per cent of the total dietary nitrogen as with a linseed meal control diet, but the average weight gain of these calves was only 0.52 kg per day.

The lower dry matter digestibility of the meat meal containing diets is due to the lower digestibility of meat meal when compared to sorghum (Morrison 1959).

The excretion of a larger proportion of the dietary nitrogen in the urine with high urea intakes has been previously observed (Kay ***et al.*** 1967). Sulphur excretion followed a similar pattern resulting in a constant ratio of nitrogen to sulphur retained as observed in sheep (Bray and Hemsley 1969).

The decrease in the concentration of plasma urea nitrogen with age was also observed by Leibholz (1966) and may be partially attributed to the higher concentration and digestibility of the nitrogen in the milk replacer as compared to the subsequently fed concentrates. Lewis (1957) showed a correlation between dietary nitrogen and plasma urea nitrogen.

The high dietary urea intakes increased the plasma urea nitrogen concentration and urine nitrogen excretion confirming the results of Brown ***et al.*** (1956) and Kay ***et al.*** (1967). However, the differences in the present experiment were greater than those previously reported.

In conclusion, this study has indicated that urea may be an economical nitrogen supplement in the diet of the young calf.

V. ACKNOWLEDGMENTS

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