INFLUENCE OF DIETARY PROTEIN ON DRY MATTER INTAKE, RUMEN FERMENTATION AND HAEMATOLOGICAL PARAMETERS IN CROSSBRED COWS

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Abstract

A study was conducted in crossbred cows in early lactation to assess whether inclusion of a readily degradable protein source like urea in the concentrate mixture at two levels of CP and UDP will influence the dry matter intake, rumen fermentation and haematological parameters. Eight crossbred cows within 20 days of lactation as uniform as possible with regard to their age, parity, body weight and milk yield were selected and were fed with four isocaloric concentrate mixtures with 17 per cent and 20 per cent CP containing 28, 39.15, 26.46 and 40 per cent of CP as UDP, respectively, on DM basis. The CP content of the four experimental rations formulated with concentrate mixture and paddy straw in the ratio of 70:30 was 13.41, 13.71, 15.50 and 15.50 per cent, respectively. All the four dietary treatments contained one per cent urea as source of RDP. There was no significant difference (P>0.05) between the animals given the four dietary treatments in dry matter intake, rumen NH3-N, total volatile fatty acid levels or any haematological parameters studied in the present study. The results obtained in the study indicate that neither the level of CP (17 and 20) nor UDP (28, 39.15, 26.46 and 40 per cent of CP) has any significant effect on the dry matter intake, rumen fermentation and haematological parameters in crossbred cows in early lactation.

Keywords: *Dairy cows, CP and UDP, dmi, haematology, rumen*

Dairy cows have an increased demand for protein in the form of amino acids, which is achieved by intestinal absorption of amino acids from dietary, microbial and endogenous proteins.

To achieve the greater flow of amino acids to the small intestine, dietary protein must escape ruminal degradation without decreasing the efficiency of synthesis of microbial protein. An excess of rumen degradable protein (RDP) in the ration will result in an accumulation of ammonia in the rumen, while, an increase in undegradable protein (UDP) level in the ration will reduce the microbial protein synthesis due to shortage of ammonia for rumen bacteria. Therefore the dietary protein should supply metabolisable protein by providing both RDP that is utilized for microbial protein synthesis and UDP that is digested directly by the cows. Non protein nitrogen (NPN) is a cheaper source of nitrogen, which can be utilised by rumen microbes. Urea is the cheapest and most commonly used NPN source, which is degraded completely in the

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rumen. So a combination of UDP and NPN substance like urea can be equally effective and economical in dairy rations. The present study was undertaken to assess whether inclusion of a readily degradable protein source like urea in the concentrate mixture at two levels of CP and UDP will influence the dry matter intake, rumen fermentation and haematological parameters of crossbred cows in early lactation.

Materials and Methods

Eight crossbred cows within 20 days of lactation as uniform as possible with regard to their age, parity, body weight and milk yield were selected and housed in a shed with all the facilities for individual feeding, care and management. The animals were fed four isocaloric concentrate mixtures with 17 and 20 per cent CP, respectively containing 28, 39.15, 26.46 and 40 per cent of CP as UDP, respectively, on DM basis. The CP content of the four experimental rations formulated with concentrate mixture and paddy straw in the ratio 70:30 was 13.41, 13.71, 15.50 and 15.50 per cent, respectively. All the four dietary treatments contained one per cent urea as source of RDP (Table 1).

Table 1. Ingredient composition and calculated nutrient content of the four concentrate mixture given to the experimental animals (Kg)

Item	T1	T2	T3	T4
Yellow maize	50.5	44.0	42.0	39.5
Groundnut cake	10.5	4.0	19.0	11.0
Coconut cake	0.0	29.5	0.0	36.5
Wheat bran	35.0	18.5	35.0	9.0
Urea	1.0	1.0	1.0	1.0
Salt	1.0	1.0	1.0	1.0
Shell grit	2.0	2.0	2.0	2.0
CP, %	17.06	17.21	20.04	19.95
RDP, %	12.33	10.41	14.77	11.98
UDP, %	4.73	6.80	5.27	7.97
TDN, %	70.60	69.24	70.26	68.98
Calcium, g%	0.72	0.75	0.74	0.77
Phosphorus, g%	0.65	0.53	0.58	0.51

The feeding trial was conducted in a switch over design. Each treatment was given for a period of three weeks with an adaptation period of one week in between the treatments. The total feeding experiment was for 15 weeks. The concentrate mixture and paddy straw were fed at the ratio 70: 30 of daily dry matter. Daily dry matter intake (DMI) was recorded through out the experimental period. Rumen liquor was collected from all the animals using a stomach tube, at the beginning and end of each feeding period and was analysed for pH (pH meter, Cyberscan, 2500), total volatile fatty acids (Barnett and Reid, 1957) and rumen ammonia nitrogen (Beecher and Whitten, 1970).

Blood samples collected from the experimental animals at the beginning and end of each feeding period were used to determine haemoglobin (cyanmethaemoglobin method), plasma glucose (GOD-PAP method), plasma phosphorus (phosphomolybdate method), plasma urea nitrogen (modified Berthelot method), plasma creatinine (modified Jaffe's method), plasma total protein (direct Biuret method) and albumin (bromcresol green method) using the kits supplied by Agappe diagnostics, Maharashtra, India. Plasma calcium was estimated by Atomic Absorption Spectrophotometer (Perkin Elmer model – 3110) using hollow calcium cathode tubes. Proximate analysis of the four concentrate mixtures and paddy straw was carried out as per standard procedure (AOAC, 1990) and data is given in Table 2. The results obtained were analysed by the method for switch over design (Snedecor and Cochran, 1985).

Results and Discussion

Dry matter intake

The DMI of the animals as per cent of their body weight in the four groups were similar and were 3.03, 3.01, 3.0 and 3.03 per cent, respectively. All the diets were consumed readily and feed refusal was rare. There was no significant difference (P>0.05) between the average DMI of animals (10.53, 10.54, 10.53, and 10.65 kg, respectively) given the four dietary treatments (Table 3).

Rumen fermentation parameters

The average values on rumen pH, rumen ammonia nitrogen (NH_3–N) and total volatile fatty acid (TVFA) concentrations were not significantly affected (P>0.05) by the four dietary treatments (Table 4). Rumen liquor from all the animals was collected three hours after feeding. The ruminal pH was not affected (P>0.05) by the dietary CP level (Annextad *et al.*, 1987; Sannes *et al.*, 2002) and UDP level (Kanjanapruthipong *et al.,* 2002; Reynal and Broderick, 2003). It could be observed that feeding of concentrate mixture containing 20 per cent CP concentrate mixture at 26.46 and 40 per cent UDP produced more NH_3–N (27.85

Table 2. Chemical composition of the four concentrate mixtures and paddy straw fed to experimental animals* (%)

Parameter	Concentrate mixtures				Paddy straw
	I	II	III	IV	
Dry matter	88.82 ± 0.30	89.38 ± 0.41	89.03 ± 0.27	89.60 ± 0.57	90.41 ± 0.64
Crude protein	16.93 ± 0.08	17.37 ± 0.09	19.92 ± 0.14	19.92 ± 0.11	5.20 ± 0.13
Ether extract	5.52 ± 0.45	6.32 ± 0.28	4.31 ± 0.39	6.08 ± 0.57	1.77 ± 0.32
Crude fibre	8.78 ± 0.55	9.07 ± 0.72	10.84 ± 0.72	8.27 ± 0.56	31.88 ± 0.78
Total ash	10.11 ± 0.74	7.78 ± 0.34	10.21 ± 0.07	8.38 ± 0.55	17.02 ± 0.48
NFE	58.66 ± 1.05	59.46 ± 0.36	54.72 ± 1.03	57.35 ± 1.45	44.13 ± 0.58
AIA	3.24 ± 0.17	2.11 ± 0.16	3.34 ± 0.26	1.85 ± 0.35	12.99 ± 0.33
NDF	28.63 ± 0.84	30.24 ± 0.75	28.06 ± 0.46	30.67 ± 0.84	71.48 ± 0.66
ADF	13.29 ± 1.18	14.68 ± 1.4	16.89 ± 1.42	16.23 ± 0.77	48.58 ± 1.06
ADL	6.03 ± 0.59	6.62± 0.82	5.34 ± 0.94	5.78 ± 0.94	4.49 ± 0.99
Calcium	0.98 ± .096	1.08 ± 0.12	1.08 ± 0.115	1.02 ± 0.04	0.23 ± 0.04
Phosphorus	0.43 ± 0.02	0.47 ± 0.018	0.48 ± 0.02	0.47 ± 0.02	0.26 ± 0.14

Table 3. Average dry matter intake of animals maintained on the four experimental rations (kg)

Parameter	T1	T2	T3	T4	P value
Dry matter intake	10.53 ± 0.40	10.54 ± 0.44	10.53±0.35	10.65 ± 0.39	0.37

and 23.21 mg per cent, respectively) compared with that containing 17 per cent CP at 28 and 39.15 per cent UDP (23.46 mg and 17.40 per cent) even though the difference was not significant (P>0.05). This linear response to NH_3–N concentration with increase in dietary protein level is similar to the reports of Sannes *et al.* (2002) and Davidson *et al.* (2003). The decrease in NH_3–N concentrations in response to increase in UDP levels observed in the current study is similar to the findings of Rodriguez *et al.* (1997) and Kanjana pruthypong *et al.* (2002). This is because dietary protein, which is more degradable in the rumen, promotes the ammonia production by the microbes in the rumen.

It could be seen that the average TVFA concentration was not significantly affected (P>0.05) by the four dietary treatments. The dietary CP levels had no significant effect on TVFA production as reported by Davidson *et al.* (2003). The observation made in the present study agrees with the findings of Sannes *et al.* (2002) in which the level of UDP did not affect TVFA concentration of rumen liquor.

Haematological and Biochemical Parameters

None of the haematological and biochemical parameters in the present study were significantly affected (P>0.05) by the four dietary treatments (Table 5). The lack of significant effect of dietary protein and UDP level on haemoglobin concentration is also reported by Ally *et al*.(2007). The plasma glucose level falls in the lower limits of normal

Table 4. Summarised data on average rumen fermentation parameters in animals maintained on the four experimental rations*

Parameter	T1	T2	T2	T3	P value
Rumen pH	7.28 ± 0.24	7.44 ± 0.15	7.49 ± 0.19	7.34 ± 0.15	0.13
NH_3-N, mg/100ml	23.46 ± 3.32	17.40 ± 2.45	27.85 ± 2.95	23.21 ± 5.18	0.08
TVFA, meq/l	110.00±10.20	94.38 ± 4.26	107.38 ±13.0	96.44 ± 2.30	0.60

** Mean of eight values*

Table 5. Summarised data on average haematological and biochemical parameters of the animals maintained on the four experimental rations*

Parameter	T1	T2	T2	T3	P value
PGL, mg%	46.17 ± 1.67	46.32 ± 1.88	49.80 ± 2.35	49.53 ± 2.39	0.40
Hb, g%	8.93 ± 0.35	8.95 ± 0.69	8.13 ± 0.43	8.71 ± 0.41	0.51
BUN, mg%	12.81 ± 1.66	15.90 ± 1.48	17.46 ± 1.82	13.82 ± 1.03	0.19
Creatinine, mg%	1.29 ± 0.22	1.37 ± 0.13	1.23 ± 0.14	1.57 ± 0.18	0.31
Calcium, mg%	8.84 ± 0.43	9.15 ± 0.40	9.19 ± 0.59	9.64 ± 0.35	0.67
Phosphorus, mg%	5.00 ± 0.46	4.99 ± 0.41	4.79 ± 0.44	5.26 ± 0.33	0.79
Total protein, g%	7.11 ± 0.33	6.61 ± 0.41	6.65 ± 0.33	6.85 ± 0.27	0.69
Albumin, g%	3.24 ± 0.15	3.55 ± 0.18	3.46 ± 0.21	3.37 ± 0.23	0.56

** Mean of eight values*

range (40 to 60 mg/100ml) for cows. It could also be seen that PGL levels tend to increase (though not significant) corresponding to an increase in CP in the concentrate mixture from 17 to 20 per cent.

The average plasma urea nitrogen was not significantly affected (P>0.05) by the CP levels or UDP levels (Zimmerman *et al.,* 1991; Rodriguez *et al.,* 1997). The plasma creatinine was not affected (P>0.05) by the four dietary treatments and similar to the reports of Wiley *et al.* (1991) in which levels were not affected by post partum protein sources.

The four dietary combinations had no significant effect (P>0.05) on both plasma calcium and phosphorus levels as reported by Jordan *et al.* (1983) and Ally (2003). In the present study, the dietary protein and its degradability did not significantly affect (P>0.05) both the plasma total protein and albumin concentration. The observation made in the present study is in agreement with the reports of Cressman *et al.* (1980), McGuffey *et al.* (1990) and Aharoni *et al.* (1993).

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