Indian Journal of Animal Sciences **82** (7): 741–744, July 2012

Effect of undegradable dietary protein supplementation on early lactating crossbred dairy cows

ALLY K [1], MERCY A D [2] and VISWANATHAN T V[3]

Kerala Veterinary and Animal Sciences University, Mannuthy, Thrissur, Kerala 680 651 India

Received: 25 July 2011; Accepted: 12 January 2012

ABSTRACT

A study was conducted for 100 days in crossbred dairy cows to assess the influence of degradability of dietary protein on milk production. Crossbred dairy cows (14) within 1 week of their lactation were selected and grouped into T1 and T2 as uniformly as possible. They were fed with isocaloric (72% TDN) and isonitrogenous (17% CP) concentrate mixtures with 2 levels of undegradable protein, i.e. 26.8 (T1) and 42.9 (T2) of the dietary CP. Paddy straw was the roughage fed and the ratio between concentrate and paddy straw was 70: 30 in the ration. The results showed no significant differences in the body weight of cows of the 2 groups. The dry matter intake and average daily milk yield of animals under T1 were higher than those of T2 from third and seventh weeks of the experiment, respectively. Percentage of milk fat and total solids and rumen ammonia nitrogen (mg/dl) were higher in T1. The cost of production of 1 kg milk was ₹ 15.61 and 16.09, respectively, for the T1 and T2. It may be concluded that a concentrate mixture with a UDP level of 26.8% of CP improved the quality and quantity of milk in cows producing on an average 8–10 kg milk daily economically.

Key words: Crossbred cows, Milk production, Undegradable protein

The beneficial effects of undegradable protein is dependent upon their ability to supply the essential amino acids. Even though the response on milk production is highly variable, supplementation of UDP invariably increased the cost of feed and production. The average peak of daily milk production of the dairy cow in Kerala ranges from 7 to 8 kg and a dietary CP content of 17% was sufficient for these animals (Ally *et al.* 2007). The present work was undertaken to optimise the degradability of dietary protein (17% CP) in concentrate mixtures having sufficient energy to support maximum milk production under the management practices existing in the state.

MATERIALS AND METHODS

Crossbred cows (14) in early lactation were selected and they were grouped into two as uniformly as possible with respect to their age, stage of lactation, parity, body weight and previous milk yield. Two isocaloric and isonitrogenous concentrate mixtures (72% TDN and 17% CP) with 26.8 and 42.9% of their CP as undegradable protein (UDP) were allotted to the 2 groups,T1 and T2 randomly for 100 days. The UDP level was calculated using the reported value for the ingredients (Ensminger *et al.* 1990). The ingredient and proximate composition of the 2 concentrate mixtures fed are given in Tables 1 and 2, respectively.

The rations, T1 and T2 comprising concentrate and roughage (paddy straw) in the ratio 70:30 were offered at 3 to 3.5% of body weight initially. Animals were weighed fortnightly and the feed offered was revised accordingly.

Table 1. Composition of the two concentrate mixtures

Ingredient	Concentrate mixture	
	1	2
Yellow maize	45.0	30.0
Ground nut cake	20.0	6.0
Wheat bran	26.4	15.4
Coconut cake	5.0	45.0
salt	1.0	1.0
Shell grit	2.0	2.0
Sodium bicarbonate	0.6	0.6

To 100 kg of the above concentrate mixture 12 g of vitamin mixture containing: 40,000 IU of vitamin A, 20 mg of vitamin B_2 and 5,000 IU of vitamin D_3/g were added.

Present address: [1]Associate Professor (allyk_vet@yahoo.co.in); [2]Professor and Head (Kerala.drmercyad@gmail.com), Department of Animal Nutrition, College of Veterinary and Animal Sciences.

[3] Retired Professor, College of Veterinary and Animal Sciences, Pookod, Wayanad, Kerala.

Table 2. Chemical composition of the two experimental concentrate mixtures and paddy straw (on dry matter basis)

Component (%)	Concentrate mixtures 1	Concentrate mixtures 2	Paddy straw
Dry matter	92.89±0.24	93.25±0.18	87.78±0.11
Crude protein	17.24±0.52	17.18±0.18	4.22±0.22
Ether extract	5.28±0.32	5.55±0.14	2.80±0.19
Crude fibre	8.78±0.48	8.24±0.22	34.96±0.16
Total ash	7.68±0.28	8.18±0.34	10.76±0.11
Nitrogen free extract	61.02±0.41	60.85±0.18	47.26±0.28
Acid insoluble ash	1.98±0.28	3.08±0.14	2.78±0.08
Neutral detergent fibre	24.18±0.09	23.08±0.12	74.89±0.12
Acid detergent fibre	15.28±0.12	15.98±0.18	54.23±0.08
Acid detergent lignin	6.07±0.02	6.28±0.18	4.76±0.04
Calcium	0.84±0.06	0.88±0.02	0.29±0.02
Phosphorus	0.49±0.14	0.58±0.09	0.09±0.07

Records on daily feed intake and milk production were kept during the experiment. Milk samples were collected fortnightly and samples were analysed for total solids, fat (IS: 122A 1977), protein (AOAC 1990) solids not fat (SNF) and milk urea nitrogen (Bector *et al.* 1998). The various haematological parameters, viz. haemoglobin (Wong 1928), glucose (Folin and Wu 1920), plasma calcium (Clark and Collip 1925), plasma phosphorus (modified metol method using kit) and blood urea nitrogen (Coulombe and Favrreau 1963) were estimated from the blood samples collected on the 50th and 98th day of the experimental period. The rumen fermentation parameters such as pH, total volatile fatty acids (Barnett and Reid 1957), rumen ammonia nitrogen (Beecher and Whitten 1970) and lactic acid (Pennington and Sutterland 1956) were estimated from the samples collected at the beginning and end of the feeding trial. A 7- day digestibility trial was conducted towards the end of the feeding trial by total collection method. Proximate analysis of the feed, straw and dung were done by standard procedures (AOAC 1990). The neutral detergent fibre (Van Soest and Wine 1967) and acid detergent fibre (Van Soest 1963) of the feed, straw and dung were also estimated. The calcium content in the feed and straw was estimated using atomic absorption spectrophotometer and the phosphorus content by Vanado-Molybdate method (AOAC 1990). The results were analysed statistically as per Snedecor and Cochran (1985).

RESULTS AND DISCUSSION

Body weight and dry matter intake: The average body weight of the animals were 323.57±15.11 and 309.43±23.58 initially in the 2 groups and the corresponding values at the end of seventh fortnight was 318.18±10.52 and 313.25±11.28, respectively. There was no significant difference between the 2 groups regarding the body weight. The animals of T1 had higher (P<0.05) DMI from the third week of feeding trial to the end of the trial. The DMI of the animals in both groups peaked at the second week of trial

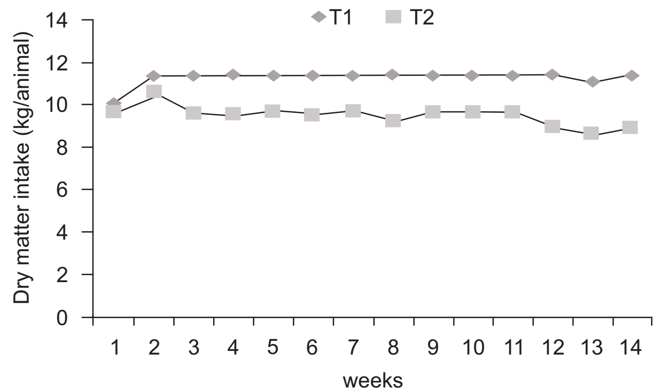

Fig. 1. Average daily dry matter intake of animals fed the 2 rations.

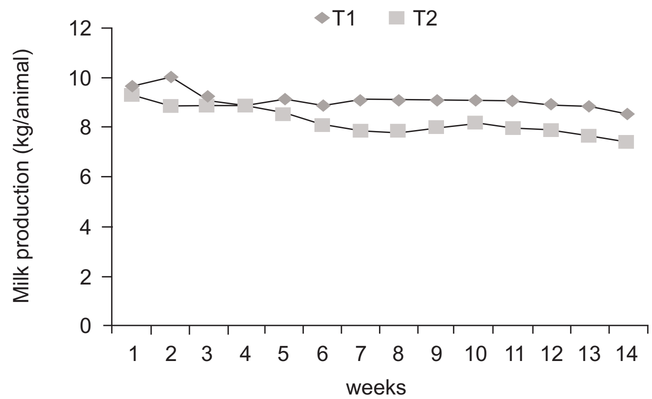

Fig. 2. Average daily milk production of animals fed the 2 rations.

and this level was maintained in T1 while there was much fluctuation in T2 (Fig.1). Dry matter intake, which was higher (P < 0.05) in T1 was 3.49 and 2.97% of body weight in T1 and T2, respectively. A decrease in the palatability and a lowered DMI in response to an increase in UDP was also reported by Calsaminglia *et al.* (1995) and Gracia- Bajolil *et al.* (1998).

Milk production and milk composition: The daily average milk productions by the animals of the 2 groups are represented in Fig.2. There was a higher (P< 0.05) milk yield by the animals of T1 during the second, seventh, eighth, ninth, 11th, 12th, 13th and 14th, weeks of trial. Kalbande and Thomas (1990) observed a positive response in milk production in medium to high producers, fed mainly on crop residue based diets. Nocek and Russell (1988) opined that the failure of undegradable protein to increase milk production may be due to low productivity of the cows or low availability of protein post ruminally.

Statistical analysis of the pooled fortnight values showed a significantly higher % of milk fat, SNF and total solid in T1 than that of T2. Crawford and Hoover (1984) reported a decrease in the SNF level of milk and Aharoni *et al.* (1993), observed that milk fat % was higher in cows fed diets of low degradability when a 17% CP ration at 75 and 65%

Table 3. Various observed/estimated parameters

Parameter	T1	T2
DMI, kg /animal	11.27±0.11	9.47±0.12
Milk yield, kg/ animal	9.08±0.12	8.23±0.12
Milk components		
Fat(%)	3.6±0.09 [a]	3.18±0.06 [b]
Total solids (%)	12.31±0.19 [a]	11.31±0.22 [b]
SNF (%)	8.7±0.16 [a]	8.13±0.16 [b]
Protein (%)	2.88±0.04	2.82±0.08
Urea nitrogen (mg/dl)	47.67±3.06	49.29±3.04
Haematological parameters		
50^{th} day		
Hb (g/dl)	10.27±0.16	10.58±0.54
Blood glucose (mg/dl)	43.57±1.43 [a]	53.57±3.46 [b]
Blood urea nitrogen(mg/dl)	44.40±4.04	39.61±3.03
Plasma calcium (mg/dl)	10.86±0.51	9.8±0.16
Plasma phosphorus(mg/dl)	6.50±0.31	6.24±0.4
98^{th} day		
Hb(g/dl)	9.69±0.41	10.00±0.73
Blood glucose (mg/dl)	62.14±0.65	57.14±2.14
Blood urea nitrogen(mg/dl)	43.01±5.05	35.30±2.03
Plasma calcium (mg/dl)	11.00±0.44	11.0±0.92
Plasma phosphorus(mg/dl)	7.74±0.29	6.7±0.73

Means with different superscripts in the same row for each parameter vary significantly (P< 0.05).

Table 4. Digestibility coefficient of nutrients of the two experimental rations

Nutrient	T1	T2
Dry matter	62.34±0.17	66.67±1.57
Crude protein	74.22±2.41	73.69 2.66
Ether Extract	71.33±2.86 [a]	86.19±1.44 [b]
Crude fibre	52.07±3.13	55.67±1.76
Nitrogen free extract	68.11±2.68	69.21 2.45
Neutral detergent fibre	42.70±2.94	45.02±2.68
Acid detergent fibre	48.96±4.11	54.02±2.53

Means with different superscript in the same row differ significantly (P<0.05).

degradability was given.

Rumen fermentation and haematological parameters: The final values for the various rumen fermentation parameters such as pH, total volatile fatty acids, lactic acid and NH_3-N for T1 and T2, were well within the normal range. There was no significant variation between groups regarding the parameters except for rumen NH_3-N level which was higher (P< 0.05) in T1 than T2. There was no significant difference on the haematological parameters between the treatments except for blood glucose levels measured on the 50^{th} day collection which was higher (P<0.05) in animals of T2 than that of T1 (Table 3). Lower rumen degradability of T2 ration might have increased nutrient flow into the small intestine which might have increased the absorption of glucose. However the blood glucose levels, of both the collections were within the normal range.

Table 5. Total dry matter intake and cost per kg milk production of animals maintained on the two experimental rations

Parameter	T1	T2
Total concentrate consumed in 100 days (kg)	4620 [a]	3889.2 [b]
Total straw consumed in 100 days (kg)	2038 [a]	1693 [b]
Total feed consumed in 100 days (kg)	6658 [a]	5582.2 [b]
Dry matter intake per 100 kg body weight (kg)	3.49 [a]	2.97 [b]
Dry matter intake per kg metabolic live weight (W $kg^{0.75}$) (kg)	2.46 [a]	2.08 [b]
Total milk produced in 100 days (kg)	5549.9	4623
Feed intake per kg milk produced (kg)	1.2	1.21
Cost of one kg concentrate (₹)	14.34	14.77
Cost of one kg straw (₹)	10.0	10.0
Total cost of feed (₹)	35140.02	34004.54
Cost/kg milk produced (₹)	15.61	16.09

Means with different superscripts in the same row for each parameter vary significantly (P< 0.05).

Digestibility coefficient of nutrients: The digestibility coefficient of nutrients such as DM, CP, CF, NDF, ADF, EE and NFE are given in Table. 4. There was no significant effect of the UDP level of the concentrate mixture on the digestibility of nutrients, except for the digestibility of EE, which was higher (P<0.05) for T2 ration. Digestibility of DM, CF, NDF and ADF of the T2 ration was numerically higher than that of T1, but the difference was not significant. The lower DMI might be the reason for the higher digestibility values. Christensen *et al.* (1993) reported that the digestibility of DM, ADF and NDF and nitrogen metabolism in cows were not influenced by the amount of UDP (30 and 45%) in the ration.

Cost of production: The total DMI and DMI/kg metabolic live weight of the animals (Table 5) of T1 was higher (P < 0.05) than that of T2 group. The feed intake per kg milk production was similar (1.20 and 1.21 kg) in both groups, but the cost of production of 1 kg milk was ₹ 0.48 higher in the second group than that of the first group. Although the total milk production was more in the first group, the covariance analysis of the data on milk production revealed that the milk production by animals of the second group fed 42.9% UDP concentrate was maintained better than that of the animals of the first group.

REFERENCES

Aharoni Y, Arieli A and Tagari H. 1993. Lactational response of dairy cows to change of degradability of dietary protein and organic matter. *Journal of Dairy Science* **76**: 3514–32.

Ally K, Mercy A D and Viswanathan T V. 2007. Effect of dietary crude protein levels on the performance of lactating cows. *Indian Journal of Animal Nutrition* **64** (2) : **8**4–87.

AOAC. 1990. *Official Methods of Analysis*. 13th edn. Association of Official Analytical Chemists, Washington D C Pp.180.

Barnett A J G and Reid R L. 1957. Studies on the production of volatile fatty acids from grass by rumen liquor in artificial rumen. 1. The volatile fatty acid production from fresh grass. *Journal of Agricultural Sciences* **48**: 315–21.

Bector B S, Ram M and Sighal O P. 1998. Rapid platform test for added urea in milk. *Indian Dairyman* **50** (4): 59–62.

Beecher G P and Whitten B K. 1970. Ammonia determination: Reagent modification and interfering compounds. *Analytical Biochemistry* **36**: 243.

Calsaminglia S, Caja G, Stern M D and Crooker B A. 1995. Effect of ruminal versus duodenal dosing of fish meal on ruminal fermentation and milk composition. *Journal of Dairy Science* ***78:***1648–53.

Christensen R A, Cameron M R, Clusmeyer T H, Elliot J P, Clark J H, Nelson D R and Yu Y. 1993. Influence of amount and degradability of dietary protein on nitrogen utilization by dairy cows. *Journal of Dairy Science.* ***76:*** 3497–3513.

Clark J A and Collip J R. 1925. A study of Tisdall metod for determination of blood calcium with a suggested modification. *Journal of Biological Chemistry* **63**: 461.

Coulombe J J and Favrreau L.1963. A new simple semimicro method for colorimetric determination of urea. *Clinical Chemistry* **9**: 102.

Crawford R J Jr and Hoover W H. 1984. Effect of particle size and formaldehyde treatment of soybean meal on milk production and composition for dairy cows. *Journal of Dairy Science* **67**: 1945–52.

Ensminger M E, Oldfield J E and Heinman W W. 1990. *Feeds and Nutrition*. 2nd edn. Pp.1511. Ensminger publishing Co., California, USA.

Folin O and Wu H. 1920. A system for blood analysis.Supplement I. A simplified and improved method for determination of sugar. *Journal of Biological Chemistry*. **41**: 367.

Gracia-Bajolil C M, Staples C R, Risco CA, Savio D J and Thacher W W. 1998. Protein degradability and calcium salts of long chain fatty acids in the diets of lactating cows: Productive responses. *Journal of Dairy Science* **81**:1374–84.

IS: 1224. 1977. Determination of fat by Gerbers method. Part.I. *Milk* (First revision). Indian Standards Institution. New Delhi.

Kalbande V H and Thomas C T. 1999. Effect of bypass protein on yield and composition of milk in crossbred cows. *Indian Journal of Animal Sciencse* **69** (6): 614–16.

Pennington R J and Sutherland T M. 1956. Ketone body production from various substrates by sheep rumen epithelium. *Biochemistry Journal* **63**: 353.

Snedecor G W and Cochran W G. 1985. *Statistical Methods*. 7th edn, Pp. 313. Iowa state university press. Iowa, USA.

Wong J. 1928. *Hawk's Physiological Chemistry*. 14th edn. Pp. 1472. (Eds) Oscar B L. Tata McGraw- Hill publishing company Ltd. 330 West 42nd street, New York.