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Relative study of nutrient requirement of cows and assessment of excess or deficit of energy and protein in the diet

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Abstract
Feeding trial conducted on 20 lactating cows and data is collected to assess their nutrient requirement of energy and protein of lactating cattle using the combined nutrient intake and performance data of almost all of the experimental animals under feeding trial was evaluated. Animals were strategically supplemented exactly as per their nutrient requirement according to their maintenance and production. In Group I, there was 28.48% DCP and 28.98% TDN. In Group II, there was 28.40% DCP and 28.44% TDN.

Keywords: Cattle, protein requirement, energy requirement, lactation, strategic supplementation

Introduction
Introduction in India, agricultural prosperity is intimately associated with the livestock development. Under nearly all practical management conditions, milch cows and growing dairy calves are fed ad lib. Thus, voluntary feed intake is the major limitation to balance nutrient supply in dairy cows. Feed intake is usually characterized as dry matter intake (DMI) to compare balance diets of variable moisture concentrations. DMI is affected by both animal and feed factors. Relative body size, milk production, and stage of lactation or gestation are the major animal factors. At peak DMI, daily DMI of high-producing cows may be 5% of their body wt, and even higher in extremely high-producing milking cows. More typical peak DMI values are in the range of 3.5%–4% of body wt. In mature and adult cows, DMI as a percentage of body weight is lowest during the nonlactating, or dry, period. In most cows, DMI declines to its lowest rate in the last 2–3 wk of gestation. Typical DMI during this period is <2% of body wt/day, with intake rates depressed more in fat cows than in thin ones. Feed intake during this period has an important relationship to postpartum health, with low DMI and associated prepartum negative energy balance increasing the risk of postpartum disease. After parturition, DMI increases as milk production increases; however, the rate of increase in feed consumption is such that energy intake lags behind energy requirements for the first several weeks of lactation. Milk production and associated energy requirements generally peak around 6–10 wk into lactation, whereas DMI usually does not peak until 12–14 wk into lactation. This lag in DMI relative to energy requirements creates a period of negative energy balance in early lactation of milking cows. Cows are at greater risk of metabolic disease during this period than at other times during their lactation cycle. Management and nutritional strategies should be designed such that to maximize DMI through the period of late gestation and early lactation.
Livestock rearing being the major source of income. Animal productivity is a major part of agricultural productivity and plays important role in the national economy. Large ruminants such as cattle continue to play an important role in the livestock production system in our country India. Indian cattle breeds are of smaller mature body size, grow at slower rate and produce a small quantity of milk as compared to the breeds found in temperate countries. However, the Indian breeds are hardy, and well adapted to heat stress and poor quality diets, a situation which is characteristic of tropical countries. The nutrient requirement of these animals probably differ from those prescribed in the feeding standards of temperate countries (NRC, 1989; AFRC, 1990) [8, 2] because of differences in genetic makeup, mature body size and growth rate, quality of feeds, atmospheric climatic conditions and differences in efficiency of nutrient utilization. Very few studies in field and in research aspect have been conducted so far to measure nutritional requirements of tropical breeds, which is perhaps the most important consideration to obtain the best efficiency in any type of production and reproductive aspect. Knowing the properties of the feed like quality and quantity is equally important.

The appropriate and exact feeding standards for these animals are not yet clearly defined, there being wide differences (as high as 40%) in nutrient requirements prescribed by existing and prevailing feeding standards. Although western countries have adopted RDP and UDP system and NE for expressing protein and energy requirements, whereas India and many tropical countries still continues to use CP and DCP, TDN or ME for expressing nutritive values of feeds and feeding standards. Most of the available publications on feeding trials on lactating cattle in India reported nutritive values of feed in terms of CP, DCP, TDN and ME.

The feeding standards for cattle, which are currently being followed in India (Kearl, 1982; ICAR, 1998) [5, 3], are based on only a few feeding trials. As these standards were developed from a small database, they do not reflect precise requirements for widely different planes of nutrition, quality of feed or individual variations under the diversified tropical conditions prevailing in India. An optimum milk production, growth rate and feed efficiency according to inherent genetic potentiality of a particular category of animal can be achieved only through accurate evaluation of their balance nutrient needs and requirement.

Keeping these in views, the present study was undertaken to determine and analysis of energy and protein requirements of lactating cattle using the combined nutrient intake and their eventual performance.

India has emerged as the largest milk producer in the world, but the productivity of dairy animals is still low. The low milk productivity by Indian cattle and buffaloes has been attributed to several factors. However, inadequate nutrition is the single largest factor responsible for low milk productivity in dairy animals. Several reports indicate that there is deficiency of both green and dry fodder and commercial concentrate in the country due to which animals don't get adequate feed for expression of their genetic potential [kundu *et al*., 2005] [6]. Efforts to increase the feed and fodder resources during the last four decades have been offset by the increase in the bovine population at an annual rate of 1.5 percent. Therefore, availability of feed fodder to the livestock has remained unchanged during this period further feeds fodder cost constitute about 60-70 percent of cost of milk production, thus cultivated fodder has an important role in meeting requirement of the livestock in terms of nutrients and bulk for economic milk production. The green fodders are known to be cheaper source of nutrients as compared to concentrate and hence useful in bringing down the cost of feeding and reduce the need for purchase of concentrate feeds from the market. Moreover, it was observed that energy and protein are the main limiting factors for production of livestock, however, mineral deficiencies may also limit the animal performance [kabaija and little, 1998] [4]. Therefore, in the present study was planned to see the nutrient requirement of cows and excess or deficit of energy and protein in the diet.

Materials and Methods

The present study was conducted on 20 lactating cows of the second to third lactation were selected individually from villages Baddaua, Semadhana, Baroda, Sallaiyagazi, Hinnpur, Gosra and Kakarkuiya situated as Jaisinagar road of district Sagar, Madhya Pradesh. Cows were divided randomly into 2 dietary treatment of 10 animals each considering their body weight, milk yield, parity and stage of lactation. The experiment was conducted for the period of 180 days.

Dietary Treatment

The 2 dietary treatment used are as under.

Group I (T_1)

Group I will be control. The animals were be fed diet regularly used in the farmer's field. It will consist of wheat straw adlib and in addition to that green berseem is provided daily in the evening while concentrate mixture will be provided at the time of milking daily in the morning and evening.

Group II (T_2)

The animals of this group were be fed similar diet to control but it will be supplemented with mineral mixture @ 2% of the diet.

Statistical analysis

The data obtained were analyzed using general statistics *viz*., computation of percentage, mean, standard deviation and correlation coefficient. Two sample test for mean and proportion on normal distribution and one way ANOVA was used to find significant differences among groups.

Result and Discussion

Feeding practices existing in the dairy farm

In all the lactating cows ad lib feeding of straw was practiced. The preferred straw used for the feeding of animals was wheat straw. Besides wheat straw limited quantity of green Berseem was offered daily to each cow. Studies were conducted to assess and study the effects of strategic nutrient supplementation in the performance of lactating cows. Singh *et al*. (2003) [12] reported that elevating feeding plane by 20% above feeding standards during 60 d prepartum to 120 d postpartum period improved productive and reproductive performance of high yielding Indian cows. Still the appropriate feeding standards for the milch animals are not yet clearly defined, there being wide differences (as high as 40%) in balance nutrient requirements prescribed by existing feeding standards. Increasing DMI can minimize commonly occurring metabolic disorders, minimize weight loss, and improve reproductive and productive performance. During late stage of gestation, DMI can decline 2–4 kg per cow. If dry matter is lower than predicted values, the nutrient concentration in daily diet must be increased to meet the cow's nutrient requirements to enhance production of milk and reproductive parameters. The data obtained in the study were statistically analyzed and presented.

Feed/Dry Matter intake of the animals

Dry matter intake of the animals was recorded before the start of the experiment. The offered feed ingredients were green Berseem, wheat straw and concentrate mixture. The quantity of each feed ingredients offered to the animals was recorded. It was 5 kg green fodder, 4.34 kg concentrate and the dry fodder mainly wheat straw was provided adlib. The quantity recorded was 6 kg dry fodder. The actual dry matter intake was 5.64 through wheat straw, 0.75 through green Berseem and 3.84 through concentrate mixture. The total dry matter intake in all the animals was 10.23 from all the feed ingredients. While, the quantity consumed as such was 15.34 kg including all the feed ingredients. The data recorded about dry matter intake and nutrient supplied in terms of DCP and TDN is presented in Table.

Table 1: Dry matter, DCP and TDN intake of animals through concentrate and roughage

Ingredients	Quantity (kg)	Dry matter (kg)	DCP (gm)	TDN (kg)
Berseem	5.00	0.75	93.80	0.44
Wheat Straw	6.00	5.64	0.00	2.71
Concentrate	4.34	3.84	489.20	2.44
Total	15.34	10.23	583.00	5.59

Nutrient requirement of the animals

Nutrient requirement of different animals pertaining to different groups was calculated using Ranjan (1998) feeding standards. The maintenance requirement of cows was calculated on the Nutrient requirements of the animals' basis of their body weight. Production requirement was calculated on the basis of their milk yield.

Table 2: Ingredient composition of concentrate mixture (Dairy gold)/ kg

S. No.	Ingredients	Quantity
1	Moisture	11%
2	Protein	18%
3	Fat	2.5%
4	Fibre	20%
5	Silica	5%
6	Salt	2%
7	Urea	1%
8	Calcium	0.5%
9	Phosphorus	0.5%
10	Vitamin A	500IU
11	Metabolizable energy	2240 kcal
Calculated		
DCP		12.74%
TDN		63.63%

Table 3: Composition of mineral mixture (Agrimin forte)/ kg used at field

S. No.	Ingredients	Quantity
1	Calcium	25.5%
2	Phosphorus	12.75%
3	Sulphur	0.72%
4	Zinc	9600 mg
5	Sodium	5.9 mg
6	Vitamin A	7 lakh
7	Vitamin D	7500 IU
8	Vitamin E	250 mg
9	Nicotinamide	1000 mg
10	Cobalt	150 mg
11	Copper	120 mg
12	Iodine	325 mg
13	Iron	150 mg
14	Magnesium	600 mg
15	Potassium	100 mg
16	Selenium	10 mg

Table 4: Nutrient requirement of animals of Group I

S. No	Animal No.	Animal body weight (kg)	Maintenance requirement		Average milk yield (lit.)	Production requirement		Total requirement	
			DCP (gm)	TDN (Kg)		DCP (gm)	TDN (Kg)	DCP (gm)	TDN (Kg)
1	A1	370.2	230	2.7	4.52	203.4	1.42	433.40	4.12
2	A2	355.2	230	2.7	6.26	281.7	1.97	511.70	4.67
3	A3	334.9	200	2.4	4.43	199.35	1.40	399.35	3.80
4	A4	337.7	200	2.4	4.30	193.50	1.35	393.50	3.75
5	A5	353.6	230	2.7	3.52	158.40	1.11	388.40	3.81
6	A6	371.3	230	2.7	5.20	234.00	1.64	464.00	4.34
7	A7	335.7	200	2.4	3.60	162.00	1.13	362.00	3.53
8	A8	370.3	230	2.7	3.24	145.80	1.02	375.80	3.72
9	A9	337.7	200	2.4	4.90	220.50	1.54	420.50	3.94
10	A10	385.2	230	2.7	4.25	191.25	1.34	421.25	4.04
Mean		355.18	218	2.58	4.42	198.90	1.39	416.99	3.97
SE		5.79	4.90	0.05	0.28	12.69	0.09	14.10	0.10
SD		18.31	15.49	0.15	0.89	40.11	0.28	44.57	0.33

Table 5: Nutrient requirement of animals of Group II

S. No.	Animal No.	Animal body weight (kg)	Maintenance requirement		Average milk yield (lit.)	Production requirement		Total requirement	
			DCP (gm)	TDN (Kg)		DCP (gm)	TDN (Kg)	DCP (gm)	TDN (Kg)
1	B1	332.9	200	2.4	5.20	234.00	1.64	434.00	4.04
2	B2	388.1	230	2.7	4.85	218.25	1.53	448.25	4.23
3	B3	352.9	230	2.7	3.25	146.25	1.02	376.25	3.72
4	B4	371.3	230	2.7	3.80	171.00	1.20	401.00	3.90
5	B5	363.7	230	2.7	3.52	158.40	1.11	388.40	3.81
6	B6	355.5	230	2.7	4.60	207.00	1.45	437.00	4.15
7	B7	369.5	230	2.7	4.50	202.50	1.42	432.50	4.12
8	B8	377.7	230	2.7	5.25	236.25	1.65	466.25	4.35
9	B9	373.7	230	2.7	3.60	162.00	1.13	392.00	3.83

10	B10	389.0	230	2.7	3.75	168.75	1.18	398.75	3.88
Mean		367.43	227	2.67	4.32	190.44	1.33	417.44	4.00
SE		5.39	3.00	0.03	0.23	10.45	0.07	9.44	0.06
SD		17.04	9.48	0.09	0.73	33.04	0.23	29.85	0.20

Strategic, supplementation to the animals

Animals were strategically supplemented exactly as per their nutrient requirement according to their maintenance and their production. By the strategic supplementation we have reduced the feed supplied to different groups of animals at the farmer's field. Group I was control so their feeding was as per their normal feeding schedule. In group II there was only supplementation of mineral mixture along with feed @ 2% of concentrate mixture).

Percent excess and deficit of nutrients supplied to the animals

After calculation the total nutrient offered as well as the total nutrient required by the animals according to their maintenance as well as their production status. The percent excess and deficit of the nutrient were calculated by subtracting the total nutrient offered and total nutrient required by the animals. In group I, there was 28.48% excess DCP and 28.98% excess TDN were supplied in the feed. In group II after calculating their nutrient requirement and nutrient supplied the percent excess of nutrients in terms of DCP was 28.40% and 28.44% of TDN in the diet was 22.85% and 16.90%. The percent excess and deficit of the nutrients are presented in Table.

Table 6: Percent excess or deficit of energy a protein in the diet of animals of diff GPS

S. No.	Group	Supplied		Required		Excess (+) or Deficit (-)	
		DCP (gm)	TDN (kg)	DCP (gm)	TDN (kg)	Excess/ deficit DCP (%)	Excess/ deficit of TDN (%)
1.	Group I	583.00	5.59	416.99	3.97	+166.01 (28.48%)	+1.62 (28.98%)
2.	Group II	583.00	5.59	417.44	4.00	+165.56 (28.40%)	+1.59 (28.44%)
	Mean	583.00	5.59	430.46	4.10	152.54 (26.16%)	1.49 (26.65%)

Strategic supplementation

In the present experiment we found that there was feeding of DCP and TDN to the animals and farmers were not using mineral mixture in the diet of animals which was also reported by Nagalakshmi *et al*. (2006b) [7]. In group I, there was 28.48% DCP and 28.98 TDN. In group II, there was 28.40% DCP and 28.44 TDN. ss These results were in agreement with Singh *et al*. (2006) [13]. Similarly, Shahi and Saraswat (1997) [11] also observed 31.25% higher TDN intake in milch cows and buffaloes.

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