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Full Length Research Paper

Intervention of traditional feeding systems of small scale rural farmers rearing crossbred dairy cattle and its impact on production–An Indian perspective

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Abstract

A field experiment was conducted to study effect of different levels of RDP:UDP containing concentrate supplementation on production performance of crossbred dairy cattle under field conditions. Eighteen crossbred dairy cattle (JBX) were divided into three groups (RBD), T_1 (60: 40) and T_2 groups (55: 45). The animals in T_1 and T_2 groups were supplemented concentrate with different levels of degradable protein for 90 days, while in control (c) group feeding system traditionally adopted by the farmers was considered without any intervention. The impact of altered feeding on milk production, composition and efficiency of production of crossbred milch cows was studied. The intake of DM, CP, DCP and TDN were more (P< 0.05) in treatment groups (T_1 and T_2) as compared to the control group. There was increased (P< 0.05) FCM yield in T_1 and T_2 groups to the tune of 27.3% and 31.2% respectively. The fat (30.5 and 32.8%), SNF (21.3 and 30.5%), total solids (24.2 and 31.3%) and milk protein (40.8 and 42.7%) yield was more (P< 0.05) in T_1 and T_2 groups as compared to control during the period of 90 days, due to increased level of UDP in the rations. It can be concluded that altering the feeding systems traditionally adopted by the farmers in a scientific way improved milk production.

Keywords: Feeding system, RDP, UDP rural farmers, cattle, crossbred.

INTRODUCTION

Feeding pattern in unorganized dairy farming by small and marginal farmers solely depend on grazing with supplementation of limited supplements. High milk production can be achieved by providing required nutrients in proper form (Aparna et al., 2009). Major constraint in ruminant feeding is the scarcity of feeds and fodders in quantity and quality. Due to high pressure on land for crop production for human consumption, farmers cannot spare sufficient land for fodder production. Cattle mainly subsist on straw based ration with limited supplementation of green fodder and a little concentrate. So the productivity of the ruminants is severely constrained by inadequate nutrition which interferes the production performance of the animals. Rice straw is the commonly available and cheapest roughage source for feeding of livestock in India (Prasad et al. 2005). As the straw is low in nitrogen content and poor digestibility, nutritive value can be improved by proper supplementation of nitrogen and energy. Modified feeding of dairy cattle has been described frequently as an appropriate tool to improve dairy production. Supplementation particularly with high quality protein is often necessary to maintain adequate productivity, which not only mitigate under nutrition problem but also enhan-

ces the animal productivity of dairy cattle by providing high quality protein in proper form. Protein supplements are generally one of the most expensive feed ingredients in ruminant rations, especially in the Indian conditions. Thus there is a global interest to optimize the utilization of dietary proteins within the ruminant system. There are limited protein supplements available in the farm of cakes and meals which are not sufficient to meet the requirements of dairy cattle. If their degradation is controlled in the rumen, their efficiency of protein utilization for different productive purposes can be substantially increased. It has been reported that if protein is supplemented in the correct quantity and correct proportion in the form of RDP and UDP it optimizes fermentation in the rumen and reduces nitrogen wastage and improves utilization of protein besides reduce environmental pollution.

In India livestock rearing is traditional and based on socio- economic conditions of farmers due to low availability of quality feeds with poor feeding practices. Animal Husbandry and dairy development play a predominant role in the rural economy in supplementing the income of rural households, particularly the landless, small and marginal farmers. It also provides subsidiary occupation in semi-urban areas and people living in drought prone areas, where crop output may not sustain the family (Tiwari et al. 2005). The average Indian farmer has very small land holdings and accordingly small scale of operation when compared to other farmers in developed countries.

Modified feeding of dairy cattle has been described frequently as an appropriate tool to improve dairy production. Hence this study was undertaken to assess the nutrient availability in dairy cattle through existing feeding practices and to correct the deficiency by strategic supplementation of suitable supplement in the correct form of protein (RDP : UDP) Hence present study was aimed to formulate a suitable concentrate mixture with limited feed ingredients, based on the feeding practices adopted by the farmers, so that farmers can easily adopt and at the same time it will provide optimum nutrition and to study the effect of supplementation on milk yield. Field based, resource specific and farmer oriented approach has been selected to develop a feeding system to ensure sustainability of dairy production for small holder farmers in rural areas to achieve enhanced production.

MATERIALS AND METHODS

Location of study

A field study was conducted in Chittoor district of Andhra Pradesh State, which is situated between 12-37" to 14-8" of Northern latitude and 78-33" to 79-55" of Eastern longitude. Maximum temperature ranges from 36º to 38ºC and in eastern parts it touches 46ºC. Minimum temperature in western parts ranges from 12º to 14ºC and in eastern parts it ranges from 16º to 18ºC with average rainfall of 918.1 mm. Chittoor is the second largest milk -producing district in India after Anand of Gujarat state. The district is known for its impressive livestock population and milk yield. More than 70 per cent of the cattle in the district are crossbred. Indian farmers largely follow traditional farming practices and have very little access or opportunity to use modern farming systems.

Study of ongoing feeding practices

Nutritional status of dairy cattle under field conditions was studied in a village, (Chandamamavari palli) in Chittoor district of Andhra Pradesh by conducting a preliminary survey. Mostly Jersey crossbred (JBX) cows were available in this village. The observation of feeding practices showed that paddy straw was the major roughage source fed to dairy cattle. Maize and jowar fodders were grown seasonally and concentrate feed supplements like rice bran and groundnut cake/soybean meal were regularly fed as supplements at the time of milking. The information on dairy cattle feeding was collected from dairy farmers. The nutrient requirements and availability based on the existing feeding practices were calculated to assess the deficit / excesses of any particular nutrient. Existing feeding practices showed that, there was sever protein deficiency (36.6-56.6%) and marginal energy deficiency (13.6-16.5%) in the animals as compared to the requirements Ranjhan (1998). To rectify the discrepancies observed in the feeding schedule adopted by the farmers, appropriate feeding strategy was planned in terms of supplementing the deficit nutrients through concentrate mixture with different levels of RDP: UDP, with feed ingredients which are regularly used by the farmers, to improve productivity of the animals.

Experimental animals

Dairy crossbred cattle (JBX) with average body weight 390-440 kg, in 2-3rd lactation, yielding 8-10 Kg/day were selected that were reared under semi-loose housing system. The animals (18) were randomly divided into three groups of 6 each. Body weight of animals was arrived before and after experiment by using Shaeffer's formula (Length in inches) X (Girth in inches)^2 /300 = body weight (lbs) as suggested by Sastry and Thomas (1976) and then converted to Kilograms. The nutrient requirements of animals were calculated based on their body weight and milk production (Ranjhan, 1998). The amount of dry matter (DM), digestible crude protein (DCP) and total digestible nutrients (TDN) available to the

animals was calculated from the actual measurements of feed and fodder intake and using the average nutritive values of various feeds and fodders as per Ranjhan (1998). After arriving at the nutrient quantity from forage portion the remaining nutrients were met from the concentrate with different levels of RDP and UDP by adjusting the quantity of concentrate mixture in treatment groups (T_1 and $T_{2)}$, while control (c) group was considered as such without any alteration of the feeding regimen traditionally adopted by the farmers.

Experimental feeds

I Group (Control)

The first group (Control) of crossbred dairy animals the feeding system in vogue, followed by the farmers (Groundnut meal 0.5 Kg, rice bran 1.5 Kg, green forage 8 Kg and Paddy straw).

Treatment 1 (T_1)

To the second group of crossbred dairy animals (3.5 Kg concentrate mixture (with 60% RDP and 40% UDP), 10 Kg green forage and Paddy straw. The rations were formulated in such a way that a slight modification in addition to the feeding system followed in vogue by the farmer.

Treatment 2 (T_2)

To the third group of crossbred dairy animals (4.0 Kg concentrate mixture (with 55% RDP and 45% UDP), 10 Kg green forage and Paddy straw). The rations were formulated in such a way that a slight modification in the quantities of feed ingredients and the proportions was made in addition to the feeding system followed in vogue by the farmer.

The experimental period lost for 90 days (February to April). During this period the animals were offered the calculated amount of concentrate supplement twice daily at the time of milking which was the common practice of the farmers in the studied area. Drinking water was provided ad libitum and made available during entire day.

Recording of data

Milking was done morning at 6.00 AM and evening at 6.00 PM. Daily milk yield (MY) was recorded for individual animals at each milking by using a spring balance with the capacity to weigh up to 10 Kg with an accuracy of 0.10 Kg during morning and evening and lactometer reading were recorded at the time of milking.

Collection of samples

Feed and fodder samples offered to the animals were collected prior to the start of experiment. Milk samples from individual animals were collected prior to the start of experiment, at the end of experiment as well as at weekly intervals during the experimental period, for the analysis of milk components. The samples collected from two milkings were pooled together which represented the milk of that animal on that particular day. Representative samples were drawn in a clean, dry plastic bottle and analysed for different milk components.

Analytical procedures

Feed samples were analysed for proximate components (AOAC, 1995). Effective degradability of feed DM and CP were estimated according to Mc Donald (1981). Milk samples were analyzed for fat % (Gerber‘s method), protein (%) by Kjeldahl method (AOAC, 1995). SNF (%) content was estimated using Richmond‘s formula

SNF= CLR / 4+ (0.2*F) +0.5

Where,

SNF is solids not fat

CLR is the corrected lactometer reading

F is the fat percent and 0.5 is the correction factor

FCM (4%) Kg = 0.4XMY (Kg/d) + 15X MY (Kg/d) X fat (%)/100

Where, MY is milk yield Kg/d

The data were analyzed statistically (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The chemical composition of feeds and fodders offered to the animals are presented in Table 1. Average body weight of the animals and nutrient intake during the trial period is shown in Table 2. The total DMI (Kg/d) of various groups were 9.20, 11.95 and 11.50 respectively for C, T_1 and T_2. The DMI per 100 Kg body weight (2.88 and 2.73) and g per $KgW^{0.75}$ (130 and 123) were more in treatment groups T_1 and T_2 as compared to the control (2.29; 102). These observations are similar to that reported by Mondal and Chopra (2008) in crossbred dairy cows offered 70:30 or 50:50 RDP and UDP in concentrate and Ravi Kumar et al. (2005).

Total crude protein intake (g/d) was 1295, 1681 and 1692 respectively for C, T_1 and $T_{2.}$ The CP intake was deficient by 23% in control group as compared to the treatment groups (T_1 and T_2). The DCP intake in control (330 g/d) group was 50% less than the recommended level by ICAR (Ranjhan, 1998), while in treatment groups (T_1 and T_2) it was 695 and 660 g/d which was as per the recommendations. The RDP intake (g/d) was 799 in control while 1020 and 956 was observed in T_1 and T_2

Table 1. Composition of Feeds and fodders offered to the experimental animals.

	OM	CP	EE	CF	TA	NFE
Paddy straw	87.5	2.9	1.5	32.2	12.5	50.9
Green fodder	87.9	8.0	2.5	26.4	12.1	51.0
Groundnut cake	94.8	39.6	2.5	7.5	5.2	45.2
SBM	91.4	44.6	3.8	5.4	8.6	37.6
Rice bran	84.2	12.7	3.9	24.5	15.8	43.1

Table 2. Nutrients intake of crossbred milch cows supplemented different levels of RDP and UDP

Attribute	Control	T_1	T_2
Body weight (Kg)	403	415	422
Dry matter intake			
Total DMI (Kg/d)*	9.20 ^{b}	11.95 ^{a}	11.50 ^{a}
DMI Kg /100 Kg B.Wt*	2.29 ^{b}	2.88 ^{a}	2.73 ^{a}
DMI g/KgW$^{0.75}$*	102 ^{b}	130 ^{a}	123 ^{a}
Protein intake			
CP intake (g/d)*	1295 ^{b}	1681 ^{a}	1692 ^{a}
CPI g/100 Kg B.Wt*	321 ^{b}	403 ^{a}	401 ^{a}
CPI g/KgW$^{0.75}$*	14.4 ^{b}	18.3 ^{a}	18.2 ^{a}
DCP intake (g/d)**	330 ^{b}	695 ^{a}	660 ^{a}
DCPI g/100 Kg B. Wt**	82 ^{b}	167 ^{a}	156 ^{a}
DCPI g/KgW$^{0.75}$ **	3.7 ^{b}	7.6 ^{a}	7.1 ^{a}
RDP intake (g/d)*	799 ^{b}	1020 ^{a}	956 ^{a}
RDPI g/100 Kg B.Wt*	198 ^{b}	246 ^{a}	227 ^{a}
RDPI g/KgW$^{0.75}$*	8.9 ^{b}	11.0 ^{a}	10.3 ^{a}
UDP intake (g/d) **	496 ^{b}	660 ^{a}	736 ^{a}
UDPI g/100 Kg B.Wt**	118 ^{b}	159 ^{a}	174 ^{a}
UDPI g/KgW$^{0.75}$*	5.51 ^{b}	7.18 ^{a}	7.91 ^{a}
TDN intake			
TDN intake (Kg/d)*	4.77 ^{b}	6.37 ^{a}	6.28 ^{a}
TDNI Kg/100 Kg B.Wt*	1.18	1.54 ^{a}	1.49 ^{a}
TDNI g/KgW$^{0.75}$*	53	69 ^{a}	68 ^{a}

$^{a\ b}$different superscripts in a row indicate significant difference *($P < 0.05$); **($P < 0.05$)

groups, indicated significant ($P<0.05$) differences. Similar trend was also observed in UDP especially addition of more UDP in concentrate mixture of T_2 (45%) resulted in more UDP intake (174 g/d) by the animals in T_2 group; followed by T_1 (159 g/d) which received concentrate mixture with 40% UDP and control (118 g/d). These intakes were 24.9% more in T_1 and 48.4% more in T_2 as compared to control. Similar change was also reported by Mondal and Chopra (2008) due to altered RDP UDP contents in the ration.

TDN intake was 4.77, 6.37 and 6.28 Kg/d, respectively in control, T_1 and T_2 groups under study. In control group there was a deficiency of 25% as compared to the T_1 and T_2. The treatment groups received more concentrate mixture as per the recommended quantities as compared to the control group because of which TDN intake was more in these groups.

Milk yield and composition

The average daily milk yield was 7.62, 9.35 and 9.80 Kg/d respectively in control, T_1 and T_2 groups (Table 3). The data indicated that, with the change of feeding schedule, there was increase in milk production (Kg) to the tune of 841.5, 882.0, which is 22.7% and 28.6% more in T_1 and T_2 treatment groups as compared to control (Table 5) during the study period of. 90 days. Mondal and Chopra (2008) reported 14.6 to17.51% and Ravi Kumar et al. (2005) 13.65% increase in production

Table 3. Milk yield (L /h /d) and milk composition in crossbred milch cows supplemented different levels of RDP and UDP

Milk yield	**Control**	**T_1**	**T_2**
Milk yield* (Kg/day)	7.62 [b]	9.35 [a]	9.80 [a]
FCM yield* (Kg/day)	7.57 [b]	9.64 [a]	9.93 [a]
Milk composition			
Fat %	3.96	4.21	4.09
SNF %	8.70	8.60	8.83
Total solids %	12.66	12.81	12.92
Protein%	3.42	3.75	3.59

[a b] different superscripts in a row indicate significant difference *($P < 0.05$)

Table 4. Efficiency of nutrient utilization of crossbred milch cows supplemented different levels of RDP and UDP

	Control	**T_1**	**T_2**
DM consumed /Kg FCM(Kg)	1.21	1.24	1.16
CP consumed /Kg FCM(g)	171	174	170
TDN consumed /Kg FCM(g)	630	660	632
RDP consumed /Kg FCM(g)	92	106	96
UDP consumed /Kg FCM(g)	65.5	68.5	74.1
Protein Efficiency	19.83	21.51	21.66
CP milk /CP ingested (%)			

Table 5. Total Milk and milk components yield (Kg) of milch cows supplemented different levels of RDP and UDP during the experimental period (90 days)

	Control	**T_1**	**T_2**	**Additional yield (%) T_1**	**Additional yield (%) T_2**
Milk yield (Kg)	685.8	841.5	882.0	22.7	28.6
FCM yield (Kg)	681.3	867.6	893.7	27.3	31.2
Fat (Kg)	27.16	35.43	36.07	30.5	32.8
SNF (Kg)	59.66	72.37	77.88	21.3	30.5
Total solids (Kg)	86.82	107.80	113.95	24.2	31.3
Protein (Kg)	23.11	32.54	32.97	40.8	42.7

due to altered RDP and UDP in the ration. Increasing UDP to RDP ratio increased milk yield in T_2 as compared to T_1, but these values were statistically not significant. The FCM yield (Kg/day) was significantly ($P<0.05$) higher in T_2 (9.93), followed by T_1 (9.64) and control (7.57), which indicated improvement of 27.3% and 31.2% in the T_1 and T_2 treatment groups respectively. Garg et al. (2005) reported that there was increase in milk yield up to 24% in lactating cattle. Mondal and Chopra (2008) and Dhiman et al (1993) also observed similar results, due to supplementation of concentrate with 40 or 50% UDP. While Ravi Kumar et al. (2005) observed 11.74% increase, which is slightly lower than the present observations by increasing UDP level from 41 to 48%. The results of the investigation indicated that supplementation of nutrient in correct form resulted in not only meeting the deficiency of the nutrients but also improved utilization there by enhanced the production of the animals. Study of Aparna et al., (2009) revealed that, there was an increase of 2.24 Kg/animal/day or 13.34% in milk production when feeding system was having RDP deficit that ranged from 7-20%, which was modified to have appropriate RDP (60-64) : UDP(36-40) proportions (Stallings and James, 2007). The production of milk and milk components was greater and persistency of milk protein production was observed for cows fed the diet containing treated soybean meal (Atwal et al., 1995). Feeding protein correct amount and correct form to meet dairy cow nutrient requirements can results in cheaper, environmentally friendly rations and more efficient utilization.

The average milk fat (3.96, 4.21 and 4.09%), SNF

(8.70, 8.60 and 8.83%), total solids (12.66, 12.81 and 12.92%) and Protein (3.42, 3.75 and 3.26%) content did not differ significantly due to concentrate mixture supplementation between T_1 and T_2 as well as in control. But there was increased fat yield (30.5 and 32.8%), SNF (21.3 and 30.5%), total solids (24.2 and 31.3%) and milk protein content (40.8 and 42.7%) in T_1 and T_2 as compared to control (Table 5) during the period of 90 days. These results corroborated with observations of Mondal and Chopra (2008) and Blauwiekel and Kinacid (1986). Contrary to the present observations, Chaturvedi and Walli (2001) observed higher FCM yield with higher UDP level in the diet but without any effect on milk composition. Higher CP content in the ration resulted in more milk, but did not affect milk composition (Blauwiekel and Kinacid, 1986 and Mondal and Chopra, 2008). While decrease in SNF and increase in fat content was reported by Ravi Kumar et al. (2005). Garg et al. (2005) reported that there was observed increase in milk fat and protein percent along with milk yield due to supplementation of UDP.

Efficiency of nutrient utilization

Efficiency of nutrient utilization by various groups presented in Table 4. Feed conversion efficiency (DMI/ Kg FCM yield) was more in T_2 (1.16), followed by control (1.21) and T_1 (1.24). The DMI was similar to the reports of Mondal and Chopra (2008). While CP consumed per Kg FCM yield was almost similar among the three groups. This was due to the fact that, there was increased production in T_1 and T_2 treatment groups corresponding to the increased protein intake, which has resulted in the similar efficiency of utilization in control as well as treatment groups. The production of milk and milk components was greater and persistency of milk production was observed for cows in T_1 and T_2 treatment groups as compared to control. There was overall improvement in the body condition and health of the animals. Similarly the efficiency of protein utilization in terms of CP in milk/ CP ingested (%) was 19.83, 21.51 and 21.66 for control, T_1 and T_2 was also non significant. The animals in T_1 group utilized more amount of RDP g /Kg FCM (106) as compared to T_2 (96) and control (92). These values are in accordance to the results obtained by Mondal and Chopra (2008) with different levels of RDP: UDP containing rations. While the reverse situation was observed regarding efficiency of utilization of UDP for milk production. In T_2 group it was 74.1 followed by T_1 (68.5) and control (65.5). Higher UDP intake in the ration increased milk production and persistency, along with the body weight was maintained in treatment groups as compared to control. While in control group there was reduction in milk production and there was tendency to reduce body weight. Differences in body condition score (BCS) between the beginning and the end of the experiment were +0.48, +0.37 and -0.13 units, respectively, for T_1 , T_2 and control groups. The efficiency of energy utilization (TDNg / Kg of FCM) was 630 (control), 660 ($T_{1)}$ and 632 (T_2), which indicated non significant differences. But in the control and T_2 groups production of 1 Kg milk required less amount of energy.

It was concluded that the UDP when supplemented at 40 or 45% level of the concentrate mixture, improved the milk production in medium producing crossbred cows without affecting its composition.

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