



Effect of different feeding regimes on productive performances of HF × Kankrej crossbred cows

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ABSTRACT

Present experiment was conducted to study the effect of different feeding regimes on productive performances of HF × Kankrej crossbred cows. The study was conducted on 18 crossbred cows which were distributed into three treatment groups comprising of 6 animals each. Animals of T1 (Farmers' feeding) group were maintained as per the feeding regime followed by small and marginal farmers in India. Animals of T2 (Modified feeding) group comprised of feeding with scientific interventions. Animals of T3 (Farm feeding) group were fed as per feeding practices followed at Livestock Research Station, Anand Agricultural University. Milk yield and 4% Fat Corrected Milk (FCM) yield was significantly higher in T2 and T3 as compared to T1 group. Lactation yield was highest in T3 followed by T2 and T1 groups. Average total solid of milk was significantly more in T3 as compared to T1 and T2 groups. Milk fat was maximum in T3 followed by T2 and T1 groups which did not differ significantly among each other. SNF, protein and lactose content of milk was found significantly higher in T3 as compared to T1 and T2 groups. Milk salt was highest in T3 followed by T2 and T1 group which differed significantly among each other. It may be concluded from the present study that feeding regime significantly influenced productive performances of crossbred cows as modified feeding group performed better over farmers feeding group and at par with farm feeding group.

Keywords: Crossbred cows, Feeding regimes, HF × Kankrej, Productive

In developing countries like India, 70% of expenditure in dairy farming is on feeding of animals (Singh *et al.* 2003). Though feeding standards for crossbred cattle is devised long back, most of the poor and illiterate farmers are not aware of the benefits of quality feeding in Indian subcontinent which leads to underfeeding of animals in field conditions (Khan *et al.* 2004). Continuous supply of good quality balanced feed leads to success of livestock farming (Suharyono *et al.* 2018). Only in certain parts of India, green roughage feeding to livestock is practiced. Mostly the animals are maintained on straw based rations and on such rations often livestock suffer from malnutrition. In most part of country maintaining livestock on grazing without access to mineral and vitamin supplementation is a common practice (Garg *et al.* 2004). Hence, failure of mineral homeostasis mechanism is seen in animals due to dietary deficiencies which result in affecting the productive potential of animals (Underwood and Suttle 1999) and finally it causes great economic loss to the dairy farmers (Prasad and Gowda 2005). Comprehensive reports on nutrition-production-reproduction inter-relationship of crossbred cattle kept by small and marginal farmers in India are not available. This experiment was, therefore, planned to study, how the plane of nutrition offered by farmers

during pre-partum period and during lactation period, affects the productive performances of crossbred cows.

MATERIALS AND METHODS

Present experiment was conducted at Livestock Research Station (LRS), College of Veterinary Science and Animal Husbandry, Anand Agricultural University, Anand, Gujarat, India. The experiment was planned and conducted from 45 d prior to calving (advance pregnancy) to 300 d postpartum/drying.

Animals, experimental design and feeding regimes: The study was conducted on 18 dry pregnant HF × Kankrej (50:50) crossbred cows at LRS. Experimental animals were randomly selected on the basis of first lactation milk (300 d) yield, no. of calvings (parity) and body weight (kg) in sequence (Table 1). Animals were distributed into three treatment groups comprising of 6 animals each.

Animals of T1 (Farmers' feeding) group were maintained as per feeding regime followed by small and marginal farmers. Concentrate feed was not given during pre-partum period and fed @ 50% of milk production during lactation period. Calving mixture (500 g/cow) was prepared by mixing equal proportion of Purple Fleabane, Garden Cress and Dill seeds and fed to animals of T1 group only @ 100 g/d after boiling and mixing with 250 g jaggery from the day of parturition to 5 d postpartum. Animals were devoid

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Table 1. Grouping of experimental animals

Treatment	Parameter		
	First lactation milk yield (kg)	Parity (nos.)	Body weight (kg)
T1	3008.00±356.94	3.00±0.55	515.00±39.99
T2	3072.80±321.63	3.00±0.89	513.33±30.67
T3	3048.00±229.59	3.00±0.94	500.00±39.41

of mineral mixture and fed with paddy/wheat straw on *ad lib.* basis and 10 kg/animal/d cereal (hybrid napier CO3 variety) green fodder. Animals of T2 (Modified feeding) group comprised of feeding with scientific interventions and provided concentrate feed @ 1 kg/animal/d during pre-partum while @ 50% of milk production during lactation period. Mineral mixture was provided to animals @ 30 g/animal/d. Legume (pigeon pea/groundnut) and cereal (paddy/wheat) straw (50:50 ratio) was given to animals on *ad lib.* basis and 10 kg/animal/d cereal (hybrid napier CO3 variety) green fodder was given to animals. Animals of T3 (Farm feeding) group were fed as per feeding followed at LRS. Concentrate feed was given for steaming up in pre-partum period starting from 500 g/animal/d in first week of experiment and increasing by 500 g every week, reaching 3.5 to 4.0 kg/animal/d till parturition. During lactation period concentrate feed was given @ 40% of milk production plus 1 kg maintenance/animal/d. Animals were fed with 50 g/animal/d mineral mixture. Jowar hay was fed to animal on *ad lib.* basis and 10 kg/animal/d cereal (hybrid napier CO3 variety) green fodder was fed to animals.

Productive performances: Daily intake of concentrate, green and dry fodder was recorded for individual animals. Measured quantity of feeds and fodders were offered to experimental animals as per treatment and left over feed was measured next day morning to know the actual amount of feed consumed by animals. All experimental animals were milked by pipeline milking machine (DeLaval) two times a day, i.e. 6.00 AM and 6.00 PM and recorded up to drying/300 d of lactation. Total milk yield, lactation length and lactation yield were calculated from the records of milk yield. 4% Fat Corrected Milk (FCM) yield was also calculated from the values of milk yield and fat percentage of milk using following formula.

$$\text{FCM} = 0.4 (\text{MY}) + 15 (\text{FY})$$

where, MY, milk yield and FY, fat yield.

Fat yield was calculated by multiplying milk yield and fat per cent divided by 100. Peak milk yield and days to attain peak milk yield were calculated from the milk yield of the experimental animals. 25 ml of representative milk samples of each experimental animal was collected in a cleaned plastic bottle at fortnightly interval starting from 4th d upto 300 d of lactation. Morning and evening milk samples were collected separately and analyzed for various milk components using automatic milk analyzer (Lactoscan, Milkotronic Ltd).

Analysis of feeds and fodders: Representative samples

of concentrate mixture (Amul dan), jowar hay, hybrid napier, paddy/wheat straw and legume straw were collected during experiment and were analyzed for proximate principles as per AOAC (2000). Details are given in Table 2.

Statistical analysis: Observations of various parameters recorded during experimental period were statistically analyzed by Completely Randomized Design (Factorial) and one-way ANOVA using SAS software 9.3 version and SPSS software 20.00 version, respectively.

RESULTS AND DISCUSSION

Feed and nutrient intake: Average fortnightly DMI either kg/animal/d or kg/100 kg b.wt. was significantly ($P<0.05$) more in T2 and T3 as compared to T1 group (Table 3). Average fortnightly DCPI (g/animal/d) was significantly ($P<0.05$) more in T2 and T3 as compared to T1 group. Whereas, average DCPI (g/100 kg b.wt.) differed significantly ($P<0.05$) among each other. Average fortnightly TDNI either kg/animal/d or kg/100 kg b.wt. was significantly ($P<0.05$) more in T2 and T3 when compared with T1 group.

Milk yield: Average fortnightly milk yield was significantly ($P<0.05$) higher in T2 and T3 as compared to

Table 2. Proximate composition of various feeds and fodders (on DM basis)

Feed/Fodder	Composition (%)					
	DM	CP	CF	EE	NFE	Ash
Concentrate (Amul Dan)	90.30	16.02	10.43	4.23	56.04	13.28
Jowar Hay	89.97	5.61	32.50	2.84	49.71	9.34
Hybrid Napier CO-3 variety	20.47	13.66	25.40	3.58	40.95	16.41
Paddy/ Wheat straw	91.24	3.02	30.18	1.94	46.77	18.09
Pigeon pea/ Groundnut straw	92.29	7.47	27.34	3.27	49.17	12.75

Table 3. Feed and nutrient intake of crossbred cows during experiment

Parameter	Treatment		
	T1	T2	T3
DMI (kg/animal/d)	9.71 ^a ±0.20	12.45 ^b ±0.28	12.62 ^b ±0.22
DMI (kg/100 kg b.wt.)	2.24 ^a ±0.05	2.74 ^b ±0.06	2.81 ^b ±0.06
DCPI (g/animal/d)	543.83 ^a ±	801.87 ^b ±	839.53 ^b ±
DCPI (g/100 kg b.wt.)	14.83	22.30	16.63
TDNI (kg/animal/d)	128.49 ^a ±	177.40 ^b ±	187.84 ^c ±
TDNI (kg/100 kg b.wt.)	4.51	5.00	4.51
TDNI (kg/animal/d)	4.82 ^a ±0.10	7.13 ^b ±0.16	7.30 ^b ±0.13
TDNI (kg/100 kg b.wt.)	1.11 ^a ±0.03	1.57 ^b ±0.04	1.63 ^b ±0.04

Means with dissimilar superscripts in a row differed significantly ($P<0.05$).

T1 group (Table 4). Overall milk yield of T2 and T3 group was 27.21 and 26.51% more than T1 group, respectively. Milk yield during third fortnight was found maximum irrespective of treatment groups. Average 4% Fat Corrected Milk (FCM) yield was significantly ($P<0.05$) higher in T2 and T3 as compared to T1 group (Table 4). FCM yield in T2 and T3 was 39.39 and 40.45% more than T1 group, respectively. Lactation yield was highest in T3 followed by T2 and T1 groups. However, there was no significant difference among treatment groups. Absence of significant difference among treatment groups was due to large variation within the groups. Lactation length also did not differ significantly among each other. Three animals in T2 and two animals each in T1 and T3 group conceived before 85 d of ideal service period with one or two services. For providing ideal dry period of 50 d before subsequent lactation they were force dried before completion of 300 d of lactation. Due to force drying of animals, lactation length was shorter in all treatment groups. Results of present study is corroborated with the results of Bwire and Wiktorsson (2003) where they had observed that daily milk yield (6.2 vs. 5.0 kg) and total milk yield (304 vs. 247 kg) during 2 to 8 weeks' post-partum was recorded significantly higher ($P<0.05$) in cows on high level of concentrate supplementation (4 kg DM/animal/d) as compared to cows on low level of concentrate supplementation (2 kg DM/animal/d). Results of present study are also supported by the findings of Singh *et al.* (2003) who observed that average milk production was significantly ($P<0.05$) higher in group fed 20% above NRC during both 60 d pre-partum to 120 d postpartum (18.40 kg) compared to group fed 20% above NRC during 60 d pre-partum and as per NRC during post-partum (16.4 kg) and group fed as per NRC feeding standard (15.15 kg) indicating, that higher plane of nutrition both during pre and postpartum period, could improve milk production potential of crossbred cows. Das (2007) reported that steaming-up had a beneficial effect on milk production

in subsequent lactation which again supports the present findings. Milk yield and FCM yield increased by 9.5 and 11.8%, respectively due to inclusion of area specific mineral mixture in the rations of lactating cows as studied by Sahoo *et al.* (2017) which supports the present findings. Gupta *et al.* (2017) also observed that average daily milk yield was significantly ($P\leq 0.05$) higher by 13.4%, in mineral mixture fed group than control group. Increasing concentrate level had no significant effect on milk yield as per the study of Taskin (2013) which might be due to a lower total intake of ME when 0.40 kg feed level was increased to 0.50 kg feed level per kg milk yield, which is not in accordance with present study.

Average peak milk yield was found to be maximum in T3 followed by T2 and T1. Although there was non-significant difference due to high variation within treatment groups, average peak yield was quite high in T2 and T3 compared to control group which might be due to feeding effect. Days to attain peak yield was significantly ($P<0.05$) low in T1 as compared to T2 group. However, the corresponding value in T3 group was at par with T1 and T2 groups. These values themselves indicate that there was very high variation within treatments. Normally it takes 4–6 weeks to achieve peak yield in crossbred cows. Due to low lactation yield, animal of T1 group achieved peak very early and started decline thereafter at a faster rate throughout lactation period. Results of present study are in agreement with the study of Bindal (2012) where it was revealed that mean peak yield of steamed-up cows (24.6 ± 2.37 kg) was non-significantly higher than the control cows (21.8 ± 2.07 kg). Contrary to the present study, Bhat *et al.* (2000) observed that challenge-feeding during last 3 weeks' pre-partum had no significant effect on peak yield. Days to attain peak yield in crossbred cows under standard feeding management practices was 28.98 ± 1.68 as observed in the study of Patel (2007) which is similar to the present finding. However, in poor feeding and modified feeding group days to attain peak

Table 4. Milk yield and composition of experimental animals during study

Parameter	Treatment		
	T1	T2	T3
<i>Milk yield</i>			
Average fortnightly milk yield (kg/animal/d)	7.65 ^a ±0.28	10.51 ^b ±0.44	10.41 ^b ±0.39
Average fortnightly FCM yield (kg/animal/d)	7.54 ^a ±0.27	10.51 ^b ±0.41	10.59 ^b ±0.41
Lactation yield (kg)	2143.65±194.13	2843.37±473.71	2837.63±417.42
Lactation length (d)	280.17±7.17	274.67±7.71	272.83±10.46
Peak milk yield (kg/animal/d)	12.87±1.09	16.10±2.45	16.33±1.37
Days to attain peak milk yield	14.17 ^a ±3.48	40.67 ^b ±8.06	30.33 ^{ab} ±5.88
<i>Milk composition (%)</i>			
Total solid	12.14 ^a ±0.10	12.33 ^a ±0.09	12.59 ^b ±0.09
Fat	3.91±0.07	4.05±0.07	4.09±0.05
SNF	8.22 ^a ±0.04	8.28 ^a ±0.05	8.52 ^b ±0.04
Protein	3.01 ^a ±0.01	3.03 ^a ±0.02	3.11 ^b ±0.02
Lactose	4.52 ^a ±0.02	4.56 ^a ±0.03	4.67 ^b ±0.02
Salt	0.67 ^a ±0.00	0.68 ^b ±0.00	0.69 ^c ±0.00

Means with dissimilar superscripts in a row differed significantly ($P<0.05$).

milk yield was lowest and highest, respectively as compared to farm feeding group which might be due to feeding effect. Das *et al.* (2007) reported that mean peak yield was achieved earlier in control group as compared to steaming-up group (26 d v/s 35 d) which is similar to the results of present study. As per the study of Bindal (2012), days required to attain peak milk yield in group of cows fed usual feed and group of cows steamed-up were 25.2 ± 2.05 and 29.4 ± 1.63 d, respectively which differed significantly ($P < 0.05$) and in support of the present findings.

Milk composition: Average total solid content of milk was significantly ($P < 0.05$) more in T3 as compared to T2 and T1 groups. Total solid content of milk in T3 was 3.7 and 2.1% higher than T1 and T2 groups, respectively. Fat content of milk was maximum in T3 followed by T2 and T1 groups. However, the differences among the treatment groups were found to be non-significant. Average overall milk SNF was found significantly ($P < 0.05$) higher in T3 as compared to T1 and T2 groups. SNF content of milk was 3.65 and 2.89% more in T3 compared to T1 and T2 groups, respectively. Overall milk protein was also found to be significantly ($P < 0.05$) higher in T3 as compared to T1 and T2 groups. Milk protein was 3.32 and 2.64% more in T3 compared to T1 and T2 groups, respectively. Similarly, milk lactose was significantly ($P < 0.05$) more in T3 when compared to T1 and T2 groups. Milk lactose was 3.32 and 2.41% higher in T3 compared to T1 and T2 groups, respectively. Overall mean of milk salt was highest in T3 followed by T2 and T1 groups which differed significantly ($P < 0.05$) among the treatment groups.

Similar results were observed in present study but the improvement in total solid and SNF was 2 to 4 and 2.9 to 3.6%, respectively in farm feeding group compared to poor and modified feeding group. Results of Ryan *et al.* (2003) are corroborated with the results of present study where they had reported that during 1 to 4 weeks of lactation, there was no significant difference in milk fat yield but protein and lactose yields were significantly ($P < 0.01$ and $P < 0.05$, respectively) higher in group fed grass silage *ad lib.* with 3 kg concentrate/animal/d compared to group fed grass silage/straw mixture (75:25 on DM basis) *ad lib.* for nine weeks before expected date of parturition. Similar to present experiment, Taskin (2013) observed that increasing dietary level of concentrate, increased milk protein content (2.72 vs 3.08%) significantly ($P < 0.01$) however, it did not affect milk fat. Milk fat was significantly ($P < 0.05$) more in group fed area specific mineral mixtures @ 2% of concentrate mixture (4.78%) as compared to group with no mineral mixture supplementation (4.05%) as studied by Sahoo *et al.* (2017) which is not in accordance with present study.

It may be concluded from the present study that feeding regime significantly influenced productive performances of crossbred cows. Modified feeding group performed better over farmers feeding group and at par with farm feeding group. Hence, farmers are advised to feed crossbred cows a mixture of cereal and legume straw at 50:50 ratio along with mineral mixture.

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