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Economics of crossbred calves as an effect of watering frequency and feed

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Abstract
Farmers often neglect watering and feeding calves because they are reluctant to allocate their limited resources during the calves' non-productive growing phase. The current study was planned and conducted on twenty-four crossbred calves over a period of 98 days to observe the effects of watering frequency and feed on feeding cost and feed efficiency. The calves were randomly assigned to four watering frequency (T_1, T_2, T_3 & T_4) and two feeding treatments (F_1&F_2), a total of eight treatments, on the basis of sex and body weight. Four different watering frequency containing *ad lib*., once a day, twice a day and thrice a day were offered to T_1, T_2, T_3 and T_4 treatment group calves, respectively. Within each watering frequency treatment, half of the calves were offered 50:50 mixture of legume (soyabean) and cereal (wheat) straw (F_1) and another half of Jowar hay (F_2) as dry roughage. In all treatments, fixed quantity of concentrate and green Hybrid Napier were also offered to calves. Cost of feeding under different treatments was calculated from daily records of daily feed consumption and by considering the procurement cost of feeds and fodders. In respect of watering frequency, feed cost was significantly (p<0.05) lower in T_2 followed by T_3, T_1 and T_4, however, the value of T_1 was at par with T_3 and T_4 groups. The feed cost (Rs./kg BW gain) significantly (p<0.05) decreased to the tune of 27.59%, 22.83% and 27.98% in T_1, T_3 and T_4 as compared to T_2, respectively. Daily feed cost (Rs./head/d) increased significantly on feeding Jowar hay but feed cost (Rs./kg BW gain) reduced by 15.19% in calves. There was net saving of Rs. 22.22/ kg BW gain on feeding Jowar hay. In conclusion, *ad lib.* or thrice a day watering frequency and feeding Jowar hay are superior with respect to feed efficiency and economical (lower) cost of feeding per unit weight gain in crossbred calves.

Keywords: Feed efficiency, economics, watering frequency, jowar hay, straw, crossbred calves

1. Introduction
A significant portion of the livestock population in India is owned by small and marginal farmers (ICAR, 2013) [8]. These farmers derive substantial income from livestock farming (Hegde, 2019) [7]. In dairy farming, the care and management of calves are crucial since they represent future dairy animals. Proper rearing and scientific management of livestock during their early growth stages form the foundation of successful animal husbandry. Water is one of the essential nutrients in all feedstuffs, alongside fat, carbohydrates, protein, minerals, and vitamins. Among these nutrients, water is often the most neglected in livestock production. It supports the health and integrity of every cell and forms the basis of bodily fluids. It has been reported that water loss exceeding 10% can be fatal and lead to death, whereas an animal can survive even after losing all its body fat and one-third of its body protein (ICAR, 2013) [9]. Nutrition is a key economic factor in livestock husbandry, and balanced feeding is essential for maintaining health and productivity. Hay and low-quality straw are the main sources of roughage for animals. Feeding a mixture of cereal and non-leguminous straw improves feed and nutrient intake (Mahesh and Mohini, 2014) [11]. Non-leguminous straw, such as Jowar hay, has advantages over leguminous straw due to its higher productivity per hectare. High-quality Jowar hay is as nutritious as green Jowar fodder and helps maintain balanced feeding during periods of green fodder scarcity (Chaudhary and Parihar, 2013) [6]. Water accessibility, along with feed and other resources will be significantly impacted by climate change (Ahmed and Ammar, 2001) [2].

Therefore, this study was planned to examine the effects of watering frequency and a mixture of soybean and wheat straw with Jowar hay on feed costs and feed efficiency in crossbred calves.

2. Materials and Methods

2.1 Experimental location, animals and duration

The present study was conducted at the Livestock Research Station (LRS) of the College of Veterinary Science & Animal Husbandry, Anand, Gujarat, after receiving permission from the Institutional Animal Ethics Committee (Sanction No. 300/LPM/2019). The experiment was conducted for a period of 98 days (a total of 7 fortnight intervals) on twenty-four crossbred calves (HF x Kankrej) with an average body weight of 104.96±2.85 kg.

2.2 Experimental treatments

There were eight experimental groups with three calves (one male and two female) in each group. Calves were offered four different watering frequency containing *ad lib*. (T_1), once a day (T_2), twice a day (T_3) and thrice a day (T_4) and two feeding treatments (F_1&F_2). Within each watering frequency treatment, half of the calves were offered 50:50 mixture of legume (soyabean) and cereal (wheat) straw (F_1) and another half of Jowar hay (F_2) as dry roughage (Table 1).

Table 1: Watering frequency and feeding treatment in experimental animals

Groups		No. of calves	Watering frequency/day	Roughage Feeding	Timing of watering
T_1	F_1	3	*Ad lib.*	50:50 mixture of Legume straw and Cereal straw	Throughout the day
	F_2	3		Jowar hay	
T_2	F_1	3	One time	50:50 mixture of Legume straw and Cereal straw	10 a.m.
	F_2	3		Jowar hay	
T_3	F_1	3	Two times	50:50 mixture of Legume straw and Cereal straw	10 a.m. 9 p.m.
	F_2	3		Jowar hay	
T_4	F_1	3	Three times	50:50 mixture of Legume straw and Cereal straw	10 a.m. 3 p.m 9 p.m.
	F_2	3		Jowar hay	

2.3 General and feeding management

All the experimental calves were kept under iso-managerial conditions in well ventilated hygienic shed and were provided. Animals were tied individually with a neck chain in front of the pakka manger with partitions for individual watering and feeding as per treatment.

The nutrient requirements of the calves under different treatment were met as per ICAR feeding standard [9]. Compound concentrate mixture (Amul Dan) and chaffed green Hybrid Napier was offered to experimental animals @ 1.25 and 3.00 kg at 9:30 and 11.00 am daily to calves up to 150 kg body weight, respectively. However, after attending 150 kg body weight in calves, 1.5 kg concentrate and 5 kg green Hybrid Napier was offered to animals. This adjustment was necessary to compensate the demand of nutrients and dry matter. *Ad lib*. mixture of legume (Soyabean) and cereal (Wheat) straw (50:50) or chaffed Jowar hay were offered at 3:00 pm to fulfill their nutrient requirement as per treatment schedule. Measured quantity of feed and fodders were offered to the experimental animals as per the treatment and leftover fodder was measured on the next day morning (7.30 to 8.00 a.m.) to calculate amount of feed consumed by experimental animals. Generally, there was no leftover of either concentrate or green Hybrid Napier.

2.4 Cost of feeding

The cost of feeding experimental calves in each treatment groups were worked out from daily feed intake. Actual purchase price of different feeds and fodder were considered for calculating cost of feeding (Table 2). The feed cost per kg BW gain also worked out from recorded body weights of different group of calves at fortnightly interval.

2.5 Analysis of data

Observations of various parameters recorded and derived during the experimental period were tabulated and statistically analyzed using RBD (Factorial) as stated by Snedecor and Cochran (2014) [13].

Table 2: Cost of feed and fodders used for feeding experimental animals

Sr. No.	Feed and Fodders	Cost (Rs.) per kg
1	Compound Concentrate Mixture	28.00
2	Green Hybrid Napier	2.00
3	Soyabean (Legume) Straw	9.00
4	Wheat (Cereal) Straw	5.00
5	Jowar Hay	11.00

3. Results and Discussion

3.1 Feed cost (Rs./head/d)

Feed cost (Rs./head/d) of crossbred calves was calculated at fortnightly interval during the experiment. The average feed cost (Rs./head/d) at first fortnight and last fortnight of the experiment, ignoring treatments was 54.80±0.93 and 66.63±2.04, respectively. Feeding cost (Rs./head/d) increased by 21.59% over an experimental period of 98 days. When roughage feed source was ignored, average feed cost (Rs./head/d) was found to be 60.19±1.19, 56.55±1.16, 59.81±1.46 and 61.71±1.40 in *ad lib*. (T_1), once a day (T_2), twice a day (T_3) and thrice a day (T_4) watering frequency groups, respectively (Table 3). Feed cost was significantly ($p<0.05$) lower in T_2 followed by T_3, T_1 and T_4, however, the value of T_1 was at par with T_3 and T_4 groups. Higher feeding cost in *ad lib*. and thrice a day group is because of higher feed intake.

Table 3: Feeding cost and feed efficiency of experimental animals

Particulars	Group									
	T_1		T_2		T_3		T_4		F_1	F_2
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2		
Average Body Weight (kg)	131.46±5.63	131.40±5.02	120.30±4.70	128.58±5.32	127.33±4.44	134.73±5.23	132.48±4.60	136.49±4.75	127.89±5.07	132.80±4.60
	131.43^{B}±3.73		124.44^{A}±3.56		131.03^{B}±3.43		134.48^{B}±3.28			
Total Gain in Body Weight (kg)	57.54	56.03	43.30	54.93	48.37	60.90	55.54	62.20	51.18	58.51
	56.79		49.12		54.64		58.87			
Growth Rate (g/head/d)	587.08±57.51	571.77±40.64	441.84±57.88	560.54±43.90	493.54±43.99	621.43±42.79	566.67±59.02	634.69±42.14	522.28±28.68	597.11±15.84
	579.42±34.80		501.19±37.05		557.48±31.91		600.68±36.21			
Feed Cost (Rs./head/d)	57.72±1.64	64.07±1.45	51.99±1.09	61.11±1.50	53.92±1.15	65.70±1.99	56.46±1.30	66.98±1.90	55.02^{a}±0.68	64.47^{b}±0.88
	60.90^{BC}±1.19		56.55^{A}±1.16		59.81^{B}±1.46		61.71 ^{C}±1.40			
Feed Cost (Rs./kg BW gain)	119.08±12.65	124.48±10.10	198.53±40.85	137.79±26.00	142.00±25.79	117.54±9.90	125.67±13.68	116.56±10.29	146.32±13.16	124.10±7.74
	121.78^{A}±8.01		168.17^{B}±24.38		129.77^{A}±13.77		121.11^{A}±8.48			
Total Feeding Cost (Rs.)	16969.19	18838.58	15283.65	17966.84	15852.33	19316.20	16599.52	19691.29	16176 .17	18953 .23
	17903.89		16625.25		17584.27		18145.41			

Means with dissimilar superscripts in a row (A, B, C) differ significantly for watering frequency and (a, b) differ significantly for roughage feed source (p<0.05).

On avoiding watering frequency, average feed cost (Rs./head/d) was significantly (p<0.05) lower in calves fed mixture of soyabean & wheat straw (F_1: 55.02±0.68) as compared to Jowar hay (F_2: 64.47±0.88). Low feed cost in mixture of soyabean & wheat straw is due to low cost of straws. The interaction between treatment and feed (T×F) was also found to be significant (p<0.05) over an experiment period. Highest feed cost was observed in thrice a day watering frequency and Jowar hay feed source (T_4F_1: Rs. 66.98±1.90) which might be due to higher feed intake. While lowest in once a day (T_2F_1: Rs. 51.99±1.09) watering frequency and mixture of legume & cereal straw.

Kapadiya (2019) [10] reported that feed cost (Rs./head/d) was 42.87±0.89 of Jowar hay feeding in crossbred calves. The value was lower than present findings. Anjum *et.al.* (2015) [3] observed that average feed cost (Rs./head/d) was 86.98 when buffalo calves were fed wheat straw with concentrate and green fodder, which cost was higher than this cost. More (2018) [12] reported feeding cost (Rs.) per day to be Rs. 86.21, 86.15, 85.85 and 85.71 when crossbred calves were fed 100% Jowar straw + 3 kg berseem + concentrate (T_1), 60% Jowar straw +40% Soyabean straw + 3kg berseem + concentrate (T_2), 40% Jowar straw +60% Soyabean straw + 3kg berseem + concentrate (T_3), and 100% Soyabean straw + 3kg green fodder + concentrate (T_4), respectively. Their findings were higher than present findings.

3.2 Feed cost (Rs./kg BW gain) or Feed efficiency

Irrespective of roughage source, average feed cost (Rs.) per kg body weight gain of calves was Rs. 121.78±8.01, 168.17±24.38, 129.77±13.77 and 121.11±8.48 in T_1, T_2, T_3 and T_4 watering frequency groups, respectively (Table 3). Significantly (p<0.05) lower value of feed cost (Rs./kg BW gain) was observed in T_1, T_3 and T_4 as compared to once a day watering frequency (T_2) which might be due to higher growth rate. The feed cost (Rs./kg BW gain) decreased to the tune of 27.59%, 22.83% and 27.98% in T_1, T_3 and T_4 as compared to T_2, respectively. Therefore, it is recommend to go for thrice a day watering or *ad lib*. watering frequency with regard to lower feed cost per kg body weight gain. Average feed cost (Rs./kg BW gain) in F_1 and F_2 group calves on avoiding watering frequency, was found to be 146.32±13.46 and 124.10±7.74, respectively. Feed cost (Rs./kg BW gain) did not differ statistically but it reduced by 15.19% when crossbred calves were fed a Jowar hay (F_2). The observed saving was Rs. 22.22/ kg BW gain on feeding Jowar hay. However, cost of feeding per kg body weight gain observed lower in T_4F_2: Rs. 116.56±10.29, due to higher average daily gain and higher feed cost in once a day watering frequency and mixture of legume & cereal straw (T_2F_1: Rs.198.53±40.85).

Results of the present study were in line of Chaudhari *et al.* (2023) [4], who observed that average feed cost (Rs./kg BW gain) of crossbred calves was 121.40±6.77 in feeding of Jowar hay based TMR. This finding is in partially accordance with report of Chaudhari (2018) [5] who indicated reduced (p<0.05) cost of feeding (85.85 Vs. 114.85 Rs./kg BW gain) on replacement of TMR (50% concentrate + 50% wheat straw) with TMR (50% concentrate + 25% wheat straw + 25% pigeon pea straw) in crossbred calves having 50% Holstein Friesian and 50% Kankrej inheritance. Contrary to this, Adangale *et al.* (2008) [1] noted that feeding of soybean straw with Jowar straw is superior over feeding of Jowar straw or soybean straw alone. Kapadiya (2019) [10] observed that average feed cost per day was 94.36±2.36 of Jowar hay roughage feeding which was lower than present study. More (2018) [12] reported feed cost (Rs./kg BW gain) 275.43, 245.44, 249.56 and 258.94 where crossbred calves were fed, 100% Jowar straw (T_1), 60% Jowar straw +40% Soyabean straw (T_2), 40% Jowar straw +60% Soyabean straw (T_3), and 100% Soyabean straw (T_4), respectively. The report was higher than present findings.

4. Conclusion

Feeding Jowar hay significantly increased the daily feed cost per head (Rs./head/d) due to higher feed intake and price, but it reduced the feed cost per kilogram of body weight gain (Rs./kg BW gain) by 15.19% in calves. Feeding Jowar hay resulted in a savings of Rs. 22.22 / kg BW gain. Therefore, the study concluded that ad libitum or thrice-a-day watering frequency, combined with feeding Jowar hay, leads to superior feed efficiency and lower feeding costs per unit weight gain in crossbred calves.

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