



Original Research

Effect of Nutritional Status and Management Systems on Nutrients Intake in Sahiwal Calves

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Abstract

The present experiment was conducted on twenty four female Sahiwal calves between 4 to 8 months of age during April to October, 2017 to study the effect of two levels of feeding and management systems on their performance. Mean daily dry matter intake were 4.31 ± 0.142 , 5.18 ± 0.174 , 4.63 ± 0.176 and 4.86 ± 0.185 kg and dry matter intake per 100 kg body weight were 2.95 ± 0.017 , 3.32 ± 0.025 , 3.09 ± 0.041 and 3.18 ± 0.044 kg in 100 per cent, 120 per cent ICAR feeding, routine and improved management systems, respectively. The mean daily crude protein intake was 0.615 ± 0.020 , 0.786 ± 0.030 , 0.677 ± 0.030 and 0.724 ± 0.032 kg in 100 per cent, 120 per cent ICAR feeding, routine and improved management systems, respectively. The average daily total digestible nutrients intake and total digestible nutrients intake per 100 kg body weight were 2.66 ± 0.075 , 3.39 ± 0.115 , 2.96 ± 0.125 , 3.10 ± 0.120 and 1.81 ± 0.023 , 2.17 ± 0.022 , 1.95 ± 0.042 , 2.03 ± 0.045 kg in 100 per cent, 120 per cent ICAR feeding, routine and improved management systems, respectively. The dry matter intake per 100 kg body weight, crude protein intake per 100 kg body weight, total digestible nutrients intake per 100 kg body weight and dry matter intake per kg metabolic body size, crude protein intake per kg metabolic body size and total digestible nutrients intake per kg metabolic body size were significantly high ($P < 0.01$) in calves fed 120 per cent of ICAR feeding and kept under improved management systems in comparison to calves fed 100 per cent of ICAR feeding and reared in routine management systems.

Key words: Dry Matter, ICAR Feeding, Management, Nutrients Intake, Sahiwal Calves

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Introduction

Female calves are future herd of a dairy farm. They must be produced to replace the older and uneconomical females of the farm through voluntary culling. When genetic trends are positive, such replacements help harvest the benefits of genetic gain. Calf production is most expensive part of the dairy farm operation. It requires more inputs for a longer period of time with no visible returns than any other farm operation. Raising young calves is one of the most often neglected jobs on the dairy farm but one of the most economically. The future of the herd's milk production begins before the calves are born. How a heifer calf develops into her potential for milk production depends upon how well we raise and manage her. Too often, the future of herd's production is in jeopardy because of the lack of attention to the care and feeding of the young calf. The mother's dry period success with the calf starts with proper care.

Materials and Methods

Twenty four female Sahiwal calves between 4 to 8 months of age were selected from the herd of Sahiwal cattle breeding farm, Livestock Research Station Kodamdesar, Rajasthan University of Veterinary and Animal Sciences, Bikaner. These calves were divided into four groups of six calves each on the basis of nearness in their body weight and age. The experimental groups were randomly allocated to one of the following treatments (Table 1).

Table 1: Feedings and managements of calves

S. No.	Treatment Group	Treatments
1	T1	100 Per cent ICAR feeding and routine management
2	T2	100 Per cent ICAR feeding and improved management
3	T3	120 Per cent ICAR feeding and routine management
4	T4	120 Per cent ICAR feeding and improved management

Managermental Systems

Routine Management

House having covered area with coated tin shed roofing with concrete floor and open area with kachha floor having free access of feeding and water troughs and surrounded by four feet fencing with galvanized iron pipes.

Improved Management

Improved management in summer months having additional facilities then routine managements are white painting over roof of tin sheds, feeding dry fodder in cool hour (i.e. 7:00 PM to 6:00 AM), prevention of calves from direct western hot wind (Loo) and water splashing twice daily (morning and evening).



Feeds and Feeding

All the experimental calves in each group were fed as per ICAR recommendations (ICAR 1985). The calves were fed groundnut stalks and wheat straw during the experimental period. A concentrate mixture containing crushed wheat, groundnut cake and wheat bran was prepared. The ingredient composition of concentrate mixture along with its nutritive value is given in Table 2. The concentrate mixture contained 21.50 per cent crude protein and 77.10 per cent total digestible nutrients. The allowance of concentrate mixture was fixed in such a way that calves of T3 and T4 got 20 per cent higher than calves of T1 and T2 at normal ICAR recommended levels of protein per head per day. A weighed amount of groundnut fodder was fed to all the calves daily and its protein content was taken into consideration while fixing the allowance of concentrate mixture for each group. The quantity of different feeds fed to each calf was adjusted at fortnightly intervals in order to meet the requirements of the calves with the change in their body weight.

Table 2: Percent ingredient composition of concentrate mixture used

Ingredient	Per cent Proportion
Wheat	40
Wheat bran	30
Groundnut cake	30
Mineral mixture	2
Common salt	1
Nutrient Content on Dry Matter Basis	
Dry Matter	90.79
CP	21.5
TDN	77.1

Feed Intake

To determine the feed intake the Sahiwal calves were given weighed quantity of feed and fodder as per their requirement. The feed intake during the experimental period was determined on the basis of feed and fodder offered and left over for two consecutive days in a fortnight. The crude protein intake and total digestible nutrients intake were calculated fortnightly as per dry matter intake. Representative sample of groundnut fodder, wheat straw and concentrate mixture were taken daily for two consecutive days in each fortnight before feeding calves and kept in hot air oven for determining the dry matter content. These samples were also analyzed for proximate principles according to AOAC, 1995 (Table 3).

**Table 3:** Proximate composition (%) of feeds and fodders (on dry matter basis) fed to experimental calves

Ingredients	Moisture	CP	CF	EE	NFE	Total Ash
Wheat	9.5	10.46	1.68	2.06	82.85	2.95
Wheat Bran	9.25	12.2	10.77	2.4	65.66	8.97
Groundnut Cake	9.56	45.54	8.2	7.2	34.88	5.18
Groundnut fodder	9.85	11.24	31.6	2.2	40.68	11.67
Wheat Bhusa	9.45	2.53	36.19	1.18	52.02	8.08

Statistical Analysis

The experiment was planned and analyzed as 2 x 2 Factorial Randomized Block Design (Snedecor and Cochran, 1994). The differences among treatment means were tested for significance by performing Duncan's Multiple Range Test.

Results and Discussion

Nutrients Intake

Dry Matter Intake

The mean values of daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per kg metabolic body size under different treatment groups during the experimental period have been presented in Table 4.

Table 4: Mean $\pm$ SE values of daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per metabolic body size under different treatment groups

Variables	T1	T2	T3	T4
Daily dry matter intake (kg)	4.19 $\pm$ 0.189	4.43 $\pm$ 0.213	5.07 $\pm$ 0.243	5.28 $\pm$ 0.256
Dry matter intake per 100 kg body weight (kg)	2.90 $\pm$ 0.014	3.00 $\pm$ 0.026	3.27 $\pm$ 0.025	3.36 $\pm$ 0.041
Dry matter intake per kg metabolic body size (kg)	0.100 $\pm$ 0.000	0.103 $\pm$ 0.000	0.115 $\pm$ 0.000	0.118 $\pm$ 0.000

The Table 5 shows that the mean values of daily dry matter intake in treatment groups T1, T2, T3 and T4 were 4.19 $\pm$ 0.189, 4.43 $\pm$ 0.213, 5.07 $\pm$ 0.243 and 5.28 $\pm$ 0.256 kg, respectively.

Table 5: Effect of feeding levels and management systems on mean $\pm$ SE values of daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per metabolic body size

Variables	Feeding Levels		Management Systems	
	100% ICAR	120% ICAR	Routine Management	Improved Management
Daily dry matter intake (kg)	4.31 $\pm$ 0.142 ^a	5.18 $\pm$ 0.174 ^b	4.63 $\pm$ 0.176	4.86 $\pm$ 0.185
Dry matter intake per 100 kg body weight (kg)	2.95 $\pm$ 0.017 ^a	3.32 $\pm$ 0.025 ^b	3.09 $\pm$ 0.041 ^a	3.18 $\pm$ 0.044 ^b
Dry matter intake per kg metabolic body size (kg)	0.101 $\pm$ 0.000 ^a	0.117 $\pm$ 0.000 ^b	0.107 $\pm$ 0.001 ^a	0.111 $\pm$ 0.001 ^b

Means with different superscripts differ significantly ($P < 0.05$), highly significant ($P < 0.01$)

When dry matter was expressed as per 100 kg body weight, it was 2.90 ± 0.014 , 3.00 ± 0.026 , 3.27 ± 0.025 , 3.36 ± 0.041 kg in T1, T2, T3 and T4, respective treatment groups. The corresponding values of dry matter intake per kg metabolic body size were 0.100 ± 0.000 , 0.103 ± 0.000 , 0.115 ± 0.000 , 0.118 ± 0.000 kg in treatment groups, respectively. The mean daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per kg metabolic body size in calves fed 100 per cent of ICAR feeding were 4.31 ± 0.142 , 2.95 ± 0.017 and 0.101 ± 0.000 and it was 5.18 ± 0.174 , 3.32 ± 0.025 and 0.117 ± 0.000 in calves fed 120 per cent of ICAR feeding. The mean daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per kg metabolic body size were highly significant ($P < 0.01$) in calves fed 120 per cent of ICAR feeding in comparison to calves fed 100 per cent of ICAR feeding. Chapman *et al.* (2017) reported that calves fed higher amount of crude protein (CP) have higher dry matter intakes (DMI). Iqbal *et al.* (2014) reported daily milk intake was significantly ($P < 0.05$) high in sahiwal calves when fed different level of feeding. There was significant increase in feed intake in calves that were fed higher level of crude protein, Kumar *et al.* (1981); Mudgal and Sivaiah, (1982); Singh *et al.* (1991); Ichhponani *et al.* (1993); Singh and Kumar (1995).

Table 6: Analysis of variance of data on dry matter intake

Source	d. f.	Mean Sum of Square		
		Daily dry matter intake (kg)	Dry matter intake per 100 kg body weight (kg)	Dry matter intake per kg metabolic body size (kg)
Feeding levels (FL)	1	8.97869**	1.6096**	0.002777**
Management systems (MS)	1	0.616533	0.098102**	0.000145**
FL x MS	1	0.004033	0.000602	0
Error	44	0.621583	0.009802	0

* Significantly at ($P < 0.05$), **highly significant ($P < 0.01$)

The analysis of variance revealed (Table 6) that there was highly significant ($P < 0.01$) difference in daily dry matter intake, dry matter intake per 100 kg body weight and dry matter intake per kg metabolic body size due to levels of feeding. Management systems had also highly significant ($P < 0.01$) effect on dry matter intake per 100 kg body weight and dry matter intake per kg metabolic body size. The interaction between levels of feeding and management systems was found non-significant.

Crude Protein Intake

The mean values of daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size under different treatment groups have been presented in Table 7.

Table 7: Mean $\pm$ SE values of daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size under different treatment groups

Variables	T1	T2	T3	T4
Daily crude protein intake (kg)	0.585 $\pm$ 0.021	0.646 $\pm$ 0.033	0.770 $\pm$ 0.043	0.803 $\pm$ 0.045
Crude protein intake per 100 kg body weight (kg)	0.411 $\pm$ 0.007	0.437 $\pm$ 0.004	0.498 $\pm$ 0.004	0.513 $\pm$ 0.004
Crude protein intake per kg metabolic body size (kg)	0.014 $\pm$ 0.000	0.015 $\pm$ 0.000	0.017 $\pm$ 0.000	0.018 $\pm$ 0.000

The mean daily crude protein intake and crude protein intake per 100 kg body weight were 0.585 $\pm$ 0.021, 0.646 $\pm$ 0.033, 0.770 $\pm$ 0.043, 0.803 $\pm$ 0.045 kg and 0.411 $\pm$ 0.007, 0.437 $\pm$ 0.004, 0.498 $\pm$ 0.004, 0.513 $\pm$ 0.004 kg in T1, T2, T3 and T4, treatment groups respectively. The corresponding values for crude protein intake per kg metabolic body size were 0.014 $\pm$ 0.000, 0.015 $\pm$ 0.000, 0.017 $\pm$ 0.000 and 0.018 $\pm$ 0.000 kg in, respective groups.

Similar results were obtained by Prasad *et al.* (2000) reported that the digestibility of dry matter and crude protein was higher ($p < 0.05$) in crossbred heifers fed 75 per cent CP of NRC (1988) than 100 per cent CP of NRC (67.62 vs. 63.18 and 61.83 vs. 52.99 %) in heifers. Seyoum (2000) and Shenu *et al.* (2003) reported that nutrients intake was significantly higher ($P < 0.05$) in high plane of nutrition. The findings of present study are in agreement with Baruah *et al.* (1988); Singh *et al.* (1991); Ichhoponani *et al.* (1993); Singh and Kumar (1995); Hol *et al.* (1995); Kumar *et al.* (1981) and Mudgal and Sivaiah (1982).

Table 8: Effect of feeding levels and management systems on Mean $\pm$ SE values of daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per metabolic body size

Variables	Feeding Levels		Management Systems	
	100% ICAR	120% ICAR	Routine management	Improved management
Daily crude protein intake (kg).	0.615 $\pm$ 0.020 ^a	0.786 $\pm$ 0.030 ^b	0.677 $\pm$ 0.030	0.724 $\pm$ 0.032
Crude protein intake per 100 kg body weight (kg)	0.424 $\pm$ 0.005 ^a	0.506 $\pm$ 0.003 ^b	0.455 $\pm$ 0.010 ^a	0.475 $\pm$ 0.008 ^b
Crude protein intake per kg metabolic body size (kg)	0.014 $\pm$ 0.000 ^a	0.017 $\pm$ 0.000 ^b	0.015 $\pm$ 0.000 ^a	0.016 $\pm$ 0.000 ^b

Means with different superscripts differ significantly ($P < 0.05$), highly significant ($P < 0.01$)

Table 8 shows that the mean daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size in calves fed 100 per cent of ICAR feeding were 0.615 $\pm$ 0.020, 0.424 $\pm$ 0.005 and 0.014 $\pm$ 0.000 kg and it was 0.786 $\pm$ 0.030, 0.506 $\pm$ 0.003 and 0.017 $\pm$ 0.000 kg in calves fed 120 per cent of ICAR feeding. The mean daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size were highly significant ($P < 0.01$) in calves fed 120 per cent of ICAR feeding in comparison to calves fed 100 per cent of ICAR feeding.

The mean daily crude protein intake, crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size in calves reared under routine management systems were 0.677 ± 0.030 , 0.455 ± 0.010 and 0.015 ± 0.000 kg and it was 0.724 ± 0.032 , 0.475 ± 0.008 and 0.016 ± 0.000 kg in calves kept in improved management systems. The crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size were significantly high ($P < 0.01$) in improved management may be due to provision of ameliorative measures of heat stress like white paintings over roof of sheds to reflect maximum of sun light, prevent direct western hot wind (Loo) feeding dry fodder in cool hour (*i.e.* 7:00 PM to 6:00 AM) and water splashing twice daily.

Present findings are in line with Patel and Dave (1989) and Bempong and Gupta (1989) who reported that the nutrients intake was significantly higher in groups in which showering and cool hour feedings was done as compared to control in case of buffaloes and cattle.

Table 9: Analysis of Variance of data on daily crude protein intake

Source	d. f.	Mean Sum of Square		
		Daily crude protein intake (kg)	Crude protein intake per 100 kg body weight (kg)	Crude protein intake per kg metabolic body size (kg)
Feeding levels (FL)	1	0.3495**	0.07946**	0.000119**
Management systems (MS)	1	0.02632	0.00522**	0.00000007**
FL x MS	1	0.002269	0.000358	0.00000005
Error	44	0.016644	0.000355	5.7E-09

*Significantly at ($P < 0.05$), **highly significant ($P < 0.01$)

The analysis of variance (Table 9) revealed that crude protein intake per 100 kg body weight and crude protein intake per kg metabolic body size were significantly ($P < 0.01$) influenced by different levels of feeding and management systems. There was significant ($P < 0.01$) difference in average daily crude protein intake due to different feeding levels. The interaction of the levels of feeding and management systems was found non-significant.

Total Digestible Nutrient Intake

The mean values of daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size under different treatment groups have been presented in Table 10.

Table 10: Mean $\pm$ SE values of daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size under different treatment groups

Variables	T1	T2	T3	T4
Daily total digestible nutrients intake (kg)	2.56 $\pm$ 0.099	2.76 $\pm$ 0.111	3.35 $\pm$ 0.166	3.43 $\pm$ 0.167
Total digestible nutrients intake per 100 kg body weight (kg)	1.76 $\pm$ 0.023	1.85 $\pm$ 0.037	2.13 $\pm$ 0.025	2.21 $\pm$ 0.034
Total digestible nutrients intake per kg metabolic body size (kg)	0.061 $\pm$ 0.000	0.064 $\pm$ 0.000	0.076 $\pm$ 0.000	0.077 $\pm$ 0.000

The mean daily total digestible nutrient intake and total digestible nutrient intake per 100 kg body weight were 2.56 $\pm$ 0.099, 2.76 $\pm$ 0.111, 3.35 $\pm$ 0.166, 3.43 $\pm$ 0.167 kg and 1.76 $\pm$ 0.023, 1.85 $\pm$ 0.037, 2.13 $\pm$ 0.025, 2.21 $\pm$ 0.034 kg in T1, T2, T3 and T4 treatment groups, respectively. The corresponding values for total digestible nutrient intake per kg metabolic body size were 0.061 $\pm$ 0.000, 0.064 $\pm$ 0.000, 0.076 $\pm$ 0.000, 0.077 $\pm$ 0.000 kg in T1, T2, T3 and T4, respective treatment groups.

The data of Table 11 shows that the mean daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size in calves fed 100 per cent of ICAR feeding were 2.66 $\pm$ 0.075, 1.81 $\pm$ 0.023, 0.063 $\pm$ 0.000 kg and it was 3.39 $\pm$ 0.115, 2.17 $\pm$ 0.022 and 0.076 $\pm$ 0.000 kg in calves fed 120 per cent of ICAR feeding. The mean daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size were significantly high ($P < 0.01$) in calves fed 120 per cent of ICAR feeding in comparison to calves fed 100 per cent of ICAR feeding. Similar results were found by Seyoum (2000) and Shenu *et al.* (2003) reported that nutrients intake was significantly higher ($P < 0.05$) in high plane of nutrition. Similar results on higher level of feeding were obtained by Baruah *et al.* (1988); Singh *et al.* (1991); Ichhophonani *et al.* (1993); Singh and Kumar (1995); Hol *et al.* (1995) and Fasil (1999).

Table 11: Effect of feeding levels and management systems on daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient per kg metabolic body size

Variables	Feeding Levels		Management systems	
	100% ICAR	120% ICAR	Routine management	Improved management
Daily total digestible nutrients intake (kg)	2.66 $\pm$ 0.075 ^a	3.39 $\pm$ 0.115 ^b	2.96 $\pm$ 0.125	3.10 $\pm$ 0.120
Total digestible nutrients intake per 100 kg body weight (kg)	1.81 $\pm$ 0.023 ^a	2.17 $\pm$ 0.022 ^b	1.95 $\pm$ 0.042 ^a	2.03 $\pm$ 0.045 ^b
Total digestible nutrients intake per kg metabolic body size (kg)	0.063 $\pm$ 0.000 ^a	0.076 $\pm$ 0.000 ^b	0.068 $\pm$ 0.001 ^a	0.071 $\pm$ 0.001 ^b

Means with different superscripts differ significantly ($P < 0.05$), highly significant ($P < 0.01$)

The mean daily total digestible nutrient intake, total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size in calves reared under routine managements were 2.96 ± 0.125 , 1.95 ± 0.042 and 0.068 ± 0.001 kg respectively, and it was 3.10 ± 0.120 , 2.03 ± 0.045 and 0.071 ± 0.001 kg in calves kept under improved management systems. The total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size were significantly high ($P < 0.01$) in calves reared in improved management systems in comparison to calves kept under routine management systems. The highly significant total digestible nutrient intake in improved management may be due to more dry fodder intake in comfortable environment by ameliorative measures of heat stress like white paintings over roof of sheds to reflect maximum of sun light, prevent direct western hot wind (Loo) feeding dry fodder in cool hour (*i.e.* 7:00 PM to 6:00 AM) and water splashing twice daily. Present findings are in line with Patel and Dave (1989) and Bempong and Gupta (1989) who reported that the nutrients intake was significantly higher in groups in which showering and cool hour feeding was done as compared to control in case of buffaloes and cattle.

Table 12: Analysis of Variance of data on total digestible nutrients intake

Source	d. f.	Mean Sum of Square		
		Daily total digestible nutrients intake (kg)	Total digestible nutrients intake per 100 kg body weight (kg)	Total digestible nutrients intake per kg metabolic body size (kg)
Feeding Levels (FL)	1	6.380**	1.5986**	0.0022**
Management Systems (MS)	1	0.226875	0.08840**	0**
FL x MS	1	0.046875	0.000208	0
Error	44	0.23339	0.011447	0.000000001

*Significantly at ($P < 0.05$), **highly significant ($P < 0.01$)

The analysis of variance (Table 12) revealed that total digestible nutrient intake per 100 kg body weight and total digestible nutrient intake per kg metabolic body size was highly significant ($P < 0.01$) by different levels of feeding and management systems. There was highly significant ($P < 0.01$) difference in daily total digestible nutrient intake due to different levels of feeding. The interaction of the levels of feeding and management systems was found non-significant on crude protein intake.

Conclusion

The dry matter intake per 100 kg body weight, crude protein intake per 100 kg body weight and average total digestible nutrients intake per 100 kg body weight were significantly high ($P < 0.01$) in calves fed 120 per cent of ICAR feeding and kept under improved management systems. The mean daily dry matter intake, crude protein intake and total digestible nutrients intake was also significantly high ($P < 0.01$) in calves fed 120 per cent of ICAR feeding, while it did not significantly influenced by management systems. The



nutrients intakes per kg body weight gain did not significantly influence by feeding levels and management systems.

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