Effect of Different Dietary Regimes and Management Systems on Physiological Reactions and Feeding Behaviour of Sahiwal Calves

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A B S T R A C T

The present experiment was conducted on twenty four female Sahiwal calves of 4 to 8 months age. Calves were subjected to four treatment groups viz. 100 per cent of ICAR feeding and routine management (T_1), 100 per cent of ICAR feeding and improved management (T_2), 120 per cent of ICAR feeding and routine management (T_3) and 120 per cent of ICAR (Indian Council of Agricultural Research) feeding and improved management (T_4). The mean rectal temperature was 38.21 ± 0.029, 38.00 ± 0.023, 37.98 ± 0.03 and 38.23 ± 0.025 ºC in the morning and 38.89 ± 0.027, 38.94 ± 0.030, 39.15 ± 0.020 and 38.68 ± 0.023 ºC in the evening, the mean respiration rate was 25.50 ± 0.070, 25.61 ± 0.076, 25.50 ± 0.047 and 25.61 ± 0.072 per minute in the morning and 26.75 ± 0.218, 26.89 ± 0.218, 27.25 ± 0.295 and 26.39 ± 0.080 per minute in the evening and average pulse rate was 52.76 ± 0.099, 52.86 ± 0.097, 52.82 ± 0.100 and 52.80 ± 0.096 per minute in the morning and 53.91 ± 0.153, 53.98 ± 0.162, 54.91 ± 0.139 and 52.98 ± 0.136 per minute in the evening respectively for T_1, T_2, T_3 and T_4 group. The rectal temperature, respirations rate and pulse rate in evening were significantly ($P<0.01$) influenced by management systems. The time spent in rumination and resting was significantly influenced by the levels of feeding. The time spent by labourer for water splashing and care of calf per day were significantly ($P < 0.01$) influenced by levels of feeding as well as management system.

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. Growth rates

of replacement calf affect economic returns on dairy farms. Balanced feeding, improved management and minimum disease prevalence can be helpful in reducing the age at first calving.

Microclimate of the house has significant effect on the dry matter intake (DMI), milk yield and water intake of the animal. Lee *et al.,* (1999) reported that daily feed intake increased by 2.79 kg in cooled cows compared with control cows. Patel *et al.,* (1995) studied the effect of different housing patterns on feed and water intake in Mehsana buffalo heifers under semi arid conditions. The housing effect on feed intake was not significant, but monthly variations were significant. The total daily water intake was significantly different during different months.

Considering the tropical climate of Indian subcontinent, the summer stress is a major problem in managing dairy animals in India. During the extreme hot humid or hot dry weather, thermoregulatory capability of animals to dissipate heat by sweating and panting is compromised and Summer/heat stress occurs. Continued exposure to the direct sun results in loss of body water through evaporation resulting in dryness of skin, increased rectal temperature, respiration and pulse rates, off-feed and cessation of rumination leading to higher calf mortality, poor growth rate during summer (Hemsworth *et al.,* 1995). Generally calves are housed in groups in confined outdoor yards during day that leave them exposed to episodes of high environmental temperatures, which can exceed their ability to dissipate body heat. The ensuing heat stress has important implications for cattle welfare as well as a negative impact on health and production; in extreme cases resulting in death. It has been observed that radiation energy flow on animal is 685 kcal/m² h, but actually only 340 kcal/m² h is from the direct solar radiation and

rest is by reflected by floor, dust, wall, etc (Thomas and Sastry, 2007). Every year, loss in milk production due to heat stress causes huge financial loss in our country. Though indigenous breeds of cattle are more thermo-tolerant, crossbred and exotic breeds of cattle are highly sensitive to heat stress. Heat stress can be alleviated through housing management, making provision of cooling devices and nutritional management.

Hence, the present experimental design was planned to carry out the study on effect of Different Dietary Regimes and Management Systems on Physiological Reactions and Feeding Behaviour of Sahiwal Calves

Materials and Methods

Animals and treatments

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, RAJUVAS, Bikaner. These calves were divided into four groups of six calves each on the basis of nearness in their body weight and age. The particulars of these animals are given in table 1. The experimental groups were randomly allocated to one of the following treatments.

Management systems

Routine management

Routine management houses having covered area with coated tin shed roofing and concrete floor and open area with kachha floor, surrounded by four feet high fencing of galvanized iron pipes.

Improved management

Improved management in summer months having additional facilities of 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 western hot wind (Loo, local wind) and water splashing twice daily than routine managements.

Feeds and feeding

All the experimental calves in each group were fed as per ICAR recommendations (ICAR, 1985). The calves were fed groundnut fodder 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 of total digestible nutrients. The allowance of concentrate mixture was fixed in such a way that calves of treatment group T_3 and T_4 got 20 per cent higher levels of protein per head per day than calves of T_1 and T_2. 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.

Physiological reactions

Rectal temperature, respiration rate and pulse rate of all the calves were recorded at fortnightly interval in the morning (8:00 AM) and evening (6:00 PM) during the experiment. Rectal temperature was recorded by inserting clinical thermometer into the rectum for two minutes taking all precautions. Respiration rate was recorded by counting the movement of right flank (count per minute) of the animal. Pulse rate was recorded by palpating the coccygeal artery (count per minute)

Behavioural studies

Behavioural studies on calves under four different treatment groups were also conducted two times during the experiment i.e. at 3 months and at the end of experiment. The actual time spent by individual calf with respect to eating, rumination and resting were recorded over a twenty four hours period for day and night separately.

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

Physiological reactions

Despite the study of growth of Sahiwal calves under two levels of feeding and managements systems, it is important to make sure that 117 all the calves were under normal physiological conditions. The physiological response is the process of adjustment of the animal itself to other living material and to its external physical environment. Physiologists have used simple animal reactions like body temperature, respiration rate and pulse rate to assess animal reaction to environment and evaluate an animal's comfort.

Mean±SE values and effect of feeding levels and management systems on physiological parameters in morning (8PM) and evening (6PM) of each group of calves have been presented in Table 3 and their analysis of variance in Table 4.

Rectal temperature

The average morning rectal temperature in

calves fed 100 per cent and 120 per cent of ICAR feeding were 38.21±0.024 and 38.00±0.023 ℃, respectively. The corresponding values for evening rectal temperature were 38.89±0.027 and 38.94±0.030 ℃. The average morning temperature in calves reared under routine management system and improved management were 37.98±0.033 and 38.23±0.025 ℃. The corresponding values for evening were 39.15±0.020 and 38.68±0.023℃, respectively. The mean rectal temperature of calves recorded in the morning was 38.20±0.029, 38.22±0.09, 37.76±0.024 and 38.24±0.033℃ and it was 39.10±0.029, 38.69±0.034, 39.21±0.028 and 38.67±0.032℃ in evening in T1, T2, T3 and T4 treatment groups, respectively. The evening rectal temperature was significantly lower (P<0.05) in calves reared under improved management system. It might be due to low ambient temperature in shed of improved management by the provision of ameliorative measures like white painting over the shad, twice water splashing daily and prevention of calves from direct western hot wind.

Analysis of variance of data on rectal temperature in the morning showed that there was no significant difference due to levels of feeding and management systems but evening rectal temperature was significantly influenced (P<0.05) by management systems. The interaction between the levels of feeding and management systems was found non significant.

Purwar *et al.,* (2017)[reported that the overall mean value of afternoon rectal temperature was significantly (P<0.01) lower in the treatment group fed protected fat plus yeast, niacin, zinc, and chromium dietary supplementation on the reduction of heat stress in Karan Fries (KF) heifers during hot humid months.

The present finding are in agreement with Tucker *et al.,* (2008) who concluded that cows provided with more protection (99% shade) from solar radiation as compare to 50 per cent shade and no shade had lower rectal temperature with higher level of ambient solar radiation. Khongdee *et al.,* (2010) found significantly lower mean rectal temperature (38.56 °C) in shade cloth than that of the cows housed under normal roofing (39.86°C). One has to consider also the normal diurnal variation in rectal temperature and other physiological reactions due to which the afternoon observations were higher than the morning ones. Alim and Ahmad (1957) observed such a diurnal variation in rectal temperature Egyptian buffaloes during summer. Thus it can be concluded that the behaviour of all the calves in various treatment groups was similar in this respect indicating their identical response to the microclimatic conditions to which they were exposed which was finally reflected in the rectal temperature pattern within physiological limits in the various groups.

Respiration rate

The average morning respiration rate in calves fed 100 per cent and 120 per cent of ICAR feeding were 25.50±0.070 and 25.61±0.076count per minute, respectively. The corresponding values for evening respiration were 26.75±0.218 and 26.89±0.218 counts per minute. The average morning respiration rate in calves reared under routine management system and improved management were 25.50±0.047 and 25.61±0.072 count per minute, respectively. The corresponding values for evening respiration rate were 27.25±0.295 and 26.39±0.080 counts per minute. The mean values of respiration rate of calves recorded in the morning were 25.43±0.097, 25.56±0.100, 25.56±0.111 and 25.66±0.104 count per minute and it was 27.19±0.419, 26.32±0.110,

27.32±0.417 and 26.47±0.116 count per minute in evening in T1, T2, T3 and T4 treatment groups, respectively.

The evening respiration rate was significantly lower (P<0.05) in calves reared under improved management system. The higher levels of respiration rate in routinely managed calves in the evening indicated that these animals might have encountered relatively more thermal stress than the calves under improved management. The higher respiration rate in routinely managed calves might be attributed to more heat load which was get rid off by increased pulmonary evaporative cooling through respiratory channel.

Analysis of variance of data on respiration rate in the morning showed that there was no significant difference due to levels of feeding and management systems but evening respiration rate was significantly influenced (P<0.05) by management systems. The interaction between the levels of feeding and management systems was found non significant.

The present finding is similar to observation of Soley and Singh (2001) who reported higher respiration rate during afternoon than morning hours in crossbred calves during summer. Yazdani and Gupta (2005) observed higher (P<0.05) respiration counts in loose house as compared to those animals kept in thatch house. Khongdee *et al.,* (2010), found significantly lower respiration rate in shade cloth than that of the cows housed under normal roofing. Schutz *et al.,* (2010) reported increased respiration rate with increase in surrounding heat. The results of the present study is also supported by (Verma and Hussain, 1988; Bempong and Gupta, 1989; Verma *et al.,* 1990; Kumar and Gupta, 1991; Sethi *et al.,* 1994; Singh, 1996; Sirohi, 2003) who reported that the calves subjected to body wetting and cool hour feeding had significantly lower respiration rate.

Pulse rate

The average morning pulse rate in calves fed 100 per cent and 120 per cent of ICAR feeding were 52.76±0.099 and 52.86±0.097 count per minute, respectively. The corresponding values for evening pulse rate were 53.91±0.153 and 53.98±0.162 count per minute. The average morning pulse rate in calves reared under routine management systems and improved management were 52.82±0.100 and 52.80±0.096 count per minute, respectively. The corresponding values for evening pulse rate were 54.91±0.139 and 52.98±0.136 count per minute. The mean values of pulse rate of calves recorded in the morning were 52.74±0.144, 52.79±0.136, 52.91±0.141 and 52.82±0.136 count per minute and it was 54.87±0.193, 52.96±0.182, 54.94±0.203 and 53.01±0.202 count per minute in evening in treatment groups T1, T2, T3 and T4, respectively. The evening pulse rate was significantly lower (P<0.01) in calves reared under improved management system due to low ambient temperature in the improved management shed by adaption of heat ameliorative measures.

Analysis of variance of data on pulse rate in the morning showed that there was no significant difference due to levels of feeding and management systems but evening pulse rate was significantly influenced (P<0.01) by management systems. The interaction between the levels of feeding and management systems was found non-significant.

Similar results were obtained by Vijaya Kumar, (2005) observed significance (P<0.05) reduction in pulse rate in buffalo heifers subjected to cooling treatment than non cooled heifers at 2.00 PM.

Feeding behavior

When livestock are introduced in a new environment, they show distinct changes in their behaviour relating to eating, rumination and resting. Although animals of a particular species have some common specific behavioural pattern yet several factors may influence variation in the same. Knowledge on feeding behaviour is of great importance for improving the management and production. In fact behaviour or rather changes in normal behaviour is an important means of adjusting to change in the environment to which animals are exposed.

Mean±SE values and effect of feeding levels and management systems on feeding behaviour during 24 hours have been presented in Table 5 and their analysis of variance in Table 6.

Eating time

The average values of time spent in eating in 100 per cent, 120 per cent of ICAR feeding, routine and improved management systems were 203.66 ± 4.019, 211.52 ± 3.723, 205.45 ± 3.941 and 202.65 ± 3.945 minutes per day, respectively. The corresponding values of time spent in eating by the calves were 201.08±5.849, 206.25±5.674, 209.81±5.726 and 213.08±5.033 minutes per day in T1, T2, T3 and T4 treatment groups, respectively. The mean time spent in eating was higher in the calves fed higher level of nutrition and calves kept under routine management systems.

The analysis of variance revealed that time spent in eating was not significantly (P<0.05) influenced by levels of feeding and management systems. The interaction between the levels of feeding and management systems was found non-significant.

Similar results were obtained by Yazdani and Gupta (2005) who reported that the eating time recorded at monthly interval of crossbred calves shows no significant difference between thatch and loose house system. Maekawa (2002) reported that cow spent more time in eating when fed 40 per cent silage TMR than cows fed SI (243 vs. 198 min/day). Yazdani (1996) who observed non significant higher eating time in thatched roof house as compared to loose house in crossbred calves. The contrary results were found by Klinger *et al.,* (2007) reported different type of feeding had significant effect (P<0.05) on eating time in cattle.

Rumination time

The average values of time spent in rumination in 100 per cent, 120 per cent ICAR feeding, routine and improved management systems were 435.16 ± 2.436, 444.47±2.071, 437.20±2.453 and 442.34±2.366 minutes per day, respectively. The corresponding values of time spent in rumination by the calves were 431.58±3.367, 438.75±3.339, 442.63±3.107 and 446.16±2.803 minutes per day in T1, T2, T3 and T4 treatment groups, respectively. The time spent in rumination was slightly higher in calves reared under improved management systems and it was significantly higher (P<0.01) in calves fed 120 per cent of ICAR feeding in comparison to calves fed 100 per cent of ICAR feeding. This might be due to the fact that the animals fed higher plane of nutrition spent more time on feeding which in turn might have resulted in higher rumination time, although calves kept under improved management, spent slightly more time on rumination in comparison to routine management.

Table.1 Feedings and managements of calves

Treatments	Feedings and managements
T1	100 per cent of ICAR feeding and routine management
T2	100 per cent of ICAR feeding and improved management
T3	120 per cent of ICAR feeding and routine management
T4	120 per cent of ICAR feeding and improved management

Table.2 Percent ingredient composition of concentrate mixture used

Ingredient	Proportion
Wheat	40 %
Wheat bran	27 %
Groundnut cake	30 %
Mineral mixture	2 %
Common salt	1 %
Nutrient Content on dry matter basis	
Dry Matter	90.79 %
Crude Protein	21.50 %
Total Digestible Nutrients	77.10 %

Table.3 Mean ± SE values and effect of feeding levels and management systems on physiological parameters

Variable	Rectal temperature (ºC)		Respiration rate (per minutes)		Pulse rate (per minutes)	
	Morning	Evening	Morning	Evening	Morning	Evening
Feeding Level	NS	NS	NS	NS	NS	NS
100% ICAR (F1)	38.21±0.024	38.89±0.027	25.50±0.070	26.75±0.218	52.76±0.099	53.91±0.153
120% ICAR (F2)	38.00±0.023	38.94±0.030	25.61±0.076	26.89±0.218	52.86±0.097	53.98±0.162
Management systems	NS	S*	NS	S*	NS	S**
Routine Management	37.98±0.033	39.15±0.020[b]	25.50±0.047	27.25±0.295[b]	52.82±0.100	54.91±0.139[b]
Improved Management	38.23±0.025	38.68±0.023[a]	25.61±0.072	26.39±0.080[a]	52.80±0.096	52.98±0.136[a]
Interaction (FLXMS)	NS	NS	NS	NS	NS	NS
T1 (F1M1)	38.20±0.029	39.10±0.029	25.43±0.097	27.19±0.419	52.74±0.144	54.87±0.193
T2(F1M2)	38.22±0.039	38.69±0.034	25.56±0.100	26.32±0.110	52.79±0.136	52.96±0.182
T3 (F2M1)	37.76±0.024	39.21±0.028	25.56±0.111	27.32±0.417	52.91±0.141	54.94±0.203
T4 (F2M2)	38.24±0.033	38.67±0.032	25.66±0.104	26.47±0.116	52.82±0.136	53.01±0.202

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

Table.4 Analysis of variance of data of physiological parameters

Source	d. f.	Mean Sum of Square					
		Rectal temperature (ºC)		Respiration rate (per minute)		Pulse rate (per minute)	
		Morning	Evening	Morning	Evening	Morning	Evening
Feeding levels (FL)	1	3.261571	0.161571	1.038462	1.551282	0.721154	0.320513
Management systems (MS)	1	4.900032	17.31*	1.038462	57.55*	0.028846	288.46**
FL x MS	1	3.993878	0.340032	0.012821	0.012821	0.387821	0.012821
Error	308	4.78235	0.075865	0.840493	7.336164	1.524184	2.988262

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

Table.5 Mean ± SE values and effect of feeding levels and management systems on feeding behavior

Variable	Eating time (minutes per day)	Rumination time (minutes per day)	Resting time (minutes per day)
Feeding Level	NS	S**	S*
100% ICAR	203.66±4.019	435.16±2.436^a	800.87±4.631^b
120% ICAR	211.52±3.723	444.47±2.071^b	784.17±4.249^a
Management systems	NS	NS	NS
Routine Management	205.45±3.941	437.20±2.453	797.41±4.698
Improved Management	202.65±3.945	442.34±2.366	787.78±4.657
Interaction (FLXMS)	NS	NS	NS
T1 (F1M1)	201.08±5.849	431.58±3.367	807.33±6.316
T2(F1M2)	206.25±5.674	438.75±3.339	794.41±6.497
T3 (F2M1)	209.81±5.726	442.63±3.107	787.72±6.434
T4 (F2M2)	213.08±5.033	446.16±2.808	780.91±5.720

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

Table.6 Analysis of variance of data on feeding behaviors

Source	d. f	Mean Sum of Square		
		Eating time (minutes per day)	Rumination time (minutes per day)	Resting time (minutes per)
Feeding levels (FL)	1	724.6722	1018.33**	3275.90*
Management systems (MS)	1	206.569	310.2285	1090.083
FL x MS	1	14.78381	69.46515	177.1641
Error	43	365.3888	117.8925	458.4345

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

The analysis of variance revealed that time spent in rumination was significantly (P<0.05) influenced by levels of feeding while it was not significantly affected by management systems. The interaction between the levels of feeding and management systems was found non significant.

Similar results were found by Klinger *et al.,* (2007) reported different type of feeding had significant effect (P<0.05) on rumination time in cattle while Grewal (1980) observed that there was no significant difference in rumination time between two levels of concentrates. McCleod *et al.,* (1994)[10] observed that the time spent on rumination was not affected by feeding sequence of hay averaging 428 minutes and rumination tended to occur when there was no eating activity.

Maekawa (2002) reported that rumination time (546 min. per day) was similar in cow fed 40 per cent silage TMR and cows fed SI but rumination time increased from 498 to 516 and 584 minutes per day as silage in the TMR increased from 40 to 50, and then to 60 per cent, respectively.

Resting time

The average values of time spent in resting in 100 per cent, 120 per cent of ICAR feeding, routine and improved management systems were 800.87±4.631, 784.17±4.249, 797.41±4.698 and 787.78±4.657 minutes per day, respectively. The corresponding values of time spent in resting by the calves were 807.33±6.316, 794.41±6.497, 787.72±6.434 and 780.91±5.720 minutes per day in T1, T2, T3 and T4, treatment groups, respectively. The resting time was significantly higher (P<0.05) in calves fed 100 per cent of ICAR feeding in comparison to calves fed 120 per cent of ICAR feeding.

In conclusion, the present experiment was concluded that the mean evening rectal temperature, evening respirations rate and evening pulse rate were highly significant (P<0.01) influenced by management systems and the time spent in rumination and resting was significantly influenced by levels of feeding.

Acknowledgement

Conflict of Interest

We declare that we have no conflict of interest.

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