Original Research

Study on Conventional *vs.* Artificial Rearing of Surti Buffalo Calves

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Abstract

Present investigation was conducted at Livestock Research Station, Navsari Agricultural University, Navsari, Gujarat. Twenty-four Surti buffalo calves on 6th day of their age were divided into three groups viz. Control: suckling group, T_1: whole milk feeding (10% body weight) and T_2: commercial milk replacer (MR) (10% body weight). Perusal of data revealed that there was non-significant difference in the body weight of control, T_1 and T_2 group of calves at all test days. However, live body weight of T_1 group was higher than control and T_2 group of calves from 48 to 90 days. Average daily gain in body weight of T_1 group of calves were higher than control and T_2 group of calves at all stages except between 76-90th day of age. In T_1 group of calves, total feed intake on dry matter basis was significantly ($p<0.05$) higher than the control and T_2 groups. Serum glucose concentration of T_1 group (108.12±3.60 mg/dl) was significantly ($p<0.05$) higher than control (86.70±5.51mg/dl) and T_2 group (88.42±5.63mg/dl) on 27 days of age. It was observed that incidence of diseases was more in T_2 group calves than control and T_1 group. Thus, it was concluded that live body weight and average daily gain was comparatively better for Surti buffalo calves raised artificially on whole milk than on milk replacer and calves raised under conventional calf rearing system.

Key words: Average Daily Gain, Body Weight, Milk Replacer and Surti Buffalo Calves

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Introduction

Calves form the future dairy herd and raising calves is the most difficult operation in a dairy farming enterprise, which requires a great deal of management skill, application and constant attention (Sastry, 2005). Feeding usually accounts for more than 60% of the total expenses involved in rearing cattle. Success of dairying in terms of profitability can be improved by reducing the feed costs, without compromising their performance. To reduce the cost of calf rearing on whole milk-based feeding and to increase the

availability of whole milk in the market, a good quality milk replacer would be a better substitute to the young calves (Heinrichs *et al*., 1995). Appropriate and ample supply of nutrient for calves through liquid feed (Milk or Milk replacer) is essential for performance and welfare (Lee *et al*., 2009). It has focused on improving the quality of the milk replacers to enhance calf performance, while minimizing the cost of calf rearing.

Fresh milk feeding is most common in calves at small as well as large dairy farms in India. However, the feeding of dairy calves based on a calf milk replacer (CMR) may be cheaper than the feeding based on whole milk. By using CMR for calf feeding, farmers can save large quantity of milk which can be sold. The goals of feeding milk replacers are to achieve as well as optimize rumen development and minimize cost of feeding the preweaning calf. The information on artificial rearing of buffalo calves is limited thus present study was proposed with the objective to study the effects of artificial rearing of Surti buffalo calves on its growth, feed intake, blood biochemical parameters and health.

Materials and Methods

The study was conducted on twenty-four Surti buffalo calves maintained at Livestock Research Station, Navsari Agricultural University, Navsari during September, 2015 to April, 2016**.** These calves were included in the study at 6th day of their age and were assigned to one of the three groups:(1) Control (C): calves of this group were allowed to suckle their dam before milking for 1 minute (to facilitate milk let down) and after milking till the calves leave udder willingly, (2) Treatment1 (T_1) : group of calves were allowed to suckle their dams only before milking for 1 minute and then were fed remaining amount of the milk through bottle till 90th day postpartum and (3) Treatment 2 ($T_{2)}$: group of calves were also allowed to suckle their dams only before milking for 1 minute and then remaining amount of the milk was replaced with milk replacer and it was fed through bottle till 90th day postpartum. All groups were provided 200 gm of concentrate mixture and *ad lib* amount of green fodder after one month of age. The concentrate allowance was increased up to 250 gm daily after two months of age. Remaining management practices were same for all calves.

Body weights, average daily gains (gm/day) were recorded postpartum on 6th day and thereafter at fortnight intervals till 90 days of their age. Average daily dry matter intakes (DMI) from all feed sources were calculated separately and then all were added to find out the total dry matter intake for each individual calf. Approximately 5 ml of blood samples were collected from all calves starting from 6th day postpartum till 90th days postpartum at fortnight intervals from jugular vein puncture in the morning. Serum sample was analysed for concentration of glucose, total protein, urea, triglyceride, total cholesterol, triglycerides, cortisol, tri-iodothyroxine (T_3) and tetra iodothyroxine (T_4). All calves were observed twice daily (morning and evening) for the signs of diseases like diarrohea, respiratory and any other disease and incidence of any

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such conditions were recorded. The collected data were compiled, tabulated and analysed by using SAS 9.3.

Results and Discussion

Growth Performance

The least squares' means of live body weight of Surti buffalo calves have been depicted in Table 1. There was non-significant difference in the body weight of control, T_1 and T_2 group of calves at all stage (Table 1). However, live body weight of T_1 group was higher than control and T_2 group of calves from 48 to 90 days. Further, it was observed that body weights of T_2 group of calves were lowest than other groups at almost all test days. Similar trend was reported by Bharti *et al*., (2011), wherein they observed 73.43, 64.0 and 58.16 kg body weight at 3 months of age in Holstein Friesian crossbred calves on whole milk, whole milk+skim milk and milk replacer group, respectively.

Table 1: Least squares' means and standard error (LSM ± SE) of body weight of Surti buffalo calves at fortnight interval

Group	Body Weight (kg)						
	6th day	20th day	34th day	48th day	62nd day	76th day	90th day
C	27.33±1.51 (8)	31.47±1.77 (8)	35.07±2.07 (8)	37.96±2.16 (8)	42.03±2.27 (8)	47.125±2.58 (8)	52.35±2.55 (8)
T_1	25.94±1.03 (8)	30.72±0.84 (8)	34.59±0.89 (8)	38.96±1.16 (8)	43.49±1.64 (8)	48.81±2.83 (8)	55.13±3.73 (8)
T_2	26.05±0.88 (8)	28.24±1.07 (8)	30.84±1.45 (8)	34.13±1.30 (8)	38.05±1.62 (8)	42.31±1.58 (6)	48.84±1.48 (6)
Overall	26.44±0.65 (24)	30.14±0.76 (24)	33.50±0.94 (24)	37.01±0.98 (24)	41.19±1.13 (24)	46.42±1.50 (22)	52.40±1.70 (22)

Figures in parentheses are number of animals used to derive LSM.

There was non-significant difference in the average daily gain of control, T_1 and T_2 group of calves at all stages except between day 6-20th where it was significantly ($p<0.05$) lower for T_2 group (156.61±41.68) than control (295.89±39.85 g/day) and T_1 group (340.98±34.30) of calves (Table 2).

Table 2: Least squares' means and standard error (LSM ± SE) of average daily gain (gm) in body weight of Surti buffalo calves at fortnight interval

Group	Average Daily Gain (ADG) in gm					
	6-20th day	20-34th day	34-48th day	48-62nd day	62-76th day	76-90th day
C	295.89±39.85[a] (8)	257.32±36.30 (8)	206.07±31.35 (8)	290.89±47.31 (8)	363.57±40.31 (8)	373.21±37.78 (8)
T_1	340.98±34.30[a] (8)	276.34±55.91 (8)	312.41±55.07 (8)	323.75±44.93 (8)	380.18±100.47 (8)	451.07±91.93 (8)
T_2	156.61±41.68[b] (8)	185.54±41.94 (8)	234.64±60.85 (8)	280.54±36.54 (8)	236.43±28.69 (6)	466.67±57.66 (6)
Overall	264.49±26.91 (24)	239.73±26.38 (24)	251.04±29.51 (24)	298.39±24.13 (24)	334.94±40.62 (22)	427.01±38.65 (22)

LSM showing different superscripts in lower case letters in a column differ significantly at P<0.05; Figures in parentheses are number of animals used to derive LSM.

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Further, average daily gain in body weight of T_1 group of calves were higher than control and T_2 group of calves at all stages except between 76-90th day of age where it was higher for T_2 group of calves (466.67±57.66 g/day). The average gain in body weight for T_2 group of calves were lower than remaining two group of calves at most of the stages however at the age of 90 days it was higher than control and T_1 group of calves. The initial slow rate of progressive growth in group T_2 may be attributed to poor adaptability to take milk replacer during early part of their life as well as to occurrence of comparatively higher incidence of diarrhoea in this group of calves than other groups. The result of present investigation corresponds with the earlier reports of Fisher (1976) who suggested that early postnatal growth of calves' performance on some milk replacers was inferior to that of whole milk. Raheja *et al.* (1960) suggested that whole milk should be given as an essential diet up to a certain age and later should be replaced by a suitable calf milk replacer. Arora *et al*. (1973) reported that milk replacement has been a complex problem in economical feeding of calves. Reducing whole milk in the diet of calves resulted in slow rate of gain in body weight, reduced vitality and increased health disorders in calves. Some milk replacers do not form a rennin clot but form a watery clot which passes out of the abomasum rapidly without undergoing adequate gastric digestion as has been reported by Emmons *et al.* (1976).

Feed Intake

Total feed intake on dry matter basis was significantly (P<0.05) higher in T_1 group of calves, than the control and T_2 groups (Table 3). Better palatability, higher total solid contents, better nutrient profiles of whole milk which lead to better early growth, health and thriftiness, resulted in higher feed intake in T_1 group of calves than control and T_2 group of calves.

Table 3: Least squares means and standard error (LSM ± SE) of total feed intake of Surti buffalo calves at monthly interval

Group	Total Feed Intake on Dry Matter Basis (g/day)		
	28 days	56 days	84 days
C	374.44±31.11^{b} (8)	582.42±19.83^{b} (8)	743.84±37.99^{b} (8)
T1	557.22±22.49^{a} (8)	861.31±40.18^{a} (8)	1089.99±67.32^{a} (8)
T2	401.20±12.00^{b} (8)	583.34±22.43^{b} (8)	818.20±25.78^{b} (6)
Overall	444.29±21.13 (24)	675.69±31.68 (24)	889.99±43.55 (22)

LSM showing different superscripts in lower case letters in a column differ significantly at P<0.05; Figures in parentheses are number of animals used to derive LSM.

Blood Bio-Chemical Parameters

Serum glucose concentration of T_1 group (108.12±3.60 mg/dl) was significantly higher (P<0.05) than control (86.70±5.51mg/dl) and T_2 group (88.42±5.63mg/dl) on 27 days of age (Table 4). Serum glucose concentration was highest at day 6 for control and T_2 group and on day 27 for T_1 group of calves. Further, lowest value for T_1 and T_2 groups were observed on day 90. It might be due to the higher total DM intake

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in T_1 group than T_2 and control group of calves and later on lesser value due to the development of the rumen. Petit *et al*. (1988) reported that the blood glucose concentration is a function of the hydrolysis and absorption of dietary carbohydrates and, therefore, could be affected by the flow rate of lactose in the duodenum.

Table 4: Least squares' means and standard error (LSM ± SE) of serum metabolites concentration of Surti buffalo calves at fortnight interval

Glucose Concentration (mg/dL)					
Group	**6th day**	**27th day**	**48th day**	**69th day**	**90th day**
C	94.92±7.23 (8)	86.70±5.51^{b} (8)	86.18±5.91 (8)	90.20±6.30 (8)	88.60±5.57 (8)
T_1	97.43±7.15 (8)	108.12±3.60^{a} (8)	90.47±4.79 (8)	86.09±5.02 (8)	80.48±3.87 (8)
T_2	91.33±9.26 (8)	88.42±5.63^{b} (8)	88.27±5.42 (8)	89.03±3.84 (6)	79.33±6.03 (6)
Overall	94.56±4.41 (24)	94.41±3.42 (24)	88.31±3.00 (24)	88.44±2.86 (22)	83.12±2.96 (22)
Total protein concentration(g/dl)					
C	6.55±0.23 (8)	6.19±0.30 (8)	6.54±0.24 (8)	6.57±0.28(8)	6.93±0.14^{ab} (8)
T_1	14.08±7.09 (8)	6.70±0.37 (8)	6.54±0.34 (8)	6.57±0.20 (8)	7.31±0.24^{a} (8)
T_2	6.50±0.33 (8)	6.79±0.26 (8)	6.30±0.25(8)	6.29±0.23 (6)	6.15±0.42^{b} (6)
Overall	9.04±2.38 (24)	6.56±0.18 (24)	6.46±0.16 (24)	6.48±0.14 (22)	6.86±0.18 (22)
Urea concentration(mg/dL)					
C	24.52±2.61 (8)	20.19±1.58 (8)	25.00±2.06 (8)	23.08±2.41 (8)	22.60±1.53 (8)
T_1	26.44±3.94 (8)	25.48±3.77 (8)	26.44±3.44 (8)	24.52±4.11 (8)	24.04±3.23 (8)
T_2	25.96±2.97 (8)	18.27±2.97 (8)	25.48±2.81 (8)	21.63±2.99 (6)	26.92±2.81 (6)
Overall	25.64±1.79 (24)	21.31±1.73 (24)	25.64±1.56 (24)	23.08±1.81 (22)	24.30±1.48 (22)
Cholesterol concentration (mg/dL)					
C	129.60±16.36 (8)	148.02±22.89 (8)	152.60±15.78^{a} (8)	145.13±13.07^{a} (8)	158.72±17.71^{a} (8)
T_1	117.28±12.10 (8)	125.72±11.07 (8)	129.57±7.44^{ab} (8)	123.91±8.67^{ab} (8)	123.17±8.39^{ab} (8)
T_2	94.92±7.81 (8)	104.72±9.51 (8)	103.75±12.55^{b} (8)	95.26±8.10^{b} (6)	102.49±3.97^{b} (6)
Overall	113.94±7.56 (24)	126.15±9.40 (24)	128.64±8.01 (24)	121.43±7.06 (22)	130.46±8.51 (22)
Triglyceride concentration (mg/dL)					
C	66.71±8.67^{a} (8)	32.92±3.87 (8)	39.39±4.67 (8)	40.11±4.20 (8)	39.55±6.34 (8)
T_1	48.34±3.92^{ab} (8)	46.70±9.77 (8)	42.80±4.18 (8)	38.76±3.99 (8)	45.12±5.29 (8)
T_2	39.57±5.54^{b} (8)	48.49±6.73 (8)	47.84±6.07 (8)	35.51±4.19 (6)	46.59±5.11 (6)
Overall	51.54±4.23 (24)	42.70±4.23 (24)	43.34±2.87 (24)	38.13±2.31 (22)	43.50±3.23 (22)

LSM showing different superscripts in lower case letters in a column differ significantly at P<0.05; Figures in parentheses are number of animals used to derive LSM.

There was no definite trend in the value of total protein at different stages of the study. On 90th day of the study, total protein concentration of T_2 group (6.15±0.42 g/dl) of calves were significantly lower (P<0.05) than T_1 group (7.31±0.24 g/dl) of calves. Mee *et al*. (1996) reported that measurement of blood total protein is one of the most convenient methods of indirectly evaluating the humoral immune status of calves because significant correlations exist among blood total protein content, blood IgG concentration and the risk of neonatal disease which is in the agreement with findings of this study. There was neither a definite trend nor significant difference in urea concentration among the groups at any stage of the study. Similar findings were reported by Lammers *et al*. (1998) who found a non-significant difference in the BUN in calves fed with whey protein concentrate or dried skim milk in milk replacer. Roy *et al*. (2011) also did not observe any significant variations of BUN.

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Serum cholesterol concentration of control group was higher than T_1 and T_2 group of calves at all stages. However, T_1 group has an intermediate position between T_2 and control group at different test days. Further, from day 48 to day 90 it was significantly lower ($P<0.05$) in T_2 group than control group. The lower serum cholesterol in T_2 group of calves fed milk replacer agreed with the previous reports (Nagaoka *et al.*, 1992; Sautier *et al.*, 1983), which showed that serum cholesterol was lower in rat fed whey protein and whey protein exhibited a greater hypocholesterolemic effect in comparison with casein or soybean protein. There was non-significant difference in the serum triglyceride concentration among the three groups from 27 days onwards. It might be due to the fact that at day 6 of the experiment there was problem with the adaptability of calves on milk replacer hence lesser intake of milk and consequently lesser growth rate was observed. Daniels *et al*., (2008) reported that the pancreatic lipase activity and efficiency of triglyceride clearance also affect plasma triglyceride concentrations.

Serum Hormone Profile

It was observed that there was non-significant difference in the serum cortisol concentration among the three groups at all test days however its values were found to be higher in T_1 group of animals than control and T_2 groups at all test days (Table 5). Kim *et al*. (2011) suggested that buffalo calves may be more vulnerable to stress than cow calves because they are highly social animals with strong instincts and closely bonded with their dams. Mustafa *et al*. (2010) reported that the buffalo calves may subject to stress of weaning, cortisol level showed no association with growth parameters.

Table 5: Least squares means and standard error (LSM ± SE) of hormone concentration of Surti buffalo calves at fortnight interval

Cortisol Concentration (ug/dL)					
Group	**6th day**	**27th day**	**48th day**	**69th day**	**90th day**
C	2.28±0.68 (8)	3.59±2.36 (8)	1.84±0.69 (8)	5.19±0.98 (8)	3.31±1.12 (8)
T_1	4.41±1.28 (8)	4.56±1.46 (8)	4.66±1.25 (8)	6.53±0.80 (8)	6.46±1.31 (8)
T_2	2.98±1.07 (8)	2.98±1.08 (8)	4.61±1.21 (8)	5.14±1.16 (8)	2.74±1.08 (6)
Overall	3.22±0.60 (24)	3.71±0.96 (24)	3.70±0.66 (24)	5.62±0.56 (24)	4.30±0.75 (22)
T_3 concentration (ng/ml)					
C	2.61±0.60 (8)	1.50±0.40 (8)	2.74±1.46(8)	$1.21±0.18^{b\ (8)}$	1.01±0.11 (8)
T_1	2.08±0.51 (8)	1.40±0.29(8)	1.73±0.41 (8)	$2.01±0.39^{ab\ (8)}$	2.20±0.44 (8)
T_2	2.16±0.52 (8)	1.70±0.31 (8)	1.93±0.45 (8)	$2.35±0.34^{a\ (8)}$	2.09±0.64 (6)
Overall	2.28±0.29 (24)	1.53±0.19 (24)	2.14±0.51 (24)	1.86±0.20 (24)	1.74±0.26 (22)
T_4 (ug/dL)					
C	11.25±2.10 (8)	10.56±1.90 (8)	10.96±2.00 (8)	10.18±1.26 (8)	6.80±0.66 (8)
T_1	9.18±1.55 (8)	8.99±0.54 (8)	9.55±1.22 (8)	9.33±0.88 (8)	10.02±1.25 (8)
T_2	10.24±1.20 (8)	10.22±0.82 (8)	9.45±1.24 (8)	8.73±0.80 (8)	7.66±1.17 (6)
Overall	10.22±0.93 (24)	9.92±0.70 (24)	9.98±0.86 (24)	9.42±0.57(24)	8.20±0.65 (22)

LSM showing different superscripts in lower case letters in a column differ significantly at P<0.05; Figures in parentheses are number of animals used to derive LSM.

There was no definite trend in the serumT_3 concentration among the three groups except significantly ($P<0.05$) higher levels in T_2 (2.35±0.34 ng/ml) group at day 69th of age as compared to control (1.21±0.18

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ng/ml) and T_1 (2.01±0.39 ng/ml) group. There was non-significant difference in serum T_4 concentration among the three groups at all test days. Thyroid gland has a key role in the distribution of nutrients from the gastrointestinal tract to the various tissues and organs during growth. Similar findings were reported by Ortigues-Marty *et al*. (2003), who found a non-significant difference in T_4 and T_3 concentrations in three treatments groups over 140 days: a control diet, a diet containing solubilized wheat protein without or with branched-chain amino acid supplementation. The T_4 and T_3 concentrations are markedly influenced by energy intake in calves of at least first week of age (Grongnet *et al*., 1985; Kinsbergen *et al*., 1994).

Incidence of Diseases

We observed a higher number of calves from T_2 group, suffering from diarrhoea, pneumonia and others diseases in comparison with control and T_1 group (Table 6). Our findings are in agreement of findings of several studies done by Lee *et al*. (2009); Ribeiro *et al*. (2009); Uys *et al*. (2011); Bhatti *et al*. (2012) where all of these researchers reported higher incidences of diseases in the calves raised on milk replacer.

Table 6: Incidence of diarrhea, respiratory and other disorders at monthly interval

Group	Month			Total
	First	Second	Third	
Control	2	0	2	4
T_1	0	3	0	3
T_2	3	5	1	9
Overall	5	8	3	16

Conclusion

Thus, it was concluded that live body weight and average daily gain was comparatively better for Surti buffalo calves raised artificially on whole milk than on milk replacer and calves raised under conventional calf rearing system. Further, for calves raised artificially on whole milk, total feed intake on as such and dry matter basis was significantly ($P<0.05$) higher than the other two groups of calves on all test days. These findings were well corroborated with significant changes in serum biochemical parameters. There were non-significant differences in the concentration of cortisol, T_3 and T_4 hormones among all three groups. Overall there was comparatively higher incidence of diseases in milk replacer feeding group than milk feeding and control group of calves.

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