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RESEARCH ARTICLE

# Effects of Various Weaning Diets Contained Varying Protein and Energy Levels on Growth Performance and Nutrient Digestibility in *Red Sindhi* Calves

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**ABSTRACT**

A study was conducted to determine the effects of different weaning diets on growth performance and nutrient digestibility in male calves of *Red Sindhi* cattle. Thirty newly born calves were randomly divided into five experimental groups i.e. A, B, C, D and E of six calves in each. Each group was housed separately in the pens having common feeding and watering systems. Calves were fed adequate colostrum immediately after birth for three days. From day 4$^{th}$, group A was fed whole milk at the rate of 1/10$^{th}$ of body weight (BW) per calf for first 4 weeks, 1/15$^{th}$ of BW for 5-8 weeks and 1/20$^{th}$ of BW for 9-13 weeks of age. The remaining four groups were given milk at the rate of 1/10$^{th}$ of BW per calf for first 4 weeks, 1/15$^{th}$ of BW for 5$^{th}$ week and 1/20$^{th}$ of BW for 6$^{th}$ week of age. From fourth week, these groups were randomly introduced one of the four experimental diets having two crude protein (CP) i.e.16 and 18% and two metabolizable energy (ME) 2.8 and 3.0Mcal/kg levels on *ad-libitum* basis. At the end of 6$^{th}$ week, milk supply to these five groups was stopped and calves were shifted to weaning diets that were fed for further 2 months. Feed intakes, body weights and feed efficiency (FE) were determined weekly. Feed efficiency of group A reared on milk was significantly ($P<0.05$) better (2.55) as compared to other two groups (2.87 to 3.30) however the cost with milk was higher. Weight gain and FE of calves fed on weaning diet contained 16% protein and 2.8 Mcal/kg were significantly ($P<0.05$) poorer compared to other groups. However, there was no significant difference in dry matter intake (DMI) among the groups. Calves in group A showed better ($P<0.05$) DM and CP digestibility compared to other groups. These results indicate that a weaning diet having combination of 16% protein and 3.0Mcal/kg energy (Group C) is adequate for successful weaning in *Red Sindhi* calves because it showed similar performance when compared with the weaning diets having 18% CP and 2.8 or 3.0Mcal/kg energy.

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## INTRODUCTION

Pakistan is deficient in animal proteins to feed large human population. According to international recommendations, the per capita consumption of proteins should be 60.0 g, out of which 27.4 g should come from animal source. The per capita availability of animal proteins is only 19.4 g and still there is shortage of 8.0 g for human consumption in Pakistan (Anonymous, 2014).

Beef is the second major source of animal protein, after poultry, which is available for human consumption in Pakistan. According to the Economic Survey (Anonymous, 2014) there are 39.7 million cattle and 34.6 million buffaloes in Pakistan producing 49 billion liters of milk and 1.9 million tons every year. Cattle and buffaloes are mainly reared for dairy purpose. There is no beef breed in Pakistan. Beef mainly comes from old, emaciated and diseased animal. In big cities, livestock including cattle and buffaloes are kept for dairy purpose in large cattle colonies in the periphery of the big cities. In these colonies, male calves are normally slaughtered at very young age and rearing of these calves for fattening

purpose is not practiced (Khan *et al.,* 2008). Among numerous reasons for negligence of calf rearing such as requirement of extra labor, space and finance etc., consumption of a substantial quantity of milk by the calf remains the major one. However, it can be reduced by offering milk substitutes i.e. milk replacer or calf starter to the calf and sparing milk for human consumption (Anjum *et al*., 2013). On the other hand, rearing of young calves specially the male ones for beef purpose would certainly help in bridging the gap between requirement and availability of good quality animal protein.

Recommendations and practices like the timing of calf separation, the amount of milk that is provided, when and how solid food is provided, the age and the method by which they are weaned vary considerably (Quigley, 1997). Early consumption of dry feed by young calves is desirable to support rapid rumen development and enable early weaning. Early weaning of calves contributes to early development of ruminal microflora activity because of accelerated intake of dry feed (Ahmad *et al*., 2004). It has been emphasized to adopt dry feed consumption in calves so as to wean at an early age, which in addition spares milk for human consumption (Babu *et al*., 2003).

Proteins and energy are most critical nutrients influencing the growth of calves (Bhatti *et al.,* 2007). However, minerals and vitamins are also important. According to NRC (2001) a good quality calf starter should contain minimum 18% crude protein and 3.0 Mcal/Kg metabolizable energy. However, these recommendations are based on the research with European and American cattle breeds, which are heavier than *bos indicus* cattle breeds. These reference values can be used for buffalo calves because of similarity in body weights of buffalo calves with Holstein Friesian (Jabbar, 2004). However, the nutritional requirements of young cattle calves of sub-continental breeds could be different. The use of calf starter for early weaning and sparing the milk for human consumption and the impact of different protein and energy levels of calf starter on growth performance of young calf are largely unexplored. Therefore, the present study was launched to determine the effects of different weaning diets varying in protein and energy levels on growth performance and nutrient digestibility in *Red Sindhi* male calves.

## MATERIALS AND METHODS

Thirty healthy newly born male calves (23±2; kg) of *Red Sindhi* cattle at Livestock Experimental Station, Karachi were used in this study. Just after birth each calf was weighed and tagged for identification. These calves were randomly divided into five experimental groups with six calves in each i.e. A, B, C, D and E. Each group was housed separately in the pens having common feeding and watering systems with ample open space to enjoy sunbath and exercise.

Calves were fed adequate colostrum immediately after birth for three days. From day 4$^{th}$, group A was offered whole milk at the rate of 1/10$^{th}$ of body weight (BW) per calf for first 4 weeks, 1/15$^{th}$ of BW for 5-8 weeks and 1/20$^{th}$ of BW for 9-13 weeks of age. The remaining four groups were given milk at the rate of 1/10$^{th}$ of BW per calf for first 4 weeks, 1/15$^{th}$ of BW for 5$^{th}$ week and 1/20$^{th}$ of BW for 6$^{th}$ week of age. From fifth week, these groups were randomly introduced one of the four experimental diets having two crude protein (CP) i.e.16 and 18% and two metabolizable energy (ME) 2.8 and 3.0 Mcal/kg levels on ad-libitum basis (table 1).

| Groups | Feeding Pattern |
|---|---|
| A | Whole milk for 3 months |
| B | Whole milk for 1$^{st}$ month then weaning diet having 16% CP and 2.8Mcal/kg ME |
| C | Whole milk for 1$^{st}$ month then weaning diet having 16% CP and 3.0Mcal/kg ME |
| D | Whole milk for 1$^{st}$ month then weaning diet having 18% CP and 2.8Mcal/kg ME |
| E | Whole milk for 1$^{st}$ month then weaning diet having 18% CP and 3.0Mcal/kg ME |

**Table 1:** Composition of experimental weaning diets

| Ingredients | Experimental rations | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Corn grain | 25.0 | 25.0 | 20.0 | 23.0 |
| Barley | 15.0 | 15.0 | 12.0 | 12.0 |
| Rice polishing | 10.0 | 12.0 | 12.0 | 12.0 |
| Wheat bran | 10.0 | 8.0 | 8.0 | 8.0 |
| Cottonseed meal | 8.0 | 10.0 | 12.0 | 10.0 |
| Rapeseed meal | 8.0 | 8.0 | 10.0 | 10.0 |
| Sunflower meal | 6.0 | 5.0 | 5.0 | 5.0 |
| Corn gluten meal 30% | 5.0 | 4.0 | 8.0 | 8.0 |
| Lime stone | 1.3 | 1.3 | 1.3 | 1.3 |
| Dicalcium phosphate | 1.2 | 1.2 | 1.2 | 1.2 |
| Molasses | 10.0 | 10.0 | 10.0 | 09.0 |
| Mineral premix | 0.5 | 0.5 | 0.5 | 0.5 |
| Total | 100 | 100 | 100 | 100 |
| *Chemical analysis | | | | |
| Crude protein (%) | 16.08 | 16.02 | 18.00 | 17.98 |
| ME (Mcal/kg) | 2.81 | 3.03 | 2.79 | 3.00 |
| Crude fiber (%) | 6.13 | 5.65 | 5.89 | 5.38 |
| Cost ($/kg) | 0.27 | 0.28 | 0.28 | 0.31 |

B: (diet with 16%CP and 2.8 ME), C: (diet with 16% CP and3.0 ME), D: (diet with 18% CP and 2.8 ME), E: (diet with 18% CP and 3.0 ME), *Calculated value, Cost of milk (A) = 0.8$ per kg.

At the end of 6$^{th}$ week, milk supply to these five groups was stopped and the calves were shifted to weaning diets that were fed for further 2 months. All the calves were also offered chopped green fodder along with fresh and clean water. Feed intakes, body weights and feed efficiency (FE) were determined weekly. Proximate analyses (dry matter, ether extract, ash, crude fiber and CP) of feed samples were carried out as described in AOAC (1990).

Two digestibility trials I and II were conducted at 8$^{th}$ and 12$^{th}$ week of experiment respectively. In digestibility trial, 20 calves were used and daily feed intake was recorded. Feed and orts samples were also collected. Total feces voided were collected, weighed, mixed manually and sub-sampled. Feces samples were frozen daily and subsequently composited for each calf. Samples were oven dried at 70°C and subsequently analyzed for dry matter and CP content according to AOAC (1990).

All results were subjected to analysis of variance in completely randomized design using the General Linear Model procedure of SAS (2000) and where the significant difference is indicated at 5% probability; the means were tasted by Duncan's multiple range test.

**Table 2:** Dry matter intake, weight gain and feed efficiency of *Red Sindhi* calves fed on milk and different weaning diets.

| Parameters | Groups | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | PSE |
| 0-4 week | | | | | | |
| Weight gain (kg) | 3.90 | 3.94 | 4.13 | 3.92 | 4.00 | 0.20 |
| Dry matter intake (kg) | 8.29 | 7.75 | 8.42 | 8.13 | 7.97 | 0.48 |
| Feed efficiency (kg/kg) | 2.13 | 1.97 | 2.04 | 2.08 | 1.99 | 0.11 |
| 5-8 week | | | | | | |
| Weight gain (kg) | 4.53 | 4.43 | 4.47 | 4.13 | 4.60 | 0.28 |
| Dry matter intake (kg) | 12.75 | 17.05 | 15.79 | 16.52 | 16.15 | 0.89 |
| Feed efficiency (kg/kg) | 2.81a | 3.83b | 3.53ab | 4.00b | 3.51ab | 0.15 |
| 9-13 week | | | | | | |
| Weight gain (kg) | 13.95a | 10.18b | 12.88ab | 12.75ab | 13.05ab | 0.78 |
| Dry matter intake (kg) | 36.10 | 36.43 | 39.45 | 38.73 | 37.99 | 3.51 |
| Feed efficiency (kg/kg) | $2.59^{a}$ | $3.58^{b}$ | $3.06^{ab}$ | $3.04^{ab}$ | $2.91^{ab}$ | 0.13 |
| 0-13 week | | | | | | |
| Weight gain (kg) | $22.38^{a}$ | $18.55^{b}$ | $21.48^{a}$ | $20.80^{ab}$ | $21.65^{a}$ | 1.21 |
| Dry matter intake (kg) | 57.14 | 61.23 | 63.66 | 63.38 | 62.11 | 5.89 |
| Feed efficiency (kg/kg) | $2.55^{b}$ | $3.30^{a}$ | $2.96^{ab}$ | $3.05^{ab}$ | $2.87^{ab}$ | 0.13 |
| Avg. daily gain (kg) | $0.248^{a}$ | $0.206^{b}$ | $0.239^{a}$ | $0.231^{a}$ | $0.241^{a}$ | 0.011 |
| Avg. daily intake (kg) | 0.635 | 0.680 | 0.707 | 0.704 | 0.690 | 0.038 |
| Feed cost ($)* | 2.07 | 1.10 | 1.12 | 1.16 | 1.20 | -- |

PSE: Pooled Standard Error. [a, b]Means in a row bearing dissimilar superscripts differ significantly (P<0.05); *Cost of ration for gaining one kg live weight.

## RESULTS AND DISCUSSION

Results regarding weight gain, feed intake and FE are shown in table 2. Weight gain and FE of group B calves fed on 16% protein and 2.8 Mcal/Kg energy diet were significantly (P<0.05) poorer as compared to other groups at 5-8 week and 9-13 week. Similarly, overall weight gain and FE of group B were also significantly poorer. However, there was no significant difference in DMI among the groups. Weight gain and FE of group A fed milk was significantly better as compared to other groups however the cost of feeding was higher. Feed efficiency appeared to improve significantly in calves fed liquid diet (group A) than calves fed solid diets (group B, C, D and E) might be due to higher biological value of liquid diet as reported by Khan and Azim (2000). Babu *et al.* (2003) also observed better growth performance and feed digestibility in calves fed on milk up to 8 week of age.

It has been observed that those calves (group C, D and E) started consumption of DM at early age weaned successfully with improved average daily gain and DMI than the calves fed liquid diet (group A). This might be due to the earlier reticuloruminal development of calves fed solid diet. Similar findings have been reported by Khan and Azim (2000), who reported that solid feed stimulates gastrointestinal tract development in young calves. (Ahmad *et al*., 2004) reported that micro-flora need longer time to establish in rumen of the calves fed whole milk compared with the calves fed starter ration.

Chattha (1991) observed more feed consumption and weight gain in calves fed on high energy diet with medium protein level (16 % CP). In our study, calved fed on diet having 16% CP and 3.0Mcal/kg ME (group C) performed almost similar to group A calves in term of daily weight gain and FE. The cost of that weaning diet was also less as compared to other groups.

Values of DM and CP digestibility during 8th and $12^{th}$ week of experiment are given in Table 3. In digestibility trial I, DM digestibility was 96.58, 83.51 84.94, 83.92 and 86.07% and CP digestibility was 94.29, 73.75, 75.42, 76.80 and 76.97% in group A, B, C, D and E respectively. Digestibility of both DM and CP was higher (P<0.05) in group A than B, C, D and E; however, no difference was found between later four groups. Similar trend of DM and CP digestibility was found in trial II. Higher digestibility of DM and CP in group A was because of high biological values of liquid diet than other four groups consumed solid diet. The result is in accordance with the findings reported by Anjum *et al.* (2013) who suggested that digestibility of DM and CP was (P<0.05) higher in cow calves fed milk replacer than early weaning diet.

**Table 3:** Apparent digestibility in *Red Sindhi* calves fed on milk and different weaning diets.

| Digestibility (%) | Groups | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | PSE |
| Trial I | | | | | | |
| Dry matter | $96.58^{a}$ | $83.51^{b}$ | $84.94^{b}$ | $83.92^{b}$ | $86.07^{b}$ | 3.92 |
| Crude protein | $94.29^{a}$ | $73.75^{b}$ | $75.42^{b}$ | $76.80^{b}$ | $76.97^{b}$ | 3.48 |
| Trial II | | | | | | |
| Dry matter | $94.53^{a}$ | $79.43^{b}$ | $81.17^{b}$ | $81.13^{b}$ | $82.60^{b}$ | 4.28 |
| Crude protein | $93.75^{a}$ | $70.05^{b}$ | $71.79^{b}$ | $70.52^{b}$ | $73.15^{b}$ | 4.28 |

PSE: Pooled Standard Error. [a, b]Means in a row bearing dissimilar superscripts differ significantly (P<0.05).

## Conclusion

These results indicate that a weaning diet having combination of 16% protein and 3.0Mcal/Kg energy (Group C) is sufficient to introduce successful weaning in *Red Sindhi calves* as it produced similar results to that of other diets with 18% protein and 2.8 or 3.0Mcal/Kg energy (Group D and E) and are also comparable with group A calves fed on milk. By early weaning through feeding of suitable calf starter, the male calves can be reared for fattening purposes to fulfill the beef requirement and on the other hand, milk can be spared for human consumption.

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