

ANIMAL

The optimum post-weaning growth using different levels of dietary protein in Pakistan calves

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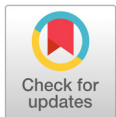
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Abstract

The aim of this study was to provide different levels of dietary protein for optimum growth performance in calves and to investigate the impact on the concentration of insulin-like growth factor-1 (IGF-1) in serum. Female Sahiwal calves ($n = 12$, body weight (BW) = 40 ± 4.3 kg and age = 60 ± 10 days) were selected and divided into three groups with 4 animals in each group. Three diets of T0, T1 and T2 with 18, 20 and 22% of crude protein levels, respectively, were given to the calves to assess the post-weaning growth performance. Calves fed the T2 diet showed a higher ($p < 0.05$) dry matter (DM) intake than those fed the T0 and T1 diets. The feed conversion ratio (FCR) for the calves fed the T2 diet was lower ($p < 0.05$) than those of the calves fed the T0 and T1 diets. The T2 group had the highest BW ($p < 0.05$) compared with the other groups. The concentration of IGF-1 in serum increased (121.9, 143.3, and 152.9 ng/ml for T0, T1, and T2, respectively) as the crude protein (CP) level increased. Overall, the results of this study suggest that post weaning diets T1 and T2 with 20 and 22% crude protein in Sahiwal female calves had significantly increased the BW and serum IGF-1 concentration. The IGF-1 estimation might be a physiological indicator for growth performance.

Keywords: dietary protein level, insulin-like growth factor-1, post weaning growth, Sahiwal calves



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Introduction

The growth in cattle is not achieved optimum due to underfeeding and poor management conditions in Pakistan (Sarwar et al., 2002). Farmers are mostly concerned with milk yield and obtain milk prices at the cost of calves. Ultimately, calves are badly neglected and undernourished (Azim et al., 2011). Consequently, calves are weaned earlier to reduce input costs.

Calves weaning and its management is an important issue in dairy industry. The survivability of young calves is based on various factors and most considerable

factor was live weight at weaning time (Quigley, 2011). Although early weaning is advantageous during low forage yield season, poor condition of cow or when adequate rebreeding performance is impossible. However, weaning practice without consideration of age and management might suppress many innate immune responses in calves (Hulbert et al., 2011).

Post-weaning diets have prevalent effects on growth process and Insulin-like growth factor-1 (IGF-1) level in blood serum in young calves. IGF-1 plays vital role in growth and reproduction of bovine calves because it has positive impact on cell proliferation, transformation and differentiation (Kumar and Laxmi, 2015). Generally, the growth hormone (GH) mediates the biosynthesis of IGF-1 in the liver (Daughaday, 2000) even though function of IGF-1 in farm animals has been limitedly reported (Chen, 2001).

Previously, positive correlation was observed between serum IGF-1 concentration and liver IGF-1 mRNA expression with body gain, feed efficiency and body protein synthesis rate in different farm animals (Wu et al., 2010). Growth performance of Holstein steers was also found positively correlated with plasma IGF-1 concentration (Lee et al., 2005). However, no report is available for Sahiwal cattle in its native habitat. Therefore, the study was planned to provide dietary protein levels for optimum growth performance in female calves and to investigate its impact on concentration of insulin-like growth factor-1 (IGF-1) in serum.

Materials and Methods

Experimental design and animal managements

All the experimental procedures were reviewed and approved by the scrutiny committee at University of Agriculture Faisalabad, Punjab Pakistan. This research work was carried out using female Sahiwal calves ($n = 12$, body weight (BW) = 40 ± 4.3 kg and age = 60 ± 10 days) in three groups having 4 animals in each.

Calves were kept in individual movable pens having dimensions $1.5 \times 1 \times 1$ m³ of length, width and height respectively. Floor of the pen was approximately 23 cm higher from floor of barn. These pens were provided with one bucket for feeding, one bucket for watering and one bottle having nipple for milk feeding. Floor of the pen was made with wooden pieces having tiny space among them for drainage. During pre-weaning period of 30 days, the calves were given milk at 10% of their body weight individually with calf starter and offered ad libitum seasonal fodder and water. The weaning was executed at 60 days of age through withdrawing milk step wise in a period of seven days. During post-weaning period of 30 days female calves were divided into three groups and each calf was kept in separate stall. The animals were given three dietary protein levels i.e., T0 = 18%, T1 = 20% and T2 = 22% of crude protein (CP), respectively (Table 1).

Data collection and lab analysis

During the trial, the data for total milk intake, feed intake, BW and growth performance were collected. Proximate analysis of diets in terms of dry matter (DM), CP, crude fiber (CF), ash and ether extract was performed according to Choi (2017). Fiber analysis in terms of acid detergent fiber (ADF), neutral detergent fiber (NDF) and nitrogen free extract (NFE) was accomplished as per standard methods of Van-Soest et al. (1991). Blood samples were taken from Jugular vein of calves at day 0, 30 and 60 day of experiment and serum was separated after centrifugation for 15 minutes (USAID Predict, 2016). The serum was kept at - 20°C until analysis. The analysis of IGF-1 was performed by using kits specified to estimate the IGF-1 level in serum (Bovine IGF-1 ELISA Kits by CUSABIO, China).

Statistical analysis

The collected data was analyzed through ANOVA technique under the completely randomized design (CRD) run in R environment while means were compared using Tukey's test (R Development Core Team, 2013).

Results and Discussion

The results mentioned in Table 2 depicted that calves fed diet T2 having 22% protein consumed more feed than of those fed T0 and T1 crude protein diets. However, average feed consumption was not different ($p > 0.05$) between groups of calves fed diets T0 and T1 having 18 and 20% protein. The same pattern was followed in case of total feed intake as shown in Table 2. The feed conversion ratio (FCR) found in T2 diet having 22% protein was found better than that of T0 and T1 protein diets. The average daily gain (ADG) in calves fed T2 protein diet was higher than of those fed T0 protein diet, whereas it was not different between T0 and T1 protein diets. Concentration of IGF-1 was increased (121.9, 143.3, and 152.9 ng/ml) with increasing dietary protein level from 18 to 22% (Fig. 1).

The optimum weaning weight gain with good condition in dairy calves has crucial importance for their better future performance (Johnsen et al., 2016). Therefore, immune and health status of calves need dire attention and negligence lead to calf morbidity (Hulbert and Moisa, 2016). Findings of

Table 1. Chemical Composition (% of DM) of experimental dietary protein levels.

Composition	Treatments ^z		
	T0	T1	T2
ME (Mcal/kg)	2.83	2.85	2.85
DM (%)	91.40	92.00	90.10
Organic matter	93.40	93.50	90.10
CP	17.90	20.20	22.00
Neutral detergent fiber	39.09	42.40	41.06
Ash	6.60	6.50	9.90
CP : ME	63.60	70.17	77.19

ME, metabolizable energy; DM, dry matter; CP, crude protein.

^zDietary treatments were T0 = 18%, T1 = 20% and T2 = 22% of CP, respectively.

present study were affirmed by (Toker and Ozkaya, 2014) that growth performance of Holstein calves fed diet having 22% protein was found better than of those fed 18% protein diet. The daily gain observed in that study was 0.68 and 0.775 kg for 18 and 22% CP diets, respectively. Positive impact of higher dietary protein on growth of calves during post weaning period might be attributed to factor of higher feed intake. Previously, Brown et al. (2005) reported while evaluating similar dietary protein levels that dry matter intake increased significantly from 0.847 to 1.213 kg/day as CP level increased. It was also corroborated with an earlier report in Holstein cows where an increase DM intake was reported following increasing CP levels (Davidson et al., 2003).

Provision of higher dietary protein during post weaning period in calves might be adequate nutritional strategy which could enhance digestibility of dietary protein. The linear increase in

Table 2. Effect of dietary protein levels on animal performance parameters in Sahiwal female calves.

Parameter	Treatments ^z		
	T0	T1	T2
DM intake (g/d)	584 ± 4.5b	603 ± 6.8b	643 ± 10.4a
Total DM intake (kg/d)	16.4 ± 0.1b	16.9 ± 0.1b	18.0 ± 0.2a
Feed conversion ratio	2.1 ± 0.1a	1.5 ± 0.1b	1.1 ± 0.04c
Average daily gain (g/d)	39.0 ± 1.2b	43.6 ± 1.2ab	47.6 ± 2.2a
Total body weight gain (kg)	7.5 ± 0.5c	11.4 ± 0.8b	16.5 ± 0.2a

DM, dry matter.

^zDietary treatments were T0 = 18%, T1 = 20% and T2 = 22% of CP, respectively.

a - c: Means in a row with different letters are significantly different ($p < 0.05$).

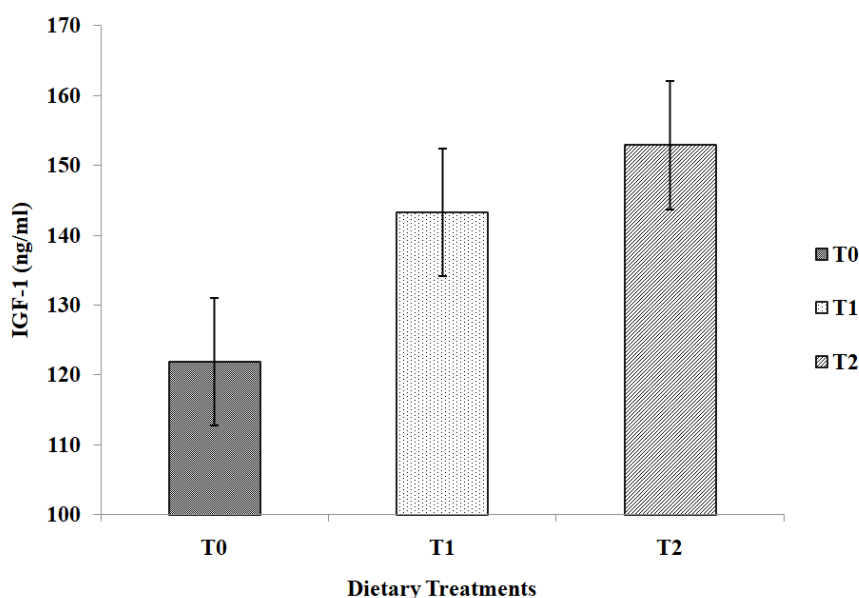


Fig. 1. Effect of dietary protein levels on serum insulin-like growth factor-1 (IGF-1) concentration in Sahiwal female calves. Dietary treatments were T0 = 18%, T1 = 20% and T2 = 22% of CP, respectively. CP, crude protein.

digestibility of crude protein has been observed with increasing dietary protein levels (Dabiri and Thonney, 2004; Promkot and Wanapat, 2005; Lohakare et al., 2006). Higher digestibility could enhance more amino acid absorption in rumen and absorbed amino acid from rumen could be essential as building blocks for tissue synthesis (NRC, 2001).

The current findings indicated that IGF-1 concentration in serum was found to increase with increasing dietary protein level. These findings were also ascertained by previous work. Smith et al. (2002) documented that weaned calves usually received higher nutrient in the form of milk replacer that ensure the maximum nutrient bio-availability and IGF-1 level in serum concentration that in turn results better growth performance on diets comprising of 20% CP. Recently, Wan et al. (2017) also reported that dietary protein level might be a crucial factor to regulate insulin-like growth factor-1. Results in that study showed that IGF-1 concentration was found higher in response to higher dietary protein (CP 20%) than that of low protein diet (CP 14%).

Conclusion

The post weaning diet with 20 and 22% protein in Sahiwal female calves had significantly increased body weight and serum IGF-1 concentration. The IGF-1 estimation might be a physiological indicator for growth performance. However, further research work is required to authenticate.

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