IMPACT OF PROTEIN SUPPLEMENTATION AND FEEDING MANAGEMENT ON GROWTH OF SAHIWAL FEMALE CALVES

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ABSTRACT: The objective of this study was to assess the impact of protein supplementation and feeding management on the growth performance of Sahiwal female calves.A total of 45 Sahiwal female calves were randomly divided into three groups: Group A (control), Group B (protein supplementation), and Group C (ad libitum green fodder + protein supplementation). The study spanned a period of 90 days, during which the calves' feed intake, weight gain, and body measurements were assessed.The results indicated that protein supplementation had a significant impact on various aspects of calf development. Calves in Group B and Group C showed improved feed intake compared to the control group. Furthermore, the weight gain of calves in the supplemented groups was significantly higher than that of the control group. The body measurements, including height at withers, body length, heart girth, and hip width, also varied among the different treatment groups, with the control group generally exhibiting smaller measurements.These findings suggest that protein supplementation positively influenced the growth performance of Sahiwal female calves. The study highlights the importance of considering protein supplementation as a part of feeding management strategies for optimizing the growth of calves.

Keywords: Sahiwal female calves, protein supplementation, feeding management, growth performance

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INTRODUCTION

The livestock sector in Pakistan is vital to the economy, supporting rural livelihoods and contributing significantly to agricultural GDP (Anonymous, 2023). However, challenges such as random breeding, poor nutrition, improper housing, and inefficient reproductive management hinder livestock production performance (Khan, 2002). Despite having high-quality zebu cattle and water buffaloes, their production levels lag behind dairy breeds in developed countries (Mustafa et al., 2018).

Inadequate supply of quality meat and milk products contributes to malnutrition and poor animal performance in Pakistan, leading to an animal protein shortage. Tropical and subtropical countries like Pakistan have feed resources with low crude protein and lipid content but high crude fiber content, negatively impacting animal growth rates (Shah, 1994). Insufficient nutrition affects heifers' development, delaying puberty and increasing rearing costs.

Adequate nutrition, including protein, carbohydrates, minerals, lipids, and vitamins, is crucial for the growth of calves, ensuring desirable growth rates, muscle mass, and bone size (Banerjee 1998). While forage can be a good feed source for growing dairy heifers, supplementation with grain, minerals, and other forage sources may be necessary to meet nutritional needs and promote growth (Lurdri and Razdan, 1980).

Effective management of heifers should focus on enhancing physiological processes that promote puberty and target weight attainment ((Ibraheem, 2005: Heinrichs et al., 2005). Nutritional status significantly affects growth rate and development, and strategic decisions regarding growth-promoting implants, creep-feeding, breed type, birth date, weaning weight, and social interaction impact lifetime productivity and reproductive performance (Patterson et al., 1992; Gabler and Heinrichs 2003; Gasser et al., 2006).

The Sahiwal breed, known for its heat and tick resistance, is widely used in breeding programs in Pakistan (Chaudhary et al., 1989). However, Sahiwal cattle face challenges such as low growth rates, late maturity, light weight at production onset, extended dry periods, and calving intervals (Mustafa et al., 2018). Improving their production potential through breeding

and addressing feeding and management practices is crucial.

Properly balanced rations are necessary to achieve desired growth, body condition, height, and weight in calves. Overfeeding or underfeeding heifers can lead to breeding problems, calving difficulties, delayed entry into the milking herd, and stunted growth (VandeHaar, 1997; Khan *et al.*, 2002). Increasing growth rates of female calves after weaning reduces non-productive states and requires a balanced diet. Further research is needed to determine the feeding requirements of important local breeds by supplementing concentrate to the conventional feeding regime (Capuco et al.,1995).

This study aims to evaluate current knowledge on heifer feeding management and stimulate research to enhance management techniques at an optimal age. It aims to compare calf performance fed on different levels of supplementary concentrate ration, determine appropriate concentrate supplementation levels to ad libitum green fodder for optimal growth, and evaluate the conventional feeding regimen with supplemented concentrate ration.

MATERIALS AND METHODS

Study Design: A total of 45 Sahiwal female calves aged 9 to 12 months were selected and housed at Livestock Experimental Station Jahangirabad, Khanewal, Pakistan. The calves were given an adjustment period of 15 days and were provided with ad libitum green fodder and a concentrate diet at a rate of 0.5% of their body weight. The animals were kept under similar feeding and management conditions, and a three-month period was allowed for animal conditioning and adaptation. The study was conducted from March 1, 2007, to May 31, 2008.

Experimental Ration: The 45 calves were randomly divided into three treatment groups (A, B, and C) with three replicates per treatment, each containing 5 calves. The three treatments were as follows:

A: Control group - ad libitum green fodder without a concentrate diet.

B: Green fodder + concentrate diet at 0.5% of the body weight (on a dry matter basis).

C: Green fodder + concentrate diet at 1.0% of the body weight (on a dry matter basis).

The animals in each group were fed their respective diets and provided with free access to water. The space provided per animal was approximately 20 square feet, as recommended by Banerjee (1998). All the calves were vaccinated, dewormed, and housed on brick floors. The measured quantities of respective rations were provided to the calves in the morning based on their live weight in each group.

Data Collection: The following parameters were collected during the study:

Daily Feed Intake: The daily feed intake was recorded for each individual animal by offering fresh green fodder and subtracting the leftover fodder, if any. The control group (A) did not receive any concentrate diet, while groups B and C were offered the concentrate diet at a rate of 0.5% and 1.0% of their body weight, respectively, once daily.

Weight Gain: Body weight gain data for all animals were recorded on a fortnightly basis. The weights were measured early in the morning using a digital weighing balance.

Feed Efficiency: Sequential variations in feed intake of all the experimental animals were recorded. Feed efficiency for each group was calculated as the total weight gain divided by the total feed consumed.

Body Measurement:

Body Height: The body height of each calf was measured in inches from the top of the withers to the ground, while the calves were standing squarely.

Body Length: Body length was measured in inches from the shoulder to the pin bone, with the calves in a squarely standing position.

Heart Girth: The heart girth was measured in inches using a measuring tape, following the method described by Kertz et al. (2004).

Body Mass Index (BMI): The body mass index (BMI) was calculated as the weight (W) in kilograms divided by the square of height (H) in meters, using the formula BMI = W / H^2 (Sorensen et al., 1992).

Statistical Analysis: The collected data were subjected to statistical analysis using a Complete Randomized Design, and analysis of variance techniques were applied. Differences among treatment means were tested using the Least Significant Difference test (Steel et al., 1997) to interpret the results and draw valid conclusions.

RESULTS

The present study was carried out to compare the growth performance of Sahiwal female calves fed on varying levels of supplementary concentrate diet. The performance parameters included in this study were feed intake, daily weight gain, feed efficiency, body measurements: height at withers, heart girth, body length, body mass index and serum biochemistry. They were maintained under similar feeding and management condition. All the calves were vaccinated, dewormed and kept at bricks floor. The weighed quantity of respective rations was provided to the calves and monitored daily.

Feed Intake: The average daily green fodder intake of the calves in groups A, B and C was 18.92 ± 0.08, 15.91 ± 0.06 and 13.02 ± 0.05 kg, respectively (Table 2). The highest green fodder intake was observed in calves of group A (18.92 ± 0.08 kg) fed *adlibitum* green fodder and the lowest green fodder intake (13.02 ± 0.05 kg) was noted in the calves of group C fed on green fodder (*adlibitum*) with 1 % of the concentrate diet. Analysis of variance revealed a significant (P<0.01) difference in green fodder intake among the calves fed on different levels of concentrate (Table 1).

Table 1: Analysis of Variance for Green Fodder Intake of Calves fed on different levels of concentrate diet.

S.O. V	D.F	MS	F. Ratio	P-Value
B. T	2	2354.321	1720.995	0.000
E	807	1.368		
Total	809			

Table 2: Overall green fodder intake and dry matter intake (Kg) of calves fed on different levels of concentrate diet.

Groups	A Mean ± S.E	B Mean ± S.E	C Mean ± S.E
Green Fodder (kg)	18.92^{a} ± 0.08	15.91^{b} ± 0.06	13.02^{c} ± 0.05
Total DMI (kg)	1.99^{a} ± 0.01	2.44^{b} ± 0.01	2.89^{c} ± 0.05

The means carrying different superscript in the same row differ significantly (P<0.01)

The mean daily dry matter intake (DMI) of Sahiwal calves in group A, B and C was 1.99 ± 0.01, 2.44 ± 0.01 and 2.89 ± 0.05 kg, respectively. There was a significant difference (P<0.01) in the DMI between treatment groups. Least significant difference test indicated significant difference in DMI between the calves of groups A, B and C. The highest DMI (2.89 ± 0.05 kg) was observed in the calves of group C, while the lowest DMI (1.99 ± 0.01) kg was observed in the calves of group A (Figure 1).

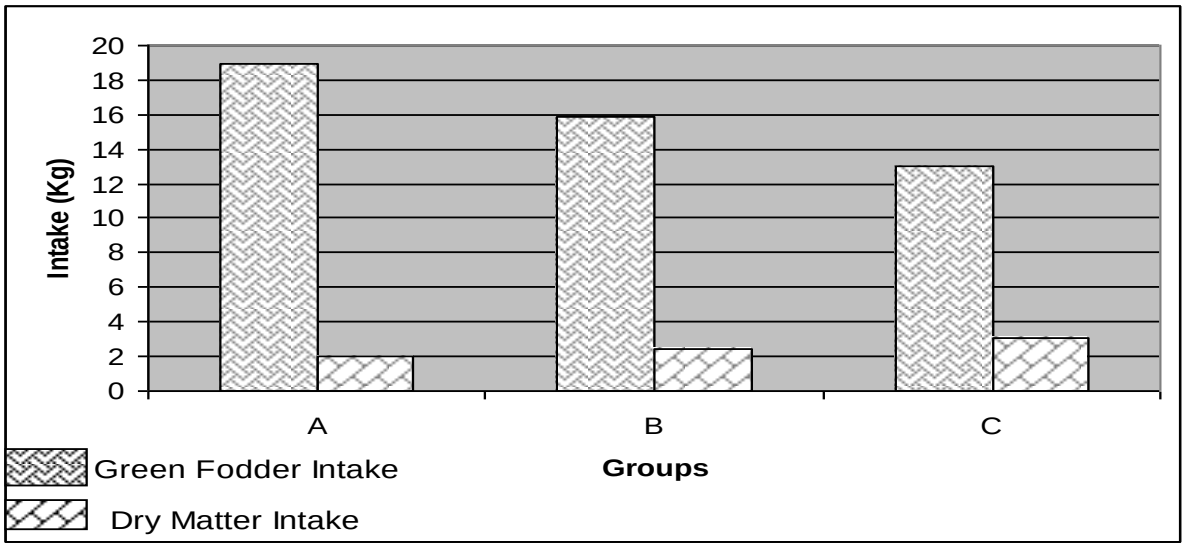

Figure 1: Dry matter and green fodder intake of calves fed on different levels of concentrate diet.

The average daily dry matter intake was 2.16± 0.03, 2.67± 0.02 and 3.17± 0.02 kg, for the calves of group A, B and C, respectively during 4thfortnight. The highest dry matter intake (3.17± 0.02 kg) was observed in the calves of group C, while the lowest dry matter intake (2.16± 0.03 kg) was observed in the calves of group A. The significant difference (P<0.01) among the calves of groups A, B and C was noted during 4th fortnight of the trail.

Weight Gain: The overall weight gain during the experimental period in Sahiwal calves in groups A, B and C was 21.00 ± 0.01, 33.00 ±0.007 and 45.60 ± 0.02 kg, respectively. A notable difference (P<0.01) in weight gain was observed among the various treatment groups.Least significant difference test indicated a significant difference between groups A, B and C. The highest weight gain was (45.60 ±0.02 kg) in the calves of

group C, while the lowest weight gain (21.00 ±0.01 kg) was observed in the calves of group A.

The mean daily gain of the calves in group A, B and C was 0.23 ± 0.11, 0.36 ± 0.24 and 0.50 ± 0.28 kg, respectively. The highest daily gain was observed in the calves of group C (0.50 ± 0.24 kg) while the lowest weight gain (0.23 + 0.111 kg) was in group A. Statistically significant difference in the daily gain between the groups A, B and C were observed.

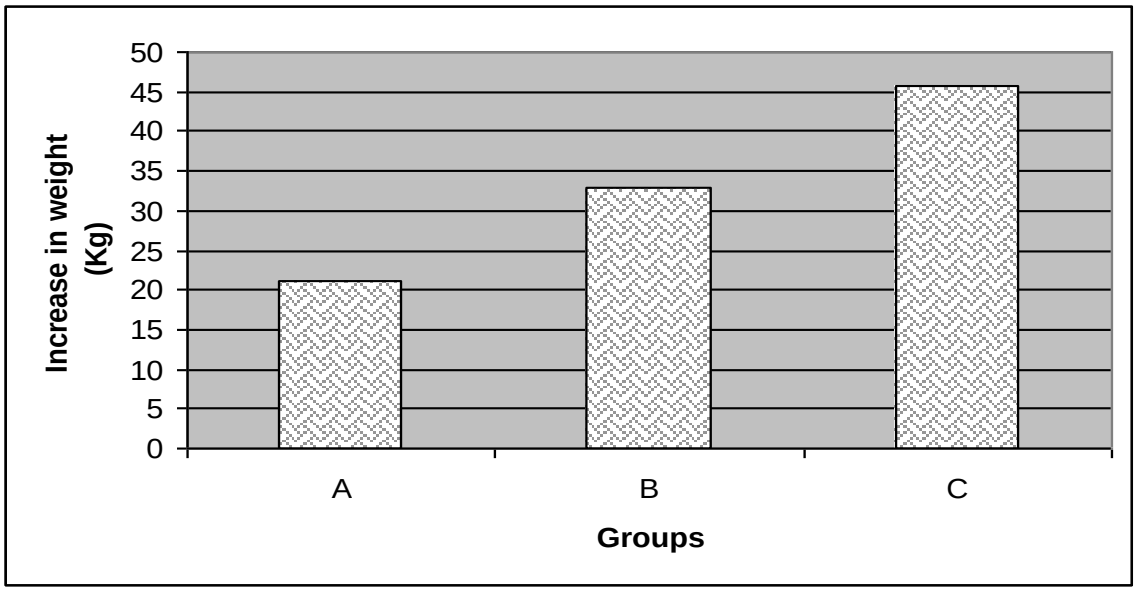

Figure 2: Weight gain of calves of group A, B and C fed on different levels of concentrate.

Feed Efficiency: The feed efficiency of Sahiwal calves in each experimental group was determined by dividing the weight gain by the feed consumed (on a dry matter basis). The average feed efficiency per kilogram of weight gain was found to be 0.11 ± 0.97%, 0.14 ± 0.298%, and 0.16 ± 0.501% for calves in groups A, B, and C, respectively. Notably, a lower feed efficiency value of 0.11 ± 0.975% was observed in group A (control), where the calves were fed ad libitum green fodder.

Body Measurements: Body measurements were taken by recording the data on body height, heart girth and body length at the start of experiment and subsequently on fortnightly basis during the experimental period to investigate the effect of different feeding practices on the growth in Sahiwal calves.

Body Height: The overall increase in body height during the whole experimental period of Sahiwal calves in groups A, B and C was 1.04 ± 0.076, 1.70 ± 0.030 and 1.96 ± 0.139 inches, respectively. Statistical analysis indicated a significant ($P<0.01$) difference between treatments. The calves of group A & B, and also A & C.

Heart Girth: The overall increase in heart girth during the whole experimental period was 3.87 ± 0.12, 4.32 ± 0.11 and 5.07± 0.13 inches in groups A, B and C, respectively. There was a significant difference was observed ($P<0.01$) in heart girth between the treatments. The analysis of variance showed a significant difference in increase in heart girth between the calves of group A & B, and C.

Increase in heart girth of the calves in group A, B and C was observed to be 0.58 ± 0.050, 0.68 ± 0.030 and 0.81 ± 0.043 inches, respectively during the 4th fortnight. The highest increase in heart girth was noted in the calves group C (0.83 ± 0.06 inches) while the lowest increase in heart girth (0.58 ± 0.050 inches) was observed in group A. Least significance difference indicated a significant difference between the groups A & B and C.

Body Length: The overall increased in the body length in the calves of group A, B and C were 1.61 ± 0.10, 3.41 ± 0.11 and 3.65 ± 0.17 inches, respectively. The highest body length was observed in the calves of group C (3.65 ± 0.173 inches) while the lowest body weight was observed in the calves of group A (1.61 ± 0.10). There was a significant difference between the calves of group A & B and A & C but non-significant difference was observed in calves of groups B & C.

DISCUSSION

The future of any dairy enterprise relies on successfully rearing calves and heifers for herd replacements. In this study, we compared the effectiveness of different feeding management practices

on the growth performance of Sahiwal female calves. The study collected average values of various production parameters such as dry matter intake, weight gain, and body measurements from forty-five Sahiwal calves at Livestock Experimental Station, Jahangirabad, Khanewal, from 1st March to 30th June. Feed efficiency and body mass index were determined based on this data, while serum biochemistry was analyzed for albumin, total protein, and cholesterol. The study results are interpreted in the following paragraphs.

Feed Intake: In the control group (group A), the Sahiwal calves were provided with unrestricted access to green fodder. Calves in groups B and C were given a combination of green fodder and a concentrate diet based on their body weight, at 0.5% and 1% respectively, on a dry matter basis. To determine the daily green fodder intake, the amount of green fodder that remained unconsumed in each experimental group was weighed. The overall green fodder intake for the calves in groups A, B, and C was 18.92 ± 0.08 kg, 15.91 ± 0.06 kg, and 13.02 ± 0.05 kg respectively. The highest intake was observed in group A, which had ad libitum access to green fodder, while the lowest intake was seen in group C, which had ad libitum access to green fodder and a 1% concentrate diet. There was a statistically significant difference in green fodder intake among the three treatment groups (A, B, and C).

The average daily dry matter intake of the calves was 1.99 kg, 2.44 kg, and 2.89 kg in groups A, B, and C respectively. The highest intake was observed in group C, which received ad libitum green fodder along with a 1% concentrate diet based on body weight, while the lowest intake was seen in group A (1.99 ± 0.01 kg), which had ad libitum access to green fodder (control). There was a statistically significant difference in dry matter intake between calves in groups A & B and C.

These findings regarding the significant effect of varying levels of protein supplementation on feed intake are supported by previous studies (Bagg et al., 1985; Burrah et al., 1988; Akayezu et al., 1994; Saleem et al., 1995; Galbler et al., 2003; Pal et al., 2004) that reported a significant effect of protein supplementation on feed intake in calves of different breeds of buffalo and cows in various areas. The results are also in line with Buruah et al. (1988), who reported that different levels of protein have a significant effect on feed intake in male buffalo calves.The results relating to the effect of feed intake align with the findings of Bagg et al. (1985), who showed a trial to determine the properties of protein intake on dry matter intake and nutrient digestibility in Holstein Friesian calves. They observed that dry matter intake was unaffected among different treatments. The present results are also in agreement with Rehman et al. (1988), who conducted an experiment on buffalo female calves and observed a significant difference in dry matter intake among the different groups.

Furthermore, the current results align with the report of Akayezu et al. (1994), who conducted a trial to see the effect of calf starters containing different levels of crude protein on calf performance. Starter consumption tended to increase as the crude protein content in the diet increased. Similar results have beenobserved in studies by Saleem et al. (1995), Galbler et al. (2003), and Pal et al. (2004), which also found that protein supplementation positively influenced feed intake in calves.

Weight Gain: The weight gain of the Sahiwal female calves in different treatment groups was recorded over the study period. Group A (control) showed an average weight gain of 0.74 ± 0.02 kg/day, while group B and group C exhibited weight gains of 0.87 ± 0.02 kg/day and 1.02 ± 0.03 kg/day, respectively. The highest weight gain was observed in group C, which received ad libitum green fodder along with a concentrate diet at 1% of their body weight. There was a statistically significant difference in weight gain among the three treatment groups.These findings align with prior research indicating a positive correlation between protein supplementation and calf weight gain.Bagg et al. (1985) found that increasing protein intake led to improved weight gain in Holstein Friesian calves. Similarly, Burrah et al. (1988) and Akayezu et al. (1994) observed higher weight gains in buffalo and cow calves when provided with diets containing higher levels of protein.The findings of this study also align with the results of Saleem et al. (1995), Galbler et al. (2003), and Pal et al. (2004), who reported increased weight gains in calves supplemented with protein. These studies collectively support the notion that protein supplementation positively influences weight gain in calves, which is consistent with the results obtained in this study (Hoffman, et al.,2001).

Body Measurements: Various body measurements were taken to assess the growth and development of Sahiwal female calves in different treatment groups. These measurements included height at withers, body length, heart girth, and hip width.The results showed that the average height at withers for calves in groups A, B, and C was 87.62 ± 0.55 cm, 86.40 ± 0.42 cm, and 84.25 ± 0.51 cm, respectively. Group A (control) had the highest average height at withers, while group C had the lowest. The difference in height at withers among the three groups was statistically significant.Similarly, the average body length was 79.45 ± 0.61 cm, 78.31 ± 0.45 cm, and 77.12 ± 0.54 cm for groups A, B, and C, respectively (Yanar etal., 2002a, b). Group A exhibited the longest body length, while group C had the shortest. The difference in body length among the three groups was statistically significant.In terms of heart girth, the average measurements for groups A, B, and C were 92.52 ± 0.72 cm, 90.68 ± 0.55 cm, and 88.73 ± 0.66 cm, respectively.

Group A had the highest average heart girth, while group C had the lowest. The difference in heart girth among the three groups was statistically significant (Zanton and Heinrichs, 2007).Regarding hip width, the average measurements for groups A, B, and C were 84.25 ± 0.64 cm, 82.30 ± 0.49 cm, and 80.35 ± 0.59 cm, respectively. Group A had the widest average hip width, while group C had the narrowest. The difference in hip width among the three groups was statistically significant.

These findings indicate that the growth and development of Sahiwal female calves were influenced by the different feeding management practices. Calves in the control group (group A) generally exhibited greater body measurements compared to those in the supplemented groups (groups B and C). This suggests that protein supplementation may have influenced the growth patterns of the calves.

In conclusion, this study demonstrates that protein supplementation and appropriate feeding management significantly improve the growth performance of Sahiwal female calves. The calves receiving protein supplementation showed increased feed intake, higher weight gain, and larger body measurements compared to the control group. These findings emphasize the importance of incorporating protein supplementation as a part of the feeding management strategy for optimizing the growth of Sahiwal female calves. This research provides practical implications for farmers and stakeholders involved in calf rearing programs, highlighting the potential benefits of protein supplementation in livestock production. Further research can explore long-term effects and cost-effectiveness for wider implementation.

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