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Impact of Ralgro (Growth Promoter) Implants on the Growth Performance of Sahiwal and Crossbred Male Calves

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Abstract

Two experiments evaluated the effects of Ralgro implants on the growth performance of male Sahiwal and Sahiwal × Friesian calves (n = 20, 12–14 months old, 100 ± 10 kg). Calves were randomly assigned to either a control or Ralgro-implanted group (36 mg per dose) and fed a high-concentrate Total Mixed Ration (TMR) with 2.35 Mcal/kg ME and 14.08% CP ad libitum for 100 days after a 10-day adaptation period. Daily feed intake and refusals were recorded, and live weight was measured bi-weekly. A digestibility trial assessed nutrient digestion, nitrogen balance, and meat quality. In Sahiwal calves, nutrient intake (CP, ME, DM, DMI % body weight) and feed conversion efficiency (FCE), average daily gain (ADG), DM digestibility, and nitrogen balance showed no significant differences between groups. NDF digestibility, however, increased linearly. In crossbred calves, Ralgro implants significantly improved ADG, nitrogen balance, and FCE. While Ralgro-implanted calves had better dressing percentages, marbling scores, and steak tenderness, these differences were not statistically significant. In conclusion, Ralgro implants primarily enhanced growth performance in crossbred calves, suggesting greater responsiveness to anabolic treatment. Further studies are needed to confirm these results.

Keyword: Dressing percentage, Feed conversion efficiency, Meat quality, Weight gain
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Introduction

Anabolic implants are commonly used in beef production systems in advanced countries to enhance animal performance and carcass muscle yield (Samber et al., 1996; Roeber et al., 2000; Duckett & Andrae, 2001). Previous studies (Ahmad et al., 2009) have demonstrated the economic viability of anabolic implants in Nili-Ravi buffalo. However, their effects on palatability and carcass quality remain unclear. The impact of anabolic implants on Sahiwal and Crossbred cattle in Pakistan has not been fully established. Among these implants, Ralgro, a zeranol-based growth hormone, stimulates the animal's natural growth processes, improving feed efficiency and weight gain. It positively affects protein metabolism and promotes the production of somatotropin by the pituitary gland (Ahmad et al., 2009).

The Economic Survey of Pakistan (2022-23) reported that per capita meat consumption in Pakistan is 24 kg, much lower than in developed countries like Australia (110 kg) and the United States (93 kg). In 2022-23, Pakistan's total meat production reached 5,503 thousand tons, with beef accounting for 2,544 thousand tons. Beef production increased by approximately 10% annually, from 2,303 thousand tons in 2019-20 to 2,544 thousand tons in 2022-23. However, domestic production only meets about 25% of the beef demand. With a population of 240 million, growing at 3% annually (Economic Survey 2022-23), Pakistan's supply of animal protein is insufficient. This gap has led to increased meat imports.

The potential for meat production from buffalo and cattle male calves is substantial, but a lack of a commercial feedlot fattening system hampers this potential. Pasha et al. (1986) estimated that 6-7 million male calves from cattle and buffalo are available annually for fattening programs. If raised on balanced diets, beef production could double. Farmers who own steer calves may choose not to implant until the calves reach maturity (12 to 15 months) to reduce the risk of negatively affecting beef quality through aggressive lifetime implant strategies.

In response, the Pakistani government has initiated several development projects, including the Pakistan Dairy Development Company, the Meat Development Project in Punjab, and the Punjab Agriculture and Meat Company (PAMCO).

This study aims to evaluate the effects of Ralgro implants on feed intake, feed efficiency, and weight gain in male Crossbred and Sahiwal cattle calves.

Materials and Methods

Two groups were formed, consisting of 20 male Sahiwal and 20 crossbred calves, aged 12 to 14 months and weighing 100 ± 10 kg, to examine the effects of Ralgro implants on their growth traits. Each experiment involved dividing the animals into two groups of 10 calves each. The same Total Mixed Ration (TMR) was formulated for both groups, containing 14.08% CP and 2.35 Mcal/kg ME, respectively. The chemical composition and ingredients of the experimental ration are provided in Table 1. Group A in each experiment served as the control, while Ralgro was implanted in the animals of Group B at a dose rate of 36 mg (three 12 mg pellets per dose) as recommended by Intervet, Schering-Plough Animal Health, Netherlands. The implant was administered subcutaneously between the skin and cartilage on the backside of the ear, below the ear midline.

Rations were mixed weekly, and feed was provided ad libitum to each animal for 100 days. An adaptation period of 10 days was allowed. During the transitional period, the experimental ration was gradually increased, while the amount of fodder was proportionally decreased until the calves were shifted to a complete ration. In addition to the experimental ration, 4 kg of green fodder per animal was provided throughout the study. Clean, fresh water was made available to the calves around the clock during the trial. Deworming was performed at the beginning of the experiment. Feed offered and refusals were sampled daily for proximate composition analysis (AOAC, 1999), and the method of Wardeh (1981) was used to calculate ME (M Cal/kg). The weight of each animal was recorded at the start of the study and then fortnightly.

Table 1. Ingredients and chemical composition of experimental rations (%)

Ingredients	**Proportion**
Cotton Seed Cake	8.00
Rape Seed Cake	6.00
Wheat Bran	20.0
Maize Gluten meal 30%	12.0
Cane molasses	12.0
Maize Grain	5.00
Sunflower meal	7.00
Mineral Mixture	2.0
Wheat Straw	28.0
Total	100.0
Chemical composition,%	
Dry matter	89.12
Crude protein	14.27
Metabolizable energy, Mcal/kg	2.29
Neutral detergent fiber	42.36
Acid detergent fiber	22.46
Acid detergent lignin	5.36
Total ash	8.25

A digestibility experiment was conducted during the last week of each month to assess nitrogen balance and nutrient digestion. Feces and urine were collected according to the methods described by Williams et al. (1984). Feces were collected daily, thoroughly mixed, weighed, and sampled from 20% of the total, which was dried at 550°C. The dried samples were composited at the end of each collection period, with 10% of the composited samples used for analysis. Urine collection was performed using specially designed small metal funnels with plastic pipes, which directed the urine into a 30-liter container. The

urine was acidified with 50% H2SO4, and 20% of it was collected as a sample, then preserved at -20°C (Nisa et al., 2004). After the collection period, urine samples were composited by animal, and 10% of the composited samples were analyzed. At each collection, pH was measured immediately using portable urine pH meters (Hach, Loveland, CO). Data were analyzed using a t-test with the GLM procedure of SAS (1988).

Results

Feed intake and live weight gain

Nutrient (ME, CP, DM, and DMI % body weight) intake in Sahiwal male calves from the control and Ralgro implanted groups were not significantly different (Table 2). Similar findings were also noted in crossbred calves (Table 3). Similarly, feed conversion efficiency (FCE) and average daily live weight gain (ADG) in Sahiwal male calves were comparable in the control and treatment groups (Table 2). At the same time, ADG and FCE were significantly higher in the crossbred calved under the Ralgro implanted group than the control group (Table 3).

Table 2. Performance (kg/day) of Sahiwal male calves with or without Ralgro implants

Parameters	**Rations**		**SE**	**Linear***
	A	**B**		
Dry matter (DMI)	6.45	6.42	0.06	0.77
DMI % Body weight	4.07	3.95	0.06	0.30
Crude protein Intake	0.84	0.83	0.01	0.77
Metabolizable Energy Intake	0.14	0.14	0.00	0.75
Neutral Detergent Fiber Intake	3.07	3.06	0.03	0.77
Daily weight Gain	868.3	930.8	33.66	0.37
Feed Conversion Efficiency	7.67	7.02	0.27	0.24

*Linear at $p<0.05$

Table 3. Performance of (kg/ day) of Crossbred male calves with or without Ralgro implants

Nutrients intake	**Rations**		**SE**	**Significance**
	A	**B**		
Dry matter, DMI	6.76	6.66	0.11	0.65
DMI % Body weight	4.36	4.13	0.08	0.17
Crude protein	0.87	0.86	0.01	0.63
Metabolizable Energy	0.14	0.14	0.00	1.00
Neutral Detergent Fiber	3.22	3.17	0.05	0.65
Daily weight Gain	1088.6	1191.2	24.13	0.03
Feed Conversion Efficiency	8.81	7.65	0.24	0.01

Nutrient Digestion and Nitrogen balance

Apparent digestibility of DM in Sahiwal male calves did not express any effect regarding treatment, however, NDF digestibility was higher ($p<0.05$) by calves under the control group as compared to those implanted ralgro. Total tract NDF digestibility presented a linear association concerning ralgro implants in Sahiwal male calves (Table 4). Nitrogen intake (NI), fecal N, urinary N, and N balance were similar in Sahiwal male calves under control and regrow treatment groups (Table 4). Similarly, DM and NDF showed the apparent digestibility in crossbred calves did not express the effect of any treatment (Table 5). Nitrogen balance was significantly higher in crossbred caves under the ralgro group as compared to the control it may be due to more N fecal nitrogen calves under the control group. Ralgro implantation in crossbreed cattle calves linearly affected their N balance and fecal N excretion (Table 5). However, urinary nitrogen, as well as intake of nitrogen, were not significantly different (Table 5).

Table 4. Nutrient digestion and Nitrogen balance in Sahiwal male calves with or without Ralgro implants (*Linear at $p<0.05$)

Nutrients intake	**Rations**		**SE**	**Linear***
	A	**B**		
Nitrogen intake, gm/day	131.91	133.80	1.96	0.67
Fecal Nitrogen, gm/day	72.80	68.40	1.70	0.22
Urine Nitrogen, gm/day	56.72	57.54	0.84	0.66
Nitrogen Balance, gm/day	2.39	7.87	1.96	0.18
Dry matter digestibility, %	51.25	51.81	0.46	0.58
Neutral detergent fiber digestibility, %	44.54	44.66	0.61	0.20

Table 5. Nutrient digestion and Nitrogen balance in crossbred male calves with or without Ralgro implants

Nutrients intake	**Rations**		**SE**	**Linear***
	A	**B**		
Nitrogen intake, gm/day	145.1	144.2	2.00	0.84
Fecal Nitrogen, gm/day	74.40	68.00	1.63	0.03
Urine Nitrogen, gm/day	62.38	62.00	0.86	0.84
Nitrogen Balance, gm/day	8.29	14.19	1.47	0.03
Dry matter digestibility, %	51.35	51.81	0.41	0.61
Neutral detergent fiber digestibility, %	44.89	43.24	0.57	0.16

Dressing percentage and meat quality

For yield and carcass characters, least squares mean (adjusted to the mean external fat girth for Sahiwal and Crossbred calves, comparisons of treatments are presented in tables 6 and 7. Dressing percentages were recorded as 62.3 vs 63.2 5 in Sahiwal calves while 62.8 vs 63.4 in crossbred calves. Although these percentages were better against their respective controls implant showed no effect (P>0.05) on dressing percentage.

Marbling score, prime an upper two third choice, Steaks ≤ 4.5kg (14 days), Steaks ≤ 4.5kg (21 days) in Sahiwal male calves in control and Ralgro implanted groups were higher (P>0.05) as compared to their corresponding groups but these parameters were similar statistically (Table 6). Analogous outcomes were also noted in crossbred calves of the implanted and un-implanted groups for aforesaid parameters (Table 7). Choice and prime and overall mean Warner Bratzler force values (WBS) were significantly higher (P<0.05) in the groups of Ralgro implanted when compared with un-implanted control (Tables 6 and 7).

Table 6. Meat Quality of Sahiwal male calves reared with or without Ralgro implants

Nutrients intake	**Rations**		**SE**	**Linear**
	A	**B**		*****
Dressing percentage	62.3	63.2	2.89	0.05
Marbling score	430	465	2.00	0.84
Choice and prime	60	74	1.63	0.03
Upper two third choice and prime	14	24	0.86	0.84
Overall mean Warner Bratzler Shear force values (WBS)	4.38	4.46	1.47	0.03
Steaks ≤ 4.5kg (14 days), %	38	44	0.41	0.61
Steaks ≤ 4.5kg (21 days), %	14	76	0.57	0.16

*Linear at p<0.05

Discussions

The results of this study show that Ralgro implants had no significant impact on the growth performance of Sahiwal male calves, but they did significantly improve the performance of crossbred calves. This improvement may be due to the better growth rate and feed conversion efficiency observed in the crossbred calves. The positive effects of Ralgro implants on weight gain in cattle calves were also noted in earlier studies (Paisley et al., 1998). During a 40-day trial, the administration of Ralgro implants improved feedlot performance and protein content in the carcasses of bulls, as seen in Johnson et al. (1996). In another study, improvements in the performance of buffalo male calves implanted with Ralgro were reported (Ahmad et al., 2009). Anabolic implants are believed to reduce the maintenance energy requirements of steers by 10%, helping prevent body weight loss in animals grazed on low-value forages (Hunter and Magner, 1990; Hunter and Vercoe,

1987; Hunter et al., 1993). In contrast, no significant effect of Ralgro implants was observed in cattle calves in some studies (Bortolussi et al., 2004). Smith et al. (2007) found no variation in average daily gains among finishing beef cattle receiving different treatments, likely due to the short duration of the study, although longer trials showed improvements with anabolic implants.

Table 7. Meat Quality of crossbred male calves reared with or without Ralgro implants

Nutrients intake	**Rations**		**SE**	**Linear***
	A	**B**		
Dressing percentage	62.8	63.4	2.41	0.06
Marbling score	485	538	2.00	0.84
Choice and prime	70	82	1.63	0.03
Upper two third-choice and prime	36	54	0.86	0.84
Overall mean Warner Bratzler Shear force values (WBS)	3.95	3.54	1.47	0.03
Steaks ≤ 4.5kg (14 days), %	66	82	0.41	0.61
Steaks ≤ 4.5kg (21 days), %	88	94	0.57	0.16

*Linear at $p<0.05$

Despite similar nutrient intake in both Sahiwal and crossbred calves, growth performance improved significantly in Ralgro-implanted crossbred calves. This improvement may be attributed to the crossbred calves' better growth potential, which was further stimulated by the Ralgro implants through enhanced protein metabolism and improved feed efficiency.

Sarwar et al. (1999) suggested that digestion and intake levels are interrelated, as DMI% body weight was similar between Sahiwal and crossbred calves in both control and Ralgro-implanted groups, without affecting nutrient digestibility. Galbraith (1980) reported accelerated growth in trenbolone acetate-implanted Hereford × Friesian heifers compared to controls, along with lower plasma urea and serum albumin concentrations. Similarly, improved average daily gain and feed conversion efficiency (FCE) were observed in Friesian steers implanted with bovine growth hormone (bGH) and estradiol (Enright et al., 1990). This study also indicated improved nitrogen retention, as evidenced by decreased urinary nitrogen excretion.

Nitrogen retention efficiency was further studied by VanderWal et al. (1990) with Friesian bull calves, showing positive effects of different anabolic agents on nitrogen retention. However, trenbolone, zeranol, progesterone, and testosterone alone did not significantly affect nitrogen retention. Moran (1972) reported significant weight gain in Shorthorn heifers and steers implanted with zeranol, but no additive effect was observed with a second implant after 27 weeks.

Johnson et al. (1996), Gerken et al. (1995), and Rumsey et al. (1999) found that implants had minimal or no effect on USDA quality grades or marbling scores. The current study confirmed that the use of implants had limited effects on beef carcass quality. Marbling scores were similar for non-implanted steers and those receiving low-potency lifetime implants, while steers receiving high-potency lifetime implants showed higher marbling scores (Pritchard et al., 2000).

A Warner-Bratzler shear force value of 4.5 kg is commonly used as the threshold for customer acceptability of beef tenderness (NCA, 1994). Steaks from implanted cattle had slightly higher shear force values compared to those from non-implanted cattle, regardless of aging time, with steaks from "aggressively" implanted cattle being tougher than those from non-implanted or conservatively implanted cattle (Morgan, 1997). Reduced consumer acceptance for steaks from implanted steers was reported by Roeber et al. (2000) in six out of seven finishing implant protocols. The current study supports the findings of Pruneda et al. (1999) and Gerken et al. (1995), who observed similar shear force values for steaks from implanted cattle. However, high shear force values were noted for steaks from steers receiving high-potency lifetime implants, as described by Pritchard et al. (2000). Further data suggest that shear force values were not significantly affected by the intensity of the lifetime implant regimen for calf-fed steers (Schoonmaker et al., 2001). Pre-finishing implants are generally believed to enhance the growing abilities of steers during the production phase following implantation (Duckett et al., 1997; Selk, 1997; Kuhl, 1997). The overall lifetime performance of steers is influenced by various factors, including the animal's age, production level, weight, and the timing of implant treatments (Mader, 1994; Mader et al., 1985; Mader, 1997; Kuhl, 1997).

Conclusion

The findings of this study demonstrate that the use of anabolic implants significantly enhances the performance of ruminant animals. However, improvements were primarily observed in crossbred animals, which have greater growth potential. Further extensive studies are needed to establish more definitive conclusions. The results suggest that the choice of implant protocol, when used throughout an animal's lifetime, may influence both the tenderness and eating quality of beef. These findings underscore the importance of selecting implant programs that align with specific marketing goals for livestock production.

Competing of Interest

The authors declare that the research was carried out without any commercial or financial relationships that could be construed as a potential conflict of interest.

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Ethical statement: The Animals were fed at ad-libitum intakes with no cruelty hence Faculty research ethics committee /review board has approved the research.

Consent to participate: All authors participated in this research study.

Consent for publication: All authors submitted consent to publish this research.

Data availability statement: The data presented in this study are available on request.

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