Growth and Fattening Performances of Friesian-Boran Crossbred Bull Calves Fed on Different Protein Supplements

Molla Shumye, Zewdie Wondatir, Getu Kitaw and Aemiro Kahaliw
Ethiopian Institute of Agricultural Research, Holetta Research Center, Ethiopia;
P.O.Box 31, Holetta , Ethiopia. E-mail: mollabrkt@gmail.com

አህፅሮት

50 እና 75 በመቶ የሆልስቴን ፍሬዥያን ዝርያ ደም ያላቸው ወተት መመገብ ያቀመ የዲቃላ ወንድ ጥጆችን የዕድገት ብቃትንና በወይፈንነት ዕድሜያቸው የማደለብ ኢኮኖሚያዊ አዋጪ ነትን ለመገምገም በሆለታ ዋብርና ምርምር ማዕከል ለ 626 ቀናት ያህል ጥናት ተካሂዷል። ለዚሁ ጥናትም ሃያ አራት 50 በመቶ እና ሌሎች ሃያ አራት 75 በመቶ የሆልስቴን ፍሬዥያን ደም ያላቸውን ጥጆች በስድስት የአመጋገብ ስርዓት (Treatments) እንዲመደቡ ተደርጓል። የአመጋገብ ስርዓቶቹም፣ 1ኛ. 25 በመቶ የኑግ ፋጉሎ +74 በመቶ የስንዴ ፉርሽካ +1 በመቶ የጨው ቅልቅል ሆኖ 18 በመቶ፣ 2ኛ. 38.5በመቶ የኑግ ፋጉሎ +60.5 በመቶ የስንዴ ፉርሽካ +1 በመቶ የጨው ቅልቅል ሆኖ 20 በመቶ፣ 3ኛ. 29 በመቶ የተልባ ፋጉሎ +70 በመቶ የስንዴ ፉርሽካ +1 በመቶ የጨው ቅልቅል ሆኖ 18 በመቶ፣ 4ኛ. 43 በመቶ የተልባ ፋጉሎ +56 በመቶ የስንዴ ፉርሽካ + 1 በመቶ የጨው ቅልቅል ሆኖ 20 በመቶ፣ 5ኛ. 27 በመቶ የጥጥ ፋጉሎ +72 በመቶ የስንዴ ፉርሽካ + 1 በመቶ የጨው ቅልቅል ሆኖ 18 በመቶ፣ 6ኛ. 40 በመቶ የጥጥ ፋጉሎ +59 በመቶ የስንዴ ፉርሽካ +1 በመቶ የጨው ቅልቅል ሆኖ 20 በመቶ የሰውነት ገንቢ ንጥረ ነገር (ክሩድ ፕሮቲን) ይዘት ያላቸው ነበሩ። 20በመቶ ክሩድ ፕሮቲን ይዘት ያለው የጥጥ ፋጉሎ የተካተተበትን የድንማ መኖ የተመገቡት ወይፈኖች በ1 ዓመት ዕድሜያቸው በአማካይ 196.50 ኪ.ግ፣ በ2 ዓመታቸው ደግሞ 404.88 ኪ.ግ መመዘን ችለዋል። በሌላ መልኩ 18 በመቶ ክሩድ ፕሮቲን ይዘት ያለው የተልባና የጥጥ ፋጉሎ የተካተተበትን የድንማ መኖ የተመገቡት ወይፈኖች በ1 ዓመታቸው 162.50 ኪ.ግ፤በ2 ዓመታቸው ደግሞ 314.25 ኪ.ግ መመዘን ችለዋል። እንዲሁም 20 በመቶ ክሩድ ፕሮቲን ይዘት ያለው የጥጥ ፋጉሎ የተካተተበትን የድንማ መኖ የተመገቡ 50 በመቶ የሆልስቴን ፍሬዥያን ደም ያላቸው ወይፈኖች 75በመቶ የሆልስቴን ፍሬዥያን ደም ካላቸው ወይፈኖች የተሻለ የቁም ክብደትና የቀን ዕድገት ያሳዩ መሆኑን ጥናቱ ጠቁሟል። ቀደም ብሎ የተጠቀሰውን የድንማ መኖ ተመግበው የደለቡ 50በመቶ የሆልስቴን ፍሬዥያን ደም መጠን ያላቸው ወይፈኖች በአማካይ 10792.70 ብር፣ ተመሳሳይ የፕሮቲን ይዘት ያለው የተልባ ፋጉሎ የተካተተበትን የድንማ መኖ ተመግበው የደለቡ ተመሳሳይ የደም መጠን ያላቸው ወይፈኖች ደግሞ 5772.60 ብር በከብት የተጣራ ገቢ የሚያስገኙ መሆኑን ጥናቱ አረጋግጧል። በአጠቃላይ የወተት ከብት አርቢዎች በዕርባታቸው የሚወለዱ ወይፈኖችን፤ በተለይም 50 በመቶ የሆልስቴን ፍሬዥያን ደም ያላቸውን ወይፈኖች 20 በመቶ የፕሮቲን ይዘት ያላቸውን የጥጥና የተልባ ፋጉሎዎች የተካተቱባቸውን የድንማ መኖዎች እየመገቡ በማደለብ ተጠቃሚ መሆን ይችላሉ።

Abstract

The study was conducted at Holetta Research Center to evaluate growth performance and economic feasibility of fattening 50 and 75% Friesian-Boran growing crossbred bull calves for the period of 626 days. *Twenty-four 50% Frisian-Boran crossbred weaned male calves and another twenty- four 75% Frisian-Boran crossbred growing weaned calves reared at Holetta Research Center were randomly assigned to six dietary treatments; T_1=Noug seed cake based supplement with 18% CP level, T_2=Noug seed cake based supplement with 20% CP level, T_3= Linseed cake based supplement with 18% CP level, T_4= Linseed cake based supplement with 20% CP Level, T_5=Cottonseed cake based supplement with 18% CP and T_6=Cottonseed cake*

based supplement with 20% CP Level. The interaction effect between feed supplements and calf genotypes was not significant. In this study higher (p<0.05) body weight of 196.50±7.78 and 404.88±17.96 kg was attained for 12 and 24-months growing bull calves that were supplemented with cotton seed cake at 20% crude protein level, respectively than calves supplemented with 18% CP level. Crossbred bull calves supplemented with cotton seed cake at 20% CP had also higher (p<0.05) final body weight, live weight change, daily weight gains and feed conversion efficiencies of 404.88±17.96, 334.25±17.62, 0.558±0.03 kg and 9.46±0.87 kg DMI/kg gain, respectively than those fed on noug seed cake at 18% CP level (314.25±17.96, 244.25±17.62, 0.407±0.03 kg and 13.60±0.88 DMI/kg gain), respectively. Except for initial weight, i.e., weaning weight and feed conversion efficiencies, Friesian-Boran (50% FB) crossbred growing bull calves had better (p<0.05) final body weight, live weight change and daily weight gain of 378.04±17.96, 308.79±10.17 and 0.518± 0.02, respectively compared to those with 75% exotic blood level (346.25±10.37, 275.38±10.17, and 0.463.02) respectively. Friesian Boran (50% FB) crossbred growing bull calves fed on cotton seed cake-based supplement with 20% CP level (T_6) had better net income of 10792.7 ETB/head followed by those supplemented with linseed cake with 20% CP level (T_4) which was 5772.6 ETB/head. Generally, dairy producers (farmers) can benefit from fattening of their crossbred dairy bull calves; especially 50% Friesian-Boran crosses using Cotton and linseed cakes-based concentrates formulated with 20% crude protein.

Keywords: Crossbred; Economic benefit; Frisian Boran; Growth; Supplements

Introduction

In Ethiopia, agricultural development is considered a priority by the government for stimulating overall economic growth, reducing poverty and achieving food security (MoFED, 2013). Within agriculture, the livestock subsector is a major contributor to the overall economy. The livestock sector contributes 15 to17% of GDP, 35 to 49% of agricultural GDP and 37 to 87% of the household incomes (Birara and Zemen, 2016). In Ethiopia, indigenous cattle account for almost all the fresh cattle meat consumed locally (Zewdu *et al.,* 1988). But they are characterized by low productivity and production level. Their average yield per animal slaughtered is estimated to be 105 kg of beef (Azage *et al.*, 2006). The same author also reported that this level of production could not support the demand of fast-growing population and resulted in declining of per capita consumption of meat, which is estimated at 8 kg and this makes the country 43% below the African average of 14 kg. However, meat production from local cattle is low in quantity and its quality is poor due to their small body size (frame) and mostly fattened after retiring from draught work.

Because of cost of production to maintain male calves, large, medium and small-scale dairy farms are usually selling their surplus crossbred male calves before and after weaning at lower price. Zewdie, (2010) also confirmed that crossbred male calves were sold at low prices (less than 1000 Birr/calf) at an early age in peri-

urban dairy farms of Jimma and Sebeta towns of Oromia region. On the other hand, research result by Sendros *et al.,* (1987) showed that at one year of age the Friesian crossbred growing calves had heavier weight than their Zebu contemporaries (151.9 kg Vs 128.6 kg). This indicates that crossbred young bulls have better body frame and weight gain than local breeds. In a feedlot experiment, Chala *et al.,* (2004) concluded that Friesian-Horro crossbred male calves kept longer under fattening would contribute much to total beef production and economy of dairy farmers.

Most farmers who own crossbred cows in urban and peri-urban areas usually cull a week-old crossbred male calves from their herd for veal purpose. These producers also perceive that keeping male calves for long period in a herd is not affordable in terms of feed cost and cost of milk provided to rear these calves. However, a few dairy farm owners rarely select male calves to breed female cows. In a mixed crop livestock production system, farmers are not often keeping crossbred animals due to inadequate availability of improved cattle germ plasm. In this system, farmers that have access to improved cattle genotypes rear crossbred male calves for draught power. When these animals are retired from traction, they would be fattened and channeled into the market. Despite the large number of crossbred male calves born in urban and peri-urban areas, the alternative use of these animals for beef production and economic return has not yet been well addressed. This study was therefore designed to evaluate the effect of different protein-based supplements on growth performances and economic feasibility of fattening 50% and 75% Frisian Boran (FB) crossbred growing male calves.

Material and Methods

Description of the study Area:

The study was conducted at Holetta Agricultural Research Center (9^{O}N latitude; 38^{O}E longitude). The center is located 34 Km west of Addis Ababa. The area is located at an altitude of 2400 meters above sea level (masl) and receives an annual average rainfall of 1100 mm. The average maximum temperature of the area is 21.3^{o}C.

Study animals and feeding management

All calves were weighed at birth and separated from their dams immediately after this time and moved to individual calf pens. For the first 4 days, each calf was allowed to consume 3 Litters of colostrum per day. The calves were reared on bucket feeding of whole milk until weaning. The total amount of whole milk provided to each calf until weaning age (98 days) was about 260 kg. All calves

had free access to hay and an allowance of 0.5 kg of concentrate feed was provided starting from 15th day of birth until weaning.

For this study, a total of forty-eight weaned FB crossbred calves with an average live weight of 70.06 kg reared at Holetta Research Center were used. Twenty-four crossbred weaned growing male calves having 50% Friesian blood level and another 24 crossbred growing weaned calves having 75% Friesian blood level were randomly assigned to six dietary treatments. Post weaning management cost was monitored. The experimental diets considered in this study were native pasture hay and three types of concentrate protein supplements (Noug seed cake, Cotton seed cake and Linseed cake) with two different CP levels for each supplement (18 and 20% of the concentrate mixture). The feed mixture was formulated based on initial body weight that meets the nutrient requirements according to Kearl, (1982). The feed provided was adjusted based on every fortnight body weight of the calves. Accordingly, 50% of the diet was basal diet and the remaining 50% was covered from concentrate diet. The feed required was subjected to revision on every fortnight body weight change. Body weight measurements were taken every two weeks. Experimental animals were de-wormed against internal parasites. Water was provided ad libitum.

Dietary treatments

1 = 25% Noug seed cake +74% Wheat bran+1% Salt, 18% CP Level
2 = 38.5% Noug seed cake+60.5% Wheat bran+1% Salt, 20% CP Level
3 = 29% Linseed cake+70% Wheat bran+1% Salt, 18% CP Level
4 = 43% Linseed cake+56% Wheat bran+1% Salt, 20% CP Level
5= 27% Cottonseed cake +72% Wheat bran+1% Salt, 18% CP Level
6 = 40% Cottonseed cake +59 Wheat bran+1% Salt, 20% CP Level

In this study, we didn't use any control treatment, however, Comparison was made among the above dietary treatments. Total dry matter requirement was 3 kg /day/head up to 150 kg liveweight of experimental animals when the trial was started, after which the feed provided was adjusted based on body weight. In all the treatments hay was provided as a basal diet at the rate of 50% daily total DM intake of experimental animal i.e., the concentrate to hay ratio was 50:50. The chemical composition of individual feed ingredients is shown in Table 1.

Table 1. Chemical composition for experimental feed ingredients and mixed treatment diets (g/kg DM)

Ingredient type	DM	Ash	CP	NDF	ADF	Lignin	DOMD	ME, MJ/kg DM
Natural pasture grass hay	921.00	65.00	57.00	728.00	423.00	102.00	514.00	8.22
Wheat bran	903.00	47.00	169.00	441.00	120.00	18.00	726.00	11.62
Nougseed cake	941.10	80.00	342.00	375.00	297.00	74.00	657.10	10.51
Linseed cake	943.00	64.00	268.00	359.00	214.30	37.00	698.50	11.18
Cottonseed cake	925.00	75.00	248.90	616.60	310.00	97.00	590.00	9.44

DM = Dry matter, CP = crude protein, NDF = Neutral detergent fiber, ADF = Acid detergent fiber, DOMD = Digestibility of organic dry matter, ME = Metabolizable energy

Type of data collected

Data on body weight, feed offered, feed refused, post weaning rearing and finishing costs, and market data on purchasing and selling prices of bull calves were collected.

Experimental design and data analysis

Data analysis employed 2 by 6 factorial arrangements with Randomized complete block design (RCBD) considering genetic group and diet levels as independent factors in the model. The independent factors were dietary protein sources and levels indicated 1 through 6 above and genetic group (50 and 75% FB crosses). Initial body weight of weaned male calves was used as a blocking factor in the experiment. Data were analyzed using General Linear Model (GLM) of the Statistical Analysis System (SAS, 2008) software. Means were separated using Tukey's Studentized Range (HSD) Test (alpha=0.05). The statistical model used was:

$y_{ijk} = \mu + B_i + G_j + T_k + (GT)_{jk} + \varepsilon_{ijkl}$ where: y_{ijkl} = observation l in level j of factor G and level k of factor T; μ = the overall mean; B_i = the effect of initial weight (weaning), G_j = the effect of j^{th} genetic group (j= 50% and 75% FB crosses); T_k = the effect of k^{th} diet (k= 1,2,3,4,5,6); $(GT)_{jk}$ = interaction of j^{th} genetic group and the k^{th} feeding treatments; ε_{ijkl} = random error.

Cost-benefit analysis

Partial budget analysis was conducted using input and output market prices of the year 2018/2019 that only vary over the treatments. The average price was used for cost benefit analysis. The economic parameters considered for final analysis included benefit cost ratio (Net Return (NR)/ Total Variable Cost (TVC). Input and output data collected during the entire experimental period (EP) of 626 days included; management cost (labor and medication costs), purchase and selling prices of bull calves and costs of ingredients from which concentrates were formulated. Purchase prices were taken for feed ingredients (Noug cake, linseed cake, cottonseed cake, salt, wheat bran) and grass hay. Fixed costs were not included in the economic analysis.

Result and Discussion

The result of analysis of variances indicating the effects of initial body weight (weaning) treatments, genotypes and their interaction on different performance parameters of crossbred bull calves is presented in Table 2. The result showed that the interaction between dietary treatment and genotypic group had no significant effect ($p>0.05$) on feed intake, body weight performances and feed conversion efficiency of crossbred bull calves. So, only the result of main effects (treatments and genotype) was interpreted and discussed in the study.

Table 2. Analysis of variance of the effects of different factors on body weight performances, feed intake and feed conversion efficiency of crossbred bull calves.

	Factors			
Variables	**Block**	**Treatments**	**Genotype group**	**Treatment*Genotype group**
Weaning (Initial) weight	S	NS	NS	NS
6 months weight	S	NS	NS	NS
12 months weight	S	S	NS	NS
18 months weight	NS	NS	S	NS
24 months weight	NS	S	S	NS
Final Body weight	NS	S	S	NS
Body weight change	NS	S	S	NS
Daily weight gain	NS	S	S	NS
Feed Intake (hay+ concentrate)	NS	NS	NS	NS
FCE	NS	S	NS	NS

NS= not significant ($p>0.05$), S= Significant ($p<0.05$), FCE =Feed Conversion Efficiency

Feed Intake of crossbred growing bull calves

Daily basal feed (natural pasture hay), concentrate mixture and total dry matter intake of the growing crossbred bull calves supplemented with different sources of protein and levels of CP are presented in Table 3. Variations in both dietary treatments and genotype did not affect ($p>0.05$) daily basal, supplemental and total dry matter intake of experimental animals. Total daily dry matter intake (TDMI) in the current study was lower than that reported earlier for old oxen at Adet (7.65 Kg) and Fogera (8.70 Kg) fed on natural pasture hay and supplemented with 2, 4 and 6 Kg concentrate feeds per day (Adebabay *et al.*, 2014). However, TDMI of growing male calves of both genotypes in our study is higher than Friesian Boran growing crossbred calves (4.35 Kg) supplemented with linseed, cotton seed and noug seed cakes based diets (Rehrahie *et al.*, 2013). This variation might be attributed to the difference in the age and breeds of experimental animals used in the studies.

Growth performance

Body weight at weaning (3), 6, 12, 18 and 24 months of age of Borana Friesian crossbred growing bull calves supplemented with different protein-based concentrates are shown in Table 4. The body weight changes of crossbred bull calves varied significantly($p<0.05$) with dietary protein sources and levels of crude protein at the age of 12 and 24 months while variation in genotype considerably affected ($p<0.05$) body weight changes of growing BF crossbred bull calves at the age of 18 and 24 months. However, body weight of growing bull

calves did not vary ($p>0.05$) with protein sources and levels of supplementation at weaning (3-months), 6- months, and 18-months of age. The body weight changes from weaning through 12 months of age between the two genotypes of growing calves was the same ($p>0.05$) for the different dietary protein sources and levels of protein supplements. Considerably higher ($p<0.05$) body weight was observed for 12- and 24-months growing bull calves that were supplemented with cottonseed cake at the rate of 20% over those calves receiving the linseed and nougseed cakes at 18% CP level. This could be further explained by the fact that cotton seed contains by pass protein compared to other seed cakes. This result is in line with the findings of Marishet *et al.,* (2019) who reported that crossbred cows supplemented with cottonseed-based concentrate diet attained the highest weight gain. Likewise, body weight change was significantly varied($p<0.05$) between the level of genotype of calves at18 and 24-months of age. Hence, 50% HF inheritance as attained higher body weight compared to those calves with 75% level of HF blood inheritance. The observed difference between the two genetic groups of bull calves could be attributed to the in adequacy of the experimental diets viz-a-viz to requirements of the growing bull calves with 75% HF blood inheritance to express their growth potential. However, the current feed supplement substantially supports the growth performance of F1 Friesian-Boran growing crossbred bulls for meat production in potential areas of the country.

The overall mean body weight of Friesian Boran crossbred bull calves at the age of 12 months (174.46 kg) was almost comparable to the results reported by Chala and Ulifina, (2013) for Horro Friesian crossbred bulls attained at the age of 12-24 Months (199.2 Kg). Moreover, mean body weight of bull calves at the age of 24 months (362.15 kg) in this study was found to be higher than the body weight (329.6 kg) reported by the same authors earlier for Horro Friesian bulls fed on Rhodes grass and supplemented with recommended level of concentrate i.e. 3.5 kg/head/day) which was composed of 49.5% nougseed cake, 49.5% maize grain and1% salt at the age of 37-48 months. The difference could be attributed to genetic difference of experimental bulls and variation of supplemental feed ingredients used in formulating the ration.

Table 3. Least square means for daily feed intake of Friesian Boran crossbred bull calves supplemented with different protein source-based concentrate

Factors	N	Feed intake (kg, d^{-1})		
		Hay Intake	Concentrate Intake	TDMI
Overall Mean	**48**	**2.63**	**2.63**	5.26
Treatment				
1	8	2.74±0.09	2.74±0.09	5.47±0.18
2	8	2.71±0.09	2.71±0.08	5.43±0.18
3	8	2.61±0.09	2.61±0.09	5.21±0.18
4	8	2.52±0.08	2.52±0.09	5.04±0.17
5	8	2.63±0.08	2.63±0.09	5.27±0.18
6	8	2.55±0.08	2.55±0.09	5.10±0.17
LS		NS	NS	NS
Genetic group				
50% FB	24	2.61±0.05	2.61±0.05	5.22±0.10
75% FB	24	2.64±0.05	2.64±0.05	5.29±0.10
LS		NS	NS	NS

Means with different superscripts with in column are significantly different ($p<0.05$) and $p<0.01$;
NS= Non Significant; *= $p<0.05$; **=$p<0.01$; TDMI= Total Dry Matter Intake; LS= level of significance

The body weight change of crossbred bull calves with their corresponding age groups exposed to different feeding treatments is presented in Figure 1. Change in body weight of crossbred bull calves across the dietary treatments and age group was linear. In general, bull calves attained higher body weight in the order: T6>T4>T5>T2. The result of this study is similar to the findings of Genet *et al.*, (2020) who reported that better body weight change of F_1 Friesian X Arsi crossbred young male calves fed on cotton seed-based concentrate compared to those fed on noug seed-based concentrate over experimental period.

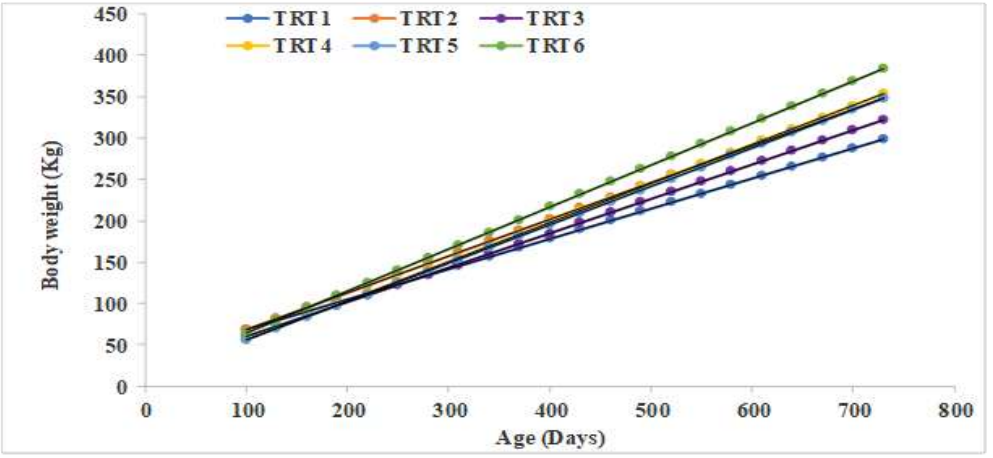

Figure 1. Body weight change of crossbred bull calves supplemented with different protein source-based concentrate supplements over experimental period

Change in the body weight of crossbred bull calves with different exotic blood level and dietary protein sources is presented against different age groups in Figure 2. Accordingly, body weight changes of growing bull calves of different genotype had also linear relation with age groups. Crossbred growing bull calves having 50% exotic blood level (50% FB) had better body weight change than those having 75% exotic blood level (75% FB) over the entire experimental period. The different result was obtained by Rehirahie et al (2013) who showed that 75% FB crossbred growing calves had better body weight gain than 50% FB crossbred calves. This implies that 75% FB crossbred male calves used for this study was not fed as they required expressing their genetic potential for growth traits.

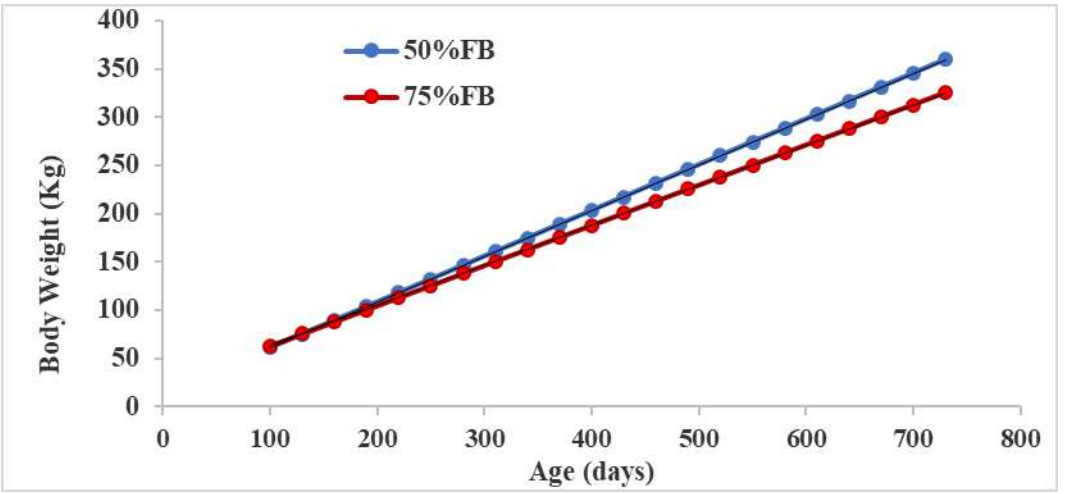

Figure 2. Change of body weight of crossbred bull calves having different genotypes supplemented with different protein-based diets over experimental period.

Live weight change and feed conversion efficiency of crossbred bull calves

The initial body weight, final body weight, live weight change, daily weight gain and feed conversion efficiency of growing crossbred bull calves are indicated in Table 5. Except the initial weight, both dietary treatments and genotype of experimental growing bull calves had significant ($p<0.05$) effect on all the rest growth parameters.

The result of this study indicated that crossbred bull calves supplemented with cotton seed cake at 20% CP level had superiorly higher growth performance expressed in terms of average final body weight, live weight change, daily weight gains and feed conversion efficiencies than those fed on noug seed cake at 18% CP level. Other than this, however, growth response to the other dietary treatments remained non-significant ($p>0.05$). Regardless of calf genotype, higher growth performance differences ($P<0.05$) of bull caves receiving cotton seed-based concentrates (CP level 20%) compared to calves fed on 18% CP level

noug seed cake-based concentrate. This could be associated with higher level of dietary escape nitrogen intakes.

Table 4. Least square means of body weight at different age of Borana Friesian crossbred growing bulls calves supplemented with different protein-based concentrates.

Variable			Age (months)				
		N	Weaning (Initial) (3)	6	12	18	24
Overall mean		48	70.06	100.26	174.46	249.83	362.15
Treatments							
	1	8	70.00±1.31	98.25±5.12	170.00±7.78^{ab}	227.12±14.59	314.25±17.96^{b}
	2	8	70.37±1.30	106.75±5.12	174.25±7.78^{ab}	250.50±14.58	375.13±17.96^{ab}
	3	8	69.13±1.31	95.25±5.12	162.50±7.78^{b}	234.00±14.58	345.25±7.96^{ab}
	4	8	69.75±1.31	97.75±5.11	172.13±7.78^{ab}	259.37±14.58	368.00±17.96^{ab}
	5	8	70.50±1.31	93.00±5.12	171.34±7.78^{ab}	246.87±14.58	365.38±17.96^{ab}
	6	8	70.63±1.31	110.75±5.12	196.50±7.78^{a}	281.12±14.59	404.88±17.96^{a}
LS			NS	NS	*	NS	*
Genotype group							
50% FB		24	69.25±0.75	101.58±2.95	180.75±4.49	263.13±8.42^{a}	378.04±10.37^{a}
75% FB		24	70.87±0.75	99.00±2.95	168.17±4.49	236.54±8.42^{b}	346.25±10.37^{b}
LS			NS	NS	NS	*	*

Means with different superscripts with in column are significantly different (p<0.05) and p<0.01; NS= Non Significant; *= p<0.05; **=p<0.01; 50% FB= Friesian Boran cross with 50% Exotic blood level, 75% FB= Friesian Boran cross with 75% Exotic blood level; T1= 25% Nougseed cake +74% Wheatbran+1% Salt (18% CP Level), T2 = 38.5% Nougseed cake +60.5% Whea tbran+1% Salt (20% CP Level), T3 = 29% Linseed cake +70% Wheatbran+1% Salt (18% CP Level), T4 = 43% Linseed cake +56% Wheatbran+1% Salt (20% CP Level), T5 = 27% Cottonseed cake +72% Wheatbran+1% Salt (18% CP Level), T6 = 40% Cottonseed cake +59 Wheatbran+1% Salt. (20% CP Level), CP= Crud Protein

Table 5. Least square means for body weight change and feed conversion efficiency of Friesian Boran crossbred bull calves supplemented with different source and levels of protein-based concentrates

Factors		Growth parameters (Kg)				
	N	Initial (weaning) Body weight	Final Body weight	Live Weight Change	Daily Weight Gain	FCE (kg DMI/kg Gain)
Overall Mean	48	70.06	362.15	292.08	0.491	11.20
Treatment						
1	8	70.00±1.31	314.25±17.96^{b}	244.25±17.62^{b}	0.400.40	13.60±0.88^{b}
2	8	70.37±1.31	375.13±17.96^{ab}	304.75±17.61^{ab}	0.505±0.03^{ab}	11.18±0.87^{ab}
3	8	69.13±1.31	345.25±17.96^{ab}	276.13±17.62^{ab}	0.464±0.03^{ab}	11.62 ±0.88^{ab}
4	8	69.75±1.31	368.00±17.96^{ab}	298.25±17.62^{ab}	0.506±0.03^{ab}	10.38±0.87^{ab}
5	8	70.50±1.31	365.38±17.96^{ab}	294.88±17.62^{ab}	0.503±0.03^{ab}	10.96 ±0.88^{ab}
6	8	70.63±1.30	404.88±17.96^{a}	334.25±17.62^{a}	0.558±0.03^{a}	9.46±0.87^{a}
LS		NS	*	*	*	*
Genetic group						
50% FB	24	69.25±0.75	378.04±10.37^{a}	308.79±10.17^{a}	0.518±0.02^{a}	10.63±0.51
75% FB	24	70.88±0.75	346.25±10.37^{b}	275.38±10.17^{b}	0.463±0.02^{b}	11.77±0.50
LS		NS	*	*	*	NS

Means with different superscripts with in column are significantly different (p<0.05) and p<0.01; NS= Non Significant; *= p<0.05; **=p<0.01; FCE =Feed Conversion Efficiency; LS= level of significance;

This finding is in line with the result of Hayaz *et al.*, (2013) who confirmed increasing the proportion of cotton seed cake up to 35% in concentrate ration resulted in an increase of milk yield of crossbred cows in accordance with the

increase in the level of bypass protein feed intake. Except for initial weight and feed conversion efficiencies, the remaining growth parameters were observed to have been significantly affected ($p<0.05$) by the genotype to which the growing experimental bull calves belong (Table 5). Accordingly, F_1 Friesian Boran (50% FB) crossbred growing bull calves had better final body weight, live weight change and daily weight gain than those with 75% exotic blood level. This study is supported by the reviewed result of kefena *et al.*, (2006) who indicated that F_1 Friesian Boran crosses were heavier in yearling body weight than crosses with 75% exotic inheritances by 5.23 kg. The observed genotypic difference for body weight between 50% FB and 75% FB crossbred bull calves could probably be attributed to the inadequacy of supplemental protein-based concentrate to growing cross bred bull calves with 75% of exotic blood inheritance.

The overall mean final body weight, daily weight gain and live weight change of Friesian Boran crossbred bull calves fed on different sources and level of protein were 362.25, 0.500 kg and 292.08, respectively. The observed result was found to be lower than the reported final body weight of 387.4 and 411.0 kg, average daily weight gain of 0.650 and 0.913 kg, but better than weight gain of 58.8 and 82.0 kg which was reported by Adebabay *et al.*, (2014) for old oxen fattened for 90 days at Adet and Fogera, respectively. Perhaps this could be linked to age and breed difference of experimental animals, duration of experimental period and variation of feeding supplements. The observed feed conversion efficiency (11.20 kg DMI/kg body weight gain) was comparable with the results of Mengistu *et al.*, (2012) who reported 12.0 kg DMI/kg body weight gain for Friesian X Boran crossbred non-working matured bulls used in traction experiment.

Cost benefit analysis

The result of cost benefit analysis for crossbred bull calves fattened using different protein source-based concentrate supplements is presented in Table 6. F_1 Friesian Boran (50% FB) crossbred growing bull calves fed on cotton seed cake-based supplement with 20% CP level (T_6) had better economic benefit i.e., net income of 10792.7 ETB/head followed by those supplemented with linseed cake having 20% CP level (T_4) which was 5772.6 ETB/head with benefit cost ratio of 0.5 ETB for T_6 followed by (T_4) which was 0.27 ETB. This means for the cost of 1.0 ETB incurred in fattening 50% FB crossbred bull calves feeding T_6, resulted in a profit of 0.5 ETB. Similarly, for the cost of 1.0 ETB incurred in fattening 50% FB crossbred bull calves using T_4 resulted in a 0.27 ETB. In general, crossbred bull calves having 50% exotic blood level (50% FB crosses) fed on T_6 and T_4 had better economic benefit (net income) of 10792.7 and 5772.6 ETB/head compared to those having 75% Friesian blood level (75% FB) which was 3751.2 and3997.9 ETB/head, respectively.

Table 6. Cost-benefit ratio from fattening of crossbred bull calves using different protein source-based concentrate during experimental period (EP) of 626 days.

Variables	50% FB						75% FB					
	T1	T2	T3	T4	T5	T6	T1	T2	T3	T4	T5	T6
GR (ETB/head/EP	22731.3	29231.1	24265.9	27154.7	27443.6	32986.5	22659.0	24952.0	25602.0	25999.2	25331.2	25493.7
TVC (ETB/head/EP (a+b+c)	22608.7	23729.5	22077.6	21382.2	22148.17	22193.8	23699.4	22850.8	22557.1	22001.3	22521.7	21742.5
TFC(a)	17662.0	18726.4	17196.4	16397	17155.5	17107.8	18711.6	17836.0	17603.1	16930.1	17343	16757.1
APC (b)	2508.6	2481.9	2428.3	2446.1	2419.4	2553.3	2490.8	2544.3	2508.6	2535.4	2615.8	2490.8
AMC (c)	2438.1	2521.2	2453.0	2539.0	2573.3	2532.7	2497.0	2470.5	2445.3	2535.8	2562.9	2494.6
NI/head/EP	122.51	5501.6	2188.3	5772.6	5295.4	10792.7	-1040.4	2101.3	3044.9	3997.9	2809.5	3751.2
BCR (NI/TVC)	0.0054	0.23	0.10	0.27	0.24	0.50	-0.0439	0.09	0.13	0.18	0.12	0.17

GR=gross return; TVC=total variable cost; TFC= total feed cost; APC=animal purchase cost; AMC= animal management cost; NI= net income; EP= experimental period; BCR= benefit cost ratio

Conclusion and Recommendations

This study confirms that supplementation of cottonseed cake-based diet at 20% CP level supports better growth of crossbred male bull calves across all ages. Moreover, using this level of diet guarantees a higher economic return. The daily gain of 50% F1 crossbred calves is relatively higher than that of 75% crossbred growing calves. As a result, a separate feeding level supplementation by genetic groups requires further research attention. A follow-up study at on-farm level, particularly feasibility of beef fattening using male calves born at the dairy farms in potential areas is substantial for further verification. Moreover, application of strategic feed supplementation such as total mixed ration (TMR) may also support optimum growth of crossbred male calves.

Acknowledgements

We thank the Ethiopian Institute of Agricultural Research (Holetta Agricultural Research Center) for financing this work. Technical assistances of Dairy Research Program at Holetta Research Center are also acknowledged for their unreserved support during the experiment.

References

Adebabay K, Addisu B, Tewodros B, Asresu Y, Yihalem D, Yeshiwas F and Getinet Z. 2014. Coparative E Comparative Evluation of th efattening performance of Fogera and Adet old Oxen at Andassa Livestock research center. ESAP (Ethiopian Society of Animal Production). Livestock and Economic growth; value chain as Pathways for Development. Proceedings of the 21th annual conference of Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 28-30, Addis Ababa, 185 PP.

Azage T, Berhanu G, Dirk H. 2006. Input supply system and services for market-oriented livestock production in Ethiopia. ESAP (Ethiopian Society of Animal Production) 2006. Institutional arrangements and challenges in market-oriented livestock agriculture in Ethiopia. Proceedings of the 14th annual conference of Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, September 5-7 Part I: Plenary session.

Birara Endalew and Zemen Ayalew. 2016. Assessment of the Role of Livestock in Ethiopia: A Review. College of Agriculture and Environmental Science, Bahir Dar University, Bahir Dar, Ethiopia. American-Eurasian Journal of Scientific Research 11 (5): 405-410.

Chala Merera Ulfina Galmessa Mulugeta Kebede Jiregna Dassalegn. 2004. Study on the utilization and management of draft animals in East and West Wellega Zones, http//: www.AGRIS.FAO.Org/agris-search/home

Chala Merera and Ulfina Galmessa. 2013. Fattening performances of culled dairy bulls to boost benefits of dairy farmers in western oromia, Ethiopia. International Journal of Livestock Production. Vol. 4(10), pp. 161-164.

Genet Dadi, Ashebir Worku, Tesfaye Alemu, Girma Debale, Mieso Gurru, Aman Gudeto, and Firehiwot Messele. 2020. Growth Performance Evaluation of F1 Holstein Frisian X Arsi Male Calves. Results of Livestock Research Completed in 2019 EIAR, Addis Ababa. Pp 187-193.

Hayaz U, Abdur R, Rajwali K, Bakht D, Din M, Kamran F, Khrshaid A, Sibghat U. and Zubair A. 2013. Effect of Cotton Seed Cake on Cattle Milk Yield and Composition at Livestock Research and Development Station, Surezai, Peshawar, Pakistan. Pakistan Journal of Nutrition 12 (5): 468-475.

Kearl, LC. 1982. Nutrient Requirement of Ruminants in Developing Countries. International Feed Stuffs Institute, Utah Agricultural Experiment Station, Utah State University, Logan, Utah 84322, USA.

Kefena Effa, Tesfaye Kumsa and Yohannes Gojjam. 2006. Review of the performance of crossbred dairy cattle in Ethiopia. ESAP (Ethiopian Society of Animal Production). Institutional arrangements and challenges in market-oriented livestock agriculture in Ethiopia: Proceedings of the 14th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia. Part II:Technical Papers. 196-197 pp.

Marishet T, Mengistu U, Getnet A and Kassahun M. 2019. Effects of sources of dietary protein supplemented to oat-vetch hay mixture on milk yield and milk composition of crossbred dairy cows. International Journal of Livestock Production. Vol. 10(2), pp. 56-61.

Mengistu A, Zewdie W, Yohannes G, and Kassahun WG. 2012. Evaluation of Friesian x Boran crossbred and Ethiopian highland zebu oxen with a reciprocal work effect on carcass characteristics. In Livestock Research Proceedings. Annual National Workshop on Review of Results of the Livestock Research, Held at EIAR, Addis Ababa, Ethiopia. pp:34

MoFED (Ministry of Finance and Economic Development). 2013. Development and poverty in Ethiopia: 1995/96– 2010/11. Addis Ababa, Ethiopia.

Rehrahie Mesfin, Tadesse Bekele, Getu Kitaw, Mesfin Dejene and Aeimro Kehaliew.2013. Growth Performance of F1 and High-Grade Friesian - Boran Crossbred Calves Fed on Oilseed Cake Based Concentrate Supplements. Livestock Research Proceedings. The 2012 Annual National Workshop on Review of Results of the Livestock Research, Held at EIAR, Addis Ababa.

SAS. 2008. *Statistical Analysis system user's guide, Release 9.1*. SAS Institute, Inc., carey, NC, USA.

Sendros D, Beyene K, Tesfaye K, Taye B, and Hailu GM. 1987. Preliminary crossbreeding results of cattle crossbreeding (European x zebu) studies: Milk Production performances of F_1 cows. *In*: Proc. of 1st National Livestock Improvement Conference (NLIC), Addis Ababa, Ethiopia.

Zewdu K, Sintayehu GM, Schildkemp SP. 1988. Towards on uniform grading system for commercial cattle. IAR proceedings. Second National Livestock Improvement, Conference held in Addis Ababa, Ethiopia 24-25, IAR, and Addis Ababa.

Zewdie Wondatir. 2010. Livestock production systems in relation with feed availability in the highlands and central rift valley of ethiopia. M.Sc Thesis, Haramaya University, Ethiopia.