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Research Article

Effect of Improved Feeding Management on Body Weight Gain and Carcass Characteristics of Afar Bulls for Export Market

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Abstract

This study was conducted at Werer agricultural research center from May 2014 to April 2015 with the objectives of evaluating different feed supplementation options for two years old Afar bulls to attain export market weight and investigating duration required for the purpose. A total of twenty one bulls with an average initial weight of 151.2 kg were used for the experiment. Three different dietary feed rations were formulated as treatments; T1= 20% molasses, 35% wheat bran and 45% linseed cake; T2= 45% wheat bran, 20% maize grain and 35% noug cake, and T3= 65% wheat bran and 35% cotton seed cake. Bulls were blocked by weight, and randomly assigned to the three dietary treatments. In overall, a total of 254 days were required for the bulls to attain export market weight of 300 kg. Higher average daily feed intake was observed in bulls fed under T1, followed by T2 and T3, yielding 3815.1 gm per day, 3594.5 gm per day and 3581.2 gm per day, respectively. However, the difference was not significant statistically. Average Daily Weight Gain (ADG) and Total Weight Gain (TWG) were significantly higher in bulls fed under T1, with a value of 0.62gm and 158.3 kg, respectively, over the entire feeding period. The ADG of experimental animals during the 84th and 112th feeding period were 0.72 gm and 0.67 gm, respectively. No significant difference was observed on the carcass and non-carcass traits among the three treatment groups. In conclusion, the preliminary feeding trial indicated that supplementation of 20% molasses, 35% wheat bran and 45% linseed cake after grazing to two years of Afar bulls enabled them to attain market weight of above 300 kg in 254 days. However, cost-benefit analysis should be conducted before deciding to use Afar bulls of the indicated age for fattening based businesses in such feeding systems.

Introduction

Ethiopian cattle population is estimated to be 59.5 million TLU [1], being the largest in Africa. Diverse agro-climatic conditions of the country are very suitable for production of different kinds of livestock. The government of Ethiopia envisions positioning the country among middle income countries by 2025, which partly relies on improving export, led economic growth.

Geographic proximity of Ethiopia to high livestock importing countries of the Middle East gives relative advantage in exploiting organic meat demand in the region, as the export market prefers young beef cattle that weigh between 280 and 300 kg. Nonetheless, Ethiopia's meat and live animals export business is much lower than that of neighboring countries such as Somalia and Sudan. Shortage of beef animals supply and inferior quality are among major problems of the country's beef business, as commonly complained by meat and live animal exporters [2]. Moreover, there is no specific cattle breed exclusively selected and used for beef production in Ethiopia [3], due to lack of comprehensive research and development of indigenous breeds for particular production traits. To improve the situation, few studies have been under taken in some parts of the country mostly focusing on fattening performance of different Ethiopian cattle breeds such as Ogaden, Horro, Borana and Fogera breeds [4-6]. However, available technologies and knowledge on beef cattle improvement are very few, incomplete and fragmented, even in potential areas including pastoral and agro-pastoral areas, which supply 95% of livestock destined for export market, mainly for meat [2]. Due to the reasons mentioned so far and potential market opportunity, it is mandatory to generate technologies and information for beef cattle improvement specific to type of cattle breeds.

Cattle breed in Afar region is believed to be multipurpose, though mainly used for milk production traditionally. It is characterized by its resistance to feed shortage, diseases and heat stress, as natural pasture is major feed resource for livestock production in the region [7]. Unfortunately, there is no reliable information regarding fattening potential, improved feeding systems as well as carcass characteristics of Afar beef cattle breed.

In this manner, developing feeding packages that enhance the existing traditional production and emerging private business is among timely interventions required to increase production and productivity of beef cattle in the region, and thereby exploit the growing demand for meat and live animal export market, based on scientific evidences [8]. Hence, the present study was conducted to evaluate the growth performance and carcass characteristics of Afar bulls under different feeding options for meeting export market weight and to investigate the duration required to meet the export market weight of two years old Afar bulls.

Materials and Methods

Study area

The study was conducted at Werer Agricultural Research Center, in Amibara district of Afar region, from May 2014 to April 2015. The district is located at an altitude of 740 m asl (above see level) south of the region, at about 280 km from country's capital, Addis Ababa. The mean annual minimum and maximum temperatures of the district are 19.1°C and 34.3°C, respectively. It also features arid and semi-arid agro-climatic condition with ranging annual rainfall of 200 to 700 mm.

Experimental animals

Twenty one healthy Afar bulls with the age of 2-2.5 years were purchased from local markets of the study area. Age of each animal was estimated using dental examination. All bulls were ear tagged and quarantined for three weeks before transferring to experimental barn. All were vaccinated against Anthrax, Lumy Skin Diseases (LSD), Foot and Mouth Disease (FMD) and Bovine pastuerollosis and were treated against internal and external parasites using anthelmintic and acaridae, respectively. In addition, a prophylactic treatment was administered using Oxytetracycline 20% before commencement of the experiment. All of them were also monitored regularly throughout the experiment period for their health status; and animals with clinical diseases were treated immediately based on observed clinical symptoms.

Feeding management and body weight measurement

Experimental animals were blocked by weight and randomly assigned into three treatment groups, each having seven animals. Animals in all treatment groups were subjected to similar management by allowing them to graze on irrigated pasture dominated by Rhodes grass for about 6 hours (3 hrs in the morning and 3 hrs in the afternoon) every day. After grazing, animals were separated into respective treatment group and supplemented with varying type and level of concentrate feeds in their separate pens. The three treatment feeds were: T1= Grazing + Molasses 20% + Wheat bran 35% + Linseed cake 45% + Salt 1%; T2= Grazing +Wheat bran 45%+ Maize grain 20% + Noug cake 35% + Salt 1% and T3= Grazing + Wheat bran 65%+ Cotton seed cake 35% + salt 1%. Feed samples from each treatment were sent to animal nutrition laboratory of National Veterinary Institute (NVI), for chemical analysis. The chemical composition of each dietary treatment groups are indicated in Table 1.

Table 1: Chemical composition of experimental feed ingredients.

Type of feed	DM%	MM%	CF%	CP%	CFat%	Ca%
Wheat bran	91.487	3.501	5.543	21.998	3.507	1.822
Linseed cake	93.251	8.521	5.143	34.700	9.340	2.136
Maize grain	89.893	1.995	1.669	12.654	2.169	1.483
Noug cake	93.980	8.803	13.396	56.794	7.559	2.305
Cotton seed cake	93.167	4.258	32.415	39.063	6.934	2.248

Each daily allocated dietary feeds were divided into two equal amounts and offered to respective animals twice per day; half in the morning and half in the afternoon, after return from grazing. Concentrate supplement were formulated based on daily DM requirement of each animal. The supplements were introduced to experimental animals gradually in two weeks adaptation period. All experimental animals had full access to potable water.

Supplementation continued until animals in all treatments attained export market weight. The total amount of daily feed supplements offered and leftover were collected and measured for each animal to determine intake by calculating the difference between "amount offered" and "refusal". Body weight measurement of all animals was taken fortnightly using weighing scale.

Carcass characteristics

After the end of the feeding period, three animals were randomly selected from each group for carcass analysis. Accordingly, a total of nine bulls were selected and slaughtered after an overnight fasting. Pre-slaughter body weight was taken before slaughter. Blood was collected using plastic bowl from each slaughtered animals and weighed immediately. Weight of skin, legs and head was measured right after skinning. Edible and non-edible components of each slaughtered animal weighed separately. Hot carcass was dissected in to two equal parts (right and left carcasses) by cutting along the dorsal mid-line; and weight of each side of entire carcass was taken immediately. Left half of each carcass was kept on refrigerator for 24 hours, then deboned and separated to lean meat and fat. Dressing Percentage (DP) was calculated as hot carcass weight over slaughter weight multiplied by 100 [DP = (HCW/SW)*100].

Statistical analysis

Descriptive analysis carried out using Excel spread sheet. Data on the feed intake, body weight changes and carcass measurements of each treatment were analyzed following a completely randomized design using the general linear models (GLM) procedure. R- Studio version 3.4.0 software was used to compute the statistical analysis.

Results and Discussion

Feed intake and growth performance

Experimental animals under the three treatment groups fed for a total of 254 days to attain export market weight. Trend of body weight change of two years old Afar bulls supplemented with respective concentrate feeds over the entire supplementation periods are shown in Figures 1 and 2. With the same type of feeds, two years old Borana breed attained export market weight at 154 days of supplementation [6]. However, the initial body weight of Borana bulls were higher (182 to 183 kg) than the initial body weight of Afar bulls used in this study which was between 150 and 153 kg. On the other hand, yearling age of Borana bulls attained export weight at 224 days of supplementation

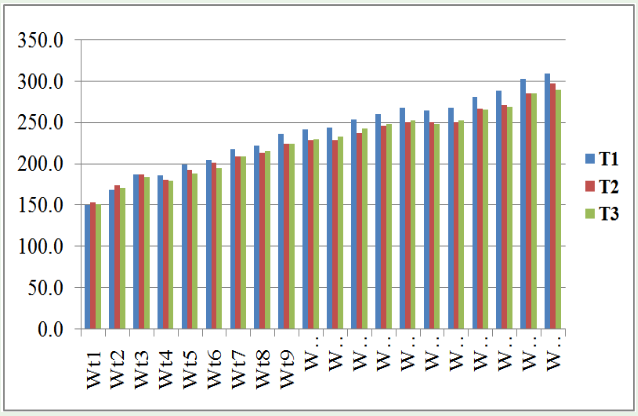

Figure 1: Body weight change of two years old Afar bulls supplemented with different type and level of concentrate feeds over the entire supplementation period.
Where Wt1 = weight of the first 14 supplementation days; Wt2 = weight of 28th day etc.

[5]. Higher initial body weight of Borana bulls before supplementation may be ascribed to their higher genetic performance. In addition, the average daily feed intake of Borana bulls was higher than the present finding [6] (Table 2).

Higher average daily feed intake was observed in experimental bulls fed under T1 (3815.1 gm) followed by T2 (3594.5 gm) and T3 (3581.2 gm). However, the difference was not statistically significant among the three treatment groups. Bulls under T1 had a significantly higher ($P<0.05$) average daily weight gain (0.62 gm) than bulls fed under T3 (0.54 gm) over the entire supplementation period (Table 2). Bulls under T1, gained a higher body weight with total of 158.3 kg over the entire supplementation period, while bulls under T2 and T3 gained 143.6 and 138.6 kgs, respectively. The Final Body Weight (FBW) was also higher in animals fed under T1 compared to the other treatment groups. This infers that the dietary treatment offered for experimental bulls under T1 have a better nutritional value to bring the animals' better weight gain and to attain the required export market weight with shorter supplementation period. Means of the feed intake, Initial Body Weight (IBW), Final Body Weight (FBW), Total Weight Gain (TWG) and Average Daily Weight Gain (ADG) of the three treatment groups are summarized in Table 2.

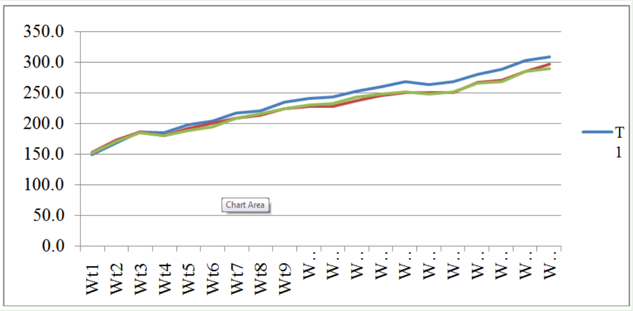

Figure 2: Body weight change of two years old Afar bulls over the entire feeding period.
Where Wt1 = weight of the first 14 supplementation days; Wt2 = weight of 28th day etc.

The ADG of Ogaden bulls supplemented with hay and different levels of concentrate were between 0.47 and 0.65 kg [4]. Girma et al., [6] reported that two years Borana beef fed with the same treatment of the present study revealed a higher ADG (up to 0.8 kg), which indicates that Afar cattle grow at lesser rate than Borena beef cattle. Adebabay and his coworkers also reported a 0.88 kg ADG of old Fogera bulls fed with hay and 6 kg concentrate feed per day. On the other hand, Fadol and Babiker [9] reported 0.89 kg and 0.74 kg ADG of Sudan Baggara zebu bulls fed in ad libitum and restricted manners, respectively. It is however worth to mention that, unlike the above breeds, Afar bulls in the present experiment were fed for an extended period (254 days) which might have resulted in diminishing ADG. Kuswati et al., [10] reported significant effect of length of supplementation period with better quality feed on daily weight gain of steers and heifers reared for longer supplementation period which resulted in lower daily weight gain over time. Likewise, the overall ADG of Afar bulls recorded for the first 84 and 112 days feeding period in the present study was 0.72 kg and 0.67 kg, respectively, with a total body weight gain of 59.7 kg and 75.7 kg during the respective periods. Bulls under T1 revealed the highest ADG with 0.82 kg and 0.76 kg during the 84th and 112th days of the supplementation, respectively. Moreover, in agreement to the present finding, yearling Borana breed fed with similar ration for a total of 224 days gained an an average daily weight of of 0.77 gm, while they gained about 1kg during the first 84 days [5]. Yearling animals are expected to grow faster than the two year-old ones due to high compensator growth rate but the extended supplementation period might reduced the expected result. Values of ADG, TWG and FBW of experimental bulls for different periods of supplementation are shown in Table 3.

Carcass characteristics

Results of important indicators in evaluating beef cattle supplementation such as slaughter weight, carcass weight and dressing percentage of supplemented Afar bulls are presented in Table 4. Similar to weight gain result, bulls fed under T1 showed a relatively higher slaughter and hot carcass weight compared to the cases in other two treatments. However, no significant difference was noticed on the weights of hot and cold carcass among the three treatment groups statistically. This may be due to similarity of age and breed of the experimental animals. Similar findings were also reported by Mieso et al., [5] and Girma et al., [6].

Slight difference in slaughter and hot carcass weights of experimental animals was most likely due to effect of three different types of concentrate feeds supplemented to the respective treatment groups. The carcass weight is an important factor affecting meat

Table 2: Feed intake and growth performance of two years old Afar bulls fed under different supplement for 254 days.

Parameter	$T1_a$	$T2_a$	$T3_a$
Feed intake (gm/day)	3815.1_a	3594.5_a	3581.2_a
Initial BW (Kg)	150.0_a	152.9_a	150.7_a
Final BW (Kg)	308.3_a	296.4_a	289.3_a
TWG (Kg)	158.3_a	143.6_{ab}	138.6_b
ADG (Kg/day)	0.62_a	0.56_{ab}	0.54_b

Means in a row with different subscript letter differ significantly ($P <0.05$); ADG = Average Daily Gain, TWG= Total Weight Gain, FBW= Final Body Weight.

Table 3: Growth performance of two years Afar bulls at different period of feed supplementation.

Weight Parameter (kg)	Treatment group	Period of supplementation (days)		
		84 days	112 days	140 days
ADG	T1	0.82±0.08	0.76±0.05	0.68±0.05
	T2	0.67±0.05	0.63±0.05	0.53±0.02
	T3	0.68±0.04	0.66±0.05	0.58±0.04
	Overall mean	0.72±0.03	0.67±0.03	0.58±0.20
TWG	T1	67.5±6.0	85.0±5.2	93.3±6.1
	T2	55.7±4.1	70.7±5.2	75.0±2.7
	T3	57.1±4.0	72.8±5.2	81.4±5.4
	Overall mean	59.75±2.8	75.75±3.2	82.75±3.1
FBW	T1	217.5±4.2	235±5.8	243.3±6.4
	T2	208.6±6.4	223.6±7.4	227.9±5.1
	T3	207.8±4.9	223.6±5.5	232.1±6.0
	Overall mean	211±3.1	227±3.7	234±3.5

ADG = Average Daily Gain, TWG= Total Weight Gain, FBW= Final Body Weight.

quality through its effect on fattiness [11]. In the present study, heavier hot carcass weight observed on Afar bulls fed under T1 followed by T2 indicates important role of those concentrate supplementations in improving both the quality and yield of beef.

Dressing Percentage (DP) becomes another economically important parameter in carcass evaluation, since hot carcass weight is also affected by values of non-carcass weight which includes values of economically less important components of the carcass such as head, hind and front legs, skin as well as visceral [10]. Accordingly, DP of slaughtered bulls in this experiment was in the range of 53.4% and 54% (Table 4). These values presented by the current study are slightly higher than value reported by Maggioni et al., [12] for *Bos indicus,* which was 52.6%; and same reported by Fadol and Babiker [9] for Sudan Baggara Zebu bulls, which was 52.5%. This may be partly due to quality of feed and extended period of supplementation in the present study. Similarly, Kuswati et al., [10] reported that cattle reared for longer supplementation period showed significantly higher slaughter weight, hot carcass weight, and dressing percentage. According to the authors, higher slaughter weight and hot carcass weight were mostly due to accumulation of weight over time, since

Table 4: Mean (±standard error) of slaughter, hot, cold carcass weight and dressing percent of supplemented Afar bulls.

Parameters	Treatment (mean ± SE)		
	T1	T2	T3
SWT (kg)	320±10.4	308.3±10.9	298.3±4.4
HCW (kg)	172.3±4.1	165.7±9.7	161.3±6.4
CCW (kg)	158.2±4.5	160.7±10.8	154.1±3.7
DP (%)	53.9±1.1	53.4 ±1.3	54.0±1.4

average daily weight gain, especially for steers, tended to decrease with longer supplementation period. In contrast, the DP finding of supplemented Afar bulls in this study was lower than other indigenous Ethiopian breeds such as Ogaden and Borana bulls where an average DP of 56% and 61% were reported by Yoseph et al., [4] and Mieso et al., [5] respectively. Variation may occur as a result of differences on the genotypes, localities and/or conditions of animals. Ogaden breed bulls used for the study by Yoseph and his co-woekers [4] were obtained from Haramaya University where the bulls were managed for breed selection at on-farm condition, while bulls for the present study were bought from local markets supplied by pastoralists of the locality. In addition, variation may also occur as a result of variations in types of feed supplementation, age of the animals and degree of thoroughness in cleaning process of carcass [12].

Proportion of carcass components

Basically, carcass is composed of meat, bone and fat. Meat is an edible and economically important part of the carcass while bone and fat are non-edible and less economically important. Therefore, good carcass must have higher proportion of meat or meat-to-bone ratio; and lower proportion of fat and bone [10]. The proportion of important components of carcass such as meat, bone and fat of Afar bulls subjected to different types of feed supplementation are summarized in Table 5. Generally, bulls fed under T1 had slightly higher weight of lean meat than bulls in T2 and T3 in the present study.

Non-carcass characteristics

The non-carcass characteristics of Afar bulls exposed to different types of feed supplementation is presented in Table 6. Similar to carcass characteristics, the three feed supplementations did not bring significant change ($P > 0.05$) on both the edible and non-edible non-carcass components. Similar finding was reported by Yoseph et al., [4], where no significant difference on the non-carcass characteristics were observed on supplemented and non-supplemented Ogaden bulls.

Table 5: Proportion of carcass components (meat, bone and fat) of two years Afar bulls subjected to three different types of feed supplementations.

Parameters (kg)	Treatment (mean ± SE)		
	T1	T2	T3
Hot Carcass Weight (HCW)	172.3±4.10	165.7±9.70	161.3±6.39
Cold Carcass Weight (CCW)	158.2±4.51	160.7±10.81	154.1±3.70
Chiller shrinkage weight	14.1±3.18	4.1±0.47	7.2±2.69
Muscle (Retailed cut weight)	106.5±2.40	103.8±6.47	104±0.60
Bone	34.2±2.71	38.2±3.20	33.3±1.44
Boneless meat	124.0±3.40	122.9±7.97	119.1±3.96
Trimmed carcass fat	17.5±3.00	19.1±2.08	14.7 ± 3.90
Meat percentage (%)	67.4±1.10	64.5±1.5	68.6±1.50
Bone percentage (%)	21.6±1.25	23.7±0.85	21.9±1.20
Fat percentage (%)	11.0 ±1.70	11.8 ±0.70	9.5±2.30

Table 6: Mean (±standard error) of fat thickness, rib-eye area and weight of different non-carcass components of supplemented two years old Afar bulls.

Parameters	Treatment groups		
	T1	T2	T3
Fat thickness (12th -13$^{th)}$ rib (cm)	0.43±0.03	0.37±0.03	0.33±0.03
Ribeye area (mm^2)	2923.67±597.63	3727.00±211.33	4661.0±1220.40
Free draining blood (Kg)	9.53±1.92	10.00±0.72	9.2±0.20
Tail (Kg)	0.71±0.05	0.57±0.04	0.50±0.11
Head with skin (Kg)	18.07±0.71	15.80±0.70	15.2±0.53
Skin (Kg)	28.27±1.05	25.27±2.82	25.27±0.37
Feet with hooves (Kg)	6.17±0.44	5.53±0.35	5.53±0.13
Tongue (Kg)	0.85±0.01	0.84±0.08	0.96±0.02
Lung + trachea (Kg)	3.06±0.30	2.92±0.36	2.96±0.43
Heart (Kg)	1.08±0.11	1.10±0.12	1.09±0.11
Heart fat (Kg)	0.63±0.19	0.44±0.07	0.62±0.61
Spleen (Kg)	0.77±0.05	0.73±0.12	0.82±0.07
Pancreas (Kg)	0.13±0.04	0.24±0.02	0.27±0.01
Kidney (Kg)	0.52±0.02	0.43±0.03	0.50±0.06
Kidney fat (Kg)	1.85±0.61	1.20±0.12	1.2±0.50
Urinary bladder (Kg)	0.01±0.01	0.08±0.15	0.13±0.36
Liver + bile (Kg)	3.2±0.13	2.8±0.20	2.63±0.27
Pelvic fat (Kg)	0.77±0.09	0.53±0.09	0.74±0.17
Small intestine (Kg)	5.93±0.70	6.60±0.46	5.7±0.40
Large intestine (Kg)	4.73±0.06	3.13±0.24	3.6±0.61
Omental fat (Kg)	2.18±0.40	1.7±0.01	1.36±0.50
Penis (Kg)	0.51±0.07	0.42±0.05	0.45±0.10
Testicle (Kg)	0.55±0.04	0.46±0.05	0.47±0.11
Scrotal fat (Kg)	1.23±0.12	1.05±0.08	1.0±0.31
Full gut (Kg)	42.33±3.76	40.20±4.50	41.0±3.75
Empty gut (Kg)	7.60±0.42	8.00±0.12	6.7±0.68
Hump (Kg)	3.66±0.07	4.00±0.26	3.93±0.47

Conclusions

The preliminary feed supplementation trial indicated ability of Afar bulls to attain export market weight of 300 kg under concentrate supplementation. Afar bulls fed with T1 required shorter supplementation period to attain export market weight and had shown greater body weight gain, slaughtering weight and carcass yield compared to bulls fed with T2 and T3. Biologically, feeding of animals with T1 (20% molasses, 35% wheat bran and 45% linseed cake) was feasible for attaining export market weight of 300 kg in 254 days. However, economic analysis of this feed supplementation experiment needs further investigation. Considering, potential supply of Afar bulls in the local markets, its resistance to harsh climatic condition and high demand of Ethiopian beef cattle by Middle East countries, further research should be conducted to consolidate and qualify purpose of the study. In this regard, studies on cost-benefits and alternative feed supplements to meet the intended purpose of Afar bulls could be immediate areas of future research consideration.

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