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Feedlot has been used worldwide as a technological alternative and a strategy to increase productivity and break seasonal production. Hence, this study was conducted at Andassa Livestock Research Center (ALRC) with the objectives to evaluate the feedlot performance and physicochemical composition of meat of Highland Zebu bull fed on different levels of concentrate to roughage ratio and to selecting the most economical rations for fattening bulls. A total of 24 Highland Zebu bulls were used for the experiment in randomized complete block design (RCBD) in a 2 x 3 factorial arrangement (with three feed levels (high, medium and low concentrates) and two age groups (young and adult). Data on initial body weight, live weight change, final weight, feed intake, meat physicochemical composition, cost of experimental feeds, purchasing and selling price of animals were collected. Total dry matter (DMI), average daily weight gain (ADG) and feed conversion efficiency (FCE) varied (P<0.05) between ages and feeding levels. The highest DMI (10.66 kg/day), ADG (0.55kg/day) and FCE (0.53kg/day) values were recorded from young highland Zebu breed bulls. The highest final body weight (337.25 kg) and feed conversion efficiency (0.053) values were recorded from young highland zebu breed bulls. The young Highland Zebu bulls had significantly different (P< 0.05) ADG (550 gram/day) c adults (390 gram). The mean of proximate composition of *meat ((Ash (3.2%), protein (67.8%), and fat (29.7%)) were recorded for diet while Ash (3.23%), protein (67.8%) and fat (29.6%) were observed for age. The observed concentration of α-Linolenic acid from the young bull meat (18.9mg/g) was greater than adult meat (16.2 mg/g). The benefit-cost ratio revealed that highland zebu breed bulls fattening in all the treatment groups were economically viable with benefit-cost ratio of 115.34%, 104.15% and 113.68% for high, medium and low concentrate feeding levels, respectively. Finally, high level of concentrate feeding is recommended for fatteners in areas where highland zebu breeds are available predominantly.*

***Key words:** age group, beef cattle, body weight change, cost benefit ratio, feeding levels*, *Linolenic acid and meat quality*

Production of beef cattle in tropical developing countries is usually associated with poor live weight gain and low nutritive value tropical feeds; largely crop residues. Most authors who used concentrated diets for fattened cattle registered markedly increased daily weight gain during grain feeding in comparison with fodder-based fattening (Schoonmaker *et al* 2003). In addition, if body weight gains of higher than 1 kg/day are desired, roughages should not make up more than 15-20% of the ration. In order to obtain higher level of body weight gain, high energy feeds such as maize grain should be fed in place of roughages. But, proportion of concentrates in the diets for growing-finishing bulls depends on prices of different feeds and quality of forage, and can vary from 30 to 65% for all cycle of growing finishing period and up to over 80% for finishing stage at feedlots (Boreš and Barton 2012). Grain and roughage diets are commonly fed at 75:25 or 80:20 to attain adequate weight gain with minimal risk of adverse effects, and are usually fed at a rate of 2.5–3% of live weight and produce 1.2–1.5 kg live weight each day (DPI Vic 2011 and MLA 2012). The inclusion of roughage in a feedlot diet has been shown to help in preventing digestive upsets and maximize energy intake (Gaylean and Defoor 2003). Cattle fed rice hulls (85% neutral detergent fiber) displayed a higher carcass yield (55%) compared with cattle fed grass hay (66% neutral detergent fiber) (53.5%), indicating that rice hull is an alternative source of roughage (Beretta et al 2021).

To achieve satisfactory growth rates, a crude protein level of 11–15% is required with adequate mineral supplement depending on the age and weight of the cattle. The feed ingredients used by most feedlots in Ethiopia (agro-industrial byproducts, hays or crop residues) are low in calcium. On the other hand, the agro-industrial byproducts contain more phosphorus than calcium, a condition that is very likely to cause calcium deficiency. Limestone is an excellent source of calcium and it can be included at the rate 1-1.75% of the ration to avoid the problem (Tolera 2008).

Feedlot industry in Ethiopia is a great potential to produce quantity and quality beef because of the availability of large number of livestock species used for fattening (Teklebrhan and urge 2013). Feedlot has been used worldwide as a technological alternative and a strategy to increase productivity and break seasonal production. However, in most countries in the world, including Russia the hays, hay-lages and silages are significantly cheaper (by 25-35% and more) than cereals and other concentrates (Legoshin et al 2008). In Ethiopia, feed price change has increased significantly in recent years. The price change in hay and concentrates becomes very high in recent years, which leads to use feedlot fattening strategy as main option in feedlot operations.

Various studies have shown that meat quality is influenced by breed, sex, the quality and quantity of feed consumed, age and level of fatness. Particular to diet, concentrate (grain-based) and forage (grass-based) are quite different and lead to change in the fatty acid compositions of muscle and adipose lipid tissue as well as the flavor of beef finished on these diets (Mapiye et al 2015). One of the factors that affect the competitiveness of Ethiopian meat in the Middle East Market was the quality of beef (Yesihak and Webb 2015). The reason for considering castrated and un castrated bulls in feeding experiment is due to the current fattening practice in the area. Moreover, most of current fattening practice in the region is male cattle, due this sex is not considering in this experiment (Mekonnen et al 2021). Limited research has been conducted concerning meat production in Ethiopia and in particular, on carcass quality of beef cattle (Yesihak and Webb 2014). The same author also reported that continuous assessment of meat-eating qualities was suggested to satisfy the demand of consumers. Thus, this research was initiated with the following objectives: (i) to evaluate feedlot performance of Highland Zebu breed bulls fed on different levels of concentrate diet, (ii) to determine the proximate composition and taste preference of Highland Zebu breed meat and (iii) to identify the most economical roughage and concentrate feed ingredient proportions for highland zebu breed bulls

The study was conducted at Andassa Livestock Research Center (ALRC), located in Amhara Regional State (ARS), at 513 km away from Addis Ababa, capital city of Ethiopia. It is 22 km far from the regional city, Bahir Dar, on the way to the Blue Nile Falls. The center is situated in $11^{0}29'$ N latitude and $37^{0}29'$ E longitude at an altitude of 1730 meters above sea level. The mean experimental period of rainfall is 236 mm, the temperature is 20.51°C, and the humidity is 95% during experimental period. The topography of the area varies from river valley plain to gentle slope grassland. In general, the area is characterized by dark clay soil, which is seasonally water logged (Denekew 2005).

The experimental feeds used in the study were grass hay (basal diet) and concentrate mix. Grass hay was harvested from the grazing land of Andassa Livestock Research Center. The harvested hay was properly dried and stored under a shed for subsequent use for the feedlot evaluation. The feed ingredients such as wheat bran, noug seed cake, maize grain and salt were purchased from the local in Bahir Dar City and transported to the study location. Moreover, the lime stone was obtained free of charge from Amhara Region Agriculture Bureau. The concentrate diet was formulated with a mixture of wheat bran, noug seed cake, maize, salt and limestone with the ratio of 17:26:55:1 and 1%, respectively (Hunegnaw et al 2019).

A total of 24 highland zebu, 12 young (intact) and 12 adult (castrated) bulls were purchased from local market. The age of experimental bulls were identified by both dental and owners information during purchasing at local market. So, their age estimation is castrated bulls were 5 years where as the un-castrated experimental bulls were 3.5 years. Randomized complete block design with factorial arrangement (two age group and three feeding levels) with four replications was employed for this experiment. All experimental animals were individually fed with their corresponding rations for 21 days of adaptation followed by 120 days of experimental period. The blocking of experimental bulls was based on the initial body weight for both age groups and randomly assigned one of the feeding treatments. The treatments used in the current experiment were:

Factor one (feeding level):

25% natural pasture hay +75 %concentrate mix (HC)
50% natural pasture hay + 50%concentrate mix (MC)
75% natural pasture hay + 25% concentrate mix (LC)
Factor two (age group): Castrated (adult) and Un-castrated (young)

Before the start of the experiment, bulls were treated for internal and external parasites using Albendazole and acaricide, respectively and subjected to 3 weeks of adaptation and 120 days of actual experimental periods. Vaccinations for FMD, Anthrax, Black leg, and pasteurellosis diseases were given for experimental animals. After the adaptation period, bulls in each age category were grouped into four based on their initial body weight. For each treatment group four bulls were assigned and fed with the respective dietary treatments throughout the experimental period. At the end of the adaptation period (at the beginning of the experiment), each animal was weighed using cage balance as an initial body weight and fortnightly thereafter up to the end of the fattening period. Data on initial body weight, fortnightly live weight changes, final weight, feed offered and refusal, feed intake, cost of experimental feeds, purchasing and selling price of animals were collected. Dry matter feed intake is calculated as feed offer minus feed refusal multiply by dry mater percentage of a given feed. Average daily gains (gram/day) were calculated as differences between final and initial body weights divided by the total feeding days.

All chemical composition analysis of experimental feeds was done at Debre Birhan Agricultural Research Center, Animal Nutrition Laboratory. The Kjeldahl method is used to measure the nitrogen content of the sample. The nitrogen content is converted to a crude protein estimate under the assumption all proteins contain approximately 16% nitrogen (CP= N*6.25). Accordingly, CP for feed offered was determined according to the procedures of (AOAC 1990). The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents of feed were analyzed using the method of Van Soest *et al* (1994). Ash was determined according to the AOAC standard procedure (AOAC 2005). The dry matter percentage was calculated as the flowering formula in lab by own procedure.

DM%: (Over dried weight- crucible Wt x 100) / (Sample weight)

Twelve animals (2 animals from each treatment combination) were selected randomly from each age and feeding rations and slaughtered by traditional method (backyard.) Traditional slaughtering is the cutting the throat: that is cutting the trachea and oesophagus and the jugular veins and chest sticking without any modern slaughtering facilities. Meat samples were taken from the Longissimus dorsi muscle for proximate composition determination. Duplicate measurements per sample were taken for analysis.

Evaluation of meat chemical composition (moisture, protein, crude fat, and ash) was performed according to the methods described by the Association of Official Analytical Chemists (AOAC 1990), at JIJE Analytical Testing Service Laboratory, Addis Ababa, Ethiopia. Nitrogen content was determined by using the Kjeldahl method and protein was calculated as N x 6.25 (ES ISO 187:2013). Fat was extracted by the Soxhlet method (AOAC 2005). Ash was determined according to the AOAC standard procedure (AOAC 2005).

The meat was dried at temperature of 60˚C for 72 hours using an oven according to the standard meat drying method (Ayanwale et al 2007). After drying, the meat size was reduced by grinder followed by fat extraction (Folch et al 1957). For preparation of Fatty Acid Methyl Esters (FAMEs), the esterification reactions of the fatty acids were carried out according to the methodology of (Tansawat et al 2013). The fatty acid composition was analyzed using Gas chromatography (Agilent 7890B) with Mass Spectroscopy Detector (Agilent 5977A MSD), equipped with an Agilent mass Hunter detector model 5977B MS (sector instrument) and a capillary column of HP-88 (30 m × 0.25 mm x 0.20µm film thickness), carrier gas helium, constant pressure 90 kPa, split 1:30.

Twelve semi-trained panelists were selected based on their interest, familiarity with beef and ability to express the meaning of scales rate used in evaluation of meat. The panelists were trained on the procedures and principles of sensory evaluation according to the procedures described by (AMSA 2015). Each Batch of age and diet-based samples was thawed for 24 hours at room temperature (25˚C) for steaks preparation. All the participants were taught how to infer and record scores for each variable tasted, and meat from each sample was evaluated and tasted randomly by consumer panelists. The waiting period between meat sample tasting was 10 min. After tasting, the panelists were instructed to rinse their mouth with water before tasting the next sample to avoid crossover effects. The steaks were prepared according to procedures developed by (AMSA 2015). Cooking pan was heated for about 205˚C before placing the steak on the pan. The steak was cooked until the internal temperature reached 70˚C. The steaks were uniformly cut to reduce any bias related to serving position and presented in white color plate randomly. Each assessor has evaluated three most important eating quality (tenderness, juiciness, and flavor) parameters. The evaluators scored each sample on a nine-point hedonic scale for tenderness, flavor and juiciness.

All variable costs such as bull purchasing cost, feed cost, and veterinary cost during all the experiment periods were collected. The purchasing price was collected and recorded at initial stage of experiment while the selling price of the highland zebu at end of experiment was estimated by six (local traders) who had experience on bull marketing. Each of the local traders was set their own individual market price and then we take mean of their price for final estimation. The purchasing price of experimental feeds costs were also used for analysis.

Total benefit (TB): The gross benefit for each treatment was calculated by multiplying estimated market price related number of bulls per treatment. Gross benefit = selling price X number of bulls.
Total variable costs (TVC)*:* This is the sum of all the costs that vary for a particular treatment.
Net benefit (NB This was calculated by subtracting the total costs from the gross benefit for each treatment. NB = GB – TVC
Benefit cost ratio This was calculated by total benefit divided by total variable costs and multiply by 100. (BCR= GB/TC*100)

The data on feed intake, body weight change and feed conversion efficiency were subjected to analysis of variance (ANOVA) using the model: $Y_{ijk} = \mu + A_i + F_j + A_i * F_j + E_{ijk}$, Where, Y_{ijk} = the response variable, μ = overall mean, A_i = Age effect, F_j= feed effect, age and feed interaction effect and E_{ijk} = random error. Treatment means were compared by Least significance difference (LSD ($P<0.05$) using SAS (2002) software. Differences were considered statistically significant at a 0.05% significance level. Proximate and fatty acid composition of meat was calculated as mean, due limited samples.

The chemical composition of experimental feeds (natural pasture grass hay and concentrate mix) used in this study are presented in Table 1. The current result showed that the CP, NDF, ADF and ADL contents differed considerably between the basal diet and the concentrate mixture as real expectation. As a result, the concentrate mixture had better CP, less NDF, ADF and ADL than natural pasture hay. The CP content (4.5%) of natural pasture grass hay was close to the value reported by Denekew (2005) and similar to the value that reported by Walie et al (2018) for the same area. The CP content of grass hay from the current study was below the minimum level (7%) required for normal rumen microbial growth and fermentation (Van Soest 1994). The low CP, high NDF, ADF and ADL content could be attributed to the delayed harvesting stage of pasture (McDonald et al 2002).

According to Van Saun (2006), forage grass with less than 50% NDF described as high quality whereas NDF greater than 60 % considered as low quality. Therefore, the current result of NDF content from concentrate mix (8.4%) classified as high-quality supplement whereas natural pasture hay (55.4%) was classified as low-quality forage, which is greater than 50 % NDF.

Table1: Chemical composition of experimental feeds

Parameters	Experimental feeds	
	Natural pasture Hay	Concentrate mix
DM %	91.5	91
CP (%)	4.5	25.9

ASH (%)	12	9
NDF (%)	55.4	8.4
ADF (%)	44	4.4
ADL	14.5	1.3

Note: DM: dry matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber, ADL acid detergent lignin.

The dry matter intake and body weight change of experimental highland zebu cattle breed bulls fed on natural pasture grass hay and concentrate mix was shown in (Table 2). The total dry matter (DM) and nutrient intake of experimental feeds showed significant ($p<0.05$) differences among treatment groups of feeding levels and age group. Higher ($p<0.05$) dry matter intake was recorded from young Highland Zebu breed bulls at all feeding levels where as lower ($p<0.05$) feed intake was observed from adult Highland Zebu breed bulls at low and medium concentrate feeding levels. This was due to the effect of feeding levels of those experimental feeds and age of experimental animals.

Table 2: Dry matter intake (g/day) Highland Zebu bulls feed on different levels of concentrate to roughage ratio

Variables	Treatments						Over all mean	SEM	SL
	HCA	HCY	MCA	MCY	LCA	LCY			
CDMI	8011.45^{a}	8045.61^{a}	4912.67^{c}	6330.53^{b}	2979.53^{e}	3136.97^{d}	5580.37	44.77	***
HDMI	2423.85^{e}	2463.58^{e}	3924.44^{d}	4935.05^{c}	6579.68^{b}	7167.42^{a}	4593.3	42.003	***
TDMI	10435.3^{ab}	10509.19^{ab}	8837.11^{c}	11265.58^{a}	9559.21^{c}	10304.39^{b}	10173.67	43.38	**
CPI	2184.4^{a}	2194.67^{a}	1448.98^{c}	1861.68^{b}	1067.73^{e}	1135.01^{d}	1652.01	10.52	***
ASHI	1011.89^{c}	1019.73^{c}	913.07^{d}	1161.95^{a}	1057.7^{b}	1142.42^{a}	1053.43	4.03	***
NDFI	2015.78^{e}	2040.65^{e}	2586.8^{d}	2265.78^{c}	3895.41^{b}	4234.26^{a}	3013.44	21.12	***
ADFI	1419.0^{e}	1437.98^{e}	1942.91^{d}	2449.97^{c}	3026.15^{b}	3291.65^{a}	2266.58	17.31	***
ADLI	455.61^{e}	461.81^{e}	632.91^{d}	797.88^{c}	992.78^{b}	992.78^{a}	738.57	5.74	***

Note: Means within a row with different superscripts are statistically significantly different , CDMI= Concentrate dry matter intake, HDMI= hay dry matter intake, CPI= crude protein intake, ASHI= ash intake, NDFI= neutral detergent fiber intake, ADFI= acid detergent intake, ADLI= acid detergent lignin intake, HCA= High concentrate level of adult, HCY= high concentrate level of young, MCA= Medium concentrate level of adult, MCY= Medium concentrate level of young, LCA= low concentrate level of adult, LCY= low concentrate level of adult, SEM= standard error of mean, SL= significance level

The analysis of variance for mean body weight change of experimental highland zebu bulls feed on natural pasture hay and concentrate mix was presented in Table 3 and Table 4. Body weight change parameters studied in this study (FBW, TWG, ADG and FCE) showed significant ($P<0.05$)

difference among treatment groups. The highest FBW, TWG, ADG and FCE were observed for young Highland Zebu breed bulls at high and medium concentrate feeding levels. This might be associated with high feed intake of experimental animals, high or efficient utilization of given feed and better feed conversion efficiency in to animal body and muscle tissues.

Table 3: Feedlot performance of Highland Zebu bulls feed on different levels of concentrate to roughage ratio

Factors		Variables (kg)				
Age group	Concentrate feed level	IBW	FBW	TWG	ADG	FCE
Adult	LC	270.25	315.75^{c}	45.50^{c}	0.379^{c}	0.041^{cd}
	MC	260.00	307.75^{d}	47.75^{c}	0.397^{c}	0.045^{bc}
	HC	281.50	330.50^{b}	49.00^{c}	0.408^{c}	0.038^{d}
Young	LC	268.50	330.50^{b}	62.00^{b}	0.516^{b}	0.051^{b}
	MC	274.25	338.00^{a}	63.75^{b}	0.53^{ab}	0.047^{b}
	HC	269.00	343.25^{a}	74.25^{a}	0.619^{a}	0.059^{a}
	Overall	270.58	327.625	57.042	0.475	0.047
	SEM	4.185	4.457	2.536	0.021	0.0019

compared to Tanzanian indigenous breeds (266 kg live weight) as reported by (Shirima et al 2016). On the other hand, very high values was reported in final body weight temperate breeds than did in the current study of Highland Zebu breed (Casas et al 2010), which might be due to the fact that temperate breeds are improved breeds for beef and kept on better management conditions than the tropical local breeds (Teklebrhan 2018).

The average daily weight gain of adult Highland zebu bulls in the current study ranged from 0.389 to 0.408 kg. Similarly, the average daily weight gain of young Highland zebu bulls in the current study ranges from 0.516 to 0.619 kg. In this feedlot study lower gain was achieved as compared to previous report by Teklebrhan (2018) on ADG of Hararghe highland which ranged from 1.03 to 1.33 kg. This higher difference might be from breed and feed ingredients difference. Moreover, the obtained results in the current study were higher than the report of Tegegne, and Singh (2009), which showed the daily body weight gain of Ethiopian Boran as 0.44 kg at low input management. The difference in weight gain might be attributed to difference in quantity and quality of the supplements, basal diet feed, and the physiological and genetic potential of the feeder animals (Teklebrhan 2018).

Effect of age and concentrate feeding level on the IBW, FBW, TWG, ADG and FCE in the current study are presented (Table 4). The age had significant effect on body weight changes in the current study. The highest FBW (337.25 kg), TWG (66.7 kg), ADG (0.55) and FCE (0.053) were recorded (p<0.05) from experimental young highland zebu breed bulls. Similarly concentrate feeding level in this study showed significant difference (P<0.05). The highest FBW, TWG, ADG, and FCE were recorded (P<0.05) from high and medium levels of concentrate feeding except for the MCL for FBW and DMI for adults. In all the parameters considered in the current study low concentrate feeding level showed low response; this might be due to low feed intake and high number of fibers in the experimental feeds, and due to high inclusion of natural pasture hay in that specific feeding treatment.

Table 4: Effect of age, concentrate level and interaction on feedlot performance of Highland Zebu bulls

Factors	Variables (kg)				
Age	IBW	FBW	TWG	ADG	FCE
Adult	270.58	318^{b}	47.42^{b}	0.39^{b}	0.041^{b}
Young	270.58	337.25a	66.67a	0.55^{a}	0.053^{a}
LSD	18.82	17.23	6.23	0.05	0.006
SL	NS	**	**	**	**
Concentrate feed level					
LC	269.38	322.88	53.75^{b}	0.447^{b}	0.045
MC	267.13	323.13	55.75^{ab}	0.46^{ab}	0.046
HC	275.25	336.88	61.625^{a}	0.51^{a}	0.048
LSD	23.04	21.27	7.63	0.06	0.0081
SL	NS	NS	*	*	NS
P-value					
Age	0.9569	0.045	0.046	0.046	0.013

Feed level	0.7444	0.0966	0.043	0.043	0.1238
Age*feed level	0.5004	0.044	0.033	0.033	0.2287

Note: LSD= least significant difference LC= low level (75% hay and 25% concentrate), MC= medium level (50%hay and 50% concentrate), HC= high level (75% concentrate and 25% hay), SL= significant level, IBW=initial body weight, FBW= final body weight, TWG=total weight gain, DMI= Dry matter intake, ADG= average daily gain, FCE= feed conversion efficiency

The mean of Ash, Protein and Fat were 3.2%, 67.8%, 29.7% for diet and 3.23%, 67.8% and 29.6% for age, respectively (Table 4). The result of the present study in respect to protein content implied that the Highland Zebu is better for red meat production at younger age than adult. The protein and ash contents in the present research were higher than the report of Temeketa et al (2021) for Arsi, Borana and Harar cattle breeds in Ethiopia. From the current study, difference in ash composition was observed from Harar bulls above 4 years of age contains lower (1.28%) as reported by Temeketa et al (2021).

Table 5: Proximate composition of meat from Highland Zebu bulls

LC	69.6	3.4	69.7	27.5
MC	70.5	3.5	69.9	28.1
HC	64.9	3.0	63.9	33.4
Over all mean	68.3	3.2	67.8	29.7
Young	68.6	3.3	70.3	29.9
Adult	68.0	3.2	67.5	29.5
Over all mean	68.3	3.23	67.8	29.67

LC, low concentrate; MC, medium concentrate; HC, high concentrate

The fatty acid profile of meat from Highland Zebu bull breed meat is presented in Table 5. The concentration of α-Linolenic acid from the young bulls (18.9mg/g) was higher than from adult bulls (16.2 mg/g). This indicated that consumption of meat from young bulls has less health hazard to human. This might be as a result of maturity and age. The probable reason for higher essential fatty acid (omega-3) content in tissues of beef from medium concentrate feed might be the dependence of diet variation in the concentrate level. The present finding is agreed with the Temeketa et al (2021) reported that 17.75mg/g Linolenic acid concentration for Boran breed in Ethiopia.

Table 6: Fatty acid profile of the meat from Highland Zebu bulls (mg/g)

1	Myristoleic acid	10.1	8.2	12.1	9.2	11.1
2	Myristic acid	43.6	42.1	43.9	39.8	46.7
3	Palmitoleic acid	41.9	37.2	46.2	39.2	44.2
4	Palmitic acid	270.5	250.8	276.4	262.8	269.1
5	methyl palmitate	7.3	6.6	5.9	6.9	6.1
6	Methyl heptadecanoate	7.2	6.3	5.8	6.4	6.4
7	Methyl Margarate	9.5	9.2	7.6	9.2	8.1
8	α-Linolenic acid	18.1	17.7	16.9	18.9	16.2
9	Oleic acid (18:1	390.1	369.5	413.9	379.8	402.6
10	13-Octadecenoic acid	12.1	11.9	10.6	9.1	14.2
11	10-Octadecenoic acid	12.9	14.8	8.3	10.8	13.8
12	Stearic acid	173.2	158.1	146.9	163.0	155.7

Note: LC, low concentrate; MC, medium concentrate; HC, high concentrate

The taste preference of meat from highland zebu bull and eating quality are presented in Table 6. The age interaction within breeds and diet showed significant difference (P<0.05) on juiciness and taste of meat. This might be due to the feed variation in the concentrate level that affect the amount of water retained in a cooked meat product of the fattened animals. Diet has significant (P<0.05) effect on the overall acceptability of meat. This might be due to the variation in the concentrate level effect on the flavor and aroma taste. On the other hand as age of fatten animals increased for adult animal the overall acceptability value of meat (6.65) is lower than the young bull (7.08).

Table 7: Mean scores of eating quality for meat Highland Zebu bulls

Juiciness	7.15	7.15	7.28	7.19	7.33	0.24	0.70	0.04
Tenderness	7.01	7.25	7.11	7.23	7.02	0.31	0.64	0.41
Flavor	7.01^b	7.17^a	6.82^c	7.21	6.79	0.04	0.40	0.72
Aroma	6.84	7.03	6.67	6.97	6.73	0.18	0.26	0.33
Taste	7.07^a	7.11^a	6.71^b	7.23	6.70	0.01	0.23	0.05
Color	7.38	7.34	7.28	7.35	7.32	0.79	0.86	0.26
Overall Acceptability	6.8^b	6.98^a	6.75^c	7.08	6.65	0.04	0.68	0.16

LC, low concentrate; MC, medium concentrate; HC, high concentrate

As indicated in the table 7 below fattening of the adult and young bulls has profits in all of the treatments with net benefits of 3,979.93, 1,025.13 and 3,143.74 Birr per each animal for T1, T2 and T3, respectively. However, higher benefit is obtained for fattened animals fed on T1 (25% natural pasture hay + 75 % concentrate mix (HC)) followed by T3 (75% natural pasture hay + 25% concentrate mix (LC)). The analysis of cost benefit in feeding experiments is important to know if the different concentrate feeding levels were economically visible and at what percent. Accordingly, it also confirms if further technology demonstration acceptable or not at stallholder farmer's level in study areas and where the concentrate mix feeds are available. The benefit-cost ratio (B/C) revealed that the adult and young bulls fattening in all used treatments is economically viable with B/C ratio of 115.34%, 104.15% and 113.68% respectively for T1, T2 and T3. The B/C ratio of 115.5% in T1 indicates that, one birr investment in fattening provides 115.5% of returns, which means for every one-birr investment we can get a net profit of 0.155 birr.

Table 8: Cost-Benefit Analysis of Highland Zebu bulls fed on different concentrate levels

Attributes	T1 natural pasture hay	T2 natural pasture hay	T3 natural pasture hay
Fattened cattle selling	29,925.25	25,738.29	26,125.13
Cattle purchasing	14,337.50	14,275	13,937.50
Concentrate cost	9,304.8	5,994.36	2,992.92
Hay cost	1,937.025	3,745.5	5,664.975
Medication cost	116.00	448.30	136.00
Labor cost	250.00	250.00	250.00

T1 (25% natural pasture hay + 75% concentrate mix (HC); T2 (50%natural pasture hay + 50%concentrate mix (MC) and T3 (75% natural pasture hay + 25% concentrate mix (LC).

Higher dry matter intake was recorded from young Highland Zebu breed bulls at all feeding levels than the adult one. The high total dry matter, final body weight, average daily weight gain and feed conversion efficiency were observed from young than adult Highland Zebu bulls at high and medium concentrate feeding levels. The age had significant effect on body weight changes of current study. The meat from young fattened animals has high protein and high α-Linolenic acid (omega 3) than adult. The benefit-cost ratio revealed that Highland Zebu breed fattening in all the treatment groups were economically viable with benefit cost ratio of 115.34%, 104.15% and 113.68% for high, medium and low concentrate feeding levels, respectively. In all parameters young Highland Zebu breed bulls showed better fattening performances at both high and medium levels of concentrate feeding. Finally, high level of concentrate feeding for on-farm demonstration for fatteners in areas where Highland Zebu bulls are available predominantly and further study on the meat quality and fatty acid profiles of each feeding levels and age group are recommended.

The authors would like to thank, EIAR (Ethiopian Institute of Agricultural Research-National Beef Research Program) and ARARI (Amhara Regional Agricultural Research Institute) for their financial and logistic support for conducting this particular study.

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