International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 10, Issue 7 -2023

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2023.10.07.006

Effect of partial substitution of concentrate mix with poultry litter on body weight gain and carcass characteristics of arsi cattle young bulls

Berhanu Tassew*, Genet Dadi, Aman Gudeto, Frehiwot Mesele
Adami Tulu Agricultural Research Center, P.O. Box, 35, Batu, Ethiopia
*Corresponding author. E-mail address: berhanut42@gmail.com

Abstract

The experiment was conducted using 24 Arsi young bulls with initial body weight of 178.88 ± 16.47 Kg (Mean ± SD) with the objectives to investigate the effect of partial substitution of concentrate-mix with poultry litter on body weight gain and carcass characteristics of Arsi young bulls .The treatment diets were; 24% maize grain + 46% wheat bran + 30% noug seed cake (T1), 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter (T2), 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter (T3) and 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter (T4). At the end of 98 days three bulls were randomly selected from each treatment for carcass evaluation. body weight gain and carcass characteristics of the bulls were not significantly different (P>0.05) among treatments. However, the result of partial budget analysis indicated that substitution of poultry litter to concentrate-mix at 27.5% (T3) is economically feasible. Therefore, substitution of concentrate-mix with poultry litter in the ration of fattening Arsi young bulls by 27.5% is recommended.

Keywords: Arsi bulls; Body weight; Carcass characteristics; Concentrate; Poultry litter

1. Introduction

Ethiopia has the lowest levels of beef production per animal. Ethiopia's average beef yield per animal of 108 kg/head is by far less than 119kg/head for the Sudan, 146kg/head for Kenya, 127kg/head for eastern Africa and 205kg/head for the whole world (Asfaw *et al.*, 2011).

To improve this scenario, various research activities have been undertaken in different parts of the country. From the recent studies on evaluation of feedlot performance of Boran, Kereyu and Arsi cattle breeds at different ages at Adami Tulu Agricultural Research Center various feeding options have been recommended (Mieso *et al.*, 2013; Girma *et al.*, 2015; Aman *et al.*, 2019; Ashebir *et al*., 2019, Tesfaye *et al.*,2018). However, these recommended feeding options were based on concentrate mixture. However, the use of such a supplement is limited under smallholder livestock production systems due to the scarcity and high cost of concentrates. In order to mitigate the problems associated with the lack of protein supplement, there is a need to look for alternative protein sources. Poultry litter and poultry manure are good sources of non-protein nitrogen and they are cheap. Incorporation of poultry waste into beef cattle rations has a great impact on the economics of beef production, provided the rations are properly balanced. However there is no work done (information) on level of inclusion of poultry litter to fattening Arsi cattle young bulls. Therefore, this experiment was conducted with objectives to investigate the effect of substitution of different levels of poultry litter to concentrate-mix on body weight gain and carcass characteristics of Arsi young bulls and to identify the most economical substitution level of poultry litter to recommended concentrate-mix ration for Arsi young bulls.

2. Materials and Methods

2.1. Description of the experimental area

The experiment was conducted at Adami Tulu Agricultural Research Center (ATARC), which is located 167 km South of Addis Ababa at an altitude of 1650 meter above sea level in mid rift valley. The agro-ecological zone of the area is semi-arid and sub humid with acacia woodland vegetation type. The mean annual rain fall is 760mm. The minimum and maximum temperature is 12.6°C and 27°C, respectively.

2.2. Experimental feeds preparation

The experimental feeds; noug seed cake, wheat bran and maize grain were purchased from Adama town. Poultry litter was purchased from Alema koudijs feed PLC. Maize grain was grinded by milling machine. The poultry litter was sifted before feeding to remove foreign materials, lumps and bird carcasses. The Rhodes grass used as a basal diet was harvested from Adami Tulu Agricultural Research Center farm.

2.3. Experimental animals and their management

Twenty-four intact Arsi young bulls with similar body weight were purchased from Meki and Bulbula cattle markets of the East Shoa Zone of Oromia Region. The age of the bulls was estimated based on dentition and asking information from the owners of the bulls. The bulls were held in quarantine in a separate barn until the experiment commences and observed for any health problem. During this time, the bulls were vaccinated against common diseases in the area and dewormed and sprayed against internal and external parasites respectively. The bulls were ear tagged for identification. The animals were placed in an individual pen equipped with a separate feeding trough for supplement and basal diet in a well-ventilated concrete floor experimental barn. The bulls were acclimatized for fifteen days to the dietary treatments to which they were allocated prior to the commencement of the actual experiment by offering them gradually. Pen cleaning was conducted every day.

2.4. Experimental design and treatments

Randomized Complete Block Design (RCBD) was used for the study. To minimize the error due to differences in initial body weight, the experimental bulls were blocked into six blocks of four animals each based on their initial body weight. Bulls within a block were assigned randomly to one of the four dietary treatments indicated in Table 1. The dietary treatments were formulated on iso-nitrogenous bases to contain 19% CP. The basal diet (Rhodes grass hay) was offered *ad libitum* to all experimental animals, while the supplementary feeds were offered at a rate of 2.5% of their body weight throughout the fattening period. The amount of supplementary feeds was adjusted every fourteen days depending on the weight change of the experimental bulls during the whole fattening period. All experimental animals were individually fed their respective diet for 98 days. The daily allocated feed was divided into two equal portions to offer in two equal meals at 8:00 AM and 4:00 PM in separate feeding troughs. Drinking water was freely available to all experimental bulls throughout the experimental period. common salt was added to supplementary feeds at a rate of 1%.

Table 1. Dietary treatments

Treatments	Rhodes grass hay	Supplements DM %			
		Maize grain	Wheat bran	Noug seed cake	poultry Litter
T1	*Ad libitum*	24	46	30	0
T2	*Ad libitum*	22	42	21	15
T3	*Ad libitum*	19	40.5	13	27.5
T4	*Ad libitum*	17.5	37	5.5	40

2.5. Body weight change

Body weight of the animals was taken at the beginning of the feeding trial and at 14 days interval during the 98 days of feeding trial. All animals were weighed in the morning hours before feed provision using ground weighing balance with a sensitivity of 1 Kg. Average daily body weight gain was calculated as the difference between final live weight and initial live weight divided by the number of feeding days.

$$\text{Average daily body weight gain} = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Number of feeding days}}$$

2.6. Carcass parameters

At the end of the experiment, three bulls were randomly selected from each treatment for carcass evaluation. Feed was withheld from the bulls over night, they were weighed the next morning, and the weight was recorded as slaughter body weight (SBW). Once the slaughter body weight was taken the animals were slaughtered immediately for carcass evaluation and all-important internal organs and carcass parameters were individually measured. The hot carcass weight (HCW) was taken after removing the head, thorax, abdominal and pelvic cavity contents as well as legs below the hock and knee joints. Offal components were categorized into edible and non-edible according to the culture of the society around the study area. The main carcass components were split down at the vertebral column having the two sides as symmetrically as possible and stored in a cold room for 24 hours for properly partitioning the carcass in to bone, muscle and fat. The frozen carcass was weighed and the weight was recorded as chilled carcass weight (CCW). The right part of the frozen carcass was divided in to five main primal cuts carcass components namely: leg, loin, rack, breast and shank, and shoulder and neck. The dressing percentage was calculated as the proportion of hot carcass weight to slaughter body weight.

2.7. Chemical analysis

The chemical analysis of the experimental feeds was carried out after taking the representative samples. Samples of feed offered were ground to pass a 1 mm sieve mesh. Analysis for DM, Ash and N contents was done according to AOAC (2005) procedures. Dry matter and ash contents of representative samples of the feeds were determined by oven drying at 105^0C overnight and by combusting in a muffle furnace at 550^0C for 3 h, respectively. Total nitrogen (N) content was determined by using Kjeldahl method and crude protein (CP) was calculated as N×6.25. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined by using the procedures of Van Soest and Robertson (1985).

2.8. Partial budget analysis

Variable costs incurred in conducting the trial were recorded. Total variable costs such as animal purchase cost, animal transportation cost, cost of feeds, labor and veterinary costs were included in partial budget analysis. At the end of the fattening period, the gross output/revenues were obtained from prices of the bulls as estimated by the help of people who have enough knowledge on the prices of fattened animals. Fixed costs incurred for feeding the animals were not included in cost benefit analysis. Net return of each treatment was computed as the difference between total return (TR) and total variable cost (TVC) and calculated as NR= TR-TVC.

2.9. Statistical analysis

Data on body weight change and carcass parameters were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (SAS, 2004) version 9.1. When significant, Least Significant Difference (LSD) was employed to locate differences between the treatment means. Pearson's correlation analysis was employed to determine the association among body weight and carcass characteristics.

Data was analyzed using the following model.

$$\mathbf{Y_{ij} = \mu + T_i + B_j + E_{ij}}$$, where:

Y_{ij} = Response variable

μ = Overall mean

T_i = Treatment effect

B_j = Block effect, and

E_{ij} = Random error

3. Results and Discussion

3.1 Chemical composition of experimental feeds

The results of chemical analysis of the experiential feeds used in this study is given in Table 2. The 7.6 CP% of Rhodes grass hay used in this experiment is slightly higher than the 7% CP required for microbial protein synthesis in the rumen that can support at least the maintenance requirement of ruminants (Van Soest, 1994). The CP content of wheat bran and noug seed cake used in this study was comparable with the 14.39% and 29.16% CP content of wheat bran and noug seed cake respectively used by Estefanos *et al.*, (2016) for growing F1 (Boran x jersey) dairy heifer calves. However, the CP content of poultry litter used in this study was lower than the 27.47% CP content of poultry litter used by the same author. This Variation in the CP content of poultry litter might be associated with the amount of soil contamination, type of litter, number of batches of birds reared on the litter, poultry house management and type of feed used for the poultry (McCaskey, 1995).

Table 2. Chemical composition of experimental Feeds

Feed offered	DM%	Ash	OM	CP	NDF	ADF
		%DM				
Rhodes Grass Hay	89.9	14.2	85.8	7.6	48.9	27.5
Maize Grain	91.5	7.2	92.8	10.0	36.5	27.1
Wheat bran	92.9	3.5	96.5	16.3	25.2	5.8
Noug seed cake	94.3	6.6	93.4	30.5	21.4	20.1
Poultry Litter	92.9	11	89	23.9	32.8	13.1

ADF=Acid Detergent Fiber; CP=Crude Protein; DM=Dry Matter; NDF=Neutral Detergent Fiber; OM=Organic Matter

3.2. Body weight change

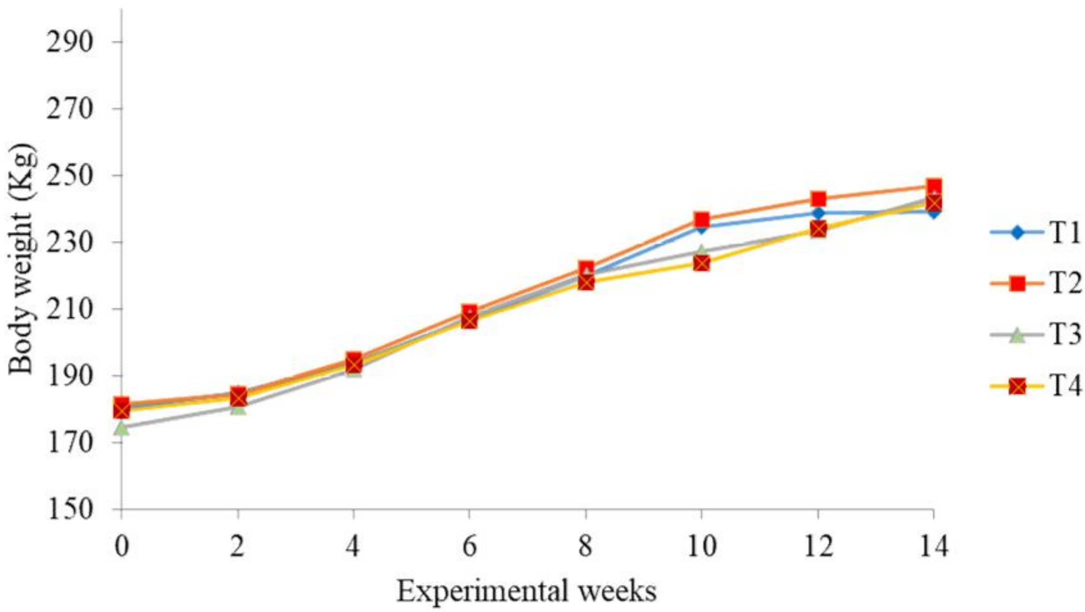
The mean initial body weight (IBW) of the experimental bulls were similar (P>0.05) across all treatments due to blocking of bulls according to their initial body weight at the commencement of the experiment (Table 3). Final body weight (FBW), body weight change (BWC) and average daily gain (ADG) were not significantly different among treatments. This might be associated with iso-nitrogenous formulation of dietary treatments. Aman *et al.,* (2019) also reported statistically similar final body weight for yearling Arsi bulls fed the same level of crude protein. Although the body weight change and average daily gain in this study were not statistically different, they were numerically higher for T3. The Average daily gain in the current experiment was comparable with finding of Aman *et al.,* (2019) at 120 days of feeding yearling Arsi bulls. In this experiment, it was clearly observed that poultry litter can replace favorably conventional CP sources such as noug seed cake without affecting the biological response of the animal. The study conducted at Haramaya University to investigate the effect of different levels of poultry litter inclusion in the supplemental diets of Hararghe Highland goats on feed intake, digestibility, N retention and daily body weight gain indicated that poultry litter can replace favorably conventional CP sources such as noug seed cake by up to 28% in the ration of goats (Asrat *et al.*, 2008). Estefanos *et al.,* (2016) also found that substitution of poultry litter for concentrate in the diet of growing F1(Boran x Jersey) heifer calves is economical without affecting the biological response. Poultry litter supplementation has brought about 741.44 gm/day average daily weight gain of fattening cattle in Tigray (Embaye *et al.,* 2022). The experiment of Gebreslassie *et al.,* (2019) also indicated that supplementation of 1.8 Kg/day mixture of poultry litter and wheat bran (74% poultry litter, 25% wheat bran and 1% salt) resulted in 487g/day of average daily gain of cattle.

Table 3. Live body weight parameters of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix.

Parameters	**Treatments**					
	T1	**T2**	**T3**	**T4**	**SEM**	**SL**
IBW (kg)	180.3	181.3	174.5	179.3	3.36	ns
FBW (kg)	239.0	246.8	243.2	241.7	4.44	ns
BWC (kg)	58.7	65.5	68.6	62.3	1.92	ns
ADG (g/day)	598.6	668.4	700.7	636.1	19.69	ns

ADG=Average Daily Gain; BWC=Body Weight Change; FBW=Final Body Weight; IBW=Initial Body Weight; ns=not significant; SEM=Standard Error of the Mean; SL=Significance Level; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.

The trend of body weight change across the feeding period of Arsi bulls in the current study is depicted in Figure 1. There was steady increase in body weight across the growth period in all experimental treatments though the rate of increment differs slightly. In all treatments the body weight of animals under all treatments were increasing throughout the experiment though the rate at which animals gained their body weight was decreasing as experimental day advances. McDonald *et al*. (2010) illustrated that during the fetal period and from birth to puberty, the animal's rate of growth increases; after puberty, it progressively decreases as the animal reaches maturity under constant environmental condition and nutrition. Therefore, the trend of body weight change seen in the current study was in line with this illustration.



T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.

Figure 1. Trends in body weight change of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix.

3.3. Carcass characteristics

3.3.1. Main carcass parameters

Main carcass parameters of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix is shown in Table 2. The result indicated that the main carcass parameters in the current study was not significantly affected (P>0.05) by proportion of concentrate-mix and poultry litter of the ration. This indicates that poultry litter has favorably replaced the concentrate-mix without significant loss of carcass weight as a result of poultry litter inclusion in the ration of Arsi young bulls. Numerically, slaughter body weight and hot carcass weight was highest for T3 among other treatments, while the dressing percentage was highest for T1. The Dressing percentage recorded in this study was slightly lower than the dressing percentage (56.4 -59.6) reported by Aman *et al.*, (2019) for Arsi bulls fed different dietary rations and slightly higher than the dressing percentage (49.77 -50.84) reported by Ashebir *et al.*, (2019) for yearling Kereyu bulls fed different dietary rations.

Table 4. Main carcass parameters of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

Parameters	Treatments					
	T1	T2	T3	T4	SEM	SL
SBW (kg)	255.7	266.3	268.7	242.0	5.23	ns
HCW (kg)	141.7	142.3	146.3	130.3	3.09	ns
CCW (kg)	139.3	139.3	143.7	127.3	2.93	ns
Dressing%	55.4	53.4	54.5	53.9	0.52	ns

CCW=Chilled Carcass Weight; HCW=Hot Carcass Weight; ns=non-significant; SBW=Slaughter Body Weight; SEM=Standard Error of the Mean; SL=Significance Level; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.

3.3.2. Edible offal components

Edible offal components of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix **a**re presented in Table **5.** The edible offal components in this study were not significantly affected (P>0.05) by treatments except tongue. This indicates that substitution of poultry litter to concentrate-mix did not affect the edible offal components of Arsi bulls. This might be associated with the fact that bulls in all treatments received the diet with equal concentration of CP%. On the other hand, Riley *et al.* (1989) indicated that differences in internal organs are more influenced by age, breed and sex of the animals rather than plane of nutrition, which support the current result. Moreover, Aman et *al.*, (2019) and Ashebir *et al.*, (2019) also reported that the weight of offal components was not significantly affected by different feeding regime.

Table 5. Edible offal components of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix.

Parameters	Treatments					
	T1	T2	T3	T4	SEM	SL
Hump (Kg)	5.15	6.03	6.18	4.58	0.4	ns
Liver + Bile (Kg)	4.70	4.22	3.90	3.90	0.14	ns
Kidney (Kg)	0.62	0.58	0.53	0.50	0.03	ns
Heart (Kg)	0.97	0.95	0.95	0.83	0.04	ns
Tongue (Kg)	0.9^{ab}	0.98^{ab}	0.82^{ab}	0.72^{b}	0.04	*
SI (Kg)	2.27	3.2	2.85	3.05	0.24	ns
LI (Kg)	3.05	4.35	3.05	3.77	0.33	ns
Testicle (Kg)	0.43	0.48	0.55	0.42	0.03	ns
Kidney fat (Kg)	2.62	3.83	2.78	3.80	0.25	ns
Heart fat (Kg)	0.57	0.40	0.47	0.27	0.05	ns
Omental fat (Kg)	3.53	4.13	3.17	3.27	0.27	ns
Scrotal fat (Kg)	1.7	2.18	1.13	1.57	0.17	ns
Pelvic fat (Kg)	0.55	0.88	0.43	0.61	0.07	ns
Empty gut (Kg)	9.42	10.82	11.35	10.10	0.56	ns

[a,b,] *means with different superscripts in a row are significantly different; *=(P<0.05); LI=Large Intestine; ns=non-significant; SEM=Standard Error of the Mean; SI=Small Intestine; SL=Significance Level; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.*

3.3.3. Non-edible offal components

Non-edible offal components of Arsi bulls fed a basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix are presented in Table 6. All non-edible offal components were not significantly differed (P>0.05) across treatments showing that non-edible offal components were not affected by the level of substitution of concentrate-mix with poultry litter. The result of the current study revealed that since the weight of offal components were less affected by plane of nutrition the major objective of supplementing the young bulls with high protein feeds should be to increase the weight of muscles rather than the weight of offal components. Previous studies also indicated that non-edible offal components were not significantly affected by the proportion of feed ingredients in the ration of Arsi and Kereyu bulls (Aman *et al.*, 2019; Ashebir *et al.*, 2019).

Table 6. Non-edible offal components of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

Parameters	Treatments				SEM	SL
	T1	T2	T3	T4		
Head without tongue (Kg)	15.08	14.68	14.72	13.43	0.40	ns
Tail (Kg)	0.60	0.63	0.85	0.67	0.04	ns
Hide (Kg)	21.33	22.75	21.98	21.50	0.42	ns
Lung with trachea (Kg)	2.28	2.87	2.20	2.82	0.13	ns
Spleen (Kg)	0.82	0.68	0.55	0.70	0.07	ns
Pancreas (Kg)	0.25	0.17	0.15	0.17	0.03	ns
Bladder (Kg)	0.07	0.08	0.08	0.08	0.01	ns
Penis (Kg)	0.53	0.58	0.58	0.48	0.03	ns
Feet with hooves (Kg)	4.10	4.62	4.53	4.28	0.09	ns

ns=non-significant; SL=Significance Level; SEM=Standard Error of the Mean; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.

3.3.4. Primal cuts

The weight of muscle, bone and fat and their proportions in most of the primal cuts of carcass of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix were not significantly different (P>0.05) among treatments. The proportion of muscle was highest for those bulls fed the ration containing 15% poultry litter (T2). Numerically the highest weight of leg muscle was obtained from those bulls fed the ration containing 27.5% poultry litter (T3).

On the other hand, the proportion of muscle from loin was significantly higher (P< 0.05) for those bulls supplemented with the ration which does not contain poultry litter (T1) than bulls supplemented with the ration containing 40% poultry litter (T4). However, the highest numerical value of weight of loin muscle was recorded for those bulls supplemented with the ration containing 27.5% poultry litter (T3) than all other treatments though the difference was not statistically significant. This indicates that the optimum level of poultry litter inclusion in supplementary diet of Arsi bulls is 27.5%. Estefanos *et al.*, (2016) also indicated that poultry litter can be favorably included in the diet of F1 (Boran x Jersey) heifer calves by 28%.

Table 7. Primal cuts of dissected half carcass of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

Primal cuts			Treatments					
			T1	T2	T3	T4	SEM	SL
Leg	Muscle	Kg	14.88	14.95	15.5	13.78	0.35	ns
		%	74.82[a]	70.20[b]	74.25[a]	76.50[a]	0.83	**
	Bone	Kg	2.82	3.48	3.12	2.85	0.12	ns
		%	14.11	16.42	14.96	15.84	0.47	ns
	Fat	Kg	2.17	2.88	2.25	1.38	0.23	ns
		%	11.07	13.40	10.79	7.67	0.98	ns
Leg total (Kg)			19.87	21.32	20.87	18.02	0.52	ns
Loin	Muscle	Kg	6.80	5.45	7.23	5.62	0.33	ns
		%	65.29[a]	56.29[b]	61.31[ab]	57.71[b]	1.26	*
	Bone	Kg	1.43	1.35	1.65	1.50	0.08	ns
		%	13.74	14.17	14.0	15.52	0.59	ns
	Fat	Kg	2.17	2.85	2.90	2.57	0.13	ns
		%	20.98[b]	29.54[a]	24.70[ab]	26.77[a]	1.20	*
Loin total (Kg)			10.40	9.65	11.78	9.68	0.42	ns
Rack	Muscle	Kg	5.37	4.43	5.43	4.83	0.21	ns
		%	60.74[a]	47.19[b]	59.19[a]	59.33[a]	1.95	*
	Bone	Kg	1.67	2.33	1.93	1.70	0.10	ns
		%	18.80	25.03	21.12	20.92	0.95	ns
	Fat	Kg	1.8	2.6	1.8	1.62	0.17	ns
		%	20.46	27.78	19.69	19.75	1.63	ns
Rack total (Kg)			8.83	9.37	9.17	8.15	0.26	ns
Breast and shank	Muscle	Kg	2.90	3.62	3.85	3.20	0.17	ns
		%	51.88	49.94	57.78	51.47	1.54	ns
	Bone	Kg	1.42	1.67	1.55	1.53	0.04	ns
		%	25.71	23.34	23.29	24.66	0.68	ns
	Fat	Kg	1.23[b]	1.92[a]	1.27[b]	1.48[ab]	0.10	*
		%	22.41	26.73	18.93	23.88	1.17	ns
Breast and shank total (Kg)			5.55	7.20	6.67	6.22	0.24	ns
Shoulder and neck	Muscle	Kg	16.02	14.40	17.02	15.47	0.59	ns
		%	70.63	69.39	70.32	71.11	0.71	ns
	Bone	Kg	4.20	3.42	4.08	3.90	0.24	ns
		%	18.17	16.41	16.89	17.85	0.61	ns
	Fat	Kg	2.52	3.02	3.05	2.40	0.18	ns
		%	11.20	14.20	12.80	11.04	0.67	ns
Shoulder and neck total (Kg)			22.73	20.83	24.15	21.77	0.85	ns

*[a,b] means with different superscripts in a row are significantly different; *=(P<0.05); ns = not significant; SL = Significance Level; SEM = Standard Error of Means; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.*

Mean weight of muscle, bone and fat and their proportions in dissected half carcass of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix are presented in Table 8. The sum weight of muscle, bone and fat from the dissected half carcass was not significantly affected (P>0.05) by the level of inclusion of poultry litter in the supplementary diet of Arsi bulls. This is most probably associated with iso- nitrogenous formulation of the dietary treatments. Muscle comprised the highest proportion (62.75 -68.17%) followed by bone (16.97 - 18.06%) and fat (14.77-19.20%). The proportion of muscle (62.75%- 68.17%) from the dissected half carcass in this study was much higher than the report of Asebir *et al.*, (2019) who reported 49.33-52.51% of muscle from the dissected half carcass of Kereyu breed fed different dietary rations. According to Ameha (2008), the ideal carcass can be described as the one that has a minimum amount of bone, a maximum amount of muscle and an optimum amount of fat. Therefore, the dietary rations used in the current study were able to produce the ideal carcass than earlier reports.

Table 8. Mean weight of muscle, bone and fat and their proportions of dissected half carcass of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

Parameter		**Treatments**					
		T1	**T2**	**T3**	**T4**	**SEM**	**SL**
Muscle	Kg	45.97	42.85	49.03	42.90	1.25	ns
	%	68.17[a]	62.75[b]	67.46[a]	67.25[a]	0.78	*
Bone	Kg	11.53	12.25	12.33	11.48	0.35	ns
	%	17.00	18.06	16.97	17.98	0.37	ns
Fat	Kg	9.88	13.27	11.27	9.45	0.68	ns
	%	14.88	19.20	15.57	14.77	0.84	ns

*[a,b] means with different superscripts in a row are significantly different; *=(P<0.05); ns = not significant; SL = Significance Level; SEM = Standard Error of Means; T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.*

3.4. Correlation among body weight parameters and carcass characteristics

Correlation among body weight parameters and carcass characteristics of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix are given in Table 9. Hot carcass weight was positively and strongly (P<0.001) correlated with slaughter body weight. This obviously indicates the increment of hot carcass weight as a result of increment in slaughter body weight.

The average daily gain was positively and significantly (P<0.05) correlated with slaughter body weight. The proportion of muscle is negatively correlated with the slaughter body weight, while the proportion of fat was positively correlated with slaughter body weight. This indicates that as the weight of animal increases, the proportion of fat increases and to the contrary the proportion of muscle decreases. Dressing percentage is positively correlated with proportion of muscle and inversely correlated with the proportion of fat.

Table 9**.** Correlation among body weight parameters and carcass characteristics of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

Parameters	**ADG**	**SBW**	**HCW**	**Dressing%**	**Muscle%**	**Bone%**	**Fat%**
ADG	1.00						
SBW	0.60*	1.00					
HCW	0.46^{ns}	0.90***	1.00				
Dressing%	-0.17^{ns}	-0.02^{ns}	0.42^{ns}	1.00			
Muscle%	-0.35^{ns}	-0.33^{ns}	-0.05^{ns}	**0.55^{ns}**	1.00		
Bone%	-0.28^{ns}	-0.26^{ns}	-0.16^{ns}	0.17^{ns}	-0.08^{ns}	1.00	
Fat%	0.45^{ns}	0.42^{ns}	0.12^{ns}	-0.59*	-0.9^{ns}	-0.36^{ns}	1.00

= (P<0.05); *= (P<0.001); ADG= Average Daily Gain; HCW= Hot Carcass Weight; ns=non-significant; SBW= Slaughter body weight.*

3.5. Partial budget analysis

Partial budget analysis of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix is presented in Table 10. Partial budget analysis was done to evaluate the economic feasibility of substituting concentrates with different levels of poultry litter. The result of partial budget analysis showed that total variable cost (feed cost) decreased with increasing levels of poultry litter substitution for concentrate-mix. Poultry litter substitution for concentrate-mix decreased feed cost by 9.35, 21.57, and 32.13% for T2, T3 and T4, respectively as compared to T1.

Gross return was higher for T2 and T3 and lower for T4 as compared to T1. However, net return was higher for T2, T3 and T4 relative to T1. Net return increased as the level of substitution increases up to 27.5% and decreased when substitution level raised to 40%. This indicates that substitution of poultry litter to concentrate-mix up to 27.5% is economical and when the substitution levels exceed 27.5% net return starts to decline.

Table 10. Partial Budget Analysis of Arsi bulls fed basal diet of Rhodes grass hay and supplemented with different proportions of poultry litter and concentrate-mix

List of items (Parameters)	T1	T2	T3	T4
Purchasing Price/Bull (ETB)	12,595.00	12,595.00	12,595.00	12,595.00
Transportation cost/ Bull (ETB)	150	150	150	150
Feed Costs/ Bull (ETB)	11,000.23	9,972.01	8,627.57	7,465.58
Labor Cost/Bull (ETB)	612.5	612.5	612.5	612.5
Veterinary cost/bull (ETB)	150	150	150	150
Total variable cost/bull (ETB)	24,507.73	23,479.51	22,135.07	20,973.08
Gross return/bull (ETB)	44,680	44,896	48,240	41,880
Net return/ bull (ETB)	20,172.27	21,416.49	26,104.93	20,906.92

T1 = Rhodes grass hay ad libitum+ 24% maize grain + 46% wheat bran + 30% noug seed cake; T2 = Rhodes grass hay ad libitum+ 22% maize grain + 42% wheat bran + 21% noug seed cake + 15% poultry litter; T3 = Rhodes grass hay ad libitum+ 19% maize grain + 40.5% wheat bran + 13% noug seed cake + 27.5% poultry litter; T4 = Rhodes grass hay ad libitum+ 17.5% maize grain + 37% wheat bran + 5.5% noug seed cake + 40% poultry litter.

Conclusion and Recommendation

From the results of the current study, it can be concluded that poultry litter can substitute 27.5% of the concentrate-mix economically without affecting the biological response of the animal in the ration of fattening Arsi young bulls. Furthermore, investigation of the effect of substitution of concentrate-mix with poultry litter on carcass quality and health of internal organs of the animal is recommended.

Acknowledgements

The authors would like to thank Ethiopian Institute of Agricultural Research (EIAR) for funding this experiment and Adami Tulu Agricultural Research Center for allowing to use the experimental facilities.

Statements & declarations

Funding

This work was supported by Sinana Agricultural Research Center.

Competing Interests

The authors declare no competing interests.

Author Contributions

All authors contributed to the study conception and design. The first draft of the manuscript was written by Berhanu Tassew and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics approval

The national guidelines for the care and use of animals have been followed

References

Aman Gudeto, Tesfaye Alemu, Mieso Guru, Ashebir Worku and Genet Dadi 2019. Evaluation of Different Feeding Options for Yearling Arsi Bulls to Attain Export Market Weight. Journal of Biology, Agriculture and Health care. ISSN 2224-3208 (Paper) ISSN 2225-093X (Online) DOI: 10.7176/JBAH. Vol.9, No.14, 2019.

Ameha Sebsibe. 2008. Sheep and goat meat characteristics and quality.pp.325-340. *In:* Alemu yami and Merkel, R.C. (eds.), *Sheep and Goat Production Handbook for Ethiopia*: ESGPIP (Ethiopia Sheep and Goat productivity Improvement Program). Addis Ababa, Ethiopia.

AOAC (Association of Official Analytical Chemists). 2005. *Official Methods of Analysis*. Association of Official Analytical Chemists, Washington DC.

Asfaw Negassa, Shahidur Rashid, and Berhanu Gebremedhin. 2011. Livestock production and marketing in Ethiopia. Ethiopian Support Strategy Program II (ESSP II) Working Paper 26. Washington, D.C.: IFPRI.

Ashebir Worku, Tesfaye Alemu Tucho, Mieso Guru, Aman Gudeto, Frehiwot Messele and Genet Dadi. 2019. Evaluation of different feeding options on growth response and carcass characteristic of yearling Kereyu-Bulls to attain local/export market weight. International Journal of Agricultural Science and Food Technology 5(2): 050-053. DOI: http://doi.org/10.17352/2455-815X.00004.

Asrat Gebre Tsadik, Berhan Tamir and Solomon Melaku. 2008. Inclusion of different proportions of poultry litter in the rations of yearling Hararghe Highland goats. *Livestock Research for Rural Development*, *20*(3), p.9.

CSA (Central Statistical Agency). 2021. Livestock and livestock characteristics (private peasant holdings), federal democratic republic of Ethiopia, *agricultural sample survey*. *Statistical bulletin* 589 volume II, Addis Ababa, Ethiopia.

Embaye Kidanu Kindeya, Mehari Kebede and Gebreslassie Gebru. 2022. Poultry litter supplementation for effective cattle fattening in Tigray, Northern Ethiopia. International Journal of Livestock Production (Article in press).

Estefanos Tadesse, Abdela Eda’o and Birhanu Shelima. 2016. Evaluation of partial substitution of poultry litter for concentrate in the diet of growing F1 (dairy heifer calves in mid-rift valley of Ethiopia. Basic Research Journal of Agricultural Science and Review ISSN 2315-6880 Vol. 5(1) pp. 17-23.

Gebreslassie Gebru, Desta Tekle, Meseret Redae, Minister Birhanie, Mulalem Zenebe and Hailay Hagos. 2019. Effect of supplementation of poultry litter-based diet on body weight gain of cattle. Livestock Research for Rural Development 31 (4).

Girma, D., Mieso, G., Tesfaye, A., Arse, G., Frehowit, M., Ashebir, W. and Aman, G., 2015. Effect of different feeds option on growth response and carcass characteristic of two years aged Borana bulls for export market weight gain at Adami Tulu agricultural research center. *Basic Research Journal of Agricultural Science and Review*, *4*, pp.139-145.

McCaskey, T. A. 1995. Feeding broiler poultry litter as an alternative waste management strategy. p. 493-502. In Kenneth Steele (ed.) *Animal Waste and the Land-Water Interface*. Lewis Publishers, New York.

McDonald, P., Edwards, R .A., Greenhalgh, J .F. D., Morgan, C. A., Sinclair, L .A., and Wilkinson, R .G. 2010. *Animal Nutrition, 7th ed*, Prentice hall, Harlow, England, London.

Mieso Guru, Girma Debele,Tesfaye Alemu Tucho., Frehiwot Messele and Tesfaye Alemu Aredo, 2013. Evaluation of different feeding options on yearling Borana bulls to attain export market weight at Adami Tulu agricultural research center. *American Journal of Cell and Animal Biology*, *1*(1).

Riley, R.R., Savell, J.W., Shelton, M. and Smith, G.C. 1989. Carcass and offal yields of sheep and goats as influenced by market class and breed. *Small Ruminant Research*, *2*(3), pp.265-272.

Van Soest, P.J. 1994. Fiber and physicochemical properties of feeds. *In*: *nutritional ecology of the ruminant.* Second edition. Cornell University press. pp. 140-155.

Van Soest, P.J. Robertson, J.B., 1985. Analysis of forage and fibrous foods. A laboratory manual for Animal Science 613. Cornell University (USA).

Access this Article in Online

Website: www.ijarbs.com

Quick Response Code

Subject: Veterinary Sciences

DOI:10.22192/ijarbs.2023.10.07.006

How to cite this article:

Berhanu Tassew, Genet Dadi, Aman Gudeto, Frehiwot Mesele. (2023). Effect of partial substitution of concentrate mix with poultry litter on body weight gain and carcass characteristics of arsi cattle young bulls. Int. J. Adv. Res. Biol. Sci. 10(7): 43-55.

DOI: http://dx.doi.org/10.22192/ijarbs.2023.10.07.006