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Full Length Research Paper

Evaluation of the effects of concentrate supplementation on carcass merits of Farta sheep

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The experiment was conducted at Debre Tabor University research center with the main objective of to evaluate the carcass merits of Farta sheep and to evaluate the effect of concentrated feed on carcass quality of Farta sheep fed on different concentrated mixture and hay as basal diet. The experiment was conducted using a randomized complete block design (RCBD) with five treatments and five replications. Blocking was based on the initial body weight of sheep. Twenty five Farta sheep with yearling age and average initial was 21.45 kg used for the feeding trial were randomly assigned to five treatments. The treatments were hay allow (T1),100% wheat bran +basal hay (T2), 67% wheat bran and 33% NSC +basal hay (T3), 67% NSC and 33% wheat bran +basal hay(T4) and 100% NSC + basal hay. Feed offers and refusals for feeding trials were recorded daily, while body weight change of sheep during the feeding trial was recorded every fifteen days. The chemical compositions of the experimental feeds indicated that the NSC allow with basal diet was highest than (30.57%) other treatments and 66.7% wheat bran and 33.3% NSC (23.83%), 33.3% wheat bran and 66.7% NSC (29.20%) CP contents, respectively. Feeding of Farta sheep cows with NSC resulted in significantly ($p<0.05$) lower daily dry matter intake (1.85kg/sheep, but higher daily weight gain (57.4g/day) when compared with those sheep fed on basal hay. Dressing percentage as proportion was greater ($P<0.05$) for animals supplemented with 67.3% NSC and 33.7% (48.04%) of wheat bran with hay as basal diet (35.51%). The juiciness score of loin samples from NSC and wheat bran fed the 90% was higher ($p < 0.05$) than fed others treatments. Hence, according to the results of this study feeding of yearling Farta sheep with feed 66.7% wheat bran and 33.3% NSC and 33.3% wheat bran and 66.7% NSC was efficient for both biologically as compared to other treatments. For farther research we recommended that to determine the level of concentrated feed added in basal diet of yearling farta sheep for maximum body conformation.

Key words: yearling weight, ripe eye area, quality meat, carcass

INTRODUCTION

The domestic meat demand is believed to increase with increasing literacy and family income. Meat consumption is often an indicator of the economic status of a country or an individual. People with a higher social or economic status demand a greater amount of high-quality meat products. The per capita consumption of meat in developed/industrialized countries is much higher as compared to developing countries. Countries whose population consumes the least amount of meat are located in Africa and Asia (Ameha, 2008). In Ethiopia, the average annual meat consumption per capita is estimated to be 8 kg/year. Consumption of meat in the USA is 124 kg per capita per year (340 g/day) (Ameha, 2008).Ethiopia has about 25.5 million sheep and meat production is the most important function of these animals in the country (CSA, 2013). There is high demand for live animals as well as meat from small ruminants by consumers in the Middle East and North and West African countries. There is also a high domestic demand for small ruminant meat, particularly during religious festivals (Tsedeke, 2007). The country exported 12,000 tons of small ruminant meat in 2005/6. The goal for ruminant meat export in 2008 is 30,000 tons, of which 33% is expected to be from small ruminants (Ameha, 2008).

The annual national mutton meat production is 77 thousand metric tons and about 30% is high average off-take rates estimated from sheep (Workneh, 2006). Sheep contribute some 21% of the total ruminant livestock meat output (Ameha, 2008). While contributing

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significantly to meat production in Ethiopia, present production levels of sheep are far below their potential. A major cause contributing to such low meat yield is that animals are commonly slaughtered at immature body weights, 18–20 kg for sheep and 16–18 kg for goats (Ameha, 2008).

The proximity of Ethiopia to consumers in Middle Eastern countries and their taste preference for our indigenous animals are advantageous for the Ethiopian meat export market (Ameha, 2008). However, the international market for meat is becoming increasingly competitive and meat traders must adopt improved practices in production, processing and packaging of meat to maintain and grow market share. Strict quality control measures to meet specific export-market demands also need to be implemented. Hence, considerable training and extension will be essential in assisting various stakeholders to meet market requirements and maximize the foreign exchange generated from the growing meat industry.

Hay is usually made from mixed pasture by farmers from September up to November in order to feed the animals including sheep at the time of feed scarcity from March up to July (BoARD, 2005). Hay in the central highlands of Ethiopia was harvested after the crude protein (CP) content of the pasture passed peak production and the protein content on dry matter (DM) basis was usually less than 5% (Kidanie, 1993). This was below the level of maintenance requirements for ruminants (Van soest, 1994). Then chemical compositions of hay harvested at North Gondar Wegera woreda was characterized by low CP (4.21%), high NDF (76.75%), and ADF (52.04%) on DM basis (Mulu, 2005). Thus, to improve the utilization of poor quality feed resources in ANRS, it is important to develop supplementation strategy using available agro-industrial by products.

Wide variability exists among Ethiopian small ruminant breeds with respect to potential growth rates and mature weight. Further, most Ethiopian breeds have undergone little selection for improved meat production and true breed potentials are not known. Horro rams have shown capability for post-weaning growth rates of approximately 150 g/day, which would enable them to reach a mature body weight of 45–50 kg at one year of age. Afar rams attain average mature body weights of approximately 40 kg, but post-weaning growth rates have been reported to be less than 100 g/day with supplementary feeding. The maximum post-weaning growth rate of Menz (small-sized breed) ram lambs under improved on-station management appears to be less than 100 g/day. The Awassi × Menz crossbred ram, however, was 40% heavier in yearling body weight under supplementary feeding than purebred Menz (Ameha, 2008). There are opinions that are highland sheep meat is black in color but not supported by research and there is no any study about Farta sheep carcass. Hence, this study will be filling the gap of this and to generate full documents about this Farta sheep.

Objective of the study

- To evaluate the carcass merits of Farta sheep
- To evaluate the effect of concentrated feed on carcass quality of Farta sheep

MATERIAL AND METHODS

Description of the Study Area

The Experiment was conducted in Debre Tabor university research center, which is found in ANRS, South Gondar Administrative Zone. The site is situated at $11^0$40' North latitude and $38^0$00' East longitudes and at 2650 meter above sea level. The mean annual rainfall is 1570 mm and the mean minimum and maximum annual temperatures are 9.6 and 21.5^{0}C, respectively (DoPED, 1997).

Experimental Ration and Ingredients

The feed ingredients was used in the formulation of the different experimental rations of the present study was wheat bran, noug seed cake, salt and hay. Chemical analysis was taking from representative samples of the ingredients and based on the analysis results, five treatment rations was formulated.

Experimental Animal Management

Age of the animals and breed was determined by looking their dentations and asking the information from the owners and phenotypic characteristics, respectively. The animals were adapted for 15 days at the site of the experiment in order to let the animals get accustomed to the specific environment and to observe their health situations. Health precautions and diseases control measures was taking throughout the experimental period. Before the commencement of the actual experiment, the experimental pens, watering and feeding troughs were thoroughly cleaned. A total of twenty five (25) yearling sheep similar body weight was randomly distributed to five dietary treatments. Animals were fed experimental diets for 90 experimental days. The sheep were fed adlibitum in individual pen and feeds were offer twice a day at 08:00 and 16:00 hours and water was available at all times throughout the experimental period.

Table 1: Five dietary treatments that consist of different levels of concentrated feeds

T1 = grass hay alone
T2= Grass hay + 300gm wheat bran
T3= Grass hay+ 200 gm wheat bran +100 gm NSC
T4= Grass hay + 100 gm wheat bran + 200 gm NSC
T5= Grass hay+300 gm Noug Seed Cake

Experimental Design and Treatments

The experiment was conduct in randomized complete block design (RCBD) for consisting five treatments. The experimental animals were blocked into five blocks of five animals based on initial live weight, which was determined by two consecutive weightings after overnight fasting. The animals were randomly assigned in each experimental treatment. The five dietary treatments that consist of different levels of concentrated feeds are shown as follow,

Measurement and Observation

Chemical analysis of feed ingredients and experimental rations

Representative Samples of treatment rations offered was taking at each mixing weighing in each day, bulked over throughout the experimental period for each treatment and sub-sample taken at the end of the experiment. After weighing the ort for each replicate was mixed thoroughly and bulked per treatment, then small amount of samples was take every day, bulked over the experimental period for chemical analysis. Feed samples was analyzed for dry matter (DM), nitrogen (N), ether extract (EE), crude fiber (CF), neutral detergent fiber (NDF), acid detergent fiber (ADF) acid detergent lignin (ADL) and ash by employing the procedure of AOAC (2000).

Feed intake

A weighed amount of feed was offered twice daily 8:00 Am in the morning and 4:00 pm in afternoon. Orts were collect the next morning and weighed after removing external contaminants by visual inspection. For each replicate, the feed offered and refusal was recorded. The amount of feed consumed was determined as the difference between the feed offered and refused on DM basis.

Body weight measurement

The body weight measurement was taking at the beginning and with interval of 15 days up to end of the experiment weighed by balance for individual sheep. The mean daily body weight gain was determined at the end of the experiment as a difference between the final and initial body weight divided by number of feeding days.

Feed conversion ratio

Feed conversion ratio was determined as a ratio of the weight of feed consumed per carcass weight. The formula is as follows:

$$\text{Feed conversion ratio} = \frac{\text{Weight of feed consumed (g)}}{\text{Carcass weight (g)}}$$

Carcass evaluation

At the end of the feeding trial half of the experimental sheep were fasted for 12 hours and slaughtered. Animals were weighed immediately before slaughter. The blood were drained in to bucket and weighed. The head were detached from the body. The skin was flayed, fore and hind legs were trimmed off at the carpal and tarsal joints and weighed. After that internal contents of the gut were emptied and weight of the empty gut was recorded. The empty body weight was then determined as slaughter weight less gut contents. The hot carcass weight was estimated after removing weight of the head, thorax, abdominal and pelvic cavity contents as well as legs below the hock and knee joints. Rib eye muscle area was traced on transparency paper after cutting the vertebrae between the 12th and 13th ribs. The weights of both the edible and non-edible carcass components were recorded.

For sensory panel test (Smell, tenderness, juiciness and taste) meat from each cut was cooked for 70 minutes in a circulating water bath at 70^0C temperature, then was cut in to small cubes, and offered to a panel of 6 evaluators. Each evaluator will score for each of the above parameters on their scale.

Partial budget analysis

The partial budget analysis involved the calculation of the variable cost of sheep, feeds and benefits gained from the result. Market prices of sheep was assess in Debre Tabor town animal market before the experimental sheep

Table 2: Chemical composition of different concentrated mixture in treatments

Chemicals composition of Offered feed	Treatment diet				
	T1	T2	T3	T4	T5
DM (%)	91.3	90.2	91.6	91.5	92.4
Ash (%)	6.34	5.34	6.62	7.96	7.91
CP (% DM)	7.2	17.16	23.83	29.20	30.57
NDF (% DM)	55.88	46.57	67.99	72.04	88.19
ADF (% DM)	48.95	28.93	28.12	28	31.66
ADL (% DM)	10.27	4.04	5.06	5.23	6.51

ADF= acid detergent fiber; NDF= neutral detergent fiber; ADL = acid detergent lignin

Table 3: Feed intake of Farta sheep fed different mixture of ingredients

Body weight	Treatment					Mean	P value
	T1	T2	T3	T4	T5		
Total Hay intake (kg/head)	177.79^{a}	175^{ab}	174.14^{ab}	169.42^{b}	166.9^{b}	172.65	0.03
Hay intake (kg/head/day)	1.97^{a}	1.94^{ab}	1.9^{ab}	1.88^{b}	1.85^{b}	1.908	0.04
Supplement intake (g/h/day)	0.00	300	300	300	300	240	0.76
Total DDMI (g/h/day)	394^{c}	688^{a}	680^{ab}	676^{b}	670^{b}	621.6	0.02

*$^{a, b}$ Means within a row with different superscripts are significantly different; Ns = no significant; * = significant at (P<0.05); TDMC = Total Dry Mater Consumed; DDMI = Daily Dry Matter Intake*

was purchase. In the analysis, the total return (TR) was determined by the difference between selling and purchasing price of sheep in each treatment after and before the experiment. The change of net income (∆NI) was calculated by subtracting change of total variable cost (∆TVC) from the change of total return (∆TR):

∆NI= ∆TR-∆TVC

The change in net income (∆NI) was calculated as the difference between the change in total return (∆TR) and the change in total variable cost (∆TVC):

∆NI = ∆TR - ∆TVC.

The marginal rate of return (MRR) measures the increase in net income (∆NI) associated with each additional unit of expenditure (∆TVC):

MRR = (∆NI)/ (∆TVC).

Methods of data analysis

Analysis of variance (ANOVA) in using SAS 9.1.3 version of statistical software package used to analyze the data.

RESULT AND DISCUSSION

Chemical composition of experimental feeds

The chemical composition of different experimental feeds is shown in Table 2. The dry matter of basal diet in this experiment was contradictory to the DM content of 93.42% reported by Fentie Bishaw (2007). But it was in line with Aschalew and Getachw (2013) that reported 91.06%. The CP content of basal diet in this experiment disagrees with the CP content of 3.56% reported by Fentie Bishaw (2007) but was similar with Aschalew and Getachw (2014) reported 6.70% and Brihanu and Getachew (2013) reported 6.23%. The ADF of basal diet used in the current experiment was similar that reported by Aschalew and Getachew (2013) but less than 53.48 that reported by Fentie (2007) and greater than 45.33 that reported by Brihanu and Getachew (2013). But the ADL was almost similar that reported by Aschalew and Getachw (2013) and brihanu and Getachew (2013) and greater than Fentie (2007) repot 5.6.

Dry matter intake

Dry matter intake (DMI) of yearling Farta sheep fed diet containing hay basal diet and different concentrate supplementation is presented in Table 2. The daily dry matter intake of yearling Farta sheep fed 100% NSC with basal hay was significantly (P<0.05) lower than basal hay. This daily intake is shows as the basal diet because the concentrate neither was nor refused. Therefore, the intake of basal diet was reduced when concentrate added in the ration of yearling sheep. The intake of basal diet in the current experiments agrees with the report of Fentie Bishaw (2007). In the current experiment, the daily dry matter intake of basal diet was significantly lower than

Table 4. Yearling sheep body weight change and feed conversion efficiency

Body weight	Treatment					Mean	P value
	T1	**T2**	**T3**	**T4**	**T5**		
Initial body weight (kg)	20	21.67	21.56	21.72	21.83	21.32	0.26
Final body weight (kg)	21.08^{b}	25.40^{ab}	25.83^{ab}	26.7^{a}	27^{a}	24.45	0.009
MDBWG (g)	1.2^{c}	41.4^{b}	47.4^{ab}	55.3^{ab}	57.4^{a}	23.45	0.04
FCE	0.93^{b}	1.1^{a}	1.12^{a}	1.04^{ab}	1.07^{ab}	1.03	0.001

*[a, b] Means within a row with different superscripts are significantly different; Ns = no significant; * = significant at (P<0.05);* MDBWG *= Mean Daily Body Weight Gain in Gram; FCE = Feed conversion efficiency*

Table 5: Carcass characteristics of Farta sheep fed on hay and different concentrated level

Carcass characteristics	**Treatment**					**Mean**	**P value**
	T1	**T2**	**T3**	**T4**	**T5**		
Pre-slaughter weight (kg)	22.5	26	26.5	26.25	27	25.65	0.196
Hot carcass weight (kg)	7.99	12	11.5	12.51	11.5	9.9	0.241
Dressing percentage (%)	35.51	46.15	43.4	48.04	42.59	38.48	0.406
Rib eye area (cm2)	11.25^{b}	12^{ab}	14.75^{a}	11^{b}	12.25^{ab}	12.25	0.027
TEOC (kg)	2.66	2.28	3.31	2.62	2.73	2.72	0.16
TNEOC (kg)	6.44	7.44	7.35	6.04	7.92	7.04	0.34

*[a, b] Means within a row with different superscripts are significantly different; Ns = no significant; * = significant at (P<0.05); TEOC = total edible organ component; TNEOC = total none edible organ component*

540.5 g/h/day that reported by Fentie Bishaw (2007).

Body weight change

The effect of concentrate supplementation on body weight change of Farta sheep is represented in Table 4. According to Ascalew and Getachew (2013) and Brihanu and Getachew (2013) for Farta and Ogaden sheep the daily body weight gain is increases when the concentrated level increased. In the current experiment was also increased when the concentrate level increased. There was significance difference in initial body weight and final body weight among treatments, and mean daily body weight gain of sheep fed diet consisting hay as basal diet was significantly (P<0.05) lower than other treatments. The result indicated that the daily body weight gain and feed conversion efficiency was increased when yearling sheep were fed concentrated feeds accordingly.

Carcass Components

In the current experiment the dressing percentage of the supplemented yearling sheep was greater numerically than the non-supplemented ones (Table 5) below. The pre-slaughter weight, hot carcass weight, and gut fill in this study appeared to be of no different among treatments but rib eye area was significantly different. Among the supplemented groups, there was no significant (P>0.05) difference in empty body weight, ribeye muscle area and dressing percentage as a proportion of slaughter weight. Dressing percentage as proportion was greater (P<0.05) for animals supplemented with 67.3% NSC and 33.7% of wheat bran with hay as basal diet.

Meat quality

Panelists rated their samples in well ventilated, partitioned booths, under red lighting. Panelists cleansed their palate between each sample with apple juice diluted 50% with filtered water, unsalted crackers and filtered room temperature water. Attribute ratings were electronically collected using eight-point descriptive scales for initial and overall tenderness (8=extremely tender; 1=extremely tough), juiciness (8=extremely juicy; 1=extremely dry), lamb flavour intensity (8=extremely intense lamb flavor; 1=extremely bland lamb flavor), off flavor intensity (8=extremely bland or none, 1=extremely intense off flavor). Flavor desirability and overall palatability were rated on an eight point hedonic scale, (8=extremely desirable; 1=extremely undesirable).

Initial tenderness was rated on the first bite through the cut surface with the incisors, juiciness was rated after eight chews with the molars, and flavor desirability was evaluated after 10 to 15 chews, lamb flavor and off flavor intensity between 10 to 20 chews and overall tenderness

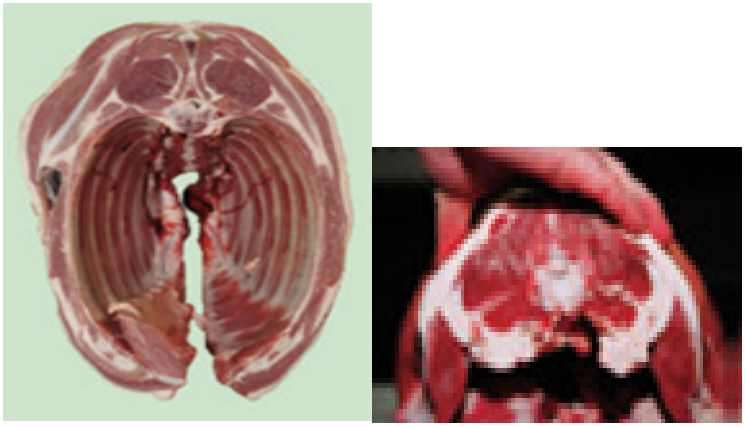

Table .6: Mean sensory attributes of yearling Farta sheep meat obtained from different feeds

Meat characteristics	Treatments					Mean
	T1	T2	T3	T4	T5	
Juiciness	80%	60%	60%	60%	60%	64
Tenderness	20%	20%	20%	20%	20%	20
Salty	0%	20%	20%	20%	20%	16

Table 7: Partial budget analysis for Farta sheep and feed

Parameter	Treatments				
	T1	T2	T3	T4	T5
Purchasing price of sheep ETB/head	850	850	850	850	850
Hay consumed (kg/head)	177.79	175	174.14	169.42	166.9
Concentrate feed consumed (kg/head)	0.00	27	27	27	27
Total feed consumed (kg/head)	177.79	203	201.14	196.42	193.9
Cost of hay (ETB/head)	88.89	87.5	87.17	84.86	83.6
Cost of concentrate (ETB/head)	-	62.1	72.9	83.7	94.5
Total feed cost (ETB/head) (TVC)	88.89	149.6	160.07	168.56	178.1
Gross income (R) (ETB/head)	1122	1142	1156	1250	1330
Total return (TR) (ETB/head)	272	292	306	400	480
Net income (NI) (ETB/head)	183.11	142.4	145.93	231.44	301.9
Change of net income (ΔNI)	-	-40.71	-37.18	48.33	118.79
Change of total variable cost (ΔTVC)	-	60.71	71.18	79.69	89.21
MRR (ΔNI/(ΔTVC)	-	-0.67	-0.52	0.61	1.33

TVC = Total variable cost; TR = Total return; NI = Net income; ΔTVC = change of total variable cost; ΔNI = change of net income; MRR = marginal rate of return; ETB = Ethiopian birr's NR = net return

after 25 chews. At the end of each ballot, all panelists had the opportunity to comment on any off flavors or texture characteristics that were found in the samples.

High sensory scores (7 on a scale of 0 to 10) were recorded for all treatments (Table 6). These scores correspond well with previous sensory scores obtained by the same taste panel for bran with NSC fed normal feedlot diets (Webb et al., 1997; 1999). The juiciness score of loin samples from NSC and wheat bran fed the 90% was higher ($p < 0.05$) than fed others treatments. Ilian et al. (1988) recorded the highest juiciness scores in meat from sheep fed a diet.

Partial budget analysis

The partial budget analysis for the feeding trial is presented in Table 7. The result of the partial budget analysis indicated that the gross financial margin or total return obtained in this trial was 272, 292, 306, 400 and

480 ETB/sheep for yearling Farta sheep fed on T1, T2, T3, T4 and T5 diets, respectively.

As it is indicated from the partial budget analysis in Table 7, yearling farta sheep fed on 100% of NSC (T5) returned a higher net income (251.9 ETB/sheep) as compared to the other treatments.

The net return from each treatment was 183.11, 102.4, 95.95, 181.44 and 251.9 ETB/head for T1, T2 T3, T4 and T5 respectively. The percent of marginal rate of return (MRR) was 61 and 133 for T4 and T5, respectively. Thus, it indicated that each additional unit of one ETB per body weight of sheep cost increment resulted in one ETB and additional 0.61 and 1.33 ETB benefit for T4 and T5, respectively. Yearling farta sheep fed on rice straw treated by effective micro- organism (T5) had the highest net income and MRR value (118.79 and 133%, respectively) as compared to the other treatment groups. Therefore, feeding of noug seed cake for yearling farta sheep had better economic benefits as compared to feeding of other diets.

CONCLUSIONS AND RECOMMENDATIONS

The chemical composition of the experimental feeds indicated that the basal diet of hay low CP (7.2%) content which is below the maintenance requirement of animals. The concentrate level of ration added in the basal diet increases its CP content. The NSC allows and hay had 30.57% of Cp as compared to T2, T3 and T4; this was increases the dressing percentage as compared to sheep fed hay allows. The daily mean body weight gain of animals fed on hay allows (23.1 g/h/day) was significantly lower ($p<0.05$) than animals fed concentrated feed. The result of the feeding trial indicated that animals fed NSC allow with hay was higher ($p<0.05$) daily dry matter intake (57.4g/h/day) as compared to other treatments. Hence, according to the results of this study feeding of yearling Farta sheep with feed 66.7% wheat bran and 33.3% NSC and 33.3% wheat bran and 66.7% NSC was efficient for both biologically as compared to other treatments. For farther research we recommended that to determine the level of concentrated feed added in basal diet of yearling Farta sheep for maximum body conformation.

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