ECRONICON OPEN ACCESS

EC VETERINARY SCIENCE
Research Article

# Nutrient Utilization and Fattening Performances of Menz Ram Lambs Fed Grass Hay Basal Diet and Supplemented with Different Concentrate Mixtures

**Wude Tsega Beyene***

*Ethiopian Institute of Agricultural Research, Debra Zeit Agricultural Research Center, Bishoftu, Ethiopia*

***Corresponding Author**: Wude Tsega Beyene, Ethiopian Institute of Agricultural Research, Debra Zeit Agricultural Research Center, Bishoftu, Ethiopia.

**Received:** February 18, 2020; **Published:** March 30, 2020

## Abstract

An experiment was conducted to evaluate fattening performance of 24 Menz ram lambs fed grass hay basal diet and supplemented different concentrate mixes. The treatments were $T_1$ (30g wheat bran 133g broken lentil screening), $T_2$ (235g broken lentil screening only), $T_3$ (285g wheat bran only), and $T_4$ (227g wheat bran and 120 broken lentil screening). Concentrate mixes affected ($P \leq 0.01$) the daily total dry matter intake (TDMI), concentrate dry matter intake and total crude protein intake of the lambs with the highest TDMI (814.47g) recorded at $T_4$. Final body weight attained, total body weight gain and average daily body weight gain of lambs on $T_4$ were highest ($P \leq 0.001$). The experimental lambs showed lower ($P \leq 0.01$) feed conversion efficiency (0.06) in $T_1$ than the values recorded from $T_2$, $T_3$ and $T_4$ diets. Sheep assigned to $T_4$ and $T_3$ diets showed higher ($P \leq 0.05$) dry matter digestibility than in $T_1$. Total nitrogen intake nitrogen digestibility and nitrogen retention were higher ($P \leq 0.001$) for lambs in $T_4$ than $T_2$, followed by $T_3$ and $T_1$ diet categories. Thus, a 227g wheat bran and 120g broken lentil screening concentrate mixture supplementation on grass hay basal diet was the best for fattening of Menz ram lambs.

***Keywords:*** *Digestibility; Feed; Lamb; Concentrate Mixes; Nutrient Utilization*

## Introduction

Sheep production exists in a variety of environments under different production systems around the world. The sheep population in Ethiopia is estimated at 25.9 million and constitutes about 24% of the total livestock population [1]. Due to expansion of towns and crop production, land is becoming scarce; rearing of large ruminants is likely to be more difficult than sheep production. Because, sheep require less feed and space as compared to cattle. Additionally, the feeding behaviors of sheep enables to integrate sheep production with various perennial crops with additional benefit of reduce input cost that can be allocated to eliminate weeds [2]. Due to short reproductive cycles of sheep, there is a potential for a higher annual off take and allows the producers for quick interval of selling part of the flock to generate cash income. In addition, sheep manure has a higher dry matter content that provides gardeners with high quality organic fertilizer and does not cause significant pollution to the environment [3].

Though, production of sheep has a lot of advantages as compared to large ruminants, getting of lambs with required slaughter weight is not good enough in Ethiopia. The nature of breed and feed scarcity are the main determinant factors for lower birth weights, weight gains, weaning weights and then lower slaughter body weight. Ethiopian sheep are slaughtered on average at about 12 months of age with live

weights ranging from 18 - 20 kg [4]. Sheep finishing activities are undertaken in different areas of Ethiopia to improve the low slaughter weight of sheep. Younger growing animals utilize feed nutrients more efficiently than older and mature animals during fattening [5].

Plane of nutrition as a factor of environment has central role to determine the body weight change performance of sheep [6]. Moreover, sheep require large quantities of energy and protein during the main period of growth between weaning and attaining mature body weight [5]. Supplementing animals with energy and protein rich diets have proven to improve animal performance and profitability [7]. But different studies explained that excess dietary energy and protein in sheep feeding is disadvantageous from various perspectives. So, it is important to determine best levels of energy and protein source feeds those can be result in better slaughter body weight of lambs.

Thus, identifying the best combination of dietary energy and protein source concentrate supplements is important in practical feeding system to avoid under or overfeeding of the animals and to improve feed efficiency. Manipulation of nutrition and short term intensive feeding using locally available feedstuffs is a strategy that can be employed to increase animal live weight gain and economic feasibility [8]. According to the survey work result [9] wheat bran and lentil split screening locally called "ymiser kik bitari (Elet)" are the most predominant dietary energy and protein source concentrate supplements use for sheep fattening in and around Debre Berhan Town where surroundings are the niches for Menze sheep breed

Therefore, it was worthwhile to evaluate feed nutrient utilization and body weight change of Menz ram lambs fattened on feeding of different wheat bran and lentil screening mixtures supplementation and grass hay basal diet.

## Materials and Methods

### Experimental Site

The feeding and digestibility trials were conducted at Debre-Zeit Agricultural Research Center located at about 45 km from Addis Ababa at an altitude of about 1900 meters above sea level. The mean annual rainfall and mean maximum and minimum temperatures for the area are 1100 mm and 28.3°C and 8.9°C, respectively [10].

### Experimental animals

Experimental animals were 24 Menz-sheep-breed ram lambs. The age range of lambs was from 8 to 10 months and the initial body weight was 17.97 ± 0.28 kg (mean ± SE). Age was estimated based on dentition and information obtained from the owners. Lambs were quarantined for 3 weeks during which they were treated against internal and external parasites with albendazole bolus and acarimic spray, respectively. Lambs were also vaccinated against pneumonia, sheep pox, blackleg, and anthrax diseases. The ethical clearance was obtained from veterinary research team of the center for performing animal trials.

### Feed ingredients and experimental diets

The feed ingredients used for feeding the experimental lambs were native pasture grass hay, wheat bran; broken lentil screening locally called "ymiser kik bitari (Elet)" and salt which were among commonly available feed ingredients, where the experimental animals are predominantly found. Broken lentil screening is a mixture of high amount of broken lentil and very few lentil bran and lentil spur. Experimental diets were formulated by reviewing of different literatures about the energy and protein requirements of dietary energy and protein for growing lambs.

The combination of these dietary energy and protein source concentrates were determined based on nutrient recommendation guides for other breeds. Wheat bran and broken lentil screening combination was set (Table 1) the total offered feed to be contained around 8 to 9 MJ ME per kg DM and 10% to 12% CP considering the energy and protein the animals can also get from grass hay ad libitum feeding.

| Treatment | Experimental feed ingredients (g) | | | Total (g) | Nutrients | |
|---|---|---|---|---|---|---|
| | Wheat bran | Broken lentil screening | Salt | | ME (MJ/kg DM) | CP (%) |
| $T_1$ | 30 | 133 | 5 | 168 | 10.5 | 25.73 |
| $T_2$ | 0 | 235 | 5 | 240 | 10.4 | 27.73 |
| $T_3$ | 285 | 0 | 5 | 290 | 11.7 | 18.23 |
| $T_4$ | 227 | 120 | 5 | 352 | 11.3 | 21.62 |

***Table 1:*** *Concentrate feed ingredients used to formulate treatment diets.*

### Experimental design and layout

Randomized complete block design (RCBD) was used to undertake the experimental study. Four dietary treatments from different wheat bran and lentil screening combinations were arranged as:

| |
|---|
| $T_1$ = Diet containing 30g wheat bran and 133g broken lentil screening combinations |
| $T_2$ = Diet containing 235g broken lentil screening combinations |
| $T_3$ = Diet containing 285g wheat bran |
| $T_4$ = Diet containing 227g wheat bran and 120 broken lentil screening |

The experimental lambs were grouped into six blocks of four lambs based on their initial body weight, which was determined two weighing average after overnight fasting at the end of the adaptation period of 15 days. Four treatment diets were randomly assigned to each lamb in the block, making six lambs per treatment.

### Feeding of experimental lambs

Lambs were fed individually during the experimental period by offering grass hay basal diet *ad libitum* ensuring a refusal of 20%, based on previous day's intake. Concentrate supplements were offered twice a day in two equal portions at 0800 and 1600 hours. There was an adaptation period of 15 days to the experimental feeds before the commencement of data collection. Water was given ad libitum. Feed offered and refused was measured daily using 5 kg sensitive balance with one gram precision, and the difference between the daily total feed offered and the daily refused was considered as daily feed intake on DM basis.

### Body weight change and feed conversion efficiency

On the first day of the commencement of the feeding trial, at the end of 15 days of adaptation period to treatment feeds the average of two weighing was taken as initial body weight of lambs. The daily feed and subsequent body weight measurements were taken at a ten-day interval after overnight fasting using a 100 kg Salter fixed balance. The average daily body weight change was calculated as the difference between the initial and final live weight of the lambs divided by the number of experimental days. Feed conversion efficiency (FCE) of the lambs was determined as the proportion of daily body weight gain to the daily total DM intake [11].

### Digestibility and nitrogen balance evaluation

After 90 days feeding trial the digestibility and nitrogen balance evaluation was conducted. Five lambs per treatment were randomly selected and fitted with faecal collection bags and urine collection tube for three days of adaptation period followed by seven days of faeces collection period for determination of the digestibility of the total diet. The daily feed intake of each lamb was recorded. Samples of feed offered and refused as well as faeces excreted were collected every day in the morning. Total faeces voided in the harness were

weighed and recorded daily during the collection period. Faeces collected from each lamb were mixed thoroughly and 10% of the mixed faeces were sub-sampled daily and bulked over the experimental period per lamb and kept in a deep freezer below -20°C pending analysis. At the end of the collection period, the bulked samples of each lamb were towed and thoroughly mixed and sub-sampled for partial drying at 60°C in a draft oven. Then, apparent digestibility coefficient of DM, CP, NDF, and ADF of the total feed was determined as the difference between nutrients consumed and nutrients in the faeces divided by nutrient intake [12], using the following formula:

$$\text{Apparent digestibility (\%)} = \frac{\text{Nutrient intake} - \text{Faecal nutrient output}}{\text{Nutrient intake}} \text{ x } 100$$

Urine voided by each lamb was collected in a glass placed in plastic bucket under the metabolic cage. Hundred ml of sulfuric acid solution (10%) was added to each urine collection buckets daily to trap N that might escape as ammonia from the urine. The urine collected from each lamb was measured daily using graduated cylinder and 20% of urine-voided per lamb was sampled and pooled over the collection period. The urine was stored at -20°C pending chemical analysis. Then, the N-excreted through urine was calculated by multiplying the total urine voided by its nitrogen content. The daily N retention then was calculated as a difference between N-intake and N-excreted through urine and faeces [12].

### Partial budget analysis

The partial budget analysis was conducted according to [13] to illustrate and estimate the economic importance of feeding lambs on diets containing different wheat bran and lentil screening combinations in terms of feed cost per unit weight gain.

### Laboratory analysis

The partially dried representatives of feed and faeces samples were milled using laboratory mill to pass through 1 mm sieve screen and analyzed for DM and ash according to the procedure of [14]. The two-stage method outlined by [15] was followed to determine IVOMD and then metabolizable energy (ME) content was estimated using the equation: ME (MJ/kg DM) = 0.16*IVOMD [12]. Nitrogen (N) was analyzed according to Kjeldhal procedure and CP was determined as N * 6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were analyzed [16].

### Data analysis

Data generated from experimental work was analyzed using SAS software [17]. Mean comparison was done using Duncan's multiple range test and significant differences between the treatment groups were considered at $P \leq 0.05$.

The model fitted to calculate the different response variables were:

$Y_{ij} = \mu + a_i + e_i$

Where:

$Y_i$ = Response variables

$\mu$ = Over all mean

$a_i$ = $i^{th}$ Effect of wheat bran and broken lentil screening combinations

$e_i$ = Effect of the $i^{th}$ random error.

## Result and Discussion

### Feed nutrient composition

The laboratory chemical analysis result for experimental feed ingredients is presented on table 2. The dry matter (DM), metabolizable energy (ME) and crude protein (CP) contents of grass hay were 92.01%, 7.69 MJ and 6.85%, respectively. The contents of *in vitro* organic

matter digestibility (IVOMD), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) of grass hay were 48.09, 32.5, 36.5 and 11.8%, respectively.

| Feed ingredient | Nutrient composition (%DM) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | DM% | IVOMD | ME | CP | NDF | ADF | ADL | Ash |
| Hay | 92.01 | 48.09 | 7.69 | 6.85 | 32.5 | 36.5 | 11.8 | 9.54 |
| Wheat bran | 91.17 | 74.62 | 11.94 | 18.55 | 35.94 | 10.8 | 2.9 | 17.50 |
| Broken lentil screening | 91.73 | 66.45 | 10.63 | 28.32 | 30.2 | 8.51 | 3.8 | 15.61 |

***Table 2****: Nutrient composition of experimental feed ingredients (%).*

*Note: DM: Dry Matter; IVOMD: In Vitro Organic Matter Digestibility; ME: Metabolizable Energy; CP: Crude Protein; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; ADL: Acid Detergent Lignin.*

The chemical analysis result also showed that wheat bran contained 91.17% DM, 74.62% IVOMD, 11.94 MJ, ME, 18.55% CP, 35.94% NDF, 10.8% ADF and 2.9% ADL. The DM, IVDOM, ME, CP, NDF, ADF and ADL values of broken lentil screening were 91.73%, 66.45%, 10.63 MJ, 28.3%, 30.2%, 8.51%, and 3.8%, respectively.

Almost similar CP content (6.85%) of grass hay was reported previously [18]. Another author [19] indicated higher DM (93.3%), NDF (76.8), ADF (52.0%), and lower CP (4.2%) contents of grass hay than the present finding. The ME value of hay in the present study (7.69 MJ $Kg^{-1}$ DM) was lower than 10 MJ $Kg^{-1}$ DM reported by [20]. In agreements with the present report, the ME value of grass hay at different harvesting seasons was 6.97 - 8.65 MJ ME $Kg^{-1}$ DM [21].

The higher CP (18.55%) and similar ME (11.94 MJ) content of wheat bran was reported [22]. The present study showed that broken lentil screening had less energy value and more CP value as compared with wheat bran, indicating that it could be a reliable source of protein supplement for the animals. The CP value of broken lentil screening found in the present study (28.3%) was within the range of the wider varieties of lentil seed CP content (23 - 30%) reported [23]. The composition of lentil split screening used in the present study was broken lentil grain, bran (hulls) and spur. Thus, the higher CP value in broken lentil screening could be due to the presence of lentil spur in it. The value differences in nutrient contents of grass hay, wheat bran and broken lentil screening between the present and the previous studies could be due to harvesting stage and time, storage facility, soil type and weather condition and varietal differences.

## Dry matter and nutrient intake

The effects of different combinations of wheat bran and broken lentil screening on the average daily dry matter and nutrient intake of ram lambs is presented in table 3. Wheat bran and broken lentil screening combinations lowered ($P \leq 0.05$) the daily hay dry matter intake (HDMI) and the hay crude protein intake (HCPI) and increased ($P \leq 0.05$) total dry matter intake (TDMI). The total metabolizable energy intake (TMEI) and total crude protein intake (TCPI) of lambs were different ($P \leq 0.001$) between treatment groups.

The hay dry matter intake of the lambs was highest for a combination of 30g wheat bran and 133g lentil screening ($T_1$) than $T_3$ and $T_4$ concentrate supplement. Lambs assigned for 227g wheat bran and 120g lentil screening combination ($T_4$) showed highest TDMI than $T_1$, $T_2$ and $T_3$ diet groups. The total metabolizable energy intake of lambs was higher in $T_4$ than $T_1$ and $T_2$ groups. Lower TCPI was recorded for lambs assigned to a concentrate diet with 30g wheat bran and 133g lentil screening combinations ($T_1$) than recorded for $T_3$ followed by $T_2$ and $T_4$ diet groups.

The higher DMI in $T_4$ and $T_3$ was associated with more concentrate offered for the animals assigned to higher energy higher contained diets. In agreement with the present findings [24] dietary energy levels influenced the nutrient intake of lambs. The total dry matter in-

| Treatment | Measured Variables<br>Measured Variables | | | | | | |
|---|---|---|---|---|---|---|---|
| | Hay DMI | Conc. DMI | TDMI | TMEI | Hay CPI | Concentrate CPI | Total CPI |
| $T_1$ | 548.06$^{a}$ | 168.0$^{a}$ | 716.06$^{a}$ | 5.75$^{a}$ | 37.54$^{a}$ | 43.23$^{a}$ | 80.77$^{a}$ |
| $T_2$ | 520.17$^{ab}$ | 240.0$^{b}$ | 760.17$^{a}$ | 6.23$^{b}$ | 35.63$^{ab}$ | 66.55$^{b}$ | 102.18$^{b}$ |
| $T_3$ | 485.11$^{b}$ | 290.0c | 775.11$^{a}$ | 7.09$^{c}$ | 33.23$^{b}$ | 52.87$^{c}$ | 86.10$^{c}$ |
| T4 | 462.47$^{b}$ | 352.0$^{d}$ | 814.47$^{b}$ | 7.18$^{cd}$ | 31.68$^{b}$ | 76.09$^{d}$ | 107.77$^{d}$ |
| Sig. | * | *** | * | *** | * | *** | *** |

***Table 3:*** *Dry matter and nutrient intake as affected by concentrate mixture (g).*

***Note:*** *DMI: Dry Matter Intake; DMD: Dry Matter Digestibility; CPI: Crude Protein Intake; CPD: Crude Protein Digestibility; NDFD: Neutral Detergent Fiber Digestibility; ADFD: Acid Detergent Fiber Digestibility; abc: Values in the same column with different superscripts differ significantly;*: P ≤ 0.05; **: P ≤ 0.01; ***: P ≤ 0.001.*

take (TDMI) of the animals was higher for the diets containing higher energy concentrate supplement than was at lower level. Similarly, another author [25] reported that finishing Awassi lambs on high energy diet improves DMI better than on low energy diet. The higher concentrate dry matter intake (CDMI) at 227g wheat bran and 120g lentil screening ($T_4$) was associated with high concentrate offered for these groups. More amount of CP concentrate feed offered also resulted in a higher concentrate crude protein intake (CCPI) and total crude protein intake (TCPI) of the animals.

In line with the present finding, low hay dry matter intake as levels of concentrate intake increased in Afar sheep lambs was observed [26]. The total DMI (814.47g) observed from $T_4$ diet was in agreement with 802 ± 9.35g of previously reported [4] from one year old Menz lambs fed on hay *ad libitum* and 400g concentrate supplement. In disagreement with, low total feed intake as protein levels in the lamb's diet increased was observed [27]. Other scholars [28] reported 568 ± 11g daily DM intake from 5 - 7 month-old Menz ram lambs on grazing and supplemented with 80 g molasses-urea-block, which was less than the DMI recorded in the present study. It could be due to the experimental animals' age and feed composition differences.

The feed intake data showed that there was an increasing trend as the feeding period increases (Figure 1). The dry matter intake of lambs in $T_1$ was increased during the first ten days of feeding period at an increasing rate. Then, from 30$^{th}$ up to 60$^{th}$ days it was increasing at decreasing rate followed by increasing with higher rate up to the last days of the experimental period. Lambs assigned to $T_2$ showed higher rate of dry matter intake during the 1$^{st}$, 2$^{nd}$, 3$^{rd}$ and 4$^{th}$ ten-day interval but, afterwards it increased at decreasing rate and then kept increasing till the last experimental days.

In a diet containing 285g wheat bran ($T_3$) during the 1$^{st}$ ten days interval, the DMI was increased at decreased rate then became increased at higher rate till the 70$^{th}$ day and then the increasing rate became lower. The lambs offered a diet contained 227g wheat bran and 120g lentil screening ($T_4$) showed less DMI increasing rate during the 1$^{st}$ and 2$^{nd}$ ten day intervals, then increased at increased rate up to the end of experimental days.

## Dry matter digestibility and nutrient utilization

Table 4 shows the effect of wheat bran and lentil screening combinations on dry matter and nutrient digestibility. During the digestibility trial, the dry matter intake (DMI) and dry matter digestibility (DMD) of experimental lambs were different (P ≤ 0.05) between the concentrate supplement combinations. The crude protein intake (CPI) and the, crude protein digestibility (CPD) were significantly

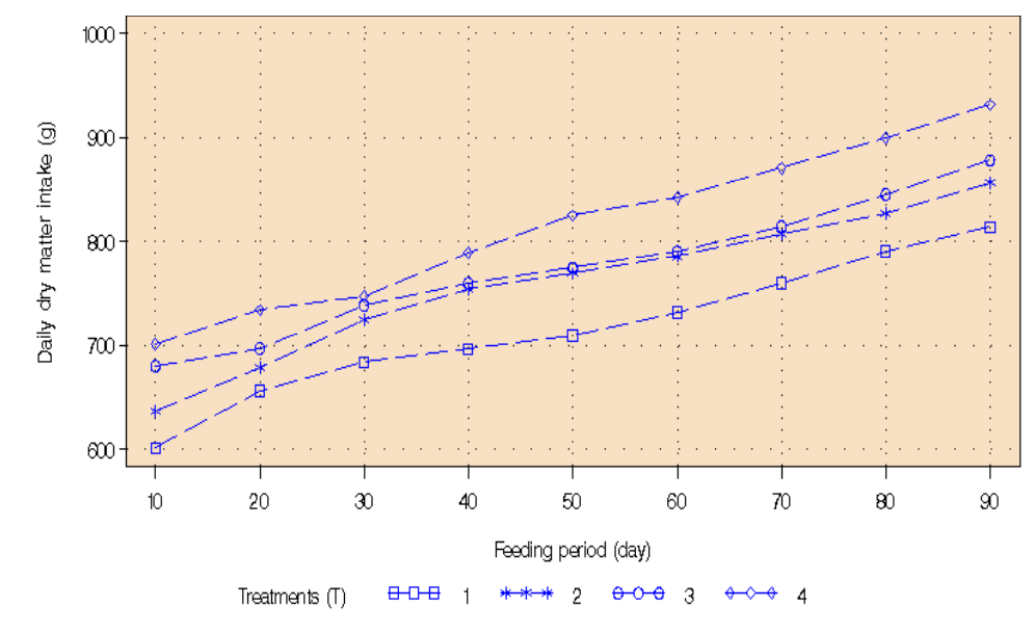


***Figure 1:*** *Trends of dry matter intake by experimental animals as affected by concentrate mixtures.*
*Note: 1 = A diet contained 30g wheat bran and 133g lentil screening ($T_1$); 2 = A diet contained 235g lentil screening ($T_2$); 3 = A diet contained 285g wheat bran ($T_3$); 4 = A diet contained 227g wheat bran and 120g lentil screening ($T_4$).*

affected (P ≤ 0.001) by wheat bran and lentil screening combinations. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) digestibility were different (P ≤ 0.01) between the treatment diets groups. Accordingly, higher DMI and DMD were recorded for lambs assigned to 227g wheat bran and 120g lentil screening contained concentrate supplement ($T_4$) than those fed 30g wheat bran and 133g lentil screening mixture ($T_1$) diet.

| Treatments | Measured variables | | | | | |
|---|---|---|---|---|---|---|
| | DMI (g) | DMD (%) | CPI (g) | CPD% | NDFD (%) | ADFD (%) |
| $T_1$ | 649.30$^{a}$ | 62.95$^{a}$ | 76.20$^{a}$ | 74.77$^{a}$ | 43.02$^{a}$ | 47.89$^{a}$ |
| $T_2$ | 672.02$^{a}$ | 66.75$^{ab}$ | 96.15$^{b}$ | 81.17$^{b}$ | 49.89$^{ab}$ | 48.58$^{a}$ |
| $T_3$ | 709.43$^{ab}$ | 74.59$^{b}$ | 81.60$^{ac}$ | 82.86$^{c}$ | 63.99$^{b}$ | 64.52$^{b}$ |
| T4 | 791.87$^{b}$ | 75.76$^{b}$ | 106.22$^{d}$ | 86.41$^{d}$ | 66.48$^{b}$ | 66.70$^{b}$ |
| Sig. | * | * | *** | ** | * | ** |

***Table 4:*** *Dry matter and nutrient digestibility as affected by wheat bran and lentil screening combinations.*
*Note: DMI: Dry Matter Intake; DMD: Dry Matter Digestibility; CPI: Crude Protein Intake; CPD: Crude Protein Digestibility; NDFD: Neutral Detergent Fiber Digestibility; ADFD: Acid Detergent Fiber Digestibility; abc: Values in the same column with different superscripts differ significantly;* * = P ≤ 0.05; ** = P ≤ 0.01; *** = P ≤ 0.001.*

The CPI was higher at a diet contained 227g wheat bran and 120g lentil screening mixture ($T_4$) than on a diet contained 235g lentil screening ($T_2$), followed by on 285g wheat bran ($T_3$) and 30g wheat bran and 133g lentil screening ($T_1$) diet group. The CPD was also higher in $T_4$ than $T_3$ followed by $T_2$ and $T_1$. Similarly, NDF and ADF digestibility was higher for lambs fed with 227g wheat bran and 120g lentil screening contained concentrate supplement ($T_4$) than those lambs assigned to $T_1$ diet categories.

Better DM and nutrients utilization observed was due to increasing of dietary energy level at higher concentrate combination. In agreement with this, different researchers [24] and [33] reported a higher digestibility of DM and N as energy levels increased in the diet. Finishing Awassi lambs on 2.92 Mcal $kg^{-1}$ diet improved nutrient digestibility than on 2.40 Mcal $kg^{-1}$ diets [25]. The total CP intake of lambs was higher at higher protein containing concentrate in the present study. The DM and N intake and digestibility of Awassi lambs was higher at 13.5 than 11.5% CP but, it decreased at a diet with highest CP (15.5%) content [34]. Better NDF and ADF digestibility observed at higher wheat bran and lentil screening combination level could be due to a better rumen environment created for fiber fermented microbial population. The DM intake was decreased during digestibility trial than the feeding trial, which might be due to stress conditions created due to urine and feces collection materials tied to experimental animals.

The effect of wheat bran and lentil screening combinations on nitrogen balance of fattening ram lambs is presented in table 5. The effect of concentrate combinations was significant ($P \leq 0.001$) on total nitrogen intake (TNI) and nitrogen digestibility (ND) of the experimental lambs. The total nitrogen voided via feces and urine was significantly difference ($P \leq 0.001$) among the dietary treatment groups. The wheat bran and broken lentil screening combination effect was not significant ($P \geq 0.05$) on feces and urine nitrogen content. The N retention was significantly affected ($P \leq 0.001$) by the concentrate diet combinations.

| Treatment | Measured variables | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | TNI (g) | ND (%) | Urine N (%) | Feces N (%) | Void Nitrogen(g) | | Total NR | |
| | | | | | Urine | Feces | (g) | (%) |
| $T_1$ | $12.19^a$ | $74.77^a$ | 1.96 | 1.30 | $3.42^a$ | $3.06^a$ | $5.72^a$ | 46.26a |
| $T_2$ | $15.38^b$ | $81.17^b$ | 2.44 | 1.30 | $4.92^b$ | $2.87^{ab}$ | $7.59^a$ | 49.17a |
| $T_3$ | $13.06^a$ | $82.86^b$ | 1.75 | 1.26 | $3.29^a$ | $2.24^b$ | $7.52^a$ | 57.55ab |
| $T_4$ | $16.99^c$ | $86.41^b$ | 2.09 | 1.22 | $3.98^{ab}$ | $2.32^b$ | $10.71^b$ | 63.04bc |
| Sig. | *** | *** | NS | NS | * | ** | *** | * |

***Table 5:*** *Nitrogen intake and utilization of lambs as affected by concentrate mixtures.*
*Note: TNI: Total Nitrogen Intake; ND: Nitrogen Digestibility; TNR: Total Nitrogen Retained; abc: The same column with different superscripts differ significantly; * = P ≤ 0.05; ** = P ≤ 0.01; P ≤ 0.001; NS: Non-Significant; Sig.: Significance level.*

The experimental lambs showed a higher TNI in $T_4$ than $T_2$ followed by $T_3$ and $T_1$ diet groups. Nitrogen digestibility in a diet containing 30g wheat bran and 133g lentil screening ($T_1$) was lower than recorded from $T_4$, $T_3$ and $T_2$ diet groups. The total nitrogen void via urine was higher from lambs were assigned for $T_2$ (a diet contained 235g lentil screening) than seen for $T_1$, $T_3$ and $T_4$. The higher amount of N was retained for the lambs that were assigned in 227g wheat bran and 120g lentil screening containing diets ($T_4$) than were in $T_1$, $T_2$ and $T_3$ groups. The nitrogen void via feces was more from lambs fed 30g wheat bran and 133g lentil screening concentrate supplement ($T_1$) than were in $T_3$ and $T_4$ categories.

Higher total nitrogen intake and digestibility at 227g wheat bran and 120g lentil screening mixture diet ($T_4$) could be due to increasing of dietary energy in the concentrate supplement. The higher feces N voided from $T_1$ could be indicated that there was inefficient nitrogen digestibility for this diet. In agreement with the present study feces produced on low-protein diet had lower amount of N than feces on a

high-protein diet [36]. The higher amount of total N retention in the animals at $T_4$ indicated that N utilization was improved at this concentrate combination.

### Body weight change and feed conversion efficiency

The effect of wheat bran and lentil screening combinations on body weight change and feed conversion efficiency (FCE) of fattening ram lambs is presented in table 6. The initial body weight of the experimental animals was similar ($P \geq 0.05$) between the dietary treatment groups. Final body weight (FW) of the animals was higher ($P \leq 0.01$) for those animals fed 227g wheat bran and 120g lentil screening concentrate ($T_4$). Total body weight gain (BWG) and daily body weight gain (DBWG) of those animals allocated to $T_4$ were higher ($P \leq 0.001$) than recorded for lambs were in $T_1$ followed by $T_2$ and $T_3$ diet group.

| Treatment | Measured variables | | | | |
|---|---|---|---|---|---|
| | IBW (kg) | FW (kg) | TWG (kg) | DWG (g) | FCE |
| $T_1$ | 18.08 | $21.42^{a}$ | $3.33^{a}$ | $37.04^{a}$ | $0.06^{a}$ |
| $T_2$ | 17.79 | $22.58^{abc}$ | $4.79^{b}$ | $53.24^{b}$ | $0.07^{b}$ |
| $T_3$ | 18.08 | $23.25^{b}$ | $5.17^{b}$ | $57.41^{b}$ | $0.07^{b}$ |
| $T_4$ | 17.92 | $24.13^{c}$ | $6.21^{c}$ | $68.98^{c}$ | $0.08^{b}$ |
| Sig. | NS | ** | *** | *** | ** |

***Table 6:*** *Body weight change and feed conversion efficiency as affected by wheat bran and lentil screening combinations. Note: IBW: Initial body weight; FW: Final Body Weight; TWG: Total Body Weight Gain; DWG: Daily Body Weight Gain; FCE: Feed Conversion Efficiency (BWG / DMI); **: P ≤ 0.01; ***: P ≤ 0.001; NS: Non-Significant; Sig.: Significance level.*

The wheat bran and lentil screening concentrate combination effect was significant ($P \leq 0.01$) on FCE in terms of kg body gain per kg dry matter intake. The experimental sheep showed superior feed efficiency (0.08) for the diet containing 227g wheat bran and 120g ($T_4$) lentil screening concentrate than offered a diet containing 30g wheat bran and 133g lentil screening ($T_1$).

In agreement with the present study [29] and [30] reported that daily body weight gain improved at a higher dietary energy than at a lower energy level. The final body weight of the lambs fed a diet containing 2.90 Mcal/kg DM was higher than lambs fed a diet with 2.40 Mcal/kg DM [31] was in similar trend with the present finding. In another report [27] the FCE was higher in a diet containing a higher ME and CP level. Dietary energy density has effect on performance of lambs and it is the major dietary element responsible for the variation in the utilization of nutrients [32].

Menz ram lambs attained 19.12 ± 0.47 kg body weights at their 12 month of age with DWG of 50.62 ± 2.20g [4]. The 5 - 7 months old Menz ram lambs resulted in 4 kg extra body weight after 6 months of grazing and supplemented with 80g molasses-urea-block [28]. Indoor feeding supplementation with 227g wheat bran and 120g lentil screening mixed diet resulted in better final body weight during the 3 months feeding period seemed to be acceptable to obtain best body weight of fattening Menz ram lambs. Almost in all treatment groups, the body weight change trend was increasing with slower rate at the beginning of experimental weeks then increased at a higher rate followed by slower rate towards the last week indicated that the three months lambs fattening time with the same age and initial body weight group and diet could be enough.

The body weight change trend of the experimental lambs during the feeding trial is indicated in figure 2. Lambs allocated to $T_1$ (30g wheat bran and 133g lentil screening) showed increased body weight gain at lower rate between $10^{th}$ and $30^{th}$ days and then increased at higher rate from the $40^{th}$ up to the $70^{th}$ days. Then, the rate slowed after wards. The body weight change for $T_2$ and $T_3$ diet groups was growing at higher increasing rate, then after $70^{th}$ day it continued to increase at slower rate up to the end of experimental period. Those lambs assigned to $T_4$ (a diet contained 227g wheat bran and 120g broken lentil screening) grew at increasing rate from the first $10^{th}$ up to $80^{th}$ days of experimental period, but thereafter, the growth rate was at a slower rate.

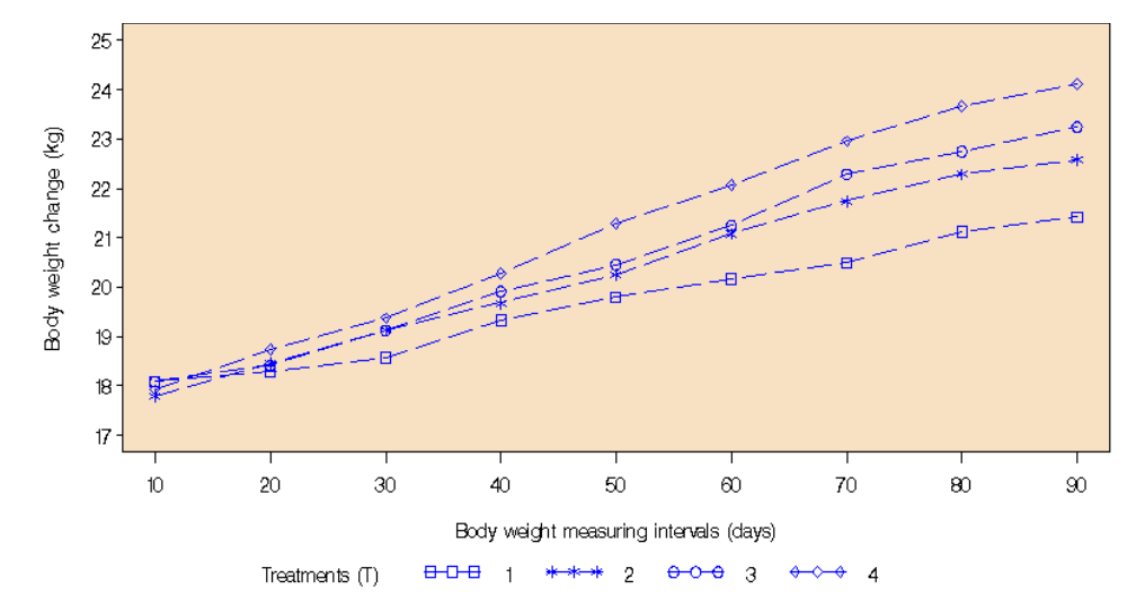


***Figure 2:*** *Body weight change trends of sheep as affected by wheat bran and broken lentil screening combinations.*
*Note: 1 = A diet contained 30g wheat bran and 133g lentil screening ($T_1$); 2 = A diet contained 235g lentil screening ($T_2$); 3 = A diet contained 285g wheat bran ($T_3$); 4 = A diet contained 227g wheat bran and 120g lentil screening ($T_4$).*

## Partial budget analysis

The partial budget analysis or the cost benefit analysis of feeding as affected by wheat bran and lentil screening combination is presented in table 7. The effect of these concentrate was significant (P ≤ 0.001) on costs of wheat bran and lentil screening. The feed cost per kg body weight gain was different (P ≤ 0.05) between the treatment groups with the lower feed cost per unit body weight gain recorded at $T_4$.

| Treatments | Measured variables | | | | | |
|---|---|---|---|---|---|---|
| | Growth (Wt. gain/head) | Individual Cost (birr) | | | Feed cost/kg BW gain | |
| | | Hay | Wheat Bran | Lentil Screening | Total Feed | |
| $T_1$ | 3.33$^{a}$ | 153.46 | 8.29$^{a}$ | 52.20$^{a}$ | 213.95$^{a}$ | 65.80$^{a}$ |
| $T_2$ | 4.79$^{b}$ | 145.65 | 0.00$^{b}$ | 92.23$^{b}$ | 237.87$^{ab}$ | 51.31$^{b}$ |
| $T_3$ | 5.17$^{b}$ | 135.83 | 78.78$^{c}$ | 0.00$^{c}$ | 214.61$^{a}$ | 42.45$^{b}$ |
| $T_4$ | 6.21$^{c}$ | 129.49 | 76.56$^{d}$ | 47.09$^{d}$ | 253.15$^{b}$ | 42.23$^{b}$ |
| Sig. | *** | NS | *** | *** | * | *** |

***Table 7:*** *Feed cost per kg weight gain analysis as affected by concentrates mixtures.*
*Note: BW: Body Weight; abc: The same column with different superscripts differ significantly;*
** = P ≤ 0.05; *** = P ≤ 0.001; NS = Non-Significant; Sig. = Significance Level.*

The present study indicated that weight gain per head and cost incurred for one kg body weight gain was affected by concentrate diet combinations. The feed cost per kg body weight gain of Menz ram lambs was reduced as the level of metabolizable energy increased in the supplement concentrate diet. The results indicated that fattening of Menz ram lambs on a concentrate diet containing 227g wheat bran and 120g lentil screening mixture could be economical. In agreement with results of the present study [36] feeding of lambs on lower dietary energy and protein diets reduced growth rate and increased production costs. However, contrary to this [31] a higher economical advantage was obtained from lambs on a diet with low dietary energy (2.40 Mcal/kg DM) than with higher one (2.90 Mcal/kg DM).

## Conclusion

The sheep feeding experiment was conducted using locally available feed resources, which was identified from the survey study. The objective of conducting the feeding trial was to evaluate feed nutrient utilization and growth performances fattening Menz ram lambs fed grass hay basal diet and supplemented different mixtures of wheat bran and broken lentil screening. Nutrient utilization, final body weight, total weight gain, average daily weight gain and feed conversion efficiency were significantly affected by the concentrate feed mixtures with the higher values recorded for the lambs assigned to $T_4$ diet. As one meat production improvement package a grass hay basal diet supplementing with 227g wheat bran and 120g broken lentil screening mixture ($T_4$) can be considered as the best for fattening of Menz ram lambs with better feed nutrient utilization and body weight gain.

## Acknowledgement

I acknowledge the financial support by Rural Capacity Building Project and Addis Ababa University. I am very glad to express my gratitude and appreciation to Ethiopian Institute of Agricultural Research for permitting and organizing to conduct this study.

## Bibliography

1. Central Statistical Agency (CSA). "Federal Democratic Republic of Ethiopia, agricultural sample survey volume II, report on livestock and livestock characteristics, CSA Statistical Bulletin 468, Addis Ababa, and Federal Democratic Republic of Ethiopia" (2010).
2. Solomon G., *et al*. "Conservation priorities for Ethiopian sheep breeds combining threat status breed merits and contributions to genetic diversity". *Genetic Selection and Evolution* 40.4 (2008): 433-447.
3. Adane H and Girma A. "Economic Significance of Sheep and Goats, Chapter one: Sheep and Goat Production Handbook for Ethiopia". Ethiopian Sheep and Goat Production Improvement Program (ESGPIP) (2008).
4. Kassahun A. "Comparative performance evaluation of Horro and Menz sheep of Ethiopia under grazing and intensive feeding conditions". PhD Thesis submitted to Humboldt University, Germany (2000): 119.
5. Alemu Y. "Nutrition and Feeding of Sheep and Goats. Sheep and Goat Production System in Ethiopia, Chapter Seven". In: Sheep and Goat Production Handbook for Ethiopia, Ethiopian Sheep and Goat Production Improvement Program (ESGPIP) (2008): 104-156.
6. Ružić-Muslic MP., *et al*. "Effects of different protein sources of diet on yield and quality of lamb meat". *African Journal of Biotechnology* 10 (2011): 15823-15829.
7. Salo S., *et al*. "Effects of Supplementation with Different Forms of Barley on Feed Intake, Digestibility, Live Weight Change and Carcass Characteristics of Hararghe Highland Sheep Fed Natural Pasture". *Journal of Food Processing and Technology* 7 (2016): 568.
8. Chiba I. "Sheep nutrition and feeding: Animal Nutrition Handbook". 2nd edition (2009): 426-446.
9. Tsega W., *et al*. "Characteristics of urban and peri-urban sheep production systems and economic contribution in Highlands of Ethiopia". *Iranian Journal of Applied Animal Sciences* 4 (2014): 341-349.

10. Debre Zeit Agricultural Research Center (DZARC). "Annual Research Report 2002/03". DZARC, Ethiopian Institute of Agricultural Research, Debre-Zeit, Ethiopia (2003).

11. Malik RC., *et al*. "Feedlot growth and efficiency of three-way cross lambs as affected by genotype, age and diet". *Proceedings of the Australian Society of Animal Production* (1996): 21.

12. McDonald P., *et al*. "Animal Nutrition 6th Edition". Prentice Hall, London (2002): 583-559.

13. Upton M. "Farm Management in Africa: The Principle of Production and Planning". Oxford University Press, Great Britain (1979): 282-298.

14. Association of Official Analytical Chemists (A.O. A. C.). "Official method of analysis, 15th edition". (Helrich, K., ed.), Pub. A. O. A. C, Washington, DC (1990).

15. Tilley JMA and Terry RA. "A two-stage technique for in vitro digestion of forage crops". *Journal of British Grassland Society* 18.2 (1963): 104-106.

16. Van Soest PJ and Robertson JB. "Methods for dietary neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition". *Journal of Dairy Science* 74.10 (1985): 3583-3597.

17. SAS. SAS (r) Proprietary Software Version 9.00 (TS MO), Copyright(c) by SAS Institute Inc., Cary, NC, USA (2002).

18. Aschalew A and Getachew A. "Supplementation of Raw, Malted and Heat Treated Grass Pea (Lathyrus Sativus) Grain on Body Weight Gain and Carcass Characteristics of Farta Sheep". *International Journal of Soil and Crop Sciences* 1 (2013): 1-6.

19. Mullu M., *et al*. "The Effects of Supplementation of Grass Hay with Different Levels of Brewer's Dried Grain on Feed Intake Digestibility and Body Weight Gain in Intact Wogera Lambs". *East African Journal of Sciences* 2.2 (2008): 105-110.

20. Shewangzaw A., *et al*. "Effect of different levels of dietary bole (Lake Soil) inclusion on feed intake, milk yield and composition of Holstein Friesian cows". *International Journal of Agricultural Bioscience* 2 (2013): 377-382.

21. Fekede F., *et al*. "Dynamics in Nutritional Characteristics of Natural Pasture Hay as Affected by Harvesting Stage, Storage Method and Storage Dudietin the Cooler Tropical Highlands". *African Journal of Agricultural Research* 9.43 (2014): 3233-3244.

22. Endashaw T., *et al*. "Market Weight and Carcass Characteristics of Intact Yearling Afar Goats under Semi-Intensive Feeding Management". *International Journal of Livestock Production* 4 (2013): 95 -101.

23. Sandhu SJ and Sarvjeet S. "Lentil: An Ancient Crop for Modern Times". Springer, the Netherlands (2007): 47.

24. Sultan J., *et al*. "Nutrient digestibility and feedlot performance of lambs fed diets varying protein and energy contents". *Tropical Animal Health and Production* 42.5 (2010): 941-946.

25. Haddad SG and Husein MQ. "Effect of dietary energy density on growth performance and slaughtering characteristics of fattening Awassi lambs". *Livestock Production Science* 87 (2004): 171-177.

26. Tesfay H and Solomon M. "Feed intake, digestibility, and body weight and carcass parameters of Afar rams fed tef (Eragrostis tef) straw supplemented with graded levels of concentrate mix". *Tropical Animal Health and Production* 41.4 (2009): 599-606.

27. Ebrahimi R., *et al*. "Effect of Energy and Protein Levels on Feedlot Performance and Carcass Characteristics of Mehraban Ram Lambs". *Pakistan Journal of Biological Sciences* 10.10 (2007): 1679-1684.

28. Anindo D., *et al*. "Effect of molasses-urea-block (MUB) on dry matter intake, growth, reproductive performance and control of gastro-intestinal nematode infection of grazing Menz ram lambs". *Small Ruminant Research* 27.1 (1998): 63-71.

29. Moharrery A., *et al*. "Effect of dietary energy level and docking on carcass characteristics of fat tailed Kurdi sheep". *Iranian Journal of Livestock* 1 (2012): 19-27.

30. Yagoub YM and Babiker SA. "Effect of dietary energy level on growth and carcass characteristics of female goats in Sudan". *Livestock Research for Rural Development* 20 (2008): 202.

31. Wandrick H., *et al*. "Biological and economic performance of feedlot lambs feeding on diets with different energy densities". *Revista Brasileira de Zootecnia* 41.5 (2012).

32. Hosseini SM. "Effect of different energy levels of diet on feed efficiency, growth rate and carcass characteristics of fattening lambs". *Journal of Animal and Veterinary Advances* 7 (2008): 1551-1554.

33. Mahgoub O., *et al*. "Effects of dietary energy density on feed intake, body weight gain and carcass chemical composition of Omani growing lambs". *Small Ruminant Research* 37.1-2 (2000): 35-42.

34. Hassan SA and Saeed A. "Effect of Protein Levels and Degradability in the Dieton Awassi Lambs Performance 1-Productive Parameters". *Kahramanmaraş Sütçü İmam Üniversitesi Doğa Bilimleri Dergisi* 15 (2012): 34-45.

35. Vliet PC., *et al*. "Effects of cow diet on the microbial community and organic matter and nitrogen content of feces". *Journal of Dairy Science* 90.11 (2007): 5146-5158.

36. Beauchemin KA., *et al*. "Effects of crude protein content, protein degradability and energy concentration of the diet on growth and carcass characteristics of market lambs fed high concentrate diet". *Canadian Journal of Animal Sciences* 75 (1995): 387-395.

**Volume 5 Issue 4 April 2020**