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Digestibility of Sheep Ration Containing Different Levels of Native Grass Hay and Concentrate Mixture of Wheat Bran and Dried Food Left over

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Abstract

The experiment was carried out at Mekelle University livestock farm, Tigray, Ethiopia. 12 male yearling Highland sheep with an average live weight of 20 + 2.5 kg (mean ± standard deviation) were used in the experiment. The objective of the study was to investigate the effect of digestibility of sheep ration containing different levels of roughage and concentrate mixture on performance of highland sheep. Food left over was collected from Mekelle University student cafeteria and dried with sun light for 3 - 4 days. The experimental design was a randomized complete Block design (RCBD) with four treatments and three replications. The experimental animals were grouped into three blocks based on their initial live body weight, which was determined by weighing after overnight fasting. The experiment was carried out for 15 days including 5 days of adaptation period and 3 days of adaptation and harnessing (fecal bags). At the end of the feeding trial, digestibility trial was carried out for seven consecutive days. There was significantly higher ($P < 0.05$) total DM intake in the supplemented group than in the control treatment. Digestibility of DM and OM were non-significance ($P > 0.05$) for all treatments. Generally, the present study indicated that supplementation of Tigray highland rams with concentrate mixture had an effect on performance of sheep and the effects were relatively more pronounced on rams supplemented with the highest level of concentrate mixture.

Keywords

Dried Feed, Digestibility, Grass Hay, Wheat Bran, Sheep

1. Introduction

Ethiopia is a nation that is blessed with possession of huge livestock population. According to a recent report of [1], the country has about 60.39 million cattle, 31.30 million sheep, 32.74 million goats and 56.06 million chickens. Livestock provides economic and social benefits both at national and household levels. Livestock contribute about 15% - 17% of national gross domestic product (GDP), 35% - 40% of agricultural GDP and 37% - 87% of the household incomes [2]. Furthermore, livestock provides food products like milk, meat, manure, hides and skins that play important roles in improving the nutritional status and income gain of people. Despite this fact, production and productivity of livestock remain low for many reasons. The causes of low productivity of livestock in Ethiopia are multifaceted that include poor genetic makeup, poor veterinary services, inadequate quantity and quality of feed, and poor breeding strategy. Among these limiting factors, poor feed supply and feeding system are the most important as the feed resources in the highlands of Ethiopia are generally natural pasture and residues of different crops.

The meat production and consumption are by far low as compared to other countries. Empirical evidence show that the national cattle carcass weight (110 kg) is very low compared to other nations with 25% - 30% lower than Eastern Africa's average (143 kg/head) and 50% lower than the world average (212 kg/head) (EIAR, 2016). Similarly, the average carcass weight of Ethiopian sheep (10 kg) is the lowest relative to all countries and the world average, by about 1, 3 and 6 kg from east African countries, least developed countries, and the world, respectively [3].

The reduced production of meat is attributed to many complicated problems such as inadequate feeds and nutrition, non-commercial oriented animal husbandry practices, poor genetic potential of indigenous animal breeds and occurrence of diseases and pests [4]. The feed resource bases for sheep production in Ethiopia are mainly natural grazing and crop residues, which have seasonal variability in both their quality and quantity. Due to seasonal changes, there is a serious shortage of feedstuff that results in the fluctuation of animal production and therefore many farmers in Ethiopia feed their livestock with crop residues, mainly various straws. However, the use of such straws has limitations due to their low nutritive value indicated by their high cellulose, hemicellulose and lignin contents, and their low protein content and digestibility [5].

The small ruminant production is very low. Moreover, there is an acute shortage of feed supply in urban and peri-urban areas and the availability of the feeds are of very poor quality. This can cause low voluntary intake and low digestibility. The problem is aggravated by a lack of alternative feeds during the critical period. These days the price of conventional feed resources like wheat bran and oilseed cakes became more expensive. On the other hand, feed leftover is one of the untapped feed resources as animal feed. However, there are several reasons, which limited the utilization of food left over as animal feeds, such as poor processing and storage ability, heavy contamination due to uninformed dump-

ing mainly constrained by contamination with unsafe materials especially plastic bags, softies and moulds that might be serious hazards to animal health and production. Therefore, it should be made feed evaluation to avoid any risk that can affect our production animal and get good quality of production. Unless done there will be risk for the side of production and for the animal. In addition, to this our animal should supplement food of good quality rather than feeds that have low quality. This can be improved production of our animal. Thus, this study was to evaluate the digestibility of sheep ration containing different levels of native grass hay and concentrates mixture of wheat bran and dried food left over.

2. Materials and Methods

2.1. Study Location

This feeding and digestibility experiment was conducted from October, 2014-February, 2015 in Mekelle University small ruminant farm, which is located at 13˚30'0"N latitude and 39˚28'11"E longitude with altitude of 2200 meter above sea level. It has an average annual rainfall amount of 528.8 mm, which is highly variable from year to year and erratic in nature. Annual average maximum temperature is 28˚C and minimum 11˚C with 55.60% relative humidity 2.2, maintaining the Integrity of the Specifications.

2.2. Experimental Design and Treatment

The experiment was conducted using RCBD with four treatments and three replications using 12 uncast rated yearling male Highland sheep for digestion trials. The experimental animals were grouped into three blocks based on their initial live body weight, which was determined by weighing after overnight fasting. Each animal in each block was randomly assigned to one of the four dietary treatments. Diets including grass hay and supplement feed prepared with different proportions of mixed dried cafeteria food left over and wheat bran were used. The treatment feeds (T1-T4) were made to feed 1000g as a feed base. The concentrate feed, consisting of equal proportion (50%:50%) of dried cafeteria food left over and wheat bran was made to mixed and used to replace basal grass hay. Dietary feed treatments were prepared in such a way that amount from grass hay was substituted with amount from mixed dried food left over and wheat bran at a ratio of 0, 10%, 20% and 40% on a feed basis. The experimental treatments were offered as (gram/sheep/day on a feed basis):

- T1 = 1000 g Hay (Control);
- T2 = 900 g Hay + 100 g mixed supplement;
- T3 = 800 g Hay + 200 g mixed supplement;
- T4 = 600 g Hay + 400 g mixed supplement.

2.3. Animal Feeding and Management

Twelve yearlings' uncast rated growing male Tigray Highland sheep breed was

used. The sheep were housed in well-ventilated, concrete made and shaded room. Then the experimental animals were identified and penned individually in the pen; and were offered grass hay and supplement feeds for 5 days to get them adapted to the feeds and feeding pattern prior to the beginning of the experiment. Animals were observed closely for the occurrence of any abnormalities and disorders during the experimental periods. The mixed feed and grass hay was obtained from Mekelle University small ruminant farm. Then the supplementary feeds were thoroughly mixed at the specified proportion indicated in the experimental treatments. Clean water was provided to the animals with free choice. The actual data collection for digestion trial was done for 7 days. The basal feed and supplementary diets were offered twice per day at 8:00 and 16:00 hours in two equal portions. The amount of feed offered and a refusal was recorded daily throughout the study periods and was measured using sensitive balance a graduate ranging from 1.0 - 5100 gm.

2.4. Digestibility Trails

The feeding treatment animals were employed for digestibility trial. Total feces collection was conducted for consecutive seven days following three days of adaption for harnessed fecal collection bags. Feaces were collected and weighed every morning for each animal before giving feed and water. About 20% of sample was taken from the feces collected daily for each animal and composited in container (airtight plastics) and stored at −20˚C until the end of the collection period. At the end of the collection period, the fecal sample for each animal was thoroughly mixed and sub-sample of feces was taken for further analysis. The apparent digestibility coefficient (DC) of dry matter (DM), organic matter (OM) was calculated using the following equation.

$$\mathrm{CoDMD}(\%) = \frac{\mathrm{DMI} - \mathrm{DME}}{\mathrm{DMI}} \times 100$$

where: CoDMD (%) = Coefficient of dry matter digestibility, DMI = dry matter intake, DME = dry matter excreted in feces

$$\mathrm{CoND}(\%) = \frac{\mathrm{NI} - \mathrm{NEF}}{\mathrm{NI}} \times 100$$

where: CoND = Coefficient of nutrient digestibility, NI = nutrient intake, NEF = nutrient excreted in feces.

2.5. Fecal Sample Collection

All lambs used the feeding trial were adapted to carrying faecal collection bags for 3 days, which was followed by a total faces collection for a period of 7 successive days for each animal. Total Feaces voided was collected and weighed every morning before feeding and 20% of faeces were sampled, composite samples were stored in airtight plastic bags in a deep freezer at −20˚C. On the last day of the collection period, faecal samples were thoroughly mixed for each animal from which DM and OM were determined. While feed offers and refusals were

weighed daily, each animal was taken at the start and end of the collection period.

2.6. Chemical Analysis

Representative samples of basal feed were offered and refused after thoroughly mixing on daily basis and the concentrate per batch was collected over the digestion trial stage and stored in air tied plastic bags. At the end of the experiment samples of offered and refused in the digestion trial. The feed and fecal samples were dried in an oven at 65˚C for 48 hours for dry matter (DM) determination according to the standard procedures of [6]. Ash content was determined by igniting the DM residue at 600˚C for 2 hours in muffle furnace [7]. Organic matter was calculated as the difference between 100% dry matter and ash. All chemical analyses were done in duplicate.

2.7. Statistical Analysis

The data obtained from the experiment were analyzed using descriptive statistics, correlation, ANOVA by the business unit of SAS, JMP5. The treatment means of the parameters were separated using Tukey HSD (Tukey Honestly Significant Difference) Test. The model used for the analysis of all parameters feed intake, weight gain, digestibility, and carcass parameters of the experiment was:

$$Yij = \mu + i + \beta j + ij$$

where: Yi = response variable, μ = overall mean, i = i^{th} treatment effect, βj = block effect and ij = i^{th} random error.

3. Result and Discussion

3.1. Chemical Composition of Feeds

The chemical composition (DM, OM, and Ash content) of the experimental feeds are presented in **Table 1**. The DM content of GH (grass hay) was almost comparable to the values of 91.5%, 92.94%, 94.18% and 93.38% reported by [8] [9] [10] [11], respectively. The OM of GH for this study is 88.51% which more relatively similar with the report of [12] [13], which were 91.9% and 89.7%, respectively. But, it was lower than the value of 91.71%, which was reported by [13], Ash content of GH is little bit higher than when relatively comparable with

Table 1. Chemical composition of feeds consumed by high land Tigray sheep.

Nutrient%	Type of feeds		
	Grass hay	Wheat bran	Cafeteria food left over
DM (%)	90.5	87.02	90.5
ASH (%)	11.4	3.46	6.02
OM (%)	88.5	96.54	93.98

DM = Dry Matter; ASH = Mineral contents; OM = Organic matter.

other studies [13] [14] with values of 8.23% and 9.28, respectively.

DM content of wheat bran is lower than the value of 90.6 reported by [15] but it is more similar to the report of [16] [17] [18] [19], which was 85%, 86.12% and 87.38%, respectively. The OM content of wheat bran (96.54%) was similar to the evaluation of 96% reported by [18] [20] but, it was higher than 94.7% noted on [20]. The ash value of wheat bran used in the current study was virtually related to the value of 3.96% and 3.42% reported by [14] [18], respectively, but lesser than 5.4% and 5.3% [15] [20], respectively.

3.2. Dry Matter and Nutrient Intake

The dry matter and nutrient intake data are presented in (**Table 2**). Significant variation ($P < 0.001$) was observed in total dry matter intake (TDMI) and total organic matter intake (TOMI) among treatments. and supplemented with wheat bran for Afar sheep and 850 $g \cdot d^{-1}$ to 914 $g \cdot d^{-1}$ reported by [3] [19] for Horro sheep supplemented with wheat bran, *Acacia albida* leaf meal and their mixture fed vetch (*Lathyrus sativus*) haulm basal diet, but lower than 565-711 $g \cdot d^{-1}$ DMI reported by [21] for Wogera sheep offered brewery dried grain and grass hay and 710 $g \cdot d^{-1}$ DMI for sheep supplemented with culinary wastes [22]. However, lower than 1123.10 $g \cdot d^{-1}$ to 1186 $g \cdot d^{-1}$ DMI reported by [23] for Awassi sheep breed with 0%, 20% and 40% inclusion of *Acacia saligna*, [22]reported that DM intake was increased and food left over was quite acceptable by the sheep. Similarly, [24] had described in ruminant animals food leftover gives an opportunity for a higher feed intake and available higher energy consumption. Also, [25] reported that total DM intake increased with a progressive substitution of formula concentrates for dried food left over. Furthermore, [26] reported that DM intake was increased with food waste mixture feeding (6.1% for 25% food waste mixture and 9.4% for 50% food waste mixture) compared to control group fed sole

Table 2. Daily dry mater and nutrient intake of highland sheep fed on grass hay based diet.

Nutrient%	Treatments				
	T1	T2	T3	T4	SL
DGH (g/day)	689[a]	585.8[b]	480[c]	326.3[d]	***
DMS (g/day)	_	88.76[b]	172.52[a]	355.04[c]	***
TDMI (g/day)	689[a]	674.56[c]	657.92[d]	681.37[b]	***
GHOM (g/day)	661[a]	563[b]	461.8[c]	304.8[d]	***
MSOM (g/day)	_	64.4[c]	128.80[b]	257.55[a]	***
TOMI (g/day)	661[a]	651.7[c]	640.32[d]	659.84[b]	***

GH = Grass Hay; MS = Mixed Supplement; TDMI = Total Dry Matter Intake; GHOM = Grass Hay Organic Matter; MSOM = Mixed Supplement Organic Mater; TOMI = Total Organic Matter Intake; T1 = Control feed basis (1000 g); T2 = 900 g hay + 100 g supplements; T3 = 800 g hay + 200 g supplement; T4 = 600 g hay + 400 g supplement.

grass hay, which was indicated that food waste mixture was more palatable. In line with this, total feed intake was increased with increasing substitution level of dried food left over [27].

For this study total dry matter intake (TDMI) for T1 is higher than other treatments whereas T3 has the lowest value. The GH of dry matter intake is higher than other treatments due to the amount of grass that has been provided. But, the DGH for treatment T4 has the lowest value because it has fed for less amount of feed when compared to rest of other treatments. On the other hand, the DMS for treatment (T1) has no value because its control group means only for grass hay feed basis. The DMS for T4 has the highest value for comparing other treatments. In addition, T2 has the lowest value depending on amount of feed. The observation for all treatments in DMS has various amounts of dry matter intake. This variation is caused by amount of feed that has been supplemented. The GHOMI for T1 has the greatest amount of nutrients as compared to the other treatment as same like this above DGH but TOMI for T2, T3 and T2 have lower than control.

3.3. Digestibility

The DMD and OMD content of Highland sheep fed grass hay as basal diet supplemented with dried food left over as a replacement for wheat bran was not significantly different ($P > 0.05$) among all treatment groups (**Table 3**). These results were comparable with the digestibility value of 63.39%-64.08% DM for sheep supplemented with different levels of noug seed cake and wheat bran mixture [28]; however, the observed digestibility for DM and nutrient which did not differ ($P > 0.05$) among all treatments are not much difference. For this study DM and OM digestibility are non-significance ($P > 0.05$) as compared to [17] found non-significant difference ($P > 0.05\%$) in DM and OM digestibility coefficient. The DMD of T4 is highest as compared to the other treatment due to amount of feed supplemented. In addition to this T2 has the lowest value as compared to the rest. Whereas T1 and T3 are similar to their value of DMD. On the other hand, The OMD for T4 is the highest one due to variation of the feed. But for T2 has the lowest value when compared to the other treatment.

4. Conclusion and Recommendations

Replacing native grass hay at 71.46% with mixed concentrate gave optimum feed

Table 3. Digestibility of treatments.

Variables	Treatments				
	T1	T2	T3	T4	P-V
DMD (%)	67.79 ± 1.38	62.80 ± 0.62	68.78 ± 0.32	71.46 ± 0.89	0.057
OMD (%)	38.11 ± 2.8	30.6 ± 0.1	32.74 ± 6.8	33.63 ± 2.7	0.06

DMD = Dry Matter Digestibility; OMD = Organic Matter Digestibility; T1 = Control feed basis (1000 g); T2 = 900 g hay + 100 g supplements; T3 = 800 g hay + 200 g supplement; T4 = 600 g hay + 400 g supplement.

intake and digestibility to Tigray Highland sheep. Generally, this study's supplementation of Tigray highland rams with concentrate mixture had an effect on performance of sheep and the effects were relatively more pronounced on rams supplemented with the highest level of concentrate mixture. Digestibility for DM and nutrient, which did not differ among all treatments, was due to the achievement of relatively similar protein requirements. Thus, it can be concluded that food left over is a good protein, energy and palatable feed source for ruminant animals. Therefore:

- A huge amount of food leftover is disposed of from public universities in Ethiopia, thus, from the current findings, it can be suggested that food leftover should be an asset rather than a liability.
- Due attention should be given while collecting, drying and storing food left over that produce food born disease.
- Alternative drying methods should be addressed to continue the drying of food leftover during rainy season.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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