Animal and Veterinary Sciences
2023; 11(4): 94-99
http://www.sciencepublishinggroup.com/j/avs
doi: 10.11648/j.avs.20231104.12
ISSN: 2328-5842 (Print); ISSN: 2328-5850 (Online)

Apparent Dry Matter and Nutrient Digestibility of Different Varieties of Vetch Hay Supplemented to Arsi Bale Sheep Fed a Basal Diet of Fodder Oat Hay

Berhanu Tassew Dassie

Meat Animals Research Team, Adami Tulu Agricultural Research Center, Batu, Ethiopia

Email address:
berhanut42@gmail.com

To cite this article:
Berhanu Tassew Dassie. Apparent Dry Matter and Nutrient Digestibility of Different Varieties of Vetch Hay Supplemented to Arsi Bale Sheep Fed a Basal Diet of Fodder Oat Hay. *Animal and Veterinary Sciences*. Vol. 11, No. 4, 2023, pp. 94-99.
doi: 10.11648/j.avs.20231104.12

Received: July 23, 2023; **Accepted**: August 8, 2023; **Published**: September 14, 2023

Abstract: An experiment was conducted to evaluate apparent dry matter and nutrient digestibility of hay of vetch varieties supplemented to sheep fed a basal diet of fodder oat hay. Thirty-five yearling intact male sheep were assigned to one of the five treatments in a randomized complete block design. The dietary treatments were *ad libitum* fodder oat hay alone (T1) and *ad libitum* fodder oat hay supplemented with 350g hay of Gebisa, Lalisa, Abdeta and *Vicia sativa* vetch varieties for T2, T3, T4 and T5 respectively. The Digestibility trial lasted for 10 days. Supplementation of the vetch varieties increased dry matter digestibility by 11.6 and 1.9% for T2 and T3, respectively and by 3.6% for T4 and T5 compared to the control. Among the supplemented groups, supplementation of Gebisa vetch variety (T2) induced the highest (65.2%) dry matter digestibility. Supplementation of the vetch varieties increased the crude protein digestibility by 15.3, 6.2, 5.9 and 8.2% for T2, T3, T4 and T5, respectively compared to the un-supplemented treatment. Among the supplemented treatments, T2 induced significantly higher ($P<0.001$) crude protein digestibility than T3, T4 and T5. In conclusion, supplementation of Gebisa vetch variety (T2) induced highest dry matter and nutrient digestibility than all other treatments. Therefore, Gebisa vetch variety should be introduced and scaled up widely for sheep feeding.

Keywords: Arsi-Bale Sheep, Dry Matter, Digestibility, Vetch Variety

1. Introduction

The digestibility of a feedstuff is the proportion of the feed or of any single nutrient of the feed, which has not recovered in feces. Although the potential value of a feed can be approximately determined by proximate analysis, the actual value of the feed to the animal can be determined only if the digestibility is known. The digestibility coefficients of various nutrients from the same feedstuffs is affected by species of the animal, age of the animals, level of feeding, feed composition and ration composition. The fiber fraction of feed has the greatest influence on its digestibility [1].

Much of the energy contained in the fiber of sheep diet requires fermentation by microbial enzymes to hydrolyze the linkage in the fiber [2]. Digestibility of a feed is influenced not only by its composition, but also by the composition of other feeds consumed with it.

Three vetch varieties; Gebisa, Lalisa and Abdeta [3] were released from Sinana Agricultural Research Center for their superiority in terms of yield or biomass production, disease resistance, wider adaptation and quality based on chemical analysis. However, chemical analysis alone will be of limited value in predicting the digestibility of feed resources, which may contain antimicrobial compounds that inhibit digestibility or material toxic to the animal itself [4]. The experiment conducted to evaluate feed intake and body weight gain of Arsi Bale sheep supplemented with these vetch varieties indicated that Gebisa vetch variety was found to be the best variety in terms of stimulating higher feed intake and body weight gain [5]. Another experiment conducted to evaluate the carcass characteristics of sheep fed these vetch varieties also indicated that Gebisa is the best vetch variety to induce the highest carcass parameters of sheep [6]. Digestibility of the feed is also very important in

evaluating the nutritive value of the given feedstuff. However, the digestibility of these released vetch varieties is not yet evaluated. Therefore, the objective of this study was to investigate the effect of varietal differences of vetch hay on dry matter and nutrient digestibility of Arsi Bale Sheep.

2. Materials and Methods

2.1. Description of the Experimental Area

The experiment was conducted at Sinana Agricultural Research Center (SARC), which is located in Bale zone of Oromia National Regional State, south eastern Ethiopia. The research center is situated 463 km south east of Addis Ababa (capital city of Ethiopia) at 07° 07' N latitude and 40° 10 ' E longitude and at an altitude of 2400 m above sea level. The area is characterized by bimodal rainfall pattern with total annual precipitation ranging from 750 to 1000 mm and the mean annual maximum and minimum temperature are 21°C and 9°C, respectively.

2.2. Experimental Feeds Preparation

The experimental feeds, all varieties of vetch and fodder oat were sown according to their respective agronomic practices during the main rainy season of the area (August-December) The vetch varieties were harvested at 50% flowering, while fodder oat was harvested at heading stage during which they give optimum performance in terms of dry matter yield and nutritive value The harvested fresh forages were field-cured and stored as hay under a roofed shelter to protect from rain and intense sun light. During the digestibility trial, the oat and vetch hays were chopped to about 3-5 cm in length to make uniform for sampling and easier to be seized by the animals.

2.3. Experimental Animals and Their Management

Thirty-five yearling intact male Arsi-Bale sheep with similar body weight were purchased from the nearby markets. The age of the sheep was estimated based on dentition and asking information from the owners of the sheep. The sheep were held in quarantine for 21 days and observed for any health problem. During this time, the sheep were vaccinated against ovine pasteruolosis, anthrax and sheep pox and dewormed against internal and external parasites. The animals were placed in individual pens equipped with a bucket and a feeding trough in a well-ventilated concrete floor experimental barn.

2.4. Experimental Design and Treatments

Randomized complete block was used for the study. To minimize the error due to differences in initial body weight, the experimental sheep were blocked into seven blocks of five animals each based on their initial body weight. Sheep within a block were assigned randomly to one of the five dietary treatments indicated in table 1. The basal diet (fodder oat hay) was offered *ad libitum* to all experimental animals at about 15% refusal while the supplementary feeds were offered in two equal meals at 8:00 AM and 4:00 PM in separate feeding troughs. Drinking water and common salt block were freely available to all experimental sheep throughout the experimental period.

Table 1. *Dietary treatments.*

Treatments	Fodder oat hay	Vetch hay supplements (DM g/day)			
		Gebisa	Lalisa	Abdeta	*Vicia sativa*
T1	*Ad libitum*	0	0	0	0
T2	*Ad libitum*	350	0	0	0
T3	*Ad libitum*	0	350	0	0
T4	*Ad libitum*	0	0	350	0
T5	*Ad libitum*	0	0	0	350

2.5. Digestibility Trial

Digestibility trial was conducted for 10 days. All sheep were harnessed with a fecal collection bag to collect feces for the determination of digestibility. The sheep were accustomed to the fecal collection bags for three days. This was followed by collection of feces for ten consecutive days. During this period, feed offered and refused were recorded and samples of feed offered were pooled per treatment, while samples of feed refused were pooled per animal individually. Fresh feces were collected into a fecal collection bag fitted to the animal. The total fecal output was collected by emptying the bag twice per day at 6:00 AM and 6:00 PM per animal and were weighed and recorded for each sheep throughout the digestibility trial. The feces was weighed fresh, thoroughly mixed and 20% of the feces were sampled for each sheep and stored in a deep freezer at -18°C. The samples were pooled per animal across the collection period and 20% of the composite sample was taken, weighed and partially dried at 60°C for 72 hours. The partially dried fecal samples were milled by Wiley mill to pass through a 1mm sieve and stored in airtight polyethylene bags pending chemical analysis. Apparent digestibility of DM and other nutrients were determined as a percentage of the nutrient intake not recovered in the feces using the following formula [1].

$$\text{Percent apparent digestibility} = \frac{(\text{Nutrient intake} - \text{Nutrient in feces})}{\text{Nutrient intake}} \times 100$$

2.6. Laboratory Analysis

Samples of feed offered and refusals were ground to pass through a 1 mm sieve mesh. Analysis for DM, ash and N contents was done according to standard procedures [7]. Total nitrogen (N) content was determined by using Kjeldahl

method and crude protein (CP) was calculated as N×6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by using the procedures of Van Soest and Robertson, 1985 [8].

2.7. Statistical Analysis

The statistical model used for data analysis was:

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

where: Y_{ij} = Response variable; μ = Overall mean; T_i = Treatment effect; B_j = Block effect; E_{ij} = Random error

Data on feed intake and Apparent digestibility were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS version 9.1 [9]. When significant, Least Significance Difference (LSD) test was employed to locate differences between the treatment means.

3. Results

3.1. Chemical Composition of Experimental Feeds and Refused Feed

Gebisa vetch variety had highest CP content and lowest NDF, ADF, hemicellulose and cellulose contents compared to other vetch varieties, while Lalisa had highest NDF, ADF and ADL. This variation in chemical composition might have impact on Dry matter and nutrient digestibility.

Table 2. *Chemical composition of experimental feeds and refused feed.*

Feed offered	DM%	Ash	OM	CP	NDF	ADF	ADL	HC	Cell
		%DM							
Fodder oat hay	87.2	10.6	89.4	8.9	53.7	30.0	2.7	23.7	27.3
Vetch hay supplements									
Gebisa	87.5	15.0	85.0	21.1	36.5	27.1	5.0	9.4	22.1
Lalisa	87.1	15.7	84.3	19.5	48.3	36.9	7.7	11.3	29.2
Abdeta	86.6	11.9	88.1	18.0	39.6	28.8	4.6	10.8	24.1
V. sativa	87.7	17.9	82.1	18.4	42.1	32.0	6.4	10.1	25.7
Fodder oat hay refusal									
T1	84.7	9.9	90.1	7.3	59.0	33.4	2.9	25.6	30.5
T2	84.3	9.9	90.1	7.5	56.5	32.9	2.5	23.6	30.4
T3	84.2	10.1	89.9	7.5	57.4	33.4	2.9	24.0	30.5
T4	83.4	10.4	89.6	7.4	58.6	32.7	2.8	25.9	29.9
T5	84.9	9.9	90.1	7.5	56.5	32.6	3.3	23.9	29.3

ADF=Acid Detergent Fiber; ADL=Acid Detergent Lignin; Cell=Cellulose; CP=Crude Protein; DM=Dry Matter; HC=Hemicelluloses; NDF=Neutral Detergent Fiber; OM=Organic Matter.

The CP content of fodder oat hay refusal in this study was lower by 15.7% for T2, T3 and T5 and by 18 and 16.9% for T1 and T4, respectively, as compared to the CP content of the offered fodder oat hay. Fodder oat hay refusals in all treatments had comparatively higher contents of NDF, ADF and cellulose than the basal fodder oat hay offered.

3.2. Dry Matter and Nutrients Intake During Digestibility Trial

All sheep readily consumed the dietary supplement without any refusal across the experiment. The sheep in T1 consumed highest ($p<0.001$) amount of fodder oat hay. Total Dry matter, Organic matter, Neutral detergent fiber, Hemicelluloses and Cellulose intake were not significantly different among treatments.

Supplementation of vetch varieties has increased CP intake by 33.4, 26.8, 24.4 and 26.6% for T2, T3, T4 and T5, respectively, as compared to T1. The highest CP intake was recorded for sheep supplemented with Gebisa vetch variety, whereas, the lowest was recorded for the non-supplemented group.

Table 3. *Average daily dry matter and nutrients intake of sheep fed a basal diet of fodder oat hay and supplemented with different varieties of vetch hay.*

Intake	Treatments					SEM	SL
	T1	T2	T3	T4	T5		
Oat hay DM (g/day)	1007.5^{a}	823.8^{b}	740.7^{b}	740.2^{b}	775.2^{b}	28.42	**
Supplement DM (g/day)	-	350	350	350	350	-	-
Total DM (g/day)	1007.5	1173.8	1090.7	1090.3	1125.2	24.54	ns
OM (g/day)	893.6	1028.2	953.5	968.7	975.0	21.47	ns
CP (g/day)	105.8^{c}	158.8^{a}	144.6^{ab}	140.0^{b}	144.2^{ab}	3.83	***
NDF (g/day)	487.6	547.1	539.4	499.8	541.9	12.09	ns
ADF (g/day)	268.0^{b}	318.1^{a}	326.2^{a}	303.0^{ab}	324.4^{a}	7.15	*
ADL (g/day)	25.2^{d}	41.4^{b}	45.5^{a}	35.3^{c}	38.7^{bc}	1.31	***
HC (g/day)	219.7	229.0	212.9	196.9	217.5	5.51	ns
Cell (g/day)	242.8	276.7	280.7	267.2	286.1	6.14	ns

$^{a, b, c, d, e}$ means with different superscripts in a row are significantly different; ***= (P<0.001); **= (P<0.01); *= (P<0.05); ADF=Acid Detergent Fiber; ADL=Acid Detergent Lignin; BW=Body Weight; Cell=Cellulose; CP=Crude Protein; DM=Dry Matter; HC=Hemicelluloses; NDF=Neutral Detergent Fiber; ns=non-significant; OM=Organic Matter; SEM=Standard Error of the Mean; SL=Significance Level.

3.3. Apparent Dry Matter and Nutrient Digestibility

Dry matter and nutrient digestibility were significantly (P<0.001) differed among treatments and positively affected by supplementation (Table 4). Supplementation of the vetch varieties increased DM digestibility by 11.6 and 1.9% for T2 and T3, respectively and by 3.6% for T4 and T5 compared to the control. Among the supplemented groups, supplementation of Gebisa vetch variety (T2) induced the highest (65.2%) DM digestibility. The DM digestibility among other supplemented groups was not significantly different (P>0.05).

Crude protein digestibility was significantly (P<0.001) differed among treatments and was positively affected by supplementation. Supplementation of the vetch varieties increased the CP digestibility by 15.3, 6.2, 5.9 and 8.2% for T2, T3, T4 and T5, respectively compared to the un-supplemented treatment. Among the supplemented treatments, T2 induced significantly higher (P<0.001) CP digestibility than T3, T4 and T5. Similarly, NDF, ADF, HC and Cell digestibility also significantly differed (P<0.001) among treatments and positively affected by supplementation of the vetch varieties. Among supplemented groups, supplementation of Gebisa vetch variety induced better NDF, ADF, HC and Cell digestibility.

Table 4. *Apparent dry matter and nutrient digestibility of Arsi-Bale sheep fed a basal diet of fodder oat hay and supplemented with different varieties of vetch hay.*

Apparent Digestibility (%)	Treatments					SEM	SL
	T1	T2	T3	T4	T5		
DM	58.4^{c}	65.2^{a}	59.5^{bc}	60.5^{b}	60.5^{b}	0.48	***
OM	58.9^{c}	65.9^{a}	59.8^{bc}	61.2^{b}	60.1^{bc}	0.51	***
CP	67.3^{c}	77.6^{a}	71.5^{b}	71.3^{b}	72.8^{b}	0.66	***
NDF	41.4^{b}	49.7^{a}	42.6^{b}	43.0^{b}	44.0^{b}	0.70	***
ADF	36.4^{c}	45.8^{a}	42.0^{b}	42.7^{b}	42.0^{b}	0.69	***
HC	47.7^{d}	60.7^{a}	52.6^{c}	55.4^{bc}	57.4^{ab}	0.96	***
Cell	48.8^{c}	58.5^{a}	51.5^{bc}	54.6^{ab}	56.8^{a}	0.83	***

$^{a, b, c}$ means with different superscripts in a row are significantly different; ***= (P<0.001); **= (P<0.01); *= (P<0.05); ADF=Acid Detergent Fiber; Cell=Cellulose; CP=Crude Protein; DM=Dry Matter; HC=Hemicelluloses; NDF=Neutral Detergent Fiber; ns=non-significant; OM=Organic Matter; SEM=Standard Error of the Mean; SL=Significance Level; T1 = Fodder oat hay *ad libitum*; T2 = Fodder oat hay *ad libitum* + 350 g DM/day Gebisa; T3 = Fodder oat hay *ad libitum* + 350 g DM/day Lalisa; T4 = Fodder oat hay *ad libitum* + 350 g DM/day Abdeta; T5 = Fodder oat hay *ad libitum* + 350 g DM/day *V. sativa*.

4. Discussion

4.1. Chemical Composition of Experimental Feeds and Refused Feed

The 8.9% CP content of fodder oat hay used in this study was slightly lower than the 11.5% CP content of the same variety reported in earlier study [10]. Although the CP content of fodder oat hay used in this study was lower than previous reports, it was higher than the 7% CP required for microbial protein synthesis in the rumen that can support at least the maintenance requirement of ruminants [11]. The CP content of Abdeta and Lalisa vetch varieties was also lower than the 24.8% and 24.1% CP content of the same varieties, respectively reported by other author [3]. The lower CP content of experimental feeds registered in this study might be due to losses of the leaf fractions containing high CP while curing the experimental forages in the field. The lower CP and higher NDF, ADF and Cellulose contents of fodder oat hay refusal than the offered fodder oat hay indicates the selective nature of sheep in feeding more nutritious and palatable portion (leafy part) of the hay than the lignified parts.

4.2. Dry Matter and Nutrient Intake During Digestibility Trial

The highest (P<0.001) intake of fodder oat hay in the un-supplemented group than the supplemented ones could be due to an effort of sheep in that group to satisfy their nutrient requirements. Feed that is high in protein and low in fiber content results in high digestibility and voluntary feed intake [12].

The higher CP intake (158.8 g/day) of T2 than T1and T4 could be attributed to higher DM intake in T2 and the highest CP content of Gebisa compared to other vetch varieties (Table 2; Table 3). The lowest CP intake (105.8 g/day) recorded for the non-supplemented group could be because of the lowest DM intake and absence of high protein feed supplementation.

4.3. Apparent Dry Matter and Nutrient Digestibility

The highest DM digestibility recorded for T2 might be associated with the low NDF and ADF concentration of Gebisa vetch variety (T2) and high CP intake of T2 compared to other treatments (Table 3; Table 4). Neutral detergent fiber, which is a measure of cell wall content, is the primary chemical component of feeds that determines the rate of digestion; thus, there is a negative relationship between the NDF content of feeds and the rate at which they are digested [1]. Organic matter digestibility also showed the same trend with DM digestibility for the same reasons.

Improvements in DM and nutrient digestibility due to supplemental protein and/or energy has been also well documented by various authors [13-16]. This is obviously a result of increased nutrient supply to rumen microbes for their

proliferation to be present abundantly to colonize and digest the DM and other nutrients consumed [1]. Therefore, the result of this study was in line with earlier studies as the sheep in T2 showed better digestibility of DM and nutrients as a result of low NDF content and high CP content of Gebisa vetch variety.

The value of apparent DM digestibility in this study (58.4-65.2%) was within the range of digestibility of tropical forages (40-65%) [2]. Comparable values of apparent DM digestibility (65%) and CP digestibility (74%) were also reported for Arsi-Bale sheep fed a basal diet of urea treated barley straw and supplemented with 350g DM *Vicia dasycarpa* 'lana [13]. Similarly, a comparable apparent DM digestibility of 65.13% was reported for Begait sheep fed a basal diet of natural pasture hay and supplemented with 320g DM Pigeon pea leaf [17].

5. Conclusion

From the results of the current study it was observed that dry matter and nutrient digestibility was affected by the varieties of vetch. The highest dry matter and nutrient digestibility was obtained by supplementation of Gebisa vetch variety. Therefore Gebisa vetch variety can be recommended as a best variety for use as supplementary forage legume in ruminants fed roughage based diets. Furthermore, metabolic trial using this variety and the effect of feeding this variety on carcass quality of sheep is recommended.

Statements and Declarations

Funding

This work was supported by Sinana Agricultural Research Center.

Competing Interests

The author declare no competing interests.

Ethics Approval

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

Acknowledgements

I want to thank Sinana Agricultural Research Center for allowing me to use the experimental barn and facilities.

References

[1] 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.

[2] Bakrie, B., Hogan, J., Liang, J. B., Taraque, A. M. M. and Upadhyay, R. C. 1996. Ruminant nutrition and production in the tropics and subtropics. *Australian Centre for International Agricultural Research.*

[3] Dawit Abate, Aliye Kadu and Sisay Belete, 2011. Registration of Abdeta, Gebisa and Lalisa Vetch Varieties for Bale Highlands, Ethiopia. East African Journal of Sciences. 5 (2), 135-137.

[4] El Hassan SM, Lahlou-Kassi A, Newbold CJ and Wallace RJ, 2000. Chemical composition and degradation characteristics of foliage of some African multipurpose trees. Animal Feed Science and Technology. 86 (1-2), pp. 27–37.

[5] Berhanu Tassew, Adugna Tolera, Mengistu Urge. 2022. Effect of different varieties of vetch hay supplementation on performance of sheep fed a basal diet of fodder oat hay. Int. J. Adv. Res. Biol. Sci. 9 (6): 29-38. DOI: http://dx.doi.org/10.22192/ijarbs.2022.09.06.004.

[6] Berhanu Tassew, Adugna Tolera, Mengistu Urge. 2022. Effect of Different Varieties of Vetch Hay Supplementation on Carcass Characteristics of Sheep Fed a Basal Diet of Fodder Oat Hay. *American Journal of Life Sciences*. Vol. 10, No. 4, 2022, pp. 78-87. doi: 10.11648/j.ajls.20221004.14.

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

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

[9] SAS (Statistical Analysis System) Institute Inc, 2004. SAS Online Doc® 9.1.3. Cary, NC, SAS Institute Inc.

[10] Dawit Abate and Teklu Wegi, 2011. Registration of Bonsa and Bona-bas Fodder Oats Varieties for Bale highlands, Ethiopia. East African Journal of Science. 5 (2), 131-133.

[11] Van Soest, P. J, 1994. Nutritional Ecology of the Ruminant, second edition. Cornell University press.

[12] Adugna Tolera, Merkel, R. C., Goetsch, A. L., Tilahun Sahlu and Tegene Negesse, 2002. Nutritional constraints and future prospects for goat production in East Africa, in*:* Merkel, R. C. Adebe, G. Goetch, A. L. (Eds.), Langston University, Oklahama, United States.

[13] Dawit Abate and Solomon Melaku, 2009. Effect of supplementing urea-treated barley straw with lucerne or vetch hays on feed intake, digestibility and growth of Arsi Bale Sheep. Tropical Animal Health and Production. 4, 579–586.

[14] Ermias Tekletsadik, Solomon Mengistu and Mengistu Urge, 2013. The effect of barley bran, linseed meal and their mixes supplementation on the performances, carcass characteristics and economic return of Arsi-Bale sheep. Small Ruminant Research. *114* (1), 35-40.

[15] Teklu Wegi, Adugna Tolera, Jane Wamatu, Getachew Animut, and Barbara Rischkowsky, 2018. Effects of feeding different varieties of faba bean (*Vicia faba* L.) straws with concentrate supplement on feed intake, digestibility, body weight gain and carcass characteristics of Arsi-Bale sheep Asian-Australasian Journal of Animal Sciences; 31 (8): 1221-1229.

[16] Biruk Bekele, 2017. Supplementation of *Vernonia amygdalina* Leaves with Different Levels and Crushed Maize on Feed intake, Digestibility, Body weight gain and Carcass characteristics of Arsi Bale sheep fed wheat straw basal diet. MSc Thesis. Haramaya University, Haramaya, Ethiopia.

[17] Abraham Teklehaymanot. 2015. Supplementation of *Tsara* (*Pterocarpus lucens*), Pigeon Pea (*Cajanes cajan*) leaves and concentrate mixture on growth performance and carcass characteristics of *begait* sheep fed hay as a basal diet. MSc Thesis, Haramaya University, Haramaya, Ethiopia.