Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.1, 2015 www.iiste.org

Determination of Digestibility of Faba Bean (Vicia Faba L.) Hull and Wheat Bran in Afar Sheep

Abadi Nigus[1*] Mehammed Yusuf[2] Getachew Animut[2]
1.Adigrat University, Department of Animal Sciences, P.O.Box 50, Adigrat, Ethiopia
2.Haramaya University, Department of Animal Science, P.O.Box, 138, Dire Dawa, Ethiopia
Corresponding author E-Mail: abadinigus@gmail.com

Abstract
A study was conducted to determine the chemical composition and digestibility of faba bean hull (FBH) and wheat bran (WB). Chemical compositions of FBH and WB were determined. The crude protein (CP) and acid detergent lignin (ADL) of WB were higher than FBH but neutral detergent fiber (NDF) and acid detergent fiber (ADF) of FBH were higher than those of WB were. With the exception of digestibility of CP, the digestibility of DM, OM, ADF, and NDF were not significantly affected by treatments (P>0.05). Digestibility of CP was greater in sheep (P<0.05) of supplemented treatments as compared to the control group, while differences among the supplemented group in CP digestibility were not significant (P>0.05). In general, FBH had almost comparable with CP of WB.
Keywords: Faba bean hull, byproduct, chemical composition, digestibility

Introduction

Faba bean *(Vicia faba L.*) is one of the earliest domesticated food legumes in the World, (Bond, 1976; Cubero, 1976; Witcombe, 1982).Today, faba bean is a major crop in many countries including China, Ethiopia, and Egypt, and are widely grown for human food throughout the Mediterranean region and in parts of Latin America. Ethiopia is the third main faba bean producing country in the world, next to China and UK, and there are large faba bean varietal diversifications in Ethiopia (Metayer, 2004). Even though faba bean is grown in most parts of Ethiopia, up to an altitude of 3200 meter above sea level (masl) the highest concentration of production is observed in cereal-pulse Zones between 2000-2700 masl (Alem, 1993). The crop requires a moderate and evenly distributed rainfall of about 600-800 mm during growing period, and it is generally considered to be the least drought resistant of all legumes Alem (1993).

The palatability of faba bean haulms to animals is least compared with the palatability of other pulse hay or straws. However, it is totally consumed once animals become accustomed to it (Hawthorne, 2006). If bean haulm is properly harvested, it is a useful roughage feed for sheep but because of its thick fibrous stems, it is more difficult to dry than cereal straws and frequently become mouldy during storage (McDonald *et al.,* 2002). According to McDonald *et al.* (2002), faba bean haulms are rich in protein, calcium and magnesium than cereal straws. Lulseged and Jamal (1989) reported that faba bean residue has 91.1 DM, 0.8 EE, 10.4 ash, 7.2 CP and 74.3% NDF. Similarly, Yetimwork (2005) reported that haulms of different faba bean varieties contained 90.5-92.4 DM, 10-13.6 CP, 11.3-16.2 ash, 33.1-51.5 NDF, 30.4-42.4 ADF and 5.46-8.3% ADL. In the study of Li-Juan *et al.* (1993), the value of faba bean was 87 and 31% for DM and CP, respectively.

In Tigray Region, a total of 14,889 hectares of land were covered by different crops including maize, chickpeas, horse-beans, sorghum, barley and wheat in Raya Azebo, Alamata, Enda -Moni, Alaji and Ofla weredas using the unseasonal rains received. Faba beans are produced in large quantities throughout the year in highland of Alamata woreda. The internal part of the seed is used for human consumption and the outer cover (seed coat) is a byproduct, can be used as livestock feed. However, there is scarce information on the nutritive value of this feed resource. Thus, the objective of this study was to determine the effect of faba bean hull substituting to wheat bran on feed intake, digestibility, live weight gain, carcass Characteristics and partial budget analysis of Afar sheep.

Wheat grain is very variable in composition. According to Gillespie (2002), DM, crude fiber (CF) and ADF content of WB is 89, 11.3 and 15%, respectively. The chemical composition of wheat bran is also reported to be 891, 39, 166, 469, 6.4, 155 g/kg DM for DM, ash, CP, NDF, NDF-N, ADF, respectively (Kaitho *et al*., 1998). According to Beyene (1976), the composition of wheat bran was 92.46 DM, 17.01 CP, 17.25 ADF, 52.12 NDF, and 4.59% EE. The CP content of wheat bran varies from 60-220 g/kg DM, though it is normally between 80 and 140 g/kg DM. The grain consists of about 82% endosperm, 15% bran or seed coat and 3% germ (McDonald *et al*., 2002). The dietetic composition and digestibility of wheat bran given to animals in intensive feeding system in Kenya had 172 g CP/kg DM and 69.6% digestibility (Abate and Abate, 1991).

Wheat bran consists primarily of the seed coat of wheat, which is detached during the manufacturing of wheat flour. It is the most popular and important livestock feed and is a good source of phosphorus, energy and protein Cullison (1979). Similarly, Ensminger *et al*. (1990) described that wheat bran as the coarse outer covering of the wheat kernel, which is separated from wheat grain in commercial milling. It is rich in vitamins, minerals, energy and protein. It is a superior supplement for use in gestating cows, sheep and swine ration. It contains 11% CF, 70% TDN, 3.1 kg Mcal DE and 17.5% CP Ensminger *et al*. (1990). Pond *et al*. (1995) and Cheeke (1999) noted that wheat bran is bulky and laxative feed, which is quite palatable and well known for its ability to prevent constipation because of its swelling and water holding capacity.

Wheat bran is fed in combination with grain and with feeds rich in CP, such as oil seed meals. It has a better value when making not over one–fourth (25%) of the concentrate mixture Seymour (2003). However, because of bulky nature and high fiber content, wheat bran and other mill feeds are not usually fed to swine and poultry, but they are most suitable for ruminants (Cheek, 1999) and wheat bran is one of the best milling products for feeding dairy cows (Etgen and Reaves, 1978). Experimental results indicated that supplementation of wheat bran with protein rich diet as peanut cake had better response in live weight gain and higher DM intake in goats (Getenet, 1998). Another study conducted by Kathio *et al*. (1998) on Ethiopian sheep supplemented with WB (150 g) on teff straw based diet, the daily live weight gain on 60 days fattening program was 34.3 g. The feed intake of sheep on the same study was 625 g DM/ day and 5.07 MJ ME to attain 34.3 g weight. The objective of this study was to evaluate the chemical composition and digestibility of faba bean hull and wheat bran as a feed for Afar sheep.

MATERIAL AND METHODS

Description of the Study Area

The experimental was conducted in Alamata district, Southern Zone of Tigray, Ethiopia. It is located 600 km North of Addis Ababa and 182 km South of Mekelle and has an elevation of 1600 meter above sea level (masl). It lies at $39^0$35'E longitude and at $12^0$15'N latitude. The area receives a bimodal rainfall distributed between March and May for the short rainy season and between June and September for the long rainy season. The annual mean precipitation is 591 mm and mean maximum and minimum temperatures are 28^0C and 13^0C, respectively. Teff, sorghum and maize are the major crops growing in the lowland and faba bean, wheat, barley are also the most crops growing in the highland of the area.

Experimental Feed Preparation

WB was purchased from Betel Wheat Flour Factory found in Alamata. FBH, which is the outer layer of the faba bean while de-hulling using mill machine or traditional available millstone for human consumption. This byproduct was purchased from neighboring people in Alamata that are involved in processing faba bean for sale, and the bulk of it was obtained in general.

Experimental Animals and Management

Twenty-five yearling male Afar sheep with average initial body weight of 19.98$\pm$0.12 Kg (mean $\pm$ SE) were purchased from Bala market. Age of the animals was determined based on their dentition or information obtained from the owner. The animals were quarantined for twenty-one days and during this period; they de-wormed using Albendazole against internal parasites and sprayed using Ivermectin against external parasites. They were also vaccinated against Anthrax, pasturollosis and sheep pox. Then experimental animals were housed in individual pens.

Experimental Design and Treatment

The experiment was conducted by using a randomized complete block design (RCBD) with five treatments and five replications. Animals were blocked based on their initial body weight (IBW) into five blocks consisting of five animals each. Treatment diets were randomly assigned to each animal in a block. All experimental animals were offered hay *ad libitum*. The hay was fed *ad libitum* allowing 20% refusal. The other supplemental feeds were offered in two equal portions twice a day at 0800 and 1600 hours. All animals had free access to drinking water and salt block. The experiment was conducted for 7 days of digestibility trial after 21 days of adaptation. The supplements were different proportions of WB and faba bean hull (FBH). Treatments, therefore, were:

T_1 = Hay fed *ad libitum*
T_2 = Hay fed *ad libitum* + 300 g WB
T_3 = Hay fed *ad libitum* + 200 g WB + 100 g FBH
T_4 = Hay fed *ad libitum* + 100 g WB + 200 g FBH
T_5 = Hay fed *ad libitum* + 300 g FBH

Measurements

Digestibility trial

The digestibility trial was conducted after 21 days of acclimatization. Total feces collections were undertaken using fecal bags harnessed to the animal for seven consecutive days after 4 days of adapting the sheep to the carrying of fecal bags. Feces were collected and weighed every morning for each animal before feed was offered. Representative samples of 15% were taken daily, bulked over the experimental period, and kept in deep freezer at -20^0C. At the end of the collection period, the overall collected samples from each animal were thawed and thoroughly mixed and 20% sub sampled. Fecal samples were dried at 55^0C for 72 hours, ground to pass through a 1mm mesh size, and stored in airtight container pending chemical analysis. Samples of feed offered from each feed and refusal from each animal was sampled daily and composited per feed type for the offered and per treatment for refusals during the digestibility period for chemical analysis. The apparent digestibility coefficient of DM, OM, CP, NDF and ADF were estimated by using the equation below:

$$DC\ (\%) = \frac{\text{Nutrient intake} - \text{Nutrient excrete in the feces}}{\text{Nutrients intake}} \times 100$$

Chemical analysis

The WB and FBH feed samples were dried at 55^{0}C for 72 hours and ground to pass 1 mm mesh size. All samples were subjected to laboratory analysis for DM, CP and ash determination following the procedure of AOAC (1990). The ADF, NDF and ADL contents of samples were determined following the procedures of Van Soest and Robertson (1985). Organic matter (OM) content was calculated as 100-ash percentage. Cellulose and hemi-cellulose were calculated (NRC, 2001) as follows:

Cellulose = (ADF% - ADL %)

Hemi-cellulose = (NDF% - ADF %)

Statistical Analysis

Data on digestibility was analyzed using the general linear model procedure of (SAS, 1998). The treatment means were separated by least significant difference (LSD). The model used for data analysis was:

$Yij = \mu + T_i + B_j + e_{ij}$

Where; Y_{ij} = Response variable

μ = Overall mean

T_i = Treatment effect

B_j = Block effect

E_{ij} = Random error

RESULTS AND DISCUSSION

Chemical Composition of Treatment Feeds

The chemical composition of the treatment feeds are given in Table 1. The hay offered to the experimental animals in the current study contained low CP comparable to value of 6.56, 6.05, 5.64, and 7.02% reported by Simret (2005), Beyene (1976), Getachew (2005), Abebaw (2007), respectively but was higher than the value of 3.5-5.3% noted by others (Kabaija and Little, 1988; Asenakew, 2005; Jemberu, 2008; Fentie, 2007) and was lower than the value of 8.46 and 9.23% reported by Alemu (1981) and Matiwos (2007), respectively. Therefore, the CP content of hay used in the current study, which predominantly consisted of mixed sward grass hay, was below 7.5% CP level required to satisfy the requirement of animals Van Soest (1982). The low CP and high NDF and ADF content could be attributed to the stage of maturity of the mixed sward from which the hay was prepared. Advance in maturity of plants is usually associated with low CP and high cell wall content McDonald *et al.* (2002).

Table 1. Chemical composition of experimental feeds and hay refusals

feeds	DM (%)	Chemical composition OM (% DM)	CP	NDF	ADF	ADL	CEL	HEM
Feed offered								
Hay	92.52	89.24	6.78	75.02	45.55	8.68	36.87	29.47
WB	89.33	95.26	13.13	51.22	12.95	10.56	2.39	38.27
FBH	90.94	95.94	12.78	63.07	52.20	8.69	43.51	10.87
Refusal Hay								
T1	91.99	93.42	2.92	93.42	83.95			
T2	91.88	93.51	2.48	93.51	83.88			
T3	91.48	93.46	2.33	93.46	83.92			
T4	93.10	93.90	2.63	93.00	84.01			
T5	92.89	93.12	2.33	93.12	84.00			

WB = wheat bran; FBH = faba bean hull; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; CEL= cellulose, HEM= hemicelluloses, T1 = hay *ad libitum* ; $T_2 = T_1$ + 300 g WB; $T_3 = T_1$ + 200 g WB + 100 g FBH; $T_4 = T_1$ + 100 g WB+ 200 g FBH; $T_5 = T_1$ + 300 g FBH.

The CP content of WB is variable. According to Lonsdale (1989), the CP content of WB varies from 13.3 to 17.0%. The result of the current study falls a little bit lower than this range. Alemu (1981), Asnakew (2005), Simret (2005), and Fentie (2007), respectively less than the value of 19.99, 19.55, 20.10, and 23.08% reported the CP content of WB observed in the current study. In addition, it was a little bit less than the result obtained by Kaitho *et al.* (1998), Abate and Abate (1991), Tesfay *et al*. (2001), and Solomon *et al*. (2004), who reported the CP content of WB to be 16.6, 17.2, 16.31, and 16.5%, respectively. However, it was comparable to the value of 14.53% reported by Giri *et al.* (2000). The differences between the results might be due to the variation in the raw material methods of milling and the prolonged storage of WB after milling.

The ADF content of WB was comparable to 12.70, 12.47, 12.36% 12.39, and 12.45% reported by Solomon *et al*. (2004), Simret (2005), Asnakew (2005), Fentie (2007), and Jemberu (2008), respectively but lower than 15.50 and 14.6% obtained by Kaitho *et al*. (1998) and Hirut (2008) correspondingly and higher than 9.49 and 9.46% reported by Giri (2000) and Tesfay (2007), respectively. The NDF value of the present study of WB was comparable to the value of 55.5% reported by Hirut (2008) and higher than the value of 44.13, 44.97, 43.83, 44.94, and 39.16% reported by Simret (2005), Mulat (2006), Fentie (2007), Abebe (2008), and Jemberu (2008), respectively.

FBH CP content in this study was comparable to the CP content of WB. Jansman *et al*. (1995) noted a CP content of about 16% for FBH, which was slightly higher than the value in this study, unlike Ermias (2008) who noted a low CP value of 7.7% for FBH. Roughage feeds with CP content of 9.92 to 15.2%, 6.6 to 9.1% and 3 to 6.5% were classified as high, medium and low quality roughage feeds, respectively Nsahlai *et al*. (1996). The FBH evaluated in this study could thus be classified as high quality feed with respect to their CP contents. On the other hand, similar NDF value to the result in this study was reported Jansman *et al*. (1995). Lower CP level was noted for hay refusals as compared to the offered hay in this study. The NDF and ADF contents were conversely greater for the refusals as compared to the offered hay. All these suggest the presence of selectivity for hay fractions by the experimental animals.

Apparent Digestibility

The digestibility of OM and nutrient intake is shown in Table 2. With the exception of digestibility of CP, the digestibility of DM and other nutrients were not significantly affected by treatments (P>0.05). Digestibility of CP was greater (P<0.05) for substituted treatments as compared to the control group, while differences among the substituted group in CP digestibility were not significant (P>0.05). The digestibility of DM and OM for supplemented treatments in this study was slightly greater than the values noted by Kaitho *et al.* (1998) but comparable other reports (Giri *et al.,* 2000; Fentie, 2007), when wheat bran or mixtures of WB with NSC used as supplemented diets.

McDonald *et al*. (2002) noted that the OM digestibility of young pasture grass to range from 45 to 85%, and the values noted in this study are within this range. Increment in CP digestibility with supplementation in this study is consistent with previous reports Mulu (2005; Simret, 2005), and is associated with greater CP intake which might have improved nitrogen supply to Ruminal microbes, resulting to more protein digestion and possibly to more microbial protein synthesis. Ranjhan (1997) and Ferrell *et al*. (1999) pointed out that the level of protein influence the digestibility of DM and nutrients. In this study however, improved CP digestibility with supplementation did not result to similar improvement in DM and other nutrients digestibility, the reason of which was not apparent.

The high fiber and low CP concentration of low quality forages are expected to result in low apparent digestibility of CP, because metabolic fecal N constitutes a high proportion of the N in the feces pointed out by Ferrell *et al*. (1999). Thus, the CP digestibility in T_1 observed in the present study, which was low as compared to the other treatments, is in line with idea mentioned. Van Soest (1987) also described that apparent digestibility values can be negative where a small intake and/or low digestibility is associated with a relatively large metabolic lose of the constituents. This occurs often in the case of apparent nitrogen digestibility of poor quality or heat damaged feeds.

Table 2. Apparent digestibility of dry matter and nutrients of Afar sheep fed on grass hay and noug seed cake and substituted with different proportions of faba bean hull and wheat bran

Apparent	Treatments					
Digestibility (%)	T_1	T_2	T_3	T_4	T_5	SEM
DM	54.55	54.25	59.28	57.76	55.95	1.34
OM	57.86	58.52	62.33	60.86	58.51	1.23
CP	27.00[b]	50.34[a]	53.54[a]	54.68[a]	51.75[a]	3.42
NDF	56.69	52.55	57.60	56.39	50.61	1.81
ADF	47.79	39.53	48.08	49.51	43.75	2.40

[a,b,] = means with different superscripts in a row are significantly different (P<0.05); SEM = standard error of mean; DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; T_1 = hay + 45 g NSC; T_2 = T_1 + 300 g WB; T_3 = T_1 + 200 g WB + 100 g FBH; T_4 = T_1 + 100 g WB+ 200 g FBH; T_5 = T_1 + 300 g FBH.

CONCLUSION

Therefore, the CP content of hay used in the current study, which predominantly consisted of mixed sward grass hay, was below 7.5% CP level required to satisfy the requirement of animals.

The crude protein (CP) and acid detergent lignin (ADL) of WB were higher than FBH but neutral detergent fiber (NDF) and acid detergent fiber (ADF) of FBH were higher than those of WB were. With the exception of digestibility of CP, the digestibility of DM, OM, ADF, and NDF were not significantly affected by treatments (P>0.05). Digestibility of CP was greater in sheep (P<0.05) of supplemented treatments as compared to the control group, while differences among the substituted group in CP digestibility were not significant (P>0.05). In general, FBH had almost comparable with CP of WB.

ACKNOWLEDGEMENT

The author would like to express special thanks to the Ministry of Education (MOE) for financial support to the research through the scientific research grant offered and Haramaya University for laboratory work/analysis.

REFERENCES

Abate, A. and A.N. Abate, 1991. Wet season nutrient supply to lactating grade animals managed under different production system. *East Africa Journal Agricultural and Forestry*. 57: 33-39p.

Abebe Hailu, 2008. Supplementation of graded levels of concentrate mix on feed intake, digestibility, live weight change and carcass characteristics of Washera sheep fed urea treated rice straw. An MSc. Thesis Presented to School of Graduate Studies, Haramaya University, Ethiopia. 25p.

Alem Berhe, 1993. Component analysis of the characters determining seed yield in faba bean *(Vicia faba L.)*. MSc Thesis Presented to the School of Graduate Studies of Alemaya University.79p.

Alemu Yami, 1991. Laboratory evaluation and estimation of nutritive value of some feedstuffs produced in the Alemaya woreda. An. MSc Thesis presented to the School of Graduate of Studies of Addis Ababa University. 81p.

Asnakew Awoke, 2005. Feedlot fatting performance and carcass characterization of intact male Hararghe highland goat feed different level of hay to concentrate ratios. An. MSc Thesis Presented to the School of Graduate Studies of Alemaya University. 65p.

Beyene Chichablu, 1976. Laboratory evaluation and estimation of nutritive value of some Ethiopian feedstuff and formula feeds plus animal evaluation of noug seed cake (*Guizotia abyssinica).* An MSc Thesis Presented to the Faculty of the Graduate School of Cornell University for the Degree of doctrine of philosophy. 135p.

Bond, D.A. 1976. Field bean, *Vicia faba (Legumillosae* Papilionataein Evolution of Crop Plants (Simmonds, N.W. (Ed.). Longman, London, U.K). 179-182p.

Cheeke, P.R., 1999. Applied animal nutrition. Second (Ed.). Feeds and Feeding. Macmillan, New York and Toronto. 28-60p.

Cubero, J.I. 1974: On the evolution of Vicia faba. Theoretical and Applied Genetics 45:47-51p.

Cullison Arthur E., 1979. Feeds and Feeding. Second Reston Publishing Company, Inc. A Prentice-Hall company, Reston, Virginia. 595p.

Ensminger, M.E.; J.E. Oldfield, and W.W. Heinemann, 1990. Feed and Nutrition, 2nd (Ed.). The Ensminger publishing company. 1544p.

Ermias Tekletsadik 2008. The Effect of supplementation with barley bran, linseed meal and their mixtures on the performance of Arsi-bale sheep fed a basal diet of faba bean haulms.

Etgen, W. M. and P. M. Reaves, 1978. Dairy Cattle Feeding and Management. Sixth (Ed.) John
Wiley and Sons, New York. 638p.

Fentie Bishaw, 2007. Effect of supplementation of hay with noug seed cake (*Guizotia abyssinica)*, wheat bran and their mixtures on feed utilization, digestibility and live weight change in Farta sheep. 26p.

Ferrell, C.L., K.K. Kreikemeier and H.C. Freely, 1999. The effect of supplemental energy, nitrogen, and protein on feed intake, digestibility, and nitrogen flux across the gut and liver in sheep feed low quality forage. *Journal of Animal Science.* 77: 3353-3364p.

Getenet Brehan, 1998. Performance of Somali goat supplemented with different proportion of groundnut cake and wheat bran. An MSc Thesis presented to the School of Graduate Studies of Alemaya University of Agriculture. Alemaya, Ethiopia. 85p.

Giri, S.S., A. Sahoo, and N.N. Pathak, 2000. Feed intake, digestibility, plane of nutrition and live weight gain by cross breed growing bulls fed on grain less diet containing different nitrogen sources. *Journal of Animal Feed Science and Technology*. 83: 195-203pp.

Hawthorne, W., 2006. Using pulse as forage crops. Pulse in Australia. www.pulseaus.com.au

Hirut Yirga, 2008. Supplementation with concentrate mix to Hararghe highland sheep fed a basal diet of urea-treated maize Stover: Effect on feed utilization, live weight change and carcass characteristics. An MSc Thesis Presented to School of Graduate Studies of Haramaya University. 32-48p.

Jansman, A. J. M. W. Verstegen, J. Huisman and J. W. Van den berg, 1995. Effects of hulls of faba beans (*Vicia faba L.)* with a low or high content of condensed tannins on the apparent ileal and fecal digestibility of nutrients and the excretion of endogenous protein in ileal digesta and feces of pigs. 121p.
Jemberu Dessie, 2008.Effect of supplementation of Simada sheep with graded levels of concentrate mix on feed intake, digestibility and live weight parameters.26p.
Kaitho, R.J., A.Tegene, N.N. Umunna, V. Nsahlai,I S. Tamminga, J.Van Bruchem and J.M. Arts, 1998. Effect of leucaena and sesbania supplementation on body growth and scrotal circumference of Ethiopia highlands sheep and goats fed teff straw basal diet. Livestock Production Science 54:173-181p.
Li-Juan, L., Y. Zhao-hai, Z. Zhao-Jie, X. Ming-Shi and Y. Han-qing, 1993. General survey in faba bean in China: State of the art review. ICARDA (International Center for Agricultural Research in the Dry Areas), Aleppo, Syria. 11-22p.
McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, and C.A. Morgan, 2002. Animal Nutrition, 6th (Ed.). Prentice Hall, Harlow, England, London. 693p.
Metayer N., 2004. *Vicia faba* breeding for sustainable agriculture in Europe. [Online] available: http://www.las.csices/Eufaba
Mulat Alem, 2006. Effects of supplementing different protein sources on feed intake and live weight gain of local sheep fed on finger millet (*Eleucine coracana*) straw basal diet. An. M.sc Thesis submitted to the Department of Animal Science, School of Graduate Studies. Alemaya University. 52p.
Mulu Mogos, 2005. Effect of feeding different levels of brewery dried grain on live Weight gain and carcass characteristic of Wogera sheep fed on basal diet. An. MSc. Thesis Presented to the School of Graduate Study of Alemaya University. 54p.
NRC, 2001. Nutrient Requirements of Dairy Cattle. Seventh rev. (Ed.). Natl. Acad. Sci. Washington, DC.
Nsahali, I.V. and N.N.Ummuna, 1996. Sesbania and lablab supplementation of oat hay basal diet fed to sheep with or without maize grain. *Animal Feed Science Technology*. 61: 275-289p.
Pond, W.G., D.C. Church and K.R. Pond, 1995. Basic Animal Nutrition and Feeding. John Wiley and Sons, Inc. 4th (Ed.) U.S.A. 59p.
Ranjhan, S.K., 1997. Animal Nutrition in the Tropics, 4th (Ed). Vikas publishing House. 554p.
Seymour, Jane Court, 2003. Sheep and drought: 7. The feed value of unusual feed stuffs. In: html version: http://www.dse.vic.gov.au/depi/nreninf.nsf/
Simret Betsha ,2005. Supplementation of graded level of peanut cake and wheat bran mixture on nutrient utilization and carcass parameters of Somali goats. An MSc Thesis Presented to the School of Graduate Studies of Alemaya University. 60p.
Solomon Melaku, Kurt J. Peters, and Azage Tegene, 2004. Effect of supplementation with foliage of selected multipurpose trees, their mixture or wheat bran on feed intake, plasma enzyme activities, live weight and scrotal circumference gained in Menz sheep. *Journal Livestock Production Science* 89. 253-264p.
Tesfaye Hagos, 2007.Supplementation of Afar rams with graded levels of mixtures of protein and energy sources: Effects on feed intake, digestibility, live weight and carcass parameters. An MSc Thesis Presented to the School of Graduate Studies of Haramaya University. 82p.
Tesfaye Woldemichel, P.O. Osuji and Asfaw Yimegnuhal, 2001. Effect of wheat bran supplementation at graded level on changes in physical body composition in tef straw (*Eragrostis tef*) fed zebu (*Boss indicus*) oxen of the Ethiopian highland. Pp. 99-109. Proceeding of the 9th Annual Conference of the Ethiopian Society of Animal Production Addis Ababa Ethiopia 30-31 Augest, 2001. ESAP.
Van Soest, and P. J., 1987. Nutritional Ecology of the ruminant. Ruminant metabolism nutritional strategies, the cellulolitic fermentation and chemistry of forages and plant fibers. Comstock publishing Associates, divisions of Cornell University press Ithaca and London.373p.
Witcombe, J.R. (1982). Genetic resources of faba beans. Netherlands. 1-13p.