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Effect of Supplementation of Raw, Malted and Heat Treated Grass Pea (*Lathyrus sativus*) Grain on Feed Intake and Digestibility of Farta Sheep

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Abstract: This experiment was conducted to study effects of supplementation with raw, malted and heat treated grass pea on feed intake and digestibility of Farta sheep fed on natural pasture grass hay basal diet. Twenty intact male yearling Farta sheep with an average initial weight of 17.68±1.45 kg (Mean ± SD) were arranged in a randomized complete block design. Animals were blocked in to 5 blocks based on their initial body weight and randomly assigned to treatments. Animals were fed on grass hay alone (T1), or supplemented beside the basal diet with 300 g raw grass pea (T2), 300 g malted grass pea (T3) and 300 g heat treated grass pea (T4) on dry matter (DM) basis. The study was 12 weeks feeding trial and 7 days digestibility trial. Sheep fed on the supplemented diet consume greater total DM (707-720 g/d) and CP (106-125 g/d) than sheep fed on grass hay alone (550 g/d) and (37 g/d), respectively. Among the supplemented treatments, T2 consumed greater ($P<0.05$) DM, CP, ADF and NDF than T3 and T4. On the other hand hay DM intake was higher ($P<0.05$) for T1 than the supplemented ones. Supplementation significantly ($P<0.05$) improved DM and CP digestibility (DM digestibility: 52.7, 60.4, 62.6 and 65.3%; CP digestibility: 76.1, 82.8, 88.9 and 88.4% for T1, T2, T3 and T4, respectively). Digestibility of CP was similar among the supplemented groups but DM digestibility was in the order of T4>T3>T2 ($P<0.05$). In spite of the higher CP consumed in T2, the digestibility was similar. Therefore, treatment of grass pea with heat and maltingcan reduce the anti nutritional factor and improve DM intake.

Key words: Malted and Heat Treated Grass Pea · Sheep

INTRODUCTION

A major constraint to livestock production in developing countries is the scarcity and fluctuating quantity and quality of year round forage supply [1]. Chronic feed deficient represent to animal production in many of the developing countries due to the population increase and consequently allocation of available cereal production, thereby reducing [2]. Despite among the huge livestock population of Ethiopia sheep is estimated around 23.6 million [3]. Researchers, Nutritionists, feed mill mangers and live production specialists continually look for opportunities to improve feed conversion efficiency [4].

On the other hand [5], reported that the world's growing population will keep up the pressure on demand of meat and milk rising prices of these products. Thus, to meet the increasing demand of protein of animal origin, intensified and sustainable feeding of animals of available feed resource may be one way to raise productivity [6]. Grass pea (*Lathyrus sativus*) is one of the important grain legume crops that ranks third among legumes in production comprising 7.6% of the total production of food legumes Urga [7], can be used as feed for animals.

Although it contains high levels of protein, in common with other grain legumes, grass pea seeds contain a variety of anti-nutritional factors (trypsin inhibitors, tannins and β-ODAP) that may limit its potential as feed supplement to livestock [7]. There is, therefore, need for developing methods of reducing the negative effects of such anti-nutritional factors to efficiently use grass pea as feed. Therefore, this study was initiated with the general objective of investigating the effect of differently treated grass pea supplementation on sheep fed on natural grass hay. Also to identify the best treatment method of grass pea to improve the feeding value.

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MATERIALS AND METHODS

Description of the Study Area: The experiment was carried out at Woreta ATVET College, which is situated in Amhara Regional State of Ethiopia located at 110°14' to 110°53' North latitude and 370° 41' to 110° 53' east longitude. It is found at an altitude of 1802 meters above sea level with annual average rainfall of 1259 mm. The mean maximum, minimum and average annual temperature is 28.2, 11.5 and 19.9 °C, respectively.

Feed Preparation, Experimental Animals and Management: Grass hay, the basal diet and Grass pea, the supplement feed was purchased and stored under shade. One-third of the grass pea was malted in the traditionally adopted procedure. Grass pea was cleaned from inert materials and soaked in tap water in a container for 24 hours to malt. After soaking, water was drained and the seed was put in basket and covered with plastic sheet until malted. The malted grain was then dried under sunlight and stored in sacks. The other treatment was prepared by heating grass pea on hot plate and stored in the same fashion. Hay was offered *ad libitum* and mineral lick and water were available all the time to the animals. Twenty yearling male Farta sheep with initial live weight of 17.68 ± 1.45 (Mean ± SD) were used in the study. Before the commencement of the trial the animals were ear tagged. The animals were quarantined for 25 days. During this period they were de-wormed and sprayed against internal and external parasites respectively. The experimental animals were used for digestibility and feeding trials that lasts 7 days and 12 weeks respectively. Animals were housed in individual pens equipped with water and feeding troughs.

Experimental Design and Treatments: The experiment was conducted with randomized complete block design (RCBD). animals were blocked into five blocks of four animals based on `their initial body weight. Animals within a block were then randomly assigned to one of the four treatment diets. The basal diet, grass hay was available *ad libitum* to all animals, while the daily concentrate supplement was limited to 300 grams dry matter.

Feed Treatment Used in the Experiment

T1 = Grass hay alone fed *ad libitum*

T2 = Grass hay fed *ad libitum* plus 300gm dry matter raw grass pea

T3 = Grass hay fed *ad libitum* plus 300gm dry matter malted grass pea

T4 = Grass hay fed *ad libitum* plus 300gm dry matter heat treated grass pea.

Feeding Trial: Feed offered and corresponding refusals were recorded daily throughout the experimental period. Basal and supplement feeds were fed separately and both basal and supplement feed intake were determined as a difference of the amount of feed offered and refused. A grap of feed sample from each feed was taken once in the middle of each week during the feeding trial period. Initial body weight of experimental animals was determined by taking mean of two consecutive weights after overnight fasting. Subsequent body weights of animals were measured fortnightly after over-night fasting. Average daily body weight gain were calculated as final minus initial body weights divided by the number of days of feeding.

Digestibility Trial: After feeding trial of 12 weeks, each animal was harnessed with a fecal bag. After adaptation period of three days to fecal bags, feces were collected for seven days. Each day's collection of feces per animal was weighed and 20% was sub-sampled and stored frozen at -20°C and pooled over the collection period. A composite of feed samples were also collected for each type of feed for chemical analysis. Composite samples of feces were thawed to room temperature, mixed thoroughly, sub sampled, weighed, dried at 65°C for 72 hours and were ground to pass 1 mm sieve and stored in airtight polyethylene bag pending analysis. Apparent digestibility was calculated as follows;

$$\text{Apparent digestibility (AD) (\%)} = \frac{\text{DM or TN in feed - DM or TN in feces}}{\text{DM or TN in feed}} \times 100$$

Where,

DM = Dry matter

TN = Total Nutrient

Chemical Analysis: Feeds offered and refused during the digestibility and feeding trial as well as feces excreted during digestibility trial were subjected to laboratory analysis for DM, CP and ash determination following the procedure of AOAC [8]. The ADF, NDF and ADL contents were determined according to the procedures of Van Soest and Robertson [9].

Statistical Analysis: Data from intake and digestibility, body weight gain and carcass parameters were subjected to analysis of variance (ANOVA) using the general linear model procedure [10]. Treatment means were separated by least significant difference (LSD).The model used for data analysis was Y_{ij}= ì + t_i + b_j+ e_{ij}.

Where;
Y_{ij} = response variable,
ì = overall mean,
t_i = i^{th} treatment effect,
b_j = j^{th} block effect and eij = random error

RESULTS

Chemical Composition of Treated Feeds: The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents of hay used as basal diet in this study was higher as compared to the supplement feed, grass pea. The DM content of heat treated grass pea was slightly greater than the DM content of raw and malted grass pea whereas the OM content was somewhere between the two. The CP content of raw grass pea was higher than that of malted and heat treated grass pea.

Feed Intake: The daily total DM intake of sheep supplemented with raw grass pea (T2) was significantly higher (P<0.05) than the non supplemented and supplemented with malted grass pea (T3) and heat treated grass pea (T4) (Table 2). The sheep supplemented with heat treated and malted grass pea had also significantly greater (P<0.05) daily DM intake compared to the non supplemented ones. The result of this study showed that supplementation of 300 g DM grass pea improved total DM intake of supplemented sheep by 30.88%, 28.88% and 28.39% over non supplemented group in T2, T3 and T4 treatments respectively. The hay DM intake was significantly higher (p<0.001) for non supplemented sheep than supplemented sheep. A higher substitution rate was observed in T2 among the supplemented groups. The supplemented sheep consumed significantly higher (P<0.05) total CP than sheep in the non supplemented group. Significant differences (p<0.05) in total CP intakes were also observed among the supplemented treatments in the order of T2>T4>T3.

Apparent Digestibility: The apparent digestibility of DM, OM and CP was lower for the non supplemented group compared to the supplemented group (Table 3). The apparent digestibility of DM and OM of sheep supplemented with heat treated grass pea was significantly higher than those supplemented with raw grass pea and malted grass pea. although this should have been more noticeable in protein digestibility and digestible CP intake where no significant difference were observed between the group supplemented with raw and heat treated grass pea. Apparent digestibility of NDF and ADF was not significantly different (P> 0.05) among all the treatments. The digestible NDF intake of sheep in T1 and T2 were significantly (P<0.05) higher than NDF intake of sheep in T3 and T4.

The digestible ADF intake of sheep in T3 was significantly lower than digestible ADF intake of sheep in other treatments. There was no significant (P>0.05) difference in CP digestibility among the supplemented treatments.

DISCUSSION

Chemical Composition of the Feed: The CP content of hay used in the current study was less than the value 6.56% reported by Simret, [11], but higher than the value of 3.56 reported by Fentie [12] and lower than the range (7-7.5%) of maintenance requirement of animals 13]. This difference in the CP content of hay used in the different studies might be related with different factors such as species composition, soil condition, time of harvest, climatic condition, etc. For instance high temperatures may result I n more rapid metabolic activity which

Table 1: Chemical composition of the offered feed and refusals

	Chemical composition					
Offered feed	DM %	OM	CP	NDF	ADF	ADL
Hay	91.06	88.56	6.7	73.96	48.7	8.51
Raw grass pea	88.35	93.85	32.15	39.96	25.26	7.57
Malted Grass pea	90.18	96.19	26.79	31.76	14.23	3.9
Heat treated Grass pea	91.22	94.77	29.38	29.24	21.14	11.64

ADF= acid detergent fiber; ADL= acid detergent lignin; CP= crude protein; DM= dry matter; NDF= neutral detergent fiber; OM= organic matter; T1= grass hay fed *adlibitum*; T2= grass hay fed *adlibitum* + 300 g raw grass pea; T3= grass hay fed *adlibitum* + 300 g malted grass pea; T4= grass hay fed *adlibitum* + 300 g heat treated grass pea.

Table 2: Feed intake fed on grass hay and supplemented with raw, malted and heat treated grass pea

Parameters	Treatments T1	T2	T3	T4	SEM
Hay intake (g/d)	550[a]	420[b]	420[b]	407[c]	2.5
Supplement intake (g/d)	-	300[a]	289[b]	300[a]	0.3
Total DM intake (g/d)	550[c]	720[a]	709[b]	707[b]	2.8
Total DM intake (% BW)	3.28[a]	3.27[a]	3.25[ab]	3.05[b]	74.11
OM intake (g/d)	487[c]	654[a]	650[ab]	644[b]	2.5
CP intake (g/d)	37[d]	125[a]	106[c]	115[b]	0.3
NDF intake (g/d)	407[b]	431[a]	403[b]	388[c]	2.0
ADF intake (g/d)	268[b]	281[a]	246[d]	261[c]	1.3
Substitution rate	-	0.44[b]	0.45[b]	0.48[a]	0.08

[a,b,c,d] means with different superscripts in a row are significantly different ($p<0.05$); g/d = gram per day.

Table 3:Apparent digestibility of nutrient on various feed treatments

Parameters	Treatments T1	T2	T3	T4	SEM
Digestibility (%)					
DM	52.7[d]	60.4[c]	62.6[b]	65.3[a]	1.00
CP	76.1[b]	82.8[a]	88.9[a]	88.4[a]	2.00
OM	57.5[d]	64.1[c]	66.0[b]	67.9[a]	0.38
NDF	48.4	46.5	46.0	46.1	0.78
ADF	38.1	37.5	33.6	37.7	1.43
Digestible nutrient intake (g/d)					
DM	290[d]	435[c]	444[b]	461[a]	3.0
OM	280[d]	419[c]	429[b]	437[a]	2.4
CP	28[c]	103[a]	94[b]	102[a]	1.7
NDF	198[a]	200[a]	185[b]	179[b]	3.0
ADF	107[a]	105[a]	83[b]	99[a]	3.7

decreases the pool of metabolites in the cellular contents such as CP and soluble carbohydrate and increases the structural cell wall components [14]. The higher NDF, ADF and ADL contents of hay used in this study also might be due to late harvesting after maturation of the grass that makes the hay poor quality and has to be supplemented. Conversely the CP content of the raw grass pea used in the current study was higher and comparable with the values of 31.9 noted by Mieczan and Kwiecien [15]. The reduction in CP content due to malting might be associated with the use of endosperm CP for radicle growth during malting. According to Esonu [16], sprouting initiates different types of chemical changes in the seed which include the breakdown of certain materials and transport of materials from one part of the seed to another especially from the endosperm to the embryo or from the cotyledons to the growing parts.

Feed Intake: The result of this study showed that supplementation of 300 g DM grass pea increased total DM intake of supplemented sheep by 30.88%, 28.88% and 28.39% over non supplemented group in T2, T3 and T4 treatments respectively. The higher ($P<0.05$) daily total DM intake of sheep supplemented with raw grass pea (T2) than the non supplemented and supplemented with malted grass pea (T3) and heat treated grass pea (T4) was probably due to the presence of anti nutritional factors in raw grass pea that might have reduced the bioavailability of nutrients making the sheep to consume more feed to achieve similar amount of digestible nutrient intakes. The hay DM intake was significantly higher ($p<0.001$) for non supplemented sheep than supplemented sheep. This is because of substitution effect of the supplement feed in the supplemented sheep. The low total DM intake by the animals fed straw or hay basal diet alone may be due to gut fill resulted from the high fiber content of such diets [13]. Contrary to the current result, supplementation does not affect DM intake of the basal diet [17], while others noted that supplementation improved teff straw intake when used as basal diet [18]. The supplemented sheep consumed significantly higher ($P<0.05$) total CP than sheep in the non supplemented group. Significant differences ($p<0.05$) in total CP intakes were also observed among the supplemented treatments in the order of T2>T4>T3 mainly due to variation in the protein content of the treated and untreated grass pea.

Apparent Digestibility: Lower DM, OM and CP digestibility coupled with low total OM intake of non supplemented sheep resulted to intake of less digestible DM, OM and CP intake as compared to the supplemented sheep. Similar to the results of the current study higher DM, OM and CP digestibility of dietary protein supplemented sheep than non supplemented sheep were noted in other studies [19]. The DM digestibility of the control diet or the hay in the current study is similar with the 52.84% DM digestibility of hay higher than the previously reported values 48.17% and 48% [20, 21]. Such differences in digestibility of hay among studies might be due to variations in quality of hay used for the studies which may be related to differences in ways of preparation like harvesting time, species composition of the plants in which the hay is prepared and other related factors. For instance, the NDF, ADF and cellulose contents of pasture increased with advance in harvesting period and DM digestibility consequently decreased with advance in growing season.

The apparent digestibility of DM and OM of sheep in T4 was significantly higher than those in T2 and T3. The probable reason for such observation is not apparent. However, such differences might be due to the possible inactivation by heat of anti nutritional factors like condensed tannins and trypsin inhibitors which are reported to be contained in raw grass pea that might bind dietary protein and digestive enzymes to form complexes that are not readily digestible [23, 24] although this should have been more noticeable in protein digestibility. There was no significant (P>0.05) difference in CP digestibility among the supplemented treatments. Malting was shown to bring an increase in CP digestibility due to the positive effect of malting on protein digestion and absorption [25, 26]. A similar positive effect of heat treatment of grass pea on protein digestibility is expected due to possible inactivation of antinutritional factors. However, in the current study for some reason, both malting and heat treatment of grass pea failed to show significant impact on the digestibility of dietary protein.

CONCLUSION

The total DM intake, CP intake, growth performance and carcass characteristics of supplemented sheep were enhanced due to supplementation. In spite of the higher CP consumed in T2, the digestibility was similar. Therefore, treatment of grass pea with heat and malting can reduce the anti nutritional factor and improve DM intake.

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