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Full Length Research Paper

Supplementation of Raw, Malted and Heat Treated Grass Pea (*Lathyrus Sativus*) Grain on Body Weight Gain and Carcass Characteristics of Farta Sheep

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This experiment was conducted to study effects of supplementation with raw, malted and heat treated grass pea on live weight gain and carcass characteristics of Farta sheep fed on natural pasture grass hay as 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 (RCBD). Animals were blocked in to 5 blocks based on their initial body weight and randomly assigned to treatments. Treatments were grass hay alone fed ad libitum (T1), or with 300 gm raw grass pea (T2), 300 gm malted grass pea (T3) and 300 g heat treated grass pea (T4) on dry matter (DM) basis. The study consisted 12 weeks feeding trial followed by carcass evaluation. Average daily weight gain (-11, 50, 48 and 66 g/d) and hot carcass yield (6.4, 9.3, 9.4 and 10.1 kg for T1, T2, T3 and T4, respectively) were different among treatments (P<0.05) and were in the order of T4>T3=T2>T1. Partial budget analysis also showed that net return was in the order of T4>T2>T3 and the non supplemented group resulted to a negative value. Therefore, from biological point of view as well as based on partial budget analysis, T4 was recommended and as such heat treatment of grass pea may bring better results in animal performance and economic gains.

Key words: Raw, malted, heat treated, grass pea, weight gain.

INTRODUCTION

Ethiopia is a country with varied agro-ecologies which had a subsequent variation in vegetation and crop types that resulted in larger and varied livestock population in Africa (FAO, 2001). But the return from this large livestock population is too low because of mainly in relation to shortage of feed. FAO (1997) reported that mean carcass weight of sheep in Ethiopia is less than 10 kg per animal. The major constraint to livestock production in sub-Saharan Africa is poor nutrition (Osuji *et al*., 1995; Omore *et al*., 1996). On the other hand ILRI (2008), 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 per unit of animal (Shapiro *et al*. 2004). Grass pea (*Lathyrus sativus*) is one of the important grain legume crops that can have an important role in human and livestock nutrition in the resource poor countries. The crop ranks third among legumes in production comprising 7.6% of the total production of food legumes in Ethiopia (Urga *et al.* 2005). Although it contains high levels of protein, in common with other grain legumes, grass pea seeds contain a variety of anti-nutritional factors like trypsin inhibitors, tannins and β-ODAP (Urga *et al*., 2005). There is, therefore, need for developing methods of reducing the negative effects of such anti-nutritional factors to efficiently use grass pea as feed. And this aspect has not been critically examined and most studies on *Lathyrus sativus* in Ethiopia have focused mainly on its agronomic characters. Anti nutritional factors in grass pea may be in part removed through conventional treatments such as heat treatment (Khokhar and Chauhan, 1997) and malting (Reddy et al., 1985). However, weather such treatments improve the

feeding value of grass pea compared to untreated ones remained uninvestigated. On the other hand, the feeding value of grass pea for sheep has not yet been studied as well. Therefore, this study was initiated with the general objective of investigating the effect of different forms of grass pea supplementation on the performance of sheep fed grass hay and to assess the economic feasibility of supplementation of grass pea in mutton production.

Specific objectives are

1. To evaluate the effect of supplementation of raw, malted and heat treated grass pea on weight gain and carcass characteristics
2. To assess the economic feasibility of supplementation of different forms of grass pea in mutton production

RESEARCH METHODOLOGY

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 $110^{o}14'$ to $110^{o}53'$ North latitude and 370^{o} 41' to 110^{o} 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 ^{O}C, respectively.

Feed Preparation, 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 feeding trial that 12 weeks. Animals were housed in individual pens equipped with water and feeding troughs.

Experimental Design and Treatments

Randomized complete block design (RCBD) that animals blocked into five blocks of four animals based on their initial body weight were used. 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, whereas 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.

Carcass Characteristics

At the end of the feeding trial all the experimental sheep were fasted for 12 hours and slaughtered. Animals were weighed immediately before slaughter. The blood were drained in to bucket and weighed. The head were detached from the body. The skin was flayed, fore and hind legs were trimmed off at the carpal and tarsal joints and weighed. After that internal contents of the gut were emptied and weight of the empty gut was recorded. The empty body weight was then determined as slaughter weight less gut contents. The hot carcass weight was estimated after removing weight of the head, thorax, abdominal and pelvic cavity contents as well as legs below the hock and knee joints. Rib eye muscle area was traced on transparency paper after cutting the vertebrae between the 12^{th} and 13^{th} ribs. The weights of both the edible and non edible carcass components were recorded.

Chemical Analysis

Chemical analysis of feeds offered during the feeding trial were subjected to laboratory analysis for DM, CP and ash determination following the procedure of AOAC (1990). The ADF, NDF and ADL contents were determined according to the procedures of Van Soest and Robertson (1985).

Partial Budget Analysis

According to Upton (1979) procedure, total return (TR) was determined by the difference between the purchasing price of sheep and selling price of the sheep. Net income (NI) was calculated as the amount of money left when total variable costs (TVC) were subtracted from the total returns (TR). NI= TR-TVC.

The change in net income (ΔNI) was calculated as

Table 1. Chemical analysis of treatment feeds

Treatment feed	Chemical composition					
	DM (%)	OM	CP	NDF	ADF	ADL
Hay	91.06	88.56	6.70	73.96	48.70	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	3.90
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. Body weight change and feed conversion ratio on various treatment feeds

	Treatments				
Parameters	T1	T2	T3	T4	SEM
Initial weight	17.6	17.5	17.9	17.7	0.73
Final weight (kg)	16.6^{c}	22.0^{b}	22.2^{b}	23.6^{a}	0.68
Body weight gain (g/d)	-11.1^{c}	50.0^{b}	47.8^{b}	65.6^{a}	1.95
Body weight change (kg)	-1.0^{c}	4.5^{b}	4.3^{b}	5.9^{a}	0.18
FCR	-56.1^{b}	14.6^{a}	14.9^{a}	10.8^{a}	3.15

a,b,c= means with different superscripts in a row are significantly different (P<0.05); FCR = feed conversion ratio; SEM = standard error of mean;

the difference between change in total return (ΔTR) and the change in total variable costs (ΔTVC). ΔNI = ΔTR-ΔTVC.

The marginal rate of return (MRR) was expressed as percentage.

MRR= (ΔNI / ΔTVC) x100

Statistical Analysis

Data from body weight gain and carcass parameters were subjected to analysis of variance (ANOVA) using the general linear model procedure of SAS (2002). Treatment means were separated by least significant difference (LSD).The model used for data analysis was $Y_{ij}= \mu + t_i + b_j + e_{ij}$. Where; Y_{ij} = response variable, μ = overall mean, $t_i = i^{th}$ treatment effect, $b_j = j^{th}$ block effect and eij = random error

RESULTS

Chemical Composition of Treatment Feeds

The chemical composition of treatment feeds offered and refusals are summarized in Table 1. The NDF, ADF and 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.

Live Weight Gain

Final body weight and daily body weight gain of supplemented groups was significantly (P<0.05) higher than the sheep in the non supplemented group (Table 2). Among the supplemented groups, animals offered heat treated grass pea had greater (P<0.05) daily body weight gain as compared to the other two supplemented groups. Feed conversion ratio was improved in the supplemented group than the non supplemented group whereas there was no significant (P>0.05) difference among the supplemented groups.

Carcass Components

Pre slaughter weight, empty body weight, hot carcass weight, dressing percentage and ribeye muscle area of the supplemented sheep was greater (P<0.05) than the non supplemented ones (Table 3) below. Gut fill in this study appeared to be of no different among treatments. Among the supplemented groups, there was no significant (P>0.05) difference in empty body weight, ribeye muscle area and dressing percentage as a proportion of slaughter weight. Dressing percentage as proportion of empty body weight was greater (P<0.05) for animals supplemented with heat treated grass pea as

Table 3. Carcass characteristics of Farta sheep fed on hay, raw, malted and heat treated grass pea

	Treatments				
Carcass characteristics	T1	T2	T3	T4	SEM
Slaughter weight (kg)	16.6^{c}	22.0^{b}	22.2^{ab}	23.2^{a}	0.7
Empty body weight (kg)	12.5^{b}	17.2^{a}	17.6^{a}	17.9^{a}	0.63
Hot carcass weight (kg)	6.4^{c}	9.3^{b}	9.4^{b}	10.1^{a}	0.38
Dressing percentage (%)					
- Slaughter weight basis	38.3^{b}	42.4^{a}	42.4^{a}	43.6^{a}	0.45
- Empty body weight basis	50.2^{c}	55.2^{ab}	53.6^{b}	56.4^{a}	0.85
REMA (cm2)	8.1^{b}	11.2^{a}	11.3^{a}	11.9^{a}	0.45
TEOC	2203^{b}	2953^{a}	2907^{a}	2894^{a}	67.2
Total NEO Component	8148^{c}	8836^{b}	9104^{b}	9943^{a}	282.8

REMA = rib-eye muscle area; SEM = standard error of means; TEOC= total edible offal components; NEO= non edible offal

Table 4. Partial budget analysis for Farta sheep and feeds

	Treatments			
Variables	T1	T2	T3	T4
Cost for hay, ETB/head	31.94	24.39	25.05	23.60
Cost for concentrates, ETB/head	0	106.96	106.96	106.96
Total feed cost, ETB/head	31.94	131.35	132.01	130.56
Gross income, ETB/head	208.65	408.55	399.75	435.4
Total return, ETB/head	-11.35	188.55	179.25	215.4
Net return, ETB/head	-43.29	57.2	47.24	84.84
Change in net income	-	100.49	90.53	128.13
Change in total variable cost	-	99.41	100.07	98.62
MRR, %	-	101.09	90.47	129.92

MRR = marginal rate of return; ETB = Ethiopian Birr;

compared to animals supplemented with raw and malted grass pea.

Partial Budget Analysis

Partial budget analysis of the present study showed that net return per animal obtained by subtracting feed costs from the total return was higher for the sheep supplemented with raw, malted and heat treated grass pea than unsupplemented sheep (Table 4). Sheep supplemented with 300 g heat treated grass pea (T4) had higher net return (84.84 ETB/head) as compared to the supplemented sheep in T2 and T3. Feeding hay as sole feed resulted in a loss of 43.29 ETB per animal. The change of net income obtained in T2, T3 and T4 were 100.49, 90.53 and 128.13 ETB, respectively with the corresponding marginal rate of return of 101.09, 90.47 and 129.92%.

DISCUSSION

Chemical Composition of Treatment Feeds

The CP content of hay used in the current study was comparable with the value 6.56% reported by Simret (2005), but higher than the value of 3.56 reported by Fentie (2007) and lower than the range (7-7.5%) of maintenance requirement of animals (Vansoest, 1994). 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 in more rapid metabolic activity which decreases the pool of metabolites in the cellular contents such as CP and soluble carbohydrate, and increases the structural cell wall components (VanSoest, 1982). 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 (2010). The CP contents of malted and heat treated grass pea used in this study were slightly less than the raw grass pea and the value was comparable with the one reported by Rysova *et al*. (2010). The reduction in CP content due to malting might be associated with the use of endosperm CP for adical growth during malting. According to Esonu *et al*. (1998) 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.

Live Weight Gain and Carcass Components

Among the supplemented groups, animals offered T4 had greater (P<0.05) daily body weight gain as compared to the other two supplemented groups. This may be possibly due to increased availability of bypass protein as a result of heat treatment that might have improved the profile of amino acids available for intestinal absorption that ultimately led to improved animal performance (Faldet *et al*., 1991). The average daily weight gain of sheep in T4 in this study were comparable to daily live weight gain of 62.9 g for Menz sheep supplemented with cotton seed cake at 169 g DM/day (Bonsi *et al*. 1996). Similarly, a research conducted by Fentie (2007) indicated to some extent comparable results of 70 and 71 g daily live weight for the same breed of sheep supplemented with 300g wheat bran and 300 g (67% wheat bran: 33% Noug seed cake) concentrate mix, respectively. Body weight loss of sheep in T1 indicated that hay used in this study was unable to provide sufficient nutrients for maintenance requirement. This can be mainly attributed to the low CP and high NDF and ADF content of hay offered to the animals. It has been reported that sheep fed on poor quality roughages alone are forced to mobilize energy and protein from body tissue reserves, leading to weight loss (Aziz *et al.,* 1992; Bonsi *et al.,* 1996).

Lower empty body weight of animals in non supplemented group could be a result of differences in slaughter weight than differences in absolute amount of gut fill. The relatively better result in terms of slaughter weight and dressing percentage in relation to empty body weight of sheep in T4 indicates that heat treatment of grass pea might have improved the supplemental value of the seed. A dressing percentage of 47.7% comparable to the present study was reported by Galal *et al*. (1979) in the feedlot performance of Horro lambs, when 50% of their ration was native grass hay and was higher than the result (36.07-38.4%) for Wogera sheep supplemented with brewery dried grain reported by Mulu (2005). Supplementation Significantly (P<0.05) improve the total edible and non edible offal components of supplemented sheep which is in agreement with the statement noted by Fluharty *et al*. (1999) that the weight of some visceral organs is affected by the level of nutrition. The heavier TEOC and the total NEO in supplemented sheep than the non supplemented ones suggest that most of the edible and non edible offal was not fully grown at the beginning of this study and were able to respond to supplementation.

CONCLUSION

The carcass characteristics of supplemented sheep were enhanced due to supplementation. Among the supplemented group, the daily body weight gain, hot carcass weight and dressing percentage on empty body weight basis of sheep supplemented with heat treated grass pea (T4) were significantly (p<0.05) higher than sheep supplemented with malted (T3) and raw grass pea (T2). Partial budget analysis also showed that net return was in the order of T4>T2>T3 and the non supplemented group resulted to a negative net return. Therefore, from biological point of view as well as based on partial budget analysis, T4 was found to be recommendable and as such heat treatment of grass pea may bring better results biologically and economically.

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