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The effect of barley bran, linseed meal and their mixes supplementation on the performances, carcass characteristics and economic return of Arsi-Bale sheep

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ABSTRACT

The study was conducted using 25 yearling male Arsi-Bale sheep to see the effect of barley bran (BB), linseed meal (LSM) and their mixes supplementation on DMI, apparent nutrient digestibility, body weight (BW) gain, feed conversion efficiency (FCE), carcass characteristics and economic return of Arsi-Bale sheep. A completely randomized block design consisting of five treatments and five blocks was used for the study. The basal diet (faba bean haulms) was offered in average of 50% refusal to ensure *ad libitum* intake. The supplement feeds were offered in DM basis at 08:00 and 16:00 h by dividing the daily offer into two equal parts. The digestibility and feeding trials were conducted for 7 and 90 days, respectively. At the end of the feeding trial, the sheep were slaughtered for carcass analysis. The CP content of offered faba bean haulms, BB and LSM were 7.7%, 9.7% and 24.8%, respectively. Supplementation improved ($P < 0.001$) DMI, apparent nutrient digestibility, BW gain, carcass characteristics and economic return. Sheep supplemented with two parts of BB and one part of LSM resulted significantly ($P < 0.01$) the highest net return. Therefore, sheep fed on a basal diet of faba bean haulms supplemented with two parts of BB and one part of LSM is economical.

1. Introduction

Ethiopia is among the countries that possesses large sheep population in the tropics (FAO, 2001, 2004) where, majority of them are kept smallholder farmers and grazed in small flocks on communal natural pastures (CSA, 2004). As a result of human population growth and increasing demand for food, there is expansion of crop lands that result reduction of grazing areas. Due to this the use of crop residues as sheep feed is becoming important. However, when crop residues are used alone, they have a very low feeding value, nutrient digestibility (Gebrhiwot and Mohammed, 1989). For example, most Ethiopian dry roughages have less than 9% (average 6.2%) CP content (Bediye and Silashi, 1989; Bediye et al., 1996). This indicates the need of supplementation for rumen microbial and animal protein requirements. Agro-industrial by-products can be used as energy and protein supplements to improve productivity and maximize economic return of sheep. However, the use of barley bran as a sole or in mixes of protein-rich supplements such as linseed meal with a basal diet of pulse haulms was not studied so far. Therefore, this study was conducted to see the effect of different proportions of barley bran and linseed meal supplementations on DMI, apparent nutrient digestibility, body weight gain, feed conversion efficiency, carcass characteristics and economic return of Arsi-Bale sheep.

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Table 1
Types of treatment feeds and amounts of DM offered per head per day.

Treatment	Faba bean haulms	Proportion of supplements (barley bran:linseed meal)	Supplement DM (g/head/day)
T_1 (control)	*Ad libitum*	0:0	–
T_2	*Ad libitum*	1:0	300
T_3	*Ad libitum*	2:1	300
T_4	*Ad libitum*	1:2	300
T_5	*Ad libitum*	0:1	300

2. Materials and methods

The study was conducted in Bekoji (7°33′09″ N latitudes and 39°15′37″ E longitudes), located in Arsi Administrative Zone of Oromia Region, 231 km southeast of Addis Ababa (Ethiopian capital city). The study area is typical highland having a bimodal rainfall pattern with a mean annual precipitation of 1120 mm, and the mean minimum and maximum temperature are 7.8 °C and 18.9 °C, respectively (KARC, 2005).

2.1. Experimental animals

Twenty-five yearling male Arsi-Bale sheep with mean initial body weight of 19.7 ± 1.53 kg (mean ± SD) were bought from farmers on market day. The age of sheep was determined using dentition. The purchasing price of each sheep was recorded at the time of purchasing for economic return analysis purpose. The sheep were vaccinated against pasteurellosis and sheep pox which are common sheep diseases in the study area, and they were quarantined for 3 weeks. Simultaneously, the sheep were de-wormed and sprayed against endo-parasites and ecto-parasites, respectively. Then they were kept in independent pen for 7 days of digestibility and 90 days of feeding trials.

2.2. Experimental design and treatments

A completely randomized block design consisting of five treatments and five blocks was used for the study. The treatment feeds (Table 1) were randomly assigned to each sheep in the blocks. To increase basal diet intake, the faba bean haulm was chopped to a size of 2–5 cm prior to offering and offered at 40–60% (average 50%) refusal in order to ensure *ad libitum* intake of the sheep. The supplement feeds, 300 g/head/day DM were offered at 08:00 and 16:00 h by dividing the daily offer into two equal portions. Mineral lick and drinking water were offered to the sheep all the day and night.

2.3. Digestibility trial

After the sheep were adapted with the treatment feeds for 3 weeks, the digestibility trial was conducted for 7 days. During the trail, all the feces were collected daily per animal, weighed, recorded, 20% was sampled and stored in deep freezer at −20 °C. At the end of the digestibility trial, the sampled feces were pooled for each sheep and composite samples of 20% were taken to laboratory for chemical analysis. The apparent nutrient digestibility coefficient of basal diet was calculated according to Ranjhan (2001) and that of supplement feeds was calculated according to McDonald et al. (2002).

2.4. Feeding trial

After digestibility trial, feeding trial was followed and conducted for 90 days. Throughout the feeding trail, the daily feed intake of each sheep was recorded. Simultaneously, samples of offered faba bean haulms and supplement treatment feeds were taken daily on treatment basis for laboratory analysis. Similarly, refused faba bean haulms were weighed, sampled daily per animal throughout the feeding trail and pooled on treatment basis for laboratory analysis. The body weight (BW) gain or loss of each sheep was taken at every 10 days interval after overnight fasting (using 500 g precision weighing scale) and the average daily body weight gain (ADG) or loss was calculated over the number of feeding days. Substitution rate of the supplement feeds was calculated according to Ponnampalam et al. (2004). Similarly, the feed conversion efficiency (FCE) was calculated according to Brown et al. (2001).

2.5. Carcass analysis

At the end of the feeding trial, the sheep were fasted for 12 h with free access to water, weighed and slaughtered for carcass analysis. The weight of each edible offal components was recorded. The dressing percentage was calculated on slaughter and empty body weight bases. After removal of edible offal and non-edible offal components, the hot carcass of each sheep was weighed and recorded. Then vertebra was cut between12th and 13th ribs, and cross sectional of the rib eye muscle (*longissimus dorsi*) was traced on transparency paper, then cross sectional areas were measured using polar planimeter and the average area of the two sides was taken for each sheep.

2.6. Partial budget analysis

To see the economic return of the feeding trial, the partial budget analysis was calculated according to Upton (1979), as follows:

Total return (TR) = selling price − purchasing price of the sheep;

Net return (NR) = TR − total variable cost (TVC);

Change in net return (ΔNR)

= NR of supplemented treatment − NR of controlled treatment;

Change in total variable cost (ΔTVC)

= TVC of supplemented treatment − TVC of controlled treatment;

To measure the increase in net return associated with each additional unit of expenditure, the marginal rate of return (MRR) was calculated as MRR = ΔNR/ΔTVC.

2.7. Laboratory analysis

The offered feeds, refusals and partially dried feces samples were ground to pass through 1 mm sieve and oven dried at 100 °C for 24 h to determine DM, OM, EE, CP and mineral matter according to AOAC (1990) and, the NDF, ADF and ADL were analyzed according to Van Soest and Robertson (1985).

2.8. Statistical analysis

The statistical model used for the analysis was:

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

where Y_{ij} = response variable; μ = overall mean; T_i = treatment effect; B_i = block effect; E_{ij} = random error.

Data were analyzed using SAS (2002) and when the treatment means were significant, least significant difference (LSD) was used to locate differences among means.