Effects of diets based on 2 different maize varieties (QPM and Common) on growth and slaughter performance of Ethiopian highland ram-lambs

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SUMMARY
This study was undertaken to investigate the effects of feeding with two maize (Zea mays) cultivars (Quality Protein Maize [QPM] and common maize [BH540]) on growth performance, food efficiency and carcass traits in Ethiopian highland Arsi type ram lambs. Each maize variety was offered in 3 different forms (stover form, whole plant silage and earless silage) that constituted 6 dietary treatments. A total of 49 Arsi ram lambs, 6-8 months old, weighing 18 – 21 kg were randomly divided into 7 equal groups: whereas the first group was initially slaughtered for establishing base line information, the 6 other groups received the different dietary treatments for 12 weeks. Diets based on whole plant silage significantly improved final weights and weight gains (p < 0.001), the food conversion ratio (p < 0.001) and the carcass traits (slaughter weights, hot and cold carcass weights, dressing percentage and the total edible offal) (p < 0.01 to p < 0.001) compared to diets based on earless silage or stover form. Moreover, although differences were not significant between groups fed with the 2 maize varieties for a given distributed form, the highest growth rates and the highest carcass component yields were obtained with the QPM distributed as whole plant silage and the lowest form, the highest growth rates and the highest carcass component yields were obtained with the QPM distributed as whole plant silage and the lowest results were observed with the BH540 in earless silage. These results showed the superiority of the whole plant silage form in promoting faster growth rate with higher carcass components yields in Arsi ram lambs and suggest the zootechnical interest of the variety QPM.

Keywords: Maize, sheep, growth, carcass trait, Ethiopia.

Introduction
Ethiopian highland supports 80 to 85% of human and 75% of livestock population. However livestock production is constrained by severe shortage and seasonal fluctuation of feed supply both in quality and quantity. Maize is one of the major staple foods [17], in total annual crop production and in area coverage [5]. It has a very low farm gate price [20] and it is used for livestock feeding in the dry season [21]. In the recent years, a new maize variety referred as “Quality Protein Maize” (QPM) that excels by its content in essential amino-acids (lysine and tryptophan) is introduced into farmers. CIMMYT [6] indicated that QPM could contribute to improve protein deficiency both in human and animals. However, information on the nutritional effects of the QPM compared to the common maize variety on sheep growth performance and slaughter component yields is not available. Farmers using the QPM and/or the common maize need to be better informed on the value and the biological interest of these cultivars. Therefore, the objective of this study was to evaluate the effects of feeding the Ethiopian highland Arsi type ram lambs with these 2 maize varieties on growth rate and slaughter component yields.
Materials and Methods

The study was conducted at the International Livestock Research Institute (ILRI), Debre Zeit Station located in the central highland, about 50 km southeast of Addis Ababa. Debre Zeit area has an altitude of 1850 m above sea level and receives 815 mm mean annual rainfall in a bimodal pattern with short (March to May) and long (June to September) rainy seasons. Mean annual minimum and maximum temperatures are 11.7°C and 26.4°C, respectively.

ANIMALS AND DIETS

Forty-nine Arsi ram lambs, 6-8 months old and initially weighing 18-21 kg were purchased from the local market after close examination for absence of physical and health problems. The ram lambs were treated against internal parasites with Levafas Drench (Levamisole hydrochloride 1.5% and Oxyclzoanide 3%, Norbrook Laboratories Ltd., England), administered at a rate of 5 ml per 10 kg bodyweight. They were dipped against external parasites with a solution prepared with Neocidol® 600 EC (Novartis Animal Health Inc., Switzerland) at a concentration of 0.042%. The ram lambs were also vaccinated using the sheep pox, the peste des petits ruminants and the ovine pasteurellosis vaccines of National Veterinary Institute (NVI, Debre Zeit, Ethiopia) against the ruminants and the ovine pasteurellosis. All the ram-lambs were housed in individual pens and had free access to water.

The two maize (Zea mays) cultivars were prepared in whole plant silage, earless silage and stover forms constituting six dietary treatments [Quality Protein Maize-whole plant silage or earless silage or stover (QPM-WPS, QPM-ES and QPM-S respectively) and common maize (BH450) -whole plant silage or earless silage or stover (BH540-WPS, BH540-ES and BH540-S respectively)]. Prior to the feeding trial, the ram lambs were adapted to the experimental diets for 8 weeks with gradual increase to ad libitum level. They were then randomly divided into 7 groups (n = 7 in each group). One group was randomly selected and slaughtered at the start of the feeding trial to give initial carcass characteristics whereas the other groups received the QPM or the common maize (BH540) in whole plant silage, earless silage or stover for 12 weeks. The daily offers of silage and maize stover exceeded the ram lamb’s three days mean consumption by 25% and 15% respectively. The daily allowance of each ram lamb (offered in six separate feedings of 2 hours intervals) and over-lefts were weighed using an electrical balance (Sartonius AS, Gottingen, Model QS 16000B, Germany). The dietary treatments were supplemented with 227g dry matter per head and per day of concentrate mixture composed of wheat bran (59.8%), “Noug” (Guizotia abyssinica) cake (32.2%), bone meal (6.5%) and salt (1.5%). The dietary treatments and concentrate mixture nutrients contents are presented on table I. An additional supplement of 2.86g urea per head and per day was also given for the two maize stover groups (QPM-S and BH540-S) to complete the crude protein shortage of maize stover. The supplements were fed at 07.00 hour each morning.

Diet offered and refused were sampled on weekly basis for laboratory analysis. Dry matter (DM) was determined by drying the sample at 100°C for 24 hours. Silage samples taken for chemical analyses were stored frozen at -20°C, thawed, and bulked as offer and refusal sample lots for each dietary treatment. They were dried in a 60°C forced air oven, then ground to pass through a 1 mm screen and kept at room temperature in sealed cups for subsequent chemical analysis. Maize stover and supplement samples were, also bulked separately, dried, ground, and stored like the silage samples. Dry Matter (DM), Organic Matter (OM), and Nitrogen (Kjeldahl method) were analyzed according to AOAC [2].

GROWTH AND SLAUGHTERING PERFORMANCES

The body weights were measured using a spring weighing balance (Salter, Model 235-10s, England) to the nearest 0.2 kg, on weekly basis, before the morning feedings. The feed conversion ratio was given by the dry matter intake reported to the daily weight gain.

Animals were slaughtered by severing the jugular vein and carotid artery. Blood was collected in a bucket and weighed. The head (at the atlanto-occipital joint), the forelegs (at the

| TABLE I: Nutritional analysis of dietary treatments and concentrate mixture distributed to the Ethiopian highland Arsi ram lambs (n = 7 in each experimental group). |
|------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                        | QPM              |                  |                  |                  |                  |                  |                  |                  |                  |
|                        | WPS             | ES               | S                | WPS             | ES               | S                | WPS             | ES               | S                |
| DM (g/kg)              | 280.6           | 272.4            | 917.1            | 239.1           | 242.0            | 915.2            | 906.8           |                  |                  |
| OM (g/kg DM)           | 920.2           | 895.8            | 913.1            | 918.8           | 895.4            | 904.8            | 889.2           |                  |                  |
| CP (g/kg DM)           | 75.8            | 59.7             | 42.3             | 74.3            | 54.3             | 50.4             | 210.0           |                  |                  |
| NDF (g/kg DM)          | 635.9           | 648.0            | 737.1            | 619.9           | 674.4            | 775.3            | 391.0           |                  |                  |
| ADF (g/kg DM)          | 377.4           | 421.0            | 455.7            | 380.7           | 444.3            | 493.7            | 157.5           |                  |                  |
| ADL (g/kg DM)          | 36.8            | 51.8             | 56.8             | 38.7            | 55.2             | 66.0             | 44.6            |                  |                  |
| ADF-ash (g/kg DM)      | 41.0            | 60.0             | 33.7             | 43.5            | 59.1             | 41.7             | 6.7             |                  |                  |

QPM: quality protein maize; BH540: common maize; WPS: Whole plant silage; ES: Earless silage; S: stover form; DM: dry matter; OM: organic matter; CP: crude protein (N x 6.25); NDF: neutral detergent fiber; ADF: acid detergent fiber; ADL: acid detergent lignin; Concentrate mixture contained 59.8% wheat bran, 32.2% Noug (Guizotia abyssinica) cake, 6.5% bone meal and 1.5% salt.
Some other carcass traits were obtained using the following formulas:

- Gut content (GC) = full gut weight (FGW) - empty gut weight (EGW);
- Empty body weight (EBW) = slaughter weight (SW) - gut content (GC);
- Dressing percentage (DP) = proportion of hot carcass weight (HCW) related to the slaughter weight (SW);
- Dressed carcass (DC) = proportion of hot carcass weight (HCW) related to the empty body weight (EBW);
- Total edible offal (TEO, kg) = sum of weights of blood, lung, reticulum, omasum, abomasum, small and large intestine;
- Total usable product (TUP) = hot carcass weight (HCW) + total edible offal (TEO);
- Total non-edible offal (TNEO) = sum of weights of head, skin, feet, penis, bladder, testes and GC.

### STATISTICAL ANALYSIS

The data were analyzed using the General Linear Model (GLM) procedures of SAS (2000). The statistical model used for the variables on dry matter intake, body weight gain, feed conversion ratio and slaughter component yields was given by the following formula:

\[ Y_{ijk} = \mu + V + T_j + (VT)_{ijj} + e_{ijk}, \]

where \( Y_{ijk} \) was the response variable, \( \mu \) the overall mean, \( V \) the effect of maize variety, \( T_j \) the effect of the feed type, \( (VT)_{ijj} \) the effect of interaction \( V \times T \) and \( e_{ijk} \) the random residual error assumed to be normally distributed. Difference contrast parameter test was used to make relevant comparisons in statistical differences between treatment means. The correlation between slaughter weight and carcass traits was analyzed by the calculation of the Pearson’s correlation coefficient (PROC CORR). Differences were considered as significant when \( p \) value was less than 0.05.

### Results

#### GROWTH RATE, FOOD INTAKE AND FOOD CONVERSION RATIO

The Table II shows effects of the maize varieties (QPM and common) on growth rate, food intake and food conversion ratio in Ethiopian highland Arsi ram lambs. Although there was no significant difference in the dry matter and crude protein intakes between the overall lambs fed with QPM and those fed with the common variety (Table II), these parameters were significantly modified by the offer type (\( p < 0.05 \)): they were significantly increased in animals receiving whole plant silage and the stover form compared to those feeding with earless silage (\( p < 0.05 \)). Moreover, the dry matter intake per metabolic body weight per day was significantly higher for the stover form diet followed by the whole plant silage distribution compared to the earless silage diet (\( p < 0.001 \)).

On the other hand, the growth performances evaluated by the final (empty) body weights and the (empty) body weight gains were maximal when lambs received whole plant silage from the QPM or the common maize compared to the 2 other offers (\( p < 0.05 \)) (Table II, figure 1). The diets based on the stover form gave intermediate growth rates and the lower

<table>
<thead>
<tr>
<th>Growth rate</th>
<th>Offer type</th>
<th>WPS</th>
<th>ES</th>
<th>S</th>
<th>WPS</th>
<th>ES</th>
<th>S</th>
<th>WPS</th>
<th>ES</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>FBW (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29.1 ± 0.5\textsuperscript{a}</td>
<td>25.2 ± 0.6\textsuperscript{b}</td>
<td>26.6 ± 0.6\textsuperscript{b}</td>
<td>29.5 ± 0.8\textsuperscript{a}</td>
<td>25.8 ± 0.8\textsuperscript{cd}</td>
<td>26.1 ± 0.8\textsuperscript{cd}</td>
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<tr>
<td>FEBW (kg)</td>
<td></td>
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<td></td>
<td></td>
<td>23.9 ± 0.5\textsuperscript{a}</td>
<td>20.0 ± 0.5\textsuperscript{b}</td>
<td>20.8 ± 0.5\textsuperscript{b}</td>
<td>24.2 ± 0.7\textsuperscript{a}</td>
<td>20.1 ± 0.7\textsuperscript{b}</td>
<td>20.5 ± 0.7\textsuperscript{b}</td>
</tr>
<tr>
<td>BWG (g/d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96.6 ± 4.3\textsuperscript{a}</td>
<td>55.0 ± 4.5\textsuperscript{c}</td>
<td>69.2 ± 4.5\textsuperscript{b}</td>
<td>99.7 ± 6.3\textsuperscript{a}</td>
<td>63.0 ± 6.3\textsuperscript{b}</td>
<td>76.1 ± 6.3\textsuperscript{b}</td>
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<tr>
<td>EBWG (g/d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96.0 ± 5.4\textsuperscript{a}</td>
<td>51.0 ± 5.6\textsuperscript{c}</td>
<td>60.4 ± 5.8\textsuperscript{b}</td>
<td>99.9 ± 7.9\textsuperscript{a}</td>
<td>51.7 ± 7.9\textsuperscript{b}</td>
<td>56.5 ± 8.6\textsuperscript{b}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Intake</th>
<th>QPM</th>
<th>BH540</th>
<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>DMI (g/d)</td>
<td>677 ± 17\textsuperscript{a}</td>
<td>577 ± 17\textsuperscript{b}</td>
<td>697 ± 17\textsuperscript{a}</td>
<td>647 ± 24\textsuperscript{a}</td>
<td>588 ± 24\textsuperscript{b}</td>
<td>704 ± 24\textsuperscript{a}</td>
<td>682 ± 23\textsuperscript{a}</td>
<td>567 ± 24\textsuperscript{b}</td>
<td>690 ± 24\textsuperscript{a}</td>
<td>81.4 ± 1.4\textsuperscript{a}</td>
<td>66.1 ± 1.5\textsuperscript{b}</td>
</tr>
<tr>
<td>CPI (g/d)</td>
<td>81.4 ± 1.0\textsuperscript{a}</td>
<td>67.6 ± 1.0\textsuperscript{c}</td>
<td>78.1 ± 1.0\textsuperscript{b}</td>
<td>81.4 ± 1.5\textsuperscript{a}</td>
<td>69.2 ± 1.5\textsuperscript{a}</td>
<td>76.6 ± 1.5\textsuperscript{b}</td>
<td>81.4 ± 1.4\textsuperscript{a}</td>
<td>66.1 ± 1.5\textsuperscript{b}</td>
<td>79.7 ± 1.5\textsuperscript{b}</td>
<td>9.8 ± 1.0\textsuperscript{c}</td>
<td>6.2 ± 1.5\textsuperscript{a}</td>
</tr>
<tr>
<td>DIMM (g/kgW\textsuperscript{0.75})</td>
<td>59.2 ± 1.1\textsuperscript{a}</td>
<td>54.8 ± 1.1\textsuperscript{b}</td>
<td>64.2 ± 1.1\textsuperscript{b}</td>
<td>58.6 ± 1.6\textsuperscript{a}</td>
<td>55.5 ± 1.6\textsuperscript{b}</td>
<td>65.4 ± 1.6\textsuperscript{b}</td>
<td>59.9 ± 1.5\textsuperscript{a}</td>
<td>54.0 ± 1.6\textsuperscript{b}</td>
<td>62.6 ± 1.6\textsuperscript{a}</td>
<td>3.0 ± 1.0\textsuperscript{c}</td>
<td>3.0 ± 1.0\textsuperscript{b}</td>
</tr>
<tr>
<td>FCR (gDMI/g/d)</td>
<td>7.1 ± 0.7\textsuperscript{c}</td>
<td>12.0 ± 0.7\textsuperscript{a}</td>
<td>10.5 ± 0.7\textsuperscript{b}</td>
<td>6.8 ± 1.0\textsuperscript{c}</td>
<td>10.9 ± 1.0\textsuperscript{ab}</td>
<td>11.1 ± 1.3\textsuperscript{ab}</td>
<td>7.3 ± 1.0\textsuperscript{c}</td>
<td>13.0 ± 1.0\textsuperscript{b}</td>
<td>9.8 ± 1.0\textsuperscript{b}</td>
<td></td>
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</tr>
</tbody>
</table>

QPM: quality protein maize; BH540: common maize; WPS: Whole plant silage; ES: Earless silage; S: stover form; FBW: Final empty body weight; BWG: body weight gain; EBWG: Empty body weight gain; DMI: dry matter; DIMM: Dry matter intake per metabolic weight; FCR: Food conversion ratio; W\textsuperscript{0.75}: metabolic body weight; d: day.

Different superscripts in the same low indicate significant differences (\( p < 0.05 \)).

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growth curve was observed in the case of earless silage diets (Table II, figure 1): the mean final body weight and the mean body weight gain were markedly depressed when lambs received the BH450 as in earless silage form (p < 0.05). As specifically shown in figure 1, the body weight gains registered in QPM fed groups were slightly higher (but not significantly) than those of the corresponding BH540 fed groups except for the stover form regimens. The daily mean body weight gains (corresponding to the slopes of the curves) were relatively constant during the whole experimental period for the all experimental groups, indicating a steady linear increase of weight.

An optimal food conversion ratio was obtained with whole plant silages, particularly from the quality protein maize, whereas the food efficiency was reduced with maize earless silages, specifically from the BH540 (p < 0.05) and the stover forms gave intermediate results (Table II).

![Figure 1: Evolution of the body weights of Ethiopian highland Arsi ram lambs (n = 7 in each experimental group) according to time and the diet regimens.](image)

**CARCASS TRAITS**

Significant positive gains in slaughter and carcass weights and in total edible offal were recorded in all groups feeding with maize compared to the preliminary slaughter group (p < 0.05) (Table III). The carcass shrinkage value (difference between the hot carcass weight and the cold carcass weight) in preliminary slaughter group was 2.3% of hot carcass weight while in all groups fed with maize, it was less than 1%. Furthermore, these gains were significantly more important when maize was distributed as whole plant silage instead of earless silage or stover form (p < 0.05). The lowest differences in carcass weights and in total edible offal were recorded in lambs receiving earless silage of BH540.

The carcass characteristics (hot and cold carcass weights, the dressing percentage and the dressed carcass) as well as the total edible offal were significantly improved in lambs fed with whole plant silage compared to the 2 other forms of maize distribution (p < 0.05) (Table IV). In all dietary treatment groups, the dressing percentages computed on the basis of empty body weight (dressed carcass) were significantly higher than the ones obtained on the basis of full gut body weight. However the differences were smallest in whole plant silage fed groups (Table IV). Besides, the whole plant silage prepared from the quality protein maize tended to be the more efficient on carcass traits although differences were not significant except for the total edible offal (p < 0.01). By contrast, diets based on stover form or on earless silage induced comparable carcass and edible offal yields except for the dressing percentage and the dressed carcass yield which were significantly depressed in lambs fed with the QPM as stover form (Table IV). Furthermore, the total non edible offal was similar in all groups fed with the 2 maize cultivars whatever the distributed form.

Very strong positive correlations (Table V) were obtained between weights of the slaughter, the empty body, the hot carcass and of the total usable products (the correlation coefficients ranged from 0.80 to 0.99, p < 0.001). In the same way, the total edible offal was strongly and positively associated with the slaughter, empty body, hot carcass weights and the total usable products (r were comprised between 0.77 and 0.86, p < 0.001). The dressing percentage was markedly coupled to the hot carcass weight (r = 0.70, p < 0.001) and to the empty body weight at a lesser extend (r = 0.50, p < 0.001) whereas correlations with the slaughter weight and the total edible offal were more moderate (r = 0.33 and r = 0.38 respectively, p < 0.05).

**Discussion**

There was no previous report on the QPM and BH540 maize feeding effects in indigenous breeds for comparison with the results of the present study. Voluntary dry matter

![Table III: Relative differences in slaughter and carcass weights and in the total edible offal between the initial slaughter group of Arsi ram lambs and groups feeding with the 2 maize cultivars (the quality protein maize (QPM) and the BH540) distributed as whole plant silage (WPS), earless silage (ES) or stover form (S). Results are expressed as means ± standard errors.](image)
Table IV: Carcass traits and offal component yields in Arsi ram lambs feeding with the 2 maize cultivars (the quality protein maize (QPM) and the BH540) offered as whole plant silage (WPS), earless silage (ES) or stover form (S). Results are expressed as means ± standard errors.

<table>
<thead>
<tr>
<th>Offer type</th>
<th>WPS</th>
<th>ES</th>
<th>S</th>
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<tbody>
<tr>
<td>Hot carcass weight (kg)</td>
<td>13.6 ± 0.3a</td>
<td>11.3 ± 0.3b</td>
<td>11.4 ± 0.3b</td>
</tr>
<tr>
<td>Cold carcass weight (kg)</td>
<td>13.8 ± 0.4a</td>
<td>11.6 ± 0.4b</td>
<td>11.1 ± 0.4b</td>
</tr>
<tr>
<td>TEO (kg)</td>
<td>4.4 ± 0.1a</td>
<td>3.7 ± 0.1b</td>
<td>3.9 ± 0.1b</td>
</tr>
<tr>
<td>TNEO (kg)</td>
<td>11.1 ± 0.3a</td>
<td>10.3 ± 0.3a</td>
<td>11.1 ± 0.3a</td>
</tr>
<tr>
<td>Dressing percentage (%)</td>
<td>46.1 ± 0.6b</td>
<td>44.2 ± 0.6b</td>
<td>42.2 ± 0.6c</td>
</tr>
<tr>
<td>Dressed carcass (%)</td>
<td>56.8 ± 0.7a</td>
<td>56.2 ± 0.7ab</td>
<td>54.3 ± 0.7b</td>
</tr>
<tr>
<td>SW: slaughter weight; EBW: Empty body weight; HCW: Hot carcass weight; DP: Dressing percentage; TEO: Total edible offal; TUP: total usable products.</td>
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Table V: Correlation coefficients between the carcass traits (slaughter and empty weights, hot carcass weight and dressing percentage) and the total edible offal and usable products in Arsi ram lambs (n = 42).

<table>
<thead>
<tr>
<th>EBW</th>
<th>HCW</th>
<th>DP</th>
<th>TEO</th>
<th>TUP</th>
</tr>
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<tbody>
<tr>
<td>SW</td>
<td>0.94***</td>
<td>0.91***</td>
<td>0.33*</td>
<td>0.80***</td>
</tr>
<tr>
<td>EBW</td>
<td>0.94***</td>
<td>0.50***</td>
<td>0.80***</td>
<td>0.95***</td>
</tr>
<tr>
<td>HCW</td>
<td>0.70***</td>
<td>0.77***</td>
<td>0.99***</td>
<td></td>
</tr>
<tr>
<td>DP</td>
<td>0.38*</td>
<td>0.65***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TEO</td>
<td>0.86***</td>
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Intakes of the stover form and of the whole plant silage were relatively higher than those of the earless silage in both QPM and BH540 cultivars. Moreover, the whole plant silage also exhibited the highest crude protein (CP) intake between the 3 distributed forms. Differences in crude protein content of the three feed types might be the possible cause for the above-indicated differences in dry matter intake. Van Soest [22] stated crude protein content around 7-8% as a critical level below which voluntary feed intake and digestibility are reduced. In the present study, the crude protein content for the whole plant silage (75g/kg DM or 7.5% CP) was within the reported critical range while it was notably below the threshold for the earless silage (57g/kg DM or 5.7% CP) and for the stover form (46.4g/kg DM or 4.64% CP). Nevertheless, the maize stover intake would have been stimulated by the urea addition. FERRET et al. [10] reported that 41.1 to 68.6g DM/kg W0.75/day in maize silage were sufficient for feeding ram lambs, although MORAIRA et al. [16] indicated slightly lower intakes (41.8g DM/kg W0.75/day for maize silage alone and 51.5-52.4gDM/kg W0.75/day maize silage with graded levels of poultry manure) and PINTO et al. [19] and EZEUQUEL et al. [9] reported relatively higher intake levels (67.6 and 64.1-71.4 g DM/kg W0.75/day, respectively).

The comparison between the 3 distributed forms (whole plant silage, earless silage and stover form) within each maize variety showed that diets based on whole plant silages supported better feed conversion ratio and highest growth performance, carcass weight and dressing percentage of ram lambs, probably because of the high-energy (starch), crude protein, digestible organic matter and lower fibre values of the whole plant silage. AWGICHEW et al. [3] indicated a daily gain of 90-109 g/day under feedlot condition, which was comparable to the values obtained in the groups fed with the whole plant silage (93.5 to 99.7 g/day). The mean final weight recorded in these groups (29.1kg) was comparable to that of crossbred (indigenous “Menz” sheep with improved exotic Awassi or Corriedale breeds) grazing on established pasture and supplemented with concentrates (28.8 to 29.1kg) [7]. This improved slaughter weight in “Arsi” breed can partly be attributed to the plane of nutrition.

The maize stover form tended to improve the daily body weight gain compared to the earless form but the superiority of the stover form was not maintained when empty body weight gain was considered. The relatively higher gut content in the group fed with the stover form due to slow rate and low extent of microbial degradation, a characteristic of low quality roughage with higher fibre content [22], would be the cause for this inconsistency.

The overall average carcass weights obtained in the present study (12.1 ± 0.24 kg) was higher than those reported by ERMIAS et al. [8] (10.4 to 10.5 kg) and DEMEKE et al. [7] (9.2 to 11.4 kg). The shrinkages of hot carcass during cold storage observed in the present study (< 0.1kg) was much lower than what was reported by MAHAGUB et al. [15] (0.22 to 0.27 kg) on tropical “Omani” ram lambs fed on low medium and high energy density diets, and by DEMEKE et al. [7] on “Menz” sheep or their crosses (0.4 to 0.5 kg). This could be partly attributed to higher fat cover observed in this study, which prevents moisture loss. In the same way, the

overall average dressing percentage observed in the present study (44.2%) was greater than previously reported by AKALU and GALAL [1], ERMIAS et al. [8] and Demek et al. [7] (the dressing percentage generally ranged from 36.0% to 43.3%). When reported to the empty body weight, this parameter (55.8%) was slightly higher than what was announced by MAHAGUB et al. [15] for the “Omani” growing lambs (52.8 to 53.5%). The omento-mesenteric and renal fat deposits largely contributed to the significantly heavier total edible offal in sheep fed with the whole plant silage. Previous reports also noted abundant fat deposits in renal and omento-mesenteric sites in supplemented indigenous ram lambs [11-13]. Nevertheless, the quantity of these depots observed in the present study was important (385 to 772 g) and was three fold higher than previously reported: DEMEKE et al. [7] and Ermias et al. [8] obtained a quantity ranging from 125g to 254g for “Menze” sheep and their crosses and for “Horro” breeds. As sheep in the latter reports were grazing animals, this discrepancy would be related to great energy expenditure in grazing animals. Our results were in agreement with the works of MAHAGUB et al. [15], who noted that the energy density strongly and positively correlated with fat deposition in carcass and mainly in the non-carcass components. Similarly, BUTTERFIELD [4] and NEGUSIE et al. [18] stated that the more profound effect of dietary energy density on non-carcass fat was most likely due to its early maturing characteristics. The total edible offal weights (3.6-4.6 kg) obtained in our study, were in agreement with the reports of ERMIAS et al. [8]. Ram lambs fed with the whole plant silage witnessed the promising efficiency of whole plant maize silage feeding for small ruminant meat production. This was evidenced by the corresponding feed conversion ratios to produce carcass alone or including edible offal.

The weights of empty body, hot and cold carcasses, total edible offal and total usable products highly correlated with the slaughter weight and within each other (p < 0.001). GALAL et al. [11, 12] and DEMEKE et al. [7] obtained comparable correlation coefficients among slaughter weight and carcass traits, although the associations between the dressing percentage and the slaughter weight or the total edible offal were, however, weaker than previously reported [7]. This difference could be attributed to the presence of ram lambs fed with maize stover form that had higher values of slaughter weight and of the non edible offal relative to the empty body weight and to the weights of hot and cold carcasses, leading to the decrease of the dressing percentage. The highly significant and strong positive correlations of the slaughter weights with the empty body weights or with the weights of carcasses confirm this fact.

The growth performances, the carcass weights, the dressing percentage values and the food efficiency recorded with the QPM mainly distributed as the whole plant silage appeared to be higher but not significantly than that obtained with the common variety, the BH540. The low size of the experimental groups would have contributed to the non-significance.

As a conclusion, the whole plant silages revealed superiority in promoting growth rates and slaughter component yields. This clearly indicated that whole plant silage feeding would be the promising technology option for improved small ruminant production. The overall improved performance of ram lambs also showed the possibility for a better exploitation of the potential of the “Arsi” type sheep. Moreover, the quality protein maize appeared to be useful for improving growth rate and carcass characteristics of the Arsi type ram lambs. However, further studies conducted on larger groups or at a farm level are required for comparing the economic advantages of maize silages with the stover forms.

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