ABSTRACT: This study was conducted in 2011 on 72 live animals and carcass samples of Arsi breed cattle slaughtered in Adama city’s municipality abattoir with objective to estimate slaughter parameters i.e., heart girth (HG), slaughter weight (SW), carcass weight (CW) and dressing percentage (DP). Breed and production system and age were identified by phenotypic traits and dentition development, respectively. HG, SW and CW were significantly different across age groups (P < 0.05) but significant difference was not observed due to production system differences (P > 0.05). Experimental animals had mean HG, SW, CW and DP of 164.87±9.03cm, 308.64±44.32kg, 163.13±29.09kg and 53.15±5.75% respectively. There was strong and weak positive correlation between carcass weight and heart girth (r = 0.67) and between slaughter weight and dressing percentage (r = 0.17,) respectively. Further studies maybe needed to confirm the present findings.

Keywords: Heart girth; slaughter weight; carcass weight

Introduction

Ethiopia has huge cattle resource and CSA (2012) inventory indicates 52.13million head of cattle being owned by sedentary population. These livestock resource is playing important role by contributing to the national economy (Ayele et al. 2003; Nell 2006). According to MoFED (2010) report agriculture has a contribution of 43.17% to the national GDP. Animal agriculture has 26.6% of total agricultural GDP and 11.48% of total national GDP. Livestock sector of Ethiopia is expected to continue growing given the large potential for increasing meat production, the expected growth in income, increased urbanization and improved policy environment (MoFED 2010). In recent years feedlot farms are flourishing and getting engaged in the export of processed meat and live animals. These farms are exporting live animals and processed carcasses to various countries in close proximity of Ethiopia i.e., Africa and the Middle East and absorbing in foreign currency from international markets. The Middle East and North African (MENA) countries prefer live animals and carcass produced from lowland areas. As a result, about 90% of live animals exported to the MENA countries are collected from lowland areas (MoFED 2010). Studying the reason behind this preference would help to know the variation in meat quality if affected by altitude and the value addition work needed that can satisfy consumers. In addition to this, studying the effect of age and production system on slaughter parameters can indicate variation in meat quality. Beside preference, due to other reason the amount of live animals and processed carcass that Ethiopian firms export is too small in the international market when compared to Botswana and South Africa (OECD/FAO 2007). In MENA meat market, Brazilians, Argentines and Australians exporters takes the bigger share by exporting world class quality meat products and live animals. These leading exporters have already well-developed facilities and follow stringent quality control systems to maintain their prestige and secure their share (Ross and Keeping 2008). Ethiopian beef exporters claim the lack of quality animal supply, limited processing, packaging facilities and limited application of sanitary and quality standards and others as main challenge to exploit the sector. Therefore, this study was carried out to estimate some of slaughter parameters for Arsi cattle across different ages and production systems.

Materials and Methods

The Study Area. This study was conducted in Adama municipality’s slaughterhouse. Adama city, which is one of the biggest cities in Oromia Regional State (in Ethiopia) is situated on 100km South-East of Addis Ababa, the capital city of Ethiopia. Adama city has an average altitude of 1666m above sea level (Google Earth 2012). The Adama municipality has one abattoir that gives service to cities’ community. The abattoir is semi-modern that operates with services featuring cattle, sheep and goat slaughtering. The annual average minimum and maximum temperatures of Adama city are 18 and 32 degree Celsius (Zoover 2011). The specific geographical location of the abattoir is on the geographic coordinates of 8° 33' 05.79''N and 39° 15' 34.83''E.

Animal sampling, age and production systems determination. Arsi cattle were the main target of this study. Breed identification was done using the phenotypic traits that distinguishes the breed. The typical phenotypic traits used to distinguish Arsi cattle are combinations of Coat color (typically red, black, roan, white and combinations) Muzzle color (Red or black), Dewlap structure (prominent but thin of skin), Ear type (erect), Horn type (small, usually crescent-shaped) and Hump type (usually medium size). In addition to these traits, East Shoa administrative zone is one of the zones where almost fully Arsi cattle are predominantly found (DAGRIS 2007). Arsi breed cattle are reared in Arsi, West Arsi, Bale and East Shoa administrative zones and can be found in zones adjacent to Arsi, West Arsi, Bale and East Shoa administrative zones. These Arsi cattle are reared in both lowland and highland areas of the zones and it is mainly used for draught, meat and milk (MoARD 2007). Production system was categorized based on agro-ecology of the areas under which the farmers produce cattle. Thus cattle production systems were...
categorized as highland and lowland production system (FAO 1996). To differentiate the animal under which pro-
duction system (as highland or lowland origin) it was raised
the phenotypic observations such as coat hair and fur struc-
ture was used (MoARD 2007). The highland cattle are dis-
tinguished by thick hair and the lowland cattle having short
and lustering fur. For example, highland cattle are larger in
body frame whereas lowland cattle are shorter and slender
with predominantly faun color. The highland cattle are usu-
ally healthy and hardy as they are exploited in plow. The
ages of the sampled animals were estimated according to
CABSESP (2009) Age Verification Guideline. Accord-
ingly, the production system, breed (Arsi cattle) and age of
cattle were identified and marked as the animals randomly
entered the abattoir premise. A total of 72 animals were
randomly sampled in the abattoir. According to classifica-
tion based on production system, out of 72 animals sampled
42 were from lowland and 30 were from highland. Age of
animals sampled ranges from 4 to 13 years and categorically
animals were distributed over the age considered by this
study. Since the animals were taken randomly, the animal
distribution across age and production systems treatment
was unequal. The parameters evaluated were heart girth,
slaughter weight, carcass weight and dressing percentage.
The sampled animals were also measured for heart girth
(with tape meter) and slaughter weight and carcass weight
(with digital balance). Digital cattle weighing scale (Model
number = MT1500WB that has sensitivity of 500 gram) was
used to measure slaughter weight and hot carcass weight.
Heart girth and slaughter weight were measured before
slaughter. Heart girth was measured by surrounding the
thorax (chest, breast) with a tape meter, exactly behind the
shoulder (magnitude in cm). After slaughtering, hot car-
casses were weighed with digital balance and hot carcass
dressing percentage was determined by dividing the carcass
to slaughter weight, multiplied by 100%.

Experimental design, model and statistical
analysis. The experimental design of the slaughter para-
eters study was 2^3 Factorial in a Completely Randomized
Designed (Factorial-CRD). The age has eight levels and
production systems factor has two levels. The slaughter
parameters that were estimated with this study are slaughter
weight, heart girth, carcass weight and dressing percentage.
The general linear model procedure of SAS (2008) was
employed to analyse the effect of age and the production
system on the slaughter parameters. Mean separation was
done by DMRT when the F-test was significant (P ≤ 0.05).
The model was:

\[ Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ik} + e_{ijk} \]

Where; \( Y_{ijk} \) = the response variable, \( \mu \) = the overall Mean,
\( \alpha_i \) = the effect of Age, \( \beta_j \) = the effect of Production System,
\( \alpha\beta_{ik} \) = the effect of interaction of Age with Production Sys-
tem, and \( e_{ijk} \) = Random error

Results and Discussion

Slaughter parameters. The least square means of
carcass parameters are given on Table 1. The overall f-test
for effect of age, production system and interaction of age
by production system on slaughter parameters (heart girth,
slaughter weight, carcass weight and carcass dressing per-
centage) of Arsi cattle slaughtered in Adama was significant
(P < 0.05) and this is in agreement with Bures et al. (2007)
that reported the slaughter weight varies significantly
across ages and breeds. Heart girth, slaughter weight and
carcass weight were significantly different across different
ages (P < 0.05) but not significantly different due to pro-
duction system differences. The interaction of age by pro-
duction systems has also significant effect on heart girth,
slaughter weight and carcass weight (P < 0.05). Bures et al.
(2007) and Bures and Barton (2012) also reported that
slaughter weight, hot carcass yield and dressing percentage
significantly varies between sex, breeds and ages. The aver-
age Arsi cattle’s heart girth, slaughter weight, carcass
weight and dressing percentage at the abattoir are given in
Table 2. The hot carcass weight and dressing percentage of
Arsi cattle that were slaughtered at Adama abattoir was
163.13 ± 29.09 kg and 53.15 ± 5.75% respectively were
found to be higher than 125.07 ± 21.47 kg and 47.78 ±
2.82% reported by Haryoko and Suparman (2009) for PO
cattle and 47.49% for Borana and 44.93% for Kereyu
breeds (Mohammed et al., 2008) that were grouped in the
same Small East African Zebu with Arsi cattle. The dress-
ing percentage of hot carcass for Arsi cattle is comparable
with 59.36% reported by Melton et al. (1974) for mature
Herford and 55.15-56.87% reported by Bures and Barton
(2012) for 14-18 months crosses of Charolais and Simmen-
tal bulls and heifers. But hot carcass yield of Arsi cattle is
far less than 233 kg reported by Abdelhadi et al. (2011)
for Baggara breed (zebu cattle). This large disparity in carcass
yield and dressing percentage between Arsi breed and com-
pared close breeds could be attributed to the effect of in-
breeding that long existed in Arsi cattle. This suggestion
conforms to the findings of Asimwe and Kifaro (2007).

Table 1. Least Square Means of Carcass Parameters by
different ages and production systems

<table>
<thead>
<tr>
<th>Variable</th>
<th>HG(cm)±</th>
<th>SW(kg)±</th>
<th>CW(kg)±</th>
<th>DP(%)±</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SE</td>
<td>SE</td>
<td>SE</td>
<td>SE</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6yr</td>
<td>168.5a</td>
<td>349.2a</td>
<td>187.8a</td>
<td>53.8</td>
</tr>
<tr>
<td></td>
<td>±3.51</td>
<td>±16.58</td>
<td>±11.40</td>
<td>±2.55</td>
</tr>
<tr>
<td>6-7yr</td>
<td>169.1ba</td>
<td>323.8bac</td>
<td>169.6bac</td>
<td>53.3</td>
</tr>
<tr>
<td></td>
<td>±3.72</td>
<td>±17.58</td>
<td>±13.96</td>
<td>±3.12</td>
</tr>
<tr>
<td>7-8yr</td>
<td>164.3b</td>
<td>299.6bc</td>
<td>163.3bac</td>
<td>54.5</td>
</tr>
<tr>
<td></td>
<td>±2.39</td>
<td>±11.33</td>
<td>±7.79</td>
<td>±1.74</td>
</tr>
<tr>
<td>8-9yr</td>
<td>161.5a</td>
<td>303.9bc</td>
<td>157.8bac</td>
<td>52.9</td>
</tr>
<tr>
<td></td>
<td>±2.26</td>
<td>±10.70</td>
<td>±8.18</td>
<td>±1.83</td>
</tr>
<tr>
<td>9-10yr</td>
<td>174.7a</td>
<td>354.8a</td>
<td>188.7a</td>
<td>53.1</td>
</tr>
<tr>
<td></td>
<td>±3.28</td>
<td>±15.51</td>
<td>±10.66</td>
<td>±2.38</td>
</tr>
<tr>
<td>10-11yr</td>
<td>164.7b</td>
<td>293.1c</td>
<td>146.6c</td>
<td>50.4</td>
</tr>
<tr>
<td></td>
<td>±3.39</td>
<td>±16.05</td>
<td>±11.04</td>
<td>±2.47</td>
</tr>
<tr>
<td>11-12yr</td>
<td>162.4b</td>
<td>285.8c</td>
<td>152.0bc</td>
<td>52.9</td>
</tr>
<tr>
<td></td>
<td>±3.72</td>
<td>±17.59</td>
<td>±12.09</td>
<td>±2.70</td>
</tr>
</tbody>
</table>
Correlation between carcass weight and dressing percentage (r = 0.67). There is positive relationship between heart girth (HG), slaughter weight (SW), and carcass weight (CW) (r = 0.77). Therefore, the regression model developed for these slaughter parameters i.e., heart girth, slaughter weight and dressing percentage can better estimate carcass to be harvested from an animal. Further studies maybe needed to confirm the present findings.

**Carcass weight estimator.** Carcass yield estimation models for Arsi cattle slaughtered in Adama are given in Table 3. Best fitting model was selected by model selecting tool of SAS (2008) with relatively smaller conceptual predictive (cp) criteria, higher R², smallest Akaike information criterion (AIC) than other independent variable combinations. Accordingly the following two models were selected. Y₁ estimator can be used to estimate the expected carcass yield or weight at constant dressing percentage which would be more helpful for butcher to estimate how much carcass would be produced from a given Arsi bulls. Y₂ model can be used to estimate the expected carcass weight at varying dressing percentage which would only be fitted to the analyzed data of this paper.

**Table 2. Means of slaughter parameters of Arsi cattle that were slaughtered at Adama abattoir (n = 72)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG(cm)</td>
<td>164.87</td>
<td>9.03</td>
</tr>
<tr>
<td>SW (kg)</td>
<td>308.64</td>
<td>44.32</td>
</tr>
<tr>
<td>CW (kg)</td>
<td>163.13</td>
<td>29.09</td>
</tr>
<tr>
<td>DP(%)</td>
<td>53.15</td>
<td>5.75</td>
</tr>
</tbody>
</table>

**Table 3. Carcass weight (CW) estimation model for Adama abattoir cattle samples (n = 72)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>Adj.R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW(y₁)</td>
<td>66.3 + 0.003(HG*SW) - 0.0015(HG²)</td>
<td>0.62</td>
</tr>
<tr>
<td>CW(y₂)</td>
<td>-168.65 + 3.166(HG) + 0.53(SW)</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**Relationship among carcass parameters.** The degrees of correlations among carcass parameters are given in Table 4. The heart girth and slaughter (live) weight of the animals were strongly correlated (r = 0.78). There is significantly strong positive correlation between carcass weight and heart girth for Arsi cattle (r = 0.67). There is positive but weak relationship between slaughter weight and dressing percentage (P > 0.05, r = 0.17) and this in agreement with Chladek and Ingr (2003) report of a non-significant (r = 0.04) correlation. The slaughter weight and carcass weight have strong positive relationship (r = 0.77) and this is also in agreement with Chladek and Ingr (2003) report (r = 0.98) and Wheeler et al. (2005) report (r = 0.95) of correlations between slaughter weight (live weight at slaughter) and hot carcass weight. There is strong relationship between carcass weight and carcass dressing percentage (r = 0.8).

**Conclusion**

As this study showed, heart girth, slaughter weight and carcass weight were significantly varied across different ages (P < 0.05) but not across different production systems (P > 0.05). This implies that age can significantly result in variation on slaughter parameters (heart girth, slaughter weight and carcass weight) than production system (lowland and highland). The mean figures of slaughter parameters (heart girth, slaughter weight and carcass weight, 164.8 ± 9.03 cm, 308.6 ± 44.32 kg and 163.1 ± 29.09 kg respectively) also showed that Arsi breed cattle are one of the short framed African breeds. There is strong positive relationship between carcass weight and carcass dressing percentage (r = 0.8), between heart girth and slaughter weight (r = 0.78), and between slaughter weight and carcass weight (r = 0.77). Therefore, the regression model developed from these slaughter parameters i.e., heart girth, slaughter weight and dressing percentage can better estimate carcass to be harvested from an animal. Further studies maybe needed to confirm the present findings.

**Literature Cited**


