Kebede and Getachew, Ethiop. Vet. J., 2019, 23 (1), 1-11
DOI https://dx.doi.org/10.4314/evj.v23i1.1 *Ethiopian Veterinary Journal*

Carcass characteristics of draught cattle released for beef in Eastern Ethiopia

Ewonetu Kebede Senbeta and Ashenafi Getachew Megersa

School of Animal and Range Sciences, Haramaya University

+251912927403, ewonetu2011@gmail.com, P.O. Box 138, Dire Dawa, Ethiopia

Abstract

Most cattle used for beef production in Ethiopia are Zebu breeds. Usually released for beef when they are aged for plowing and in poor body condition. However, there is little available information on carcass yield and percentage earned from these cattle. Therefore, the study was conducted to evaluate the carcass yield and the percentage of cattle released for beef after used in draught power. This study used 280 heads of male indigenous draught cattle released for beef. Each cattle were randomly measured for carcass and non-carcass components. Body weight was recorded as animals arrived. Hot carcasses were weighed and cold carcasses were estimated at 0.98 of the hot carcass weight. Dressing proportions were calculated from the ratio of hot carcass weight to slaughter weight. Descriptive statistics for carcass yield, edible and offal components were analyzed by SPSS. The average slaughter weight, hot carcass weight, dressing and shrinkage percentage recorded in this study was 247.93±5.27, 90.98± 2.11, 36.98±0.94 and 0.74±0.02; respectively. The amount of total deboned lean meat was 60.38kg (24.35% of the slaughter body weight). The price of live animals and the amount of carcass and other edible parts attained from it, is not worthy of comparison and there was a loss of 402.66± 0.29 Birr per each cattle. Therefore, draught cattle released for beef after draught power should be fattened either by farmers or beef farm to recover their body weight loss due to agricultural work load.

Keywords: Carcass; Drought cattle; External offal; Internal organ

Introduction

Ethiopia produces about 0.33 million tons of meat annually from cattle (CSA, 2008). Average carcass weight of cattle is 108 kg/head (Negassa *et al.,* 2011), while Ethiopians consume about 8-13.9 kg of meat per capita annually, being lower than the African and the world per capita averages, which are 27 and 100 kg/year, respectively (Ayele and Peacock, 2003; Betru and Kawashima, 2009; FAO, 2009). Most farmers in Ethiopia usually sell draught cattle after the plowing season when they are in poor condition and aged for drafting purposes (Teshager *et al.,* 2013; Yesihak and Edward, 2014). Carcass composition (proportions of muscle, fat and bone) largely determines carcass value (Pesonnen *et al.,* 2012). A high proportion of muscle with a low proportion of bone and an optimum level of fat represents a superior carcass (Oprzadek *et al*., 2001). Yesihak and Edward (2014) reported carcass weight of 155.02 ± 0.83 kg in wet season and 119.56 ± 0.89 kg of hot carcass in dry season for indigenous cattle of Ethiopia. The origin of animals, carcass characteristics and its quality are important criteria for butchers and consumers when it comes to making purchasing decisions (Carlos *et al.,* 2009). Characterizing carcass traits of cattle used for agricultural cultivation is important to develop an appropriate improvement strategy of the sector. Carcass traits broadly describe carcass quality (composition) and carcass quantity (Aynalem *et al.,* 2011). Carcass quantity traits comprise of pre-slaughter live weight, hot carcass weight and dressing percentage (Pariacote *et al.,* 1998). However, the carcass characteristics differ among breeds and are influenced by the plan of nutrition and production system (Keane and More O'Ferrall, 1992). Selection for these traits is greatly influenced by the market demand. The ability of the producers and buyers of beef cattle is to relate objective live animal to carcass characteristics which is essential for optimum production and value-based trading systems (Afolayana *et al*., 2002). This will also enable processors to determine returns from carcass processing and it may increase the rate of genetic gains in meat production traits. The traditional mixed crop-livestock farming practice in Ethiopia mainly demands male cattle to serve as draught animals (IGAD, 2010). Draught cattle are normally released for beef when they are aged for plowing. However, there is little available information with regard to carcass yield and the percentage contribution of various components of edible and offal carcass of cattle released for beef after draught powers. Therefore, this study was conducted to evaluate the carcass yield and percentage of various edible and offal components of cattle released for beef after draught powers.

Material and methods

Study area

The study was conducted at Haramaya University in Haramaya district, Eastern Ethiopia ,which is 5, 17, 40 and 527 km from Haramaya town, Harar city, Dire Dawa city administration and east of Addis Ababa respectively. The study area is found at an elevation of 2000m above sea level, located at 041°59'58" latitude and 09°24'10" longitudes. It receives an average annual rain fall of 900mm. With respect to Agro-ecological zones, 66.5% is midland and 33.5% is lowland. It has about 63,723 cattle, 13,612 sheep, 20,350 goats, 15,975 donkeys, 530 camels and 42,035 chickens (Unpublished data from Haramaya Agricultural office, 2017/2018).

Sampling method and sample size determination

Only male draught cattle after worked up in agricultural cultivation in different regions of Eastern Ethiopia were directly supplied by unions to Haramaya University for consumption at students' cafeteria. Among the received cattle, the carcass and non-carcass component of 280 individual animal was randomly measured.

Study animal management

Experimental animals were purchased from different markets in eastern Ethiopia namely Hirna, Chelenko, Haramaya, Kulubi and then transported by trekking to the University where they were slaughtered. According to the information from the supplying Unions, animals did not pass through the fattening process. As well, all the slaughtered cattle were used for draft power in mixed crop-livestock production system and after the end of plowing season they were immediately released for beef purpose. Body weight was recorded as animals arrived at the University's beef farm and then they fed in group pens on hay and crop residues as *ad libitum* and sometimes supplemented students' cafeteria leftover for two weeks during the quarantine and ante mortem inspection. Before slaughtering, the animals held off feed and water for 12 to 16 hours to assure complete bleeding and ease of evisceration.

Slaughter procedure and data collection

Animals were slaughtered at the University's abattoir according to the standard procedure. Bleeding was effected by cutting the jugular vein. The head was removed at the atlanto-occipital joint, fore and hind feet removed at the carpus-metacarpal and tarsus-metatarsal joints respectively (Safari *et al.,* 2009). Following the slaughter, the carcasses yield and quantitative characteristics of edible and offal were weighed by weighing balance. Hot carcass was weighed and cold carcass weight was estimated at 0.98 of the hot carcass weight (Pesonen *et al.,* 2012). Dressing proportion was calculated from the ratio of hot carcass weight to slaughter weight, i.e.

Cold carcass Dressing Percent = Hot Carcass Weight X 0.98

Hot carcass Dressing Percent = $\frac{\text{Hot Carcass Weight}}{\text{Slaughter Weight}}$ X 100

Shrinkage percentage was calculated as the loss of weight after chilling in relation to hot carcass weight. Generally, on average, each day seventeen animals were slaughtered for evaluation.

Statistical analysis

Descriptive statistics of the carcass yield, the edible and offal component of carcass was analyzed by Statistical Package for Social Sciences (SPSS) version 20 (SPSS Inc., Chicago, Illinois, USA, 2011).

Result

Table 1. Slaughter and carcass weights and dressing percentage of cattle used for draught power (n=280).

Parameters	Min.	Max.	Mean + SE
Slaughter weight (Kg)	200.00	300.00	247.93±5.27
Hot carcass weight (Kg)	72.50	119.00	90.98± 2.11
Cold carcass weight (Kg)	71.05	116.62	89.16±10.94
Hot carcass dressing % of LW	28.93	48.75	36.98±0.94
Cold carcass dressing % of LW	28.35	47.78	36.24±0.92
Shrinkage (%)	0.58	0.97	0.74±0.02

=Live weight, SE-Slandered Error of mean,

Table 2. Means weight (Kg) of non-carcass components of cattle used for draught power (n=280).

Offal's	Min.	Max.	Mean +SE	%
Feet (Legs)	4	6	5.17 ±0.13	2.09
Head with horn	11	16.5	13.43±0.27	5.42
Hide with tail	18	26..5	22.01±0.38	8.88
Trachea	0.50	2.00	1.18±0.07	0.48
Genital (Scrotal)	1.00	2.50	1.44±0.08	0.58
Ligaments (inedible fibers)	3.00	11.00	5.96±0.37	2.41

Table 3. Mean weight of internal organ components of cattle used for draught power (n=280).

Internal organ (kg)	Min.	Max.	Mean ± S. E	%
Heart	0.5	1.80	1.01±0.08	0.41
Liver	1.50	4.50	2.98±0.21	1.20
Lung	1.50	6.00	2.42±0.17	0.98
Spleen	0.50	2.00	0.94±0.08	0.38
Kidney	0.50	2.00	0.99±0.08	0.40

Table 4. Cost-benefit analysis for total hot carcass yield (n=280).

Variable	Min.	Max.	Mean ± SE
Purchase price/live cattle (ETB)	6400.00	9600.00	7933.71±168.52
Hot carcass sale price/ cattle (ETB)	5800.00	9520.00	7278.57±168.81
Other organs and hide Price/ cattle (ETB)	240.00	265.00	252.50
Total carcass sale price/ Slaughter cattle (ETB)	6040.00	9785.00	7531.05±168.81
Net profit/ Slaughter cattle (ETB)	-360.00	185.00	-402.66±-0.29

Note: Purchase price per Kg live weight-32 ETB, sale price per kg carcass weight-80 ETB

Table 5: Total proportion of carcass and non-carcass components.

Variable	Mean (Kg)	% (On slaughter weight basis)
Deboned meat	60.38	24.35
Bone without meat	11.34	4.57
Bone with residual meat	30.6	12.35
All internal organs*	8.27	3.34
All non-carcass components+	8.20	3.31

***=** *Heart, Liver, Lung, Spleen, & Kidney.* **+=** *Legs, Head with horn & tongue, Skin with tail, Trachea, Scrotal, & Ligaments (inedible fiber)*

Discussion

The average slaughter weight recorded in this study (Table 1) was higher than Sanga (202kg) and the humpless West African shorthorn (WASH) (162kg) cattle slaughtered at local abattoir in Ghana (Teye and Sunkwa, 2010). However; it is less than weight of Zebu (309kg), Nguni (324kg) and Tuli (418kg) cattle slaughtered in South Africa (Strydom, 2008). Mengistu *et al*. (2013) also reported higher slaughter weight 489.7±10.6 and 274.9±10.6 for Holstein Frisian and Boran crossbred oxen and Ethiopian highland Zebu cattle respectively. The lower slaughter weight reported in this study is consistent with Teshager *et al.* (2013), and Yesihak and Edward (2014) who reported that most of the local cattle used for meat production in Ethiopia are usually supplied to market after the plowing season when they are in poor body condition and older in age for the draught purposes. The average hot carcass weight in this finding was less than the carcass weight reported for Boran cattle (98.2-135.2kg) in Ethiopia (Lemma *et al*., 2007), Zebu breed (155.9kg) in Ghana (Teye and Sunkwa, 2010), Ogaden cattle (163-182kg) in Ethiopia (Mekasha *et al.,* 2011), Nguni (181kg) and Tuli (241 kg) in South Africa (Strydom, 2008), Arsi cattle (163.13 ± 29.09kg) in Ethiopia (Gebeyehu *et al.,* 2018), Bali and Ongole crossbreed (PO) cattle (125.07 ± 21.47 kg) (Haryoko and Suparman, 2009). Teye and Sunkwa (2010) reported higher and lower hot carcass weight than the result obtained in this study for Sanga (95.3kg) and WASH (74.1Kg), respectively. Moreover, Mengistu *et al*. (2013) reported higher hot carcass weight (248.5±5.5) and (141.1±5.5) for Holstein Frisian and Boran crossbred oxen and Ethiopian highland Zebu cattle respectively. Yesihak and Edward (2014) also reported relatively higher carcass weight for different indigenous cattle breeds at Adama (161.26 + 1.05 kg), Hawassa (142.46 ± 1.10kg), Kombolcha (95.63 ± 0.46) and Mekelle (136.15 ± 1.17 kg) abattoirs in Ethiopia. Further, the amount of total deboned lean meat obtained in this study (Table 5) is lower than 68 and 68.2kg that was the study reported by Gebeyehu *et al* (2018) and Bedhane and Dadi (2016) respectively. This lower result was due to the low slaughter weight and previous agricultural work load or stress.

The hot dressing percentage for cattle released for beef after draft powers in this experiment was less than the results reported by Teye and Sunkwa (2010) for WASH (45.9%), Sanga (47.6%), and Zebu (52.1%). Mengistu *et al* (2013) also reported higher dressing percentage for Holstein Frisian and Boran crossbred oxen (51.3±0.8), for Ethiopian highland Zebu cattle (51.4±0.8), for non-working (51.1±0.9) and worked Ethiopian cattle breeds (51.6±0.6) respectively.

Moreover, many scholars reported higher hot dressing percentage for different cattle breeds such as 47.78 ± 2.82% for PO cattle (Haryoko and Suparman, 2009), 47.49% for Boran and 44.93% for Kereyu breeds (Mohammed *et al*., 2008), 53.15 ± 5.75% for Arsi cattle (Gebeyehu *et al*., 2018). This disparity in slaughter weight, carcass yield and dressing percentage could perhaps be due to differences in environment, breed type, age of slaughter, the level of fattening, agricultural work load (draught power) and management given which were entirely absent in the present study.

Shrinkage values obtained was lower than (Table 1) that obtained by Eltahir (1994), Mohamed (1999), Elkhidir (2004) and Mohammed (2004). As well, Mohammed *et al* (2015) reported higher shrinkage percentage of 2.78, 2.04, 2.78 and 1.92 for Sudan Baggara Zebu bulls finished on urea-treated contained 0, 10, 20 and 30% of treated bagasse respectively. The lower in shrinkage value might be due to poor body condition (less expected fat deposition in carcass of oxen used in draft power due to work stress) and low slaughter weight of the experimental oxen and this is confirmed to the ideas of Mohamed (1999) and Mohammed *et al* (2015) who stated that moisture evaporation was reduced with increasing fat deposition in the carcass and that will affect chilling shrinkage.

The external offal's like head and legs (Table 2) were comparable to the result reported for Zebu cattle which were 13.05 and 4.77kg, respectively. However, lower results reported by Teye and Sunkwa (2010) for Sanga and WASH cattle heads (10.2 and 8.7kg) and legs (3.7 and 3.18kg). Likewise, Mengistu *et al*. (2013) reported lower weight for Ethiopian highland Zebu hide (19.2±0.9) and head (14.1±0.5), but he reported higher weight for Holstein Frisian and Boran crossbred oxen hide (32.8±0.9), head (24.1±0.5), and legs (10.1±0.2). Moreover, Mohammed *et al*. (2015) reported lower weight in all treatments for feet, genitalia, head, and hide of Sudan Baggara Zebu bulls finished on urea-treated contained 0, 10, 20 and 30% of treated bagasse. This study's result is in consistent with Terry *et al* (1990) who reported that hide of Bos indicus cattle is generally heaviest.

The proportion of internal organ components like heart, liver, lung, spleen and kidney are indicated in Table 3. This finding is almost as good as to the study result reported for Zebu cattle heart (1.03), liver (3.85), lung (3.48), spleen (0.99) and kidney (0.597) (Teye and Sunkwa, 2010). Besides, the same authors reported lower result for the same internal organs of Sanga and WASH cattle

(0.75 & 0.65, 2.6 & 2.38, 1.66 & 1.6, 0.6 & 0.56 and 0.48 and 0.42 respectively). Moreover, Mohammed *et al*. (2015) reported lower weight in all treatments for heart, liver, kidney, and spleen of Sudan Baggara Zebu bulls finished on urea-treated contained 0, 10, 20 and 30% of treated bagasse.

Simple economic profit calculation was done from the purchase price of live draught cattle and sale from its carcass and other edible parts (Table 4). This study result discloses that, the price of live animals and the amount of carcass and other edible parts attained from it, is not worthy of comparison and there was a loss of 402.66 ± 0.29 Birr per slaughtered animal. This is due to high proportion of offal or ligaments (Table 2), poor body conditions (might be due to previous work stress), blood drained and inedible bone thrown. Therefore, it is plain that profit is acquest barely from draught power animals if the students' cafeteria accustomed their flesh for sale. And the students' cafeteria is obliged to postulate the shamble to quell a large number of cattle to intercept the students' penury of flesh for food.

Conclusion

The average slaughter and hot carcass weight, and dressing percentage recorded for draught cattle in this study was 247.93±5.27, 90.98± 2.11 and 36.98±0.94 respectively, while the shrinkage percentage value was 0.74±0.02. The amount of total deboned lean meat obtained was 60.38kg (24.35%). The price of live animals and the amount of carcass and other edible parts attained from it, is not worthy of comparison and there was a loss of 402.66± 0.29 Birr per slaughtered animal. Generally, the carcass yield earned from cattle used in this study is low and not profitable. Therefore, draught cattle released for beef should be fattened either by the farmer themselves or at beef farm in order to recover their body weight due to agricultural work load and to minimize number of animals scarified every day. As well, detailed study should be conducted to evaluate rib eye area, fat thickness and primal cuts for leg, lion, rack, shoulder, neck, breast and shank and also meat quality needs to be addressed so as to evaluate the effect of work performance on carcass quality of draught animals released for beef purpose.

Acknowledgements

The authors would like to thank Haramaya University and the University's enterprise development directorate office for financial support to conduct this study. In addition, the authors are grateful to the University's beef farm and abattoir staffs that provided assistance during experimental work.

Conflict of interest

The authors declare that there is no conflict of interest.

References

Afolayana, R. A., Deland, M.P., Rutley, D.A., Bottema, C.D., Ewers, A.L., Ponzoni, D. R. and Pitchford, W.S., 2002. Prediction of Carcass Meat, Fat and Bone Yield across Diverse Cattle Genotypes Using Live-Animal Measurements. *Anim. Prod. Aust.*, 24, 13-16.

Ayele, S., Assegid, W., Jabbar, M. A., Ahmed M.M. and Belachew, H., 2003. Livestock marketing in Ethiopia: A review of structure, performance and development initiatives. Socioeconomics and Policy Research Working Paper 52. International Livestock Research Institute (ILRI), Nairobi, Kenya. 35.

Aynalem, H., Workneh, A., Noah, K., Tadelle, D. and Azage, T., 2011. Breeding strategy to improve Ethiopian Boran cattle for meat and milk production. IPMS of Ethiopian Farmers Project Working Paper 26. Nairobi, Kenya, ILRI.

Bedhane, M. and Dadi, H., 2016. Growth and Slaughter Characteristics of Ethiopian Boran Breed Bull. *Int. J. Livest. Res.,* 6, 41-50.

Betru, S. and Kaawashima, H., 2009. Pattern and determinants of meat consumption in urban and rural Ethiopia. *Livest. Res. Rural Dev.*, P. 21. Article # 143.

Carlos, O., Pena, F., Garcia, A., Perea, J., Martos, J., Domenech, V. and Acero, R., 2009. Carcass characteristics, fatty acid composition, and meat quality of Criollo Argentina and Braford steers raised on forage in a semi-tropical region of Argentina. *Meat Sci.*, 81, 57-64.

CSA, 2008. Ethiopian Statistical Agency. CSA, Addis Ababa, Ethiopia.

Elkhidir, I. A., 2004. Utilization of sugar-cane bagasse for fattening cattle. Ph.D thesis. University of Khartoum.

Eltahir, I. E., 1994. Beef production potential of Baggara and 50% Friesian crossbred. MSc. Thesis. University of Khartoum.

FAO, 2009. Production year book. FAO, Rome, Italy. http://faostat.fao.org/default.aspx.

Haryoko, I. and Suparman, P., 2009. Evaluation of Carcass Production of PO Cattle Based on Heart Girth Measurement, Body Condition Score and Slaughter Weight. J. Anim. Prod., 11, 28-33.

Gebeyehu, A. W., Yousuf, M., Sebsibe, A., 2018. Evaluation of microbial load of beef of Arsi cattle in Adama Town, Oromia, Ethiopia. International Conference on Food safety and Hygiene, September 06-08, 2018 | Edinburgh, Scotland.

IGAD, 2010. The contribution of Ethiopian Livestock to the Economies of IGAD Member States. IGAD LPI Working paper No. 02-10.

Keane, M.G. and More O'Ferrall, G.J., 1992. Comparison of Friesian, Canadian Hereford × Friesian and Simmental × Friesian steers for growth and carcass composition. *Anim. Prod.*, 55, 377-387.

Lemma, T., Geleta, T., Sisay, A. and Abebe, T., 2007. Effects of four different basal diets on the carcass composition of finishing Ethiopian Boran bulls. *J. Cell Anim. Biol*., 1, 015-018.

Mekasha, Y., Mengistu, U., Mohammed, Y.K. and Merga, B., 2011. Effect of strategic supplementation with different proportion of agro-industrial by-products and grass hay on body weight change and carcass characteristics of tropical Ogaden bulls (Bos indicus) grazing native pasture. *Afr. J. Agric. Res*., 6, 825-833.

Mengistu, A., Zewdie, W., Yohannes, G. and Kassahun, W., 2013. Evaluation of Friesian x Boran crossbred and Ethiopian Highland Zebu oxen with a reciprocal work effect on carcass characteristics. *Int. J. Agric. Sci., 6, 1016-1020.*

Mohamed, H. K., 1999. The effect of different dietary energy levels on performance, carcass characteristics and meat quality of Baggara bulls. Ph. D. Thesis. University of Khartoum.

Mohammed, A. M., 2004. Effect of slaughter weight on meat production heifers. Ph. D. Thesis. University of Khartoum.

Mohammed, H. A., Salih A. B., Abdelrahman, M. M. and AbdElnasir, M. A. F., 2015. Carcass Yield and Characteristics of Sudan Baggara Zebu Bulls Finished on Urea-Treated Sugar-Cane Bagasse, *Inter. J. Anim. Biol.*, 1, 11-16.

Negassa, A., Rashid, S. and Gebremedhin, B., 2011. Livestock Production and marketing. Ethiopia Strategy Support Program II (ESSP II). ESSP II Working P.26.

Oprządek, J., Dymnicki, E., Oprządek, A., Słoniewski, K., Sakowski, T. and Reklewski, Z., 2001. A note on the effect of breed on beef cattle carcass traits. *Anim. Sci. Pap. Rep.,* 19, 79–89.

Pariacote, F., Van Vleck, L.D. and Hunsley, R.E., 1998. Genetic and phenotypic parameters for carcass traits of American Shorthorn beef cattle. *J. Anim. Sci.*, 76, 2584-2588.

Pesonen, M.M.H. and Arto, H., 2012. Effect of breed on production, carcass traits and meat quality of Aberdeen Angus, Limousin and Aberdeen Angus x Limousin bulls offered a grass silage-grain-based diet. *Agr. Food Sci.*, 21, 361-369.

Safari, J. G., Mushi, D. E., Mtenga, L. A., Kifaro, G. C. and Eik, L. O., 2009. Effects of concentrate supplementation on carcass and meat quality attributes of feedlot finished Small East African goats. *Livest. Sci.*, 125, 266-274.

Strdom, P. E., Frylink, L., Van der Westhuien, J. and Burrow, H. M., 2008. Growth performance, feed efficiency and carcass and meat quality of tropically adapted breed types from different farming systems in South Africa. *Aust. J. Exp. Agr.,* 48, 499-507.

Terry, C.A., Kenapp, R.H., Edwards, J.W., Mies, W.L., Savell, J.W. and Cross, H.R, 1990. Yields of by-products from different cattle types. *J. Anim. Sci.*, 68, 4200-4205.

Teshager, A., Belay, D. and Taye, T., 2013. Traditional Cattle Fattening and Live Animal Marketing System in Different Agro-Ecologies of Ilu Aba Bora Zone, Oromia, Ethiopia. *Global Veterinaria,* 10, 620-625.

Teye, G.A. and Sunkwa, W.K., 2010. Carcass Characteristics of Tropical Beef Cattle Breeds (West African Shorthorn, Sanga and Zebu) in Ghana. *Afr. J. Food Agric. Nutr. Dev.,* 10, 2866-2883.

Yesihak, Y. M. and Edward, C. W., 2014. Ethiopian beef carcass characteristics. *Afr. J. Agric. Res.,* 9, 3766-3775.