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Assessment of Beef Cattle Production, Slaughtering and Marketing Practice in Haramaya University, Ethiopia

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ABSTRACT

Ethiopia is endowed with good livestock production potential; however, the product utilization was underutilized. Meat is one of the most nutritious animal source foods that humans can consume. In Ethiopia, domestic consumption requirements for red meat arise due to rapidly growing population, increasing urbanization, rising income, increase export of live animal and meat to generate foreign exchange earnings. This study was anticipated to assess beef fattening, processing, handling and marketing of meat and live animal in the Haramaya University, which is found in Ethiopia, and known for technology innovation, adoption, and transfer for community. The source of cattle for fattening in the university is from Tullu Dambir, Haramaya and Oda Bultum cooperatives based on weight. Sex, appearance, and weight have limitation during buying. The farm was selected only male greater than 225kg and good appearance. As cattle enter the farm identification number, vaccination, and quarantine for 15 days applied. The major feed resource for fattening was hay, silage, cafeteria leftover, and kitchen by-product. The cattle have managed in-group as a time entering to the fattening for 100 days. There was no live animal selling in farm. Even though there has been plenty of knowledge and experience in the University there is yet poor slaughterhouse management and traditional slaughtering practice. There was no compartment lairage, electrical hoist, vehicle, separated room for stomach, waste collection room, carcass classification, carcass chilling room, laboratory, refrigerator, stunning pen, chilling room, hide processing room and sterilization facilities. The University enterprise has been retailing the meat with 80kg/birr for student cafeteria service and 100 kg/birr for staff restaurant and individual/private restaurants as well as individual campus resident. The fattening station and the abattoir should work in collaboration with the scientific communities to supply quality beef.

Keywords: Abattoir; Beef; Cattle; Haramaya University; Production.

1.0 Introduction

Ethiopia is endowed with good livestock production potential mainly due to diversified natural resource availability, climate, and large populations of different livestock species (Duguma et al., 2011). The CSA, 2016/17 report indicated that Ethiopia had estimated (in million) population of 57.83 cattle, 28.89 sheep, 29.70 goat, 60.51 poultry, 2.08 horses, 7.88 donkeys, 0.41 mules, 1.23 camels. This sector plays vital role in supply of meat, milk, hide and skin, wool, egg and as a source of additional income both for smallholder and for pre-urban farmers (Ehuet al., 2002). Meat is one of the most nutritious foods that humans can consume,

particularly in terms of supplying high quality protein (amino acids), minerals (iron) and essential vitamins like B12, D and K. In Ethiopia, domestic consumption requirements for red meat was arise due to rapidly growing population, increasing urbanization, rising income, increase export of live animal and meat to generate foreign currency (Shapiro et al., 2015).

Increased demand for beef will develop the market channel for beef. In recent years, feedlot firms are flourishing and being engaged for local and export of processed meat and live animals. Improved quality will stimulate beef consumption (EMDID, 2016). Meat quality is becoming more important as consumers worldwide are increasingly demanding

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consistently higher quality meat (Scholtz, 2007). Which is because of beef industry is better in dealing with conversion and processing of live animals to different products and by products (Nebi, 2018).

Haramaya University (HU) community engagement enterprise development, under community service and the school of animal and range science have different established demonstrations and research farms viz., Beef, Dairy, Goat, Sheep, Swine, Poultry and Apiculture to provided trainings to farmers and development workers, on-farm demonstrations through academic study's outcomes. In addition to these demonstration farms, 'one hundred days' beef fattening station is the one that established with the aim of availing the access of red and cooked meat for community in the campus. This station had long history in this campus, however unforeseen things are yet available in the way of cattle production and slaughtering, carcass handling and market system are traditional and incomparable with University history as country and in Eastern Africa. Similarly, according to the World Bank (2004) report, Ethiopian meat production and marketing has been plagued due to lack of quality, sanitation, disease, and unqualified meat production process. Therefore, this manuscript was planned to assess beef fattening, processing, handling and marketing of meat and live animal in the University.

2.0 Materials and Methods

2.1 Description of study area

The study was conducted at Haramaya University, "one hundred days" beef fattening station. The University is located 17, 40, and 510 km from Harar, Dire Dawa and Addis Ababa. The beef fattening station, located at 09° 25'11 705"N; 042° 01'56 387"E; 2019 m.a.s.l. altitude and receives 780mm mean annual rainfall. The mean annual minimum and maximum temperatures are 8.5 and 24.4, respectively (Haramaya University, 2017)

2.2 Sampling and data collection

A beef fattening station was purposively selected, station visit and survey (pre-designed questionnaires) made to assess beef cattle production system, fattening program, feed resource availability

and feeding system, housing facilities, identification available resource, live animal marketing practice after finishing, abattoir operation, post slaughter and beef marketing in the campus.

2.3 Feed analysis

Feed used in experiment was analyzed at Haramaya University Animal Nutrition laboratory. The samples were analysed for proximate (DM, Ash, CP) and detergent fibre (NDF, ADF) analyses. DM and nitrogen (N) were analysed according to the standard methods of AOAC (2000), whereas NDF and ADF were determined by the methods of Van Soest et al. (1991).

3.0 Results and Discussion

3.1 Source of cattle

The assessment result in current study revealed there was no nearby market for the delivery of live animal for fattening station. The animals obtained from other districts, zones and regions, provided by cooperatives for the fattening. Those provider cooperatives were: Tullu Dambir, Haramaya and Oda Bultum Union from Meta, Haramaya and Oda Bultum districts, respectively. In contrast to that Dadi et al. (2017) report that commercial feedlot operation purchased animals for fattening purpose from different opened local market. This observation is a good experience in beef cattle value chain map for other institution and proximity cooperatives. Soon as the cooperative brought the animal via trucking and vehicle to the station, identification (ear tag) had given for each steer. However, these animals were collected from different locations by known cooperative, their specific breed and history is hitherto unknown. This resulted difference between animal in feed conversion efficiency, dressing percentage and prolong the fattening time at the station might be needed for compensatory growth.

3.2 Selection criteria to purchase cattle

The Haramaya University community engagement and enterprise development is mandated office to set criteria and purchase bulls from cooperative in a legal form; and finally, the senate of the University approves the criteria. The focus of criterions limited to live weight, appearance, and sex which was unable to address the age, breed, and

history of each animals to be included. However, breed and age are a most important criterion for selection of beef cattle fattening operators due to link with feed conversion efficiency and meat quality sources (Dadiet al., 2017)

3.3 Weight

One of those criteria set for purchasing and the cattle were bought from cooperative only by weight bases. However, in most of terminal market in Ethiopia weighing based price not practiced (Tasfaye, 2016; Harko, 2015; Yadanakachow, 2016, Birmaduma et al, 2019), rather marketing is based on visual observation on body condition and approximation of age and sex (Getachew et al., 2010). The weight-based criteria in current study revealed as weight less than 200kg is unacceptable; weight from 200-225kg accentuable about 30% out of availed population; and greater 225kg 70 % accepted (source: farm guide).

3.4 Appearance and sex

Application of this criterion is to select horned, blinded, abnormal legs, and damaged skin bulls and rejected by the enterprise for fattening. Only male animals with good physical appearance selected for fattening. The current assessment observed that, there was no age restriction, the condition which should not be neglected in the criteria, since the quality of meat is affected by the age of the animal. Consumers satisfaction is primarily based on tenderness, juiciness, flavor, color and appearances and all these qualities are affected by age particularly tenderness (Troy and Kerry 2010; Lee et al., 2012) decreases as animal become matured. The older animal the tough meat source (Birmaduma, 2018).

3.5 Animal transportation

Transportation of live cattle by the cooperative was using smaller vehicle, loading and unloading was held on sloppy ground, which is non-conventional for higher animal and interferes their welfare. Similarly, report by Josephine, (2013) who vehicle (Isuzu) common means of transport for cattle from Ambo to Kera market. However, Warriss (2003) reported that transportation involves a series of handling and confinement situations, which can lead to suffering for stress. Stress causes changes in the immune system mainly due to physiological changes (Ekiz et

al., 2012). Such changes lead to increased heart rate, respiratory rate, weight loss, depletion of muscle glycogen reserves, which may result in a higher ultimate meat pH, greater water holding capacity, tougher meat, darker meat color and injury even to death to the animal (Muchenje et al., 2009; Ekiz et al., 2012).

3.6 Precondition before cattle entrance to the farm

The steers after identification, weighed for cost determination and initial weight, given an anti-parasite to deworm internal parasite and quarantined. Isolation of all purchased animals on arrival at the farm for a minimum period of two to three weeks in isolation facility to observe for clinical signs of disease and conduct any necessary tests and treatments. These practices are supported by FAO et al. (2010), as isolation of all newly purchased animals on arrival at farm for a minimum of 28 days in isolation facility is important for farm biosecurity.

3.7 Feed and feeding

Major feed input in farm as indicated in Table 2 were hay, silage, cafeterias left over and industrial by-products. Additionally, kitchen by products (Table 1) like Cabbage trim, Potato trim, peapod was used throughout the year in feedlot. Since the availability of cafeterias leftover is high in Haramaya University it is the major beef cattle feed resource in station. Concerning the use of non-conservational feed and kitchen leftover, there is renewed enthusiasm as animal feed supplement.

Even in developed countries (Broad et al., 2016), using food scraps as animal feed in a safe, resource-efficient way can be an eco-friendly and energy-efficient alternative with multiple benefits for farm and food businesses, consumers, and communities.

3.8 Chemical composition of feed

The concentrate supplement for the beef in the farm is dried cafeteria leftover (DCLO), the leftover is transported and sun dried from three times daily collections (breakfast, lunch, and dinner) from student cafeteria.

The DCLO has different nutritional composition at different mealtime of the day. The farm feeding system and management is indigent, which could lower the quality of beef.

Table 1: Feed Type Used in Haramaya University Beef Fattening Station

Feed resource	
Preserved cafe left over	Peapod
Wheat straw	Wheat bran with maize
Cabbage trim	Brewery grain
Potato trim	Potato
Oat straw	Wheat bran
Milling byproduct	Nugcake
Hay	Wheat short
Silage	Maize and Sorghum

Source: Haramaya University beef farm

The quality of beef affected by interaction of management and feeding ,length of feeding period and prior nutritional management factors (David, 2006). Most of this feed ingredients (Table 1) used in this farm has high moisture content and which could be easily fermented and may results yeast and mold development that could cause undesirable flavor on meat. In support of this Muchakilla et al. (2014) reported that natural pasture grazed animal had good aroma score than animal finished in processed feed at feedlot. Feeding resources in the University are listed in Table 2, the laboratory analyses revealed as proximate composition of feed varied. The Cp of concentrate feed is much higher.

The proximate composition of DCLO also varied depend on mealtime time. Lunch and dinner time meal have better Cp and other nutrient than breakfast meal. This is supported by (David, 2006), as the nutrient content of by-product feeds has a large range due to different processing and the various procedures they use. Conventional feeds are much more consistent in nutrient content. The mean Cp (9.94 %) content reported here is similar with the result of 9% (Negasa, 2015; Tesfaye et al., 2015) conduct experiment on mono gastric.

Feeding food scraps is often cheaper to feed animals, opportunities to feed animals, help the environment and reduce costs (US EPA, 2017). Gebremariam (2019) also reported using equal proportion of maize grain, wheat bran, dried cafeteria leftover and scrambled whole groundnut feeding to the Hararghe Highland bull at feedlot improves

finished weight and average daily gain and carcass yield and suggested as strategic supplementation.

3.9 Fattening program and Animal management system

In the station, cattle are managed in-group for one hundred days, the second weighing is once made after quarantine; to know the initial body weight, to begin fattening program and be aware of monthly development.

In the station, the animal had not get with formulated daily ration based on stage and requirements.

Zgajnar and Kavcic (2008) indicated that's ration formulation in beef farms used for precise management to achieve economically justified outcome.

Meat quality affected by several factors including genetics, feed, handling of the live animals and subsequent handling of the meat (Khan et al., 2015). In addition to this cafeteria leftover untreated crop residue collected from crop research farm of Haramaya University and hay, purchased from Sululta (about 600 km far from the base of the farm) used as feed source. Higher plane of nutrition promotes earlier fattening while a lower level results in a delayed or slower fattening process.

Table 2: Proximate Composition of Fresh Cafeteria Food Left Over

Feed type	DM %	Ash %	CP %	EE %	CF %	N DF %	AD F %
Conce ntrate	91.8	9.54	20.04	9.74	54.4	-	-
Break fast	91.94	1.87	8.42	2.52	0.26	-	-
Lunch	92.41	3.71	11.38	6.71	0.85	-	-
Dinner	92.53	3.67	10.01	7.76	0.92	-	-
Hay	95.45	8.93	6.71	1.28	-	80.51	52.84
Corn Silage	94.96	7.66	7.76	2.4	-	75.00	41.00

DM = Dry Matter, CP = Crude Protein, EE = Ether extract, CF = Crude fibber, Source: Gemechu (2015)

4.0 Live Animal Marketing Practice After Finishing and Slaughtering

There was no live animal sold in the University farm for community or around the campus. The cattle in beef farm only slaughtered in the University abattoir. Even though there has been plenty of knowledge and experience in the University there is yet poor slaughterhouse management and slaughtering practice. Slaughter practices and storage facilities affect the sanitary status of meat and may limit its value in domestic and international trade (Morgan and Tallard, 2006).

It is important to take note that consumers worldwide always demand to have their foods of better quality (APO, 2005). Haramaya University beef farm also have abattoir for slaughter, but there is no precondition like conditions cattle pre-slaughter, compartment lairage, stunning pen, stunning equipment, data recording. According to FAO guideline (2004) warm-blooded animals (includes livestock) feel pain and the emotion of fear. Fear and pain are very strong causes of stress in livestock and affects the quality of meat. Efficient, experienced, and quiet handling of livestock, using recommended techniques and facilities, as well as taking measures to eliminate pain and accidental injuries will reduce stress in the animals and prevent quality deficiencies in meat and by-products. This is supported by Chulayo et al. (2012) who reported that stressed animal in the pre-slaughter was resulted rapid release of enzymes, cortisol's and catecholamines which may lead to depletion of glycogen, high meat ultimate pH (pHu) and dark cuts.

The equipment used for slaughtering were not updated, the abattoir uses hammer and Axes for stunning, which make animal suffer more. Injuries such as torn and hemorrhagic muscles and broken bones, caused during handling, transport and penning, considerably reduce the carcass value because the injured parts are condemned. If secondary bacterial infection occurs in those wounds, causes abscess formation and septicemia, and the entire carcass might be condemned (FAO, 2004).

The house hygiene was not good and well managed during our observation. The slaughtering process in this slaughterhouse does not care about the quality of skin and meat, the abattoir workers was operated on the floor and hit the bone to break over

the skin and trample the meat with dirt boat. Water scarcity, and trims (head, leg, skin) of previously slaughtered animal was not properly cleaned from floor. Waste disposal mechanism was also seen as poor and they simply dump the viscera outside the abattoir. Therefore, vultures and neighborhood kids came and collect for dog but these wastes might be resource would processed further and utilizes for poultry or pet food which was untried in this big institution.

4.1 Operation and facilities of the abattoir

Haramaya University abattoir was small scale, establish only for the community service slaughter up to 30-50 animals per day. Slaughtering service regularly in the early morning. The abattoir workers have been given no incentives for extra time checkup and treatments. The issue which needs urgent remedial measures. Without the workers' health guarantee, enough skill and knowledge, it is difficult to ensure food safety of the animal products. Cortosi (1994) strongly recommended that the local authorities should grant a license for abattoir workers to attain the required standard carcass dressing qualification. Similarly, FAO (2008) recommended regular and periodic training for abattoir workers to maintain sound sanitary, safe meat hygiene, and gear forward the technical operation efficiency in the sector.

There were no full facilities in the abattoirs only lairage, different class, manual hoist and electric. The abattoirs carry out slaughter mostly on floor because manual hoist was needed force. There was no compartment lairage, functional electrical hoist, vehicle, separated room for stomach, waste collected room, carcass classification, carcass chilling room, laboratory, refrigerator, stunning pen, chilling room, hide processing room and sterilization facilities. However, demonstration equipment in abattoir should not only be limited to genuine slaughter facilities but also include equipment for humane killing of slaughter animal as well as treat plants solid abattoir wastes and effluent in order to improve environmental impact of abattoirs (FAO, 2008).

Currently, meat is transported from abattoirs to the restaurant (staffs and students lounges) by any vehicle available around and there is no specified meat transporting vantruck. Because of the abattoir had not own vehicle that takes regular service for

carcass transportation. It might be causes for carcasses contamination. The University should be considered this constraint to solve since transportation and storage are vital links in meat hygiene and safety, effective control measures are essential at each point to prevent contamination (Ministry of Agriculture, 2010).

Many microorganisms stick very firmly to surfaces, in tiny almost invisible layers of organic materials, so called biofilms. Inactivation of those microorganisms requires antimicrobial treatments, carried out in food industries through hot water or steam or through the application of disinfectants. Food production premises are regularly subjected to cleaning and disinfection regimes designed to reduce bacterial load and eliminate pathogens (Fagerlund et al., 2017).

The overall abattoirs sanitary observed as below the requirements of good hygiene practices in slaughterhouses. This lack of the required instrumentation and facilities in the abattoirs, less attention from the administration, and less researches carried out on meat quality and abattoir functionality management. However, Ethiopian Minister of Agriculture has the proclamation on the issue of meat inspection No 81/1976 to determine livestock and livestock product (LLP) as fit for human consumption, classification, and database management.

Fortunately, in abattoirs, ante and postmortem carcass were inspected on daily basis. Similarly, Harko (2015) reviewed that ante mortem and pre slaughter examinations undertaken in Ethiopian abattoirs. However, meat inspector in abattoir at Haramaya University community service did not apply carcass certification. This might be due boneless carcasses transported to restaurant directly, which applied for different municipality and export abattoir in Ethiopia.

4.2 Beef marketing in university

There was about more than 20 restaurants in Haramaya University owned by University and private for serving the community in the campus through prepared sauce. The only staff launch was provided raw meat. The enterprise sold by 80kg/ birr for student cafeteria service and 100 kg/birr for staff restaurant and individual/private restaurants as well as individual campus residency. This is good

subsidized price for residence since this price is comparatively cut by about 50% (Birmaduma, 2018).

5.0 Conclusions

The study was conducted at Haramaya University hundred day's beef fattening station and in the University abattoir. The study directed through personal observation and developed question about the management practice and slaughtering procedure in abattoir through asking the workers and observation of the farm and abattoir. As per the information animal for fattened have been delivered from different zone by cooperatives of Tullu Dambir, Haramaya and Oda Bultum Union from:

Chalanco, Haramaya and Badessa respectively. The cattle bought only through weight based by some limitation on Weight, Appearance, Sex, and Age. Before stating fattening program quarantine for 15 days. The fattening program is conducted under the shade for hundred days. The major feed supplied for fattening is roughage, cafeteria leftover, crop residue and hay. When cattle finished from fattening, sent to slaughterhouse, which has limited in facilities and monitoring. The animal slaughtering procedure is observed as cruel. The equipment used for slaughtering was not updated, the hammer and axes for stunning purposes which make animal suffer for more pain and stress and results defects the products. Other problems observed in the abattoir were poor hygienic, waste disposal, hide management, slaughtering, and malpractice in slaughterhouse procedures.

- During cattle selection for fattening age, management practice and breeds consideration is important for design different research and know the feed conversion efficiency.
- Ration formulation depend on daily requirement of individual animal is important for feeding; because different fattening stage need different feed quality and quantity.
- The station and the abattoir should work closely in collaboration with the scientific communities found in the University to improve the production system and to supply quality beef.
- Periodic cleaning and sanitation, which includes disinfection of slaughterhouse premises and equipment, should consider as one of the most important activities in the abattoir.

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References

- [1] APO. Quality control for processed foods. Report of the APO Seminar on Quality Control for Processed Food, Republic of China 2002, 8-14.
- [2] B Gdisa, Y Yusuf, Mohammad, Y Kurtu. Assessment of Beef Cattle Production and Marketing Practice in Eastern Oromia, Ethiopia. *Journal of Food Science and Quality Management*, 85, 2019.
- [3] B Gadisa. Analysis of Eating Qualities, Perception of Stakeholders on Beef Qualities Determinants and Commercial Value of Meat Cuts in Eastern Oromia, Ethiopia. Msc. Thesis Haramaya University, Ethiopia, 2018.
- [4] LE Broad, O Balkus, C Rice, M Maley, R Taneja, R Cheng. *Leftovers For Livestock: A Legal Guide for Using Food Scraps as Animal Feed*, 2016.
- [5] AY Chulayo, O Tada, V Muchenje. Research on pre-slaughter stress and meat quality: A review of challenges faced under practical conditions. *Applied Animal Husbandry & Rural Development, South Africa* 5, 2012.
- [6] CSA (Central Statistical Agency). *Agricultural Sample Survey. Livestock, Poultry and. Beehives population (private peasant holdings)*, 2016.
- [7] G Dadi, M Urge, T Teklebrhan. Assessment of Commercial Beef Cattle Fattening Practices and performance in East Shoa Zone. *Int J Agric Sc Food Technol* 3(3), 2017, 067-076.
- [8] H David. *Feeding to Produce Export Quality Ethiopian Beef Requirements and Recommendations*, 2006.
- [9] D Belay, K Yisehak, PJJ Geert. Analysis of constraints facing urban dairy farmers and gender responsibility in animal management in Jimma Town. *Journal of Basic Applied Science* 3, 2011, 313–318.
- [10] B Ekiz, EE Ekiz, O Kocak, H Yalcintan, A Yilmaz. Effect of pre-slaughter management regarding transportation and time in lairage on certain stress parameters, carcass and meat quality characteristics in Kivircik. *Meat Sci.* 90, 2012, 967-976.
- [11] EMDIDI (Ethiopian Meat and Dairy Industry Development Institute). *Ethiopian Agro-Industry Strategy Meat Industry Sub-Sector Strategic Plan (2015-2025)*. Addis Ababa-Ethiopia.
- [12] A Fagerlund, T Mørseth, E Heir, R Briandet, S Langsrud. Cleaning and Disinfection of Biofilms Composed of *Listeria monocytogenes* and Background Microbiota from Meat Processing Surfaces. *Appl Environ Microbiol*, 2017.
- [13] FAO (Food and Agriculture Organization). *Guidelines for humane handling, transport and slaughter of livestock*, Edited by: Gunter Heinz. RAP Publication, 2004.
- [14] FAO (Food and Agriculture Organization). *Food Energy – Methods of Analysis and Conversion Factors and Analytical Methods for Proteins in Foods*. Italy, Rome, 2008.
- [15] FAO, OIE & WB. *Good Practices for Biosecurity in the Pig sector: Issues and Options in Developing and Transition Countries*. FAO Animal Production and Health Rome FAO, 169, 2010.
- [16] TT Gebremariam. Feedlot performance and carcass yield of hararghe highland (*Bos indicus*) bulls using different concentrate

- feeds. *Acta Scientiarum - Animal Sciences*, 41(1), 2019, 1–7.
- [17] T Gemechu. Determination of Haramaya University Beef Cattle Feeds Chemical Composition and an Overviews of Available Resource, BSc. Senior Research unpublished paper. Haramaya University, Haramaya, 2015.
- [18] L Getachew, T Hailemariam, A Dawit, N Asfaw. Live animal and meat export value chains for selected areas in Ethiopia: Constraints and opportunities for enhancing meat exports rapid, No. 25202, 2010.
- [19] Haramaya University. About University, 2017,
- [20] H Halala. Review of Beef Cattle Value Chain in Ethiopia. *Journal of Industrial Engineering Letters*, 5(7), 2015, 2225-0581.
- [21] J Josefine. Animal welfare in Ethiopia: transport to and handling of cattle at markets in Addis Ababa and Ambo. Swedish University of agricultural sciences, Department of animal nutrition and management, 461, 2013.
- [22] MI Khan, J Cheorun, and Muhammad RizwanTariq. Meat Fl AvorPrecursors and Factors in Fl Uencing Fl Avor Precursors- A Systematic Review. *MESC* 110, 2015, 278–84.
- [23] SH Lee, JH Choe, YM Choi, KC Jung, MS Rhee, KCK Hong, YC Ryu, BC Kim. The influence of pork quality traits and muscle fiber characteristics on the eating quality of pork from various breeds. *Meat Science*, 90, 2012, 284-291.
- [24] Ministry of Agriculture. Meat Transport and Storage Guideline. Meat Transport and Storage Guideline (for Abattoir and Airport Cargo Terminal Workers) Ii, 2010.
- [25] N Morgan, G Tallard. Background paper for the Competitive Commercial Agriculture in Sub-Saharan Africa (CCAA) Study. Cattle and beef international commodity profile, Food and Agriculture Organization. Rome, Italy, 2006.
- [26] MB Muchakilla, L Asimwe, AE Kimambo, LA Mtenga, GH Laswa. Effect of diet and muscle type on meat quality characteristics of Tanzania Shorthorn Zebu. *Livestock Research for Rural Development*, 26 (10), 2014.
- [27] V Muchenje, K Dzama, M Chimonyo, PE Strydom, JG Raats. Relationship between pre-slaughter stress responsiveness and beef quality in three cattle breeds. *Meat Sci.* 81, 2009, 653-657.
- [28] N Husein. Assessment of Beef Cattle Production and Marketing Practice at Mahabuba Farm in Harar, Ethiopia. *Food Science and Quality Management*, 82, 2018, 2224-6088.
- [29] N Tamasgen. The Effect of Feeding Graded Level of Dried Cafeteria Food Leftover on Egg Production and Quality of White Leghorn Chickens. *Journal of Natural Sciences Research*, 5(7), 2015, 93–105.
- [30] Scholtz. Improvement of meat quality in commercial beef and pork production systems. *SA-ANIM SCI* 8, 2007.
- [31] Tasfaye Moroda. Assessment of beef cattle production, management practices and marketing system in Lumen district East Shoa, Ethiopia. MSc Thesis Hawasa University, 2016.
- [32] T Amene, ME Urge. Effects of Different Levels of Dried Cafeteria Leftover Feed on Nutrient Digestibility in Growing Castrated Male Pigs: Implication for Efficient Alternative Feed Resources Utilization. *International Invention Journal of Agricultural and Soil Science*, 3(1), 2015, 1–8.

- [33] DJ Troy, JP Kerry. Consumer Perception and the Role of Science in the Meat Industry. *Meat Science*, 86, 2010, 214–226.
- [34] US EPA. Reduce Wasted Food by Feeding Animals. United States Environmental Protection Agency, 2017.
- [35] PD Warriss. *Meat science: An introductory text*. CAB-International: England: Wallingford, 2003.
- [36] World Bank. Confidential document of the World Bank. Ethiopia: country economic, 2004.
- [37] Y Alemayehu, A Adicha, M Mengistu, B Eshetu. Assessments of market Oriented beef cattle fattening System under farmer management condition in South Omo zone of SNNPR. *Current Research in Agricultural Sciences*, 3 (2), 2016, 21-45.
- [38] J Zgajnar, S Kavcic. Optimization of bulls fattening ration applying mathematical deterministic programming approach. *Bulg. J Agric. Sci.*, 14, 2008, 76-86.