

Full Length Research Paper

Carcass quality audit - A strategy to improve beef sector in Ethiopia

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Received 20 January, 2015; Accepted 20 May, 2015

Ethiopia has the largest cattle population in Africa. However, the potential of the sector has not fully utilized. Average carcass weight of cattle, per capita meat consumption and annual volume of meat produced were very low. Experience from developed countries indicates that implementing carcass quality audit would aid to identify quality problems, develop strategies and establish an educational plan to improve carcass quality. The audit has helped in benchmarking carcass quality parameters to quantify the progress of the sector at intervals of time. The purpose of this paper is to develop strategy on beef carcass quality audit and indicates the possibilities of implementing it at beef export abattoirs in Ethiopia.

Key words: Beef, carcass, audit, Ethiopia.

INTRODUCTION

Constraints and opportunities of beef export in Ethiopia

Livestock plays an important role in the agriculture of Ethiopia. It contributes 15 to 17% of Gross Domestic Product (GDP) and 35 to 49% of agricultural GDP, and 37 to 87% of the household incomes (CSA, 2008). Ethiopia has 53.4 million cattle, 25.51 million sheep and 22.79 million goats (CSA, 2010/2011). The potential of these resources have not been fully utilized. Average beef carcass weight at Ethiopian abattoirs was 135 kg (Mummmed and Webb, 2014). Ethiopians consumed about 8 kg of meat per capita annually, which is far less than what is consumed in developing countries (Sebsibe, 2008).

Middle East and North African countries are potential

markets for the export of livestock and meat product (NEPAD-CAADP, 2005). The annual demand of meat by these regions was estimated about 316,846 tones. However, Ethiopia exported about 16, 877 MT of meat to this region in 2010/2011 (SPS-LMM, 2011). Geographical proximity of the country to Egypt and the Gulf region compared to major meat suppliers to the region such as Brazil, India, Pakistan, Australia and New Zealand is one of the advantages (SPS and LMMP, 2010). In Ethiopia, the policy developed by the government to increase meat export has provided good opportunities for the development of the sector. The increases in the income of Ethiopians and growth of population have created a big demand for meat production. The rapid growth in the meat demand in the Gulf region is an opportunity that should not be missed (Hutcheson, 2006). Factors

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hindering Ethiopia's competitiveness in the region are unreliable continuous supply and low quality of meat (Farmer, 2010). Dark cutting, improper handling of the product, poor sanitation, careless packing, poor management during transport, lack of continuous supply and unresponsive business communications were some of the reported problems of meat in Ethiopia (Anon, 2006). Feedback from importing countries revealed that they are not satisfied with the quality of meat imported from Ethiopia (Farmer, 2010).

Ethiopia has imported significant amounts of meat from the United States of America (USA), United Arab Emirates (UAE), Italy, the Netherlands, China and South Africa. One of the main reasons given by meat importing firms in Ethiopia for importing meat from other countries was the unavailability of higher quality meat in domestic markets (SPS and LMMP, 2010). This indicated that the quality of meat produced in Ethiopia does not satisfy the quality requirements of domestic consumers.

From 2005-2011, sanitary and phytosanitary standards and livestock and meat marketing program has worked in close collaboration with public and private institutions to increase meat and live animal exports from Ethiopia. During this period, meat exports were doubled (from 7,917 MT to 16,877 MT), while official live animal exports were tripled (from 163,375 to 472,045 head). The program has assisted the public and private sectors to achieve their objectives by providing technical support to strengthen animal health and SPS certification systems. The program has helped in upgrading skills of individuals and sectors involved in animal feeding, processing, marketing and export of meat and live animals (SPS-LMM, 2011). The foundation which was laid to develop the sector by the SPS-LMM program needs to be sustained in the future to further improve the meat industry. One way of assuring quality, consistency and competitiveness of the beef industry is establishing export beef carcass quality audit (EBCQA) in Ethiopia. By establishing EBCQA, the quality and yield of carcass will be monitored at interval of time and problems will be minimized to improve the sector further. For the purpose, export abattoirs are the ideal center for the action as they have relatively better facilities and recording practice compared to the local abattoirs (Mummed and Webb 2014).

National beef quality audit in developed countries

Beef quality audit was created in different countries to improve the quality of beef. The aim of the audit in USA was to identify and measure quality problems and to establish an educational plan to address the problems identified. In USA audits were conducted in 1991, 1995, 1999, 2000, 2005 and 2010/2011 (BQA, 2003; Savell et al., 2011). Moreover, the audit was aimed to measure quality defects, which could be managed primarily

through the efforts of cattle producers. It developed benchmarking quality parameters to measure the progress of the sector at different interval of time. The NBQA supported the development of strategies to reduce the incidence of defects. The ultimate objective of the NBQA is to enhance the quality and safety of beef while increasing the profitability of a country from beef and cattle industry (NBQA, 2010/2011). For this purpose, quantitative data was collected from several abattoirs on the slaughter floor and in the cooler for analysis. The goal of the National Beef Quality Audit (NBQA) in Canada is to continually improve the value of Canadian beef carcasses by delivering a consistent high quality, safe product to consumers domestically and around the world (NBQA, 2010/2011). In Canada, the audit was conducted in 1995, 1998/1999 and 2010/2011 (NBQA, 2010/2011). In Romania national grading of quality of beef carcass and veal was conducted in 2008 (Petroman et al., 2009). The aim of the grading was to classify carcass and evaluate yield, and report the result of the classification to Romanian Commission of Pork, Beef and Sheep Carcasses Grading (Petroman et al., 2009). The report was used to make the correct payment to beef breeders, according to carcass weight and quality, and standardization, the development of common language in the international meat trade. In Italy, effectiveness of carcass data collection in cattle slaughterhouse was evaluated in 2007 (Lazzaroni and Biagini, 2009). Data on carcass was collected to verify the effectiveness of the application of the UE carcass classification in a cattle slaughterhouse. In this work data were collected and analysed to highlight the critical point and to improve the recording performance of the technical staff and to avoid the possibilities of making mistakes in registration (Lazzaroni and Biagini, 2009).

Different institution took the responsibilities of the auditing in different countries. In USA, Colorado State University, Oklahoma State University and Texas A&M University participated in collecting data for the auditing. Between May and November 2000 thirty packing plants were audited. The survey teams assessed hide condition from 43,415 cattle, incidence of bruises from 43,595 carcasses, offal and carcass condemnation from 8,588 cattle, and carcass quality and yield information from 9,396 carcasses. The data was collected once in the spring/summer and once in the fall/winter from 50% of each lot on the slaughter floor and 10% in the cooler during a single day's production (one or two shifts, as appropriate). Based on the collected data, carcasses were evaluated for coat color, breed/origin of cattle, brands, mud/manure, means of identification of cattle, sex, bruises, dentition, offal and carcass condemnation, carcass quality and yield information (Boleman et al., 1995; McKenna et al., 2002). In Romania and Italy, data was collected on categories of cattle slaughtered, degree of conformation, degree of fatness, traceability of slaughter animals (breed, sex, live weight and carcass

weight), carcass defects and condemnations (Lazzaroni and Biagini, 2009; Petroman et al., 2009). Based on the audit made different solution were sought as per the aim of the audit made in different countries.

Carcass grading/ Classification

Evaluations of carcass and meat quality are important practices in meat marketing at national and international level (Lazzaroni, 2007). Interest and questions about quality of meat are on the rise due to heightened awareness about the marketing of beef and meat, from procurement and processing to consumer acceptance (Lazzaroni, 2007). Producers are now beginning to receive information about quality of meat they produce. New marketing structures such as vertical integration and value based marketing provided direct financial rewards to cow-calf producers who offer more desirable carcasses (Drake, 2004). Carcass grading and classification system improve communication between producers, traders and consumers. These systems help to develop clearer market signals from the consumer to the producer, act as a catalyst for breed and national herd/flock improvement, act as a framework for the development of national price reporting schemes, assist producers to market their stock more effectively, improve efficiency in transactions, promote retail sale by the marking or labeling of grading information on meat and facilitate the development of any export markets (Strydom, 2011). Because of these benefits carcass grading and classification systems are continuously being developed to describe the quality and yield of a carcass.

On the global scale there are two predominant grading schemes. These are the USDA grading schemes and EU classification scheme. USDA grading scheme evaluate carcasses based on class of animals (steer bullock, bull, heifer, cow), maturity (meat color and texture), quality grade (Prime, choice, Select, Standard, Commercial, Utility, Cutter, Canner) and yield grade. Yield grade estimates amount of closely trimmed retailed cut of meat that the carcass is likely to produce. The yield grades range from 1 to 5, with 1 the highest yielding 5 the lowest yielding. EU classification system (SEUROP) evaluates carcasses based on class (calf, young bull, bull, steer, heifer, cow), conformation grade (six levels) and fat grade (five levels; Fisher, 2007). Classification is a set of descriptive terms describing features of the carcass that are useful as guidelines to those involved in the production, trading and consumption of carcasses and meat, whereas grading is the placing of different values on carcasses for pricing purposes, depending on the market and requirements of traders and consumers. Criteria used in carcass grading systems rank carcasses fairly accurately according to expected eating experience of muscles. Criteria used in carcass classification systems give limited descriptions of the quality related

characteristics of the carcass (Strydom, 2011). In UK beef carcass classification scheme was launched in 1972 using carcass weight, conformation, category and age (AHDB Industry Consulting, 2008). Similar schemes were developed in other European countries with Germany adopting a compulsory scheme in 1968 with 4x3 conformation/fatness grid. Classification in Ireland and France was similar in nature (AHDB Industry Consulting, 2008). The British and rest of Europe's classification systems evolved over many years and were combined into a single system (EUROP) in 1981 (AHDB Industry Consulting, 2008) with the main objective to describe carcasses for those involved in slaughtering, cutting, distribution and retailing according to terms relevant to trading. Adoption of the EUROP system within the EU enabled those involved in the production, slaughtering, cutting, distribution and retailing of meat to describe carcasses in terms that others would understand and that were of commercial relevance in trading. In addition to market reporting standardised description also provided a base for administration of support payments. While the support payment role has now ceased the market reporting function system remains central to beef marketing in Europe (Polkinghorne and Thompson, 2010).

The grading method practiced in different countries varies depending on the objectives of the system and on the degree of uniformity that exists among types and species of animals. The USA and Australia use a grading system based on marbling, age and sex of slaughter animals. In South Africa, carcass classification is used based on external fat covering, conformation and age of the animal. In Australia the meat grading system (AUS-MEAT) and Meat Standard Australia (MSA) are the only systems using pre-slaughter criteria, while the other grading systems perform measurements on the slaughter floor. Chiller assessments are used by all but the SEUROP and South African (SA) systems. The MSA system performs post-chiller assessments. Conformation, shape or rib eye area (REA), some form of fat measurement, carcass weight and sex are common criteria for all systems and are recorded on the slaughter floor and/or during chiller assessment (Table 1).

In South Africa beef description systems have evolved over a long period (Strydom, 2011). A carcass grading system was used from 1932 to 1985 (Strydom, 2011). The grading system was replaced by a carcass classification system in 1992 (Strydom, 2011). The change in the system was aimed to describe carcasses in more objective terms, which allowed buyers to select their ideal article for a purpose rather than impose a universal hierarchical grade structure (Anon, 2006b). The South African system classifies carcasses into four age categories derived from dentition denoted as A (no permanent incisors), AB (1–2 permanent incisors), B (1–6 permanent incisors) and C (greater than six permanent incisors). Bulls in age category B or C are noted and

Table 1. Principal component of selected beef classification and grading schemes in selected countries around the world (Adopted from Strydom, 2011).

| Scheme | Canada | SEUROP | Japan | Korea | S. Africa | USDA | Aust-Meat | Meat standard |
|----------------------------|----------------------|--------------|-----------------|----------------|--------------|--------------------------|-------------------------|--------------------------|
| Grade Unite Classification | Carcass | Carcass | Carcass | Carcass | Carcass | Carcass | Carcass | Cut |
| Quality grade | -- | Yes | -- | -- | Yes | -- | Yes | -- |
| Yield grade | Yes | -- | Yes | Yes | -- | Yes | -- | Yes |
| Pre-slaughter | Yes | -- | Yes | Yes | -- | Yes | -- | -- |
| Slaughter floor | -- | -- | -- | -- | -- | -- | Grain fed | Bosindicus % HGP implant |
| | Carcass wt | Carcass wt | | | Carcass wt | | Carcass wt | Carcass wt |
| | Sex | Sex | Carcasswt | Carcasswt | Dentition | Hot Carcass wt | Sex | Sex |
| | Conformation | Fat cover | Sex | Sex | Fat cover | Sex | Dentition | Electric stimulation |
| | | Conformation | | | Conformation | | Butt shape | Hang |
| | | | Marbling | | Sex | | P8 fat | |
| | Marbling score | | Meat color | Marbling score | | Marbling | | |
| | Meat core | | Meat brightness | Meat color | | Ossification | | Marbling |
| | Meat texture | | Fat color | Fat color | | Meat color | Left cold Half Marbling | Ossification |
| Chiller | Fat color | | Fat lust | Firmness | | Meat texture | Meat color | Meat color |
| | Fat thickness | -- | Fat texture | Meat texture | -- | Rib fat | Fat color | Hump height |
| | Skeletal development | | Fat firm | Lean maturity | | EMA | | Ultimate pH |
| | | | EMA | EMA | | Kidney and perennial fat | | |
| | | | Rib thickness | Fat thickness | | | | |
| | | | Fat thickness | | | | | |
| Post chiller | -- | -- | -- | -- | -- | -- | -- | Ageing time |
| | | | | | | | | Cooking method |

denoted MD. Seven fat classes denoted as numerals from 0 (no visible fat) to 6 (excessively fat) are added to the age group and the combination applied as a colored roller marker or brand to carcasses after classification. Colors (purple for A, green for AB, brown for B, red for C and black for MD) represent the age in classification. Five numerical carcass conformation classes - 1 (very flat), 2 (flat), 3 (medium), 4 (round) and 5 (very round) are also designated together with three damage codes of 1

(slight), 2 (moderate) and 3 (serious) where applicable (Anon, 2006b).

USDA grading system was developed for cattle finished in feedlots. Marbling and age of cattle are the major parameters used to determine quality of carcass. Moreover, this grading system was mainly developed to evaluate cattle up to 24 months of age. Steers and heifers are the only type of animals considered for top quality beef in the system (ZoBell et al., 2005).

Most Asian and European countries use

classification systems instead of grading system. Middle East countries are the potential market for meat produced in Ethiopia (NEPAD-CAADP, 2005). Hence, the development of a carcass classification system instead of grading by the Ethiopian standard agency was the appropriate choice as the potential export market for the country is Middle East countries. Ethiopia has developed a beef carcass classification system in 2012, which is a modification of the SEUROP classification system (ES, 2012). The Ethiopian

Table 2. Characteristics and description of Ethiopian beef classification (ES) system (ES, 2012).

| Conformation | Grade |
|---|-------------------|
| Carcasses with convex profiles and very well developed muscle | 1 |
| Carcasses with straight profiles and good muscle development | 2 |
| Carcasses with concave profiles and moderate muscle development | 3 |
| Fat | Grade |
| Carcasses with small or no fat coverage | 1 |
| Carcasses with fat visible on the whole body exception the hind leg and shoulder | 2 |
| Whole carcasses covered with fat and fat deposited in the thoracic cavity | 3 |
| Descriptions | Categories |
| Carcass of young bull or heifers that weight less than 70 kg | JB |
| Carcasses of grown up bulls (cartilage of the spine up to four thoracic vertebrae show no sign of ossification and from fifth to ninth show sign of ossification; discs of inter-vertebral of sacral vertebrae show sign of ossification) | JM |
| Carcasses of mature intact bulls | M |
| Carcasses of castrated bulls | O |
| Carcasses of heifers | JF |
| Carcasses of cows | F |

classification system structured per animal categories, conformation and fat grade as shown in Table 2. Carcass grading schemes differ all over the world in terms of specific technique, yet most of them include some form of assessment of both fatness and muscle development (Strydom and Smith, 2005). Carcass quality is mainly determined by age, sex, conformation and fat grades (Lazzaroni and Biagini, 2009). Conformation is defined as thickness of the muscle, intermuscular fat and subcutaneous fat relative to the dimensions of the skeleton (De Boer et al., 1974). Adequate fat cover must be present to produce corresponding marbling that determines quality of the product (Mummed and Webb, 2014). The animal category in Ethiopian beef carcass classification system represent the age, gender and intactness/castration of the bulls (Table 2). This can indicate that the Ethiopian beef carcass classification system contains all parameter required to classify carcasses.

Establishing beef carcass quality audit in Ethiopia

A carcass quality audit is one way of identifying and measuring carcasses quality problems. It is a base to establish an educational plan to address the problems identified. Quality defects, which can be managed primarily through the efforts of cattle producers, will be identified. Benchmarking quality parameters will be set to quantify the progress of the sector at specified intervals or years. A strategy to reduce the incidence of defects will be developed. The objective of the audit that will be established in Ethiopia will be to enhance the quality of beef while increasing the profitability of the Ethiopian beef industry. Quality problems in beef carcasses will be ranked and educational programs will be arranged to address these challenges.

The carcass classification system developed by Ethiopian Standard Agency in 2012 is a good opportunity to implement export beef carcass quality audit (EBCQA) at export abattoirs in Ethiopia. The reason for the implementation of the program on export abattoirs is due to the better facilities and the good practice of recording information in these abattoirs compared to the local abattoirs (Mummed and Webb, 2015). Moreover, recently MOA has developed a sector solely focusing on the export of livestock and livestock products. This sector will play a coordinating role in the execution of EBCA in Ethiopia. The audit will be conducted at two years intervals as the number of export abattoirs and the numbers of animals slaughtered per day are small compared to USA and Canada. Experience from the countries conducted the audit shows that collection of data can be accomplished by universities. The activities will be conducted for few numbers of days (5-10) per year. The universities should publish reports on the status of the carcass production and quality every other year. These reports will identify major problems associated with carcass yield and quality. The concerned body (beef export sector of MOA) should prioritize these problems and seek solutions through the extension service program. A strategy will be developed to reduce the proportion of quality problems, defects, causes of condemnation of carcasses and organs in short and long term program. For institutes involved in the auditing activity, it is one way of serving the industry beyond their academic exercise. For these institutes, it will be an excellent opportunity to get retrospective and prospective data for research purposes. Most of the data required for the audit involves information recorded already in the abattoirs. Abattoir personnel usually record information on traceability of slaughtered animals such as breed (source of purchase), sex, live weight and carcass

(weight. Federal Veterinary inspectors are well established in recording carcass defects and condemnations. Additional tasks expected from institutes involved in the auditing activity will be collecting information on classification of the carcasses (category, conformations and fat grade). This work will be done parallel to collecting recorded information at the abattoirs. One week training for personnel involved in the data collection on classification system will be sufficient to avoid subjective difference between technicians. Involving universities in different regional states will further minimize the cost of transport of researchers and materials. Gijiga University, Haramaya University, Hawassa University, Bahrdar University and Mekelle University can conduct audits at export abattoirs in Solmali, Oromiya, Southern People National and Nationalities (SPNN), Amhara and Tigray regional states, respectively. However, institute like Haramaya University will take the responsibility of managing data, analyzing and writing the report because of the long experience in research and teaching activities. Data base management should be established at this center. Those data collected at interval of a year and used for reporting at specific years need be stored in this center. After long period of time, say ten years, these data at the management center will be used to develop long term strategy to solve quality problems. The out put of the activity should be publishable rather than a mere report to the concerned body and academic exercise. This will be an opportunity to monitor the status of beef production and constraints in Ethiopia so that every concerned body will aware of the situation. By developing export carcasses audit, the major yield and quality problems will be identified and profound solution will be found. The solution of these problems will be feedback to producers through extension education so that better quality beef and meat will be produced for export market. This will sustain the quality, consistency and competitiveness of the country in meat industry.

CONCLUSION

The large cattle resources available in Ethiopia are not fully utilized. One of the major problems was inability to produce quality product for export and local consumption. Experience from developed countries show that establishing carcass quality audit will assist to identify problem and develop strategy to improve the sector. It is therefore suggested that establishing export beef carcass quality audit (EBCQA) in Ethiopia will be good opportunity to improve the sector, sustain the quality, consistency and competitiveness of the country in beef industry.

Conflict of Interest

The authors declared that there is no conflict of interest.

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