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Operation, facilities and management in public and private abattoirs in Ethiopia

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This study was conducted to evaluate the operation, facilities and management of public (Adama, Hawassa and Mekelle) and private (Elfora Kombolcha) abattoirs in Ethiopia. Direct observation, photograph and discussion with the workers were used to collect information. The results of this study revealed that lairage was not divided into compartments to accommodate different classes and types of slaughter cattle in two of the four abattoirs visited. Stunning boxes were not used at any of the abattoirs investigated, enervation method of stunning was practiced and there were no means of sterilizing cutting equipments. Even though anti- and post mortem inspection were conducted properly at all abattoirs, findings were not regularly recorded in public abattoirs. Weighing scales were not available at the public abattoirs while live and carcasses weights were regularly recorded at the private abattoir. In all public abattoirs, at horizontal position while it was performed in vertical position in private abattoir. Carcass contamination occurred during processing and/or during transport in the public abattoirs. Classification of carcasses occcured not practiced in public or private abattoirs. It was concluded that the management practiced in public and private abattoirs can partly contributed to the poor beef quality produced. Hence it was recommended that the country should develop legislation governing the operation of abattoirs. Moreover, hazard analysis critical control points (HACCP) should be established in all abattoirs to ensure animal welfare, maximum efficiency and beef quality.

Key words: Abattoir facilities, slaughter procedure, beef, carcass, Ethiopia.

INTRODUCTION

Proper handling of animals is not only a matter of welfare but also an issue of meat quality. Improper handling of animals yield poor meat quality; and poor meat quality result in poor processing properties, functional and eating qualities and is less likely to be accepted by consumers (Ferguson and Warner, 2008). Carcass and meat quality defects such as pale soft exudates, dark firm dry, skin blemish, blood splash, bruising, cyanosis, high microbial load, spoilage of meat, broken bones and death may occur from improper animal handling (Warriss, 2000; Forrest, 2010; Adzitey et al., 2011). Pre-slaughter animal handling starts from the farm, through marketing and end at the abattoir activities (Adzitey, 2011). Moreover, handling of animals during slaughter can also influence the quality of meat (MLA, 2011). Imperfect bleeding affects the quality of meat as more blood in the meat makes it more prone to microbial spoilage which ultimately reduces the quality of meat. Furthermore,

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Table 1. Descriptions of the study area.

Abattior	Region	Distance from Addis Ababa (km)	Global position	Altitude (masl)	T°C	RF (mm)
Adama	Oromiya	99 east	8°32'N39°16E	1712	13-27	809
Hawassa	SPNN	250 south	7°03'N38°28E	1500-2000	20-25	800-1000
Elfora Kombolcha	Amhara	375 north east	11°4'N39°44E	1842 - 1915	11 - 26	750 - 900
Mekelle	Tigray	783 north	7°13'N 5°52E	2000-2200	11- 24	579-650

SPNN- Southern people national and nationalities.

stunning methods affects the bleeding process (Gracey et al., 1999). Carcass handling can also affect meat quality significantly (Adzitey and Huda, 2012). During processing of carcasses, contamination can occur from slaughter facilities, equipment, workers, and environment (Jay, 1992). Different abattoirs have different facilities and management systems which can affect the quality of meat differently. In the developing countries, commercial abattoirs have sophisticated machinery (Gregory, 2005) while most municipal abattoirs have poor handling facilities (Ndou et al., 2011). These differences are thought to have an effect on animal behavior at slaughter and the quality of the product. Animals' reactions differ with different handling techniques and systems (Grandin, 1999). Slaughtering technology is becoming more important as it has a large influence on meat quality (Swatland, 2000). Animal welfare problems are related to inadequate facilities and equipment, lack of personnel training and improper animal handling (Grandin, 1996). It is the responsibility of the abattoirs to ensure minimal stress and good animal welfare from the time the animals arrive at the abattoir to the time of slaughter (RMAA, 2011). Animals which are well looked at slaughter provide good quality meat products. In less commercial abattoirs with little machinery available, there is high human-animal interaction which can be a cause of stress to the animals due to fear of humans (Breuer et al., 2000; Hemsworth, 2003; Waiblinger et al., 2006).

Research has shown that better quality meat with a longer shelf life can be produced if animals are handled with greater patience, understanding and care at slaughter (RMAA, 2011). Hence it is important to assess the level of facilities and management system practiced in public/municipal abattoirs to identify the impact of operation on meat quality. There is no documented information on operation, facilities, managements systems practiced in public and private abattoirs in Ethiopia. This study therefore conducted to assess the level of operation; facilities and management at public and private abattoirs in Ethiopia and suggest a possible improvement strategy.

MATERIALS AND METHODS

Study abattoirs

The study abattoirs are located in the capital cities of Oromiya, Amhara, SPNN (Southern people national and nationalities) and Tigray regional state of Ethiopia which contained more than 95% of cattle population of the country. Descriptions of the study areas and abattoirs are shown in Table 1.

Data collection and analysis

Information on lairage management, stunning method, bleeding, carcass processing and transporting was collected by direct observation, photograph and discussion with workers from public (Adama, Hawassa and Mekelle) and private (Elfora Kombolcha) abattoirs in Ethiopia between August 2013 and January 2014. To identify the causes of inferior quality of carcasses, the presence/absence of basic slaughter facilities, equipment and slaughter procedure were compared between abattoirs.

RESULTS

Capacity, end product and working time of public and private abattoirs are presented in Table 2. The public and private abattoirs studied had a slaughter capacity of 100 to 300 cattle per day. Adama, Hawasa and Mekelle are public abattoirs while Elfora Kombolcha is private. Public abattoirs provided slaughter service to butcheries. They distribute quartered carcasses to their clients. The private abattoir purchased cattle, process and distribute meat to clients (hotels and university cafeterias). Moreover, the private abattoir process corned beef for local and international market. Public abattoir worked during the night, early in the morning and late in the afternoon. However, the private abattoir worked during the day time. Two of the four abattoirs visited are located in the community while others are located outside the community.

Facilities available at public and private abattoirs are presented in Table 3. All abattoirs have lairage, stunning boxes, hoisting facilities and vehicle to transport carcasses and meat. However, it was only at Adama and Elfora Kombolcha abattoirs that lairage was divided into compartments to accommodate different classes and types of animals. In the other abattoirs, the lairage was constructed as a unit to accommodate all classes and types of cattle together (Figure 1).

Watering trough was available only at the lairage at Kombolcha abattoir. Information obtained from the workers in public abattoirs revealed that cattle were slaughtered in 2 to 3 h after arrival at the lairage while a private abattoir cattle were required to stay in the lairage for 12 to 24 h before slaughter. During this time, cattle had an access to water but not to feed.

Table 2. Capacity, end product and working time of public and private abattoirs.

Abattoir	Capacity	Ownership	Location	Output	Working time
Adama	100-300	Public	Outside city	Carcass	20:30-06:00
Hawasa	100-150	Public	Outside city	Carcass	20:30-06:00
Elfora Kombolcha	250-300	Private	Inside city	Meat and corn beef	06:00-16:00
Mekelle	100-150	Public	Inside city	Carcass	05:00-09:00, 14:00-20:00

Table 3. Facilities available at public and private abattoirs.

Abattoirs	Lairage	Stunning box	Stunning	Hoisting	Knife and axes sharpening facilities	Sterilization facilities for equipment	Hot water	Refrigeration section	Deboning room	Carcass quartered	Laboratory	Vehicle
Adama	Yes	Yes	Knife	Electrical	No	No	Yes	No	No	Manual axe	No	2
Hawasa	Yes	Yes	Knife	Electrical	No	No	Yes	No	No	Manual axe	No	2
Elfora Kombolcha	Yes	Yes	Knife	Electrical	Yes	No	No	Yes	Yes	Electrical saw	Yes	2
Mekelle	Yes	Yes	Hammer and Knife	Manual	Yes	No	Yes	No	No	Manual axe	No	2

Stunning boxes were available in each abattoir (Figure 2). The boxes were properly designed in all abattoirs except for Mekelle. However, in all abattoirs, boxes were not on use as cattle were not willing to enter in to the boxes (based on information from the workers). In all abattoirs, enervation method of stunning was practiced. This method was conducted by thrusting sharp knife to the atlanto-occipital space of the cattle (Figure 3).

There were no knife and axe sharpening machine in Adama and Hawasa abattoirs (Table 3). In these abattoirs, workers sharpen these equipments outside the abattoir by their own means. There were no means of sterilizing equipments in all abattoirs visited. Hot water was available during working time in all abattoirs except for Mekelle. Carcasses were manually quartered using axes in the public abattoirs while electrical saw was used in the private one. Vehicles to transport carcasses were available in all abattoirs visited (Table 3).

Inspection, recording, weighting and grading practices at public and private abattoirs are presented in Table 4. In all abattoirs visited, veterinarians inspect live animals some hours or a day before slaughter. Based on anti-mortem inspection, animals were accepted, condemned or remained for some more days of observation in the lairage. Similarly, there were good practices of inspecting carcasses in all abattoirs visited. However, recording of anti- and post mortem findings were regularly conducted only in Kombolcha abattoir. Moreover, this abattoir reports the causes of condemnations of live animals and carcasses every 3, 6 and 12 months to regional agricultural bureau. This practice of reporting causes of condemnations to responsible offices was not practiced by public abattoirs.

Weighing scale for live animals and carcasses were available only in Kombolcha abattoir. In this abattoir, live weight, carcass weight and meat yield were measured on daily basis. This facility was not available in the public abattoirs and hence there was no practice of recording live and carcass weight of cattle. Recording the origins of cattle was practiced by Hawasa abattoir. This experience was not available in other abattoirs visited. Classifying carcasses was not practiced in all abattoirs (Table 4).

Bleeding was conducted on the floor at all public abattoirs. In these abattoirs, evisceration was conducted on horizontal position on the floor by incising the hide at the bottom of the abdomen without flying the skin. At Kombocha abattoir, both bleeding and evisceration was conducted on vertical position after hoisting the carcasses (Figure 4).

Figure 1. Lairage: Elfora-Kombolcha(left), Adam (middle) and Hawassa (right).

Figure 2. Stunning box at Elfora-Kombolcha (left), Mekelle (middle) and Adama (right).

Table 4. Inspection, recording, weighting and grading practices at public and private abattoirs.

Abattoir	Anti- and postmortem inspection	Recording disease finding	Live and carcass weight	Record source of cattle	Report of causes of condemnation to regional office	Classification of carcasses
Adama	Yes	Occasional	No	No	No	No
Hawasa	Yes	Occasional	No	Yes	No	No
Kombolcha	Yes	Always	Yes	No	Yes	No
Mekelle	Yes	Occasional	No	No	No	No

Carcasses were hoisted using mechanized hoisting system in all except Mekelle abattoir where workers hoisted carcass manually using chained pulley system after flying the skin and evisceration on the floor (Table 3). The hides were flayed after hoisting the carcasses at Adama, Hawassa and Kombolcha abattoirs. In these abattoirs, carcasses were hoisted higher above the ground, creating less chance of contamination of carcasses by filth and blood on the floor. At Mekelle abattoir, carcasses were not raised high enough from the ground and they touch the floor during processing (Figure 5).

Carcasses were quartered immediately before being loaded on the vehicles. The distance between conveyer bar and the vehicle was 1 to 10 m. The distance between conveyer bar and the vehicle were relatively longer at Hawassa abattoir (about 10 m) and relatively shorter at Adama abattoir (about 1 m). Between the two points, workers transport carcasses on their shoulders. Carcasses were suspended in the vehicle to be transported to butcheries. In most cases, carcasses were touching the floor of the vehicle during transport (Figure 6).

Separate rooms from the carcasses were used to process rumen and intestine in all abattoirs. Bones, hoofs and hides were semi-processed for supply to respective companies in the private abattoirs while only hides were considered as valuable product in public abattoirs. Horns and hoof were wasted without being marketed in the latter abattoirs.

Wearing of protective clothes was practiced in both public and private abattoirs. However, at private abattoirs,

Figure 3. Stunning using sharp knife at atlanto-occipital space at Kombolcha (left) and Adama (right) abattoirs.

Figure 4. Sticking of cattle at Kombolcha (left) and Adama (right) abattoir.

workers wear clean protective clothes while those at public ones were not at the standard.

DISCUSSION

All food animals suffer from stress following transport. Therefore, it is important that lairage should provide comfortable environment to relief animals from stress. Among the abattoir visited during the study period, Adama and Elfora Kombolcha abattoirs have well designed lairage which are well ventilated and have accommodations for different classes and types of slaughter animals. The lairage in the other abattoirs were constructed as one to accommodate all classes and types of slaughtered cattle together. Lairages should be well ventilated and provided with adequate day and night lighting (Cortesi, 1994). Animals need to be separated based on their sex, ages and origin. Mixing different classes and types of animals are a source of physical and psychological stress (Gracey, 1981). In all abattoirs visited, there were no feeding troughs in the lairage. Watering trough was available only in the private abattoir. Well designed watering and feeding troughs should be placed along the walls of the lairage in adequate number (Cortesi, 1994). Drinking water must be constantly available throughout the waiting period till slaughter (Grandin, 2003). Feed must also be provided if slaughter does not take place within twelve hours (Ledger and Payne, 1990). Availability of water at all times in the lairage will make processing of rumen and intestine easier; it promotes proper bleeding and makes flaying very easy. At Kombolcha abattoir, slaughter cattle were required to pass at least 12 h in the lairage to make sure that they do not take any solid feed before slaughter. In the public abattoirs, animals reach abattoirs 2 to 3 h before slaughter. This makes it difficult to know whether cattle were starved for at least 12 h before slaughter. FAO (1991) specifies the withdrawal of feed for 12 to 24 h before slaughter. This will reduce the risk of contaminating the carcass with the gut content during evisceration, and reduce processing time and cost. Cattle were slaughtered in most public abattoirs during the night and early in the morning. This was to provide fresh meat early in the morning to the consumers.

For the health of the environment and community, abattoirs should be constructed outside residence. Large amounts of wastewater, solid waste, bad odor and fuel burning emission can be produced from processing operations which can affect the health of people living in the surrounding (DARD, 2009). However, two of the four abattoirs visited in the present study are located in the

Figure 5. Carcass processing at Mekelle (left), Kombolcha (middle) and Adama (right) abattoir.

Figure 6. Vehicle (left) and carcass suspended in the vehicle for transport to butcheries (middle and right).

community residence. Hence it is important to take strong treatment measures against by-products polluting the environment as relocating these abattoirs might require large financial resource. However, appropriate site selection for abattoir construction should be given primary importance in the future. Good manufacturing practice emphasizes the need to establish abattoirs outside the community residence (Thai Agricultural Standard, 2005).

Anti-mortem examination of animals and post mortem inspection of carcasses and organs were conducted in all abattoirs visited. However, the causes of condemnations were regularly recorded in the private abattoir. The record book in the public abattoirs revealed that there was no practice of daily recording on causes of condemnations of live cattle. Moreover, the private abattoir provides quarter, semi-annual and annual reports on causes of condemnations of live animals, carcasses and organs to regional Bureau of Agriculture. This practice was not observed at public abattoirs. All abattoirs should be able to report their finding to the responsible sector in the Ministry of Agriculture so that the latter body will develop integrated preventive and control strategy on major animal and public health important diseases.

Recording the origin of slaughter animals were not practiced in all but Hawassa abattoir. This experience must be shared by other abattoirs so that quality, yield and disease problems can be traced to the origin thereby taking appropriate measure to improve the situations. Slaughtering is a stressful process and hence must be efficient to minimize fear, excitement, pain or suffering of animals before slaughter. Unstressed animals before slaughter make slaughter operations easier and safer (Cortesi, 1994). However, what was practiced at the abattoirs in the present study was different from this reality. A group of cattle were allowed to enter into slaughter floor at a time. In this part of the slaughter house, they wait for their turn for stunning and sticking, watching all activities of slaughter. The stunning boxes in each abattoir were not in use as information from the workers revealed that cattle were not willing to enter into this box. The reasons for this must be sorted out and appropriate measure must be taken in the future. Cattle were stunned by workers by holding their horns and/or tying on any available poles. Stunning cattle without stunning boxes would compromise the safety of the worker. Moreover, it increases the level of stress on animals. Enervation method of stunning was practiced in all abattoirs. Enervation was reported the least effective methods of stunning known till date (Gracey, 1981). This method was reported to paralyse the animal but does not produce loss of consciousness, as blood supply to the brain does not stop (Leach, 1978). This method was banned from European community long ago. Efficient stunning methods are well defined in European Union (formerly Economic Community, EEC), Directive 74/577 (Council of Europe, 1974). According to this Directive, "stunning means a process effected by a mechanically operated instrument, electricity, or gas anesthesia without adverse effects on the condition of the meat or the offal,

which when applied to the animal puts it into a state of insensibility which lasts until it is slaughtered, thus sparing it in any event needless suffering." Similarly, for abattoirs in Ethiopia, stunning methods should be defined that minimize suffering of animals, maximize safety of workers and improve quality of meat product.

It is important that each abattoir should have its own sharpening machine and sterilizers to avoid the use of blunt knife and unhygienic equipments. Given the responsibility of sharpening knife for each worker will compromise the sharpness of the knife and hygiene of equipments. The knife that is used for slaughter purpose must be clean and sharp (FAO, 2004).

Even though proper equipment for hanging carcasses was found in each abattoir, it was not properly used. Proper equipment for handling carcasses includes manual or electric hoists for lifting up the carcass – getting it off the floor for flaying, eviscerating and splitting (FAO, 2008). In all public abattoirs, bleeding was conducted on the floor on horizontal position. Even though horizontal bleeding promotes faster bleeding rates (RMAA, 2011), it is not as hygienic as vertical bleeding. Moreover, in the pubic abattoirs evisceration was made on the filthy floor without flying the skin. This might expose carcasses for contamination by blood and mud from the skin. At one of the public abattoirs, it was observed that flaying of the skin was conducted on the floor. This would further contaminate the carcasses and compromise the quality of meat. This might be the reason for poor quality of beef reported at local markets in Ethiopia (Kumar et al., 2010).

At public abattoirs, workers transported carcasses from conveyer bar to the vehicle on their shoulders. They used plastic gowns which covered their head and their back. However, the hygienic condition of these clothing was not up to the standard required for abattoir personnel. Personnel at the abattoirs did not wear clean aprons, clothing, boots, mesh gloves and hair caps during meat processing. This might be the reason for high aerobic plate count (APC) in beef sold at local markets in Ethiopia (Kumar et al., 2010). For good hygienic practices and production of high quality meat, workers should ensure their hands are always clean, and also wear clean protective clothing to cover both their body and hair.

During transporting of carcasses to butchery, quartered carcasses were suspended in the vehicle from touching the floor of the vehicle. The rumen, intestines and head were placed on the floor under suspended carcasses. This might further increase the chance of microbial contamination due to the contact between carcasses and organs.

The tendency to pay beef producers based on carcass yield and quality traits is increasing (Lazzaroni, 2007). Hence it is important to measure the live weight, carcass weight and evaluate quality of beef slaughtered in each abattoir. The absence of weighing scale in all public abattoirs needs considerable attention. Live and carcass weight of cattle slaughtered in public abattoirs should be identified. Beef carcass classification system developed by the country (ES, 2012) must be implemented in each abattoir. Implementing this program will help identify the quality and yield problems of beef in the country and develop improvement strategy in the future.

A country like South Africa has developed legislations governing abattoir operations which includes; The Meat Act, 2000, and the Animal Protection Act, 1962 and 1935 for Animal Welfare Maintenance (RMAA, 2011). This kind of legislation should be developed for public and private abattoirs in Ethiopia to ensure public health safety, welfare of animals, maximize efficiency and quality of meat. Hazard analysis critical control points (HACCP) system is strongly recommended in all abattoirs. By regularly reporting measurements of critical control points (CCPs), various critical operations that are carried out by workers, handling and slaughtering of animals can be monitored to ensure that they are done properly, leading to steady improvements in welfare and operational quality. Monitoring and evaluation of the CCPs should be conducted on a regular basis (FAO, 2004).

CONCLUSION AND RECOMMENDATIONS

Management practiced in public and private abattoirs can partly contribute to the poor quality beef. Hence it is important that the country should develop legislation governing abattoirs operation. Moreover, hazard analysis critical control points (HACCP) should be established in all abattoirs to maintain welfare of animals, maximum efficiency and quality of beef.

ETHICAL APPROVAL

Permission was obtained from Ethical Committee of University of Pretoria to carry out the present study.

Conflict of Interest

The authors declare that there is no conflict of interest between authors and organizations.

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