Perceptions of rural consumers on behaviour and beef quality of cattle slaughtered for traditional ceremonies in the Eastern Cape of South Africa

By

Sizwe William SOGA

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Supervised by:

Prof. Voster Muchenje

Dr. Peter Olutope Fayemi

Declaration

I, Soga Sizwe William, declare that this dissertation has not been submitted to any University and that it is my original work conducted under the supervision of Professor V. Muchenje and Dr. P.O. Fayemi. All assistance towards the production of this work and all the references contained herein have been duly accredited.

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Soga Sizwe William **Date**

Approved as to style and content by:

Prof. V. Muchenje (Supervisor) **Dr. P.O. Fayemi (Co-Supervisor)**

January 2014

Abstract

Perceptions of rural consumers on behaviour and beef quality of cattle slaughtered for traditional ceremonies in the Eastern Cape Province of South Africa

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Sizwe William SOGA

The objective of the study was to determine perceptions of the consumers on how they judged behaviour and beef quality of cattle slaughtered for traditional ceremonies in the Eastern Cape Province of South Africa. A survey was conducted where a sample of 200 consumers were randomly selected and interviewed. Fifty non-descript cattle were slaughtered during traditional ceremonies and two hundred and twenty four (224) cattle were slaughtered at 3 through-put abattoirs (high, medium and low). Meat quality attributes were determined from the cattle slaughtered for traditional ceremonies and from cattle slaughtered at the abattoirs. Data for questionnaires was summarized as frequencies for each ceremony and statistical differences were analysed using chi square test (X^2). The effect of Age, breed and sex on beef pH, colour, meat tenderness, temperature and cooking loss of cattle slaughtered during traditional ceremonies, at low, medium and high throughput abattoirs were analyzed using General Linear Model (PROG GLM) of SAS (2003).

There was a significant age effect ($P < 0.05$) on beef tenderness and cooking loss of cattle slaughtered for traditional ceremonies. Age of cattle that have milk teeth to 1 year and age of 6 years to 8 years had an effect on the beef tenderness (25.55 ± 8.05) and cooking loss (48.00 ± 4.26) of cattle slaughtered for traditional ceremonies in Table 4.1. There was no significant sex effect on beef tenderness and cooking loss of cattle slaughtered for traditional ceremonies. Non-descript and Angus cattle slaughtered at low throughput abattoir had an effect on the colour of the beef in Table 4.2. The lightness (27.49 ± 2.53) and yellowness

(21.16 ± 0.79) of the beef shows that there was a significant breed effect on cattle that are slaughtered at Low throughput abattoir, however redness of the meat was not affected by breed after slaughter. Cattle that are slaughtered at high throughput abattoir between ages of 6 to 8 years and also cattle that are more than 8 years in Table 4.4 had an effect on cooking loss ($p < 0.05$). Age between 6 to 8 years had an effect on the beef tenderness from cattle that are slaughtered at medium throughput abattoir. It was concluded that the meat tenderness of the young cattle with milk teeth slaughtered for traditional ceremonies was affected. On the other hand the meat tenderness and cooking loss of beef from the cattle slaughtered from low, medium and high throughput abattoir were affected by sex and breed mostly.

Key words: Cattle behaviour, consumers' perception, meat quality, slaughter techniques, traditional ceremonies

List of abbreviations

pH – Ultimate pH

L* - Lightness

a* - Redness

b* - Yellowness

CL% - Cooking Loss percentage

WBSF – Warner Braztler Shear Force

SAS Statistical Analysis System

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Chapter 1 Introduction

1.1 Background

Perception is defined as a process in which individuals select, organise and interpret the information using appropriate body stimuli (Novak, 2011). Perceptions of meat by the consumers are determined by its quality. Factors such as appearance, juiciness, tenderness, colour, cooking loss and pH all influence the consumers' decision to consume the meat (Vimiso, 2010). Beef is one of the widely consumed protein source during traditional ceremonies. Hence, the welfare of farm cattle is a hot topic till today because it affects the output in terms of quality and quantity of production. Even though studies have been conducted around this topic, much research focused on animal welfare in terms of environment and pre-slaughter conditions such as transportation, lairage and animal behaviour. Nowadays with an increasing world population, increasing traditional ceremonies and demand for animal-derived protein puts pressure on animal production to meet this demand (Koknaroglu and Akunal, 2013). For example, in traditional ceremonies, consumers are concerned about the motive behind slaughtering the cattle ignoring animal welfare implications on the cattle. However, according to Fayemi and Muchenje (2012), the traditional proceedings of animal slaughter in Africa always give impression that shows traditional slaughter method as cruel. So far, the knowledge gap on the meat quality traits from traditionally slaughtered animals has not been filled in the continent.

The traditional slaughter is mostly practiced by Islamic, Xhosas, Zulus, Suthus, Jews, and others when conducting traditional ceremonies such as at funerals (*Umngcwabo*), circumcision (*Ulwaluko*) and during weddings (*Umtshato*) especially in the South African culture (Mnguni, 2006). In the Eastern Cape Province of South Africa the traditional slaughter of cattle is conducted in a man-made kraal where the animals are kept. Consumers believe that the blessings from the ancestors are normally found when the families conduct their traditional ceremonies in the kraal. In addition cattle, goats or sheep are slaughtered to please the ancestors or ask them for the blessings.

According to Mnguni (2006) during traditional slaughtering in the Zulu culture, such as at funerals (*Umngcwabo*) and at weddings (*Umtshato*), a group of people surrounds the animal (usually a bull/castrated bull) to be slaughtered in its visual field and cattle are slaughtered in the kraal without stunning or appropriate handling. The animal is then stabbed using a spear and the animal is not expected to be killed instantly to encourage multiple stabbing (Mnguni, 2006), thus, raising animal welfare concerns due to pain caused by frequent stabbing and not rendering the animal unconscious before slaughtering. Slaughtering without stunning is associated with stress of restraint, pain of the cut and undue distress whilst the animal is bleeding out (Gregory, 2005). Grandin (2000) reported that throat-cutting without stunning does not induce instantaneous unconsciousness. It was argued that in some cattle, consciousness is prolonged for over 60 seconds due to many factors such as age, sex, breed and method used to slaughter the animal. Also some in cattle, the immediate collapse can be induced in over 95% of cattle if the ritual slaughter makes a rapid, deep cut close to the jawbone (Grandin, 2000). Hence the way the cattle respond due to the slaughter methods during traditional slaughter processes differs.

1.2 Problem statement

Cattle are the major animals that are slaughtered during traditional ceremonies in South Africa especially in the Eastern Cape Province (Behrens, 2008). During traditional ceremonies, cattle are slaughtered without stunning. It was reported that the throat cutting without stunning does not induce unconsciousness (Grandin, 2000) hence most of the time the cattle slaughtered without stunning takes long time to lose consciousness. The animal that takes longer time to lose consciousness normally the meat quality is affected negatively. A question is raised, “what do consumers perceive when the cattle are slaughtered without stunning during the traditional ceremonies”? Research on the perceptions of rural consumers on behaviour and beef quality of cattle slaughtered for traditional ceremonies are part of relevant approaches towards addressing this issue.

1.3 Justification

Information on traditional slaughter and processes is limited because most issues to do with traditional ceremonies tend to be a closely protected secret by the elders. It should be borne in mind that the quality of meat is adversely affected by poor slaughter processes when the cattle are slaughtered for traditional ceremonies. According to Fayemi and Muchenje (2012) little research has been conducted on the meat quality traits from the cattle slaughtered for traditional ceremonies in South Africa and have not been filled in the continent. The law enforcement that accommodates the traditional ceremonies processes will benefit consumer on better methods of slaughtering the cattle to minimize stress and also without adversely affecting the quality of the meat and their norms during traditional ceremonies. This research will also bring better understanding to the consumers about the animal behaviour which will also assist them to improve their understanding on better approach to slaughter the cattle for their ceremonies. The study will give better understanding and insight to the researchers as to why the communal ceremonies are so important to the community members or consumers. It is similarly anticipated that this study will widen the consumers’ knowledge and experience that may lead to be practiced and be used on how to link the indigenous knowledge skills with modern knowledge without undermining each other’s view.

1.4 Objectives

The broad objective of the study was to determine the perception of the consumers on how they judge the behaviour and beef quality of cattle slaughtered during traditional ceremonies and at different abattoirs of the Eastern Cape Province of South Africa.

Specific objectives were to:

1. Determine the perceptions of consumers on the slaughter processes of cattle for different traditional ceremonies.
2. Determine the influence of sex, breed and age of cattle slaughtered for traditional ceremonies and at conventional abattoirs on the meat quality attributes.

1.5 References

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Chapter 2 Literature review

2.1 Introduction

The welfare of slaughter animals is a major concern to many meat consumers and producers (Vanhonacker *et al.,* 2008) and has become a priority in many European countries (European Commission, 2006). A report on intensive study of traditions in South Africa, by Wiredu (1987) showed that the animals are slaughtered during traditional ceremonies to communicate with God through the ancestors. During traditional ceremonies in Eastern Cape of South Africa the animals are slaughter without stunning. The aim of stunning is to make the animal unconscious as soon as possible so as to prevent pain and suffering dung the killing process (EU Council Directive 93/119, 1993; Ministry of Agriculture, Fisheries and Food, 1995; Gregory, 2005; RMAA, 2011). The pains during slaughter processes affect the quality of meat (Muchenje *et al.,* 2009a). Although it is difficult to define the quality of meat, what is certain is that the physical and chemical components of meat such as colour, pH, cooking loss and tenderness are used to determine the meat quality (Muchenje *et al.,* 2009b). This chapter reviews the consumers' perception on the welfare of the cattle during slaughter processes for different traditional ceremonies.

2.2 Consumers perception on animal welfare

In general, perception is an opinion of something viewed by an individual or the community. The perception of the consumers to the animal welfare is influenced by many factors, with consumers being more interested in traditional activities, economic and financial issues and need to make a living (Dyubele *et al.,* 2010; Troy and Kerry, 2010; Vimiso *et al.,* 2012). In European Countries, the issue of animal welfare is highly recognized (Martelli, 2009). In the internet consultation carried out by the European Commission in 2006, consumers were asked to list those factors they considered very important for animal welfare and protection

(European Commission, 2006). Those factors that were important for slaughtering the animals were: Humane transport, present of trained staff and humane slaughtering. In addition, slaughtering the animals without stunning during traditional ceremonies also affects the welfare of the animals (Grandin, 2010; Wiredu, 1987).

2.3 Consumers perception on the quality of beef slaughtered for traditional ceremonies

In Eastern Cape of South Africa, the consumers during slaughter of cattle for traditional ceremonies, tightly tie all the legs together just below the abdomen region, such that the knot exert pressure on the abdomen in order to facilitate the rapid release of blood following slitting without stunning. According to Gregory (2005) slaughtering without stunning is associated with stress of restraint, pain of the cut and undue distress whilst the animal is bleeding out. Bruises also occur which may result to dark, firm and dry meat and also pale coloured meat (Grandin, 2000a). These may not only impart on the mental well-being of cattle and cause pain to the animal, but may reduce consumer acceptability of beef produced from abused animal. However through the observations that was done during data collection, the consumers during traditional ceremonies tend to enjoy eating meat from cattle slaughtered for traditional ceremonies ignoring the welfare of the cattle at slaughter plant. Severity welfare procedures, such as during traditional slaughter for traditional ceremonies, may influence the ability of meat biochemical components to fall below or above the appropriate threshold levels, thereby compromising the beef quality traits of economic importance, such as colour, juiciness, tenderness, flavour and shelf life (Lawrie and Ledward, 2006). Hence it is important for the consumers to understand the behaviour of cattle so that stress can be reduced from rearing up to the time of slaughter (Grandin, 2006; Gregory, 2008).

2.4 Traditional Slaughter (Slaughter without stunning)

Slaughtering of meat animals using traditional method has come under spotlight and has caused much controversy recently (Anil *et al.,* 2006).This method of slaughtering cattle without stunning causes gradual loss of consciousness because the blood normally lead to deficiencies of nutrition and oxygen in the brain (Muchenje *et al.,* 2009b) since the animals are slaughtered through the throat and resulting to the destruction of oxygen to the brain and also cell, these reports provide scientific evidence to suggest pain after slaughter without stunning (Anil *et al.,* 2006). In contrast, Rosen (2004) claimed that Shechita cut is painless because the cut is made with a very sharp knife and no pain can be possible because brain function is lost immediately. Another concern on animal welfare is aspiration of blood into the lungs while the animal is still sensible. In cattle slaughtered without stunning, this varied from 36% to 69% of the cattle (Gregory *et al.,* 2008). To improve animal welfare, some religious authorities may accept stunning immediately before the throat cut. Based on the observations where stunning is not allowed, Grandin (2001) recommended that the practice accepted to stun animals before throat cut as is the case in some religious ceremonies should be used to improve animal welfare during slaughter.

2.5 Stunning method

Stunning is to render an animal unconscious before exsanguination to prevent suffering from pains (Gregory, 1998). Stunning can be done using different types of methods for different species. There is captive bolt, electrical stunning and carbon dioxide gas stunning. Captive bolt method or a retractable pistol is a stunning device used mostly in cattle or heavy male pigs prior to slaughter (Gregory *et al.,* 2008). Many abattoirs use this method in cattle, and less frequently in sheep. When the captive bolt is used effectively, it renders the animal unconscious immediately until death without any recovery. This method also helps to maintain the welfare of the animal (Anil *et al.*, 2006). According to Coore *et al.* (2005), the effectiveness of the captive bolt stunning is assessed by the absence of corneal reflex (through physical stimulation of the eyeball), spontaneous blinking (without physical stimulation), eye ball rotation (the pupil/pupils are partly or completely hidden), rhythmic breathing (repeated inhaling/exhaling in a rhythmic fashion) and righting reflex (arched back righting reflex with the head bent straight back). Electrical stunning works by producing brain dysfunction and unconsciousness with or without subsequent killing by cardiac stop so that bleed out is carried out (Anil *et al.*, 1997). Effective electrical stunning produces immediate onset of tonic seizure followed by clonic seizure. During this period, rhythmic breathing, righting reflex and vocalisations are also absent (Velarde and Dalmau, 2012). All these methods are proven to be the proper approach before slaughtering the animal. According to Anil and McKinstry (1998) and Lambooij *et al*. (1997), the most common electrical stunning method for animals uses a frequency of 50 Hz alternating current (AC.). This method of stunning is normally used to stun sheep and pigs.

2.6 Behaviour of consumers and cattle during slaughter processes for traditional ceremonies

During traditional ceremonies, human-animal interactions involve constant penetration of animal flight zones, use of sticks and goads in driving animals, restraint, feed deprivation, noise, agitation, ululating, shouting and passing angry vocals to the animals when moving them in the required direction or when expressing some traditional sentiments (Mnguni, 2006; Gregory, 2007). In some countries, the cattle is restrained, its neck or horns are tied on the tree, and then blood is let out by cutting on the neck in the halal way following by hitting the cow on the back of the head with a sharp axe (Fratkin, 2001).

Observations on the behaviour of cattle during traditional slaughter indicate that calm cattle lose sensibility and collapse more quickly than cattle with visible signs of agitation. Cattle that fight restraint are more likely to have prolonged sensibility; gentle operation of restraint devices facilitates rapid loss of sensibility (Ross *et al.,* 2004). The most common problem in restraining animals involves applying excessive pressure to the body. If more than 5% of cattle vocalize or struggle in the restrain device, it is either poorly designed or it is operated too roughly (Ndou *et al.,* 2011). Cattle vocalizes more when they are inverted onto their backs for ritual slaughter as compared when they are held in a restrainer that keep the animals upright position. According to Dunn (1999), restraint devices must be operated correctly in order to provide the best possible animal welfare.

2.6.1 Cattle vocalization

Previous research by Grandin (1998) indicated that 99% of the cattle vocalizations during handling and stunning in a commercial slaughter plant are associated with observable aversive events where cattle during loading and offloading to the abattoir are stimulated with an electric prod (goad), missed stuns, slipping in the stun box or excessive pressure from a restraint device. Studies of both cattle and pigs indicate that increased vocalization is correlated with physiological indicators of stress (Grandin, 2001). South African traditional slaughtering method involves stabbing of the animal on the stomach by using a spear and then forcing the animal to vocalize and move some distance (Grandin, 2002; Behrens, 2008). The objective of stubbing the cattle on the stomach is to allow the animal to vocalize before cutting the throat to prove that the ancestors agreed to conduct the ceremony. According to Grandin (1998), previous observations indicate that distractions such as seeing moving people up ahead, sparkling reactions, shiny metal that jiggles or air blowing into the faces of approaching cattle will often cause them to balk and back up, hence this promote unnecessary stress for the animal and the chances of vocalization are high (Bourguet *et al.,* 2011).

2.6.2 Duration to lose consciousness after exsanguination

Cattle take longer to lose sensibility after slaughter without stunning compared to sheep (Gibson *et al.,* 2009). Sheep lose sensibility within an average time of 2 to 14 seconds with good cutting technique (Gibson *et al.,* 2009). In cattle, some animals may take more than a minute to lose sensibility (von Wenzlawowicz *et al.*, 2010). Correct techniques of slaughter normally shorten the time required for cattle to collapse after the exsanguination. Collapse is the initial indicator of onset of insensibility (Von Holleben *et al.,* 2010). When a poor technique was used, only 68% of the cattle collapsed within 30 seconds while a good technique increased the percentage of cattle that collapsed within 30 seconds to over 90% (Grandin, 2001). Gregory (2010) reported similar results where 88% of the cattle collapsed within 30 seconds. It is possible that loss of sensibility may not be complete after the initial collapse (Gregory, 2010). Cattle lose sensibility more quickly if they enter the restraint box calmly and are cut immediately after the head is restrained with a swift knife stroke (Grandin, 2002). Releasing body and head restraints immediately after the cut also facilitates more rapid collapse. Therefore it is vital to follow the correct procedures before slaughtering the animal to improve animal welfare and the quality of meat.

2.7 Meat Quality characteristics

Meat is a valuable source of protein, vitamin and minerals and has a relatively low fat content. The quality of meat is a challenging concept that can be retrieved from different points of views. It is determined by using biochemical, physical, chemical and bacteriological processes (Waskar *et al.,* 2009). Meat quality is a combination of microbiological, nutritional, technological and organoleptic components. The important visual traits on meat quality include; colour and texture, fat colour, amount and distribution of fat as well as the absence of excess water (purge) in the tray (Warner *et al.,* 2005). Moreover, the term "quality" of carcasses has different meanings depending on local customs in different countries of the world (Prieto *et al.*, 2010). Hence, it is important to learn more about the collection "quality" to investigate individual components of meat quality such as visual aspects (e.g. the colour of lean) or eating quality (tenderness, flavour, aroma), which in turn are affected by intramuscular fat and fatty acid composition (Aaslyng, 2009).

2.7.1 Meat tenderness

Tenderness is a primary factor determining customer satisfaction of beef. According to Koohmaraie *et al.* (2002), Tenderness is one of most important component of consuming quality of meat and that differences in tenderness affect the decision to re-purchase. Meat tenderness depends upon the rate and degree of the chemical and physical changes in alteration of the muscle to meat. After the animal is slaughtered, there is no source of oxygen or nutrients being supplied to the muscles. Thus, the muscle run out of energy and begins to contract and become stiff (rigor mortis). Eventually the muscle will relax and cause the meat to be tender when cooked (Muchenje *et al.,* 2009b).

Cattle that struggle during slaughter processes normally experience high level of stress. The stress levels burns up their energy quicker and causes rigor mortis which later increases toughness of the meat (Fletcher, 2002). Swanek *et al.* (2009) reported that the levels of tenderness in beef were high after the animals have supplemented. The improved tenderness could be attributed to the tenderizing effect of vitamin E when supplemented to animals (Ali and Zahran, 2010). Vitamin E actively improves immunity in beef and other species, and protects against rancidity and prolongs shelf-life of meat through its antioxidatives (Li *et al.,* 2009). Hence supplementation of the animals before slaughter is important so as to improve meat tenderness and other meat attributes.

2.7.2 Cooking loss

Cooking loss refers to the reduction in weight of meat during the cooking process. The time taken to cook meat, temperatures and also heating method define the cooking procedure (Jama *et al.,* 2008). Major components of cooking losses are thawing, dripping and evaporation. Thawing refers to the loss of fluid in meat resulting from the formation of exudates following freezing and thawing (Jama *et al.,* 2008; Muchenje *et al.,* 2009b). Dripping is the loss of fluid from meat and water evaporation from the shrinkage of muscle proteins (Yu *et al.,* 2005). Cooking loss in meat cuts is important for maintaining an attractive retail display of meat. Asghar *et al.* (1991) reported that less drip loss from thawed meat chops obtained from pigs supplemented with vitamin E. High cooking loss in meat has a large financial impact in meat industry. For example, meat and their products are a rich source of proteins, essential minerals and vitamins. The increased loss of such nutrients deteriorates the meat nutritional quality and lowers its purchase (Jama *et al.,* 2008).

2.7.3 Meat pH and Colour

As soon as an animal is slaughtered, the muscles are converted to meat through a number of successive metabolic and structural processes that occur at cellular level *post-mortem*. Changes that occur in the muscle *post-mortem* can be determined by measuring the level of pH, colour and temperature of any given carcass (Deiss *et al.,* 2009). A high ultimate pH is generally indicative of stress in animals (Dhanda *et al.,* 2003; Muchenje *et al.,* 2009a). Most starting events that many animals experience prior slaughter include physical force during restrain and change of the environment (Hemsworth and Coleman, 1998). Naturally most animals often perceive contact with human being as predators (Veissier *et al.,* 2012). However, it has been established by many authors that muscle colour is highly correlated with muscle pH (Page *et al.,* 2001; Muchenje *et al.*, 2009a). Colour of the meat is one of the most important factors considered by consumers when selecting and making decision to purchase meat products. This is because colour is the first attribute seen by consumers and is an indication of the freshness of the meat (Muchenje *et al.,* 2009b; Troy and Kerry, 2010; Muchenje and Ndou, 2012).

2.8 Summary

Animal welfare and its influence on beef production are major considerations in many developed countries. In the developing countries and villages, where food insecurity and poverty are dominating, the welfare of animals receives low priority due to factors such as traditional ceremonies and beliefs, lack of knowledge in animal handling and slaughter for traditional ceremonies. Consumers' perception on the slaughter processes of cattle for traditional ceremonies is important for animal welfare and the quality of meat. However the methods of handling the cattle during slaughter processes are also important. Most abattoirs use the efficient equipment to restraint the animal and captive bolt stunning method prior slaughtering cattle. This method assists to improve the quality of meat and the welfare of cattle. Meat quality attributes such as meat tenderness and cooking loss are important and can be controlled during handling and slaughter processes. Research indicates that, in South Africa cattle that are slaughtered for traditional ceremonies are not stunned before slaughtered. The consumers use different method of slaughter depending on the nature of the ceremony. Hence the animal welfare and meat quality is affected.

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Chapter 3: Perceptions of consumers on the behaviour and welfare of cattle during different traditional ceremonies.

By

Soga Sizwe William

Abstract

The objective of the current study was to investigate consumers' perceptions on the behaviour and welfare of cattle during slaughter processes of cattle for different traditional ceremonies. Questionnaires were administered to a total of 200 consumers in Lukhanji local municipality of the Eastern Cape Province, South Africa. Data was summarised as frequencies for each ceremony and statistical difference were analyzed using chi square test (X^2) of SAS package (2003). Associations were tested between age-group, gender, education, employment status, source of income; traditional slaughter methods and traditional ceremonies involving the slaughter of cattle for traditional ceremonies. It was found that the demographic factors have an influence on the slaughter of cattle for different traditional ceremonies. Due to the restraining techniques, slaughter method and the presence of the consumers during traditional slaughter processes, the animals tend to experience high level of stress. Hence the animal welfare is affected. However, based on the perception of the consumers, it can be concluded that most consumers are of the opinion that they would be interested in consuming beef from cattle that are restrained and slaughtered in accordance to their traditional beliefs.

Key words: Perception; traditional ceremonies, traditional slaughter, cattle

3.1 Introduction

The Eastern Cape Province of South Africa has about 3.1 million beef cattle of which, 65% comes from the communal and 35% from the commercial sector (Mapiye *et al.,* 2009). Cattle play numerous objectives that meet multiple needs of the resource-poor communal farmers. These objectives include provision of draught power, manure, cash sales, among other socio-economic functions such as traditional ceremonies (Bayer *et al.,* 2004; Chimonyo *et al.,* 1999; Mapiye *et al.,* 2009). Traditional ceremonies are the activities that are performed by slaughtering cattle such as in funerals (*Umngcwabo*), circumcision (*Ulwaluko*) and at weddings (*Imitshato*). During all these ceremonies the consumers are conforming to their norms/tradition and value system (Ndou *et al.,* 2011).

During traditional ceremonies, the cattle are slaughtered by stabbing on the stomach using a spear before throat cutting and then forcing the animal to move some distance (Ndou *et al.,* 2011). The purpose of stabbing of the cattle on the stomach is to allow it to vocalize before cutting the throat to prove that the ancestors have agreed to conduct the ceremony. Furthermore, the consumers believed that the ancestors are the mediators between God and the living, they are also believed to be overlooking and taking care of the living, participating in the active lives of the living. Hence, the practice the slaughtering of animals which is symbolic of the relationship that people have with the ancestors (Behrens, 2008).

During traditional ceremonies in most communal areas, where food insecurity and poverty are prevalent, the welfare of animals receives low priority due to lack of knowledge in animal handling, traditional customs and beliefs, sub-standard handling facilities and failure of government legislation (Veissier *et al.,* 2008). Also the welfare of the animal involves investigating the relationship of the animals with their physical environment as well as with other organisms such as their interaction with humans. Poor environmental conditions may lead to stress that can be exhibited in the form of abnormal behaviour. Animals that are experiencing pain, fear, discomfort, thirst and hunger in a certain environment exhibit abnormal behaviour (Dodzi & Muchenje, 2011). A combination of both behavioural and physiological measures has been used to assess animal welfare (Broom, 1991).

During traditional slaughter processes depending on the handling techniques and slaughter methods or system used, affects the welfare of the animal (Grandin, 1991; Muchenje *et al.*, 2009a). For instance, when the cattle are slaughtered without stunning during any traditional ceremonies, more force is required to restrain the animal, since the cattle try to protect it-self from being injured or killed. There are various methods of slaughtering the cattle for different traditional ceremonies depending on the culture and type of ceremony. The purpose of using different slaughter methods is to make sure that the animal may feel more pain so that it can bellow before it losses consciousness (Behrens, 2008).

There are many factors that affect the consumers and animal interaction during the slaughter process of the cattle for traditional ceremonies. The behaviour of cattle especially in communal areas during traditional ceremonies is affected by lack of knowledge, experience and understanding of animal welfare. According to Coetzee (2004), the poor transfer of knowledge, skills and information is manifested by limited interaction of the consumers with livestock specialists due to many factors such as poor road networks and resources. Research has been done on consumer perception on meat quality (Klaus *et al.*, 2004), animal welfare and meat quality (Chulayo *et al.*, 2012), slaughter methods of cattle and how traditional slaughter methods affect animal welfare and quality of meat (Fayemi and Muchenje, 2012). However, there is knowledge gap regarding the perception of consumers on the welfare and slaughter of cattle for traditional purposes during the ceremonies. The objective of the study was to determine the perceptions of consumers on the slaughter processes of cattle for different traditional ceremonies.

3.2 Materials and Method

3.2.1 Selection of the Study Area

The study was conducted at Mceula village. The geographic region defining the study area extends from 32° 05'S; 26° 40' E to 32° 08' S; 26° 43' E being part of the Hewu District of the Northern region of the former Ciskei which is now part of the Eastern Cape Province (Acocks' 1988). The area was selected based on the great history and incidence of high rate of traditional ceremonies and also slaughtering animals. The Mceula village lies due northwest of Whittlesea and west of Queenstown. It is bounded by Kamastone to the north, the Hukuwa River to the south and Poplar Grove to the east. Mceula is made up of four individual villages, namely; Xaleni, KwaManzikrakra, Maqulomba and White City. The soils of this village have been described by Acocks' (1988). The distance from one village to the next village ranges from two to four kilometres. The climatic conditions of Mceula Village are modified mainly by the topography. Rainfall varies from year to year with an annual average of 500 mm in the grassland and Thornveld area, while an annual average of 800 mm is observed in the mountainous area. The average temperature is about 22^0 C, with an average summer maximum temperature of about 25^0 C, and minimum of 17^0 C.

3.2.2 Sampling Procedure and data collection

Random selection and interviews were done in household to respondents who owned cattle and were willing to participate in the study. During the data collection process, the participants were given a consent form which signified the reason as well as the confidentiality of the study.

Structured questionnaires were administered to a total of 200 consumers between June and July 2012. Interviews were conducted at the consumers' homesteads and community halls. Respondents were household heads and in the absence of household heads, any member of the household was interviewed. The interviews were conducted in the vernacular Xhosa language by trained enumerators. Some of the enumerators were selected from among the school leavers from each community to promote cooperation of community members as well as to get more information about the communities. The questionnaire consisted of both open-ended and closed questions, in order to improve the quality of data collected. Open-ended questions gave the respondents greater freedom of expression as they offered respondents an opportunity to answer and thus reducing bias to unlimited response ranges. The questionnaire collected a range of information such as consumers' socio-demographic information, resources availability, cattle ownership, traditional ceremonies were captured. The photo shoot was taken during the slaughter of the cattle for the traditional ceremony.

3.2.3 Data analysis

Data was summarised as frequencies for each ceremony and statistical difference were analysed using chi square test (X^2) of SAS package (2003). Associations were tested between age-group, gender, education, employment status, source of income; traditions slaughter methods and traditional ceremonies involving the slaughter of cattle the factors that affect the slaughter of cattle for traditional ceremonies.

3.3 Results

3.3.1 Consumer demography and characteristics

Most households interviewed were male headed (63%) and just a few were female headed (37%). Marital status of household head was summarised whereby married people were dominating (62.5%), followed by singles (19.5%), widowed (17%) and lastly divorced people (1%). The majority of the interviewed consumers had at least primary (40%) and high/secondary school education (43%). However more effort is still needed in tertiary since their level was (10%) and those with no school was less than (7%). The number of household heads that were not employed in the village was high (76.5%), followed by professional employment (21%), part-time employment, farm and informal employment was less than (5%). Respondents who believed in Christianity had the highest number of cattle for milk and income (83.5%) than traditional believers (11.5%).

Table 3.1 Demographic characteristics of consumers interviewed under Lukhanji Municipality

CHARACTERISTICS	FREQUENCY	PERCENTAGE (%)
Gender		
Male	126	63
Female	74	37
Marital Status		
Single	39	19.5
Married	125	62.5
Divorced	2	1
Widowed	34	17
Level of Education		
No education	14	7
Primary school	80	40
Secondary school	86	43
Tertiary school	20	10
Occupation		
No employment	153	76.5
Professional employment	42	21
Part-time employment	2	1
Informal employment	3	1.5
Christianity		
Christians	167	83.5
Traditions	33	16.5

3.3.2 Perceptions of consumers on the slaughter methods for traditional ceremonies

The four different types of slaughter methods differ in terms of how the cattle are normally slaughtered for different types of traditional ceremonies. 44% of the consumers reported that Sotho people restrain their cattle using physical power and rope, stabbing the cattle on the stomach using spear and followed by slaughtering on the first cervical vertebra using knife. 26% of consumers perceived that Xhosa people retrain four legs of the cattle in front of the abdomen and slaughter their cattle the same way with Sotho people but not stabbing the cattle on the stomach. A total of 4.5% of consumers perceived that Christians restrain the cattle the same way as Xhosa people but they cut the throat transversally with a knife during slaughter processes. A total of 25.5% of consumers reported that Sangoma people restrain four legs the cattle in front of the abdomen by using physical power and rope, stabbing the cattle on the stomach by using spear, followed by slaughtering the throat transversally using knife indicated in Table 3.2. The slaughter methods are illustrated in Figure 3.1 to 3.3.

Table 3. 2 Consumers' perception on the traditional slaughter techniques for different traditional ceremonies

Groups	Tradition	Slaughter methods	Frequencies	%
1	Traditional method (Sotho people)	Restrain the cattle on three legs using physical power and rope, stabbing of the animal on the stomach by using a spear, followed by slaughtering on the first cervical vertebra using knife	88	44
2	Traditional method (Xhosa people)	Restrain four legs of the cattle by using physical power and rope, slaughtering on the first cervical vertebra using knife without stabbing stomach	52	26
3	Traditional and Christians	Restrain four legs of the cattle by using physical power and rope, cut the throat transversally with the use of knife	9	4.5
4	Traditional method (Sangoma)	Restrain the cattle on four legs using physical power and rope, stabbing of the animal on the stomach by using a spear, followed by slaughtering the throat transversally using knife	51	25.5

Figure: 3. 1 shows the cattle stabbing on the stomach for the traditional ceremony of Sotho people

Figure: 3. 2 Method used to restrain cattle for traditional ceremony of Xhosa people

Figure: 3. 3 Slaughter method on the first cervical vertebra for the traditional ceremony of Sotho or Xhosa people

3.3.3 The effect of consumers' age-groups on the perceptions of the slaughter of cattle for traditional ceremonies

There was no significant effect ($p>0.05$) between the consumers aged 21-24 on their perception of the slaughter of cattle for traditional ceremonies. This indicates that the opinion of consumers on the perception of slaughter of the cattle for traditional ceremonies were the same between age of 21-24. There was a significant difference ($p<0.05$), between the consumers aged from 41 until the age of 100 on the perception of slaughtering the cattle for traditional ceremonies. That means the opinions of consumers aged between 41 until 100 were different on the perception of slaughtering the cattle for traditional ceremonies.

Table 3.3 Consumers' age-groups on the perceptions of the slaughter of cattle for traditional ceremonies

Age-groups of consumers (years)	Chi square values (p-value)
21-40	0.094
41-60	0.048
61-80	0.011
81-100	0.037

*P<0.05 - significant level, P>0.05 – NS (Not Significant)

3.3.4 Perceptions of non-educated, educated and married consumers on the slaughter of cattle for different traditional ceremonies

The perceptions of different types of consumers on the slaughter of cattle for traditional ceremonies are shown in Figure 3.4, 3.5 & 3.6. The consumers that are not educated reported that the perception of slaughtering the cattle for traditional wedding is 50%. While married and educated consumers reported that the perception of slaughtering the cattle for traditional wedding is more than 55%. Figure 3.5, non-educated consumers reported that the perception of slaughtering the cattle for the funeral ceremonies is more than 70%. While the educated consumers reported that the perception of slaughtering cattle for the funeral ceremony is 20%. More than 50% of educated and non-educated consumers perceived that the cattle are slaughtered for “bringing back the dead (ancestors)” and Sangoma ceremonies. While the married consumers reported that the perception of slaughtering the cattle for “bringing back the dead (ancestors)” and Sangoma ceremonies is less than 40%.

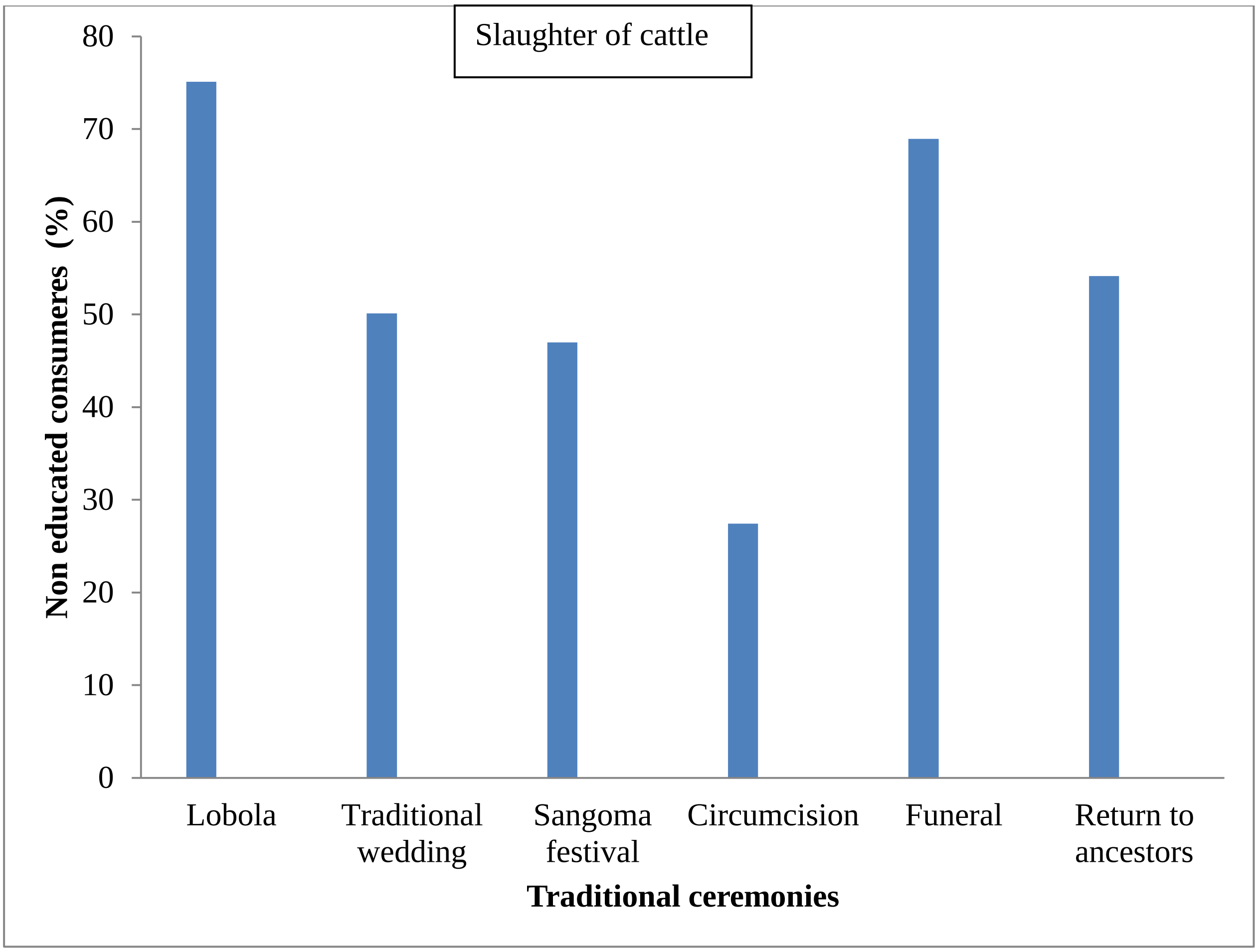

Figure 3.4: Types of traditional ceremonies for slaughter of cattle reported by non-educated consumers

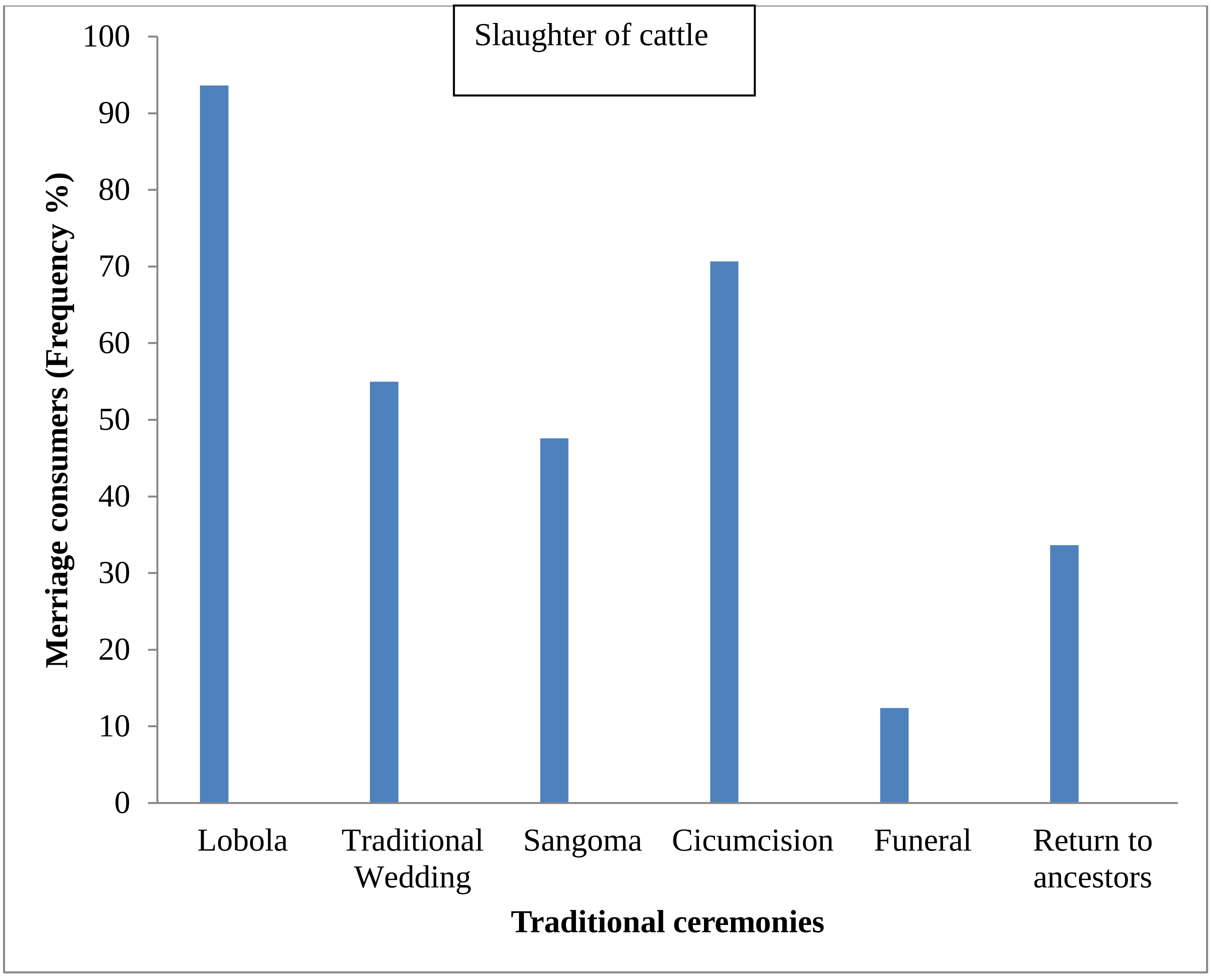

Figure 3.5: Types of traditional ceremonies for slaughter of cattle reported by married consumers

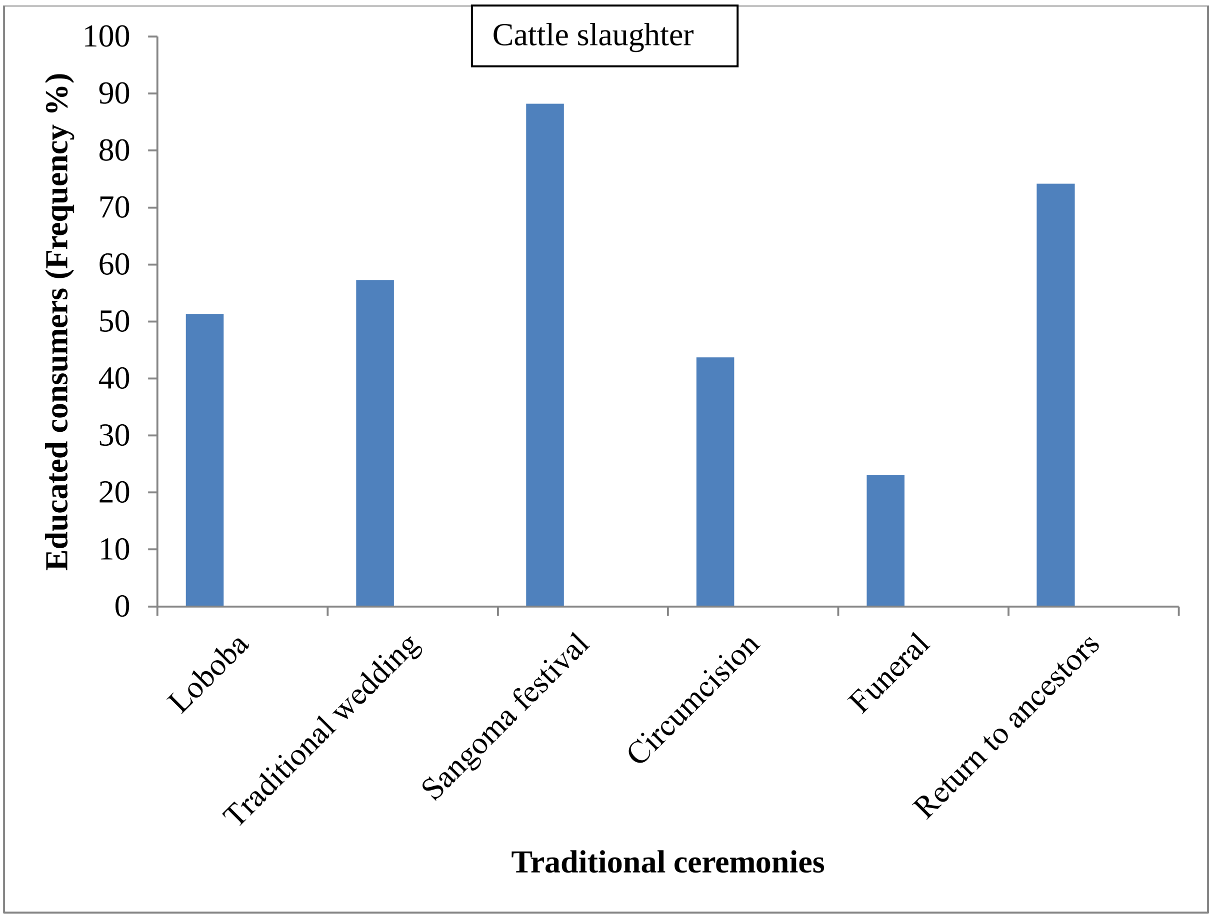

Figure: 3. 6 Types of traditional ceremonies for slaughter of cattle reported by educated consumers

3.4 Discussion

3.4.1 Slaughter method and its effects on animal welfare

Traditional slaughter method is a method done according to the religious requirements of either the Xhosa or Sotho religious faith (Klaus *et al.,* 2004). The cattle are slaughtered, without being stunned using a sharp knife. According to Grandin (2010) when the cut is done correctly, the cattle appear not to feel the pain during slaughter proceedings. From an animal welfare standpoint, the major concern during traditional ceremonies are the slaughter methods, stressful and cruel methods of restraint (holding) that are used in some slaughter plants or kraal. The progressive slaughter plants that use devices to hold the cattle in a comfortable manner are the abattoirs. Unfortunately, there are some kraals which use cruel methods of restraint and slaughter method without stunning is extremely debatable from an animal welfare standpoint. Research indicates that cutting the neck causes pain (Grandin, 2010). However, the welfare of cattle is protected by section 2 of the 1958 Humane Slaughter Act, which requires that all animals be rendered insensible to pain before being chained up, hoisted or cut (Nakyinsige *et al.,* 2013). On the other hand, the law allows slaughtering in agreement with traditional requirements of any traditional faith that prescribes a method of slaughter whereby the cattle suffers loss of consciousness by severance of the carotid artery with a sharp instrument (Grandin, 2010).

Previous research Grandin (2001) indicated that majority of the cattle vocalizations during handling for slaughters are associated with high stress level. The approved method of slaughter by ancestors during traditional ceremonies involves the methods explained in (Table 3.1) whereby the slaughterer kills the cattle by cutting the jugular vein, carotid artery, trachea and oesophagus with a sharp knife by a single swipe in order to incur less pain. Although people conduct traditional ceremonies, the way they restrain and slaughter the cattle differ according to what they believe as shown (Table 3.2). All of these slaughter methods did not consider the welfare of the animal but the consumers follow their norms of the ceremony.

The perceptions on some demographic factors like traditional wedding, age and educated and non-educated consumers had an effect on the slaughter of cattle for the traditional ceremonies. This may be due to the fact that educated consumers are more concerned about their health they prefer meat slaughtered by professionals at the abattoirs. Moreover they might have an advantage of being more knowledgeable on the ethics of animal welfare and also on the factors that have a negative impact on their health. The age of the consumers play the major role on the slaughter of cattle for traditional ceremonies. The perceptions of older consumers had different opinions of slaughtering cattle for traditional ceremonies than younger consumers. This may be due to the fact that some of the consumers do not slaughter cattle at all due to what consumers believe on or Christian's rules. According to Ndou *et al* (2011) slaughtering the cattle without stunning is associated with stress of restraint, pain of the cut and undue distress whilst the animal is bleeding out. Table 3.2 demonstrated the perception of consumers slaughtering the cattle for the traditional ceremonies without stunning. Hence the welfare of the animal is affected. As indicated in figure 3.4, 3.5 & 3.6 that the perceptions of consumers that are not educated, educated and married were not the same on the types of ceremonies where the cattle are slaughtered.

3.5 Conclusion

Based on the perception of the consumers, it was concluded that most consumers highlighted that the cattle are restrained and slaughtered in accordance to their traditional beliefs. In Chapter 4, the study will reveal the quality of meat from the cattle slaughtered for the traditional ceremonies. The study showed that the demographic factors and slaughter method had an influence on the perception of slaughtering the cattle for different traditional ceremonies. Non educated, educated and married consumers were more concerned about the traditional slaughtering of cattle for lobola and traditional wedding. Married and educated consumers were less concerned about traditional slaughtering of cattle for funeral ceremonies, while non-educated consumers were more concerned.

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Chapter 4: Physico-chemical quality of meat from cattle slaughtered during traditional ceremonies and at conventional abattoirs

Abstract

The objective of the current study was to determine the influence of sex, age and breed on the meat quality attributes of cattle slaughtered during traditional ceremonies and also slaughtered at conventional abattoirs. Fifty non-descript cattle were slaughtered during traditional ceremonies at Mceula and other villages close to Mceula around Lukhanji Local Municipality and two-hundred and twenty four (224) cattle were slaughtered at three different throughput abattoirs. The result obtained showed that age of cattle slaughtered for traditional ceremonies had an effect ($p < 0.05$) on the beef tenderness and cooking loss, i.e. The meat of cattle between the age of 6 to 8 years was harder than the meat of cattle between the age of milk teeth to 1 year. There was no significant sex effect on beef tenderness and cooking loss of cattle slaughtered for traditional ceremonies. The breed type had an effect on the colour of beef. For the non-descript and Angus cattle slaughtered at low throughput abattoir. There was a sex and breed effect ($p<0.05$) on cattle that are slaughtered at medium throughput abattoir on the cooking loss and tenderness. The age and breed of the cattle slaughtered at high throughput abattoir had an effect on beef tenderness and cooking loss ($p < 0.05$). Cattle between ages of 6 to 8 years and also cattle that are more than 8 years had an effect on cooking loss of the beef from cattle that are slaughtered at high throughput abattoir ($p < 0.05$). It was concluded that age and sex and had effect on colour, tenderness and cooking loss of meat from cattle slaughtered at the conventional abattoirs. Age had an effect on meat from cattle slaughtered for traditional ceremonies.

4.1. Introduction

Animal welfare has become an increasing concern around the world (Seng and Laporte, 2005). The main reason to improve animal welfare during slaughter processes is to prevent pains and stress. A pre-slaughter stress in cattle might compromise the quality of meat (Ferguson and Warner, 2008), and particularly, lowers water-holding capacity or tenderness or both. The pre-slaughter declination of muscle glycogen reserves has a sufficient effect on various meat quality features such as ultimate pH, colour traits, tenderness and water holding capacity (Gregory, 2003). King *et al* (2006) discovered that nervous cattle are the ones with more active stress response mechanisms than calmer ones. Carcasses of nervous cattle were normally found to have increased occurrence of dark cutting beef and reduced tenderness than the calmer numbers. Several biochemical processes and products that affect beef eating quality are at play during the immediate pre-slaughter period, and slaughtering process (Muchenje *et al.,* 2009a).

Nowadays, managers, veterinarians, scientists and farmers are more knowledgeable on how to assess and audit animal welfare at the slaughter plant/ abattoirs (Grandin, 2010). However, Fayemi and Muchenje (2012) highlighted that there is little research conducted on the area of traditional slaughter methods, their effect on animal welfare and the quality of meat. This is due to the fact that most cattle in the rural areas are slaughtered using traditional slaughter methods during ceremonies (Chapter 3). Furthermore, beef is one of the widely consumed protein sources in the world. Modern consumers are increasingly concerned about production of safe meat with no undesirable effects on their health (Muchenje *et al.,* 2009).

Since the animals are normally slaughtered for traditional ceremonies in most villages in Eastern Cape of South Africa the cattle are expected to bellow during slaughter processes (Chapter 3). According to Grandin (2010), it has been stated that bellowing of the cattle at slaughter plant is the indication of high level of stress to the cattle. Consumers believe that bellowing of the cattle is an indication that the ancestors have blessed the ceremony. This becomes the most important behaviour of cattle when slaughtered for traditional ceremonies. However, the slaughter method used for the ceremonies depends on the religion, belief, tradition and adherence to the ancestors by the consumers. Painful handling techniques, such as tail pulling and twisting or the use of physical force in the form of goads or other aids were observed during the slaughter of cattle for traditional ceremonies ref. Techniques that cause extreme pain and injury (tail bending or breaking, eye gouging) were used when difficulties of moving animals during pre-slaughter processes were encountered.

On the other hand the cattle cannot be transported for more than once because they will be slaughtered from the farm to auction centers or abattoirs. Through the processes of rounding up, kraaling, loading, transporting and off-loading cattle at the abattoir, there are animal welfare compromises. At a slaughter plant, cattle are exposed to a number of stressful factors, such as contact with unfamiliar conspecifics, loud noise, odours, painful shocks from electric goads, and hard blows from other animals, stockpersons or equipment (Hultgren *et al.*, 2014). Fear of either the handling procedures and novelty of the environment makes the animal feel pain (Chulayo *et al.*, 2012). The objective of the present study was to determine the physico-chemical characteristics from the meat of cattle slaughtered during traditional ceremonies and those slaughtered at the abattoirs.

4.2. Materials and Methods

4.2.1 Description of the study site

The study was conducted at Mceula village around Lukhanji Local Municipality, Low throughput abattoir for Adelaide, Medium throughput for Queenstown and High throughput for East London.

Site 1 Traditional slaughter

The study was conducted at Mceula village which is part of the Hewu District of the Northern Region of the former Ciskei. Mceula village used the cattle from the same community no transportation occurred. The geographic region defining the study area extends from 32^0 05'S; 26^0 40' E to 32^0 08' S; 26^0 43' E. The area was selected based on the great history and incidence of high rate on traditional ceremonies and also slaughtering animals. The Mceula village Land lies due Northwest of Whittlesea and West of Queenstown. It is bounded by Kamastone to the North, the Hukuwa River to the South and Poplar Grove to the east. Mceula is made up of four individual villages, namely; Xaleni, KwaManzikrakra, Maqulomba and White City. The soils of Mceula village have been described by Acocks (1988).The distance from one village to the next village ranges from two to four kilometres. The climatic conditions of Mceula Village are modified mainly by the topography. Rainfall varies from year to year with an annual average of 500 mm in the grassland and Thornveld area, while an annual average of 800 mm is observed in the mountainous area.

Site 2 Low through-put abattoir

The Adelaide Nxuba Municipal abattoir in the Amatole District Municipality in Eastern Cape Province of South Africa. It is located 40km away from University of Fort Hare and it is located 32`.80 S and 26`.90 E and is situated 586m above sea level. The abattoir is classified as low throughput. Data were collected from 20 cross jersey cattle and were transported from the Fort Hare dairy farm to the abattoir. Averages of five cattle are slaughtered per day in the abattoir. Data on animal source breed and sex were recorded on arrival at the abattoir and the cattle were slaughtered directly upon arrival. Slaughtering was done through stunning by captive bolt, suspension by a hind leg and exsanguination. Meat inspection and classification were done by a qualified meat inspector. The average temperature is about 24^0 C, with an average summer maximum temperature of about 27^0 C, and minimum of 18^0 C.

Site 3 Medium throughput abattoir

The Queenstown Meat Traders abattoir in the Chris Hani District Municipality of Eastern Cape Province was used. It is located at 155 km away from University of Fort Hare and it is located 31^0 54'00" S and 26^0 53' 00"E. The cattle slaughtered at the Meat Trade abattoir were brought into the abattoirs a day before slaughter by trucks and were put into abattoir holding pens overnight with access to water but with no food. The average number of cattle that are slaughtered per day is fifty (50). The Queenstown average temperature is about 22^0 C, with an average summer maximum temperature of about 25^0 C, and minimum of 17^0 C. Most rainfall comes in summer, and average rainfall is 450mm per year. The topography of the area is generally flat with few steep slopes.

Site 4 High throughput abattoir

The East London Abattoir is situated 120 km away from the University of Fort Hare and it is located 32.97^0 S and 27.87^0 E. It is situated at 32.97^0 S and 27.87^0 E in the Buffalo City Local Municipality in the Amatole District of Eastern Cape Province. The cattle slaughtered at the EL were brought into the abattoirs a day before slaughter by trucks and were put into abattoir holding pens overnight with access to water but with no food. The average number of cattle that are slaughter is hundred cattle per day. East London has an average daily temperature of about 23^0 C, with an average summer maximum temperature of about 25^0 C and a minimum of 19^0 C. Most rainfall comes in summer.

4.2.2 Animal information and classification

Animals that were slaughtered: bulls, castrates and cows, different breeds non-descript and cross of different age groups (less than1year 6 months, to more than 6 years). Sixty-four Angus young bulls with milk teeth, 19 Tuli young bulls (combination of milk teeth and 4 teeth) and 15 Afrikaners young bulls (mixed milk teeth and 8 teeth) were slaughtered at East London abattoir. The Meat Traders Queenstown abattoir had 106 Hereford castrates slaughtered between the age group of 6 teeth and 8 teeth, 16 Friesland cows were also used between the age group of 4 teeth and 8 teeth. At the Adelaide abattoir 20 cross breed of jersey cows were slaughtered between age group of 2 teeth and 8 teeth. A total of 50 non-descript cows and Castrates between age group of 2 and 8 teeth were slaughtered at the Mceula Village.

4.2.3 Determination of cooking loss and Meat tenderness from traditional and commercial slaughtered cattle

The determination of cooking loss was done by thawing the frozen samples from all sites at room temperature for 12hours. The samples were weighed early in the morning after the meat melted. A weighing scale was used to measure the weight of the meat before the meat was boiled and after boiled. The samples were labeled and placed in plastics bags and boiled for 45 minutes at 85 °C and were then weighed again.

The following formula was used to calculate the cooking loss values:

$$\text{Cooking loss \%} = \frac{[(\text{weight before cooked} - \text{weight after cooked})]}{\text{Weight before cooked}} \times 100$$

After measurements of cooking loss, the cooked samples were used to determine beef tenderness and Warner-Bratzler shear force (WBSF) values. Three sub samples measuring 10 mm core diameter were cored parallel to the grain of the meat. The samples were sheared perpendicular to the fibre direction using a Warner Bratzler (WB) shear device mounted on an Instron (Model 3344) Universal testing apparatus (cross head speed at 400mm/min, one shear in the centre of each core). The mean maximum load (N) was recorded for the batch.

4.2.4 pH and colour for meat slaughtered during traditional ceremonies

The *Longissmus dorsi* muscle at the level of the 10^{th} rib, approximately 1hour after slaughter was removed from the carcass and the measurements were taken to determine pH and colour of the meat. The measurement of pH was carried out using a portable pH meter (CRISON pH 25, CRISON Instruments SA, Spain) and the measurement were taken 1hour after slaughter and also 24hours after slaughter. The machine was first calibrated using pH 4, pH 7 and pH 9 buffers (CRISON Instruments, SA, Spain) before each day's measurement. The meat samples were then refrigerated at 0-3 ^{0}C for 24 hours and the readings were taken in carcasses.

The colour of the meat (L* = Lightness, a* = Redness and b* = Yellowness) was determined in the *Longissmus dorsi* 1hour after slaughter and also 24 hours after slaughter using a colour guide 45/0 BYK-Gardener GmbH machine, with a 20mm diameter measurement area and illuminant D65-day light, 10^0 standard observer. The guide was calibrated before each day's measurements using the green standard. Three readings were taken by rotating the colour guide 90^0 between each measurement, in order to obtain a representative average value of the colour.

4.2.5 Statistical analysis

The effect of Age, breed and sex on beef pH, colour, meat tenderness, temperature and cooking loss of cattle slaughtered during traditional ceremonies, at low, medium and high throughput abattoirs were analysed using General Linear Model (PROG GLM) of SAS (2003).

4.3. Results

The results on age breed and sex effect, are presented in Table 4.1; 4.2; 4.3 & 4.4. Age significantly effected ($p < 0.05$) the beef tenderness and cooking loss of cattle slaughtered for traditional ceremonies. On the other hand, cattle slaughtered for traditional ceremonies which were aged 1 year and 6 to 8 years had different beef tenderness (25.55 ± 8.05) and cooking loss (48.00 ± 4.26) as shown in Table 4.1. However sex had no effect on beef tenderness and cooking loss of cattle slaughtered for the same purposes. Breed of animals had an effect on the colour of beef cattle slaughtered at a low throughput abattoir. Non-descript breed had significantly different lightness in colour (27.49 ± 2.53) than that of the other breeds, while the Angus differed in redness than the other breeds from cattle that were slaughtered at Low throughput abattoir.

Table 4.3 shows that sex and breed significantly effected ($p < 0.05$) cooking loss and tenderness of cattle slaughtered at medium throughput abattoir. Age and breed of the cattle slaughtered at high throughput abattoir had effect on beef tenderness and cooking loss. The cooking loss of beef from cattle aged 6 to 8 years (32.19 ± 3.82) was high whereas the beef from cattle aged 2 to 4 years (44.73 ± 2.11) was low at a high throughput abattoir. The age of the cattle had an effect on the beef tenderness. The tenderness of cattle aged between 6 to 8 years (44.45 ± 7.93) was higher whereas the beef from cattle aged 2 to 4 years (35.49 ± 5.46) was lower at high throughput abattoir.

Table 4.1: Effect of age and sex on the beef characteristics from cattle slaughtered for traditional ceremonies

Age	Beef characteristics						
	Cooking loss (%)	**Tenderness WBSF (N)**	Colour			**pH**	**Temperature**
			Lightness (L*)	**Redness (a*)**	**Yellowness (b*)**		
Milk teeth to 1yr	46.67 ± 4.27[a]	31.96 ± 2.43[a]	30.76 ± 3.41[a]	14.68 ± 2.19[a]	9.80 ± 1.60[a]	5.34 ± 0.29[a]	26.60 ± 4.31[a]
2yrs – 4yrs	40.24 ± 1.91[a]	34.31 ± 3.04[a]	30.39 ± 1.52[a]	16.03 ± 0.98[a]	10.76 ± 0.72[a]	5.23 ± 0.13[a]	23.69 ± 1.93[a]
4yrs to 6yrs	42.18 ± 1.29[a]	33.91 ± 8.05[a]	28.95 ± 1.03[a]	16.56 ± 0.66[a]	10.58 ± 0.48[a]	5.04 ± 0.09[a]	20.57 ± 1.30[a]
6yrs to 8yrs	25.55 ± 8.05[b]	43.77 ± 3.60[b]	30.10 ± 3.41[a]	18.63 ± 2.18[a]	12.98 ± 1.60[a]	5.12 ± 0.30[a]	19.10 ± 4.31[a]
More than 8yrs	24.59 ± 1.61[b]	48.00 ± 4.26[c]	31.98 ± 1.29[a]	15.94 ± 0.83[a]	11.74 ± 0.60[a]	5.01 ± 0.11[a]	24.07 ± 1.62[a]
Sex							
Female	43.27 ± 1.52[a]	34.26 ± 3.02[a]	31.75 ± 1.18[a]	16.28 ± 0.77[a]	11.89 ± 0.55[a]	5.02 ± 0.10[a]	23.45 ± 1.54[a]
Male	41.87 ± 1.04[a]	35.06 ± 2.07[a]	29.48 ± 0.81[a]	16.29 ± 0.53[a]	10.59 ± 0.38[a]	5.12 ± 0.07[a]	21.85 ± 1.06[a]

Means in the same column with the different superscripts are significantly different ($p<0.05$). $p>0.05$ is not significant NS, *$p<0.05$ is significant.

Table 4.2: Effect of age and breed on the beef characteristics from cattle slaughtered at Low throughput abattoir (Adelaide abattoir)

Age	**Beef characteristics**						
	Cooking loss (%)	**Tenderness WBSF (N)**	Colour			**pH**	**Temperature**
			Lightness (L*)	**Redness (a*)**	**Yellowness (b*)**		
2yrs – 4yrs	46.39 ± 1.22^a	32.62 ± 3.89^a	23.61 ± 2.84^a	17.86 ± 1.39^a	10.46 ± 2.27^a	5.60 ± 0.26^a	23.63 ± 5.03^a
4yrs to 6yrs	47.23 ± 2.76^a	38.73 ± 5.69^a	22.52 ± 4.16^a	16.85 ± 2.05^a	14.04 ± 3.32^a	5.41 ± 0.38^a	20.98 ± 7.36^a
More than 8yrs	45.63 ± 1.78^a	37.67 ± 1.47^a	21.95 ± 1.07^a	20.77 ± 0.53^a	11.36 ± 0.86^a	5.62 ± 0.09^a	21.68 ± 1.90^a
Breed							
Jersey cross	38.06 ± 0.16^a	40.63 ± 4.04^b	21.79 ± 2.95^b	17.40 ± 1.45^b	11.53 ± 2.36^a	5.68 ± 0.27^a	22.35 ± 5.23^a
Jersey	35.39 ± 0.24^a	36.63 ± 4.54^a	20.17 ± 3.32^b	20.55 ± 1.64^b	12.48 ± 2.65^a	5.64 ± 0.30^a	22.27 ± 5.88^a
Non-descript	74.39 ± 1.22^b	33.87 ± 3.47^a	27.49 ± 2.53^a	14.86 ± 1.25^b	10.08 ± 2.02^a	5.40 ± 0.23^a	24.06 ± 4.48^a
Angus	37.81 ± 0.01^a	34.22 ± 2.19^a	21.17 ± 1.60^b	21.16 ± 0.79^a	13.72 ± 1.28^a	5.47 ± 0.14^a	19.72 ± 2.84^a

Means in the same column with the different superscripts are significantly different ($p<0.05$). $p>0.05$ is not significant NS, *$p<0.05$ is significant.

Table 4.3: Effect of breed, sex and age on the beef characteristics from cattle slaughtered at medium through put abattoir (Meat trade abattoir)

Age	Beef characteristics						
	Cooking loss (%)	**Tenderness WBSF (N)**	Colour			**pH**	**Temperature**
			Lightness (L*)	**Redness (a*)**	**Yellowness (b*)**		
2yrs – 4yrs	36.94 ± 1.59[a]	52.09 ± 7.47[b]	27.51 ± 2.64[a]	13.06 ± 2.23[a]	9.47 ± 1.76[a]	5.24 ± 0.29[a]	18.64 ± 2.72[a]
4yrs to 6yrs	36.64 ± 1.21[a]	63.18 ± 2.63[a]	29.62 ± 1.70[a]	14.23 ± 1.44[a]	9.00 ± 1.14[a]	5.17 ± 0.19[a]	22.87 ± 1.76[a]
6yrs to 8yrs	37.27 ± 5.32[a]	69.19 ± 3.45[a]	26.60 ± 0,79[a]	15.12 ± 0.66[a]	8.08 ± 0.53[a]	5.27 ± 0.08[a]	23.05 ± 0.81[a]
More than 8yrs	42.40 ± 3.43[a]	72.03 ± 11.59[a]	26.42 ± 0.59[a]	15.40 ± 0.51[a]	8.61 ± 0.40[a]	5.25 ± 0.07[a]	22.93 ± 0.62[a]
Sex							
Female	40.86 ± 2.55[a]	72.93 ± 5.54[a]	27.27 ± 1.30[a]	14.00 ± 1.07[a]	8.78 ± 0.84[a]	5.12 ± 0.14[a]	21.90 ± 1.30[a]
Male	35.77 ± 1.92[b]	55.32 ± 4.17[b]	27.81 ± 0.95[a]	14.90 ± 0.80[a]	8.79 ± 0.63[a]	5.34 ± 0.11[a]	21.85 ± 0.98[a]
Breed							
Non-descript	39.16 ± 4.82[a]	81.25 ± 10.49[a]	27.14 ± 2.39[a]	14.11 ± 2.02[a]	8.22 ± 1.59[a]	5.42 ± 0.27[a]	20.07 ± 2.46[a]
Friesland	40.71 ± 1.70[a]	64.23 ± 3.71[a]	29.27 ± 0.84[a]	14.68 ± 0.71[a]	8.40 ± 0.56[a]	5.20 ± 0.09[a]	24.26 ± 0.87[a]
Hereford	36.96 ± 2.46[a]	47.52 ± 4.94[b]	26.86 ± 1.12[a]	14.62 ± 0.94[a]	9.39 ± 0.75[a]	5.31 ± 0.13[a]	19.74 ± 1.15[a]

Means in the same column with the different superscripts are significantly different ($p<0.05$). $p>0.05$ is not significant NS, *$p<0.05$ is significant.

Table 4.4: Effect of age and breed on the beef characteristics from cattle slaughtered at high through put abattoir (East London abattoir)

	Beef characteristics						
	Cooking loss (%)	**Tenderness WBSF (N)**	Colour			**pH**	**Temperature**
Age			**Lightness (L*)**	**Redness (a*)**	**Yellowness (b*)**		
2yrs – 4yrs	44.73 ± 2.11^{a}	35.49 ± 5.46^{b}	29.61 ± 0.70^{a}	14.96 ± 0.82^{a}	8.52 ± 0.48^{a}	5.25 ± 0.06^{a}	21.14 ± 1.33^{a}
4yrs to 6yrs	38.38 ± 1.91^{a}	43.14 ± 2.73^{a}	29.00 ± 0.63^{a}	15.30 ± 0.74^{a}	8.67 ± 0.43^{a}	5.27 ± 0.05^{a}	21.65 ± 1.21^{a}
6yrs to 8yrs	32.19 ± 3.82^{b}	44.45 ± 7.93^{a}	26.78 ± 1.26^{a}	15.57 ± 1.48^{a}	8.16 ± 0.86^{a}	5.40 ± 0.10^{a}	21.59 ± 2.41^{a}
More than 8yrs	26.88 ± 5.55^{c}	48.71 ± 3.01^{a}	27.31 ± 1.83^{a}	15.06 ± 2.15^{a}	8.03 ± 1.25^{a}	5.35 ± 0.15^{a}	20.52 ± 3.50^{a}
Breed							
Afrikaner	37.72 ± 2.23^{a}	47.01 ± 3.19^{a}	27.73 ± 0.74^{a}	15.73 ± 0.87^{a}	8.38 ± 0.51^{a}	5.35 ± 0.06^{a}	22.33 ± 1.41^{a}
Angus	27.52 ± 3.09^{b}	39.29 ± 4.41^{a}	29.12 ± 1.02^{a}	15.06 ± 1.20^{a}	8.48 ± 0.70^{a}	5.24 ± 0.08^{a}	19.77 ± 1.95^{a}
Tuli	41.39 ± 2.31^{a}	42.56 ± 3.30^{a}	27.69 ± 0.76^{a}	14.88 ± 0.90^{a}	8.18 ± 0.52^{a}	5.36 ± 0.06^{a}	21.58 ± 1.46^{a}

Means in the same column with the different superscripts are significantly different ($p<0.05$). $p>0.05$ is not significant NS, *$p<0.05$ is significant.

4.4. Discussion

Tenderness is a primary determinant of the eating quality and acceptability of meat (Schönfeldt and Strydom, 2010; Voges *et al.*, 2007). The results in Table 4.1 and 4.4 indicates that age of the cattle slaughtered during traditional ceremonies and at high throughput abattoir affected beef tenderness and cooking loss. In table 4.1 the value of cooking loss is high than the value of tenderness. This could be due to the fact that the beef losses more water during the cooking process of the meat. According to Jama *et al.* (2008) beef with high drip loss has an unattractive appearance and therefore has low consumer acceptance, which leads to loss of sales. It also decreases meat tenderness and juiciness which lessen consumers' demand for beef.

In some developing countries in Asia, there are beliefs that stress benefits some quality traits, such as tenderness resulting in cattle being bitten with dogs, chased through streets by mounting stockman equipped with goads (Ndou *et al.,* 2011). On the other hand the cattle during traditional ceremonies are slaughtered without stunning and allow more blood to flow. Both of the situations induce high level of stress to the animal. Physical activity for hours before and during slaughter, reduces glycogen concentration and plasma glucose levels below critical values (Chambers *et al.*, 2001) eventually leading to reduced lactic acid and increased meat pH above critical range from 5.5 to 6.0. As indicated in Table 4.1, the pH value ranges on 5.24 to 5.40. According to Malterre and Jones (1992) meat quality and palatability declined with increase in animal maturity and parity.

The results on Table of low, medium and high throughput abattoirs indicates that age, sex and breed had significant effect on tenderness, cooking loss and colour of the beef. Table 4.2 indicates that breed had an effect on the colour of meat. Beef from non-descript and Angus breed were found to have a significant effect on the colour of the meat. On the other hand the breed had no significant effect on the pH of the beef. Cloete *et al.* (2008) reported that pH value has an effect on the colour and tenderness of the meat. The ultimate pH of meat is expected to range between 5.75 and 6.00 (Gregory *et al.,* 2008). According to Scheffler *et al.* (2013), low ultimate pH is often referred to as "acid meat" to distinguish it from pale, soft, and exudative (PSE) meat caused by rapid glycolysis. Table 4.3 indicates that sex of the animal affects the cooking loss and tenderness of the beef. Female animals have high value of cooking loss and tenderness as compare to male animals. This is due to the fact that most of the time female animals are slaughtered when they are old as compared to male animals. Mature cattle usually have harder meat as compared to younger cattle (Maltin *et al.,* 2003). The results are similar to the research conducted by Maltin *et al.* (2003) who reported that the sex of the cattle affects the firm and softness of the meat

According to Chulayo *et al.* (2012), age, breed, species and muscles in an animal have different effects on the quality of meat. Muscles in various breeds differ in toughness and softness of muscle because of the glycolytic and oxidative activities that occurs at different ages of the cattle (Sańudo *et al.,* 1998). This is due to its regulatory effect on biological processes in the muscles that are reflected in the quality of meat (Descalzo *et al.,* 2007). Clausen (2004) believes that the detrimental effects of O_2 on tenderness may be caused by protein oxidation. Rowe *et al.* (2004) found that oxidation of beef muscle proteins early postmortem inactivated μ-calpain and decreased myofibrillar proteolysis, thus potentially limiting tenderization. Jeremiah *et al.* (1998) indicated that meat palatability differs among breeds due to their ages, gender and slaughter weights.

In Table 4.4 tenderness and cooking loss showed a significant age and breed effect. Old animals had a significant effect on tenderness and cooking loss. The results indicate that the age at which the animals are slaughtered has an effect on beef tenderness and cooking loss including reduced muscle water holding capacity (Malterre and Jones, 1992). The age was found to be a common factor affecting the cooking loss and tenderness in all abattoirs and during traditional ceremonies. However sex had an effect on the meat cooking loss and tenderness from cattle slaughtered at medium throughput abattoir. Cooking loss was reported not to differ with breed differences, but to decrease with ageing (Jama *et al.,* 2008). Total cooking loss increased with advanced age of the animal (Schonfeldt and Strydom, 2011).

4.5. Conclusions

It was concluded that the young cattle with milk teeth had an effect on the meat tenderness of cattle slaughtered for traditional ceremonies. On the other hand the meat tenderness and cooking loss of beef from the cattle slaughtered from low, medium and high throughput abattoirs were affected by sex and breed mostly. Age only affected the cooking loss and meat tenderness from cattle slaughtered at a high throughput abattoir. It was also observed that cattle slaughtered for traditional ceremonies had completely different slaughter methods as compared to cattle slaughtered at low, medium and high throughput abattoirs.

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Chapter 5 General Discussion, Conclusions and Recommendations

5.1 General discussion

The objective of the current study was to determine the perceptions of rural consumers on behaviour and beef quality of cattle slaughtered for traditional ceremonies in the Eastern Cape of South Africa. The consumers' perceptions and the behaviour of the slaughtered cattle for traditional ceremonies were determined in Chapter 3, with the inclusion that the cattle are expected to bellow and slaughtered without stunning for traditional ceremonies. According to Grandin (2010) slaughtering the cattle without stunning is tremendously debatable from welfare perspective. In Chapter 4, physico-chemical quality of beef slaughtered during traditional ceremonies and slaughtered at different abattoirs were determined.

In Chapter 3, the experience or understanding of the consumers and the importance of slaughtering the cattle for the traditional ceremonies was determined. According to Ndou *et al.* (2011), traditional slaughtering method, involves stabbing of the cattle on the stomach by using a spear and then forcing the cattle to bellow then followed by cutting the throat. Previous research by Grandin (2006) indicated that majority of the cattle bellow during handling for slaughtering is associated with high stress level. According to Petherick (2005) cattle that are fearful, nervous, and flighty are difficult to handle, and more likely to respond in an extravagant way and injure themselves and handlers when being handled for slaughter. The study indicated that most consumers are more concerned about fulfilling their mission during traditional ceremonies than considering the welfare of the cattle during slaughter processes. Hemsworth *et al.* (2011) discussed that pre-slaughter stress increases shear force decrease flavour and juiciness increase cooking losses and may cause a higher incidence of stress-related meat quality problems such as dark cutting beef.

The results of the study presented in Chapter 4 discovered that breed, age and sex after the cattle were slaughtered for traditional ceremonies and at abattoirs affected the beef characteristics. The fact that cattle were exposed to the stressful conditions during traditional ceremonies and also at the abattoirs, the meat quality was affected at slaughter and after slaughter. Meat quality attributes such as pH, colour, tenderness and cooking loss affect the acceptability of meat by consumers (Simela, 2005). Conditions that occur prior and post-slaughter the people who normally slaughter the cattle are to be blamed for any processes that occur on the animal during slaughter. These processes result in an increase or decrease of pH depending on the level of glycogen breakdown and lactic acid accumulation in the muscle. All in all, levels of muscle pH affect meat attributes such as colour, tenderness and cooking los (Muchenje *et al.*, 2008b; 2009a, b; Muchenje and Ndou, 2012). Furthermore breed, age and sex of the cattle affect the tenderness and cooking loss of the beef cattle slaughtered at the abattoirs and during traditional ceremonies. According to Chulayo *et al.* (2012), age, breed, species and muscles of an animal have different effects on the quality of meat. In addition, sex of the cattle affects the hardiness and softness of the meat (Maltin *et al.*, 2003). In the current study, meat quality of beef slaughtered traditionally was affected negatively and the meat from animals stunned using the captive bolt method produced meat quality attributes was also affected.

5.2 Conclusion

It was concluded that the consumers do not consider the welfare of the cattle during the slaughter processes for their traditional ceremonies. Breed, sex and age after of the cattle slaughtered either for traditional ceremonies or at abattoirs affect the meat attributes (pH, colour tenderness and cooking loss). In addition sex and age affect the meat tenderness and cooking loss of the cattle slaughtered at the abattoirs while age of the cattle slaughtered at Mceula Village for traditional ceremonies affect the tenderness and cooking loss of the beef.

5.3 Recommendation

Based on the findings reported in the current study, it is recommended that a further research on the following aspects is needed:

1. The method of slaughtering cattle during traditional ceremonies without causing high level of stress. This is because animals that are stressed have high ultimate pH which results to darker cuts. Therefore, further research is needed to ascertain the levels at which glycogen level and lactic acid is produced to give rise to high pH values.
2. Documentation on the importance of slaughtering animal without stunning methods and how do consumers link the quality of meat with their health and their cultural activities.
3. Investigation on the rearing methods, animal behaviour and the occurrence of bruises on cattle slaughtered using traditional methods and link it to the production of hormonal production is also imperative. This will determine the amount of meat losses during the process of traditional slaughter and how much stressed the animals become.

At the abattoirs, more training is required on how use the stunning machine effectively and avoid double stun, as it causes the cattle to panic before slaughter processes. This will improve animal welfare and meat quality.

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Appendix 1: Consumers' perceptions on the slaughter of cattle for traditional ceremonies.

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Questionnaire number........................ **Enumerator name...........................**

Municipality Name............................. **Community name....................**

Name of respondent............................

Date..

A. HOUSEHOLD DEMOGRAPHIC INFORMATION				
A1. Head of household				
a. Sex	**Male**			
	Female			
b. Marital status	**Married**	**Single**	**Divorced**	Widowed
c. Age (specify)				
d. Highest level of education	**No formal education**	**Primary**	**High school**	**Tertiary Education**
A2. What is your principal occupation?				
A3.What is the size of your Household?		**Adults**	**Children**	
	Male			
	Female			

A4. What is your religion	Christianity	Traditional	Muslim	Other (specify)

A5. What are your sources of income? (Rank 1 as most important source of income)

Source	Amount raised	Rank
Livestock		
Crops		
Salary		
Grants		
Own business		
Others (specify)		

B. LIVESTOCK PRODUCTION AND PREFERENCES

B1. Which livestock do you keep most? (rank 1 as the most important species)

Class	Cattle	Goat	Sheep	Pig	Others (specify)
Number					
Rank					

B2. Which animals do you prefer most? (Rank 1 as the most important animal)

Livestock species	Rank	Purpose of production		
		Consumption	Sale	Traditional
Cattle				
Donkey				
Horse				
Sheep				
Goat				

Pig				
Chicken				
Other				

B3. Have you slaughtered any animal in the last 12 months?	**Yes**	**No**

B4. Which Animals did you slaughter?

Species		**Reason**	**Main market**
Goat	**Male**		
	Female		
Sheep	**Male**		
	Female		
Cattle	**Male**		
	Female		
Chicken	**Male**		
	Female		
Pig	**Male**		
	Female		

C. TRADITIONAL SLAUGHTER OF LIVESTOCK

C1. What type of livestock species do you use most for traditional purposes? (Rank 1 as the most important species)

Livestock species	**Cattle**	**Goat**	**Sheep**	**Chicken**	**Pig**
Rank					

C2 How many animals did you slaughter for traditional purposes?

	Cattle	**Sheep**	**Goat**	**Pig**	**Chicken**

Birth the door to life					
Civil marriage					
Religious marriage					
Lobola negotiations					
Holiday celebration					
Circumcision					
Initiation to womanhood					
Graduation celebrations					
Traditional healer/ Sangoma					
Tombstone ceremony					
Funeral					
Death-return to the ancestors					

C3. What do you consider on animals for traditional purposes?

	Sex		**Colour**		**Age**	
Consider	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Birth the door to life						
Civil marriage						
Religious marriage						
Lobola negotiation						
Holiday celebrations						
Circumcision						
Initiation to womanhood						
Funeral						
Tombstone ceremony						

Death- return to the ancestors						
Graduation celebrations						
Traditional healer/ Sangoma						

C4. Which part do you consider more important when slaughtering for the following ceremonies (1. Neck, 2. Bile, 3. Flank, 4. Breast, 5. Legs, 6. Ribs, 7. Blood and 9. others)

	Cattle	**Sheep**	**Goat**	**Pig**	**Chicken**
Birth the door to life					
Civil marriage					
Religious marriage					
Lobola negotiations					
Holiday celebration					
Circumcision					
Initiation to womanhood					
Graduation celebrations					
Traditional healer/ Sangoma					
Tombstone ceremony					
Funeral					
Death- return to the ancestors					

D. SLAUGHTER PROCESSES											
D1.Which animals do you prefer most on different types of ceremonies? (Rank 1 as the most important animal)											
	Types of ceremonies										
species	**Lobola**	Religious wedding	Civil wedding	Graduation celebration	Traditional healer	Circumcision	Funeral	Death–return to the ancestor	Tombstone ceremony	Initiation to womanhood	Birth the door to life
Goat											
Sheep											
Cattle											
Donkey											
Horse											
Pigs											
Chicken											
Other (specify)											

D 2.What procedures do you follow when slaughtering animal for different ceremonies
Birth the door to life (Animal, procedure & instrument used for slaughter) ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ………………………………………………………………………………………
Lobola (state animal, procedure & instrument used) ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ………………………………………………………………………………………
Religious marriage (Animal & procedure & instrument used for slaughter) ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ………………………………………………………………………………………
Civil marriage (Animal, procedure & instrument used for slaughter) ……………………………………………………………………………………… ……………………………………………………………………………………… ……………………………………………………………………………………… ………………………………………………………………………………………
Graduation ceremonies (Animal, procedure & instrument used for slaughter) ………………………………………………………………………………………

....
Traditional healer/ Sangoma (Animal, procedure & instrument used for slaughter) ....
Circumcision (Animal, procedure & instrument used for slaughter) ....
Funeral (Animal, procedure & instrument used for slaughter) ....
Initiation to womanhood (Animal, procedure & instrument used for slaughter) ....
Death to the ancestors (Animal, procedure & instrument use for slaughter)

……   ……   ……   ……
Tombstone ceremony (Animal, procedure & instrument used for slaughter)   ……   ……   ……   ……

D3. Which people are most important during different types of ceremonies? (Rank 1 as the most important person)							
		Recommended people					
Type of ceremonies	**Grand parents**	**Parents**	**siblings**	**External family**	**friends**	**Pastor**	**Others (Specify)**
Birth the door of life							
Ritual marriage							
Civil marriage							
Traditional healer/ Sangoma							
Graduation celebration							
Circumcision							

Initiation to womanhood							
Funeral							
Death-return to the ancestors							
Tombstone ceremony							
Lobola							
Public holidays							

D4. Where do you slaughter the animals during the following ceremonies? (1. Man-made kraal, 2. any field, 3. house, 4. Garden and 5. butcher)												
			Ceremonies									
Animals	Ritual marriage	Civil marriage	Traditional healer	Graduation celebration	Circumcision	Funeral	Lobola	Birth the door to life	Tomb-stone ceremony	Initiation to womanhood	Dearth-return to t ancestors	Public holiday
Cattle												
Goat												
Sheep												
Horse												
Pigs												
Chicken												
Donkey												

D5. Who should slaughter the animal during ceremony? (Mark 1 as the most important or recommended person)							
Recommended person							
Ceremony	**Grand parents**	**Parent**	**Siblings**	**External Families**	**Friends**	**Pastor**	**Other (specify)**
Birth the door to life							
Ritual marriage							
Tomb-stone ceremony							
Graduation celebration							
Civil marriage							
Traditional healer/ Sangoma							
Circumcision							
Initiation to womanhood							
Funeral							
Death-return to the ancestors							
Lobola							
Public holidays							
E. Any Additional comments about traditional slaughter of animals?							

Appendix 2: Beef characteristics

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Date:

Village or Abattoir name:
…………………………………

BEEF CHARACTERISTICS RECORD SHEET

INBORN CHARACTERISTICS					**FATNESS**							**CONFORMATION**					**TEETH #**
Ani. #	**Brd**	**Sx**	**Age**	**Wt**	**No Ft 0**	**V. lean1**	**Lean2**	**Med3**	**Ft4**	**Ovr.Ft5**	**Ex.Ft6**	**V.Flt1**	**Flt2**	**Med3**	**Rnd4**	**V.rnd5**	