ARTISANAL MEAT PRESERVATION KNOWLEDGE AND QUALITY ASSESSMENT AMONG BORANA PEOPLE OF NORTHERN KENYA

BUKE GALMA DABASSO

DOCTOR OF PHILOSOPHY

(Food Science and Nutrition)

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

2019

Artisanal Meat Preservation Knowledge and Quality Assessment among the Borana People of Northern Kenya

Buke Galma Dabasso

A Thesis Submitted in Partial Fulfilment for the Degree of Doctor of Philosophy (PhD) in Food Science in the Jomo Kenyatta University of Agriculture and Technology

2019

DECLARATION

I, the undersigned declare that this research is my original work and has not been presented to any other college, institution or university for an academic award

Signature..... Date.....

Buke Galma Dabasso

This thesis has been submitted for examination with our approval as the university supervisors

Signature..... Date.....

Prof. Anselimo O. Makokha PhD

JKUAT, Kenya

Signature …….

Date……

Prof. Arnold N. Onyango PhD

JKUAT, Kenya

Signature..... Date.....

Dr. Julius .Maina Mathara. PhD

JKUAT, Kenya

DEDICATION

I dedicate this thesis to my husband Bulle Golicha and my children Diramu, Darmi, Adale and Rufo for their unwavering support and understanding during my long period of absence from home as I undertook this study. Also, to my parents and all family members, I thank you all, for your special prayers and encouragement during the period.

ACKNOWLEDGEMENT

First and foremost, I thank the almighty God for giving me good health and opportunity to undertake this study and for his blessing. My special gratitude goes to my supervisors;-

Prof. Anselimo Makokha, Prof. Arnold N. Onyango, Dr. Julius Maina and Dr. Hassan Roba, for their professional guidance and encouragement throughout all the stages of proposal writing, data collection, data analysis, paper writing and reviews.

I appreciate and thank RELOAD (Reducing Losses Adding Value) project for funding the research through its partner the National Museum of Kenya. Special mention goes to Mr. Michael Hesse and Ms. Peris Kariuki who were always at hand in support and encouragement. Many thanks goes to Prof. Brigitte Kaufmann for her enormous support and technical direction in the areas of local knowledge and qualitative research. The opportunity to visit Germany in an exchange programme at DITSL(German Institute for Tropical and Subtropical Agriculture) or development and designing of proposal and attending various conferences and training gave me international exposure and experience which shaped my research.

I acknowledge the Kenya Agricultural and Livestock Research Organisation (KALRO) for granting me study leave to pursue this study, and in particular much appreciation goes to my institute Director, Dr. Charles Waturu Nderitu for his encouragement and support during my study period. Special thanks goes to Ms. Qaabale Diba, Centre Director Sheep, Goats and Camel Research Institute (SGRI), KALRO, Marsabit for her encouragement and support.

I also extend my deepest appreciation to women groups and individual respondents involved in this research for their important role during the data collection; this study would not be complete without them. All the women in the groups that I have worked with during this study deserve my most heartfelt gratitude. To mention but a few, Mama Galgallu, Tume, Abuke, Daki, Hadija, Darmi and Qabale, shared their special knowledge and supported in mobilising groups during interviews and practical demonstrations.

I am appreciative of the technical support and assistance I got from Department of Food Science and Technology at JKUAT, and special thanks go to Mr David Abuga and Ms

Jennifer Wambugu who assisted severally during chemical and microbial analysis. Last but not least I am grateful to Barako Golicha, Abdi Galma and a host of my friends and family members who, in one way or another, were involved and supported me in this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of variance
AOAC	Association of Official Analytical Chemists
°C	Degrees Centigrade
FAO	Food and Agriculture Organization
HPLC	High performance liquid chromatography
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agricultural and Livestock Research Organization
RELOAD	Reducing Losses Adding value
RT	Room temperature
TBARS	Thiobabituric Acid Reacting Substances
TVC	Total Viable Counts
SPSS	Statistical package for social scientists

DEFINITION OF LOCAL TERMS AND TERMINOLOGIES

Abrasa,	Month of Slaughtering *Chonni*-a ceremony
Adhayu	A Lady Who is lazy in handling household chores
Alaqa	A Lady Who Handles Issues in a Perfect Manner
Basaa, Adhano	Fat from Milk
Banya, Bisiq	Sticks Used for Fumigating Storage Items
Buthunu, Itille, Licho	Traditional Artefacts
Burki, Unga Mandazi	Wheat Flour Product
Chomm, Morr, Qorr	Fat Extracted from Meat
Chonni, Sorio, Jill	Traditional Ceremonies
Dhankah, Masen,	Barren Female Cows
Damansa	Mouldy Like Growth
Dirra, Chumfa, Baasa,	Traditional Meat Preservation Techniques
Dakar, Agobaya,	Sticks used for Smoking Traditional Storage Items
De'effe, Dam	Nourishment
Dhool, Dhibe Subb	Meat Storage Items
Fuda,Gubis, Mogati	Traditional Ceremonies
Garbu- Barley	Barley products
Fonntuma, Guguble	Traditional Meat Products
Jaji, Dadam, Dhigalo	Raw Traditional meat Products
Jagi, Indhore	Traditional artefacts
Jifuu	Share given to neighbours or relatives
Kharab,Sangaa,	Castrated Bull, a highly regarded castrated bull

Koche	Names of Preserved cooked Meat Products.
Kochesa Alalo *Guba,*	Other Traditional meat products
Miyu, Qodha, Okole	Traditional Artefacts
Obattu, Totu, Tisitu, Oketu	People Who Takes Care Of Cattle
Radhu, Kataweel	Traditional meat products
Siqe,Ororo Saqa, Saqe, Qori	Traditional Artefacts
Tuma, Qofata –Kalankal	Traditional Meat Processing Methods
Ulma, Nagesu, Medich	Traditional Ceremonies
Wadha, Konsa, Dhafinsa	Artisanal Meat Preservation Techniques.

ABSTRACT

Food preservation has been practised for centuries by different communities around the world, manifesting in different ways and in different localities. Meat is a highly valued food among the Borana pastoralist community who produced a number of traditionally preserved beef and goat meat products. Meat is not only relished for eating and nutritional contentment, but has also multiple social and cultural roles among the Borana community. Although these traditional meat products are widely utilised and appreciated, there is little information about their quality, especially because some of them are preserved with fats and other ingredients. Therefore, this study documented knowledges of artisanal meat preservation as practised by women of the Borana community and social cultural links of these products to the people in northern Kenya. This documentation is geared towards preserving the indigenous knowledge that has existed amongst the Borana community since time immemorial, but which would otherwise be lost with the passing of the older generation. Due to the sensitive and perishable nature of meat, analysis on proximate, safety and quality and of the artisanal meat product was done to establish nutritional values, safety, quality and of these traditional meat products. The study used both qualitative and quantitative methods to generate required information about the preservation and processing of artisanal meat. The data collection methods included household survey, consumer evaluation questionnaire, key informant interviews, narrative interview, focus group discussions and practical demonstrations through participatory observation. For laboratory analysis chemical, microbial and quality indices were determined for the artisanal meat products. To check for preferences and sensory quality, consumer evaluation was done. The result for the study was structured beginning with determination of knowledge and skills, then cultural aspect of artisanal meat, chemical and microbial profile of artisanal meat and finally current status of the meat. It was observed that methods of traditional meat processing and handling included different forms of drying, use of heat and storage in fat. Fourteen traditional meat products and seven preservation techniques were documented, and it was found that drying and deep frying was the major form of meat preservation. Nevertheless, it was observed that only four of the products are currently in use, an indication of steady decline in traditional meat processing practises among the community. The results also showed that, cattle played an important economic and social cultural role in Borana community where the processes of *sanga* slaughtering was used as coping mechanism during severe droughts in mitigating food insecurity and also played important role in enhancing the social cultural fabric. Result from chemical and microbial analysis of artisanal products showed moisture contents of the meat products ranged from 3.3 to 6.1 %, crude protein contents ranged from 55.8 to 72.5%, crude fat ranged from 9.4 to 13.3%, crude ash ranged from 1.7 to 2.8 %, crude fiber ranged from 1.5 to 4.1%. The result indicates strongly that artisanal meat products are nutrient rich product and have low moisture content indicative of longer keeping quality. The microbial results showed that there was presence of *Staphylococcus aureus*, yeast and mold for the period of seven weeks observed. There was significant ($p<0.05$) increase of *staphylococcus aureus* from (1.44 log cfu/g) to (2.28 log cfu/g) over the observed period at ambient temperature. For rancidity indices, free fatty acid and peroxide values increased significantly ($p<0.05$) from 0.97% to 2.05% and 2.26% to 4.45 % respectively

at week 1 and week 7. TBA levels were below the value associated with meat spoilage during the expected shelf life. Microbial and quality indices results gave positive outlook of the artisanal products. However, there is need to improve hygiene and sanitation during the traditional processing of the various meat products. The general status of artisanal meat processing and preservation practises showed that pastoralist women had skills and knowledge of processing the traditional meat products. The products were highly regarded among the community. The sensory evaluation done on perception of these products revealed that the products were well liked as special food with good organoleptic indicators.

There is good potential for scaling up production of these traditional meat products. The gap observed was that the women have notion and inherent belief that the artisanal meat products were meant for special occasion and never regarded to be for sale. The result form this study on documentation of these traditional meat products and its nutritional and quality status was important and forms the basis of exploring the options of income generation by the women groups.

CHAPTER ONE
INTRODUCTION

1.1 Background

The oxford dictionary defines 'knowledge' as 'facts, information, and skills acquired through experience or education; the theoretical or practical understanding of subject' (Oxford, 2014). As scholars have argued, it is important to remember that knowledge is not fixed or universal…Rather, knowledge is situated, partial, and embedded in a context/place/position, be that a scientific laboratory or a village kitchen (Haraway, 1991; Nightingale, 2003; Richardson-Ngwenya, 2012)

This study explored knowledge of artisanal meat preservation as practised by women of the Borana community in northern Kenya. With a view to documenting traditional meat processing and preservation and to determine nutritional and quality of the meat traditional products, the knowledge at stake in this project are highly diverse. This study actively engaged with the knowledge and practises of: local women producers in Marsabit County, food scientists, and consumers in villages and town centres. These different actors have different knowledge of, ideas about and experiences with this food products.

This approach goes against the entrenched dichotomy between science and local knowledge by critically and reflexively exploring the diverse knowledge around artisanal meat preservation. The overarching purpose was to integrate this knowledge to effectively bring out the potential for income-generating activities for the benefit of the community. Agarwal (1993) indicated that when we seek out bridges across the constructed chasm between the traditional and the scientific, then we will initiate a productive dialogue to safeguard the interests of those who are disadvantaged. Kelkar (2007) and Long (2001) concurred that scientific and non-scientific constructions should not be seen to be running parallel to each other; rather, they intersect within knowledge networks.

Due to sensitive and perishable nature of meat, analysis on nutritional quality and shelf life of the artisanal meat product was important to add value in terms of safety, quality and marketability of these products. Pastoralist have shown that they are willing to pay

for better quality food product, specifically, by more than 19% premium for assurances about milk safety, as indicated by (Wayua, Shibia & Lengarite, 2008).

Therefore, this study sought to identify and document local knowledge on approaches to meat processing and meat preservation in the pastoral production system. It also seeks to strengthen these approaches with laboratory analysis and value additions to establish information regarding the meat products for the Borana women to explore options of income generations.

1.2 Statement of the problem

Livestock keeping is the main economic activity in Marsabit County with the main livestock being cattle approximated at 218,755, goats at 1,186,482, sheep at 2,029,490, camels at 217,368. The main livestock products are: milk, beef, mutton and camel meat' (Marsabit County Integrated Development Plan, 2017)

Although, meat products preserved locally were consumed by Borana, there has been limited scientific investigation regarding the processing techniques, quality and safety aspects. High meat supply levels have existed amongst pastoralist, and indigenous preservation techniques have been used to overcome it. (Field, 2000). However, such practises amongst pastoralists in northern Kenya were poorly documented mainly the meat knowledge.

There was limited research on this important topic and the few documents available were on the Somali version of the product (*nyirinyiri*) (Field, 2000, 2012); (Kuria, 2010). The artisanal meat knowledge is tacit and verbalized sparingly, making it vulnerable to becoming extinct or unavailable as a coping measure by Borana community especially during drought. This study sought to address the knowledge gap through collaborative documentation as there is potential and opportunity for its beneficial use.

Despite the fact that these artisanal products are widely consumed locally, there was concern about their safety and acceptability as there was no information available about their quality. Some studies on quality of cooked meat revealed that there is public health concern due to improper handling, recontamination or storage conditions (Tajkarim,

2013; Abongo, 2009; Raji, 2006; Borch, 2002). Therefore, in order to understand these traditional meat products, there was need to establish its quality and shelf life.

1.3 Justification

This study has evaluated artisanal meat preservation techniques amongst the pastoral communities while investigating community approaches to meat handling, preservation and processing techniques with a view to establishing and documenting this knowledge and to determine the quality of this product.

The study was aimed at providing information on local meat processing and preservation techniques and determined nutritional, quality and safety characteristics which contributes towards providing information and form basis for options of value additions by Borana Women groups.

The study was also in line with Goal 1 and 3 of Millennium Development Goals (MDG) of eradicating extreme poverty and hunger, promoting gender equality and empowering women (UNDP, 2012) particularly among the pastoralist communities in this case.

Furthermore, the study was in tandem with Economic pillar of Vision 2030 and Marsabit County's flagship projects to improve profitability of livestock trade sector, the county shall invests in better coordination of livestock value chains, creative branding of meat products from Marsabit County and enacting structural changes to enable better linkages to meat clients in Nairobi and in export markets (Marsabit County, 2013).

This study further contributed to the subject body of knowledge, guiding professionals and practitioners of food science and technology, food artisans and researchers in general on indigenous knowledge for meat processing and preservation amongst the pastoral communities, and mitigating with compatible modern approaches, yielding a working manual for use amongst interest groups.

1.4 Objectives

1.4.1 Overall Objectives

The overall objective was to document artisanal meat processing techniques among Borana community of northern Kenya, and investigate options for enhancing quality and value additions

1.4.2 Specific Objectives

1.4.2.1 To describe and document artisanal meat preservation and processing techniques among Borana women of Marsabit County

1.4.2.2 To determine social cultural importance of artisanal meat processing and products among the Borana

1.4.2.3 To determine nutritional composition of the artisanal meat products

1.4.2.4 To assess and ascertain the microbial and quality charactersitics of artisanal meat products

1.4.2.5 To determine factors that affect consumer acceptability of the artisanal products among Borana and other communities

1.5 Hypotheses

1.5.1 There is little information on artisanal meat processing and preservation knowledge and skills among Borana women of Marsabit County

1.5.2 There is no variation among the types of artisanal meat products in relation to its chemical, microbial and quality characteristics.

1.5.3 There is no significance in acceptability of traditional meat products by the consumers among the Borana and other communities

1.6 Theoretical Framework

1.6.1 Knowledge Spiral Model

The knowledge spiral model has been proposed by the Japanese Scientists (Ikujiro Nonaka and Hirotaka Takeuchi, 1995), based on their studies on management and knowledge development in Japanese companies. This model has been very influential in management schools and it also found its way into a small community of people working on innovation in agriculture (Lwoga, 2010) in Tanzania and Nigeria (Ha, Okigbo & Igboaka 2008).

In relation to local meat knowledge among the pastoralist of Northern Kenya, this model was useful in describing and conceptualizing the roles and cooperation of women practitioners and the researcher aiming jointly at finding the potential and opportunities for local meat knowledge.

The model strongly relies on the concept of tacit/implicit knowledge as it was proposed by Polanyi, (1995). The model has four conversion modes: socialization, externalization, combination and internalization.

For the Borana, local meat preservation was a tacit knowledge and was embedded in the skills of women practitioners and the cooking and storage tools they use. It was also a process where the women just used unwritten scripts to do the preparations step by step. This tacit knowledge was not verbalized much as it was learnt by doing (Nonaka ,1995)

The central thought of the model was that tacit knowledge held by individuals or certain groups was shared with other individuals or groups so that it interconnects to a new (shared, explicit) knowledge. It was then combined with other knowledge held by the people involved, so that it becomes connected to the things they already know. It can add to this knowledge or let it appear in a new light. As a final step, it will appear again as tacit knowledge but at a higher level (Nonaka, 1995)

Table 1.1: Tacit/Explicit Knowledge Model

	Tacit knowledge	*to*	Explicit knowledge
Tacit	Socialization Sharing knowledge through in-depth interview, Face to face conversation		Externalization Articulating knowledge through dialogue Demonstration observations, and artifacts
From			**knowledge**
Explicit	Internalization Learning and acquiring new tacit knowledge in practice		Combination Systemizing and applying explicit knowledge through writing
			knowledge

CHAPTER TWO
LITERATURE REVIEW

2.1 Food Cultures and Meat Preservation

Food preservation is a phenomenon that has been practised for centuries by different communities around the world, manifesting in different ways in different localities. In Asia, America and Europe, local food preservation techniques have been practised either to increase shelf life of food, to reduce spoilage or to enhance flavour or taste (Bora, 2014; Nam, 2010; Rai, 2009; Guyot, 2006; Bessière, 1998; Marshall 1979). Food preservation practises are part of food cultures, or food ways. Food is not only for energy source and not only an occasion for sociability, but a patrimony and, as such, a strong element of local identity and culture (Fonte, 2008). Food ways include activities such as, handling, processing, preparation, cooking, storage and eating habits of food (Nam, 2010).

In Africa, there are various traditionally processed and preserved cereals, vegetables, and milk and meat products. These include *pastrima* (Egypt,), *odka* (Somalia), *qwanta or olobe* (Ethiopia) and *kilishi* (Nigeria) (Omojola, 2008; Mohammed, 2003). In Kenya, communities such as Bukusu, Luo, and Somali also have their local food preservation practises and products, such as *khusika*, *omena* and *nyirinyiri* respectively. (Chikati, 2014; Kiplangat; 2008, Oniango 2004)

The main ways of preserving meat traditionally are drying, smoking, salting and fermentation, or combinations of these processes.

As with other cultural groups, among the Borana residing in Southern Ethiopia and Northern Kenya, food is not only relished for eating and nutritional contentment, but has multiple social and cultural properties. For example, milk and meat are intertwined in the social fabric of Borana, where there is sharing and loaning of cows to relatives and among clans (Upton, 1986). Hence, it is essential to remember that food is a social commodity and has cultural value. As Mintz (2002) pointed out, eating and ritual is a mechanism for

maintaining ecological balance in local environments and/or for redistributing food. In relation to meat in the Borana cultural context, it forms part of many social occasions, rituals and ceremonies. Furthermore, skills and artefacts have emerged through the interactions of people and food, as numerous methods of processing and storage materials have been developed and maintained.

In Borana culture, the role of a man is to provide family security through livestock regeneration (Dahl, 1990). Livestock is a family resource owned by both the man and woman but for it to be used especially selling, the control mostly rest with the man. Women on the other hand, though contributing towards the labour of herding and by taking care of young animals and feeding, have to consult husband for use. Women are in charge of livestock products (milk and meat) and decisions of buying and cooking food are in woman domain. Kelkar,(2007) noted that the gender of an individual actor and gendered institutional norms do have a major significance in influencing the entire process of acquisition, processing and transfer of local knowledge.

2.2 Nutritional importance of meat

In meat, the essential amino acids that are integral components of proteins and which cannot be synthesized in the human organism – are made available in well balanced proportions and concentrations. As well, plant food has no Vitamin B12; thus animal food is indispensable for children to establish B12 deposits. Animal food, in particular meat, is rich in iron, which is of utmost importance to prevent anaemia, especially in children and pregnant women (Heinz & Hauntzinger, 2007). Further meat processing has economic, dietary and sensory aspects that make it one of the most valuable mechanisms for adequately supplying animal protein to human populations.

Through meat processing, all edible livestock parts which are suitable for processing into meat products can be optimally used. In addition to muscle trimmings, connective tissue, organs and blood, casings of animal origin are used as sausage containers.

2.3 Use of meat among the Borana

Amongst the pastoralist communities, milk and meat production is the cornerstone of production system, and more often abundance occurs without possibility of immediate consumption, triggering the need to preserve surplus for future consumption (Field, 2000). While small stock (goats & sheep) are of convenient size for a family consumption without need for preservation, the slaughter of larger ruminants necessitates the need to employ meat preservation techniques.

Historically, other than being everyday food, the local meat knowledge was as a result of a need to cope with food insecurity experienced during famine where livestock was slaughtered to preserve for the future. This is observed by Field (2000), who opined that the traditional approaches to food preservation, especially meat handling and preservation, helped avail meat to the pastoralist families during times of long drought.

According to Argawal (1993), knowledge is generated in the immediate context of the livelihoods of people; it is a dynamic entity that undergoes constant modifications as the needs of the community's change. The artisanal meat knowledge among the Borana is embedded but also dynamic, due to social- economic and cultural changes caused by urbanization and education the products have under gone some transformations. There are the original 'traditional' artisanal meat products practised by elderly women and the 'modern' products practised by younger women where spices are added (Dabasso et al, 2018).

However, like in many other rural societies the traditional knowledge in handling, processing and preserving foods are under threat from modernization where better traditional practices have been forgone for supposedly better industrial processing approaches of foods that are expensive and actually unavailable to the rural folks. This is aggravated by generational change without traditional knowledge changing hands and situation is further heightened by more frequently occurring drought and growing demand for food products, especially processed meat products

2.4 Role of women in indigenous meat preservation

Amongst the pastoral communities of Northern Kenya, women remain charged solely with the responsibility of handling, processing and preserving food, and more specifically handling of dairy and beef products, in addition to securing water and fire wood for food preparation at the household level (Keya, Ngutu & Adongo, 2005). As the managers of available local resources and knowledgeable about local resources and environment rural women are best placed to ensure sustainable food supplies and hence achievement of household food security (Ibnouf, 2011).

The local knowledge of meat processing was transmitted from one generation to another where young girls and women learnt from the older ones through observation and experience. This knowledge is public in some aspects because for the woman to use family resource in this case livestock she needs to discuss with the husband or (in case of purchasing from butchery, the man provides money). However, men do not traditionally make/cook the product, due to cultural conventions, hence are excluded from the process of preparation. Women on the hand, conventionally possess the skills and know the process and products, they are the custodians of such knowledge. Even among the women, there are some who are known locally for their expertise in making the local meat product (Dabasso, 2018).

2.5 Local meat products among the Borana

Traditional meat products are not consumed as day to day meal but mostly as a delicacy and also given to respected members of society, visitors, when the husbands come home from journey and the in-laws. It is regarded as welcoming and hospitable food. Also these meat products are used during special occasions such as ceremonies and weddings. For example when there is naming ceremony for the first borne child (as it's called *Gubbis* by the Boran*), koche* is prepared to be lavishly enjoyed and its container opened in a special way by the father of the child and his age mates to feast.

Among the Borana, when livestock is slaughtered, the most perishable parts are eaten first(liver, intestines, blood kidney and heart) then all the red meat and chunk is cut into strip and dried, the ribs and other meat on bone are eaten but the bones were not thrown away, it is boiled repeatedly and the soup consumed overtime. The head and legs were

roasted then boiled to make soup. The dried strip meat is prepared to make koche and g*uba*. The fat and fatty parts are fried to extract fat and stored as *chomm* and stored in a *dhool*. Even the skin and hides were processed and utilized as food. The preparation of these products has also the social part, when one homestead slaughters the bull, the neighbouring women give a hand in preparing the products, hence there is socializing and networking. It is also a norm among the Borana to share the meat with close relatives and pregnant women, *Jiffu*. This is described by Bessiere (1998) that the culinary heritage we find in rural areas corresponds to the memory of a whole group to its roots, which generates a feeling of belonging to this particular area, investing it with value.

Unfortunately, these vital skills and practises of indigenous meat preservation knowledge is often underrated and, in the process, this important knowledge are at risk and on the verge of disappearing if documentation is not done. Consequently, it is important to know why there is decline in the use of knowledge and less use among younger people who are either ignorant about the knowledge or abandoning it all together. Bessière(1998) further suggested that promoting a specific gastronomic product by conserving skills and techniques leads to re-enacting history, re-appropriating what has been lost and also helping to create, innovate and accept change.

Local meat preservation knowledge also faces potential loss due to lack of use by younger members of the society and to gradual loss of senior members of the society who know the most about the skills. Thus, it is important to document and address the identified gaps to improve on the traditional meat products by exploring ways of value additions through simple and adaptable technologies to diversify income opportunities in the pastoral areas.

Generational change and modernization is also contributing to loss of traditional meat preservation knowledge as more pastoralist are changing trends to settlement and young people are oblivious of traditional ways of preserving meat. These was observed by Waliongo, (2009) opined that indigenous knowledge transfer systems are collapsing, creating gaps in knowledge regarding production and utilization of indigenous foods.

2.6 Meat drying

Reducing the moisture content of the meat is achieved by evaporation of water from the peripheral zone of the meat to the surrounding air and the continuous migration of water from the deeper meat layers to the peripheral zone

Meat used for drying amongst pastoralist is usually derived from fresh carcasses, and rapid ripening processes occur during the first stage of drying as the meat temperature continues to remain relatively high. For that reason, the specific flavour of dried meat is completely different from the characteristic flavour of fresh meat.

2.7 Meat quality and deterioration

As meat ages the fat deteriorates through microbial attack and tissue enzyme activity which causes the development of free acidity and oxidation of unsaturated fatty acids. Free Fatty Acid values in meat progressively increases with storage time. For the odour to be acceptable the free fatty acid (FFA) should not exceed 1.2% Pearson, (1986).

Food quality is a multivariate notion ('it tastes good – it looks traditional, safe, healthy, etc.'). Traditional foods are sometimes used to carry an image of foods tasting good but in the same time could be perceived either good for health (as related to natural products, no chemical modification, no additives) or bad for health (as related to high fat content, microbial contaminants) (Cayot, 2006)

According to guidelines for microbiology, Anita S. Curry and Joyce G. Graf (2001) the total viable count, is one of the most common tests applied to indicate the microbiological quality of food. *Enterobacteriaceae* are useful indicators of hygiene and of post-processing contamination of heat processed foods.

Further the guideline Anita S. Curry and Joyce G. Graf (2001) state that contamination of ready-to-eat foods with coagulase-positive staphylococci is largely as a result of human contact. Unsatisfactory levels of coagulase-positive *staphylococci* indicate that time/temperature abuse of a food is likely to have occurred following improper handling during food preparation.

The food preservatives are essential in preserving the required food attributes such as tastes, chemical composition and thereby improving food shelf life and quality. Plants and their essential oils are used as preservatives, due to variety of secondary metabolites they contain and that have been identified for their ability to inhibit the growth of bacteria, yeasts, and moulds (Chorianopoulos 2008). The antimicrobial compounds in plant materials are commonly found in the essential oil fraction of various plant parts, including leaves (as in rosemary and oregano), flowers or buds(clove), bulbs (garlic and onion), seeds (fennel and parsley), and fruits (pepper) (Gutierrez and others 2008). These compounds may inactivate bacteria or inhibit the production of undesirable metabolites. Generally, essential oils are more effective against Gram-positive than Gram-negative bacteria (Chorianopoulos and others 2004; Gutierrez and others 2008).

The artisanal meat products have been consumed by Borana for a long time. These days these products are prepared by adding ingredients such as spices. It was important to test the effect of these additions and ascertain the contributions oxidative stability attributed to antioxidant properties of the phenolic substances and plant flavonoids contributed by the ingredients such as spices, onion and other plant products. Watts (1962) demonstrated that a number of plant extracts can prevent rancidity, showing that pepper (pods and seeds), onion extract and potato peelings were effective in retarding lipid oxidation in sliced roast beef.

2.8 Indigenous meat preservation knowledge

Use of indigenous knowledge to solve food shortage in times of drought/famine or food surplus in times of rare bumper harvest remains powerful means of sustaining household food security. (Ibnouf, 2011). Even in the absence of modern processing technology, the traditional approaches to food preservation, especially meat handling and preservation, helped avail meat to the pastoral families (Field, 2000), where meat was preserved and gained shelf-stable capacity, providing good nourishment to the whole family during times of severe long-lasting drought, and while on transit in search for pasture and water, or during floods or conflicts and escapes to safer grounds. Local food preservation

techniques have also been praised for being natural and free from chemical additives unlike many industrial food products.

Indigenous knowledge among the pastoral communities also represents valuable source of local solutions to the food insecurity in terms of accessibility by the rural population, particularly during seasonal food shortage or major stress periods such as droughts (Ibnouf, 2011).

2.9 Aspect of knowledge

Local artisanal knowledge is not only place based but interacts with surrounding social economic systems and cultural contexts. It is also embedded in history. According to Fonte (2008) and Sylvander (2004), 'local' refers not only to the dimension of space (zero miles), but also to the dimension of time, then tradition and history, the complex of characteristics that gives birth to the socioeconomic concept of 'territory'.

Moreover, Maretzki, (2007) has shown through Chiparoo processing procedures that the local knowledge has potential when options of value additions are explored. The ''Chiparoo'' was developed at the Pennsylvania State University. Waliongo, (2009) suggested that recipe development offers potential for increased product variety for the changing tastes and for improved marketability of the products

All Knowledge, be it scientific or local is embedded in social, physical and cultural environments and real-life practices. Sometimes knowledge is hidden and learnt by doing. Knowledge is situated and partial as Nightingale (2003) noted, 'all knowledge is partial and linked to the contexts in which it is created'.

The term` traditional` knowledge sometimes has a negative connotation of referring to knowledge that is old fashioned and used by people who are not 'modern' or exposed to Western ways of doing things. This is indicated by Antweiler (1998) who opined that traditional knowledge implies a rather static perception of knowledge with a low level of change. On the other hand, it has been argued that traditional is not necessarily ancient, knowledge is created every day and evolving due to responses to changing social environment (Fonte, 2008; WIPO, 2002).

CHAPTER THREE

INDIGENOUS MEAT PROCESSING KNOWLEDGE AMONG THE BORANA PASTORALISTS OF MARSABIT COUNTY

3.1 Abstract

Indigenous knowledge on food preparation is an activity practised in almost all agricultural production systems. Amongst the Borana pastoralists of Northern Kenya, milk and meat production are the cornerstone of livelihood, and more often abundance occurs without possibility of immediate consumption, triggering the need to preserve surplus for future consumption. The objective of this part of the study was to document and understand traditional meat preparation knowledge amongst Borana pastoralist women of Northern Kenya

The method of collecting information included in-depth interviews and participant observations to document meat preparation skills and knowledge of Borana people as appertains to traditional food ways. It was observed that methods of traditional meat processing and preparation included different forms of drying, use of heat and storage in fat. Fourteen traditional meat products and seven preservation techniques were documented. Drying and deep frying were the major form of meat preservation. Women skilfully put a lot of effort in all stages of meat preparation to produce an end product that is not only shelf stable but traditional products that are appreciated and nutritious. It was observed that only four of the products are currently in use, an indication of steady decline in meat handling knowledge and preparation.

3.2 Introduction

Borana speaking groups are the predominant group in the Marsabit County and they dominate the area stretching from southern Ethiopia and vast parts of Northern Kenya. Borana and majority of neighbouring pastoralists still rely on pastoral livelihoods that are based on frequent mobility to access pasture and water resources. However, due to social economic changes such as urbanization and school system they have largely settled. A section of Borana community now practises subsistence and small-scale farming around Marsabit Mountain and Sololo escarpment. Livestock and crop production are the major economic activities with maize, sorghum, millet, beans, fruits and vegetables being the main crops as was mentioned in KNBS (2013).

Livestock herding is commonly practised among Borana, Gabra and Rendille groups which generally fall in two categories. One is home-based herding, which involves the herding and milking cattle with calves and small stock close to the encampments and the other is satellite or *fora* herding (Liao, 2014). They keep cattle, small stock and to some extent camel.

While in the past the Borana used to depend on livestock and livestock products, the source of livelihood has changed currently. People now consume crop products such as cereals, pulses and vegetable oil. These are purchased from shops or donated by Non-Governmental Organizations who provided relief services or food assistance program especially during drought – a period of prolonged absence of good rains. This reduced dependence on livestock and livestock products has adverse consequences on the knowledge of food preparation methods and processing techniques.

Traditional food processing and preservation is a universal phenomenon that has been practised for centuries by different communities around the world, manifesting in different ways and in different localities. In Asia, America and Europe, local food preservation techniques have been practised either to increase shelf life of food, to reduce spoilage or to enhance flavour or taste (Bessiere, 1998; Bora, 2014; Guyot, 2006; Nam, 2010; Rai, 2009)

In Africa, there are many traditionally processed food products. For instance *Suya (tsire or balangu),banda (kundi*) and *kilishi* are the most important traditionally processed

meats in Nigeria and other West African countries (FNIFST, 2008). In Kenya, Chikati (2014) pointed out that meat could be dried in the sun and or on fire and then stored in the pot for as long as it was needed without rotting. Meat and fish were preserved by cutting into thin strips and drying by fire *(Khusika).* Oniango (2004) described that Somalis dried meat (*otkac or nyirnyir*) prepared from camel meat (*hilib gel*) where strips of sun-dried meat are cut into small pieces that are fried (usually in oil with garlic and (*iliki*) and immersed in camel ghee (*subag*). This is an indication that traditional food processing is an activity which has been practised in time and place.

Borana Pastoralists have profound knowledge of their livestock and their environment. Through daily intricate activities of managing livestock and livestock products they have acquired the knowledge over a long period of time. Management strategies employed by the local people to exploit the environment show that there is a store of indigenous knowledge which people have developed over generations through daily observations and practice (Akullo, et al 2007). The traditional meat processing knowledge maintained by Borana pastoralists is tacit in nature and thus only known to talented individuals within that community. In this case, the knowledge is held by women as demonstrated in the foregoing, as they prepare and process the traditional meat. According to Nonaka (2006) tacit knowledge is highly personal and hard to formalize as it is deeply rooted in actions and routines unlike explicit knowledge which is formal and systematic. Among the Borana, the daily activities of tending to livestock and domestic chores entails processes of socialization and networking. While men mostly perform outdoor activities mainly herding livestock, women usually take charge of domestic chores of milking cows, cleaning and preparation of food. Furthermore, these activities create a lot of interactions among the members of the communities creating atmosphere of actions where passing and learning of knowledge and skills happen naturally. As suggested by Fonte (2008) tacit knowledge is created through normal processes of socialization as a form of knowledge transmitted in a community through its social norms and habits.

Cajete (2000) opined that local knowledge was made understandable through demonstration and observation accompanied by thoughtful stories in which the lessons were embedded. Borana' local meat processing knowledge is rooted in the skills of women practitioners and the storage tools they use. Women milk cows using containers

made from hide and stored in gourds or wooden containers. Meat products are preserved in *dhibe* and *dhool (*traditional meat storage containers) made from hides and carved from wood. Roth (2001) pointed out that all artefacts are products of complex transaction and communication processes and that a lot of cultural knowledge and experience is "built" into them.

Traditional meat products were carefully prepared following the traditions, procedures and practises. Women paid careful attention to both taste, aroma and skilfully handled the products for appreciation by the family and communities. Women communicate through their cooking, asserting their place in the family and community, and shaping the actions and behaviours of others (Vallianatos, 2008). Such experts/skilled Borana women who possess the traditional meat processing knowledge are acknowledged and are identified in the villages. In their rural abode their skills and products are sought after beyond village borders elevating traditional meat product to a prestigious position in the community (Dabasso, 2018).

Feagan (2007), suggested that traits and characters of place and the skills of the producers and traditions of cuisine in septic places are perceived in such designation as containing more meaningful and comprehensive information about food status. It is this tacit knowledge and skills that Borana women have, which led to various processing and preservation of traditional meat products among the Borana communities.

However, like in many other rural societies the traditional knowledge in handling, processing and preserving foods is under threat from modernization where traditional practices have been neglected for supposedly better modern processing approaches of foods. The local knowledge of meat processing is thus declining, while the younger generations are not enthusiastic in learning the knowledge leaving this tacit knowledge to dwindle and remain restricted mainly amongst elderly women today. Ohmagari (1997) argued that social changes caused by modernization like schooling, and the introduction of television have induced value changes among the younger generation.

Therefore, documentation of valuable meat traditional knowledge is necessary so as to explore opportunity for reviving the knowledge and possibly promote the traditional products for income generation through value addition.

This is articulated by Bessière (1998) that promoting a specific gastronomic product by conserving skills and techniques leads to re-enacting history, re-appropriating what has been lost and also helping to create, innovate and accept change.

Moreover, since Borana traditional meat knowledge is tacit in nature, documentation of these knowledge and understanding, needs methods which can give not only historical experiences but practical aspect of processing. Hence various methods were applied to collect data and gather information. Thus, the objective of this part of the study was to document traditional meat preparation knowledge of Borana pastoralist's women of Northern Kenya focusing on the aspects of knowledge, processes, products as well as preservation techniques. . Waliongo, (2009). Suggested that recipe development offers potential for increased product variety for the changing tastes and for improved marketability of the products.

3.3 Materials and Methods

3.3.1 Study design

This study used cross sectional design where villages inhabited by Borana community were selected through key contacts. These were selected based on their geographic location, from a list of villages inhabited by the Borana tribes and included villages in Obbu, Sagante and Marsabit Central Divisions of Marsabit County. At the beginning of the study, the names and contact details of key contacts were gathered from each villages and a snowball technique was used to reach other respondents.

The groups were diverse, with people interviewed differing from each other in a number of ways like in terms of gender, age, marital status and composition of household. To build relationships through the research process focus was made on particular region and people to get in-depth information on traditional meat knowledge by employing integrated approaches of key informant interviews, narrative interviews and participant observation

3.3.2 Study sites

The study sites were Marsabit central, Sagante and Obbu divisions of Marsabit County which has four sub-counties. This study focused on Moyale and Saku sub-counties as depicted in Fig.1. In these sub-counties, Borana speaking people are majority. The area experiences temperatures ranging from a minimum of 10^{o}C to a maximum of 30^{o}C, with an annual average of 20^{o}C. Rainfall ranges between 200mm to 1000mm per annum and its duration, amount and reliability increases with increase in altitude (KNBS, 2013)

3.3.3 Study Population

Marsabit has a population of about 300,000 in terms of population density, while Moyale constituency has 103,799 and Saku has 46, 502 according to KNBS (2009) population census.

Traditionally, Borana were nomadic pastoralist but due to climatic and economic changes the livelihoods now include subsistence farming, small scale trade of livestock and livestock products. Borana who are in Marsabit Central and Sagante division practises agro-pastoralism where livestock such as cattle, goats, donkeys and camels are kept in a semi-sedentary pastoral system combined with crop cultivation in the humid zone of Mount Marsabit (Dabasso 2012). The Borana in Obbu division are still more rural and practise nomadic pastoralism. In addition to milk and meat Borana now prepare and consumes cereals, pulses, vegetables and fruits sparingly. Food is predominantly prepared by women and girls.

3.3.4 Sampling

The sampling frame for this study were women aged 20 and above in the household at the study sites and recommended by key contacts.

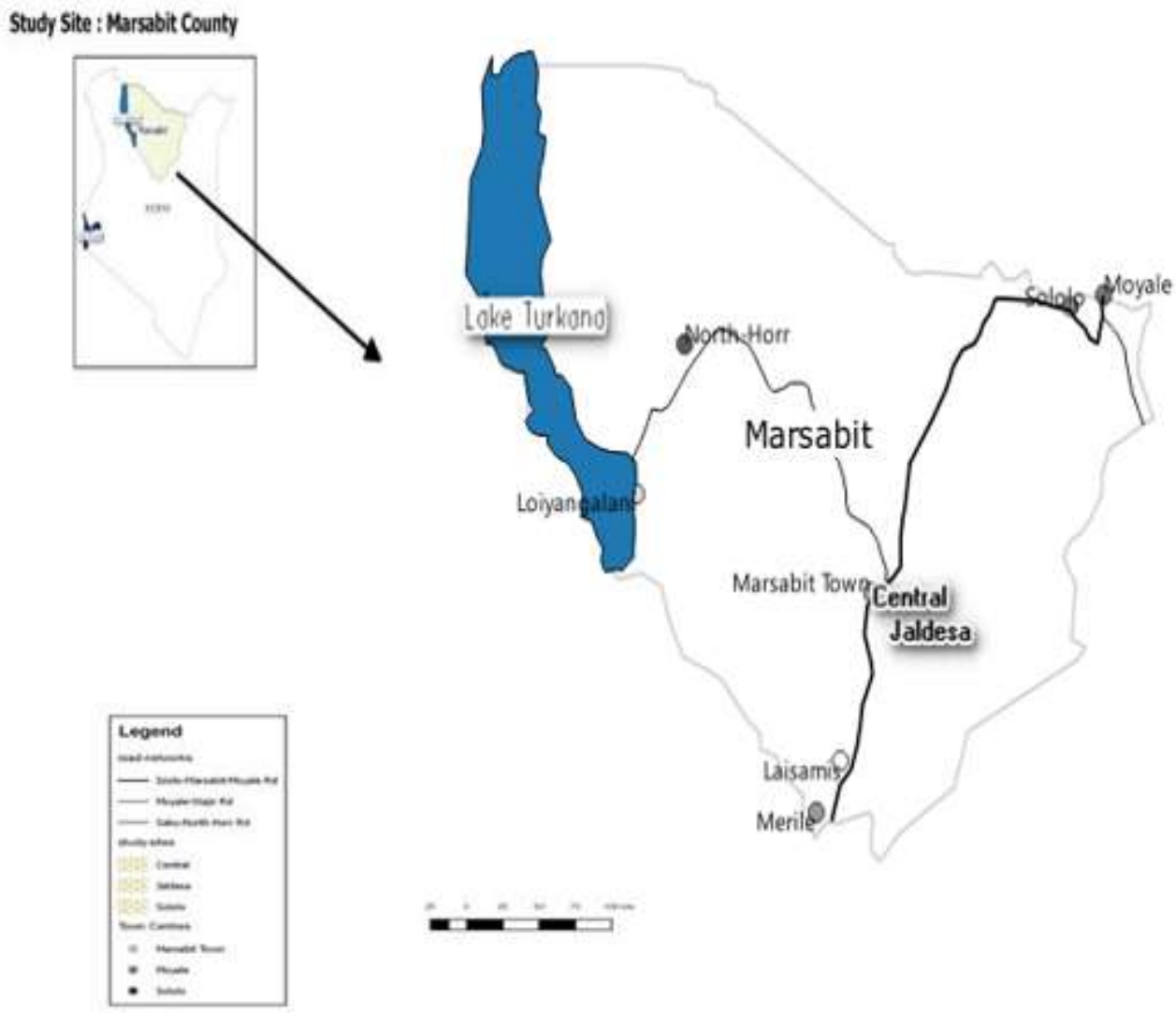


Figure3.1: Location of Marsabit County showing study sites – Sololo, Central and Jaldesa region.

3.3.5 Study Tools

3.3.5.1 Materials

Materials for production of Artisanal meat products were meat (beef, goat meat) knives, strings cooking oil, spices pots, and storage containers

3.3.5.2 Interview guide

A key informant guide and narrative interview guide (appendix.3 and 4) were used to document artisanal meat preservation techniques. For participatory observation, notes were taken as the women prepared the meat products. Questions were asked where clarification was required. A sound recorder and video were also used.

3.3.5.3 Equipment

The equipment used included weighing scale, thermometer, voice recorder and video camera.

3.3.6 Data Collection

Initially, key informants and narrative interviews were used to get detailed data from the knowledgeable women who have been recommended by the key contacts and elders in the villages. The in-depth interviews covered topics of what, how, when and why the traditional meat was processed and preserved. The respondents had time and space to give detailed information as they recalled and gave their experiences on the traditional knowledge. There were no interruptions and respondents were confident and gave passionate information and felt appreciated.

Secondly, participant observation was conducted with the women groups to get data as the action unfolded. The women prepared the products giving insights into preparation, processing and preservation of meat products as they demonstrated. The participants spoke the same language and the interview was conducted in Borana language as the researcher was also a native speaker of the language.

3.3.6.1 Narrative Interview

The narrative interview involved respondents to giving an account of experiences in traditional meat processing. At the beginning of the study, five knowledgeable women (three from Central and sagante divisions) and two from Obbu division) were identified with the help of local elders who were contact persons. After the interview, the women were asked to identify more knowledgeable women in their neighbourhood. In total ten more were identified, bringing the total of interviewed women to fifteen.

Participants were asked a series of open-ended questions about traditional meat processing and all activities involved recalling from their experiences. The respondents recalled their personal experiences and observations in traditional meat processing. The narration also included probing and clarification where necessary. Interviews generally lasted between forty minutes to one and half hours. To achieve a relaxed setting during the interview, ample time was created to initiate a small talk on general conditions of weather, livestock and happenings in the area, reducing any anxiety or feelings of uneasiness before starting the formal interview.

3.3.6.2 Key Informant Interview

For key informant interview, purposive and snowball sampling was used to identify informants who in turn led to more knowledgeable women on traditional meat preservation technique. The key informant questions to guide the discussions are in Appendix 4: In total, five key informants were interviewed and their responses recorded.

3.3.6.3 Participatory observation of traditional meat processing and preservation

The aim of participatory observation was to observe and record women groups as they demonstrated the activities of making the recipes and processing of traditional meat products. Abarca (2016), noted that the physical manipulation of a knife on a cutting board or dough rolled out on marble was a learned skill, and the memory of learning that skill was recalled in the process of performing these actions.

Participatory observation, were done with the same respondents of narrative and key informant interview. From the three research sites, five women groups were identified to participate in practical demonstrations of processing the traditional meat products. The groups consisted of rural based women groups and peri-urban women groups (refer to table 3.0). The sites for participant's observations were mostly at shared premises and in some cases at members home. All the participant observations took between two to three days. Day one was preparation and striping, day two was drying and day three cutting and cooking.

Sound recording and video recordings were used to gather information on activities of traditional meat processing. For example, what quality they want to see, why the criteria

mattered and selecting of criteria to be tested were recorded Appendix 4. Traditional meat product recipes and ingredients were documented through video recordings to come up with checklist for traditional meat products among women groups in each location.

To document recipes and ingredient of meat products, five clusters of knowledgeable women groups in each location were engaged in practical demonstration on how to prepare various traditional meat products. Meat was either sourced from butchery or a goat was purchased and slaughtered for the exercise.

For participatory observation in Obbu, goat was slaughtered for demonstration because the butchery did not stock beef. In Marsabit central, the women who showed interest in making products were the ones who were recommended as knowledgeable and they were all elderly women. This group was a peri-urban group and sourced meat from butchery. It was this group who made *fonntumma,* a rare product. Jaldesa group, in the rural setting of Saku Sub-county, were mixed with both young and elderly. They also slaughtered a goat to make *koche* from goat meat due to distance from the urban centre. This group being was predominately rural and gave detailed knowledge on traditional meat practices. The younger women 20-35 years from this area seemed knowledgeable and gave valuable knowledge on meat practices.

Table 3.1: Participants observation of traditional meat preparation exercise

Study regions	Groups	Number of participants	Venue	Source of meat	Products made
Jaldesa	Waldagena	18	Group's place	Goat slaughtered	Goat Koche
Central	Adhajabessa	10	Groups place	Beef steak and goat meat purchased from butchery	Beef *Koche* *Fonntuma* *Kochegarbu*
Central	Mata arba	7	Members house	Beef/steak purchased from butchery	Beef *Koche* *Kochegarbu*
Obbu	Ramolle	6	Members house	Goat slaughtered	Goat *Koche*

Obbu	Borolle	4	Members house	Goat slaughtered	Goat *Koche*

Observing and recording practical demonstrations of meat preparation, processing and preservation techniques were done for four traditional meat products of *Koche* made from beef or goat meat, *FonnTumm*a and *kochegarbu.* Active interaction was encouraged to categorize the traditional meat products according to types, methods, use of the products and occasion of use. Observation was made as the women engaged in the meat preparation and product handling activities. Video recording was done to enable analysis of the procedure. In addition, notes were taken and the activities were recorded. Informal talks and interactions took place as more documentation was done. The researcher sought further clarification of the activities where necessary.

3.3.7 Data management and analysis

The interviews were recorded on voice recorder, note book and transcribed verbatim. Once the interviews had been transcribed, the material was entered into the qualitative data analysis software RQDA and coded. The interviews were read to develop coding frame corresponding to themes. The code frame was categorized according to activities; knowledge, processing, products and preservation. When quoting text into the paper, the key word or theme was searched in the saved interviews to confirm the commonality and cited.

For participant observation, the following were documented: - name of traditional meat products, preparation methods, recipes and ingredients, criteria used in all stages and processes and why they did and what they did. Tacit knowledge observed was also recorded. In addition, traditional preservations methods applied by women were noted.

3.3.8 Ethical considerations

This research was carried out in Marsabit County Kenya, with group of women who lived in the villages within study sites. The research ethics were addressed by briefing the respondents about the purpose of the study and the processes involved and were assured of confidentiality. Verbal consent was then obtained from respondents to conduct the interviews

3.6 Results

3.6.1 Borana Women's Traditional Meat Knowledge and Products

When a goat was slaughtered, the carcass was separated from other products such as liver, heart, kidney, pancreas, bones, fat, horns, hides and tails. The carcasses were cut into parts. The first part to be consumed was the soft organs referred to as *daddam* partly to avoid spoilage and it also acted as an appetizer. The rest of the carcass was separated into meat used for short term and long term purposes. Meat from hind legs was stripped and dried to make products like *guba, koche* and *kataweel,* and was thus earmarked for long term use.

Out of the fourteen meat products that were documented in the interviews (narratives and key informant) as shown in table 3.2, the women in almost all the groups had knowledge of preparing only four meat products. These were *koche, beef or from goat meat, fonntuma* and *fonntumma garbu.* These products used to be consumed in large quantities at one serving, but this has changed since the introductions of cereals and pulses.

Table 3.2: Borana artisanal meat products

Product name (Boran)	Description	Source and parts used	Method of preparation	Storage	Storage time
Koche	Deep fried red meat	Beef/goat Sirloin steak	Cutting dried strip meat into smaller pieces and deep fried	Stored in fat	2 months
Guba	Deep fried red and fatty meat	Beef/goat Steak and fatty part	Cutting dried striped meat into smaller pieces and deep fried	Stored in fat	2 months
Fonntumma	Deep fried ground meat	Beef/goat Sirloin steak	Roasting dried striped meat then pounded and deep fried	Stored in fat	3 months
Kataweel	Shallow fried meat	Beef /goat steak	Cutting dried striped meat into pieces and shallow fried	Stored in fat	1 month
Fonnqadabe	Dried strip	Beef/goat steak	Roasting dried striped meat then eaten with fat	Stored in traditional container *subb*	2 months
choom	Fat	fatty tissues from meat	Extracting of fat from fatty meat and bones by boiling	Stored in traditional container *dhool*	3 months
Guguble	Fat granules	fatty parts of stomach tissues	By-product from extracted fat	In pots	2 weeks

Lafeqoan	Bone	Beef/goat bones	Boiling bones repeatedly for soup and fat	Arranged on bedlike structure *saqe*	1 month
Digallo	Meat on bone	Beef /goat	Boiled or roasted stored meat	Stored in *subb/saqe*	1 month
Marumandira	Dried intestines	Beef/goat intestines	Boiling and placing intestines in sticks to dry	Dried over fire place	2 months
Kochegarbu	Mix of fried meat with fried barley	Beef/goat steak and barley	Frying meat and barley	Stored in fat	2 months
kochemandasi	Fried meat mix with wheat flour	Beef /goat steak and *Mandasi*	Frying meat and wheat flour	Stored in fat	1 month
Radhu	Soft inner parts of hides/skin	Beef /goat hide and skin	Boiling the soft tissue of skins for soup	Placed in the sun for drying	2 months
Daddam	Soft tissues and organs	Beef /goat	Boiling or frying soft organs for sharing	None	2 days

Women displayed their skills and knowledge on meat products and added value in terms of preserving it for future use. They employed methods such as stripping and drying to reduce water content. One narrative interview respondent from Obbu expounded as: -

> *'All the meat was removed from the bones, but before that they cook dadam (appetizer) ribs, liver and small piece of steak are cut; then cooked and given to neighbours and all household members. The red meat is removed from the bones and striped, for example, when one household slaughters; the women from the homestead assist the mother of the house in striping the meat overnight. They tie two threefold of rope around the hut for suspending the meat to dry.'*

And another key informant respondent from Sagante added,

if one household slaughter a bull, women from neighbourhood will come together and strip, the meat then arrange on rope… you see, in the past, Borana had big huts--- they used rope made from skin to tie two fold on one side and two folds on the other side… four folds of rope on one side and four on the other--- then when it dries… they remove and cut, cut and cut the whole night afterward it is cooked in melted bassa," (ghee) as the song line goes (basitun bassit kadatun dhafit") the cook fries and beggars sweats--- - have you heard that in cattle song? You see the whole night they dress in work cloth 'wadhare' and cut, cut meat, cut meat to preserve.

Cooked meat was later kept in smoked storage containers (*Dhola* or *Dhibe or Subb)* and used over long time as it had long shelf life. One narrative interview respondent from Obbu affirmed this as follows;

"On the other hand, dhigalos is meat which is only dried. Dried and kept away in subb, it does not get spoil; no, it does not, because it's not wet... The rest of meat which is eaten fresh were boiled--- bones, some other parts which is not made to guba or dhigalo, all these parts are boiled and eaten overtime. The father of the house is given some bones with pieces of meat, children are given pieces of meat and they drink the soup all day long they don't get hungry… when this one finishes, the jaji in subb was used... this was also given to the father of the house and children. "

The traditional knowledge of meat processing is declining, restricting this knowledge only to the elderly women. Even among the women, there are few who are known locally for their expertise in making the local meat product. In terms of geographical distribution of study site, the respondents from Obbu who were all elderly gave detailed knowledge on the past experiences of traditional meat practises. An eighty-year-old respondent highlighted her knowledge through sayings, songs and proverbs, narrating practises she witnessed only during her youth.

"*You see I cannot tell you what people do now, I do not know because at my age I belong to the old age so I don't make any koche. Um umm but what I have seen people of now a day's… make small circular things from wheat flour and call it koche. For me I know koche of fonn tumma and garbu. When I was young my family was famous for cattle… you heard of "borr abbiyu lake" that was what was said do you know? Have you heard? (Borr abbiyu lakeh jaldessi saku dake, dheth bekhu daqe, onn bekhu daqe bor abbiyu lake') you heard. right… it's a line in cattle song. You see… those cattle were ours…and koche was plenty those times. I am daughter of Abbiyu Lake, the renowned cattle owner"*

3.6.2 Preservation Techniques and Handling of Traditional Meat

The Borana had several preservation techniques for storing meat for long periods, drying of meat was observed as a very important step in shelf stability of meat. Meat meant for long storage period was usually cut thin like a rope and suspended on the rope for aeration. Such stripping was the common technique used when making traditional meat

products. The respondents were unanimous that strip meat had advantages like having easier air circulation which enhanced drying, ease of arranging on rope and also ease of cutting after drying. The drying was moderated as much as possible to avoid quality compromise. Respondents explained that too much drying leads to hardening of product while inadequate drying leads to rotting. Sometimes sun drying was also practised especially by those at satellite camps for quick drying.

Use of heat in preserving was also applied. Table 3.3. Meat was prepared by smoking, roasting or deep frying. Meat which was dried and preserved was usually smoked in a fire place. The meat parts which were normally smoked are *mogolle*, *Iree* and *rajeji* (the lower hind legs, forelegs and pancreas), an action done to impart the sweet flavour and taste. Roasting of meat meant for pounding was done by putting the meat strip in between sticks and roasted over red charcoal. This was also done to impart flavour.

Another heat technique was deep frying of meat where the meat was heated for a short period of ten to twenty minutes. The use of additives in the meat also enhanced its quality. The addition of salt, sugar and cardamom not only improved flavour but also helped in extending the shelf life of the products by playing a role in reducing the water activity. Furthermore, these products are known to have antimicrobial properties which may have helped reduce the levels of spoilage. A narrative interview respondent from Central Marsabit opined thus.

> *"…. you know, this food, we have added new things, that enhances aroma when this jug is open… you can smell the good aroma so we do not use urgo, we use elki, I remove the top part ground like sugar and add at the point of removing the meat from fire. When I add elki at the beginning of cooking the entire aroma remain in the pot not with meat. You add at the finish."*

The storage containers were smoked well with special kind of sticks which gives good aroma and also enhance the shelf life of the products. Smoking was done on traditional storage containers to impart flavour and to keep the product for long in storage. Subsequently, the meat products were stored in oil. The oil should be full enough to cover the product and create state of protection to reduce spoilage and keep it for long.

Table 3.3: Meat preservation techniques among Borana Pastoralist in Marsabit County, Northern Kenya

Preservation technique	**Objectives**	**Activities**	**Prevalence of use**
Drying	To reduce the water content	Striping of meat and drying by suspending on ropes for aeration.	Common about 90% of respondents still practice
Preservation by use of heat	To reduce the water further and cooking the meat	Roasting, deep frying and cooking of meat	Common about 90% of respondents still practice
Storing in fat	To preserve meat by reducing air entry	keeping of meat products by immersing in fat	Not very common 50% of respondents say they completely immersed the meat in fat
Additions of salt, spices and sugar	For flavour and preservation	adding small parts of salt, cardamom and sugar	Common 90% of respondents use additives
Smoking of storage containers	To improve the flavour and preserve the meat	keeping products in smoked containers	Occasional, 20% of elderly women use smoked traditional containers. The rest used aluminium jug for storage

3.6.3 Product Preparations and the Observed Tacit Knowledge of Borana Women in Making Traditional Meat Products

Before the actual processing and preservation phases, women systematically gathered tools and implements which helped them carry out the activities. These included cutting

knives, cooking pots, ropes for suspension, bowls, spoons, firewood, fireplace, charcoal, wooden mortar and pestle.

3.6.4 Characterization of traditional meat product and product processing

3.6.4.1 Koche (Beef or Goat meat)

Koche is a dried, pea sized cooked product made either from goat meat or beef. The meat was sliced into strips and suspended on a rope at room temperature to dry for one to two days. When the expected level of dryness was attained the strips were removed from rope and cut into pea sized pieces. The pieces were then put in a pot and salt was sprinkled while cooking on low heat as it evaporates all the steams till it dries. Then oil was added for deep frying with continued stirring until it turns dark brown. Then, it was removed from fire for cooling overnight or more than ten hours. The cooled product was then stored in oil either in aluminium/stainless steel jug or traditional storage.

3.6.4.2 *Fonntuma* (pounded meat)

Fonntuma a dried, roasted and pounded product was made from beef. The meat was sliced into tiny strips and suspended on a rope at room temperature to dry for three days. When expected dryness was attained the strips were removed from rope and roasted over a jiko (hot charcoal) then pounded using wooden mortar and pestle until the meat is ground. Then it was deep fried, while stirring continued. Three spoonful of sugar, half tea spoon of salt and grounded cardamom were added. The heat used for cooking was medium and when the products turned golden brown it was removed from fire and cooled overnight or approximately ten hours and stored in closed jug (aluminium/stainless steel or traditional container).

3.6.4.3 *Fonntumma garbu* (Pounded meat with barley)

Fonntuma garbu is a mixture of *fonntuma*, (pounded meat) and barley (*Hordeum Vulgaris).* Barley grains were winnowed, soaked in hot water and pounded to remove the hull. The de-hulled grains were roasted until golden brown and mixed with *fonntuma* while deep frying. Cooling was done for subsequent storage.

The meat preparation process flow chart is shown in figure3.2 below.

Koche beef or goat meat	***Fonntuma*(pounded meat)**	***Fonntuma garbu* (barley**
Fresh meat (lean beef or goat meat)	Fresh meat **(**lean beef)	Barley
Sorting (to remove fatty tissues and ligaments)	Sorting (to remove fatty tissues and ligaments)	Barley winnowing
Striping into thin stripes	Striping into thin strips	Cleaning in hot water
Drying at room T^{o}C for 1-3 days	Drying at room T^{o}C for 1-3 days	Pounding barley on a wooden mortar
Cutting to cubes (bean size)	Roasting on a red charcoal	Roasting barley in a pan over hot charcoal
Deep frying (120-200^{o}C) for 15-20 minutes	Pounding in a wooden mortar	Mixing with *fonntuma*
Addition of salt, sugar and spices	Deep frying (120-200^{o}C) for 15-20 minutes	Deep frying and addition of salt, sugar and spices
Cooling (overnight)	Addition of salt, sugar and spices	Cooling (overnight)
Storage at room temperature	Cooling (overnight)	Storage at room temperature
	Storage at room at room temperature	

Figure3.2: Traditional meat products flow chart *"koche*" beef and goat meat. *"fonntuma*" and *koche garbu* preparation flow chart

The part of meat selected to make traditional meat was important, where women automatically removed and sorted the meat out, as a first step in Figure 3.3. When buying from the butchery and if it was meant for *koche* the butcher was instructed to cut steaks (rump, thick flank and silverside or all) depending on desired size. When it was home slaughtered, the hind leg, steaks are usually prized and reserved for making *koche*. The women explained that the part which makes the best products were the steaks of hind leg which has the red meat (as they called it *Allalo*). They further clarified that, it should have less fat and less ligaments. The ribs and back meat were described as parts which cannot produce good *koche* due to its hard texture. Sorting was done to remove fatty tissues and ligaments which the women said that it made the products hard and also lead to spoilage. Respondent summarized these by commonly used proverb that '*tandach thiiqaat fonn ajesa'* meaning small fatty node if not removed can lead to rotting of whole meat part.

When making the strip the sitting position was kind of natural as women enjoyed sitting on traditional stools and bent to cut meat into bean size pieces by holding the knife in between their toes, as shown in the second photo of Figure 3.3 below. This they explained that it helped them to do the work quickly and also when alone one cannot need a helping hand. The only shortcoming of this technique was as they explained that "it's a bit tiring, causes backache when done for long". Another technique was where two people were involved with one holding the meat and while the other did the strip. The only problem with this, as they explained, was that the holder sometimes holds the strip loosely making the cutting slow and cumbersome.

After strip process, a hand-made rope was sought, cleaned and tied. For arranging strip, the women had a particular way of arranging the strip. They would hold the strip making some kind of inverted W. This was said to make it easier for removal without it making a knot on the rope and also helped in spacing. The exercise was done with such an ease

and it was very natural. After drying, the meat was cut into bean size or tiny cubes. The women knew that different sizes may results in under cooking, for bigger and burning for tiny sizes. They therefore inherently maintained uniform cut sizes.

Drying of traditional meat product was considered a critical stage of processing, as shown in process flow chart in Figure 3.2. Drying was of two types, where one is moderate drying or *kafaf,* done within 24hrs. This is where the meat is dried in the house at room temperature to maintain good texture of the product. The individual preparing would look and touch the meat and conclude that it's at right stage of having been dried. Meat products made from such method are *koche, guba* and *kataweel.*

This is a quote from respondent from Marsabit central

> *"The steak was being striped then suspended to remove water, dry off wetness and when it dries it has to be moderate (kafaf) the active women alaqa now, start processing before it becomes smelly. The reason why strip is done is because the meat has water when fresh"*

The other drying method was complete drying or *gogosa*. Here, the strip was cut thinly and dried for several days, at least more than two days. This was done to store the raw meat in *Suub or Dhool* for future use. This complete drying technique is also a procedure for *fonntuma.*

Drying was very important step in traditional meat processing making. The women explained in participatory observation that if *koche* was not dried it does not cook to golden brown colour. If the meat does not attain the golden-brown colour it remains greyish, then it does not last for long and the unique aroma of *koche* will not be felt.

Further drying took place when deep frying was applied. The women explained that the steam which comes out of fried meat removes more moisture. Frying was done until the meat released brownish bubbles which indicated that the product was ready. In case of roasting, the meat was roasted till it was golden brown while burning was avoided. The pleasant aroma from meat also signified the readiness of meat. The women applied their skill in preparation in addition to constant observations made through unspoken actions.

They used their senses to measure meat products. Organoleptic properties of taste, aroma, appeal and texture were used to measure the progress at different stages of preparation.

For *fonntuma,* pounding was done to make meat have filaments like fish. This reduced the size completely and increased surface area for absorbing more oil. Prior to pounding the thin dried strip meat were roasted over red charcoal. The roasting helped in grounding as it also imparted flavour. Depending on the size of the pounded meat, the process can take between one to two hours. The process of lifting pestles and crushing meat in a mortar continually was labour intensive and it needed energy. During participant observation, older women were seen requesting younger ones to do the pounding on their behalf.

While roasting the meat, women used dry stick made into 'scissor or pliers like' tools for holding meat strip as shown in the third photo of Figure 3.3. Three to four meat strips were arranged in between the sticks and suspend over the red charcoal with continuous turning. The arrangement was then from side to side, from time to time making sure that it does not touch the live charcoal to avoid burning the meat. This was done skilfully and systematically by the women.

During the deep frying, frequent stirring was made. This was done to ensure uniform spreading of heat and release of more vapour from the product. A long stirring spoon was normally preferred for this exercise to avoid hot escaping vapours while turning the pieces properly.

Storage process was regarded as important aspect in obtaining long shelf life and good quality of meat product. A traditional storage container called *Ejito* made from wood was used. The smoking sticks, (*qalqach* and *bisiqaaa)* were inserted inside the *Ejiito* till some steam was produced. Smoking continued until the steam dried and was closed to cool for a while. Closing helped in imparting the aroma inside. Wetness and water inside the *Ejiito* was avoided completely. This is represented in the last photo in Figure 3.3

Proper cooling after was also an important aspects in traditional meat preparation. Hence after hearing process, the products were left to cool without any covering of the heated product to avoid steam on the cover from dripping back to the content. This was also done to prevent spoilage. One respondent narrated the importance of cooling thus.

"After cooking I remove from the fire and place it down with the oil. After it is cooled is when you cover--- because if covered while it's hot, the steam from cover will fall back into it. This steam becomes water later, and if this steam gets into meat, the meat will get spoilt. So it's good to keep uncovered while it's cooling".

Among the groups who demonstrated the processing of traditional meat, there were concepts which were similar to each group. Selecting appropriate carcass parts, stripping and drying were done in similar ways for four groups out of five. The other group differed in the process at point which oil was added. While rest of the groups cooked the meat first and added the oil later; this other group boiled the oil and added the meat, explaining that when meat was put into boiling oil the rate of moisture removal was higher.

Figure 3.3: Photos of traditional meat processing and preservation activities.

3.7 Discussions

The respondents displayed both general and product specific knowledge on processing of traditional meat products. Especially the elderly women displayed good understanding of the various meat preparation techniques, depicting how this was ingrained in their culture during their youthful life. The respondents had deep knowledge and skills of traditional meat products preparations. These skills were learnt overtime and with accumulated experiences. . Bertella (2011) pointed out that local knowledge is about "how things work": a technical form of knowledge about how to produce and prepare local food. From the responses there were reasons behind all the technique they applied. For instance, they understood that the foundation of spoilage and contamination was water. Therefore, from the initial steps of slaughtering they regarded drying as one of the important step in making meat product that is shelf stable.

From the interviews, the women showed that they are knowledgeable on traditional meat processing only that the elderly women recalled more detailed knowledge than the younger counterparts. In Sololo, which is more rural and borders Southern Ethiopia, the Borana still practised their culture and traditional meat preparation techniques were easily remembered.

There has been emergence of butcheries and slaughter houses in the region where people buy meat unlike in the past where households slaughtered even for home consumption as the source of food supply. Nevertheless, the few who sourced from butcheries still expressed selection and preference for meat parts, where women purchased the steak of hind leg for these purposes of making "*Koche*".

In Central division of Marsabit County, most people sourced their beef supply from butcheries, such that when one needed to make the traditional products, they purchased the parts or cuts that they required for the products. Most respondent reported that beef was more preferred for *koche* than goat meat because of the longer shelf life and also the size. In Obbu, and Jaldessa, most villages did not have butchery, hence people still slaughtered small stock (goats) for home use or cattle when it was a big occasion. The few butcheries in Obbu Township only stocked goat meat. In all the three places, it had emerged that due to lifestyle changes, the slaughter of bulls had been on the decline

except for ceremonies and thanksgiving, which were also fewer in occurrence. This further contributed to the dwindling traditional meat handling knowledge amongst the Borana community of Northern Kenya.

For the participatory observations, women groups were selected to demonstrate how the traditional meat was processed. This was done because most groups selected were already engaged in similar activities and the selection enhanced their abilities to do something they already knew. They passionately shared their experiences, expertise and also learnt from each other during their get-to-gather sessions.

Traditionally, Borana are organized along kinship lines into tribes and clans. This organization was used in socialization and networking and helped in sharing of responsibilities. Women would invite their friends and neighbours during occasion of slaughtering to help in the chores. However, with advent of modernization, there has been emergence of women and self-help groups who come together for specific purposes, such as pulling efforts together to achieve tasks satisfactorily in shorter time. Hence working with these existing and active groups offered the importance of getting insider information through participatory methods which also gave the group opportunities to showcase their knowledge. As Kuhnlein (1996) postulated since indigenous people are tenants of traditional food system knowledge, inter institutional initiatives will be more likely to contribute to the development of these resources if indigenous people are encouraged to participate.

From what the women groups demonstrated the knowledge of meat processing does exist, particularly among the elderly women. Therefore, there is opportunity for groups to make it one of their income generating activities targeting the locals who value the uniqueness and social value attached to the products, Consumers from other communities are also likely to be attracted to home made products which define the locality.

The women knew that meat is a perishable product and needed to be preserved in order to extend shelf life hence the need to reduce water/ moisture content as shown in figure 3.3. The women made use of drying meat moderately at room temperature by striping the meat to increase surface area for better evaporation and knew at what stage the extent

of dryness was to be done. This demonstrated inherent tacit knowledge that the women had.

They also deep fried at high temperature of 200^{o}C after cutting into small cubes to remove more water till the meat turned to dark red. Dark brown bubbles of oil are an indicator that most moisture has been removed. The meat was cooled overnight without cover to avoid collection of steam which eventually drips back to meat. Covering of meat was avoided for enhanced keeping quality. The cooled meat was then stored in smoked traditional container dipped in oil. This art had a preservative effect as the oil protected the meat from spoilage and helped preserve the quality.

3.8 Conclusion

The preparation of traditional meat products among the Borana community is an artful activity, one that requires skill and knowledge. Appreciation of the quality of these products is partly rooted in tacit knowledge of the elderly Borana women, who by their advanced age are getting fewer and will lead to gap of the knowledge in the years to come. This was evidenced by the fact that out of the fourteen documented meat products, only four products are currently being practised. Also, with fewer ceremonial events that can occasion slaughter of cattle for meat, few opportunities arise for passing knowledge through experience. Therefore, conscious efforts need to be initiated to address the generational gap and create awareness about this knowledge amongst the younger generation so that traditional food preservation methods among the community are preserved and/or integrated with modern food handling techniques.

The knowledge on processing exhibited by the women showed that processing of traditional meat products had potential not only for home consumption but could be used as income generating activities for the group.

CHAPTER FOUR

BEYOND NUTRITION: SOCIAL CULTURAL VAUES OF MEAT AND MEAT PRODUCTS AMONGST THE BORANA PEOPLE OF NORTHERN KENYA

4.1 Abstract

To most indigenous communities, livestock and crops play important socio-cultural roles that go beyond nutrition. Thus, for the Borana people, livestock, especially cattle have played a major role in the past not only as the main source of food but also in shaping social cultural values. Animals used to be slaughtered to obtain meat and other by-products. Cattle and especially bulls were slaughtered for meat consumption, rituals and high value ceremonial purposes.

This aspect of the study discusses meat cultural sharing practises, taboos, values and implications of the practises on food security. It particularly elaborates Borana meat culture in a changing social cultural environment, and the central role of cattle in mitigating food insecurity

Qualitative methods including key informant interviews and focus group discussions were used to document social cultural value of meat among Borana pastoralists of northern Kenya. The interviews were audio recorded, transcribed, and analysed.

The results showed that, cattle played an important economic and social cultural role in Borana community where the processes of *sanga* slaughtering was used as coping mechanism during severe droughts in mitigating food insecurity and also played important role in enhancing the social cultural fabric of the community.

4.2 Introduction

The Borana pastoralist community of northern Kenya, have since time immemorial attached lots of value to cattle and by extension to cattle products specifically meat and milk. The life of the Borana fully depended on livestock and entirely revolved around it, and specifically on cattle where cattle wealth was revered beyond ranges, hills and valleys. As Barthes, (1975) pointed out, in every culture food means more than just a source of nutrition. Food may also be a system of communication, a collection of images, and a cultural set of conventions.

The ownership of large number of herds of cattle was valued only second to health as posited by the saying "*Fayaan abba kaar*", meaning health is wealth (referring to wealth only in cattle context).The significance of cattle to the Boran community was historical. In spite of the many changing lifestyle, to date cattle economy forms the cornerstone of drought coping mechanisms amongst the Boran as "*buusa gonofa"* (Obba, 2000).

Its relevance as a symbol of status and wealth, cattle is a widely held notion that has been passed from generation to another, where songs and poems have been formed in praise of renowned cattle owners, herders and even raiders. Leadership status has also been offered to individuals who owned large herds, signifying how much the Borana revered the herd numbers. As Kurlansky (2007) suggested, food is not just what we eat. It is an expression of who we are, how we live and the world we inhabit. In Boran case, milk and meat indeed describes the community in all its spheres.

Livestock, used to be slaughtered to obtain meat and other by products such as hide, skin, hooves, horns, bones and blood. Milk was obtained for subsistence use and excess sold to generate income to buy other food supplies. During the rainy season, when milk supply is in excess, some of it was fermented to be drunk as sour milk called *"Ititu".* Other products such as butter were also obtained from churned milk which was then boiled to ghee for further preservation. The use of the processed meat and dairy products became more important as the supply of milk dwindled and when the dry season sets in, traditional meat products were used as drought coping food. Meat products among the Borana not only served as food but had other symbolic purposes. This was articulated by Asafa, (2010) who stated that, the Borana have used cattle for food, ritual (*ariro*) , status, wealth accumulation and sacrifice (or *sorrio*) in birth, initiation, marriage and burial/memorial ceremonies.

The actual slaughtering process was in itself a cultural procedure that demands revered approaches such as the blessing ritual called "*ariracha*", with family members lined up dressed in traditional regalia of a turban or "*ruff*" on the head of the family head – the father, with whisk or *"licho*" in hand and for the woman donned in "*saqaa*" and *"siiqee"* and the sons and daughters with respective "*thanis*", a blessed stick in hand. Hence, it was essential to remember that food was a social commodity that had cultural value as

(Mintz, 2002) pointed out eating and ritual as a mechanism for maintaining ecological balance in local environments and/or for redistributing food.

Amongst Borana communities of Northern Kenya, women had the responsibility of handling, processing and preserving food, and more specifically handling of dairy and beef products. In addition to securing water and fire wood for food preparation at the household level (Keya, Ngutu & Adongo, 2005). As the managers of available local resources and knowledgeable about local resources and environment Ibnouf (2011) further posited that rural women are best placed to ensure sustainable food supplies and hence achievement of household food security.

In the traditional Borana culture, the main role of a man was to provide family security through livestock regeneration (Dahl, 1990). Livestock was a family resource owned by both the man and woman but for it to be used or sold, the control mostly rest with the man. Women on the other hand, though contributing towards the labour of herding and taking care of young animals and feeding, had to consult their husbands for use of the livestock. Women were in charge of livestock products (milk and meat) and decisions of buying and cooking food. It was noted that the gender of an individual actor and gendered institutional norms had a major significance in influencing the entire process of acquisition, processing and transfer of local knowledge (Clancy, 2007).

As Waqayyo (1991) pointed out women had controls of the stationary resources in the house - the grain and other products of the fields once they are brought into *gotara (meaning* granary*)* for storage. Even the cattle around the house was under their care as the women would milk them and decide how much milk goes to the calves, and how much for the people in the household for drinking.

Currently, the above elaborated *Sanga* slaughtering practise is not being undertaken, or rarely happens, if it does. This was mainly due to changing lifestyle and modern practices. The changing grazing environment where land ownership had drastically changed from communal to private tenure systems, series of severe drought leading to dwindling herd numbers, changing trends from pastoralist economy to school going, urbanization and existence of modern markets for meat supplies, leaves little room for traditional *sanga* practise. According to Mengistu D. (2016))) cattle are the most affected

livestock type during severe drought due to higher input requirement than other livestock types. Yet, it is the potential top priority of the society due to its principal role in socio-economics and cultural heritage

There has also been changing food culture, where reliance on meat and milk has shifted to other food sources, such as food crops – cereals, pulses and vegetables. The changing livelihood had also contributed to shift in food culture, where occupations have changed from herding to other forms of employment for gainful income. Fratkin,(1999) opined that pastoralists have increasingly shifted their economy from subsistence production (producing mainly milk for the household consumption) to commercial production (producing beef and dairy products for sale both to domestic and export markets

This part of the study therefore, explores the elaborate Borana meat culture in a changing social cultural environment, by discussing the central role of cattle in mitigating food insecurity and highlights the social cultural values attached to livestock and its products particularly meat.

In this context, the study emphasized the value of cattle and how Borana managed processes of slaughtering a bull and stretching meat products to last through the drought. Of particular interest were practises by women with special skills who know which parts of carcass was meant for what purpose and managed to secure flow of food throughout the period.

The study attempts to uncover traditional meat cultural practises among Borana people highlighting the wide range of social cultural practises that were linked to it. Finally, to gain insight into changes in traditional meat practises, the perceived advantages and the current changes were discussed.

4.3 Methods

4.3.1 Study Design

The study used qualitative methods to generate required information about the preservation and social cultural issues of artisanal meat. . Purposive and snowball sampling was used to identify informants who in turn led to more knowledgeable women on social cultural link of artisanal meat products. Traditional meat cultural practises was

gathered through key informants interviews and focus group discussion. The questions formed the basis of identifying and describing social cultural linkages of traditional meat processing and products

4.3.2 Study site

Location of the study was Central, Sagante and Obbu divisions in Marsabit County

4.3.3 Study population

The study was conducted in Marsabit County in northern Kenya, a pastoral and agro-pastoral system with population of 291, 000 people (KEBS) 2013. The area is inhabited predominantly by Borana speaking people who are mostly settled but livestock mobility is still practised.

4.3.5 Data Collection

In order to document Borana meat culture, the study adopted qualitative methods such as key informant interviews and focus group discussions. Key contacts were made through the village elders and chiefs who gave contacts of women groups in the area. Interviews focused mainly on women because traditional meat products are usually prepared by women. The groups were contacted where meeting was scheduled and discussions on the study topic were conducted. After initial group discussion, knowledgeable women were identified. During the conversations it became clear that there were knowledgeable women who are enthusiastic in the subject of traditional meat and showed interest talking about it.

That was the time contacts were made. Interviews were scheduled depending on availability and consent of respondents. During Interview sessions, participants were selected based on their knowledge and interest in traditional meat system. In addition, more inquiries were made for recommendations of knowledgeable women in traditional meat processing and more contacts were established leading to process of snow ball. The criteria for selections for all the interviews were that they were women from Marsabit County and had knowledge of Borana traditional meat processing.

Study participants age range from 25 to 75, although the younger ones seemed not confident in giving the information citing that they didn't have the experience of what and how Borana used to slaughter cattle for sustenance.

The key informant interviews lasted between one to two hours. Ten key informant interviews were conducted, five in Marsabit and five in Obbu. They were also asked about social cultural value of livestock and the dependence on livestock as well as changes and the causes of that change.

Respondents were asked how livestock rearing supported household and community need for food requirement across the year. Interviewees were asked about social cultural value of livestock and the dependence on livestock as well as changes and the causes of that change.

Focus group discussions were held at the women groups place or one of the member's residences who agreed to host the group. The aim was to understand the group view on traditional meat; the knowledge and practice, the feelings and opinions on the subject when people are together, their interactions and attitudes of different ages and in some cases gender. The number of people who participated was eight to ten per focus group discussions. . In total four focus group discussions of eight to ten people each and ten key informant interviews were conducted in Jaldessa, Sagante and Obbu divisions. The guide questions are in appendix 6.

4.3.6 Data analysis

Key informant interviews and focus group discussions were tape recorded while a field note book was used to write down verbatim for those who don't want to be recorded. The strategies used to gain access and establish trust among the participants varied according to the situation of each area.

The open-ended nature of the questions allowed participants to provide justification for their traditional meat practices and to expound upon those aspects that were most significant to their identities. The interviews were recorded on voice recorder and note book and transcribed verbatim. Once the interviews had been transcribed, the material was entered into the qualitative data analysis software RQDA and coded.

The interviews were read to develop coding frame corresponding to themes such as Historical Perspective, Meat culture, Value of livestock and Food security. All of the interview transcripts were then reread and coded using the established categories

4.4 Results and Discussions

4.4.1 Value of the Cattle and the Bull - "*Sangaa"*Slaughtering

Cattle and especially bulls were slaughtered for meat consumption, rituals and high value ceremonial purposes. The slaughtering process was an elaborate activity which involved communal consultation to formulate coping strategies particularly during severe dry season and impending drought. Communal participation was essential in the slaughtering process. Cooking and sharing of portions called "*Jiffu*" of the slaughtered cattle were important activities after of slaughtering process.

The place to slaughter *sangaa* was in the cattle "*Kraal*". The slaughtering process had gendered tasks where men did the actual slaughtering, and women initially stood by to harvest the blood from the slaughtered bull. The carcass was then skinned artistically by men, separating meat parts at the various joints. While the slaughtering process is ongoing, the elders would gather and observe the intestines with a view to predicting future events, a process called *"uss lalan".* This was done to foretell unforeseen fortunes and how it would impact on the family and the community at large. Women would thereafter receive the meat parts to begin cooking.

The parts of the meat were identified and cooked in sequence in the order of softer parts to be eaten first, and other parts preserved to be cooked accordingly for later use. The women with artistic culinary skills cooked and served the softer parts (liver, heart, kidney, intestines) immediately after the slaughter. The serving was made to all those who had participated in supporting lifelong herding of the slaughtered bull and its flock, with priority of tasting the initial cooked piece "*dandaam"*given to the herder (or "*tiss'a"), obaat'u* (water men), and "*hamt'u"* (usually women, who are hay gatherers for young calves or the vulnerable livestock fed from homestead).

The process of bull slaughtering had many contexts according to the respondents. It was a communal decision making where elders, men and women were involved. It was a

collective responsibility touching on food security and how to tackle food scarcity. If the slaughtering was due to hunger and the community was experiencing severe drought, people met for consultation. Households who could afford and had *sanga* were directed to slaughter it. The poor were given some shares and this was institutionalized in the clan systems – a decree or *muraa gosa.* By doing this everyone was catered for.

This was elaborated by a key informant from central Marsabit respondent below.

> *"If abrassa is born… you know Boran has culture, according to culture, Borana is supposed to slaughter a cow… it is called chonni… this chonni is usually announced in the village… slaughter chonni it is month of abrasa….slaughter chonni.. for those who don't have what to slaughter… everybody who slaughters should cut for them, cut ribs for them add some piece of meat plus piece of stomach…this is cultural set rules which must be obeyed as "murti" for everyone to give to those who don't have"*

Cattle held a lot of importance in daily routine and life discourses of the Borana society. For the love of cattle, the Borana identified an individual status according to cattle ownership – as they have and the have-nots of cattle – or "*dhuress loon kaar ethuu*" or "*qoole guutu inqamne*" The first aspect of importance was the economic value of cattle, its products and the prestige it commanded. The numerous resources of milk, meat, hide and skins were obtained by every household from their herd. Cattle did more than provide readily available sources of food products whereas oxen contributed to farming activities like ploughing – land preparation or *gargalcha*, planting or *fachaasa* and weeding or *shalanshalah*. Cows were also used to pay fines or ransom *(qakhe*) or loaned to the less fortunate in the family hood as *"dabareh"* to consume the milk over its milking period as a coping strategy of "*Buusa gonofa".*

Most respondents described the importance of cattle and one respondent of focus group discussion from Jaldessa, vividly recalled

> *"Those times the cattle were many and people don't sell. So in rainy season people would drink milk, they churn milk to produce butter, where the butter is separated one for hair care and the rest boiled to ghee, the ghee is stored for future use and in the dry season this is the basaa kept in the dhool you use to eat.*

The milk is also fermented to make ititu so there is no problem in the rainy season. When the drought season comes you slaughter livestock and eat meat with the basaa"

4.4.2 Social Cultural Values of Meat

Bull slaughtering was an important cultural, social and economic event for Borana families and communities. Though less practised now in economic terms, the practise is still cultural and forms component of social life involving shared efforts and involving solidarity in the community particularly in case of ceremonies and traditional events.

Moreover, the cattle have social cultural links which defined social processes and social relationships. Bulls and cows had special purposes necessary during the occasions of ceremonies and thanks giving and most importantly cattle play major social relations roles linking neighbours and relatives that shaped the standing rules of sharing cattle resources.

"For ceremonies and special events my family would usually slaughter a cow or goat depending on the magnitude of the jill (ceremony). For naming of the first borne son (gubis), a bull had to be slaughtered. But when my children were coming home from journey or when I expected a special visitor I go to the butchery to get meat to make the products (50 year old key informant from Jaldessa"

Meat sharing was always regarded an important aspect in Borana when they slaughter the bull. The act of meat sharing was called *Jiffu* and was customarily for families to share meat. This practise not only enhances social cultural relations among the people but was also important in promoting economic welfare activities especially for families who did not have *sanga* to slaughter during the time of hunger. The people were entitled to *jifu* as well have customary rights. These were the siblings, relatives and the affine. Other members of the communities who received shared parts were pregnant women, neighbours and less fortunate families. The parts to be shared were predetermined and households who shared out and those who received knew this habitual practice. *Jiffu* parts included ribs, vertebrae and intestines. Food was also an occasion for sharing, for

distributing and giving, for the expression of altruism, whether from parents to children, children to in-laws, or anyone to visitors and strangers. (Robin fox, 2003)

The ceremonial slaughters of *sanga* and old cows had many rituals that were observed. The ritual of *ariracha wa*s an important act where women and men observed carrying traditional items such as *saqaa* and *siqee* as explained by a key informant respondent from Obbu.

In the culture of Borana we have orro, licho and saqaa. We sew beads on saqa, this cattle we have, the livestock we have we don't just slaughter them we have to bless first - ariracha. You know we are going to kill this livestock, removing the soul, we have to ariracha before we remove the soul, 'nu orsis sa namaan' we tell it to prosper both people and livestock ….kind of requesting blessing from it...

The rituals surrounding traditional meat consumption also had perception of time in Borana culture. Meat rituals were organized in accordance to a time schedule. For example *chonni* a thanks giving ceremony was usually observed in the Borana month of *(abrassa*) in January. And *sorio* also a ceremony was observed at certain time.

Further to ritual undertaken during the slaughter of the bull, the more important need of satisfying hunger was fulfilled. Therefore, *Sangaa* played an important role in mitigating food insecurity, as it fed not only the family or "*warr*", but also *"jiffu"* parts shared with relatives and neighbouring villagers. The rest of the meat was preserved and prepared into products such as *"Koche*" and "*guuba*" to be consumed over time. It was therefore, a key coping mechanism enshrined within the Borana food culture. This was elaborated by Whitehead (1984) that sharing of food certainly has both political and nutritional dimensions. On the one hand, it helps in associating, solidifying and extending social relationships; on the other hand, it serves as a mechanism to avoid food shortages and to distribute scarce resources.

Traditional meat called "*koche*" was an important food made to express passion and love. Its elaborate preparations were both social and communal affairs involving elders, women, herders and villagers. The careful artistic handling gave it a special status and those who handled it did these activities with expert skills. Adapon (2008) argues that cooks had culinary agency, not only because their work required considerable

technological skill but also because cooking and ultimately serving food was an act of exchange. In these ways cooking shapes social relations.

Because of its artistry work the preparation of *koche* took days and proper planning. The women had to fetch water and firewood and make a mat like structure called *saqe* for meat holding. In all these processes the involvement was not individual but communal there was a team work involved. The occasion of bull slaughtering was also a happy festive and prayer time when the Borana observed thanks giving ceremonies called *chonni* and *sorio*. *Koche* was a special food which was mostly consumed during ceremonies and prepared for important guests and persons. As Lupton (1996) postulated such foods were consumed during special occasions associated with highly ritualized activities imbued with happy emotions.

Koche played important role in enhancing social relationship, where the woman who had control on its processing and consumption gave it to her lover as an expression of her love and passion for him. This lover did not necessarily need to be the husband, but even a secret lover, whom if found was fined a cow to appease the husband. Such women hence, used *Koche* as a tool to gain economic mileage in the community as they gained status because of their artistic knowledge of cooking "*Koche"* that would find its way into a man's heart. This was elaborated by focus group discussion respondent from Sololo, obbu division..

If you are a woman of substance and you have dhibe in the house this dhibe usually cannot stay empty it has to have something… you see women have different kind of visitors? It's embarrassing if someone important arrives and cannot be given something um umm like koche… Yes like that. When women are in their prime age they should have special koche ….always available in the house…

To exercise profound control over the stationary resources like meat products, a woman can also present *Koche* as gift at her lover's naming ceremony called "*Guubis"* in exchange of a reciprocated reward of a cow from the lover. This traditional practice is still in action amongst the present day Boran, and seen to contribute in harmoniously unifying the community through 'Cows" as a symbol of love and communal continuity. As Beardsworth (1997) described when we eat, we are not merely consuming nutrients,

we also consuming gustatory (i. e. taste-related) experiences, and, in a very real sense, we are also 'consuming' meanings and symbols.

4.4.3 Changing Cultural Practices and Implication on Food Security.

Reasons for food insecurity ranged from recurring drought that led to reduced number of herds, poverty which was manifested through food unavailability, flash floods and diseases that led to deaths of livestock in large numbers. In severe cases droughts have compelled destitute families to abandon their nomadic lifestyle and settle in urban centres but many have fallen deeper into poverty as a result.

Traditional meat was regarded highly as it offered both economic and nutritional advantages as well as social cultural values which are essential element of food security. Respondent's used remarks such as '*we were strong and healthy'*, '*people don't get tired'* and it's a '*happier moment bringing people together to share'* to signify the strong cultural linkages to consumption of traditional meat.

The questions on the livestock and role it played in food security among the Borana and the changing scenario, generated rich narratives from the respondents who with nostalgia recounted that livestock especially cattle was not only used as source of livelihood but had uses in social cultural functions and services such as dowry (*loon arara* and *qarat*), ransom payment (*qakhe*) and prestige.

However, in recent times things have changed due occurrence of consecutive droughts that the Borana refer to as o*ollaah*. Almost all responses tended to emphasize the devastating effect of these drought that lead to high herd mortality rate making Borana communities more vulnerable and food insecure.

Several respondents said that the effects of successive droughts were felt for a long time. The increasing frequencies of these droughts also made recovery more difficult. During Focus Group Discussions and Key Informant Interviews, what came out strongly was devastating outcomes that had been caused by recurrent droughts. In all sites, respondents stressed that the majority of populations had suffered serious livestock losses and that most of the population had become poor, with recovery in some cases never to happen again. This was elaborated by a respondent in focus group discussions from Obbu as follows.

"I am telling you the truth …no sanga anymore, even milk we don't churn, no fermenting, now what we have is dry grains…maize let me tell you the reality of what we are going through now compared to what and we use to have. Yes it is true we slaughtered in the past, we processed meat products and ate for long time; however now we don't have sanga to slaughter there is no fermented milk now …the cows are no more; we have like two cows - myself I have two female cows - why because the rest have been killed by recurrent drought."

The pastoral Borana were vulnerable to droughts, they lost large number of livestock and many of them became destitute and hungry. In some instances, the drought was compounded by diseases leaving people more vulnerable.

This made many people to abandon pastoralism and settle in peri-urban centres in search for other means of livelihood. From the responses the recurrent drought even made the community to discard the traditional coping mechanism of "*buusa and gonofa*" but gave way to the introductions of relief food and aid, food for work, cash for food that has become modern strategies to cope with effect of drought to reduce immediate hunger. This was elaborated by respondents who mentioned the many Non-Governmental Organization s that worked in their area.

The modern development and urbanization not only increased varieties of foods but has also caused a shift in eating pattern and food consumption activities in households. While in the past the Borana depended on livestock and livestock products, currently they consume grains and pulses, as depicted in the response below from a focus group discussion in Marsabit Central.

"Nowadays this thing of drought has become too many… now instead of slaughtering sanga we sell… money does not do much ….the person with sanga cannot slaughter for his children and wife …no, he sells and buys a sack of maize …the maize usually cleans the pot… the pot is not dirty=children finishes everything in the pot and still asks for more, it cannot stay in the stomach like meat, it cleans… this is what we are experiencing nowadays".

Respondents explained that apart from the numerous droughts that have decreased the herd numbers, introductions of educations systems and urbanizations have also had a

great effect on livestock keeping as many people abandoned the practise after repeated losses and changed other forms of livelihood like small scale trade and causal work. Meanwhile lack of labour to cater for livestock was also cited as another setback as more children are now enrolled in school, making livestock rearing challenging for lack of herders. This has further been aggravated by more herding space being lost to commercial land owners, shrinking grazing zones.

4.5 Conclusion

Livestock and livestock products play a very important role in Borana community. Apart from providing food, livestock played role in defining the social cultural ways of living. The findings from the respondents indicate that livestock products especially the aspect of sharing meat during the drought strengthen social ties amongst people in this community and also mitigated risks such as food insecurity during the dry season. However, this practise is being threatened by the changing lifestyle and reduction of livestock numbers caused by varieties of factors such as urbanization and rural urban migration.

CHAPTER FIVE

NUTRIENT PROFILING OF TRADITIONAL MEAT PRODUCTS OF THE BORANA COMMUNITIES IN NORTHERN KENYA

5.1 Abstract

Meat is a highly valued food among the Borana pastoralist community in Northern Kenya. Borana produce a number of traditionally preserved beef and goat meat products. Although these traditional products are widely appreciated, there is little information about their nutritional composition and quality, thus, the objective of this aspect of the study was to establish their nutrient profile and quality of the meat products. Samples were collected from study sites and analysed in the laboratory. Results showed that moisture contents ranged from 3.3 to 6.1%, crude protein contents ranged from 55.8 to 72.5% while crude fat ranged from 9.4 to 13.3%. Calcium, magnesium, iron, potassium, ranged from 35.8–110mg/100g, 52.8–60.7mg/100g, 4.5–7.4mg/100g and 701–826mg/100g respectively, while riboflavin and niacin ranged from 0.03–0.14mg/100g and 2.38–3.82mg/100g respectively. The fatty acid composition showed that beef and goat koche contained good amount of monounsaturated oleic acid at mean levels of 37.2% and 39.2% respectively

5.2 Introduction

Livestock products, specifically, milk and meat products occupy a special place in the Borana diet for a variety of reasons including availability, preference, tradition and prestige. Cattle are Kenya's most important source of red meat, supplying by value about 80% of the nation's ruminant off take for slaughter (Behnke 2011), whereas goats are mainly kept for meat production for household consumption. Goat meat accounts for more than 70 % of all meat consumed in pastoralist households in Marsabit (Schwartz, 1985). Borana people produce different type of traditional meat products from Boran cattle (*Bos indicus*) and goat (*Capra hircus*) for nutritional supplement including snacks for special occasions and to meet seasonal fluctuation in the available protein in their diet. They have developed unique recipes and storage methods that increase products shelf-life under the traditional pastoral production environment. Meat is a concentrated

nutrient source essential for optimal growth and development. It is highly nutritious and provides proteins of high biological value (Roberta, 2011).

There are many types of traditional meat products which were produced and processed by the Borana. Due to frequent utilization and consumption of meat products, many traditional preservation techniques such as striping, drying and use of heat were practised by Borana to increase the quality and shelf life of these products. As Sharma & Kondaiah (2005) pointed out, processing helps in producing varieties and convenient meat products in order to meet various lifestyle requirements while preservation supported by processing extends the shelf-life of meat and meat products.

Processing is important in the context of human nutrition since it applies technology to improve or maintain quality, extend shelf life (preserving) and prepare meat for consumption (Casey, 1992). In the case of dried traditional meat, various stages of processing are applied. The dried traditional meat, *Koche* is made from particular parts of muscles of sirloin and silverside steak, from beef or goat carcass. This dried traditional meat products can be classified as dehydrated food as moisture was reduced using different ways. As Javeed and Ram (2015) described, meat drying is preservation techniques used to prolong shelf-life of raw meat which reduces storage and makes handling stress-free by reducing size and weight. Traditional meat products are still prestigious and highly valued products among the Borana at household level. They are mainly prepared for social cultural events like weddings, ceremonies and show cased in cultural and tourism festivals. Therefore, these traditional products have potential to be promoted as income generating activities for the producers. These meat products are still processed and preserved by traditional methods that lack technological advancement. As Mekonnen, (2015) observed, traditional methods of meat preservation such as drying, smoking, brining and canning have been replaced elsewhere by new preservation techniques such as chemical, bio preservative and non-thermal techniques. Despite the fact that these traditional products are widely consumed locally, there is concern about their quality and acceptability as there is little or no documented information about their nutritional composition and quality status. Up scaling production of traditional meat products is constrained by lack of understanding of its nutrient and chemical contents. Imungi, (2014) Observed that the preserved meat products from the pastoral area are not

standardized and that most of the process and product parameters are currently unknown. Thus, the objectives of this study were to establish their nutrient profile and quality of processed meat products among the Borana community in Marsabit County, Kenya

5.3 Material and Methods

5.3.1 Study Site

The study site was as indicated earlier in as in chapter three materials and method section.

5.3.2 Sample Collection

Fifty samples of different traditional meat products were processed by local women from Marsabit County. Samples of products included: Beef *koche*, Goat meat *koche*, pounded meat *fonntuma* and pounded meat mix with barley *fonntuma garbu*. The preparation of the products took one to three days and samples were transported to Jomo Kenyatta University of Agriculture and Technology food science laboratory for chemical and nutritional analysis packed in universal bottles and stored in a cool box while on transit.

5.3.3 Laboratory Analysis

5.3.3.1 Moisture content

About2g of sample was accurately weighed into a moisture dish and transferred to an oven previously heated to temperatures of 105^{0}C and drying done for 1 hour. The final weight of the sample was taken after the drying period and cooling in a desiccator. The flour residue was then reported as total solids and loss in weight as moisture by formula

Given below (AOAC, 1995, method

b925.10)

5.3.3.2 Crude protein

Crude protein was determined using the Kjedahl Method (AOAC, 1995). About 1g of sample was weighed into a digestion flask together with a catalyst composed of 5 g of K_2SO_4 and 0.5g of $CuSO_4$ and 15 ml of concentrated H_2SO_4. The mixture was heated in a fume hood till the digest colour turned blue signifying the end of the digestion process. The digest was cooled, transferred to a 100 ml volumetric flask and topped up to the mark with distilled water. A blank digestion with the catalysts and acid, but no sample, was also made. Ten (10) ml of diluted digest was transferred into a distilling flask and washed with about 2 ml distilled water. 15 ml 0f 40% NaOH was added and this was also washed with about 2 ml distilled water. Distillation was done to a volume of about 60 ml distillate. The distillate was titrated using 0.02N-HCl to an orange colour of the mixed indicator which signified the end point.

5.3.3.3 Crude fat

Crude fat was determined using soxhlet extraction method (AOAC, 1995). About 5g of sample was weighed into extraction thimble and the initial weight of the extraction flask taken. Fat extraction was done using petroleum ether in Soxhlet extraction apparatus for 16 hours. The extraction solvents were evaporated and the extracted fat dried in an oven for about 15min before the final weight of the flask with extracted fat was taken.

5.3.3.4 Crude ash

Crude ash was determined by dry ashing (AOAC, 1995). About 3g of dried sample was ashed in the crucible at 550ºC for 5 hours or until the ash is white or greyish-white. The percentage of ash in the sample was determined as follows: {[Wt (Ash+Crucible)-Wt(Crucible)]/sample (g)} X100.

5.3.3.5 Crude fibre

Crude fibre was determined as per (AOAC, 1995). Approximately 2g of the sample was weighed into a 500 ml conical flask. About 200ml of boiling 1.25% H_2SO_4 was added and boiling done for 30 minutes under reflux condenser. It was then dried in an oven at 105^0C in a porcelain dish to a constant weight (W1). Incineration was done in a muffle furnace at

550^0C for 3hrs, the dish was then cooled in a desiccator and the final weight (W2) taken. Countercheck this method. There should be both acidic and alkaline digestion conditions.

5.3.3.6 Carbohydrate was calculated by difference:

Carbohydrates = 100 – (Proteins + Lipids + Fibre + Ashes) water

The gross energy was calculated, according to WHO/FAO, (2002),by the following formula:

GE = [(Proteins × 4) + (Lipids × 9) + (Carbohydrates × 4)] × dry matter / 100

Where GE is the Gross Energy.

5.3.3.7 Determination of mineral composition

The quantification of iron, zinc, calcium, magnesium, potassium and sodium, was done by atomic absorption spectrometry using AAS (Shimadzu AA-6200) Kirk (1991). Minerals were determined by digesting about 0.1g of ground sample with 2ml of H_2SO_4-H_2O_2 mixture using a block heater. A range of concentrations of standard mineral solutions were prepared and used to generate standard curves for computation of concentration of various elements tested (AOAC, 2006 method 985.01)

5.3.3.8 Determination of vitamins composition

The AOAC method (1995) was used with slight modification according to European Standards (2003). Two grams of the sample were mixed with 20 ml of 0.1 N HCl and heated in boiling water for 60 min. The pH was adjusted to 4.0 and 100 mg of taka-diastase was added, mixed and incubated at 40°C for 18 hr. The digest was made to 50 ml with 2 % acetic acid and centrifuged at 5,000 rpm for 10 minutes and the supernatant was taken and micro-filtered with 0.45µm membrane ready for HPLC analysis as follows.

In case of thiamine pre-column derivatization was done by mixing 1 ml of the enzymatically-treated sample was mixed with 1 ml of alkaline potassium hexacyanoferrate III solution. The mixture was vortexed for about 10 seconds and allowed to stand for about 1 min for the reaction to take place. Exactly 20 µl of the oxidized thiochrome form were injected form was injected into the HPLC (Shimadzu LC-10A) with a reverse phase C18 column of 250 x

4.6 mm, and fluorometric detection at Ex 365 nm and Em 435 nm (Shimadzu RF 1501). The mobile phase for thiamine was methanol: acetate buffer of pH 4.4 (40:60). Sample solution for riboflavin was injected into the HPLC without derivatization and the mobile phase was methanol: water: acetic acid (40:59.5:0.5) at UV wavelength of 270 nm (Shimadzu SPD-10A). Thiamine hydrochloride and riboflavin were used to prepare standard solutions for quantification by comparing the peak areas of the samples with the prepared standard.

About 20g of the sample was weighed and 20ml of Hexane added to dissolve, after 15 mins it was transferred to 50ml flask and made to volume. It was centrifuge at 5000rpm at 4C for 10 and the samples was micro filtered using 0.45µm syringe filters then 20µl injected into the HPLC. For Standard of Vitamin E 100mg of Vitamin E was weighed and dissolved in 100ml of Hexane (1000ppm) the stock solution was diluted to make working standard range Retinol and α-tocopherol were analysed by a Shimadzu LC10A VP Series liquid.

5.3.3.9 Determination of fatty acid composition

Two gram of ground sample was weighed into a 50ml glass stoppered centrifuge tube and denatured over boiling water (100^{o} C) for 3 min. Two millilitres of water and 7.5ml of 2:1 v/v methanol-chloroform mixture were then added. The mixture was shaken thoroughly and left at room temperature for two hours with intermittent shaking. After centrifugation, the supernatant was decanted into another centrifuge tube and the residue resuspended in 9.5ml of methanol-chloroform-water (2:1:0.8 v/v). The homogenate was then shaken and centrifuged (10 min). This step was repeated twice and the supernatants combined with the first extract. To the combined extracts, 7.5ml of each of chloroform and water was added, shaken and centrifuged (10 min). The lower chloroform phase was withdrawn using a Pasteur pipette and brought to dryness using a vaccum rotary evaporator at low temperature (40^{o}C). Fatty acid analysis was done using Gas Chromatography ISO 26 5508: 1990 method (using GC 14A, Shimadzu Corp, Japan).

The fatty acid profile was determined by gas chromatography system (GC-9A Shimadzu Co., Tokyo, Japan). The extraction of the total lipids was done by a modification of the Ekinci,(2005) method.

5.3.4 Data Analysis

The data obtained were subjected to analysis of variance (ANOVA) to evaluate processing effect on the proximate and chemical characteristic of traditional meat products. When significant difference were observed between the samples for a parameter, the ANOVA was complemented by LSD (Least Significant Difference) test to identify the means that are different. Statistical significance was measured at ($P < 0.05$) using IBM SPSS Version 19.0 software and Microsoft office excel was also used to generate tables. The data were expressed as means ± standard error.

5.4 Results and Discussion

5.4.1 Proximate Composition

Table 5.1. Shows proximate composition of traditional meat products. Results revealed the moisture content in the processed meat products of less than 7% while protein content in the processed meat products ranged 55.8-72.5%. The gross energy values in the processed meat products ranged from 400 to 435 kcal/100 g.

Table 5.1: Nutrient profile of the traditional food products (grams/100 g) [1]

Proximate profile %	Beef *koche*	Goat *(koche)*	Beef pounded	Mix Beef and barley	Fresh meat
Ash	1.7±0.1[b]	3.4±0.2[a]	1.9±0.2[b]	2.8±0.6[b]	1.06±0.003[a]
Crude fibre	1.9±0.2[b]	1.5±0.2[b]	2.2±0.3[b]	4.1±0.4[a]	0.12±0.003[a]
Protein	65.7±3.7[b]	72.5±1.7[a]	65.2±2.0[b]	55.8±1.2[b]	20.60±0.06[a]

Moisture content	5.5±1.1 [b]	4.6±0.3 [b]	3.3±0.3 [a]	6.1±1.7 [b]	76.36±0.19[a]
Crude fat	10.2±1.4 [b]	9.4±1.0 [b]	13.3±0.9 [a]	10.3±0.8 [b]	2.24±0.066[a]
Carbohydrates	13.5±2.4 [b]	8.7±1.2 [a]	15.6±1.4 [b]	21.6±2.2 [a]	-0.69±0.20[a]
Kcal/100g	413.9±5.9 [b]	404.7±5.7 [b]	435.2±4.6 [a]	399.4±8.4 [a]	102.02±0.1[a]

[1]Means of samples analysed in triplicate ± standard error. Values in the same row with different superscript are not significantly different at ($P< 0.05$).

The drying process facilitated the reduction of moisture content to less than 7% in all the processed products compared to fresh meat which had 76% moisture content. Such low moisture level is effective in preventing spoilage, and hence facilitating preservation. Dried meat and meat products can be defined as whole muscle or ground and formed meat products which have been subjected to dehydration, resulting in unique sensory properties and enhanced stability (Gounadaki, 2009).

The proximate composition shows that traditional meat products are a shelf stable product as it has low moisture content of less than 6%, similar with the study done by Ogunsola (2008), who opined that the profile of the proximate composition of the *danbunama*. He proved that for the product to be a very shelf stable product it has to be kept at low moisture content which promotes its ability to stay at room temperature in spite of its high level of protein and fat combined.

The traditional meat products have high protein content due to processing which has increased the dry matter while there was reduction in moisture content. Egbunike (1999), observed that intermediate moisture meat is meats low in moisture content but contain three to four times the raw protein equivalent. Similarly, Badiani et al. (2002) illustrated that cooking caused moisture content decrease resulting in increased nutrient. Other ingredients added to the meat during processing also contributed to enhancing the nutrition value and quality of the traditionally processed meat. The seasonings added to traditional meat

products were salt, cardamom and sugar, which are not only important in preservation, but also improved the organoleptic properties of the products and shelf stability. Salt and sugar both have preservative effect. Sodium chloride (NaCl) in foods can be a source of osmotic stress by decreasing water activity whereas sugars has the capability to bind with moisture and reduce water activity in foods. They are generally used in dried meat processing as a source of sugars or carbohydrates to enhance flavour, reduce harshness of salt and lower water activity (USDA, 2005).

The addition of barley contributed to an increase in starch and crude fibre in the processed meat products. Apata et al. (2013) reported high crude fibre content in meat product (suya) as a result of high level of fibre in some of the constituents of the ingredient used in preparing the meat products whose source was from plants. Crude fibre is important in diet as it has a number of health benefits. It contributes towards better digestion. Barley is rich partly in soluble dietary fibres, mainly β-glucan and that scientific evidence shows adding whole-grain barley products to food can contribute to lowering serum cholesterol (Aman P. 2006). The gross energy content in cooked traditional meat was also high at 416 kcal/100g which was similar to beef jerky and dried smoked meat (USDA, 2009), particularly in the protein content and a consequent rise in energy values in cooked meat.

Table 5.2, shows mineral and vitamin composition of the traditional meat products. The levels of potassium was 701.3- 826.6 mg/100g, iron 4.5- 7.4mg/100g, calcium 35.8 - 110.0 mg/100g and sodium 158.3 - 364.4 mg/100g. The processed traditional meat also contains vitamins.

5.4.2 Minerals and vitamins

Table 5.2: Mineral and vitamin content (mg/100 g) of traditional meat [1]

Minerals and Vitamins	Beef (Koche)	Goat (koche)	Beef pounded	Mix Beef and barley
Calcium	71.6±0.6^{b}	51.8±1.4^{a}	110.0±3.4^{a}	35.8±1.7^{b}

Iron	7.3±0.2[b]	4.5±0.1 [a]	7.4±0.2 [b]	5.5±0.2 [b]
Zinc	4.6±0.1 [b]	5.7±0.3 [b]	4.7±0.1 [b]	2.9±0.1 [a]
Potassium	702.5±8.9 [b]	773.8±17.3 [b]	701.3±9.2 [b]	826.6±4.8 [a]
Magnesium	53.0±0.6 [b]	60.7±1.1 [b]	52.8±0.5 [a]	59.0±1.1 [b]
Sodium	229.8±3.5	364.4±8.2[b]	265.2±4.3	158.3±1.8 [a]
Thiamin	0.15±0.01 [b]	0.06±0.02 [b]	0.19±0.04 [b]	0.14±0.01 [b]
Riboflavin	0.07±0.01 [b]	0.03±0.01 [b]	0.11±0.03 [b]	0.14±0.05 [b]
Niacin	3.69±0.20 [b]	3.82±0.13 [b]	3.67±0.09 [b]	3.41±0.23 [b]
Pyridoxine	0.48±0.08 [b]	0.49±0.02 [b]	0.35±0.04 [b]	0.35±0.07 [b]
Retinol (µg/g)	19.54±0.35[b]	36.16±0.71 [a]	17.40±1.32 [b]	28.68±2.38[b]
α-tocopherol (µg/g)	5.19±0.32[b]	2.52±0.12 [a]	4.72±0.75 [b]	3.60±0.41 [b]

[1]Means of samples analyzed in triplicate ± standard error. Values with the different superscript are significantly different at ($P< 0.05$)

Meat and meat products are also important sources of minerals in the diet. Beef has almost all-important minerals for human nutrition. From the nutritional point of view, meat's importance is derived from its high quality protein, containing all essential amino acids and it's highly bio available minerals and vitamins. (AO 2105.) In addition, the iron in beef which is heme iron is absorbed 3 to 5 times faster than that originating from vegetables non heme iron (Oliveira et al., 2015). Traditional meat is a source of some of vitamins as Pereira (2013) described that meat and meat products are particularly important sources of all the B-complex vitamins including thiamin, riboflavin, niacin, biotin and vitamins B6

5.4.3 Fatty Acid Profile

The traditional meats' fatty acid composition is presented in Table5.3. The predominant acids in the meat were, oleic 16.4-39.2%, palmitic 19.3-33.2%, and linoleic 2.5-13.5%.

Table 5.3: fatty acid profile (%) of crude fat in traditional meat [1]

Name	Beef koche	Goat koche	Pounded meat	Beef Barley	Ghee	Rina oil
butyric	0.3	0.0	0.0	0.9	0.0	0.0
caprylic	0.0	0.0	1.2	14.9	0.1	1.4
capric	0.1	0.1	2.7	2.0	3.3	2.8
lauric	0.4	0.4	3.2	2.8	0.1	4.2
myristic	1.4	2.3	11.0	9.1	1.7	12.4
myristiloic	0.0	0.0	1.8	1.9	0.1	1.9
pentadecanoic	0.2	0.2	1.8	1.3	0.1	1.4
cis -10- pentdecanoic	1.3	1.4	0.8	0.3	0.0	0.2
palmitic	33.2	32.3	28.3	23.0	35.6	29.7
palmitoleic	1.1	1.0	2.9	2.4	0.0	2.7
heptadecanoic	0.4	0.2	0.7	0.5	0.1	0.6
cis -10- heptadecanoic	1.3	1.1	0.5	0.3	0.0	0.3
stearic	7.8	5.8	11.6	9.7	2.9	9.2
oleic	37.2	39.2	26.8	23.1	41.5	25.5
Linoleic	13.3	13.5	4.0	2.9	13.1	2.7
linolelaidic	0.0	0.0	0.0	0.0	0.0	0.0
Linolenic	1.6	1.9	1.9	2.0	0.7	2.3
Lignoceric	0.0	0.0	0.0	0.0	0.0	0.0
Trace	0.3	0.5	0.8	3.0	0.8	2.8
Total	100	100	100	100	100	100

[1]Means of samples analysed in triplicate ± standard error. Values with the same superscript are significantly different at ($P < 0.05$)

Table 5.4: Total fatty acid composition of traditional meat products (%)

	Beef *koche*	Goat *koche*	Pounded meat (*fonntuma)*	Beef Barley
Total saturated	43.8±3.6[b]	41.3±3.5 [b]	60.5±3.0 [b]	64.1±2.5 [a]
Total monounsaturated	38.3±12.2 [b]	40.2±12.6 [a]	31.5±8.1 [b]	27.±6.6 [b]
Total polyunsaturated	14.9±5.6 [b]	15.4±5.8 [b]	5.9±1.0 [b]	4.9±0.4 [a]
others	2.9±0.3 [b]	3±0.2 [b]	2.1±0.1 [b]	3.6±0.6 [b]

[1]Means of samples analyzed in triplicate ± standard error. Values with the same superscript are not significantly different at ($P< 0.05$)

Among the fatty acid found in traditional meat are palmitic(C16:0) 19.3-33.2%,oleic acid (C18:1) 16.4-39.2%, and linoleic (C18:2) 2.5-13.5% in different products. Beef and goat *koche* was also found to have higher content of oleic 37.2% and 39.2% respectively and linoleic 13.3%and 13.5%, respectively indicating that the traditional meat products do provide important essential fatty acids. The fat content in meat and meat products is a matter of concern in the diets. In meat it is highly variable depending on species, origin, feeding system, age and the cut (Daley, 2010.)In addition, 30% of the Fatty Acid content in conventionally produced beef is composed of oleic acid (C18:1), a monounsaturated FA (MUFA) that elicits a cholesterol-lowering effect among other healthful attributes (Daley C. 2010). The traditional products were cooked using Ghee or Rina vegetable oil, products cooked with ghee beef koche and goat meat koche had hiher levels of oleic and linoleic acid while products cooked with rina vegetable oil had high levels of myristic oil

5.5 Conclusion

Traditional meat processing among the Borana was accomplished through heating, drying and addition of salt and sugar. The traditional meat products were nutrient rich products, where the concentration of nutrients was enhanced by the drying process. These findings signify that the traditional products meat have the potential to provide important levels of key nutrients including monounsaturated fatty acids which are beneficial to health. There is potential to upscale the production of these traditional meat products. This will contribute to increased income among the community.

CHAPTER SIX

MICROBIOLOGICAL STATUS AND EFFECT OF DIFFERENT TEMPERATURE AND STORAGE CONDITIONS ON THE SHELFLIFE OF ARTISANAL MEAT PRODUCTS

6.1 Abstract

Preservation of meat and meat products is important due to its short shelf life and perishability. Meat is an ideal culture medium for microorganisms because of its high protein and moisture content when left unpreserved. Therefore, the objective of this part of the study was to determine microbial characteristics and to identify the influence of different temperature conditions and storage on the keeping quality of artisanal meat products.

The artisanal meat products were prepared by women groups in Marsabit County, Kenya. The samples were collected and transported in the same week in a cool box to the Department of Food Science and Technology at Jomo Kenyatta University of Agriculture and Technology for analysis.

The result showed that there was presence of microorganisms - *staphylococcus aureus*, yeast and mold - for the period of seven weeks observed. The result further indicated that, there was significant ($p<0.05$) increase of *staphylococcus aureus* from (1.44 log cfu/g) to (2.28 log cfu/g) over the observed period at ambient temperature. For storage temperatures ambient and cold 5ºC conditions and improved products there were significant decline ($p<0.05$) in microbial growth for the seven weeks observed. For rancidity indices. The peroxide value, acid value and thiobarbituric acid levels were below the value associated with meat spoilage during the expected shelf life.

Based on this result, it was noted that storage at low temperature and improved hygiene and sanitation during preparation and handling could enhance the keeping quality and shelf life of artisanal meat.

6.2 Introduction

Preservation of meat and meat products was important to increase shelf life and overcome perishability. Meat is an ideal culture medium for many microorganisms because of its high protein and moisture content when left unpreserved. It is a protein rich and nutritious food containing good amount of minerals and essential vitamins and is one of the common foods consumed by pastoralists. Raw meat gets spoilt at high ambient temperatures within a few hours due to its high moisture and protein contents (Dzudie *et al.,* 2003). Owing to its short shelf life, meat is usually preserved by several methods including drying, smoking, salting, use of heat, low temperatures and chemicals preservatives. The artisanal meat products are prestigious and served commonly during social ceremonies such as wedding, traditional events and given as special food to guests, in-laws and children. Preservation of these meat products were usually by drying and use of heat. Fermentation or drying or smoking prolongs the shelf-life of perishable raw meat (Rantsiou and Cocolin, 2006).

The artisanal meat products was prepared from beef or goat meat which is striped, dried and deep fried. It has a high cultural and economic importance to Borana people which warrants 0the efforts to ensure quality and safety. The processing and preparation of these artisanal meat products was an elaborate process where the meat parts used are selected carefully by removing fatty tissues and tendons, only lean meats parts are used. The meat is then striped and suspended to dry for one to three days to lower the moisture content. Bintoro et al (1987) observed that lowering the moisture content (dehydration) prevented foods from spoilage which is a well-known preservation method in tropical areas.

Dried and cooked meat products compared to raw meat have lower microbial load, this is because the drying reduces moisture content thereby leading to reduction of microbial growth. William (1988) reported that raw meat is subject to spoilage by its own enzymes and by microbial action and its fat may be oxidized chemically. Drying of meat as is the case with jerky or sun-dried strips of beef helps preserve by the low moisture content.

Additionally, cooking at high temperature destroys microorganism thereby making this artisanal products shelf stable at ambient temperature. The most common method of killing microorganism is to subject them to heat treatment. High temperature of 80-120^{o}C acts by killing spores and vegetative cells. It denatures the food enzymes and also destroy some of the toxins produced by certain microorganism (Neelima, 2010).Due to handling and preparation environment of artisanal meat, contamination could arise from recontamination and post handling even after high temperature has been used to kill the microorganisms during processing. Therefore, the Microorganisms on the dried product may include those that survived processing due to recontamination (ICMSF, 2005)

Under the traditional processing conditions, these meat products are suspended in the open while drying, exposing it to risk of contamination. Even though the drying could lower the moisture content other conditions such as poor sanitation during preparation may affect quality and safety of these products. Dave (2011) opined that microbial growth and metabolism depends upon the condition of the carcasses at the time of slaughter, the type of packaging and storage conditions.

The preparations and handling of the artisanal meat have been practiced for centuries some of the these meat products can be preserved and consumed for months without spoiling if processing and storage is done properly. The preservation techniques applied commonly are drying, heating, and smoking of storage containers and keeping the products immersed in oil during storage.

However, as much as these meat products have been consumed for long and are popular among the locals some of the traditional products may be contaminated with disease causing microorganisms. Microbial quality of meat products is of public health concern all over the world (Adeyeye, 2015)

The artisanal meat products are similar to *Danbunama* and *kilishi* in Nigeria which are meat products that have good nutritive value and long shelf stability at room temperature (Ogunsola, 2008). These meat products have been preserved and consumed by Borana in times of hardship or stored to be consumed overtime. Despite these benefits, there is little or

no information about their keeping quality and safety. Most of the people involved in the preparation have little or no knowledge of good hygienic practices. Furthermore, there is need to ascertain quality and shelf life as the young generation is more aware of public health issues.

Therefore, the objective of this study was to determine microbial quality and shelf life of artisanal meat products and to assess rancidity indices to ascertain about their quality, especially because some of them are preserved with fats and other ingredients

.6.3 Materials and Methods

6.3.1 Study Area

This study was conducted in Marsabit County, northern Kenya. Marsabit County falls under arid and semi-arid lands. The primary economic activities are livestock production, small scale trading with a bit of agro-pastoralism. The temperatures range from a minimum of 10^{o}C on the higher lands to a maximum of 30^{o}C in low lands. Rainfall ranges between 200mm and 1000mm per annum. (Marsabit County Development plan 2013-2017)

6.3.2 Sampling of Artisanal Meat Products

Meat products were striped and dried for one to three days at prevailing temperature conditions and later deep fried. Simple random sampling was done, seventy samples were collected from the meat products that were prepared by the women groups in Marsabit County. The samples were then collected in universal bottles, stainless steel containers and traditional storage containers.

The samples were then transported in the same week in a cool box to the Department of Food Science and Technology at Jomo Kenyatta University of Agriculture and Technology (JKUAT). Some Samples were kept at room temperature and others at cold temperature of 5^{0}Cand analysed for microbial load and rancidity indices.

Microbiological assessment was done to ascertain the quality and safety of artisanal meat as microorganisms are the main cause of spoilage in meat. Aerobic colony count was done as count of viable bacteria employed to indicate the sanitary quality of food. Indicator

organism, *Escherichia coli* was tested for any direct or indirect faecal contamination. Specific pathogen counts of *staphylococcus aureus* was done to check presence of microorganisms that may cause food borne illness while yeast and mold counts was done as an indicator of food spoilage. Quality indices such as peroxide value, acidity, free fatty acid, Thiobarbituric acid (TBA) and PH were also assessed to evaluate development of rancidity in artisanal meat products. The basic hygiene practices applied to improved products included observation of personal hygiene, washing of hands, cleaning and sanitizing knives, pots and other tools used

6.3.3 Collection of samples from the field

Samples of different artisanal meat products were collected in pairs in universal bottles, stainless steel containers and traditional containers and were stored in a cool box and transported to JKUAT for laboratory analysis.

6.3.4 Microbiological analysis

Ten grams of each sample and 90ml of normal sterile saline water was homogenized in a stomacher bag blender for 1-3 minutes. Appropriate dilutions (0.1ml) were made and surface plated on the following media for microbial count. 0.1ml samples of appropriate dilutions were spread on Nutrient agar (Oxoid), MacConkey agar (Oxoid), mannitol salt agar (oxoid) and potato dextrose agar (oxoid) for the enumeration of total bacteria, E-*coli*, *Staphylococcus aureus* and yeast and molds respectively.

6.3.4.1 Total viable count

For total bacterial counts, 0.1ml of relevant dilutions was inoculated onto sterile nutrient agar plates and spread on the surface using sterile bent glass rod. Inoculated plates were incubated at 37^{o}C for 48hr before colonies were counted and reported as colony forming units/g (cfu/g).

6.3.4.2 *Escherichia coli* count

0.1ml of relevant dilution was spread on surface of McConkey agar plates. The plates were then incubated for 24hr at 37^{o}C. Colonies were counted and reported as colony forming units/g (cfu/g)

6.3.4.3 *Staphylococcus aureus* count

0.1ml of relevant dilutions was spread on mannital salt agar plates using sterile bent glass rod on. The inoculated plates were incubated at 37oC for 48hr. Colonies were counted and reported as colony forming units/g (cfu/g)

6.3.4.4 Mould and yeast count

Yeasts and molds were enumerated by the surface plate method using potato dextrose agar (PDA). 0.1ml of appropriate sample dilutions were spread onto PDA agar and incubated at 25^{o}C for 3-5 days. Colonies were counted and reported as colony forming units/g (cfu/g)

6.3.5 Quality Indices

The peroxide value, free acid, pH thiobarbituric acid (TBA) and the acidity were analysed to determine the quality of artisanal meat products.

6.3.5.1 Determination of Peroxide Value (PV)

Two grams of sample were weighed into a glass stoppered flask. Twenty five millilitres of acetic acid- chloroform mixture (in ratio 3:2) was added and the sample dissolved. One milliliter of saturated potassium iodide (KI) solution (4 parts KI in 3 parts distilled water) was added, mixed and placed in the dark for 10 min. Thirty millilitres of distilled water was added, mixed and followed by addition of 1ml of 1% starch indicator. The mixture was titrated with 0.01N sodium thiosulphate until the blue colour disappeared. A blank test containing all the reactants other than sample was carried out at the same time. The peroxide value of each sample was calculated as follows:

PV (meq/Kg) == (B-A)*1000*N /W

B= 1st titre- A= blank, N = Normality of Normality $Na_2S_2O_4$. W= Weight of samples (g),

6.3.5.2 Determination of PH, FFA and Acidity

The pH of meat was measured in a slurry made with distilled water (1:10) and measured using pH meter (Hanna pH meter 213). Free fatty acid (% of oleic acid) were analyzed by using standard method: sample (2 g) was weighed into a 250 ml conical flask and 10ml of ethanol (95%) was added, the resulting mixture was titrated with sodium hydroxide (0.1 M) using phenolphthalein as indicator. The titration was done with constant shaking until a pink color persisted for 30 seconds. The %FFA was then calculated from the following equation:

% FFA = 1st titre*282 *N/ (F*W)

Where; W = Weight of sample (gms) N = m/w (oleic acid) NaoH, F= Factor, (10)

282=conversion factor for oleic acid

The acid value is the number of milligrams of sodium (or potassium) hydroxide necessary to neutralize the free acids in 1 gram of sample\

1st titre*dil* *m/w (oleic acid) *N/ (W*100)

6.3.5.3 Determination of Thiobarbituric Acid Reactive Substances TBARS

The standard MDA solution (1 mL) was taken in a 10 mL test tube and mixed with TBA (1 mL). The mixture was heated in a boiling water bath at 95°C for 60 minutes. The test tubes were cooled at room temperature and absorbance was measured at 532 nm using UV-visible spectrophotometer model PharmaSpec 1700 (Shimadzu, Japan

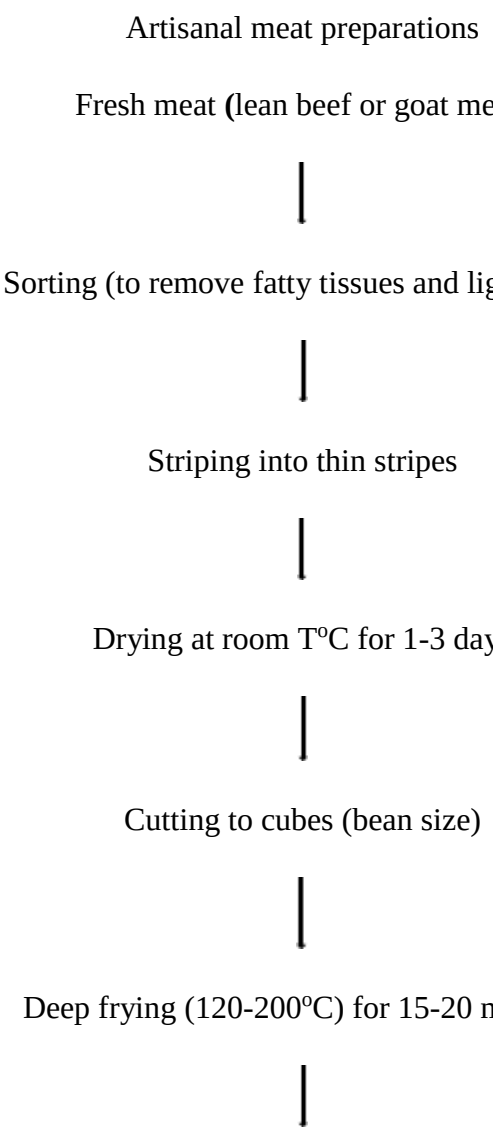
Two different kinds of samples extracts were prepared, that is, with 100% glacial acetic acid (AA) and 50% glacial acetic acid with water (AW). The extract of each sample (1 mL) was mixed with 1 mL TBA reagent and the above procedure was repeated five times (). The TBARS was calculated using the formula as µM/g of the sample:

TBARS= (µM/g) = (Ac x V)/W

Where Ac is the amount determined from the calibration curve and W is the weight of the sample taken while V is volume in mL or dilution factor of the total extract prepared.

6.3.6 Data Analysis

Data obtained from a laboratory analyses were analysed using analysis of variance (ANOVA) complemented by LSD at significant level of ($p<0.05$) to compare the mean values of the treatments. Statistical program for social sciences, Version 19 (SPSS) was used.



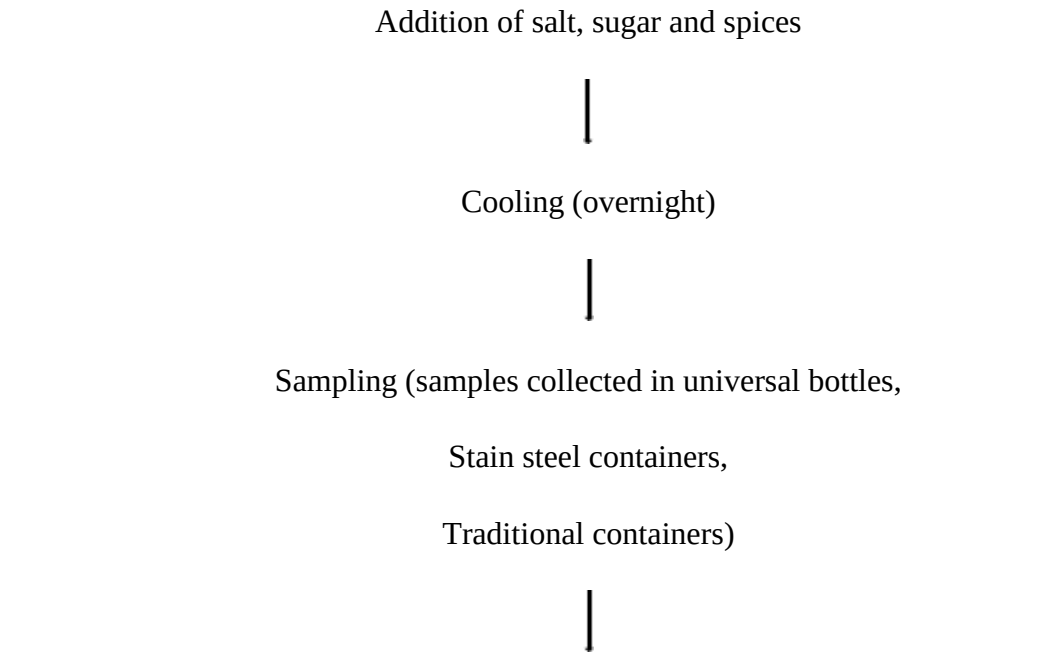


Figure 6.1: Process flow for artisanal meat products and sampling

6.4 Results and Discussions

Result presented in table 6.1shows that there was viable microorganisms as indicated by the total viable count, *Staphylococcus aureus* and yeast and mold for the period of seven weeks observed. The result further indicates that, there was significant ($p<0.05$) increase of *staphylococcus* from (1.44 log cfu/g) to (2.28 log cfu/g) over the observed period. However, for all the microbes analyzed the counts were within acceptable limit as stated by KEBS (2003) that any cooked food should contain no more than 10^6 viable counts per gram upon analysis. From all the samples tested *Escherichia coli* was not detected (ND). The presence and increase of microbial load during the time observed could be due to cross and post handling contamination. Raji (2006) observed that the application of high temperature during roasting and the process of drying of the meat were expected to have reduced the bacterial load of the meat product. However, the presence of bacterial counts despite these processes suggest possible post-production contamination. Yeast and mold can cause

spoilage of jerky during storage of the product acquires moisture from the environment (Sperber 2009).

Microbial mean count ±SE (log_{10} cfu/g) was observed biweekly for seven weeks and the results are presented in Table 6.1.

Table 6.1: Microbial mean count ±SE (log_{10} cfu/g) observed biweekly for seven weeks

Microorganism	Week1	Week3	Week5	Week 7
Total Viable Count	2.15±0.15	2.20±0.15	1.88±0.16	2.51±0.15
Staphylococcus aureus	1.44±0.23[a]	1.09±0.21[a]	1.33±0.23[a]	2.28±0.22[a]
Yeast & Mold	1.66±0.11	1.28±0.22	1.43±0.24	1.74±0.22
Escherichia coli	ND	ND	ND	ND

Means with same superscripts within a row were not significantly different (P<0.05). ND (not detected)

For the storage containers, table 6.2shows that there were counts observed in all the three-container type. However, stainless-steel containers had higher counts for total viable count, *Staphylococcus aureus* and yeast and mold than the universal glass bottle and traditional containers. This could have been due to the fact that apart from meat being pre-dried, the traditional container was fumigated and smoked by special kind of stick which is normally used by pastoralist in preservation of meat and milk. Smoke constituents play an important role in preserving the product against microbial spoilage. (Fakolade, 2008).

Table 6.2 Microbial load mean count±SE (log_{10} cfu/g) observed in different storage containers

Microorganism	Glass	Tradition container	Stainless steel
Total Viable Count	2.17±0.12	2.09±0.14	2.31±0.15
Staphylococcus aureus	1.69±0.19	0.96±0.20	2.00±0.19

Yeast & Mold	1.73±0.18	1.01±0.16	1.85±0.19
E-coli	ND	ND	ND

Means with same superscripts within a row were not significantly different (P<0.05). ND (not detected)

Comparing the samples stored at room temperature and cold temperature, table 6.3 showed that there was significant (p<0.05) decline observed in total viable count, *Staphylococcus aureus* and yeast and mold for the seven weeks observed at cold temperature 5^{o}C. This indicate that temperature condition during storage do have an effect on microbial growth and keeping quality of this artisanal meat products. The basic aim of cooling techniques is to slow or limit the spoilage rate as temperature below the optimal range can inhibit the microbial growth (Cassens, 1994)

Table 6.3: Changes in mean counts ±SE (log10 cfu/g) at different temperature conditions observed biweekly for seven weeks

Time	Microorganism	Room temp	Cold 5^{0}C
Week1	Total viable count	2.15±0.15^{a}	1.55±0.34^{a}
Week3		2.20±0.15^{a}	1.29±0.41^{a}
Week5		1.88±0.16^{a}	1.60±0.35a
Week7		2.51±0.15^{a}	1.91±0.35^{a}
Week1	*S. aurous*	1.44±0.23^{a}	0^{a}
Week3		1.09±0.21^{a}	0^{a}
Week5		1.33±0.23^{a}	0.32±0.32^{a}
Week7		2.28±0.22^{a}	0.63±0.33^{a}
Week1	Yeast & mold	1.66±0.11^{a}	0.4±0.26^{a}
Week3		1.28±0.22^{a}	0.44±0.29^{a}

Week5		1.43±0.24[a]	0.86±0.36[a]
Week7		1.74±0.22[a]	1.21±0.31[a]
Week1	*E.coli*	ND	ND
Week3		ND	ND
Week5		ND	ND
Week7		ND	ND

Means with same superscripts within a row are not significantly similar (P<0.05). ND (not detected)

Result in table 6.4 for storage containers stored at different temperature revealed that there was significant($p<0.05$) decline in growth of *Staphylococcus aureus* count for all the three containers for the seven weeks observed at cold temperature 5^0C. However, there was presence of viable microorganisms and yeast and mold at all the temperature condition. Although cooking destroys *Staphylococcus aureus,* the toxin it produces is heat stable. Good personal hygiene when handling foods will keep *Staphylococcus aureus* out of foods and refrigeration of raw and cooked foods will prevent the growth of these bacteria if any is present **(Wagner, 2001).**

Table 6.4 Changes in mean counts ±SE (log_{10} cfu/g) at different temperature condition observed in storage containers

Storage Items	Microorganism	Room	Cold
Glass	Total viable count	2.17±0.12	1.29±0.33
	S. aurous	1.69±0.19[a]	0.32±0.22[a]
	Yeast & mold	1.74±0.18	0.60±0.27
	E-coli	ND	ND
Tradition container	Total viable count	2.01±0.14	1.96±0.24
	S. aurous	0.96±0.20[a]	0[a]
	Yeast & mold	1.01±0.16	0.92±0.28

	E-coli	ND	ND
Stainless steel	Total viable count	2.31±0.14	1.63±0.32
	S. aurous	2.01±0.19[a]	0.43±0.29[a]
	Yeast & mold	1.86±0.19	0.76±0.28
	E-coli	ND	ND

Means with same superscripts within a row are not significantly different (P<0.05). ND (not detected)

Comparing the artisanal meat prepared under traditional condition by women and improved condition where basic hygiene was observed, the result in table 6.5 shows a significant ($p<0.05$) reduced growth in all the three, total viable count at (log10 cfu/g 1.15) and no counts for *staphylococcus aureus* and yeast and mold at seven weeks. This indicates that basic hygiene and monitoring critical points in processing of artisanal products have positive effect on microbial load. Preventive measures can be applied at the most critical stages of preparation, storage or display and wherever control is feasible. Food safety rests on controlling food operations from receipt of ingredients until the processed or prepared foods are distributed, sold, or eaten. (Bryan, 1992)

Table 6.5: Changes in mean counts ±SE (log10 cfu/g) observed in product processed under normal condition and improved products over seven weeks

Time	Microorganism	Normal condition	Improved condition
Week1	Total viable count	2.15±0.15[a]	1.23±0.47[a]
Week3		2.20±0.15[a]	0.82±0.40[a]
Week5		1.88±0.16[a]	1.03±0.30[a]
Week7		2.51±0.15[a]	1.15±0.44[a]
Week1	*S. aurous*	1.44±0.23[a]	0.25±0.25[a]
Week3		1.09±0.21[a]	0[a]

Week5		1.33±0.23[a]	0[a]
Week7		2.28±0.22[a]	0[a]
Week1	Yeast & mold	1.66±0.11[a]	0.78±0.38[a]
Week3		1.28±0.22[a]	0[a]
Week5		1.43±0.24[a]	0[a]
Week7		1.74±0.22[a]	0[a]
Week1	*E.coli*	ND	ND
Week3		ND	ND
Week5		ND	ND
Week7		ND	ND

Means with same superscripts within a row is significantly different (P<0.05). ND (not detected)

Table 6.6 above shows result of storage containers with samples prepared under traditional conditions and improved condition where basic hygiene of washing hands at critical stages was observed. There was significant ($p<0.05$) decline in growth of *staphylococcus aureus* counts for all the three storage containers in improved samples. Total viable count and yeast and mold count were also lower in improved products. As *Varnam. A, (1995)* explained, drying is not sterilization process although inactivation of vegetative microorganism is likely. Dried meat will therefore contain viable organism as both end spores and vegetative cells. The other factors having the greatest influence on the growth of microorganisms in meat and meat products are the storage temperatures, moisture content and oxygen availability (Forest et al., 1985).

Table 6.6: Changes in mean counts ±SE (log_{10} cfu/g) observed in storage containers product processed under normal condition and improved products over seven weeks

Storage Items	Microorganisms	Traditional condition	Improved condition
Glass	Total viable count	2.17±0.12	1.33±0.37

	S. aurous	1.69±0.19[a]	0[a]
	Yeast & mold	1.74±0.18	0.23±0.20
	E-coli	ND	ND
Tradition container	Total viable count	2.09±0.14	0.36±0.24
	S. aurous	0.96±0.20[a]	0[a]
	Yeast & mold	1.01±0.16	0.36±0.28
	E.coli	ND	ND
Stainless steel	Total viable count	2.31±0.14	1.51±0.32
	S. aurous	2.01±0.19[a]	0.18±0.29[a]
	Yeast & mold	1.86±0.19	0
	E-coli	ND	ND

Means with same superscripts within a row is significantly different (P<0.05). ND (not detected)

Table 5.2 contains the quality indices of processed traditional meat products. There was no significant difference among treatment on pH values. In this study, the Peroxide Value (PV) of the processed samples was 1.8 – 2.6 mEq/kg. These values are within the value for prevention and control of rancidity development in meat. PV in all samples were below 25 mEq/kg, which is considered as limit of acceptability in fatty foods (Pearson, 1976)

Free fatty acids values of processed meat products were 0.38-2.55% oleic acid. These values are and below the threshold for rancidity detection in dried cooked meat. Thiobarbituric acid (TBA) values expressed as mg of malondialdehyde (MDA)/kg of processed products were 0.32-0.52 (MDA)/kg hence, it was within the acceptable range. TBA value is routinely used as an index of assessing lipid oxidation in meat products in during storage. Evranuz (1993) reported that the rancid flavour is initially detected in meat products at TBA values of 2.0.

Table 6.7: pH and fat quality indices of traditional meat in1

Quality Indices	Beef (*Koche)*	Goat *(koche)*	Beef pounded	Mix Beef and barley
PH	5.90±0.18	6.1±0.08	5.7±0.05	5.85±0.03
Peroxide value mEq/kg	2.4±0.8	2.5±0.8	2.6±0.8	1.8±0.8
TBA mg MDA/kg	0.52±0.01	0.4±0.02	0.5±0.02	0.32±0.02
Acidity %	0.01±0.00	0.01±0.00	0.0±0.00	0.00±0.00
Free fatty acid %	2.55±0.01 b	1.37±0.02	0.80±0.02	0.38±0.00[b]

[1]Means of samples analyzed in triplicate ± standard error. Values with the same superscript are not significantly different at (P< 0.05)

The result of quality indices the PH, peroxide value (PV), Acidity, FFA (free fatty acid and TBA (Thiobarbituric acid) are presented in figure 6.1 shows no significant variation (p>0.05) for PH, acidity and TBA at week 1 and week 7 was observed. Joes et al., (1994) reported that the average pH for intermediate meat products was in the broad range of 4.72 to 6.73.

Peroxide value (PV) measures the concentration of peroxides and hydro peroxides formed in the initial stages of lipid oxidation and it is widely used for the estimation of oxidative rancidity in fats and oils Olafsdottir (1997). There was significant increase (p<0.05) for peroxide value 2.26 to 4.45 mEq/kg. Soyer et al. (2010) reported significant changes in peroxide value (p<0.01) due to storage period in meat samples.

Free fatty acids are the products of enzymatic or microbial degradation of lipids. The mean values of the free fatty acids (% oleic acid) of samples increased significantly (p<0.05) from 0.97% to 2.05% at week 1 and week 7 respectively. Nevertheless, free fatty acid value did not exceed the 1.2 - 2.1% limit which was reported by Pearson (1968a) to be the minimum limit for odour to be acceptable.

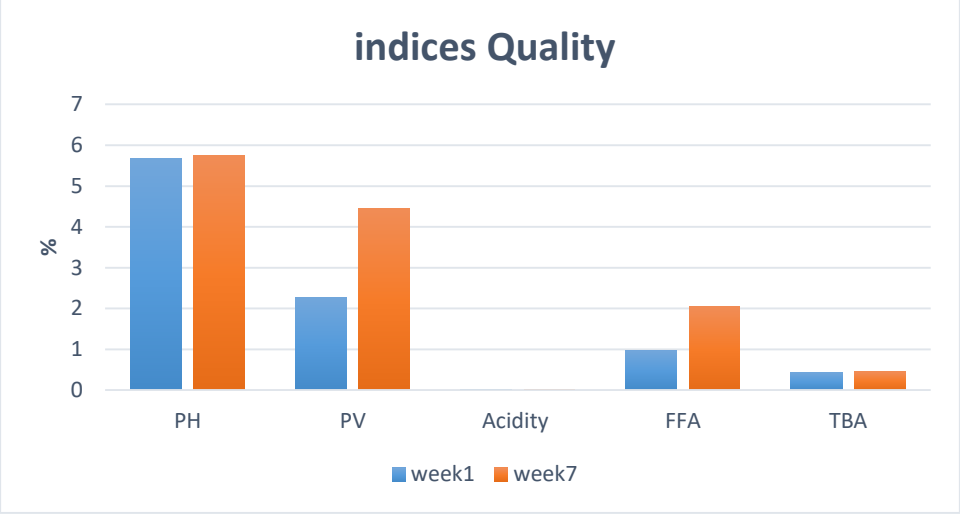


Figure 6.2: Showing changes in quality indices at week 1 and week 7

6.5 Discussions

Microbiological assessment on safety, storage stability, and sanitary quality of artisanal meat product was carried out to test artisanal meat product for the presence of some pathogens (e.g., *Staphylococcus aureus),* different microbial groups (e.g., total viable counts and yeast and molds), and indicator bacteria (e.g., *E-coli* as an indicator of sanitation). Byarugaba (2011) stated that *Escherichia coli* was the best faecal indicator organism to assess sanitation conditions during processing because of their high prevalence in the faeces of healthy animals.

The facts that there were presence of *staphylococcus aureus* and yeast and mold in artisanal meat products indicate that there was post cooking contamination at ambient temperature. *Staphylococcus aureus* may be present in small numbers in dried meat and is frequently introduced into foods by way of abscesses or the nasal cavity of food handler's (Neelima, 2010).

A significant difference in microbial load reduction was observed with different storage temperatures conditions and improved products. As Dave (2011) observed proper handling, pre-treatment and preservation techniques can improve the quality of meat and meat products and increase their shelf life.

A study by Tangkham et al (2016) found that aerobic plate count for jerky which is sold as heat treated ready to eat meat products was detected at levels considered safe for human consumption at 3.21-3.45 log cfu/g over ambient storage of 28 days. Naidoo and Lindsay (2010) also reported that biltong, a dried salted beef product in South Africa, had aerobic bacteria (6.4-7.0 log cfu/g), *staphylococcus aureus* (3 log cfu/g) and *E. coli* (1 log cfu/g) counts, yeast and mold 6 log cfu/g. This indicates that total bacterial count, *staphylococcus aureus*, yeast and mold in artisanal meat is lower 2.51 log cfu/g 2.28 log cfu/g and 1.74 log cfu/g respectively than has been reported for biltong and jerky. *Escherichia coli* was not detected in any samples of artisanal meat products. Dried meat products are shelf stable at ambient temperature. As a loose reference to determine approximately where spoilage will occur, preserved meat should have aerobic colony count less than 6 log cfu/g, *Escherichia coli* none detected, yeast and mold less than 3 log cfu/ g and S*taphylococcus aureus*< 1.3 log cfu/g (Neelima G. 2010).

6.6 Conclusion

Result obtained from this study revealed that microbiological and rancidity indices were within acceptable range throughout the storage. Drying and cooking of meat after drying contributed towards reduction of microbial load. However, poor handling and post contamination leads to proliferation of microbes. Low moisture, low temperature and observation of good hygiene practices prior and during processing of artisanal meat products was observed to enhance the shelf life and quality of artisanal meat products.

CHAPTER SEVEN

CURRENT STATUS AND CONSUMER PERCEPTION OF ARTISANAL MEAT PRODUCTS IN MARSABIT KENYA

7.1 Abstract

Pastoralist women have skills and knowledge in value addition of livestock products both for use at the household and for income generation to diversify diet and for other use. They have indigenous knowledge and skills that they accumulated overtime from their predecessors to process and preserve livestock products. This part of the study was carried out using quantitative techniques to find out general acceptability of artisanal meat products by respondents in Marsabit County. The data collection took place in Marsabit County, where a household survey using semi structured questionnaire and ssensory evaluation was done on two traditional meat products of beef and goat meat. The result showed that the Borana women have skills and knowledge of these traditional products. The products are highly regarded and the women have skills to process the products. The sensory evaluation done on perception of these products revealed that the products are preferred a lot as special foods in the community

7.2 Introduction

Marsabit County is situated in northern part of Kenya which comprises mainly pastoralist who keeps livestock and depended on livestock and livestock products for their livelihood. As described in a report by MacOpiyo (2014) Northern Kenya is largely a pastoral production system where pastoralists keep a variety of livestock mainly goats, sheep, cattle, camel, chicken and donkeys. The livestock reared represent their wealth while most of their cash needs are derived from the sale of the livestock and livestock products. However, due to various factors such as continuous drought which have reduced their livestock population and changes in social economic practices, pastoralist in northern Kenya have diversified means of livelihood in adapting the dynamism of modernization. Pastoralist societies have undergone further changes due to urbanization, an increase in population and the state-

imposed policy of sedentarisation that is attempting to integrate the pastoral economies into national and international markets. (Guyo F. 2017).

In Marsabit county women play important role in the livestock value chain especially management of livestock and livestock products particularly milk and meat at household level. Pastoralism in the arid and semi-arid areas of northern Kenya is nomadic in nature and livestock represent the key source of livelihood across most ASAL households. (Mudhe, A. 2009). Pastoralist women have indigenous knowledge and skills that they accumulated overtime from their predecessors to process and preserve livestock products. Rural women use using a diversity of simple and traditional food processing techniques to make a variety of traditional food products. These traditional food processing techniques are simple and low-cost and aim at long storage of foods. (Ibnouf, 2012). Milk and meat are mainly used for subsistence and during the glut seasons sold to improve house hold income as (Njaja, 2003) noted, utilization of livestock and their products are for subsistence while its sales contributed to the cash economy and that the system was mainly subsistence oriented and there was need for improved commercialization.

Women in these areas are learning the importance of coming together and working in groups in producing and promoting their traditionally made products during cultural shows and events to get more income from their indigenous knowledge and skills. This is described in report by MacOpiyo, L. (2014.) which indicated that commercialisation and access to money from income generation activities has been positively embraced as communities and women in particular seek economic empowerment through social aspects such as meeting and working with others, social interaction and a chance to exchange information. These traditional meat products are important especially in terms of food culture and being regarded as special foods within the community which has ensured its continued survival. Food habits are slow and difficult to change because food has important psychological associations with the family and the community. Familiar food is satisfying and reassuring, particularly the traditional foods of childhood, which evoke a deep-seated emotional response (Oniango, 2003). Finally, this being a food product, the traditional meat products begin from preparation at household level to final consumer, it is important to evaluate the

consumer perception to identify their preferences and expectations in regards to sensory and commercialization aspect of these artisanal meat products. Preference or acceptance tests, are designed to give data that indicate how many people prefer a product, how much they like the product or what they perceive about specific attributes (Meilgaard, et al, 1991)

Therefore, the objective of this part of the study was to determine the current status of traditional meat processing and products and the perception of community about the traditional meat products.

7.3 Methods

7.3.1 Study design

The research design used was cross sectional as it gave the snap shot of practices in a fairly uniform population at a certain point in time. The artisanal meat products prepared above were evaluated and ranked by 60 evaluators/ respondents consisting of men and women who were guided by five-point ranking questionnaire.

The respondents were interviewed to characterize artisanal meat attributes (organoleptic properties and preferences).

.7.3.2 Study site

The study was conducted in Central, Gadamoji and Obbu divisions of Marsabit County.
In Marsabit central the locations visited were Kiwanja ndege, Nagayo and Marsabit town. In Sagante the location, Dirib Gombo, Jaldessa, Goro-Rukhesa, Manyatta jillo and Gar qarsa were the sites visited. In Obbu location, sites visited were Sololo, Ramolle, Anona, and Damballa Fachana.

7.3.3 Sample Size and Sampling Procedure

Since the study population is Borana community, the population is concentrated in Marsabit central, Sagante and Obbu division of Marsabit County. Given that the study focus was traditional meat processing techniques, women were targeted and selected purposively.

To get a representative sample size this study used Fishers formula (Mugenda and Mugenda,

1999).

Since the target population is less than 10,000, the final sample estimate (n*f*) was calculated as follows: n*f*= (n/1+n/N)

Where: n*f*= the desired sample size (when the population is less than 10, 000).

n = the desired sample size (when the population is more than 10,000)

N = the estimate of the population size (Mugenda and Mugenda, 1999).

200 study participants were recommended as the desired sample size and to cater for those households that would decline to participate or drop out during the process. The accessible population was 3000 households in the study sites.

Mugenda and Mugenda (1999) recommend the formula for the sample size as;

$$n=n_0 / \{1+ (n_o - 1) /N\}$$

Where n_o is the desired sample size, N is the population size.

Using the above formula, sample size is: n= 200/ {1+ {200-1)/3000} = 188

7.3.4 Data Collections Methods

7.3.4.1 Household interviews

Household interviews were conducted using questionnaires with person found at home preferably the mother/female respondent because of the nature of the study. The interviews were conducted in Borana language by enumerators who were from the community. The enumerators were trained before the actual collection of the data. In a household identified for the interview and woman was not present at the time of the visit, effort was made to revisit the household. A total of 200 questionnaires were filled however 190 was analysed due to some having missing systems.

7.3.4.3 Sensory Evaluation

Sensory evaluation was done on two traditional meat products of beef and goat, a five-point consumer evaluation questionnaire was used (appendix V). The evaluators consisted of different people with varying background. Social economic and demographic factors were looked at and sensory perceptions of the products were assessed by blind coding of the samples. Sixty respondents participated in evaluating the samples. Information received from the assessors was recorded and enter into SPSS and analysed using descriptive statistics.

7.3.5 Data Management and Analysis.

The data obtained from the various methods above was analysed depending on type. Using statistical packages, descriptive statistical analysis such as means, standard deviation and descriptive was conducted for artisanal meat products types, source, and parts used and sensory evaluation in the three locations.

7.3.6 Ethical Consideration

Verbal consent from all respondents was sought before interview all the information collected during the field trip were treated as confidential and used for the purpose of the study only. Permission to work in the area was sought and respect of cultural practices observed.

7.4 Results and Discussions

7.4.1 Demographic and Social-Economic Impact

Respondents for household survey were all women the lowest-age-bracket <29 accounted for only 4% and the 30-49 categories accounted for 48% while the older category of >50 accounted for 47% out of the 190 respondents. This can be attributed to the fact that older women are the ones who have experiences and remembered with nostalgia about the artisanal meat processing. While the middle-aged women were the ones who are active and entertained guests and visitors. The younger women also prepared the meat products during ceremonies and special events.

The findings of this study showed that most of the respondents, 86% were married and 13% widowed indicating that traditional meat processing are a preserve of married women not girls. Indeed, it can be noted that no unmarried woman or girl was a respondent in this study. The main occupation of a majority in the study sample, 90% are pastoralist, as keeping livestock is their main stay with only 2% of the respondent being formally employed.

In general, the findings showed that 92% of the respondents had not gone to school at all with only 2% managing secondary education. The low levels of education could be attributed to the age of the respondent who are mostly over 30 years and it's only recently that pastoralist started taking girls to school.

7.4.2 Current Status of the Artisanal Meat Knowledge and Practices

Artisanal meat products are special kind of delicacy usually prepared for a reason. When asked whether the respondent has any of the traditional meat products in the house at the time of interview, only 12% responded in the affirmative while 80% responded that they did not have.

Amongst the Borana who are predominantly cattle keepers, the artisanal meat products are made from beef. 88% of respondent affirmed this. In the past they just slaughtered their own livestock for meat. However, nowadays they are butcheries in towns and centers which would supply meat demand. 35% of the respondent said they source meat from the butcheries when they want to make the meat products. The higher number of 54% who slaughtered their own livestock could be attributed to the fact that the traditional meat products are for a reason and season. Slaughtering also meant enough meat for the occasion as one key informant put.

7.4.3 Artisanal Skills and Value Addition

The lack of value addition skills in the community have made them disadvantage in terms of the potential income Borana have undergone many changes which has affected traditional knowledge system. The skills and knowledge are not geared toward economic benefit due to its cultural connotation.

Table 7.1: Summary of traditional meat processing and preservation responses

Theme	Questions	% responses
Consumption of the products	1. Frequency of consumption 2. When the products are consumed 3. Season of consumption 4. Reason for consumption	1. 57% and 34% consume beef and goat product once a month 2. 48% and 19% consume during special events and when hosting guests 3. 63% consume during dry season while 23% consume during wet season 4. 41% make due to special occasion 31% for guest and 17% for future use
Sources and type of meat	1. Source of meat 2. Type of meat used 3. Part used	1. 54% is own slaughter 35% from butchery and 10% traditional sharing 2. 88% use beef to make traditional product only 11% uses goat or sheep 3. 77% use steak to make the products
Methods of processing	1. What to do before cooking product	1. 91% stripe the meat and dry by hanging 2. 83% fry with oil while 10% roast

	2. Method of cooking 3. When oil/fat is added 4. Addition of spices	3. 53% add oil at the beginning 36% at the middle of cooking 4. 46% add salt while 14% add herbal leaves
Organoleptic	1. Criteria for knowing readiness 2. Important attributes in consumption	1. 32% know by aroma 30% by color while 21% texture 2. 69% thinks taste is highly important followed by aroma and appeal
Shelf life	1. Storage container 2. Duration of storage before spoilage 3. How spoilt product is known 4. What to with spoilt product	1. 55% uses metallic container while 41% uses traditional containers 2. 50% think the meat can stay for over 2 months while 17% says s <a month 3. 79% think change of taste followed by smell and appearance 4. 55% throw away spoilt meat while 12% continue eating

7.4.4 Sensory Evaluation

Result of demographic profile shows consumer evaluation by participants between 20 to 40 years is slightly higher than participants over 40 years of age. The locals are many compared the outsiders who participated.

Table 7.2: Demographic result of sensory evaluation

	Goat meat	**Beef**
	Values in Percentage (%)	**Values in Percentage (%)**
Age		
20-40	59	53
above 40	41	47
Gender		
male	48	46
female	52	54
Education		
none	48	46
primary	15	18
college/university	37	36
Ethnicity		
local	74	75
other Kenyans	21	18
foreigner	5	7
Occupation		
pastoralist	44	50
casual	8	9
formal	26	21
business	22	20

Sensory evaluation of traditional meat showed that both beef and goat *Koche* scored a mean of 4.0 to 4.6 an indication that the products were liked for all variables tested. Both products were liked moderately and like very much and thus there was no significance difference between them in terms of preference.

Table 7.3: Organoleptic result of sensory evaluation

Variables		No. of respondent	Mean rank	significance
taste	beef	28	4.6+.11	.859
	goat	26	4.6+.11	
	Total	54	4.6+.08	
aroma	beef	28	4.3+.12	.754
	goat	26	4.3+.12	
	Total	54	4.3+.08	
appearance	beef	28	4.3+.18	.707
	goat	26	4.4+.18	
	Total	54	4.3+.13	
tenderness	beef	28	4.1+.18	.790
	goat	26	4.0+19	
	Total	54	4.0+.13	
flavour	beef	28	4.3+.11	.895
	goat	26	4.3+.12	
	Total	54	4.3+.08	

Assessing the consumption of traditional day to day food compared to food prepared for special occasion, the participants reported that both products were prepared during special occasion only that beef is preferred and frequently prepared more than goat meat at 61%. Consumers evaluated also indicated that they are ready to buy the traditional meat products if it's available for sell at 72%.

Tale 7.4: Utilization of artisanal meat products

	Beef		**Goat koche**	
	As Family food	**As Special food**	**As Family food**	**As Special food**
Variable	%	%	%	%
frequently	11	61	4	50
sometimes	11	18	7	30
rarely	21	7	30	11
not at all	57	14	59	7
Ready to buy	28	72	35	65

7.5 Conclusion

Traditional meat products among the Boran people of Marsabit County are a relish and important food among the community. The product was highly regarded and the women had skills to process the products. The sensory evaluation done on perception of these products revealed that the products are preferred a lot as special food, however, due to its restriction to consumption at household level the products availability for commercial purpose need to be encouraged as women possess skills and knowledge to prepare and have shown interest in making it one of their income generating activities to diversify their income.

CHAPTER EIGHT
GENERAL CONLUSIONS AND RECOMMENDATIONS

8.1 Conclusion

The knowledge on processing exhibited by the women established that by improving some stages of processing through value addition, traditional meat products could be suitable and appealing not only for home consumption but market-oriented income generating activities. For example, striping of meat and drying processes takes days, risks contamination and was labour-intensive. It is therefore important for policy makers and development agencies to equip food handling processes to expand knowledge and skills, improve food hygiene for market adoption.

The findings from the respondents indicate that livestock products especially the aspect of sharing meat during the drought brought out the social ties among this communities and also mitigate risks such as food insecurity during the dry season. However, this practise was being threatened by the changing lifestyle and reduction of livestock numbers caused by varieties of factors such as urbanization and rural urban migration.

The keeping quality of the products was good, as all the rancidity indices including the Peroxide Value, Acidity and Thiobarbituric acid (TBA) were below the values associated with increased risk of rancidity.

These findings signify that the traditional products meat have the potential to provide important levels of key nutrients including monounsaturated fatty acids which are beneficial to health. Low moisture, low temperature and observation of good hygiene practices prior and during processing of artisanal meat products was observed to enhance the shelf life and quality of artisanal meat products. Considering the change in microbial counts at different temperature storage conditions and improved products, artisanal products may be recommended to store up to fifty days.

8.2 Recommendations

The findings from the study strongly indicated that women have knowledge and skills in preparation and processing of traditional meat products, there was need to tap these skills which were now documented with a bias towards commercialization of the products for income generating activities. The chemical and microbial result showed positive attributes of the traditional products, it would be of great assistance if the product is standardized accordingly by Kenya Bureau of Standards. There was also gap observed in improving the hygiene and sanitation of products during the processing flow especially at the stages of contacts in cutting and cooking processes.

The study also involved women groups who were engaged in demonstration of the processing during the participants observation, and were interested in utilizing their skills towards small scale production for commercial consumption. However, the need of building capacity in hygiene practices, enhancement of capacity to improve product variety and also reduce receding numbers of traditional product variety, commercialization of the products by value addition in packaging and storage of the products are some essential recommendation from this study to practitioners, entrepreneurs, funding and community support venture programs and County government.

Finally, in as far as the study has contributed to Food Science and Technology body of knowledge, through documenting artisanal meat preparation techniques amongst the Boran of Northern Kenya, while analysing nutritional and microbial properties of actual products preserved at ambient room temperature and in a controlled environment, and understanding acceptability and marketability of these products had been achieved, further research is recommended to ensure knowledge retention and propagation to future and other communities, and study wide acceptability of commercialized meat products, while timely review of the current status is still advised, with changing livelihood conditions, to further boost the body of knowledge.

REFERENCES

Adeyeye S. A et al. (2015), Quality and Safety Assessment of Traditional Smoked fish from Lagos State, Nigeria., *International Journal of Aquaculture*, 5(15): 1-9 (doi: 10.5376/ija.2015.05.0015)

Adapon. J. (2008) Culinary Art and Anthropology. Oxford: Berg, ISBN: 9781847886064

Agrawal, A. (1995), Dismantling the Divide Between Indigenous and Scientific Knowledge. Development and Change, 26: 413-439. doi:10.1111/j.1467-7660.1995.tb00560.x

Ahmadu, J.; Igene J.O.; Ada-Okungbowa, C.I,& Agboola, H.A. (2004). Economics of Kilishi production in Nigeria. *Applied Tropical Agriculture: An International Journal* 9 (1/2): 25

Almeida de Oliveira1 E., Sampaio A. (2015). Chemical and Fatty acid composition of different cuts cooked or uncooked from yearling bulls fed oil sources. *ActaScientiarum. Animal Sciences*. Doi: 10.4025/*actascianimsci.* v37i2.26510. *Maringá,* v. 37, n. 2, p. 187-194,

Aman P. (2006). Cholesterol-lowering effects of barley dietary fibre in humans: scientific support for a generic health claim. *Scandinavian Journal of Food Nutrition. ;* 50:173–6.970601057990

Anita S. Curry, Joyce G. & McEwen G. (2001) Microbiology guidelines: CTFA technical guidelines *production, Gwen Hall. Washington, DC: Cosmetic, Toiletry, and Fragrance Association, ISBN* 1882621328

AOAC, (1995). Official methods of analysis of the Association of Official Analytical Chemists. 16th Ed., Volume II Washington DC, USA.

AOAC, (2006). Official methods of analysis of the Total Carbohydrates, crude 'by difference'. *Association of Analytical Communities*, Gaithersburg. MD, 17th ed

Apata, E.S., Kuku, I.A., Apata, O.C., Adeyemi, K.O. (2013). Evaluation of Suya (Tsire) – An Intermediate Moisture Meat Product in Ogun State, Nigeria. *Journal of Food Research*, 2, 87. Doi: 10.5539/jfr. v2n1p87

Asafa Jalata, (2010) Oromo Peoplehood: Historical and Cultural Overview" *Sociology Publications and Other Works*. http://trace.tennessee.edu/utk_socopubs/6

Badiani A., Stipa S., Bitossi F., Gatta P.P., Vignola G. and Chizzolini R. (2002). Lipid composition,

retention and oxidation in fresh and completely trimmed beef muscles as affected by common culinary practices. *Meat Science,* 60, pp. 169–18.

Barthes, R. (1975) Towards a Psychosociology of Contemporary Food Consumption. *European Diet, from Pre-industrial to Modern Times. Eds. E. Forster & F. Forster.* New York: Harper & Row, 47-59.

Beardsworth, A. & Keil, T. (1997). Sociology on the Menu: An Invitation to the Study of Food and Society. *New York: Routledge,*

Bender, A.E. (1992). Meat and Meat Products in Human Nutrition in Developing Countries. *Food and Agriculture Organization of the United Nations.* FAO food and nutrition paper No.53 SN – 9789251031469

Bessière, J. (1998). Local development and heritage: traditional food and cuisine as tourist attractions in rural areas. *Sociologia Ruralis*, 38(1), 21–34.

Bintoro, P, J-I. Morita, K. & Mikawa, T. Yasui. (1987). Chemical and microbiology analysis of an Indonesian dried beef (*dendeng sapi*). J. Fac. Agr. Hokkaido Univ. 63(3):287-292.

Cassens Robert G. (1994) Meat Preservation: Preventing Losses and Assuring Safety. Food & Nutrition Press, Inc. ISBN: 9780917678349 |Online ISBN: 9780470385029 Cajete, Gregory. (2000). *Native science: Natural laws of interdependence*. Santa Fe, NM: Clear Light Publishers

Casey NH. (1992) Goat meat in human nutrition. Proceedings of the V International Conference on Goats, *Indian Council of Agricultural Research, New* Delhi;.8.

Clancy, J. S., Malik, F. U., Shakya, I., & Kelkar, G. (2007). Appropriate Gender Tools for Unpacking the Gender-Poverty Nexus. *Gender and development,* 15(2), 241-257.

Chikati D. et al 2014 Contribution of indigenous education in proper nutrition a case of Bukusu community of Kenya International journals of innovative research & studies

Chorianopoulos, NG, Giaouris, ED, & Skandamis, PN, (2008). Disinfectant test against monoculture and mixed-culture biofilms composed of technological, spoilage and pathogenic bacteria: bactericidal effect of essential oil and hydrosol of Satureja thymbra and comparison with standard acid-base sanitizers. *Journal of Applied Microbiology* 104: 1586– 96.

Dahl, Gudrun. (1990). Mats and milk pots: The domain of Borana women. In The creative communion: *African folk models of fertility and the regeneration of life*, ed. *Uppsala: Acad.*

Upsaliensis.doi: 10.1146/annurev.anthro.32.032702.131011 Environments 49:375-386

Dabasso, B.H., Oba, G., Roba, H.G., (2012). Livestock-based knowledge of rangeland quality assessment and monitoring at landscape level among borana herders of northern Kenya. Pastoralism: Research, Policy and Practice 2, 2.|DOI:10.1002/97804703850

Dabasso, B., G. et. al. (2018). Understanding Traditional Meat Processing Knowledge among the Borana Pastoralist of Northern Kenya. *Journal of Food Research*, *7*(4), 30. https://doi.org/10.5539/jfr.v7n4p30

Dave D. and Ghaly A.E. (2011), Meat Spoilage Mechanisms and Preservation Techniques: A Critical Review. *American Journal of Agricultural and Biological Sciences* 6 (4): 486-510, ISSN 1557-4989 ©Science Publications

Dzudie T, Scher J, & Hardy J (2002). Common bean flour as an extender in beef sausages. *Journal of Food Eng.* 52, 143- 147

Egan H, Kirk R. S & Sawyer R. Pearson's (1981) chemical analysis of food. (8th Edition). Churchill Livingstone, *Medical division of Longman group Ltd. Great Britain*. p. 591.

Egan, H., Kirk, R. S. & Sawyer, R. (1997). Pearson's chemical analysis of foods (9th edition) (4):609 - 634. Egan, H., R.S. Kirk and R. Sawyer, (1997). *Pearson's chemical analysis of foods (9th edition)*, pp: 609-634.

Egbunike G. N. and Okunbanjo A. O. (1999.) Effects of processing upon the quality of Nigerian meat products. *Livestock Production Sci.* 5 9

Ekinci R. and Kadakal C. (2005). Determination of seven water-soluble vitamins in tarhana, A traditional Turkish cereal food, by High-Performance Liquid Chromatography. *Acta Chromatographical*, 15: pp 289 – 297

Evranuz, E. (1993) The effects of temperature and moisture content on lipid peroxidation during storage of un-blanched salted roasted peanuts: shelf life studies for un-blanched salted roasted peanuts. *Int. J. Food Sci. Technol*., 28,193-199.

Fakolade, P. O., & Omojola, A. B. (2008). Proximate composition, pH value and microbiological evaluation of "Kundi"(dried meat) product from beef and camel meat: http://www.tropentag.de/2008/abstracts/full/38.pdf

Feagan, R., (2007). The place of food: mapping out the "local" in local food systems. Progress in

Human Geography 31, 23–42. Doi: 10.1177/0309132507073527.

Field, C. (2000) Milk and Meat Preservation in Pastoralist Areas of Kenya, *Unpublished research report of the Agriculture/Livestock Research* Support Project jointly funded by KARI and EU

FNIFST, O.C.A.P., (2008). The Role of Traditional Food Processing Technologies In National Development: the West African Experience.

Frazier W C. (1988) Food microbiology, *McGraw-Hill publishing Company limited* Published by Blacklick, Ohio, U.S.A.: McGraw-Hill College, ISBN 0-07-462101-7.

Fratkin, Elliot M., Eric A. Roth, and Martha A. Nathan. (1999). "When Nomads Settle: The Effects of Commoditization, Nutritional Change, and Formal Education among Ariaal Rendille Pastoralists of Kenya" *Current Anthropology* 40 (5):729-35.

Forest DC, Harold DA, Judge BA, & Robert EA (1985). Different types of meat and meat products consumed by Nigerian. *Principle of meat science. Pub. WA. Freeman and Co. pop.,* pp. 4-178.

Fonte, M., 2008. Knowledge, Food and Place. A Way of Producing, a Way of Knowing. Sociologia Ruralis 48, 200–222. doi:10.1111/j.1467-9523.2008.00462.x

Gray J.I, Pearson A.M. (1987) Rancidity and warmed-over flavour. In Pearson AM, Dutson TR, editors. *Advances in meat research*. Vol. 3. NY, USA: Van Nostrand

Gounadaki, .A et al. (2009), Study of the effect of lethal and sub lethal pH and aw stresses on the inactivation or growth of *Listeria monocytogenes* and Salmonella *Typhimurium.* · *International journal of food microbiology*

Gunter Heinz and Peter Hautzinger. (2007) Meat processing technology for small- to medium-scale producers. *FAO. ISBN:* 978-974-7946-99-4.

Gutierrez J, Rodriguez G, Barry-Ryan C, Bourke P. (2008). Efficacy of plant essential oils against foodborne pathogens and spoilage bacteria associated with ready-to-eat vegetables: Antimicrobial and sensory screening. *J Food Prot* 71:1846-54 Issue 3

Guyo, F. B. (2017). Colonial and post-colonial changes and impact on pastoral women's roles and status. Pastoralism, 7*(1).* *https://doi.org/10.1186/s13570-017-0076-2*

Guyot, M., Dickson, C., Paci, C., Furgal, C., & Chan, H. M. (2006).Local observations of climate change and impacts on traditional food security in two northern Aboriginal communities.

International Journal of Circumpolar Health

Heinz, G & Hautzinger, P. (2007) Meat processing Technology, for small to medium scale producers. 570-581.

Ibnouf, F. O. (2011) Challenges and possibilities for achieving household food security in the Western Sudan region: the role of female farmers. *Journal of Food Security*, 3, (2), 215-231.

Ibnouf, F. O. (2012). The Value of Women's Indigenous Knowledge in Food Processing and Preservation for Achieving Household Food Security in Rural Sudan. *Journal of Food Research*, 1(1). https://doi.org/10.5539/jfr.v1n1p238

ICMSF (2002) Microorganisms in Foods. Microbiological testing in food safety management. *Kluwer Academic / Plenum Publishers*, New York, USA.

Iheagwara M.C, Okonkwo T.M. (2016). Influence of Storage Duration on Stability and Sensorial Quality of Dried Beef Product (Kilishi). *J Food Process Technology*. (7): 574. doi:10.4172/2157-7110.1000574

Imungi, J. K. (2014). The Present Status of Meat Processing and Preservation in the Pastoral Regions of Kenya. Retrieved from *http://erepository.uonbi.ac.ke/handle/11295/84962.*

International Commission on Microbiological Specifications for Foods (Ed.). (2005). Microbial ecology of food commodities (2nd ed). New York: *Kluwer Academic/Plenum Publishers*

Javeed Akhtar and Ram Krishna Pandey. (2015). Meat drying technology and drying characteristics of meat and meat products. International *Journal of Applied and Pure Science and Agriculture* (IJAPSA) Volume 01, Issue 8, e-ISSN: 2394-5532, p-ISSN: 2394-823X

Jose F.S. & Rafael G., & Miguel AC. 1994. Water activity of Spanish intermediate moisture meat products. *Meat Sci.* 38:341–350.

Keya, GA, Ngutu M. and Adongo A. (2005) Bridging the Gap between Agricultural Technology, *KARI Pastoral Risk Management Project*.

Khaksa, R. M. Moslemy M. 2010. Comparison of lipid changes in chicken frankfurters made by soybean and canola oils during storage, *Iranian Journal of Veterinary Research,* Vol.11, No2.

Keshla Naidoo & Denise Lindsay (2010) Pathogens Associated with Biltong Product and Their in

vitro Survival of Hurdles Used during Production Food Protection Trends, *International Association for Food Protection* Vol. 30, No. 9, Pages 532–538

Kirk, S., (1991) Ronald and Sawyer Ronald, Pearson's Composition and Analysis of foodsLongman *Scientific and Technical,* UK. (9th Edition), ISBN-10: 0582409101

Ki-Chang Nam, Cheorun Jo Mooha Lee (2010) Meat products and consumption culture in the East *Meat Science* 86 95-102

Kuhnlein, H.V., Receveur, O., (1996). Dietary change and traditional food systems of indigenous peoples. *Annual review of nutrition* 16, 417–442.

Kurlansky M. (2007). The Food Chains That Link Us All. *TIME's Summer Journey*

Little, P. D., A. Aboud, and C. Lenachuru (2004) Can Formal Education Enhance Risk Management for Pastoralists: The Case of the Il Chamus of Baringo District, Kenya, 1980-2002. USAID *Global Livestock Collaborative Research Support Program Research Brief* 04-03-PARIMA

Lwoga, E.T., Ngulube, P., Stilwell, C., (2010). Understanding indigenous knowledge: Bridging the knowledge gap through a knowledge creation model for agricultural development. SA *Journal of Information Management* 12, 8–pages.

Lupton D. (1996). Food, the Body and the Self. SAGE Publications. ISBN 1446264157, 9781446264157.

MacOpiyo, L. (2014.). Women's engagement in pastoral value chains in Northern Kenya,. *Understanding Gender In Livestock Value Chains.* 64

McPeak, J. (2005), 'Confronting the Risk of Asset Loss: What Role do Livestock Transfers in northern Kenya Play?' *Journal of Development Economics* 81:415-37.

Maretzki A.N Women's (2007), Nutri-Business Cooperatives in Kenya: An Integrated Strategy for Sustaining Rural Livelihoods Original Research Article. *Journal of Nutrition Education and Behavior,* Volume 39, Issue 6, Pages 327-334

Maretzki A. & Edward W. Mills (2003). Animal Source Foods to Improve Micronutrient Nutrition and Human Function in Developing Countries. *American Society for Nutritional science*

Margaret, G., Paul, O., Judith, K., & others. (2010). Hygienic practices and occurrence of coliforms and Staphylococcus on food at a public hospital in Kenya. *Journal of Applied Biosciences*

2010 Vol.27 pp.1727-1731 ref.21

Mekonnen A. (2015). Major Causes of Meat Spoilage and Preservation Techniques: *Food Science and Quality Management* Vol.41, www.iiste.org ISSN 2224-6088

Mengistu D. (2016) Impacts of Drought and Conventional Coping Strategies of Borana Community, Southern Ethiopia. *Research on Humanities and Social Sciences* ISSN (Paper) 2224-5766 Vol.6, No.23,

Mgbemere V. N, Akpapunam M. A, Igene J.O. (2011). Effect of groundnut flour substitution on yield, quality and storage stability of Kilishi - a Nigerian indigenous dried meat product. *African Journal of Food, Agriculture, Nutrition and Development* 11 (2): 4718-4738.

Mehrdad Tajkarimi, Salam A. Ibrahim, Angela M. Fraser (2008) Total food chain safety: how good practices can contribute? *Original Research Article Trends in Food Science & Technology*, Volume 19, Issue 8, Pages 405-412

Meilgaard, M.; Civille, G.V.; Carr, B.T. (1991). Sensory Evaluation Techniques, 2nd edition. *CRC Press*, Boca Raton, FL, USA. pp. 201 - 235.

Mintz SW. 2002 THE ANTHROPOLOGY OF FOOD AND EATING *Annul. Rev. Anthropology*. 31:99–119.

Ministry of health Kenya (2013) Household Health Expenditure *Survey and Kenya National Bureau of statistic.*

Mude, A., Barrett, C. B., Carter, M. R., Chantarat, S., Ikegami, M., & McPeak, J. G. (2009). Index Based Livestock Insurance for Northern Kenya's Arid and Semi-Arid Lands: The Marsabit Pilot. SSRN *Electronic Journal.* https://doi.org/10.2139/ssrn.1844758

Neelima Garg, (2010) Laboratory Manual of Food Microbiology by Publisher: K G Mukerji (1600) ASIN: B010WFH7D.

Njanja J C, Gathuma J M, Gitau G K, Njeruh F M and Kinuthia R N (2003): Pastoralists' perception of livestock production systems and opportunities for improvement in Southwestern Marsabit, Kenya. *Livestock Research for Rural Development*. Volume 15, Article #52.

Nonaka, I. and Takeuchi, H. (1995). The knowledge creating company: how Japanese companies create the dynamics of innovation, *New York: Oxford University Press.*

Nonaka, Ikujiro. (2006). Creating sustainable competitive advantage through knowledge-based

management. Retrieved 18 February 2012 from http://www.opdc.go.th/uploads/files/nonaka.pdf

Nonaka, I., (1994). A dynamic theory of organizational knowledge creation. *Organization science* 5, 14–37.

Nurhan Ünüsan (2007) Consumer food safety knowledge and practices in the home in Turkey. *Food Control* 18(1):45-51DOI: 10.1016/j.foodcont.2005.08.006

Oba, G. 2001. The effects of multiple droughts on cattle in Obbu, Northern Kenya. *Journal of Arid Environments Volume* 49, Issue 2, Pages 375-386

Omojola, A. B. (2008) Yield and organoleptic characteristics of Suya (an intermediate moisture meat) prepared from three different muscles of a matured bull. *African Journal of Biotechnology* Vol. 7 (13), pp. 2254-2257

Oniang'o, R. K.; Shiundu, K.; Maundu, P.; & Johns, T. (2005), Diversity, nutrition and food security: the case of African leafy vegetables *Proceedings of the third workshop on sustainable horticultural production in the tropics*. pp.83-100 ref.14

Oniang'o RK, Mutuku JM and SJ Malaba Contemporary African food habits and their nutritional and health implications. *Asia Pacific Journal of Clinical Nutrition* 2003; 12 (3): 231-236.

Ogunsola, O.O., Omojola, A.B., (2008). Nutritional evaluation of a dehydrated shredded meat product, (danbunama) *Pakistan Journal of Nutrition.* 7, 554–556.

Ólafsdóttir G, Martinsdo´ ttir E, Oehlenschla¨ger J, Dalgaard P, Jensen B, et al. (1997) Methods to evaluate fish freshness in research and industry. *Trends in Food Science and Technology* 8: 258-265.

Ohmagari, K., Berkes, F., 1997. Transmission of indigenous knowledge and bush skills among the Western James Bay Cree women of subarctic Canada. Human Ecology 25, 197–222.

P.M. Ngore, P.M. Mshenga, G Owuor and B. K. Mutai (2011), Socioeconomic Factors Influencing Meat Value Addition by Rural Agribusinesses in Kenya. *Current Research Journal of Social Sciences* 3(6): 453-464

Packham, R., & Sriskandarajah, N. (2005). Systemic action research for postgraduate education in

agriculture and rural development. *Systems Research and Behavioural Science*, 22(2),

Pearson D (1968a). Application of Chemical Methods for the assessment of beef quality part I. General considerations, sampling and the determination of basic components. *J. Sci. Food Agric.*, 19: 364-36

Pearson D. (1976) The Chemical Analysis of Foods. *Edinburgh; New York: Churchill Livingstone*, (7th edition). ISBN 0443014116 : Dewey Number 664/.07

Percy, R. (2005). The contribution of transformative learning theory to the practice of participatory research and extension: Theoretical reflections. *Agriculture and Human Value.*, 22(2), 127-136.

Pereira, P. M. (2013). Meat nutritional composition and nutritive role in the human diet. *Meat Science*. 3(3), 586–592.

Perkins, E. (2006). Volatile odour and flavour components formed in deep frying. *In: Erickson, M. (Ed.) Deep Frying; Chemistry, Nutrition and Practical Applications* (pp. 51-56). Urbana, IL: AOCS Press.

Presswood H. (2012) Lipid stability of dehydrated beef strips stored in two packaging types. Faculty of Natural Resources and Agricultural Sciences Department of Food Science: *Publikation/Sveriges lantbruksuniversitet, Institutionen för livsmedelsvetenskap*, no: 360 http://stud.epsilon.slu.se

Raharjo S, Sofos JN. (1993). Methodology for measuring malonaldehyde as a product of lipid peroxidation in muscle tissues *A review Meat Science*; 35:145–169. [PubMed]

Raji, A. I. (2006). Bacteriological quality of dried sliced beef (*Kilishi*) sold in Ilorin Metropolis. *Journal of Applied Sciences and Environmental Management*, 10(1), 93–96.

Rantsiou, K. and Cocolin, L. (2006). New developments in the study of the microbiota of naturally fermented sausages as determined by molecular methods: A review. *International Journal of Food Microbiology* 108 (2): 255-267.

Roberta Boe. (2011). Oxidative stability, lipid composition and nutritional value of ruminant meat as affected by animal feeding system, sex and common household treatments. *Tesi di Dottorato in Scienze e Biotecnologie dei Sistemi Agrari e Forestali e delle Produzioni Alimentari*Indirizzo Scienze e Tecnologie Zootecniche – Università degli Studi di Sassari

Robin Fox 2003. Food and Eating: An Anthropological Perspective -the Quest for the Holy Quail. Social Issues Research Centre

Roth, W. (2001), Learning science through technological design. *J. Res. Sci. Teach*., 38: 768-790. doi:10.1002/tea.1031

Schwartz H.J. & Abdullah N. Said. (1985.) The ecological role of the goat in pastoral production systems in Northern Kenya. Conference: *Simposio Internacional de la Explotacion Caprina en Zonas Aridas,* At Fuerteventura, Islas Canarias, Spain.

Sharma, B. D., & Kondaiah, N. (2005) Development of Buffalo meat samoa and evaluation of its storage in low vacuum Family Park under frozen condition. J. *Vet. Pub. Health.* (3), 59-62.

Soyer, A., B. & Ozalp, U, (2010). Effects of freezing temperature and duration of frozen storage on lipid and protein oxidation in chicken meat. *Food Chem.,* 120: 1025-1030.

Sperber W. and Michael Doyle (2009) Compendium of the Microbiological Spoilage of Foods and Beverages, *Springer New York Dordrecht Heidelberg London*. ISBN 978-1-4419-0825-4 e-ISBN 978-1-4419-0826-1 DOI 10.1007/978-1-4419-0826-1

Sylvander, B. (2004) Concerted action DOLPHINS (Development of Origin labelled products: humanity, innovation and sustainability). WP7 Final report, synthesis and recommendations. Available online at http://www.origin-food.org/cadre/cadb.htm

Upton, M. (1986). Production policies for pastoralists: The Borana case. Agricultural Systems, 20(1), 17–35.

US Department of Agriculture, (2009). Agricultural Research Service USDA National Nutrient Database for Standard Reference. Release 22. Nutrient Data Laboratory Home Page ,*http://www.ars.usda.gov/ba/bhnrc/ndl*

USDA, FSRE (Food Safety Regulatory Essentials) (2005) Shelf-Stable, Principles of preservation of shelf-stable dried meat products. United State Department of Agriculture. Food Safety and Inspection Service.

Varnam Alan H & Jane P Sutherland (1995). Meat and Meat Products: Technology, Chemistry And Microbiology *Publisher: London: Chapman & Hall,* Series: Food Products Series, 3.

Vallianatos, H., & Joy Adapon. C. (2008). ulinary Art and Anthropology. *Oxford: Berg,* 160 Pages

Waqayyo, Q. (1991) Women's Influence in Oromo society During the Period of Gada Rule, in Waldhaansso: *Journal of the Union Oromo in North America*, August

Wagner, A. (2001). Bacteriological food poisoning, *http://aggie horticulture tamu. Edu/extension/poison*

Walingo M.K. (2009) indigenous food processing methods that improve zinc absorption and bioavailability of plants diets consumed by the Kenyan population *AJFAND* Vol. 9 (1) 2009: pp. 524-535

Warriss, P.D, (2000), Meat Science, An introductory Text. *Wallingford: CAB International, cop.* ISBN 0851994245.

Washington DC, USA. (1995). WHO/FAO. Food Energy – Methods of Analysis and Conversion. *FAO Food and Nutrition Paper,* No 77. FAO, Rome, Italy. 2003.

Wayua , F.O. Mohamed G. Shibia (2009), Willingness to Pay for Improved Milk Sensory Characteristics and Assurances in Northern Kenya Using Experimental Auctions. International Food and Agribusiness Management Review Volume 12, Issue 3,

Whitehead, T. (1984). Sociocultural dynamics and food habits in a southern community. In M. Douglas (Ed.), Food in the social order: Studies of food and festivities in three American communities (pp. 97-142). New York: Russell Sage Foundation

Williams's PR. (2007) Nutritional composition of red meat. Nutrition & Dietetics,. *Journal of the Dieticians Association of Australia.* 64(Suppl 4), S113-S119

Wong, D.W.S. (1989.) Lipids. In: Mechanism and Theory in Food Chemistry; *Van Nostrand Reinhold:* New York. pp 1-47. ISBN 978-0-442-20753-3

APPENDICES

Appendices I: Household Questionnaire

Information for enumerator

I am conducting a study that looks at Artisanal meat preservation knowledge and quality assessment with a view of value addition and household income generation among the pastoralist.

The information is strictly used for academic purpose, and information obtained will remain confidential.

The interview will take about 45 minutes; kindly allow me to start the interview

Interviewer: ----------

Day/Month/Year of interview: ___ ___ / ___ ___ / ___ ___ ___ ___

HOUSEHOLD INFORMATION

1. Name of the Area:----------Describe the feature

Urban

2. Rural

2. County ----------

3. Respondent to HH questionnaire: position in the household

Name:----------

Gender: 1. Male 2. Female

Age:----------

Education: 1. None 2. Primary 3. Secondary 4. Higher level

Income: 1. Pastoralist 2. Casual work 3. Formal work

Marital status: 1. Married 2. Single. 3. Widow/widower

A. knowledge and products of traditional meat preservation techniques

Do you know of any traditional meat products? Please list

Describe the extent to which above products are used/consumed in your hous

Currently do you have the above products in your house? Please give me the names

How often do you eat the following meat products (circle one number for each meat products?

	Once a month	bi- weekly	weekly	2-4times/week	daily
Beef	1	2	3	4	5
Lamb	1	2	3	4	5
Goat	1	2	3	4	5
Camel	1	2	3	4	5
Chicken	1	2	3	4	5

Where do you get the meat from?

1. Own slaughter
2. from butchery
3. Traditional sharing
4. Part of relief food
5. Other

6. What types of meat do your family use to make the traditional meat products?

1. Beef
2. Shoat
3. Camel
4. Other

7. When do you normally eat meat products?

1. during normal meal
2. as a snack with tea or coffee
3. During special events (naming ceremony, wedding, child birth)
4. When hosting guest/visitors
5. Other

8. What time of the year do you normally make traditional meat products?

1. Rainy season
2. Dry season
3. other

9. Why do you make traditional meat products?

1. for normal household meal consumption
2. for special occasion (ceremonies, childbirth, circumcision and weddings)
3. Visitors or guest
4. To store for later use

B. Process and Preparation of artisanal meat products

10. After slaughter what do you do with the following parts?

- Blood
- Skin/hides
- Hooves, horn, head
- Intestines
- Organs(liver, kidney, heart, lungs)

11. Which part of carcass do you use to make traditional meat?

12. What type of meat do you use for traditional meat product?

1. High fat meat
2. Low fat meat
3. red fresh meat
4. Non fresh pale meat
5. Meat on bone

13. Do you make traditional meat product when the meat is fresh

1. Yes
2. No

14. If no, what do you do before you make the meat products?
    1. slice them in to stripes and hang them
    2. salt them
    3. dry heat
    4. other
15. Why do you do the above procedure before you make your meat product?
16. How long do you dry the meat product?
17. Where do you dry your meat?
18. What kind of heat do you use when making meat product
19. What method do you use to make the meat product?
    1. Roasting
    2. Dry fry
    3. fry with oil
    4. boiling
    5. other
20. At what point do you add oil
    1. Beginning
    2. Middle
    3. End
    4. After removing from heat
    5. Other
21. What other techniques do you apply while you are cooking?
22. How long do you cook the meat product?
23. Do you add spices to the meat product?

1. None
2. Salt
3. Herbal leaves
4. Modern spices – curry powder, masalas
5. Other

24. Do you mix meat product with other food type?

1. Yes
2. No

25. If yes, which food product

26. When do you mix the two products?

27. Which criteria do you use to know that meat product is ready for consumption?

1. Color/appearance
2. Aroma/smell
3. Moisture content/shrinking
4. Texture – hard/soft
5. Taste

28. When consuming traditional meat product how important are the following attributes in your selection process?

	Of little importance			highly important
	1	2	3	4	5
A. Taste					
B. Smell/aroma					
C. Color/appeal					
D. Texture					

29. What type of container do you use for storage?

1. Metallic 2. Plastic 3. Traditionally made 4. Other

30. How long does the meat product last before it spoils?

31. How do you know that the product you stored is spoilt?

    1. Appearance – change of colour, spots or things on surface
    2. Smell
    3. Taste has change
    4. Other

32. What do you do with spoilt product?

    1. Continue eating
    2. Mix with other product and utilize
    3. Give it to other animals – dogs
    4. Throw away
    5. Other

Appendices II: Narrative Interview Questions

"You are renowned in artisanal meat processing can you tell me all activities involved from your experiences since you started doing it"

"Can you tell me all activities of artisanal meat products from your personal experiences?

"Can you tell me artisanal meat products you are known for and all activities that entail it?

Thank you for your time and all the information, do you have anything else to add or ask?

Appendices III: Key Informant Questions

1. What makes pastoralist slaughter a livestock?
2. Please explain what you do with the carcass after slaughter
3. What traditional meat product are made from the meat, please identify by names
4. What is the seasonality and frequency of use?
5. How and in what forms are these foods harvested, stored and prepared for consumption?

6. What mistake can one make that lead to spoilage of the of traditional meat products
7. Thank you for your time and all the information, do you have anything else to add or ask?

Appendices IV: Participant Observation

Participant observation to get an in-depth understanding of Borana artisanal meat processing and preservation practices

Why they do what they do; the domain of Borana pastoralist women and their skills of Meat preservation

Locations

marsabit central – Adha Jabessa Women group
Manjatta jillo – mata arba women group
Jaldessa-Waldagena Women group
Manyatta ginda - individual
Sololo – borolle women group

2. Content

Observing and recording practical demonstrations of meat preparation, processing and preservation techniques

- Names of traditional meat -preservation techniques
- Preparation methods
- Artisanal meat products recipes and ingredients
- Criteria they use in all the stage and process, drying, cutting, heating, time etc.

Why they do what they do

Observe as they engage in activities and take notes, Take part in the activities, Informal talks and interaction

Materials

Notebook, video recorder, weighing scale, thermometer, utensils- (knives, pots, spoon, plates, bowls), beef, goat meat, oil, salt, spices, sugar, wooden mortar pestle, barley, firewood

Appendices V: Questionnaire for Sensory Evaluation

My name is Buke G. Dabasso: I am a student in JKUAT undertaking PhD research Titled: Artisanal Meat Preservation Knowledge/Practices and Quality Assessment among Borana People of Northern Kenya

As part of my PhD, I am testing two traditional meat products to gain a better understanding of consumer expectations. You are asked to taste different meat products, and give your opinion on their organoleptic quality.

Score card, hedonic rating scale

Name ----------

Age: (1) below 18 (2) 20-40 (3) above 40

Gender: (1) M (2) F

Education level: (1) None (2) Primary level (3) Secondary level (4) College/ University level

Ethnicity: (1) Local (state) (2) Other Kenyan (state) (3) Foreigner

Occupation: (1) pastoralist (2) casual work (3) formal work(4) Business

In front of you is a sample; you can taste and indicate how much you like or dislike each of the characteristic , you can taste more than once Organoleptic characteristics

	Taste	Aroma	Appearance	Tenderness
Flavour				
Like a lot (5)				
Like a little (4)				
Nether like nor dislike (3)				
Dislike a little (2)				
Dislike a lot (1)				

Frequency of consumption	Family meal	Special meal	At restaurant/hotel
Frequently			
sometimes			
rarely			
not at all			
would buy			

Taste (tasty, sweet, salty, and just right) Tenderness (tough, just right, juicy/soft)

Flavour (strong, smoky just right, smoky and spicy)

Aroma (pleasant, aromatic, just right) Appeal (appealing, just right,)

Appendices VI: Publications

Publication 1

Dabasso, B., Makokha, A., Onyango, A., Roba, H., & Maina, J. (2018). Process

characterization and nutrient profiling of traditional meat products of the Borana communities in northern Kenya. *MOJ Food Processing & Technology*, *6*(2).https://doi.org/10.15406/mojfpt.2018.06.00169

Publication 2

Dabasso, B. G., Roba, H. G., Makokha, A., Onyango, A., & Maina, J. (2018). Understanding Traditional Meat Processing Knowledge among the Borana Pastoralist of Northern Kenya. *Journal of Food Research*, *7*(4), 30. https://doi.org/10.5539/jfr.v7n4p30

Appendices VII: Plates

Plate 1: Drying and pounding of traditional meat products

Plate 2: Cooking of traditional meat products