QUALITY ASSESSMENT, CHARACTERISTICS, PREFERENCE AND ACCEPTABILITY OF PROCESSED MEAT PRODUCTS; TSIRE (SUYA), KILICHI & BALANGU USING IKOLE EKITI, EKITI STATE, NIGERIA AS ACASE STUDY

BY

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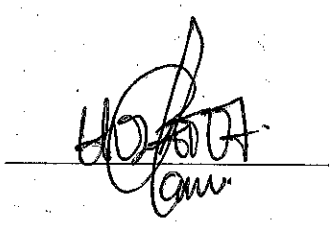
DEDICATION

This Report is dedicated to almighty God, maker of Heaven and Earth and all that is in it, it is of His faithfulness, love, grace and mercy, it is not of him that willeth nor of him that runneth but of God that showeth mercy. I also dedicate this to my indispensable and irreplaceable parents, Mr&Mrs S.B Olaleye and also my siblings for their love support and encouragement. It is also dedicated to Department of Animal Production and Health, Faculty of Agriculture, Federal University Oye Ekiti.

DECLARATION

I, **OLALEYE OLUWATOSIN OLANREWAJU JOSIAH,** hereby declare to the senatethat the project titled "**QUALITY ASSESSMENT, CHARACTERISTICS, PREFERENCE AND ACCEPTABILITY OF PROCESSED MEAT PRODUCTS; TSIRE (SUYA), KILICHI & BALANGU USING IKOLE EKITI, EKITI STATE, NIGERIA AS ACASE STUDY**" is my own original work done has been carried out by me in the Department of Animal Science, Fedral University OyeEkiti, Ekiti, under the supervision of Prof (Mrs.) A.A Aganga and Dr. A.H. Ekeocha. All citations and information derived from the literature has been duly acknowledged in the text and the list of references and this work has not been submitted before nor currently in any other institution.



21 - 3 - 2019

OLALEYE OLUWATOSIN. O **Date**

CERTIFICATION

This project titled "**QUALITY ASSESSMENT, CHARACTERISTICS, PREFERENCE AND ACCEPTABILITY OF PROCESSED MEAT PRODUCTS; TSIRE (SUYA), KILICHI & BALANGU USING IKOLE EKITI, EKITI STATE, NIGERIA AS ACASE STUDY**" by **Olaleye Oluwatosin Olanrewaju** meets the regulations governing the award of the degree of Bachelor of Agriculture in Animal Production and Health of the Federal University Of Oye Ekiti, Ekiti State, Nigeria and is approved for its contribution to knowledge and literary presentation.

AAAganga

Prof (Mrs) A.A Aganga

Supervisor

21-03-19

Date

Dr A.H Ekeocha / SUPERVISOR

Head of Department (Animal Production & H)

12/4/19

Date

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ABSTRACT

Reduction of protein malnutrition in many areas requires evaluation of simple, affordable, cheap but effective processing and preservation methods that ensure protein requirements are met. There is increase in the consumption of meat in the modern world. There is need to process raw meat to other forms to serve as alternatives to the consumers. The study is aimed at checking the acceptability of the processed meat product alternatives to boiled meat within the community.This paper is aimed at evaluating the consumption pattern of different meat products within a community and the levels of their preference and acceptability within the environment. Meat from ruminant cow is processed into different meat product suya, kilichi, balangu and was subjected to sensory evaluation to check which one the individuals within the community and why it is the most preferred. The study location is Ikole in Ikole local government in Ekiti state. The result showed that factors affecting meat purchase majorly were quality with about 21.5% of the population choosing the factor, then taste with about 19.75 and freshness with about 18.9%.The result also showed that factors determining the type of meat product purchased are taste and flavour with about 23.4% , affordability 20.7% and availability 15.3%. The result showed that the most preferred meat product was the suya with 50.8% of the population ranking it as first while kilichi has a percentage of 32.8% and balangu with 15.2%.

Keyword: Acceptability, consumption, determinants

Word Count: 234

TABLE OF CONTENTS

Contents

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0 INTRODUCTION

Meat has been defined as the flesh of animals which is suitable as food. Meat makes a valuable contribution to diets because of its high biological value and an excellent source of amino acids, vitamins and minerals (CAST, 1997). A daily intake of 100 g of meat can supply up to 50% of the recommended daily allowance for Iron, Zinc, Selenium, Vitamins B_1, B_2, B_6, B_{12} and 100% of vitamin A (Biesalski and Nohr, 2009).

In Nigeria there is a preferential consumption of different types of meat by communities due to a combination of factors bordering on religious belief, culture, food habits, sex of animal, age at slaughter, socio-economic factors and individual variation (Ajiboye *et al.*, 2011).

Meat being nutritious with high moisture content and nearly neutral pH is a good culture medium for many micro-organisms (bacteria, yeasts and moulds) and as such, classified among perishable foods whose contamination with spoilage organisms are almost unavoidable (Ikeme, 1990). This makes meat preservation more difficult than other types of food as it may result in oxidative rancidity, discolouration, off flavour, sliminess etc. The kind and amount of spoilage organisms in meat depends upon the availability of nutrients, presence of oxygen, temperature, pH at storage and generation interval of the spoilage microorganism under given environment etc. (Forrest *et al.*, 2001).

It is necessary to minimize deterioration in order to prolong the time during which acceptable levels of quality are maintained. This depends upon the processing and preservative method used and the inherent properties of the meat in question (Forrest *et al.*, 2001).

Meat and meat products are high in nutritive value and because of the high nutritive value, dressed carcass or fresh meat can only remain fresh for a short time before spoilage sets in, and to prevent this, meat are processed into products. All avenues of meat preservation must be exploited to meet the animal protein requirement of the increasing world population. The need for effective, cheap

and simple preservative techniques cannot be over emphasized. One of such simple preservative technique is intermediate moisture food processing.

Obanu et al. (1981) observed that intermediate moisture meat (IMM) are shelf stable under the tropical climate without refrigeration and may be eaten directly with or without rehydration. *Suya* is one of such intermediate moisture product that is easy to prepare and highly relished (Omojola et al., 2004). There are three types of suya namely, tsire, kilishi and balangu. Of the three types, tsire, which is boneless meat pieces that are staked on slender wooden sticks and cooked by roasting, using a glowing fire from charcoal is the most popular with consumers in Nigeria (Igene and Mohammed, 1983).

Meat processing enables the processor to convert low priced meat cuts into high priced processed products (FAO, 1995). Traditionally, most tsire suya producers use expensive cuts of meat, resulting into high prices of theproducts beyond the reach of the common man in the street. The prime cuts, apart from resulting in products with high prices might not be better than cuts from less choice parts of the carcass in terms of product yield and eating qualities. It is therefore the objective of this study to prepare tsire suya from 3 different muscle types (beef) with a view to assessing their suitability for suya production as regard the product yield and their organoleptic characteristics.

Meats are the most perishable of all important foods and this is as a result of their chemical composition. Meats contain an abundance of all nutrients required for the growth of bacteria, yeasts, and molds and an adequate quantity of these constituents exist in fresh meats in available form. Meat which refers to meat flesh, Skeletal muscles, connective tissue or fat and others than meat flesh, including brain, heart, liver, kidney, pancreas, spleen, thymus tongue and tripe that is used as food, excluding the bone and bone marrow and it contains high biological value protein and important micronutrients that are needed for good health throughout life (Ikema,1990).

Meat as a source of animal protein is consumed heavily in Nigeria and is also recommended by nutritionists as a major source of protein for growing children, the convalescent, the expectant mothers and the aged. In general, mycotoxin exposure is a critical problem in the hot and humid

low income countries where poor methods of food handling and storage are common. Inspite of occasional high profile incidents of acute poisoning outbreak, mycotoxins have not been widely prioritized from a public health perspective (Azziz etal. 2004). Raw meats, as well as final meat products are exposed to a high risk of microbial contamination at the time of their production, processing, storage and distribution.

Meat smoking as a method of red meat preservation dates back to prehistoric time. Smoking involves the use of wood fuel which in turn affects product quality. Smoking improves flavor and appearance of meat (Cardinal *et al.*, 2006), making them a delicacy in many communities. Smoking is normally used in combination with salting. The moisture content drops to 10-40 % depending on the smoking process. Preservation by smoking is achieved by dehydration and antibacterial effect of the smoke. During the smoking process, smoke components penetrate the meat to produce a stable and sensory acceptable product. Smoked meat has good shelf life unless rehydrated. Handling and storage methods are primarily concerned with minimizing microbial contamination and retarding microbial growth and activity (Benjakul and Aroonrueng, 1999).

The first phase is in accessing the perception of individuals towards the three meat products through the application of questionnaire.
The second phase is using a sensory evaluation to access the perception of individuals towards the three meat products and the final stage is in analyzing the results from the questionnaires already given to test for preference, assessment and perception.

1.1 STATEMENT OF PROBLEM

The consumption of meat by products such as suya, kilichi and balangu as compared with some other areas varies and this is as a result of cultural influences, enlightenment and personal taste and desires. This proposal is aimed at checking the acceptability of the aforementioned meat products, the quality assessment and nutritive values and also to introduce the meat products into the environment to increase the level of consumption among the population.

1.2 JUSTIFICATION OF THE STUDY

There are variations in consumption of processed meat product like tsire which is commonly known as suya, kilichi and balangu in various parts of Nigeria due to various reasons like religion background, cultural beliefs and different perceptions about the processed meat products. To check the level of acceptability of the three meats products and also check which one is the most preferred among the three and also the various reasons responsible for the level of preference is the scope of this study.

1.3. OBJECTIVE

1.3.1 BROAD OBJECTIVES

- To check the level of acceptability of the three meat product within the specified environment.
- To access the quality of the meat products based on the perception of individuals within the community

1.3.2 SPECIFIC OBJECTIVES

1. To check & determine the various reasons of why this meat products are preferred to one another.
2. To determine the level of preference to each other of the meat and to know the one most preferred and the least preferred
3. To check the importance of these meat within the specified area and also to know factors leading to non-consumption of the meat products.

CHAPTER TWO

2.0 LITERARTURE REVIEW

Meat is animal flesh that is eaten as food. The advent of civilization allowed the domestication of animals such as chickens, sheep, pigs and cattle, and eventually their use in meat production on an industrial scale (Womack, 2010). The meat industry is concerned with turning an animal carcass into many different end-products. These end-products are derived from all parts of the animal (muscle, bone, fat, cartilage, skin, fluids and glands) and are produced through a range of physical, chemical and biological process (Bala, 2010).

2.1 LIVESTOCK ANIMAL AND DOMESTICATION

Humans began domesticating animals more than 10,000 years ago beginning with dogs. Ruminants (cattle, sheep and goats) were the first food animals to be domesticated followed by pigs, possibly to dispose of table scraps and waste products. Horses and cattle were domesticated primarily for transportation and draft work purposes. Early people found animals that form large herds or flocks and eat a wide variety of feeds are easier to domesticate. Paleontological evidence suggests that meat constituted a substantial proportion of the diet of even the earliest humans. The domestication of animals dates back to 10,000 BC (Lawrie and Ledward, 2006), allowing the systematic production of meat and the breeding of animals with a view to improving meat production. The breeding of beef cattle optimized for meat production as opposed to animal best suited for draught or dairy purposes began in the mid-18th century (Mark and William, 2001).

2.2 LIVESTOCK ANIMALS AS SOURCE OF FOOD AND MEAT

Increase in population have been occurring in recent years and will still occur mainly in the developing countries and in urban areas and this will have major effects on patterns of food production, marketing and consumption. Strategies are needed to ensure food security for the growing population, to increase income, to support economic development, and to protect the environment. Livestock animals have served as a source of food and in many processed forms. The primary aim of livestock apart from provision of services is also to help meet the demand of

meat supply all over the world. The increase in population and the increasing demand for protein has pushed production of livestock forward to meet this huge and great demand for protein sources such as meat, milk etc.

2.3 MEAT

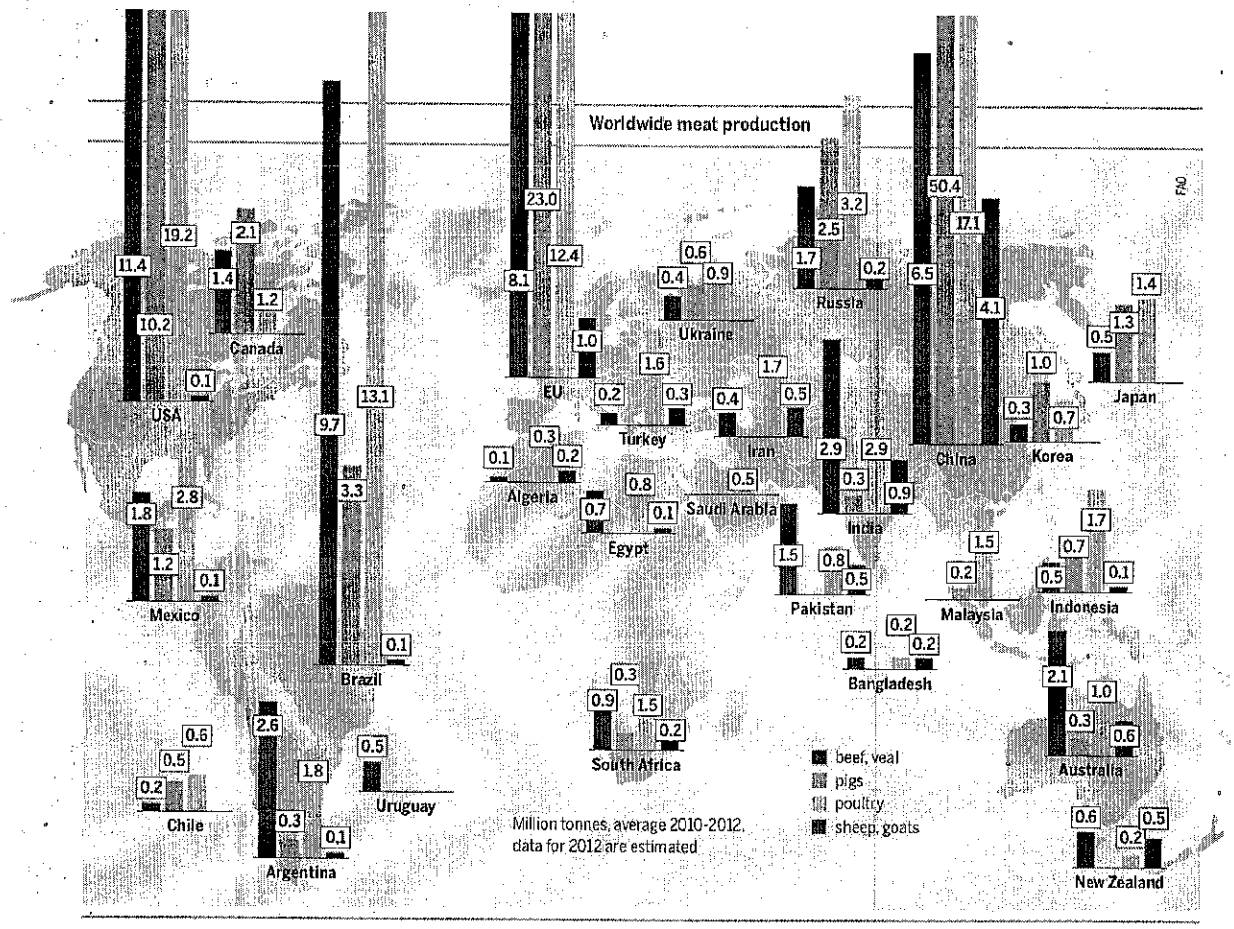
Meat is defined by the Codex Alimentarius as "All parts of an animal that are intended for, or have been judged as safe and suitable for, human consumption". Meat is composed of water, protein and amino acids, minerals, fats and fatty acids, vitamins and other bioactive components, and small quantities of carbohydrates.

The most common sources of meat are domesticated animal species such as cattle, pigs and poultry and to a lesser extent buffaloes, sheep and goats. In some regions other animal species such as camels, yaks, horses, ostriches and game animals are also eaten as meat. To a limited extent, meat is also derived from exotic animals such as crocodiles, snakes and lizards. For thousands of years, poultry supplied meat and eggs, cattle, sheep and goats provided meat and milk, and pigs provided a source of meat. These species are the main sources of animal protein for humans. The meat derived from cattle is known as beef, meat derived from pigs as pork and from chickens as poultry. Pork is the most widely eaten meat in the world accounting for over 36% of the world meat intake. It is followed by poultry and beef with about 35% and 22% respectively (FAQ, 2018)

Processed meat means a meat product containing no less than 300g/kg (30%) meat, where meat either singly or in combination with other ingredients or additives, has undergone a method of processing other than boning, slicing, dicing, mincing or freezing, and includes manufactured meat and cured and/or dried meat flesh in whole cuts or pieces. Products containing less than 30% meat, therefore not meeting the definition of processed meat, may include hamburger patties or meatloaf. These products are regarded as mixed foods and must comply with the general food standards for all foods as well as any food product standards that apply to each of the component of the food (www.health.qld.gov.au/foodsafety.).

2.4 MEAT PRODUCTION AND CONSUMPTION

Figure 1: World Meat Production.



SOURCE: FAQ

The world's appetite for meat continues to grow, with 242 million tons produced in 2002—an increase of 2.5 percent from 2001. Meat production has doubled since 1977, and over the last half-century it has increased fivefold. Production of beef, poultry, pork, and other meats has risen to nearly 40 kilograms per person, more than twice as much as was available in 1950. Consumers in industrial nations eat more than 80 kilograms of meat per person, most of it from pork and poultry, compared with just 28 kilograms for people in developing countries. In fact, people in industrial nations eat three to four times as much meat as people living in developing countries (FAO, 2002). According to a report from the World watch Institute (WI), global meat production and

consumption continues to rise. Meat production has tripled over the last four decades and increased 20 percent in just the last 10 years. Industrial countries are consuming growing amounts of meat, nearly double the quantity in developing countries. World beef production is increasing at a rate of about 1 percent a year, in part because of population growth but also because of greater per capita demand in many countries. Worldwide meat production has tripled over the last four decades and increased 20 percent in just the last 10 years. Meanwhile, industrial countries are consuming growing amounts of meat, nearly double the quantity in developing countries. Large-scale meat production also has serious implications for the world's climate. In the least developed countries with high rates of population growth, meat consumption has been growing rapidly, albeit from a low base, notably in Sub Saharan Africa where beef accounts for the bulk of additional consumption in the region, followed by poultry. Beef consumption will gradually increase over the next ten years. By 2025, and relative to the base period, it is expected to increase by almost 6% in developed countries, whereas in developing regions it is expected to increase by approximately 21%. Beef consumption per capita in the developing world remains low relative to developed countries, at about one-third in volume terms. Asian buyers' positive perception of less intensively produced and disease-free bovine meat remains a major driver of growth, resulting in 45% of additional beef consumed over the next decade in Asia.

2.5 MEAT TYPES

Meats are majorly of two different types, the red meat and the white meat, they are slightly different in composition and they both have nutritional benefits and also they have effect on health of consumers. The classification is depends on the concentration of myoglobin in muscle fibre. When myglobin is exposed to oxygen, reddish oxymyoglobin develops, making myoglobin rich meat appear red. The redness of meat depends on species, animal age, and fibre type. Red meat contains more narrow muscle fibres that tends to operate over long periods without rest, while white meat contains more broad fibres that tends to work in short fast burst. While each kind of meat has about the same composition of proteins and carbohydrates, there is a very wide range of fat content. **Meat** is an important source of vitamins and minerals which completes our dietary

allowance. They are commonly labeled as red or white. There are several ways in order to determine whether a meat belongs to "white" or "red" category.

Another method to distinguish whether a meat can be referred to as red or white is by observing its color before it is cooked. As a general rule, white meats are those with pale color. On the other hand, read meats have reddish or darker colors. The idea behind sorting out of flesh according to color is the amount of myoglobin the animal body parts contain. Myoglobin develops to muscles that are frequently used and causes meat to form a reddish color. All mammals typically have dark flesh. White meat are usually found on birds and fish though it cannot be generalized. Chicken and turkeys both contain pale and dark meat. Duck and geese are considered to have red meat because they often involve their muscles in activities like swimming and flying. Fast swimming fish like tuna have dark meat as well.

Genetics plays a big factor in flesh classification as well. No matter how lazy a pig can be, its meat which appears lighter compared to those belonging to cow and lamb would still fall under red meat. Meat with darker shade are said to contain unhealthy fats. The advantage of pork is that it holds less fat compared to beef and mutton. Same goes with poultry. White meat on chickens is found on their breast parts while the other parts are red. Even though they never attempted to walk or fly their entire life, their legs or wings will always be categorized under red meat.

Red, or dark meat is made up of muscles with fibers that are called slow-twitch. These muscles are used for extended periods of activity, such as standing or walking, and need a consistent energy source. The protein *myoglobin* stores oxygen in muscle cells, which use oxygen to extract the energy needed for constant activity. Myoglobin is a richly pigmented protein. The more myoglobin there is in the cells, the redder, or darker, the meat.

When dark meat is cooked, myoglobin's color changes depending on what the meat's interior temperature is. Rare beef is cooked to 140° F, and myoglobin's red color remains unchanged. Above 140° F, myoglobin loses its ability to bind oxygen, and the iron atom at the center of its molecular structure loses an electron. This process forms a tan-colored compound called *hemichrome,* which gives medium-done meat its color. When the interior of the meat reaches 170°

F, hemichrome levels rise, and the myoglobin becomes *metmyoglobin,* which gives well-done meat its brown-gray shade.

White meat is made up of muscles with fibers that are called fast-twitch. Fast-twitch muscles are used for quick bursts of activity, such as fleeing from danger. These muscles get energy from glycogen, which is also stored in the muscles. White meat has a translucent "glassy" quality when it is raw. When it's cooked, the proteins denature and recombine, or *coagulate,* and the meat becomes opaque and whitish. Cows and pigs are both sources of dark meat, though pig is often called "the other white meat." Pigs' muscles do contain myoglobin, but the concentration is not as heavy as it is in beef. Chickens have a mixture of both dark and white meat, and fish is mainly white meat.

Meat is a great way to get protein and numerous vitamins and minerals, but which type of meat is better: white or red?

First, what makes the meat white or red? Red meats simply have more myoglobin, which are the cells that transport oxygen to muscles in the bloodstream. Muscles used more frequently are darker. This is why chicken and turkey legs are slightly darker than breast meat - because legs are used more, more myoglobin is present, creating a darker appearance. Although it can depend on the culture or cuisine, white meat is generally classified as poultry (chicken and turkey), while red meat typically refers to beef, pork, and lamb.

The biggest difference between the two is fat content. White meat is a leaner source of protein, with a lower fat content. Red meat contains higher levels of fat, but also contains higher levels of vitamins like iron, zinc and B vitamins. The iron present in red meat is a type called heme iron, which is more easily absorbed by the body compared to iron found in plant sources. Because red meat is high in these vitamins, vegetarians and vegans are often found to be deficient, especially B vitamins.

Although it may contain more vitamins and minerals, high consumption of red meat has been correlated with increased incidence of certain cancers, specifically colorectal cancer.

High-temperature cooking, like grilling, can form carcinogenic (cancer-causing) compounds in the meat. This is especially true for charred meats.

Both white and red meat have benefits; if you eat meat, it's a good idea to include small amount of both in your diet. Opt for leaner cuts of red meat, like those that end in "-loin" (sirloin, tenderloin, etc.). Further, trim visible fat around the edges to reduce fat intake and avoid charring while cooking. In this way, you can try to reduce the disadvantages of eating red meat.

2.5.1 THE WHITE MEAT

White meat is perceived, and often promoted by producers, to be a low-fat, healthy food. The reality is that it is not even close to being so. All meats are muscles, which are made of protein and fat (PCRM, 2000). Average raw chicken meat is 17.5 per cent fat – rising to 38.1 per cent once the meat is roasted. Raw turkey comes close at 13.7 per cent of calories from fat. Our bodies can't function without some fat, but it's the right kind that's important. We have no nutritional need for saturated and monounsaturated fats as the body can make them. Diets high in saturated fat and calories raise blood cholesterol levels and contribute to cardiovascular disease, diabetes and some cancers. White meat contains no or little fibre, complex carbohydrates, nor vitamin C. Fibre cleanses the digestive tract, keeping bowels healthy and regular; slows the absorption of sugar and fat; carries away excess hormones from the blood; and lowers cholesterol. Complex carbohydrates, found only in plants, are relatively low in calories and boost metabolism. Vitamin C is an antioxidant, and is involved in immunity, wound healing and the formation of collagen in skin, tendons and bones. When white meat takes the place of fruits, vegetables, whole grains and pulses (peas, all types of beans and lentils) in your diet, you get less vitamins, less fibre, and unwanted dietary fat and cholesterol.

2.5.2 THE RED MEAT

Red meat has been an important part of the human diet throughout human evolution. When included as part of a healthy, varied diet, red meat provides a rich source of high biological value protein and essential nutrients, some of which are more bioavailable than in alternative food sources. Particular nutrients in red meat have been identified as being in short supply in the diets of some groups of the population. Red meat continues to play an important role in the human diet by providing a good source of high-quality protein as well as beneficial fatty acids and a variety

of micronutrients for optimal health. Red meat is commonly considered to include beef, pork, lamb and game Red meat contains high biological value protein with all eight essential amino acids required by adults and all nine required by children. Protein is needed for growth, maintenance and repair of the body. Red meat contains on average 20–24 g protein per 100 g (when raw) and can therefore be considered a high source of protein. In most developed countries, average protein intakes are above the minimum protein requirements for good health. Any excess protein in the diet is used to provide energy. The amount of energy provided by red meat is variable. Fat provides the richest dietary source of energy and wide variation of fat content can be seen in red meat, depending on the type, the cut and degree of trimming. The type of fat, as well as the total fat content is important to consider in terms of CVD, as not all fats are equal. Different fatty acids have different effects on blood cholesterol and risk of heart disease, some beneficial and some adverse. The fatty acid profile of red meat will vary depending on the proportions of lean meat and fat present. Lean meat is relatively higher in Poly Unsaturated Fatty Acid and lower in Saturated Fatty Acid compared with untrimmed meat. Trimming the fat off meat will affect the proportions of fatty acids, as visible fat is relatively higher in SFA, containing about 37 g SFA per 100g meat. Red meat provides a wide range of bioavailable micronutrients which are required for general health and wellbeing. For example, most of the iron in meat is in the haem iron form. Single meal studies have shown that iron is more efficiently absorbed from the diet (20–30 %) than non-haem iron (5–15 %). Theiron in red meat also enhances non-haem iron absorption from foods such as cereals, vegetables and pulses consumed at the same time Meat and meat products contribute to 21 % of iron intake in adults (aged19–64 years). Many of the micronutrients found in red meat are currently found in low levels in various population groups. According to EU health claims regulation (Regulation (EC) No 1924/2006), red meats can be described as a 'source' or a 'rich source' of several nutrients. In order to make a nutrition claim, the claim in question has to be included in the annex to the Regulation on nutrition and health claims (Regulation (EC) No 1924/ 2006).

Figure 2: NUTRIENTS AVAILABLE IN DIFFERENT MEAT TYPES

Micronutrient (EU RDA)	Cut-off 'source of' claim (15 % RDA)	Cut-off 'high in' claim (30 % RDA)	Beef	Lamb	Pork	Venison	Calf liver
Vitamin A (800 µg)	120	240	-	-	-	-	High
Vitamin B_1 (1·4 mg)	0·21	0·42	ND	6	ND	ND	18800
Vitamin B_2 (1·6 mg)	0·24	0·48	-	-	High	-	Source
Vitamin B_3 (18 mg)	2·7	5·4	0·1	0·09	0·98	ND	0·22
Vitamin B_6 (2 mg)	0·3	0·6	-	-	Source	Source	High
Vitamin B_{12} (1·0 µg)	0·15	0·3	0·21	0·2	0·24	0·25	2·52
Iron (14 mg)	2·1	4·2	Source	High	High	-	High
Zinc (15 mg)	2·25	4·5	5·0	5·4	6·9	ND	12·5
Phosphorus (800 mg)	120	240	Source	Source	Source	-	Source
Magnesium (300 mg)	45	90	0·53	0·3	0·54	ND	0·48
			High	High	High	-	High
			2·0	2·0	1·0	ND	65·0
			Source	-	-	Source	High
			2·7	1·4	0·7	3·3	11·5
			Source	Source	-	Source	High
			4·1	3·3	2·1	2·4	14·2
			Source	Source	Source	Source	High
			200	190	190	210	320
			-	-	-	-	-
			22	22	24	25	20

Data from McCance and Widdowson's Composition of Food[24,39] ND, no data; Beef, beef average, trimmed lean, raw; Lamb, lamb, average, trimmed lean, raw; Pork, pork, trimmed lean, raw; Venison, venison, raw; Calf liver, liver, calf, raw.

Red meat can play a useful role in providing nutrients to the general population. The present paper briefly discusses the role of red meat in providing some key nutrients in the diet of young infants, adolescents, women of child-bearing age and older adults. Red meat can provide an important contribution to micronutrient intakes among young infants, particularly around the time of weaning. At around 6 months, stores of some nutrients, such as iron, start to be depleted and therefore additional dietary sources are required. In practice, infants are often weaned initially onto foods such as baby rice, fruits and vegetables, with the introduction of meat often being delayed until 8 or 9 months, which can impact on iron intakes.

HOW MUCH RED MEAT SHOULD WE EAT AND CONSUME?

In response to the findings of the Scientific Advisory Committee on Nutrition report on Iron and Health the UK Department of Health issued new guidance in2011 on eating red and processed meat. The Scientific Advisory Committee on Nutrition found evidence that there is a probable link between eating a lot of red and processed meat and increased risk of colorectal cancer incidence. Hence, the Department of Health's advice is that adults who eat more than 90 g red and processed

meat daily should reduce their intake to an average of 70 g/d (cooked weight). The current average UK consumption of red and processed meat is 86 g/d among men and 56 g/d among women

2.6 PROCESSED RED MEAT

The composition of processed meat can vary widely. The salt content of processed meats is likely to be higher than lean red meat. Salt is often added to processed meats to reduce the amount of available water present in the food, and as a result, micro-organisms grow more slowly or not at all. Over the past several years, there has been considerable work done within the UK to reduce the amount of salt in processed meat products, along with consideration of the potential effects on microbial safety. Meat and meat products contribute to 27 % of sodium intake in adults (aged 19–64 years) which is just below the contribution of 31 % that cereals and cereal products make to sodium intakes in adults

Red meat provides a rich source of high-quality protein and a variety of important nutrients that are vital for optimal health. The nutrients in red meat can provide a useful contribution to the intakes of key nutrients commonly found to be in short supply in the diets of some population groups. In particular, the nutrient intakes of young infants, adolescents, women of child-bearing age and older adults may benefit from including lean red meat in their diets. Lean red meat may be a useful component of weight loss diets because of the satiating effect of its high protein content.

2.7 MEAT COMPOSITION

Meat is composed of: Water, protein, fat and other water-soluble organic material.

Table 2.1 Nutritive Composition of Beef

Substance	Composition	Proportion %
Water	Hydrogen, oxygen	73
Protein	Amino acids	22
Fat	Phospholipids, Cholesterol and Fat Soluble Vitamins	3.9
Other Soluble Organics	Vitamins, Carbohydrates	1.1

Source: Rendle and keeley (1998)

Muscle proteins are either soluble in water (sarcoplasmic proteins, about 11.5 % of total muscle mass) or in concentrated salt solutions (myofibrillar proteins, about 5.5 % of mass). There are several hundred sarcoplasmic proteins that are involved in the glycolytic pathway in the conversion of stored energy into muscle power. The two most abundant myofibrillar proteins; myosin and actin are responsible for the muscle's overall structure. The remaining protein mass consists of connective tissue (collagen and elastin) as well as organelle tissue (Moon, 2006).

Fat in meat can be either adipose tissue used by the animal to store energy and consisting of true fats (esters of glycerol with fatty acids), or intramuscular fat which contains considerable quantities of phospholipids and of unsaponifiable constituents such as cholesterol. The fat portion includes some fat-soluble substances, including some vitamins. Meat is an important source of amino acids (the building blocks of proteins), minerals, vitamins and energy (Moon, 2006).

FIGURE 3

Nutritional composition of meats and other food sources per 100g**

Product	Water	Protein	Fat	Ash	kJ*
Beef (lean)	75.0	22.3	1.8	1.2	485
Beef carcass	54.7	16.5	28.0	0.8	1351

SOURCE: FAQ

2.8 MEAT QUALITY PARAMETERS

The word carcass means the whole body of the animal after stunning, bleeding, plucking, and eviscerating. Cattle and pig carcasses are split along the mid ventral axis into two sides. Carcasses may be "dressed," where the head, feet, and hide (in the case of sheep, cattle, and pigs) are separated. Until the last decades of the twentieth century, it was a commercial practice to chill dressed carcasses prior to preservation or processing and, after chilling, to prepare primal, wholesale cuts from them. Prior to the introduction of vacuum packaging, wholesale cuts were sold with bones intact to avoid evaporative loss and minimize contamination. Now a considerable part of carcasses is de-boned, and delivered to retailers as boneless primal cuts. In the absence of bones, and because meat cuts are less bulky, chilling and freezing can be more rapidly and economically effected. The grading of carcasses (carcass meat) into market categories is generally made based on visual assessment. Although some efforts have been made to develop objective methods and quantitative indices, the sensory methods dominate in evaluation of such properties as tenderness, juiciness, flavor and odor, color, and so on. What is quantitatively measurable is lean meat ratio. In the European Union, the carcasses are evaluated as I, II, and III, the grade depending on the lean meat ratio being 45% to 55% of the total weight of the carcasses. In the case of pigs, back fat thickness is also measured.

2.8.1 TEXTURE AND TENDERNESS

Tenderness is one of or the most discussed features in meat. It is a real challenge for the scientific community and for the meat industry to achieve products with standardized and guaranteed tenderness, since these characteristics are exactly what consumers want in a meat product (Koohmaraie, 1995). It is recognized that processes leading to meat tenderization are mainly enzymatic in nature and involve proteolytic systems. There are two concepts based on enzymatic biochemistry used in explaining meat tenderness; Firstly, some researchers postulated that meat tenderization is affected mainly by calpain (a calcium-activated proteases consisting of at least three proteases; μ-calpain, m-calpain and skeletal muscle-specific calpain) which is responsible for myofibril protein degradation (Koohmaraie and Geesink, 2006). Secondly, others suggested a hypothesis that tenderization is a multi-enzymatic process

corresponding to apoptosis, where calpain is an important enzyme (Koohmaraie et al., 2002). Variation exists among muscles and differences are mainly due to the amount of connective tissue in the various cuts and amount of connective tissue present is due to the function of the muscle.

Texture refers to those qualities of food that we can feel either with the fingers, the tongue or the teeth. The factors that contribute to tenderness or toughness are still not completely understood. Species is the most general factor affecting tenderness. To some extent this is a reflection of texture (the size and condition of the meat fibers within the muscle, and the relationship between the amounts of muscle fiber and connective tissue. Generally, higher connective tissue ratio means less tenderness. Concerning the role of species it could be stated that large-size cattle, in relation to pigs or sheep, are generally associated with a greater coarseness of musculature. The connective tissue content of a given muscle also may vary between that of individual cattle or pigs within a breed. In general, increasing age connotes decreasing tenderness. In connection with connective tissue content it should be mentioned that the connective tissue in young animals has a different composition and a looser structure. This is connected with better solubility upon heating of the collagen in young animals, and greater susceptibility to attack by enzymes. There are distinct differences in tenderness between muscles. Muscles that were frequently in use have higher elastin (a type of connective tissue protein) than those that were used less extensively. Even tenderness within a given muscle may vary significantly. For example, there is a systematic decrease in tenderness in proceeding from the proximal to the distal, and of beef semi membranous. Summarizing the effects of pre-slaughter factors that affect tenderness, those may be estimated by the amounts, distribution, and type of connective tissue. . The holding of unprocessed meat above the freezing point is known as "conditioning" or "aging." The decrease in tenderness associated with the onset of rigor mortis is gradually reversed as the time of post-rigor conditioning increases. Conditioning is associated with an increase in tenderness and flavor. The changes occurring during conditioning are connected with the limited proteolysis of muscle proteins. It has been found that water-soluble nitrogen increases, due to the production of peptides and amino acids from protein. Tenderness or toughness, therefore, is a quality that represents the summation of the properties of the protein structure of skeletal muscle, and is necessarily associated with all those factors that may affect muscle and muscle protein, such as growth and development of the animal, breed,

nutrition, ante-mortem and post-mortem handling, and methods of cooling, processing, retailing, and cooking.

Attempts to make meat tender artificially are by no means new. They have included beating the meat, cutting it into small portions so that the strands of connective tissue are severed, marinating it with vinegar, wine, or salt, and enzymatic tenderizing. Enzymatic tenderizing was the process that took place when Mexican Indians wrapped meat in pawpaw leaves during cooking, as long as 500 years ago. Such attempts have become more widespread and systematic. At present proteolytic enzyme-containing commercial meat tenderizers are used. Among the enzymes that have been most commonly used in tenderizing meat are bacterial and fungal proteases, and some plant proteases, such as ficin (fig), papain (pawpaw), and bromelin (pineapple). Assessment of tenderness is mainly made by sensory methods. This is connected with the complex nature of the structure of meat and difficulties in objectively reproducing the process of chewing, which is how the consumer evaluates tenderness.

Meat texture observed when the meat is cut across the fibres could vary from fine and smooth to coarse and slightly rough.

Marbling is fat which is distributed uniformly throughout the muscle and is deposited in the perimysial connective tissue. It is also called intracellular fat. The degree of marbling varies from practically devoid or non-existent to very abundant. Colour reflects the visual or spectral characteristics of the meat.

Meat tenderness is very much appreciated by the texture, firmness and the degree of marbling of the meat. Meat juiciness is affected by its firmness and the degree of marbling. Meat colour is a function of the concentration of the myoglobin content of the meat but may be modified by the meat pH which makes it darker at ultimate pH close to 7 as in DFD condition in beef and lighter or pale at more acid ultimate pH nearer the isoelectric point of protein as in PSE condition in pork. A good quality meat that is tender juicy, flavourful and attractive would therefore have a fine texture with small fibre bundles and thin perimysial connective tissue, would be fairly firm with water holding capacity, possess a moderate amount of marbling in addition to a nice bright colour characteristic of the specie. In meat with undesirable quality, a coarse texture portends meat toughness.

2.8.2 WATER HOLDING CAPACITY AND JUICINESS

The water-holding capacity of meat is an attribute of obvious importance. Diminution of the water-holding capacity is manifested by exudation of fluid known as "weep" in uncooked meat, which has not been frozen, as "drip" in thawed uncooked meat, and as "shrink" in cooked meat. Not more than 5% of the total water of muscle (i.e. about 4% of the wet weight) is directly bound to hydrophylic groups of proteins. Most of the observed changes in water-holding capacity involve alterations in the so-called "free" water, which is immobilized by the physical configuration of the proteins, but not bound to them. Studying the factors influencing water-holding capacity, it could be stated that some considerations apply generally to all muscles. Thus, because post-mortem glycolysis in a typical muscle will normally proceed to an ultimate pH of about 5.5—the isoelectric point of the principal proteins of in muscle—some loss in water-holding capacity is an evitable consequence of the death of the animal. Conditioning (aging) of meat increases its water-holding capacity. Apart from these general effects, the water-holding capacity of meat is affected by several other factors such as species, age, and muscular function. From a practical point of view, one important phenomenon is the occurrence of PSE meat from pigs. The abbreviation PSE is formed from initials of the words pale, soft, and exudative. Such meat has a pale color, is relatively soft, and has reduced water holding capacity. This means that the uncooked meat has a bright fluid loss (weep). Its losses during cooking are high. Occurrence of PSE meats is the consequence of the increased rate of post mortem glycolysis, causing the rapid drop of pH, and structural changes in muscle proteins. Comminuted meats are on the one hand more liable to exude fluid because the original structure of muscle is destroyed. On the other hand, the nature of products prepared using comminuted meat permits direct manipulation of the meat to enhance its water-holding capacity. Increase of the water-to-meat ratio by water addition increases the overall water-holding capacity of the mix. Sodium chloride added to the mix also enhances water-holding capacity.

. It is **difficult to give a definition of juiciness**. The sensation of juiciness is composed of two organoleptic components. First is the impression of wetness during the first few chews produced by the rapid release of meat fluid; the second is a sustained juiciness largely due to the stimulatory effect of fat on salivation. **Tenderness and juiciness** are closely related and, in general, the more tender the meat, the more readily juices appear to be liberated during eating. To date, sensory assessment appears to be the only practical way of measuring this quality. As meat is masticated,

fat and meat fluids are slowly released as meat fat are slowly melted, giving the impression of juiciness.

Species of animal affect juiciness. Pork is juicier than beef. Within the same species, different breeds or strains may exhibit different levels of juiciness. Broiler is juicier than spent layers and both are juicier than turkey or guinea fowl. The amount of marbling also influence juiciness positively. Different muscles have different marbling. The degree of unsaturation of the meat fat is influenced by specie and nutrition to which the animal was subjected. Meat with higher unsaturated fat like pork tend to be juicier than beef with higher saturated fat as unsaturated fat melts faster during chewing. Physiological condition feed type may also influence juiciness. Animals subjected to stress prior to slaughter tend to accumulate lot of lactic acid resulting in rapid drop in pH at slaughter and development of acid rigour. Such meat is less juicy because of lower WHC. After slaughter, the events before and after rigour mortis also affects meat juiciness. Cold shortening and thaw rigour contraction involve the formation of actomyosin from actin and myosin interaction with appreciable loss of water and massive exudation resulting in decreased meat juiciness. Animals with high glycogen reserve at death achieve high ultimate pH of 6.5 to 6.8 thus developing the Dark Firm and Dry (DFD) condition in which the meat would be tender and juicy because of high water holding capacity of the meat proteins.

Under Pale Soft Exudative (PSE) condition in some breeds of pigs, there is a rapid drop in pH while the carcass is still warm, to an ultimate pH of 5.3 to 5.6 as a result of rapid accumulation of lactic acid. Appreciable denaturation of meat protein occurs at pH close to the isoelectric point of protein. Therefore the meat has less water holding capacity with the meat becoming tough n rubbery and less juicy. Meats frozen slowly post rigour also lose a great amount of fluid called DRIP. The ice crystals in the frozen meat exert mechanical injury, damaging the integrity of the meat structure thus less juicy meat. Ageing process does not seem to have a positive effect on meat juiciness. Prolonged ageing is often accompanied with dehydration of the meat especially at the surface layer with slight reduction in juiciness. Addition of divalent salts during the production of sausages, pork ham and other meat products such as polyphosphates tend to form complexes with magnesium and calcium ions in addition to the cleavage of actomyosin into its protein components. A greater hydration and water binding capacity of the meat protein is enhanced.

Meat juiciness is related to the water holding capacity of meat or its ability to hold on to its natural water when subjected to external forces such as cutting, heating, grinding or pressing. Muscle naturally contains 65 to 80 percent water which it practically retain through the normal process of conversion of muscle to meat. Meat with high ultimate pH hold on to most of its water and are juicier. Meat that experience rapid drop in pH during post mortem glycolysis have part of its protein denatured resulting in lower ability for the meat to hold on to its water. Meat with low water holding capacity loses excessive water during refrigerated storage (Shrink), or retail display (Weep), on thawing after frozen storage (Drip) and on cooking (cook-out or cooking loss). Moisture bound to meat are in 3 forms: Bound water is held tenaciously to electrically charge hydrophilic groups on muscle proteins and account for 5-5% o total moisture. Immobilized water are attracted to the bound water and are set in layers, each layer becoming less attached the farther it is from the hydrophilic groups on the meat proteins. Free water is held loosely to the meat proteins by surface forces and is easily dislodged. Free water is readily lost by evaporation from exposed meat surfaces. The amount of water retained in immobilized water layer contributes greatly to the juiciness of meat.

2.8.3 MEAT FLAVOUR AND EFFECT OF COOKING

Meat flavour is a complex composite of its taste and aroma. Meat flavour is the sensation as perceived by the taste cells on the tongue and mouth walls while the sensation due to aroma or dour is as perceived by the sense of smell by the cells of the nose. These sensations are richly perceived in the cooked meat but are of least and obscure importance in the raw meat. Flavour as defined by taste and aroma is therefore of low importance in the psychological decision of a consumer buying raw meat except when undesirable and easily observed putrid odour is present as in the case of spoilt meat. Meat flavour is due to the presence of water and fat soluble chemicals including meat proteins, peptides and amino acids, lipids and carbohydrates present in meat and which on cooking become partly more accentuated or volatile, rising above their normal threshold volumes for their perception in the mouth (gustatory threshold) and in the nose (olfactory threshold). Theses threshold vary among people hence the variation in the ability of people to appreciate meat flavour.

Meat flavour is innately linked to the specie of animal from which it is derived. Thus beef, pork, Chevon, mutton, chicken and other have their characteristic distinct flavour and which

distinguishes them from others. Breed differences within each specie is not usually very remarkable.

Physiological state of animals affect flavour. Mature animals have fuller and more developed flavour than younger ones. Veel and calf are relatively bland in taste compared with the well-developed breed flavour of older animals. Due to presence of hormones, sex affects flavour thus fresh meat from boar or ram can be distinguished from gilt or ewe through the fresh meat odour. The former contains traces of degraded metabolic by-products of male hormone testosterone, which is responsible for the characteristic boar, and ram odours respectively. Apart from these, sex does not seem to impart any strong influence in meat flavour in other species. Feeding regime and management also affect meat flavour through the fatty acid composition of the feed. This occurs in monogastrics and not in ruminants because of the nature of their stomach. High fish meal diet result in fishy taste on pork or poultry meat.

Storage conditions may affect flavour. Pre-rigor meat and meat that has just gone through complete rigor are similar in flavour but meat that has gone through ageing for prolonged cold storage or prolonged freezing do develop characteristic odour and taste. Cathepsin present naturally in the meat and microbial proteases breakdown meat proteins to simpler peptides, and free amino acids which impart characteristic flavour to the meat. Some degree of oxidative rancidity occurs because of anti-oxidation of polyunsaturated fats giving some characteristics' flavour.

Notable undesirable odour and flavour often develop in meat as a result of bacteria and yeast. Souring, taint and putrefaction occurs in areas around bone joint containing synovial fluids, a good nutrient for bacteria. Meat with high proportion of polyunsaturated fat like pork, chicken and fish become more rancid faster than beef.

2.8.4 MEAT COLOUR

The primary sensory stimulus that attracts a consumer to meat is its colour. Several factors affect the perceived colour of meat, both ante mortem and post-mortem factors. Ante mortem factors include genetic and physiological characteristics of animals. Species differences in meat colour e.g. beef, pork, chevon, chicken etc. Some breed differences also exist e.g. deep red colour in WAD pig and pale colour of Poland Clura and Pietran breed of pig. Between musces, there exist colour differences. E.g. Meat form leg and thigh in chicken are slightly darker than meat from breast. A cross section of the semitendinosus in beef carcass shows a darker shade of red colour

on one side that the other. Meat from more mature animals appear darker than from younger animals. Intact and more active male's giver darker meat than females, stressed cattle gives dark, firm and dry beef while stress susceptible pig gives pale soft exudative pork. Animals fed high levels of iron or poorly bled animals give darker colour meat.

Conditions to which the meat is subjected post-mortem also affect meat colour. Meat subjected to ageing process to enhance tenderness have darker colour than unaged meat. Meat exposed to prolonged period in the tropical sun may become dried and dark on the surface. Such meat left over a long time in the freezer may equally become dehydrated, rancid but lighter in colour.

Weak and dead animals if illegally dressed would not be well bled and the meat is liable to spoil fast due to chemical and bacterial action resulting in green colour formation in some places especially around major blood vessels.

Meat from chicken muscles that do a lot of work and therefore require high oxygen demand like guinea fowl have darker meat colour due to greater myoglobin content

TABLE 2.2: Typical colour of fresh meat from various species

Beef	Bright cherry red
Cheyon or goat meat	Dark red
Fish	Grey white to dark red
Horse meat	Very dark red
Lamb and mutton	Light to brick red
Pork	Greyish pink
Poultry	Gray white to dull red
Veal	Brownish Pink
Venison or game meat	Deep red

The first impression consumers have of any meat product is its color and thus color is of utmost importance. The color of meat may vary from the deep purplish-red of freshly cut beef to the light gray of faded cured pork (Rockland and Beuchat, 1997). Fortunately, the color of meat can be controlled if the many factors that influence it are understood. Fresh and cured meat color both depend on myoglobin, they are considerably different from each other in terms of how they are formed and their overall stability. Myoglobin is a water-soluble protein that

stores oxygen for aerobic metabolism in the muscle. It consists of a protein portion and a non protein porphyrin ring with a central iron atom. The iron atom is an important player in meat colour

The defining factors of meat color are the oxidation (chemical) state of the iron and which compounds (oxygen, water or nitric oxide) are attached to the iron portion of the molecule (Kropf *et al.*, 2004). Because muscles differ greatly in activity, their oxygen demand varies. Consequently different myoglobin concentrations are found in the various muscles of the animal. Also, as the animal gets older there is more myoglobin. A greater myoglobin concentration yields a more intense color. Muscle pigment concentration also differs among animal species. For example, beef has considerably more myoglobin than pork or lamb, thus giving it a more intense color.

Immediately after cutting meat color is quite dark, beef would be a deep purplish-red. As oxygen from the air comes into contact with the exposed meat surfaces it is absorbed and binds to the iron. The surface of the meat blooms as myoglobin is oxygenated. This pigment, called oxymyoglobin, gives beef its bright cherry red color. It is the color consumers" associate with freshness (Kropf *et al.*, 2004)

2.8.5 COOKED MEAT PIGMENT

During the cooking process, myoglobin is denatured. All of the pigment is not affected at the same time or to the same extent and this is why you get reddish color at different end point temperatures when heat is applied. The cooked pigment is denatured metmyoglobin, it is brown and is easily recognized in cooked meat products. Certain meat conditions can result in protection of the myoglobin in meat (Hunt *et.al.,* 1999).The ultimate pH of meat or meat products will affect how the meat color changes during smoking. If the meat has a high pH, it will be cooked to higher end-point temperatures to get the same visual degree of doneness as one with normal pH. Frequently, complains of this hard to cook defect are associated with a high pH of the meat product (Torngren, 2003).

TABLE 2.3: PARAMETERS OF MEAT QUALITY

Parameters	Acceptable	Unacceptable
Appearance		
Meat colour	Red/pink	Brown, Grey green
Fat colour	White	Yellow
Texture	Firm	Soft, mushy, dry
Palatability		
Tenderness	Tender	Mushy, tough
Flavor	Typical of specie	Boar taint, rancid, acid taste
Juiciness	Moist	Lack of flavor

Source: Laird (2006)

2.9 MEAT SPOILAGE AND DETERIORATION IN QUALITY.

The spoilage of meat occurs if the meat is untreated in a matter of hours or days and results in the meat becoming unappetizing, poisonous or infectious (Lawrie, 1990). Spoilage is caused by the practically unavoidable infection and subsequent decomposition of meat by bacteria and fungi, which are borne by the animal itself, by the people handling the meat and by their implements. Meat can be kept edible for a much longer time though not indefinitely if proper hygiene is observed during production and processing and if appropriate food preservation and food storage procedures are applied (Lawrie and Ledward, 2006). The criteria for a meat to be considered fit may sometimes include;

- Freedom from contamination- meat must be free from contaminations from flies, rodents, or insects. Handling of meat in dirty equipments or by diseased workers is not acceptable.
- Freedom from unacceptable changes in foods- microorganism and endogenous food enzymes cause unacceptable changes as in the case of meat.

The organisms spoiling meat may infect the animal either while still alive (endogenous disease) or may contaminate the meat after its slaughter (exogenous disease).There are numerous diseases that humans may contract from endogenously infected meat, such as anthrax, bovine tuberculosis, brucellosis, salmonellosis, listeriosis, trichinosis or taeniasis (Ledward and lawrie, 2006).
Meats undergo deterioration to varying degrees in their organoleptic properties, nutritional values, safety and antheseptic appeal. The progressive deterioration of food ultimately leading to to

spoilage is a natural process and cannot be prevented but delayed. From the moment the meat is slaughtered, it undergoes progressive deterioration. Infected meat however, should be eliminated through systematic meat inspection. Consumers will more often encounter meat exogenously spoiled by bacteria or fungi after the death of the animal. The large intestine of animals contains some 3.3×1013 viable bacteria, which may infect the flesh after death if the carcass is improperly dressed (Troller and Christian, 1990).

Contamination can also occur at the slaughterhouse through the use of improperly cleaned slaughter or dressing implements. After slaughter, care must be taken not to infect the meat through contact with any of the various sources of infection in the abattoir, notably the hides and soil adhering to the carcass, water used for washing and cleaning, the dressing implements and the slaughter house personnel's. Bacteria genera commonly infecting meat while it is being cut, processed, packaged, transported, sold and handled include; Salmonella spp., Shigella spp., E.*coli*, B.*proteus*, Streptococci etc. These bacteria are all commonly carried by humans, infectious bacteria from the soil include; Cl. *Botulinum*. Among the molds commonly infecting meat are *Penicillium* spp., Mucor, Cladosporium, Alterneria, Sporotrichium and Thaminidium etc. (Lawrie and Ledward, 2006) As these microorganisms colonize a piece of meat they begin to break it down leaving behind toxins that can cause enteritis or food poisoning, potentially lethal in the rare case of botulism (Rajasekhara *et al.,* 2000). The microorganisms do not survive a thorough cooking of the meat, but several of their toxins and microbial spores do. Meat spoilage by micro-organisms can manifest itself as follows:

TABLE 2.4: Symptoms of Microorganism found in meat

Oxygen	Microbial agent	Symptoms
Present	Aerobic bacteria	Surface slime Discolouration Gas production Change in odor Fat decomposition
Present	Yeasts	Surface slime Discoloration Change in odor and taste Fat decomposition
Present	Molds	Sticky and "whiskery" surface Discoloration Change in odor Fat decomposition
Absent	Anaerobic bacteria	Putrefaction and foul odors Gas production Souring

Source: Lawrie (2003)

Food is mostly subjected to physical, chemical and biological changes and these cause the deterioration in the quality and ultimately the spoilage of food. The major causes of food spoilage include:

1. Microorganisms, their growth and activity
2. Action of native enzymes
3. Insects, rodents and parasites
4. Chemical reactions of the constituents of the food
5. Environmental factors such as temperature, moisture, air and light
6. Time.

These factors operate simultaneously affecting the quality of the food. It is not possible to completely eliminate these factors and secure total prevention from meat spoilage. Preservation methods attempt to minimize the effect of these factors and enhance the storage stability and maintain the quality of meat for prolonged period.

2.10 ACTIVITY OF MICROORGANISMS

Microorganism are capable of spoiling meat, they are not found within the healthy living tissues of plants and animals. Microorganism invade the plant and animal tissues through a break in the skin or penetrate through the skin that have been weakened due to diseases or death.

2.10.1 BACTERIA CONTAMINANTS OF MEAT

During slaughtering process, there is contamination of the sterile tissue with intestinal flora such as gram-negative organisms which includes *Escherichia coli* as well as contaminants such as *Pseudomonas* specie and gram-positive lactic acid bacteria and *Staphylococci* species associated with humans, animals and their environment. Meat spoilage is usually associated with gram-negative proteolitic bacteria which literally decompose the protein with production of offensive odour (Haman, 1977).The addition of salt and drying of fresh meat have been an effective means to control the meat micro flora and thus preserve the tissue for later consumption. The curing salt (sodium chloride or sodium nitrate or sodium nitrite) and subsequent proper handling method, favours the growth of gram-positive bacteria, primarily *Staphylococcus aureus* while inhibiting the proliferation of gram-negative bacteria (Boles *et al.,* 2000). Ogunbanwo *et al.*, (2004) reported that smoking has a preservative effect on the Suya meat as part of the normal flora of the human intestinal tract, *E. coli* plays a crucial role in food digestion by producing vitamin K from undigested material in the large intestine. Most strains of *E coli* are harmless commensal members of the intestinal flora of mammals in which some strains adhere to the intestinal mucosa while others are only temporary transient in the lumen of the colon. While some strains of *E. coli* live as commensals, many are opportunistic pathogens of humans and other animals (Levine, 1994). *E. coli* is the major cause of Neonatal septicemia, Neonatal meningititis and urinary tract infections in humans and of a variety of invasive diseases in mammals. It is also a leading cause of diarrhoeal diseases in human's and other mammals (Neidhardt, 1995). *E. coli* can respond to environmental factors such as Chemicals, pH, temperature and osmolarity in a number of ways, since it is a single celled organism (Todar, 2002).Salmonella is a genus of rod-shaped, Gram-negative, non-spore forming predominantly motileentero bacteria with diameters around 0.8 to 1.5μm, lengths from 2 to 5μm and peritrichousflaglla, (flagella that are all around the cell body). There are only two specie of salmonella; *Salmonella bongori* and *enterica.* Salmonella is found

worldwide in both cold blood and in the environment. They cause illnesses such as typhoid fever, paratyphoid fever, and food poisoning (Ryan and Ray, 2004).

2.10.2 YEASTS AND MOULDS

Fungi are slow growers in comparison to bacteria and so are often out-competed seldom responsible for the spoilage of fresh proteinaceous material. Yeasts and moulds are more resistant to low temperature, low pH, lower a_w values and the presence of preservatives than Bacteria (Taniwaki et al, 2001). Moulds are aerobic organism and grow as fine threads or filaments forming a complex network or mat called mycelium which is visible by its cottony or fuzzy appearance on the surface of the food or meat. They grow at pH 4-6 and at temperatures close to 30^0C. Certain of these moulds produce toxins called mycotoxins. Prevention against these moulds may be achieved by eliminating contaminated raw food materials by use of high temperature, chemicals, radiation to kill the organisms.

2.11 EFFECT OF TEMPERATURE ON MEAT SPOILAGE

The influence of temperature in food preservation and spoilage has two separate facets: Temperatures during processing and Temperature during storage (Beuchat and Toledo, 1994). As noted above heat-resistant fungal spores may survive pasteurising processes. Apart from a few important species, little information exists on the heat resistance of fungi. Low pH and preservatives increase the effect of heat (Beuchat, 1981) and also hinder resuscitation of damaged cells (Beuchat and Jones, 1995).

2.12 MEAT PRESERVATION

Food preservation is the process of treating and handling food to slow down spoilage (loss of quality, edibility or nutritional value). Preservation usually involves preventing the growth of bacteria, eats, fungi and other microorganisms (although some methods works by introducing benign bacteria or fungi to the food), as well as retarding the oxidation of fats which cause rancidity. Food preservation can also include processes which inhabit visual deterioration that can

occur during food preparation; such as enzymatic browning reaction in some foods. Maintaining or creating nutritional value, texture and flavor is an important aspect of food preservation, although historically some methods drastically altered the character of the food being preserved. Meat preservation processes can be:

- Heating to kill or denature microorganisms e.g. boiling
- Toxic inhibition e.g. smoking
- Dehydration (drying
- Osmotic inhibition
- Low temperature inactivation
- Ultra high water pressure
- Combinations of these methods.

The spoilage of meat occurs, if untreated, in a matter of hours or days and result in the meat becoming unappetizing, poisonous or infectious. Spoilage is caused by the practically unavoidable infection and subsequent decomposition of meat by bacteria or fungi which ae borne by the animal itself by the people handling the meat and their implements. Meat can be kept edible for much longer time though not indefinitely.

2.12.1 WHY IS FOOD PRESERVATION IMPORTANT?

(A) To increase the shelf life of food as well as its supply. Although the freshness, palatability and nutritive value may be altered with time delay, perishable foods can be preserved to prevent spoilage and made to be available throughout the year.

(B) To save food for future use at the time of scarcity or drought etc. after suitable preservation and proper storage. Preservation of food also minimizes the preparation time and energy at home.

(C) To stabilise the price of food throughout the year since seasonal food can be preserved and made available for consumption throughout the year.

2.13 PRINCIPLES OF FOOD PRESERVATION

(A) Prevention or delay of the growth of micro-organisms-via

(i) Avoiding invasion of micro-organisms e.g. by aseptic techniques.

(ii) Removing micro-organisms e.g. filtration.

(iii) Inhibiting the growth and activity of micro-organisms e.g. freezing, refrigeration, drying, anaerobic conditions, chemicals or antibiotics.

(iv)Killing the micro-organisms e.g. heat or irradiation

(B) Prevention or delay of self-decomposition via-

(i) Destruction or inactivation of inherent enzymes naturally existing in food e.g. by blanching.

(ii) Prevention or delay of chemical reactions e.g. prevention of oxidation by using antioxidants

(C) Prevention of damage from insects or animals via-

(i) By using suitable chemicals to kill insects or animals from destroying the foods.

(ii) By storing foods in dry, air tight containers to prevent the insects or animals from destroying them.

2.13.1 GENERAL METHODS OF PRESERVATION INCLUDE:

1. **Anaerobic condition**: Anaerobic condition means a condition lack of or containing only minimum amount of air or oxygen. It can prevent the surviving bacteria in food from growing in the container. The container is completely filled with food and air in unfilled space is removed or replaced by nitrogen or carbon dioxide.
2. **Heat treatment**: Heat is the most commonly used media for preservation by killing micro-organisms. The heat treatment required depends on the kind of the target micro-organisms to be killed and the composition of the food.

Basically, heat treatment can be classified into three categories:

(i) Pasteurisation (temperature below 100°C): Pasteurisation is a heat treatment that kills part of the micro-organisms present in food using a temperature under 100°C. The temperature used ranges from 65-75°C.

(ii) Boiling or heating at about 100°C:

(iii) Sterilisation (temperature 100°Cor above):

3. Canning: Canning is a process in which over 100°C is used for killing all spoilage organisms and their spores as well as inactivating enzymes and sealing in sterile airtight containers.

4. Use of low temperature and cold preservation: Low temperature can lower the rate of chemical reactions and the action of enzymes. Generally, freezing can prevent the growth of most food-borne micro-organisms and the usual temperature for cold storage is 4.5-7°C. Refrigeration temperature lowers the growth rate of micro-organisms and chilling can slow down the enzymatic and microbial changes in food.

5. Drying or dehydration: Foods are preserved by drying for a long history, especially in Chinese foods. Mushrooms, dried shrimps and salted fish are some typical examples. Both the terms "drying" and "dehydration" mean the removal of water. "Drying" usually describes the process of drying under sunshine or open air.

6. Use of preservatives

Preservatives serve as antimicrobials which prevent or slow down the growth of moulds, yeasts and bacteria. By preventing the growth of moulds, yeasts and bacteria, preservatives can improve the safety of food as well as prevent the wastage of seasonal surplus by making it last longer on the shelf or in the fridge.

2.14 PREPARATION AND STORAGE OF BEEF PRODUCTS

By Heat

Meat gets putrefied due to the action of bacteria, moulds and yeasts in an effort to get nourishment from the meat while in the process, they alter the meat in various ways. To grow they require favourable temperature hence microorganisms are classified according to their temperature tolerance as

1. Psychrophiles which have an optimum temperature range of -2°C to 7°C.
2. Mesophiles which have an optimum temperature range of 10°C to 40°C
3. Thermophiles which have an optimum temperature range of 43°C to 66°C.

Therefore meat preserved at -2°C (sub optimal temp.) by chilling or freezing and 66°C (super optimal temp.) by pasteurizing, cooking or sterilizing.

Organisms cause spoilage by: Disintegrating the connective tissue, Producing gases as hydrogen sulphide, carbon dioxide, ammonia etc., Fermenting the muscle sugar (glycogen) to produce acetic and butyric acids, causing offensive smell and tastes and Discolouration of the meat by changing the myoglobin.

PRESERVATION BY COLD

Cold storage/preservation provides opportunity for long term storage of meat. During cold storage, spoilage bacteria are unable to multiply because the moisture content of the meat and the microbes themselves are changed to ice. Examples of cold storage include:

1. Chilling storage: It is useful when meat will be preserved for only about 35 days. It loses very little in appearance, nutritive value and taste. Temperature is between -1.4°C and 1°C, preferably in the dark as light has the effect of oxidizing fats. The atmosphere should be kept dry. A concentration of 5% to 10% carbon dioxide helps to prevent the growth of mould and bacteria. Meats under this condition require more space. Usually in meat cellars or chilling rooms, meat cuts are hung on hooks to allow for ventilation.
2. Freezing of meat: Temperature for ordinary freezing vary between -18°C and -5°C. This can be kept for a longer period. Frozen Beef can be stored for 12 months, veal slightly less, mutton and lamb 8 months and pork 6 months without much deterioration. Frozen meat stored too long become dry, less palatable and rancid. It is less durable after thawing than fresh killed or chilled meat. Freezing can be done by slow freezing or blast freezing can be used. Freezing can be achieved by a. slow freezing- Involving only natural air circulation or at best with electric fans.

DRYING/DEHYDRATION

Microorganisms require an adequate amount of water for growth; it is possible to preserve meat by dehydration. Temperature, humidity and circulation of air are the key factors in drying of meat. Gradual dehydration of meat cut to specific uniform shape that permits the equal and simultaneous drying of whole batches of meat. The optimal conditions for a successful and easy drying of meat are: Relative humidity of around 30%, Warm and dry air and Small temperature difference between night and day. Drying will be faster under high temperatures, low humidity and intensive

air circulation. Relatively, there is high water evaporation in the first day of drying, after which evaporation rate continually decreases. As the meat dries it becomes smaller, thinner, thinner and to some degree wrinkled. Consistency also changes from soft to firm and hard.

2.15 MEAT PROCESSING

Food processing is the set of methods and techniques used to transform raw foods e.g. meat into food or transform foods into other foods forms for consumption by humans or animals either in the home or by the food processing industry.

Meat processing is the set is the process of transforming meat through different techniques and method to bring about increase in quality and nutritional value, bring about preservation, to bring about increase in shelf life of the raw meat and also to bring about value addition. Meat processing technology comprises the steps and procedures in the manufacture of processed meat products. Processed meat products, which include various different types and local/regional variations, are food of animal origin, which contribute valuable animal proteins to human diets. Animal tissues, in the first place *muscle meat* and *fat*, are the main ingredients, besides occasionally used other tissues such as *internal organs*, *skins* and *blood* or *ingredients of plant origin*.

All processed meat products have been in one way or another physically and/or chemically treated. These treatments go beyond the simple cutting of meat into meat cuts or meat pieces with subsequent cooking for meat dishes in order to make the meat palatable. Meat processing involves a wide range of physical and chemical treatment methods, normally combining a variety of methods. Meat processing technologies include:

- Cutting/chopping/comminuting
- Mixing/tumbling
- Salting/curing
- Utilization of spices/non-meat additives
- Stuffing/filling into casings or other containers
- Fermentation and drying
- Heat treatment

- Smoking

2.16 MEAT SMOKING

Smoke for treatment of meat products is produced from raw wood. Smoke is generated through the thermal destruction of the wood components **lignin** and **cellulose**. The thermal destruction sets free more than **1000** desirable or undesirable firm, liquid or gaseous components of wood.

These useful components contribute to the development of the following desirable effects on processed meat products:

- Meat preservation through aldehydes, phenols and acids
- (anti-microbial effect)
- Antioxidant impact through phenols and aldehydes
- (retarding fat oxidation)
- Smoke flavour through phenols, carbonyls and others
- (smoking taste)
- Smoke colour formation through carbonyls and aldehydes
- (attractive colour)
- Surface hardening of sausages/casings through aldehydes (in particular for more rigid structure of the casing)

The most known **undesirable effect** of smoking is the risk of **residues of benzopyrene** in smoked products which can be carcinogenic if the intake is in high doses over long periods. With normal eating habits, a carcinogenic risk is normally not associated with moderately smoked food such as smoked meat products. Depending on the product, smoke is applied at different temperatures. There are two principal smoking techniques:

- Cold smoking
- Hot smoking

The principle of both methods is that the smoke infiltrates the outside layers of the product in order to develop flavour, colour and a certain preservation effect.

Cold Smoking – This is the traditional way of smoking of meat products and was primarily used for **meat preservation**. Nowadays it serves more for **flavour** and **colour formation**, for example in sausages made from precooked materials such as liver sausage and blood sausage.

The combination of cold smoking and drying/ripening can be applied to ferment sausages and salted or cured entire meat pieces, in particular many raw ham products. In long-term ripened and dried hams, apart from providing colour and favour, the cold smoking has an important preservative effect as it prevents the **growth of moulds** on the meat surfaces.The optimal temperature in "cold" smoking is 15 to 18°C (up to 26°C). Sawdust should be burned slowly with light smoke only and the meat hung not too close to the source of the smoke. Cold smoking is a long process which may take several days. It is not applied continuously, but in intervals of a few hours per day.

Hot Smoking – Hot smoking is carried out at temperatures of +60 to 80°C. The thermal destruction of the wood used for the smoking is normally not sufficient to produce these temperatures in the smoking chamber. Hence, **additional heat** has to be applied in the smoking chamber.

Hardwoods are made up of cellulose, hemicellulose and lignin. Cellulose and hemicellulose are the basic structural material of the wood cells while lignin acts as a kind of cell-bonding glue. Some softwoods especially pines and firs hold significant quantities of resin which produces harsh-tasting soot when burned, these woods are not often used for smoking (Hui et al., 2001). Cellulose and hemicellulose are aggregate sugar molecules. When burnt, they effectively caramelize producing carbonyls which provide most of the color components, sweet, flowery and fruity aromas. Lignin, a highly complex arrangement of interlocked phenolic molecules, also produce a number of distinctive aromatic elements when burnt, including smoky, spicy, and pungent compounds such as guaiacol, phenol, syringol, and sweeter scents. Guaiacol is the phenolic compound mostly responsible for the smokey taste, while Syringol is the primary contributor to smokey aroma (Hui et al., 2001). Wood also contains small quantities of proteins, which contribute to roasted flavors. Many of the odor compounds in wood smoke especially the phenolic compounds, are unstable, dissipating after a few weeks or months (Bala, 2010)

2.16.1 SMOKE HOUSE

The upright drum smoker (also referred to as an Ugly Drum Smoker or UDS) is exactly what its name suggests. An upright steel drum modified for the purpose of hot smoking. There are many ways to accomplish this, but the basics include the use of a complete steel drum, a basket to hold charcoal near the bottom and cooking rack near the top, all covered by a vented lid of some sort. They have been built using many different sizes of steel drums, but the most popular size is the common 55 gallon drum. The temperatures used for smoking are controlled by limiting the amount of air intake at the bottom of the drum and allowing a similar amount of exhaust out of vents in the lid. UDSs are very efficient with fuel consumption and flexible in their abilities to produce proper smoking conditions. Smoking chambers with freshly generated smoke, according to the investigated procedure, offers several advantages.

2.16.2 EFFECT OF SMOKING ON MEAT

Smoking is the process of flavoring, cooking or preserving food by exposing it to the smoke from burning or smoldering plant materials most often wood. Meats and fish are the most commonly smoked foods (McGee, 2004).Hot smoking exposes the foods to smoke and heat in a controlled environment. Like cold smoking, the item is hung first to develop a pellicle and then smoked. Although foods that have been hot smoked are often reheated or cooked, they are typically safe to eat without further cooking. Hot smoking occurs within the range of 52 to 80 °C (Myrvold, 2011). Within this temperature range, meat is fully cooked, moist and flavorful. If the smoker is allowed to get hotter than 85 °C, the meat will shrink excessively. Smoking at high temperatures also reduces yield, as both moisture and fat are cooked away. It can equally cause a toughening of meat fibres due to heat coagulation and shrinkage of the myofibrillar proteins and connective tissues. Initial toughening is due to protein denaturation which occurs when the meat reaches 50-80°C, this is followed by some tenderization which occurs as collagen hydrolyses to gelatin at temperatures greater than 75°C (Inneke, 2011). However, prolonged heating can increase the tenderness due to the conversion of collagen to gelatine by heating. Preservation technique used on beef is vital as some of the nutrients can be damaged.

Figure 4: Kilichi being smoked

2.16.3 HEALTH RISKS OF SMOKED MEAT

Evidence suggests that smoked foods may contain carcinogens (Fritz and Soos, 1991). The smoking process contaminates food with Polycyclic Aromatic Hydrocarbons (PAHs) and nitrosamines, which are known carcinogens. So, in theory consuming smoked food increases the risk of gastrointestinal cancer. Some studies have found a positive statistical correlation between intestinal tract cancer and the frequent intake of smoked foods (Fritz and Soos, 1991). The United States National Cancer Institute emphasizes that population studies have not established a definitive link between cooked meats and cancer in humans, but suggests individuals reduce their exposure to PAHs (Bala, 2010).

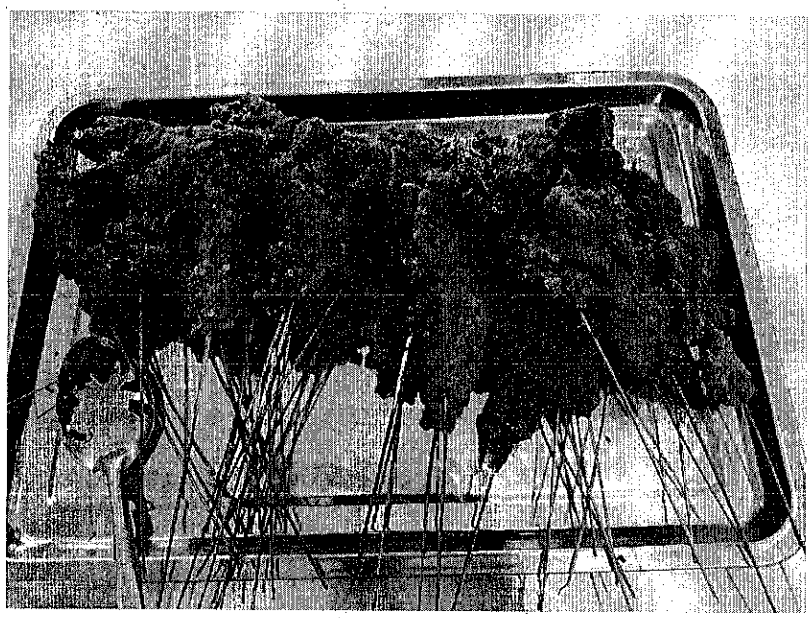
2.17 SUYA

Due to the chemical composition and biological characteristics of meat, they are highly perishable which provide excellent environment for growth of many hazardous microorganisms that can cause infection in humans and spoilage of meat and economic loss. Hence, the need for effective, cheap and simple preservative techniques. One of such simple preservative technique is intermediate moisture food processing. Obanu et al. (1981), observed that Intermediate Moisture Meat, are shelf stable under the tropical climate without refrigeration and may be eaten directly with or without rehydration. Suya is one of such intermediate moisture product that is easy to prepare and highly relished (Omojola et al., 2004).

Suya is a traditional meat product that is commonly produced by the Hausas in West Africa from mostly Beef. There are three types of Suya namely, Tsire, Kilishi and Balangu. Of the three types, Tsire, which is boneless meat pieces that are staked on slender wooden sticks and cooked by roasting, using a glowing fire from charcoal, is the most popular with consumers in Nigeria (Igene and Mohammed, 1993). In big cities and small towns, Suya vendors have become very prominent with their grill stands becoming very busy from about midday until late at night (Inyang et al., 2005).

Meat processing generally enables the processor to convert low priced meat cuts into high priced processed products (FAO, 1995). Traditionally, most tsire suya producers use expensive cuts of meat (for examples the Longissimus dorsi muscle), resulting into high prices of the products beyond the reach of the common Man. The prime cuts, apart from resulting in products with high prices might not be necessarily better than cuts from less choice parts of the carcass in terms of product yield and eating qualities.

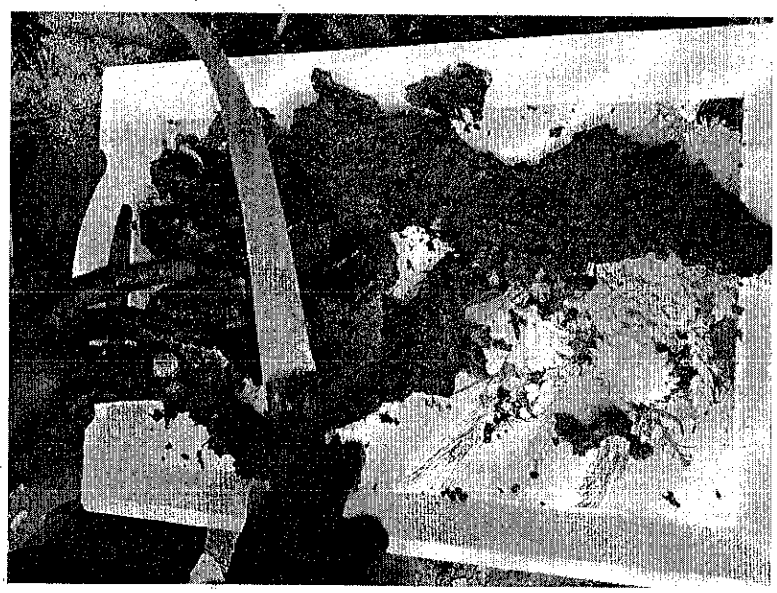
Figure 5: Sticked Suya on a flat tray



2.18 KILICHI

Lean meat was cut and sliced into pieces of about 0.2 - 0.4 cm thick and 15 cm long using a sharp knife. The sliced meat was spread on a clean mat for 2 to 3 hours under the sun. The dried meat was immersed into a 7 litre bowl containing about 3 litres of slurry of spices made up of groundnut cake, onion, magi, ginger and other aromatic condiments The seasoned meat was sun dried again for 4 to 6 hours and roasted on a wire mesh placed on a red hot charcoal for 5 – 10 minutes at a temperature of about 1000 C as described by Igene. The product becomes ready for consumption after cooling.

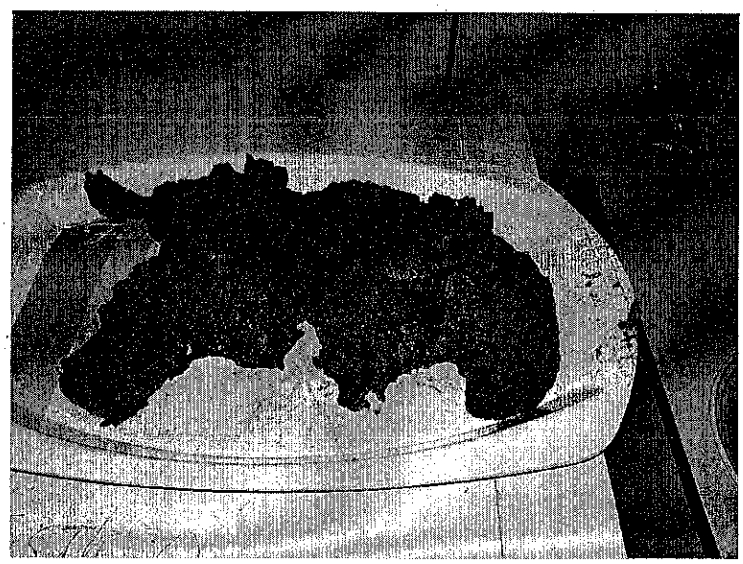
Figure 6: Kilichi being cut into pieces



2.19 BALANGU

Boneless meat of a sizeable cut was roasted by placing it on a wet brown paper on a wire mesh. The pieces of meat were sliced into thin sheets not less than 1 cm in thickness. Groundnut oil, spices and salt were sprinkled during roasting. The meat was continuously turned over until it was well roasted as proposed by Farouk.

Figure 7 : Balangu on a tray



CHAPTER 3

3.1 RESEARCH METHODOLOGY

In this section of the research work, attempt was made to describe the methodology and framework used in attaining the stated objectives of the study, how the research hypothesis was empirically determined, the research design adopted, the study population/sample frame and its characteristics, and the types of sampling techniques used in the study. Also types and sources of data were identified, procedure in testing the hypothesis and accomplishing the study objectives were defined. Concise efforts were made too to describe the choice of research instrument, questionnaire design, method of data measurement, data collection techniques, tabulation analysis and presentation of data.

3.2 STUDY LOCATION

The study was carried out in ikole ekiti, Ekiti state Nigeria which lies between latitude 7.7983^0N and longitude 5.5145^0E. The tropical climate of ikole is composed of two distinct seasons, these are rainy seasons (April-October) and dry season (November- March). Temperature ranges between 21^0 and 28^0 C with high humidity. Ikole Ekiti is made up of few other towns to make up the ikole local government. The ikole local government is made up of Ikole Ijesha Isu Oke Ayedun Ootunja OdoOro Ipao Itapaji Ara Isaba Usin Orin Odo Odo Ayedun Ayebode Oke Ako IreleIyemero Ikosi Igbona Asin Esun Temidire Ikunri Ijebu-Agege Ilamo. The people of ikoole in ikole local government Ekiti state are predominantly farmers and traders. In addition we have some people who are carpenters, blacksmith, shoemakers, tailors, civil servants and hunters by profession.

3.3 METHOD OF DATA COLLECTION

In this study, primary data was used to obtain necessary information required, the primary data was used to obtain data from the field by the use of a questionnaire designed in a simple format which was administered to the respondents in the study area to get their views of the effects of this recession and the strategies they adopted. The well-structured questionnaire sought out

information on the personal features of the respondents such as gender, age, marital status, size of household and many more.

3.4 SAMPLING TECHNIQUES

Random sampling techniques was used to identify the target respondents was used to identify the target respondents, where in the first stage 220 questionnaires were used in collecting data and the second stage involved setting up a sensory evaluation panel where 30 participants were selected to participate in sensory evaluation of the meat products. The target population was male and female of all classes and from different background and to bring about randomness.

3.5 SAMPLE COLLECTION AND PREPARATION FOR SMOKED BEEF

Six kilogram of beef-round from a freshly slaughtered 3 year old bull was obtained from the abattoir and used for this study. After excising muscle from carcass, meat was trimmed of all extra muscular fat and cleaned thoroughly with water. The meat was then separated for its different purposes, the raw beef meat for Suya was separated, and portions was separated for the balangu and also the tsire.

3.6 SMOKING OF MEAT

3.6.1 CONSTRUCTION OF SMOKING DRUMS

An upright drum smoke/roasting house was constructed, allowing opening at the top, the top was covered with a wire mesh, and the upright drum had a tripod stand to which it stands few centimeters above the ground. There is a large empty space within the drum to which the lower part was filled with stones and the upper part was filled with charcoal gotten from destructive distillation of wood. The top of the smoking drum was covered with a wire mesh so flat that the meat products can be placed on the drum.

3.6.2 USE OF ELECTRIC OVEN

The electric oven is a thermally insulated chamber used for heating, baking or drying of a substance. The electric oven was used to dry the kilichi artificially by setting it to a temperature of about 250^0C-270^0C. This is to ensure quick drying of the kilichi instead of using the natural method of solar drying the meat.

3.7 MEAT DISTRIBUTION IN SMOKE OVENS AND ELECTRIC OVEN

3.7.1 ON SMOKING DRUM

The tsire meat was sprinkled with vegetable oil after the meat has been garnished with ingredients and was arranged flatly on the wire mesh which has been placed on the roasting drum to bring about the smoking and roasting of the tsire to its final desired texture and shape.

The balangu also sprinkled with oil was prepared almost in the same way like the tsire meat, the sprinkling of the oil is to avoid sticking of the meat on the wire mesh which might disfigured the shape of the meat when removed forcefully.

The kilichi was placed after drying has almost been achieved in the electric oven and this does not need sprinkling of oil unlike the other two meat products.

3.7.2 IN THE ELECTRIC OVEN

The sliced thin and lean meat of kilichi was placed on the wire mesh within the oven without sprinkling of oil, there was no sticking as it was only raw meat without ingredient and this klast about 45 minutes. The second stage of placing kilichi meat in the oven was done with the aid of a tray, the kilichi has been soaked in a paste containing the ingredients soaked in water forming the paste. The kilichi was first placed on the tray and then placed into the oven, the kilichi meat was turned from side to side to ensure evenly distributed drying and after about 1 hour the kilichi meat was removed from the tray and laid flat on the wire mesh within the oven.

3.8 INGREDIENT PREPARATIONS

The spices used were purchased individually from specialized spice sellers in the market area within the ikole community. The spices include; Curry, Red pepper, Maggi seasoning, kulikuli, salt and dried ginger, onions.

3.8.1 TSIRE (SUYA) INGREDIENTS PREPARATION

The ingredients for were composed curry, maggi, kulikuli, dried red pepper, dried ginger. This was all grinded together to make a powder. The powder was then used to sprinkled and garnished on

the sticked meat before roasting. The vegetable oil was sprinkled on the tsire meat while on fire to bring about flavour, sweetening and sticking of the ingredients more to the meat.

3.8.2 BALANGU INGREDIENTS PREPARATION

Unlike the other two meat products (suya, kilichi) the balangu meat does not contain spices, the ingredients is made up of only maggi and salt and curry. This are all mixed together in desired proportion to ensure optimal taste of the meat. The maggi is crushed, the salt is added and also the curry, this is mixed until even mixture has been achieved. The vegetable is used when the thick raw meat has been placed on the fire, sprinkled with the salt, maggi curry mixture and then the vegetable oil is added to bring about sticking of the ingredients to the meat.

3.8.3 KILICHI INGREDIENTS PREPARATION

The kilichi ingredients is composed of the same ingredients with that of the suya but prepared differently. After the ingredients have been mixed into the form of a powder, the mixed ingredients are then poured into little bowl and then mixed with clean drinkable water until a paste like form is achieved. The use of groundnut oil is of none effect here whether used or not. The effect of the oil is little or has none at all.

3.9 MEAT PREPARATION

3.9.1 PREPARATION AND ROASTING OF SUYA

The tin sheets of beef from various muscles were inserted into thin sticks which are all equal in length. A total of 40 sticks of beef samples were prepared from each muscle type. Sticks of Suya were made from the muscle. Five to ten mills of groundnut oil was sprinkled on each suya sample prior to roasting.

The Suya samples were arranged around a glowing, smokeless fire. There was a little distance between the coals and the Suya samples. Suya samples were allowed to stay by the fire for 20 minutes with intermittent turning of the samples. Additional groundnut oil was sprinkled on the meat while roasting continued. The period of roasting took about 30-40 minutes which was as a result of inconsistence in heat generation from the charcoals and more had to be added.

3.9.2 PREPARATION AND ROASTING OF KILICHI

Lean meat was cut and sliced into pieces of about 0.2 - 0.4 cm thick and 15 cm long using a sharp knife. The sliced meat was spread on a mesh for 2 about one hour with a temperature of 250^{0}C. The dried meat was immersed into a bowl containing paste of slurry of spices made up of groundnut cake, onion, magi, ginger and other aromatic condiments. The seasoned meat was sun dried again for about 1 hour and roasted on a wire mesh placed on a red hot charcoal for 5 – 10 minutes. The product becomes ready for consumption after cooling.

3.9.3 PREPARATION AND ROASTING OF BALANGU

Boneless meat of a sizeable cut was roasted by placing it on a wet brown paper on a wire mesh. The pieces of meat were sliced into thin sheets not less than 1 cm in thickness. Groundnut oil, spices and salt were sprinkled during roasting. The meat was continuously turned over until it was well roasted.

3.10 SENSORY EVALUATION

Smoked-cooked beef products of tsire, kilichi, balangu samples were each cut into bites sample sizes and served in plates to a thirty member semi-trained panelists. The organoleptic parameters that were evaluated include appearance, taste, flavour, texture, crispiness, colour, and provision for a score on overall acceptability. A 9 point hedonic scale was used with a score of

9-Extremely Acceptable

8-Very Acceptable

7-Moderately Acceptable

6-Slightly Acceptable

5-Neither Acceptable nor Unacceptable

4-Slightly Unacceptable

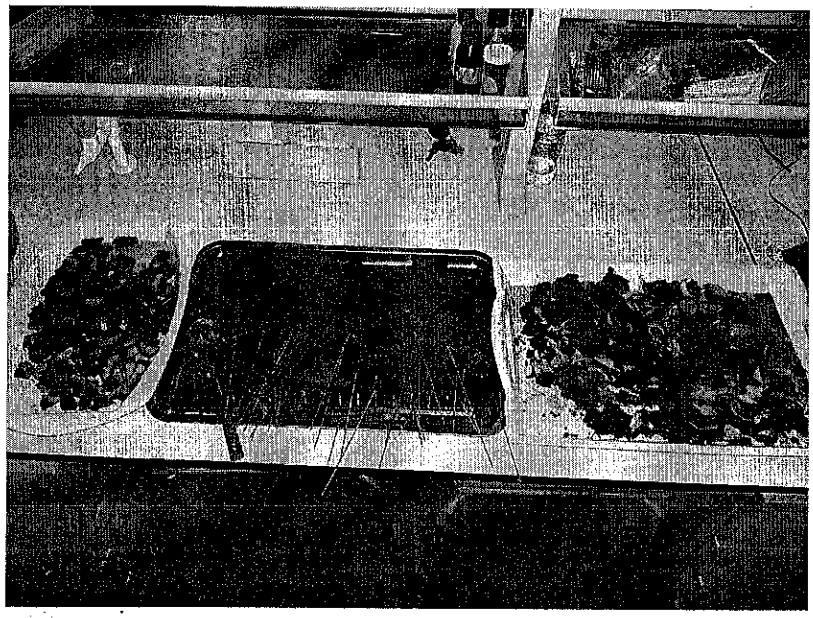
3-Moderately Unacceptable

2-Very Unacceptable

1-Extremely Unacceptable

A score below 2 was considered not acceptable. The meat products were coded with numbers of 2 digits indicating no information about the samples to avoid bias in preferred treatments. The panelists received each sample separately, rinsing their mouth in-between samples.

FIGURE 8: CROSS SECTION OF THE THREE MEAT PRODUCTS



L-R. (BALANGU, SUYA, KILICHI)

3.11 METHOD OF DATA ANALYSIS

Descriptive techniques were used throughout this research work to analyze the data collected. Descriptive statistics involving the use of frequency tables, percentages were also to elicit the data collected. Statistical Package for Social Sciences was also used for onward analysis (SPSS) and the results of the data analysis were presented in tables. Likert scale was used in the questionnaire to represent the respondent's attitude to a topic in the research work.

Agreed (A)-3, Undecided (U)-2, Disagree (1)

Likert scale- (3+2+1)/3=2

Keynote : $\geq$2.0= Agreed, $\leq$2.0= disagreed

CHAPTER 4

RESULTS AND DISCUSIONS

4.1 SOCIO ECONOMIC CHARACTERITICS OF THE RESPONDENTS

This section described the socio economic characteristics of the respondents in terms of sex, marital status, their level of education, age group, primary occupation, household size and the number of cooperatives which distinguishes and characterizes the people both socially and economically.

Below is a summary of the results;

The distribution of the respondents based on their sex indicated that 46% of the respondents and 54% of the respondents were males.

The distribution of the respondents based on their age indicated that, 22.8% of the population falls into the range of 0-20 years of age, while 56.8% falls within the range of 21-40, 14% of the population are within the range of 41-60 years of age, 4.8% of the population are between the age range of 61-80 and 81-100 years of age are only about 1.6%.

The distribution of the respondents based on their working status indicated that the working force are about 27.2% of the population, the self-employed are about 28.8%, students alone are 44%.

The income level of the respondents have a distribution that shows that the average income are about 64.4% of the total population while those with high income are about 10% with low income population to be about 25.6%.

The distribution of the respondents based on their marital status showed the individuals who are single are 58.8% of the entire population, the divorced are 8% of the population, married individuals are 32.4% in population and the separated are just 6% of the population.

The distribution of the respondents based on their religion indicated that the community is filled with more of Christians are the population of Christians are 58.4% while that of Muslims are 33.6% and the African traditional religion is about 8%.

The distribution of the respondents based on their educational level indicated that 0.4% of the population have no formal education, while 22.8% of the population have secondary education, the respondents with tertiary education are about 76.8%.

Based on primary occupation, within the community, apart from the primary, secondary and tertiary students, the occupations practiced by the members of the community include artisans, business of all sorts, some are civil servants, farming, and designing, lecturing because of the university within the area and also trading. The distribution of the respondents is that 8.4% of the population were artisans, 10.8% are into business, and 22% of the population are civil servants while 3% are into farming as their primary occupation. The graphics designers are 0.4% by distribution, lecturing 0.4%, students of both secondary and tertiary institution are about 50.8% and those into trading are about 4%.

The social association stats shows that 58% are not in any social association while 42% are in one association or the other ranging from clan associations to business group association or micro finance schemes association

The annual income of the respondents varies and the distribution is being presented in a table below;

TABLE 4.1: ANNUAL INCOME DISTRIBUTION

S/N	RANGE(NAIRA)	%
1	0-1000000	77.2
2	1000001-2000000	15.6
3	2000001-3000000	4.4
4	3000001-4000000	0.8
5	4000001-5000000	1.2
6	5000001-6000000	0
7	6000001-7000000	0.8
Total		100

The data shows majority of the populace are low and average income earners when they base their income with their spending.

The household size distribution of the respondents shows that household of size ranging between 0-4 have a distribution of about 33.6% while household size ranging from 5-8 have a percentage of about 62.45 and between household size of 9-12 are just 4%.

The secondary occupation of the individuals within the community ranges from being an artisan to blogging, business, entertainments, entrepreneur, farming, fashion designing, graphic designing, media, networking, online business, soap production and trading. The students who have no secondary occupations have stipends as their means of occupation and secondary income while some have none as their secondary occupation and no other means of income.

The summary of the socioeconomic status of the respondents are all presented in a table below;

TABLE 4.2: SUMARRY SOCIO-ECONOMIC DISTRIBUTION

VARIABLES	RESPONSE	FREQUENCY	PERCENTAGE
SEX	MALE	135	54
	FEMALE	115	46
AGE	0-20	57	22.8
	21-40	142	56.8
	41-60	35	14
	61-100	16	6.4
LEVEL OF EDUCATION	NO FORMAL EDUCATION	1	0.4
	SECONDARY	57	22.8
	TERTIARY	192	76.8
MARITAL STATUS	SINGLE	147	58.8
	MARRIED	81	32.4
	DIVORCED & SEPARATED	22	14
OCCUPATION	CIVIL SERVANT	55	22
	BUSINESS	27	10.8
	STUDENTS	127	50.8
	OTHERS	41	16.4
HOUSEHOLD SIZE	0-4	84	33.6
	5-8	156	62.4
	9-12	10	4
STATUS	WORKER	68	27.2
	SELF EMPLOYED	56	28.8
	STUDENT	110	44
RELIGION	AFRICAN TRADTIONAL	20	8
	ISLAM	146	33.6
	CHRISTAINITY	84	58.4
TOTAL		250	100

4.2 AWARENESES OF MEAT AND MEAT PRODUCTS AVAILABLE WITHIN THE COMMUNITY

4.2.1 INFLUENCE OF SOCIAL ASSOCIATION

Results shows that 24.8% of the respondents said that their association has an influence on their consumption of processed meat products. This means that the association that some of the respondents belong influence their on the consumption rate and consumption patterns of processed meat products. About 75.2% which contain both individuals who have no social association or who belong to a social association said that association does not influence their consumption.

4.2.2 CONSUMPTION OF RAW MEAT

24% of the respondents said they buy raw meat always while 43.2% of the respondents buy meat often and 32.8% said that they buy meat rarely.

4.2.3 PURCHASE OF PROCESSED MEAT AND PURCHASE RATE

On the purchase of processed meat, majority of the respondents said they do buy processed meat, the distribution shows that about 93.6% of the respondents buy processed meat while 6.4% of the said they do not buy it. Although the rate of purchase is high, the consumption patter however varies among the 93.6%. The regularity from the respondents shows that 5.2% of the respondents buy processed meat always, 42.8% buys processed meat often, the rest of the respondents which are 52% buys processed meat rarely.

4.3 AWARENESS AND AVAILABILITY OF PROCESSED MEAT.

96.8% of the respondents said they are aware of the processed meat available in the community, of which 3.2% said they are not. The results is presented in a table below.

TABLE 4.3: MEAT PRODUCT AWARENESS

Processed Meat Product	Response	Percent	Percent Of Case
Suya	236	14.6%	94.4%
Kilichi	167	10.3%	66.8%
Balangu	161	10.0%	64.4%
Meat pie	175	10.8%	70.0%
Pepper soup	181	11.2%	72.4%
Stick meat	164	10.2%	65.6%
Asun	193	12.0%	77.2%
Eranigbe (game)	177	11.0%	70.8%
Dog meat	161	10.0%	64.4%
Total	1615	100	646

The individual response shows that suya has the most level of awareness of about 236 out of the 250 respondents. The percentage rate of suya level of awareness is about 14.6% while that of balangu is 10.0% and kilichi is 10.3%, other products account for the re4st of the percentage in the distribution. The percent of case is a form of frequency where one of the variables has been picked more than once with other variables. For suya, it has been chosen more with other products with a frequency rate of about 94.4%, while for kilichi it is about 66.8% and balangu 64.4%.

4.4 MOST PREFFERED MEAT PRODUCTS

The respondents from among the various options of products available to them from the questionnaire gave the response that the most preferred products among the respondents is suya with a distribution of 32.1%, kilichi with 18.7% and balangu with 9%. Products such as pepper soup and asun are more preferred to balangu with respective distribution of 15.3% for pepper soup and 12.2% for asun.

4.5 FACTORS LOOKED OUT FOR IN PURCHASING MEAT PRODUCTS

There are qualitative traits listed that are being checked for by the individuals when they are purchasing the processed meat, these qualities include the price, income level, the taste, freshness, flavour and quality. These are factors that influence rate of consumption and consumption pattern of individuals in buying these products meat. The table below shows the frequency of each of these traits and their percent of cases i.e the extent to which each of the traits are picked and selected with other traits.

TABLE 4.4: FACTORS AFFECTING PURCHASE OF MEAT

VARAIBLES	RESPONSE	PERCENTAGE	PERECENT OF CASES
Price	92	15.1%	36.9%
Income	61	10.0%	24.5%
Taste	120	19.7%	48.2%
Freshness	115	18.9%	46.2%
Flavour	89	14.6%	35.7%
Quality	131	21.5%	52.6%
TOTAL	608	100	242.2

Traits such as quality, taste, freshness and price of the products are major factors that the respondents chosen to be a major factor that they check before consuming any of the processed products. The quality can be a summation of flavour, aroma and how packaged the processed product can be while taste is the feel and sweetness of any of the. These factors if well taken care of can help improve the rate of consumption of the processed meat products.

4.6 POINT OF PURCHASE

The point of purchase is te area and location where the products are paid and obtained from. This is important as sometimes availability of processed meat products can sometimes be affected by

the purchase points. An area with no central market and no trusted restaurant will be dependent in obtaining products from hawkers or the roadsides. The distribution among respondents on point of purchase is presented below;

TABLE 4.5: POINT OF PURCHASE DISTRIBUTION

VARIABLES	RESPONSE	PERCENTAGE	PERCENT OF CASES
Trusted restaurant	131	38.9%	52.6%
Hawker	31	9.2%	12.4%
Market	119	35.3%	47.8%
Supermarket	38	11.3%	15.3%
Car park	13	3.9%	5.2%
Roadside	5	1.5%	2.0%
TOTAL	337	100	135.3

Respondents buy processed products more in trusted restaurant and in the market more than other locations such as hawker, super market, car park and road side.

4.7 DETERMINANTS OF KIND OF PROCESSED MEAT PRODUCT CONSUMED

They are factors that play roles in preference of the kind of processed meat products to be consumed. The determinants are;

Affordability which is the extent to which each of the products are affordable and lesser in price. Nutritional constituent which is the amount of nutrient available and that can be used by the body of the consumer. The other determinants are availability of meat products, quality, taste and flavour, odour and level of packaging. The response of respondents are given in a table below.

TABLE 4.6: DETERMINANTS FACTORS FOR TYPE OF MEAT PRODUCT TO BE PURCHASED

VARAIBLE	RESPONSE	PERCENTAGE	PERCENT OF CASES
Affordability	127	20.7%	50.8%
Nutritional constituent	70	11.4%	28.0%
Availability	94	15.3%	37.6%
Quality	79	12.8%	31.6%
Taśte and flavor	144	23.4%	57.6%
Odour	35	5.7%	14.0%
Packaging	66	10.7%	26.4%
Total	615	100	246

4.8 RESPONSES TO STATEMENT FACTORS INFLUENCING CHOICE OF ACCEPTABILITY OF PROCESSED MEAT PRODUCTS AND WILLINGNESS TO PAY FOR THE PRODUCTS

The table below 4.7 shows the responses of the respondents based on the question asked to check their perception and what influences their decision to buy processed meat products. These statements is just check perception and views of respondents towards what influences choice of acceptability and willingness to pay for meat products.

TABLE 4.7: RESPONSES TO STATEMENT AND FACTORS INFLUENCING CHOICE OF MEAT CONSUMPTION

Statement	A	U	D	Respondents	Total scores	Mean scores	Remarks
The taste is better than the boiled meat	221	50	4	250	717	2.87	Agreed
It enhances storage of meat for a period of time	199	39	12	250	687	2.75	Agreed
It is a means of changing the look of meat products	217	23	10	250	707	2.83	Agreed
It enhances market acceptability	200	36	14	250	686	2.74	Agreed
It enhances the shelf-life of meat	202	38	10	250	692	2.76	Agreed
It enhances value addition	197	4	49	250	737	2.95	Agreed
It improves the economic values of meat product	201	36	13	250	688	2.75	Agreed
It exposes the people to different value added meat products	219	27	4	250	715	2.86	Agreed
It boost self-esteem of the people in the community	96	94	69	250	536	2.1	Agreed
It improves the quality of the processed meat products	195	41	14	250	681	2.72	Agreed
The affordability of the processed meat products	165	59	26	250	639	2.56	Agreed
Proximity to source of production of processed meat	146	76	28	250	618	2.5	Agreed
The market demand of processed meat products	147	69	34	250	613	2.5	Agreed
The odour of the processed meat products	178	47	25	250	653	2.61	Agreed
The products are readily Available	167	49	34	250	633	2.5	Agreed
Does cultural background affect your consumption?	66	36	148	250	414	1.65	Disagreed
Does religious background affect your consumption?	46	36	168	250	378	1.51	Disagreed
Does your level of awareness affect your consumption?	122	32	96	250	526	2.1	Agreed
Does your social association influence your consumption?	53	51	146	250	407	1.63	Disagreed

4.9 CHI SQUARE ANALYSIS TABLE OF ASSOCIATION FOR CONSUMPTION OF MEAT PRODUCTS

- **TABLE 4.8: TABLE OF STATUS BY CONSUMPTION OF KILICHI**

	Self employed		student		Civil Servant		Total yes	Total no
	Yes	No	yes	no	Yes	No		
Frequency	65	7	67	25	43	13	175	45
percentage	29.55	3.18	30.45	11.36	19.55	5.91	79.55	20.45

Chi square probability 0.02

The Chi square analysis for consumption of kilichi shows that there is no association between the status (students, Civil servants and self-employed) and if kilichi as been tasted before.

- **TABLE 4.9: TABLE OF STATUS BY CONSUMPTION OF SUYA**

STATUS (STATUS) TASTED SUYA

	Self employed		student		Civil Servant		Total yes	Total no
	yes	No	Yes	no	Yes	No		
Frequency	71	1	92	0	54	2	217	3
percentage	32.7	0.45	41.82	0	24.55	0.91	98.64	1.36

Chi square probability 0.19

The Chi square analysis for consumption of suya shows that there is no association between the status (students, Civil servants and self-employed) and if suya as been tasted before.

- **TABLE 4.10: TABLE OF STATUS BY CONSUMPTION OF BALANGU**

STATUS (STATUS) TASTED BALANGU

	Self employed		student		Civil Servant		Total yes	Total no
	yes	No	yes	no	Yes	No		
Frequency	46	26	27	65	33	23	106	113
percentage	20.91	11.81	12.27	29.55	15.00	10.45	48.18	51.82

Chi square probability < .0001

The Chi square analysis for consumption of balangu shows that there is an association between the status (students, Civil servants and self-employed) and if balangu has been tasted before.

4.10 TEST OF ASSOCIATION BETWEEN FACTORS (STATUS AND INCOME LEVEL) WITH ATTRIBUTES

THESE ATRRIBUTES ARE;

- FLAVOUR
- COLOUR
- TEXTURE

THE FACTORS

- STATUS (STUDENTS, SELF EMPLOYED, CIVIL SERVANTS)
- INCOME

NOTE

SCALE

9-Extremely Acceptable

8-Very Acceptable

7-Moderately Acceptable

6-Slightly Acceptable

5-Neither Acceptable nor Unacceptable

4-Slightly Unacceptable

3-Moderately Unacceptable

2-Very Unacceptable

1-Extremely Unacceptable

0-No Rating

CHI SQUARE PROBABILITY.

< 0.05- Significant (There is an association)

<0.01- Very Significant (There is an association)

<0.001- Highly Significant (There is an association)

TABLE 4.11: TEST OF ASSOCIATION FOR STATUS AND FLAVOUR OF THE THREE MEAT PRODUCTS

TABLE OF STATUS BY FLAVOR SUYA

	0		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%
STUDENTS	2	0.92	3	1.38	18	8.26	25	11.47	19	8.72	27	12.39
SELF EMPLOYED	0	0	2	0.92	17	7.80	14	6.42	25	11.47	13	5.96
CIVIL SERVANTS	2	0.92	2	0.92	11	5.05	10	4.59	18	8.26	12	5.50
TOTAL	4	0.92	7	3.21	46	21.10	49	22.48	62	28.44	52	23.85

CHI SQUARE PROBABILITY- 0.1905 (not significant)

The Chi square analysis for flavour as an attribute of suya shows that there is no association between the status (students, Civil servants and self-employed) and the attribute

TABLE 4.12: TABLE OF STATUS BY FLAVOR KILICHI

	0		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	25	11.36	2	0.91	0	0	0	0	4	1.82	7	3.18	17	7.73	22	10	15	6.82
SELF EMP	8	3.64	1	0.45	1	0.45	0	0	2	0.91	7	3.18	12	5.45	30	13.64	11	5
CIV SER	13	5.91	0	0	0	0	1	0.45	0	0	4	1.82	13	5.91	15	6.82	10	4.55
TOTAL	46	20.91	3	1.36	1	0.45	1	0.45	6	2.73	18	8.18	42	19.09	67	30.45	36	16.36

CHI SQUARE PROBABILITY- 0.1479 (not significant)

The Chi square analysis for flavour as an attribute of Kilichi shows that there is no association between the status (students, Civil servants and self-employed) and the attribute.

TABLE 4.13: TABLE OF STATUS BY FLAVOR BALANGU

	0		1		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	63	28.64	2	0.91	0	0	1	0.45	0	0	2	0.91	6	2.73	4	1.82	6	2.73	8	3.64
SELF EMP	26	11.82	0	0	1	0.45	1	0.45	1	0.45	2	0.91	7	3.18	17	7.73	10	4.55	7	3.18
CIV SER	23	10.45	1	0.45	0	0	0	0	1	0.45	2	0.91	6	2.73	7	3.18	9	4.09	7	3.18
TOTAL	112	50.91	3	1.36	1	0.45	2	0.91	2	0.91	6	2.73	19	8.64	28	12.73	25	11.36	22	10

CHI SQUARE PROBABILITY- 0.0203 (significant)

The Chi square analysis for flavour as an attribute of balangu shows that there is an association between the status (students, Civil servants and self-employed) and the attribute

TABLE 4.14: TABLE OF STATUS BY TEXTURE SUYA

	0		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	0	0	1	0.45	3	1.36	3	1.36	16	7.27	29	13.18	20	9.09	20	9.09
SELF EMP	0	0	2	0.91	4	1.82	4	1.82	12	5.45	12	5.45	24	10.91	14	6.36
CIV SER	2	0.91	0	0	0	0	1	0.91	7	3.18	15	6.82	17	7.73	14	6.36
TOTAL	2	0.91	3	1.36	7	3.18	8	3.64	35	15.91	56	25.45	61	27.73	48	21.82

CHI SQUARE PROBABILITY- 0.1733 (not significant)

The Chi square analysis for Texture as an attribute of suya shows that there is no association between the status (students, Civil servants and self-employed) and the attribute

TABLE 4.15: TABLE OF STATUS BY TEXTURE KILICHI

	0		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	25	11.36	0	0	1	0.45	4	1.82	7	3.18	8	3.64	19	8.64	14	6.36	14	6.36
SELF EMP	8	3.64	1	0.45	0	0	2	0.91	6	2.73	13	5.91	17	7.73	11	5	14	6.36
CIV SER	13	5.91	0	0	0	0	0	0	5	2.27	6	2.73	10	4.55	14	6.36	8	3.64
TOTAL	46	20.91	1	0.45	1	0.45	6	2.73	18	8.18	27	12.27	46	20.91	39	17.73	36	16.36

CHI SQUARE PROBABILITY- 0.3522 (Not significant)

The Chi square analysis for Texture as an attribute of Kilichi shows that there is no association between the status (students, Civil servants and self-employed) and the attribute.

TABLE 4.16: TABLE OF STATUS BY TEXTURE BALANGU

	0		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	63	28.64	1	0.45	2	0.91	3	1.36	3	1.36	7	3.18	9	4.09	4	1.82	0	0
SELF EMP	27	12.27	0	0	2	0.91	2	0.91	9	4.09	18	8.18	8	3.64	5	2.27	1	0.45
CIV SER	23	10.45	0	0	0	0	0	0	7	3.18	13	5.91	8	3.64	5	2.27	0	0
TOTAL	113	51.36	1	0.45	4	1.82	5	2.27	19	8.64	38	17.27	25	11.36	14	6.36	1	0.45

CHI SQUARE PROBABILITY- 0.0117 (significant)

The Chi square analysis for Texture as an attribute of Balangu shows that there is an association between the status (students, Civil servants and self employed) and the attribute

TABLE 4.17: TABLE OF STATUS BY APPEARANCE SUYA

	0		1		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	0	0	1	0.46	1	0.46	2	0.91	2	0.91	19	8.68	21	9.59	27	12.33	18	8.22
Self EMP	0	0	0	0	1	0.46	1	0.46	1	0.46	14	6.39	21	9.59	21	9.59	13	5.94
CIV SER	2	0.91	0	0	0	0	1	0.46	0	0	1	0.46	17	7.76	23	10.50	12	5.48
TOTAL	2	0.91	1	0.46	2	0.91	4	1.83	3	1.37	34	15.53	59	26.94	71	32.42	43	19.63

CHI SQUARE PROBABILITY- 0.1664 (Not significant)

The Chi square analysis for appearance as an attribute of suya shows that there is no association between the status (students, Civil servants and self employed) and the attribute

TABLE 4.18: TABLE OF STATUS BY APPEARANCE KILICHI

	0		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	25	11.36	2	0.91	0	0	2	0.91	4	1.82	6	2.73	17	7.73	23	10.45	13	5.91
SELF EMP	8	3.64	0	0	1	0.45	1	0.45	4	1.82	5	2.27	20	9.09	25	11.36	8	3.64
CIV SER	13	5.91	0	0	1	0.45	0	0	0	0	5	2.27	17	7.73	15	6.82	5	6.82
TOTAL	46	20.91	2	0.91	2	0.91	3	1.36	8	3.64	16	7.27	54	24.55	63	28.64	26	11.82

CHI SQUARE PROBABILITY- 0.2918 (Not significant)

The Chi square analysis for appearance as an attribute of Kilichi shows that there is no association between the status (students, Civil servants and self-employed) and the attribute

TABLE 4.19: TABLE OF STATUS BY APPEARANCE BALANGU

	0		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
STDNTS	64	28.64	1	0.45	1	0.45	0	0.45	4	1.82	5	2.27	5	2.27	7	3.18	5	2.27
SELF EMP	27	12.27	1	0.45	0	0	1	0.45	1	0.45	12	5.45	12	5.45	9	4.09	9	4.09
CIV SER	23	10.45	0	0	0	0	3	1.36	0	0	4	1.82	10	4.55	8	3.64	8	3.64
TOTAL	114	51.82	2	0.91	1	0.45	4	1.82	5	2.27	21	9.55	27	12.27	24	10.91	22	10

CHI SQUARE PROBABILITY- 0.0017 (Highly Significant)

The Chi square analysis for appearance as an attribute of Balangu shows that there is no association between the status (students, Civil servants and self employed) and the attribute .

TABLE 4.20: TABLE OF STATUS BY CRISPINESS SUYA

	0		1		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
SELF EMP	1	0.45	1	0.45	1	0.45	2	0.91	7	3.18	12	5.45	19	8.64	13	5.91	10	4.55	6	2.73
CIV SERV	2	0.91	2	0.91	1	0.45	10	4.55	5	2.27	6	2.73	8	3.64	6	2.73	10	4.55	6	2.73
STUDNTS	1	0.45	4	1.82	2	0.91	3	1.36	3	1.36	12	5.45	18	8.18	25	11.36	15	6.82	9	4.09
TOTAL	4	1.82	4	1.82	15	6.82	15	6.82	15	6.82	30	13.64	45	20.45	44	20	35	15.91	21	9.55

CHI SQUARE PROBABILITY- 0.0685 (Not significant)

The Chi square analysis for crispiness as an attribute of suya shows that there is no association between the status (students, Civil servants and self employed) and the attribute

TABLE 4.21: TABLE OF STATUS BY CRISPINES KILICHI

	0		1		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
SELF EMP	8	3.64	2	0.91	1	0.45	1	0.45	1	0.45	6	2.73	13	5.91	9	4.09	19	8.64	12	5.45
CIV SERV	13	5.91	1	0.45	0	0	4	1.82	1	0.45	4	1.82	5	2.27	12	5.45	8	3.64	8	3.64
STUDNTS	25	11.36	1	0.45	1	0.45	2	0.91	0	0	4	1.82	8	3.64	16	7.27	16	7.27	19	8.64
TOTAL	46	20.91	4	1.82	2	0.91	7	3.18	2	0.91	14	6.36	26	11.82	37	16.82	43	19.55	39	17.73

CHI SQUARE PROBABILITY- 0.2532

The Chi square analysis for crispiness as an attribute of kilichi shows that there is no association between the status (students, Civil servants and self employed) and the attribute

TABLE 4.22: TABLE OF STATUS BY CRISPINES BALANGU

	0		1		2		3		4		5		6		7		8		9	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
SELF EMP	26	11.82	0	0	1	0.45	2	0.91	5	2.27	4	1.82	6	2.73	17	7.73	8	3.64	3	1.36
CIV SERV	23	10.45	0	0	1	0.45	1	0.45	4	1.82	3	1.36	5	2.27	8	3.64	5	2.27	6	2.73
STUDNTS	63	28.64	2	0.91	1	0.45	0	0.45	6	2.73	3	1.36	4	1.82	3	1.36	6	2.73	4	1.82
TOTAL	112	50.91	2	0.91	3	1.36	3	1.36	15	6.82	10	4.55	15	6.82	28	12.73	19	8.64	13	5.91

CHI SQUARE PROBABILITY- 0.0116

The Chi square analysis for crispiness as an attribute of suya shows that there is an association between the status (students, Civil servants and self employed) and the attribute

4.11 OVERALL RANKING AND PREFERNCE

The result for each meat products shows their level of acceptability and preference for each of the products.

4.11.1 SUYA

About 50.8% of the total population said suya is the best ranked ie. It was ranked as the first while 35.6% of the population placed suya individually as 2nd, about 12.8% placed suya as 3rd and about 1.2% said they haven't tatsed suya before.

4.11.2 KILICHI

About 32.8% of the total population said kilichi is the best ranked, while 36% of the population placed suya individually as 2nd, about 12.8% placed kilichi as 3rd and about 18.4% said they haven't tasted suya before.

4.11.3 BALANGU

Majority of individuals within the population responded that they haven't tasted the meat product before. The population is around 45.2%, the meat product came as the most preferred (1st) by on 15.2% of the population while coming in 2nd Place from on 12.4% of the population with the rest of the population which is about 27.2% ranking the meat product as the 3rd.

From the data suya is a meat product well know and more acceptable to the population than the other meat products. About 51% of the population said suya is the most preferred meat produced followed by 33% of kilichi and the rest clinging to balangu within the community.

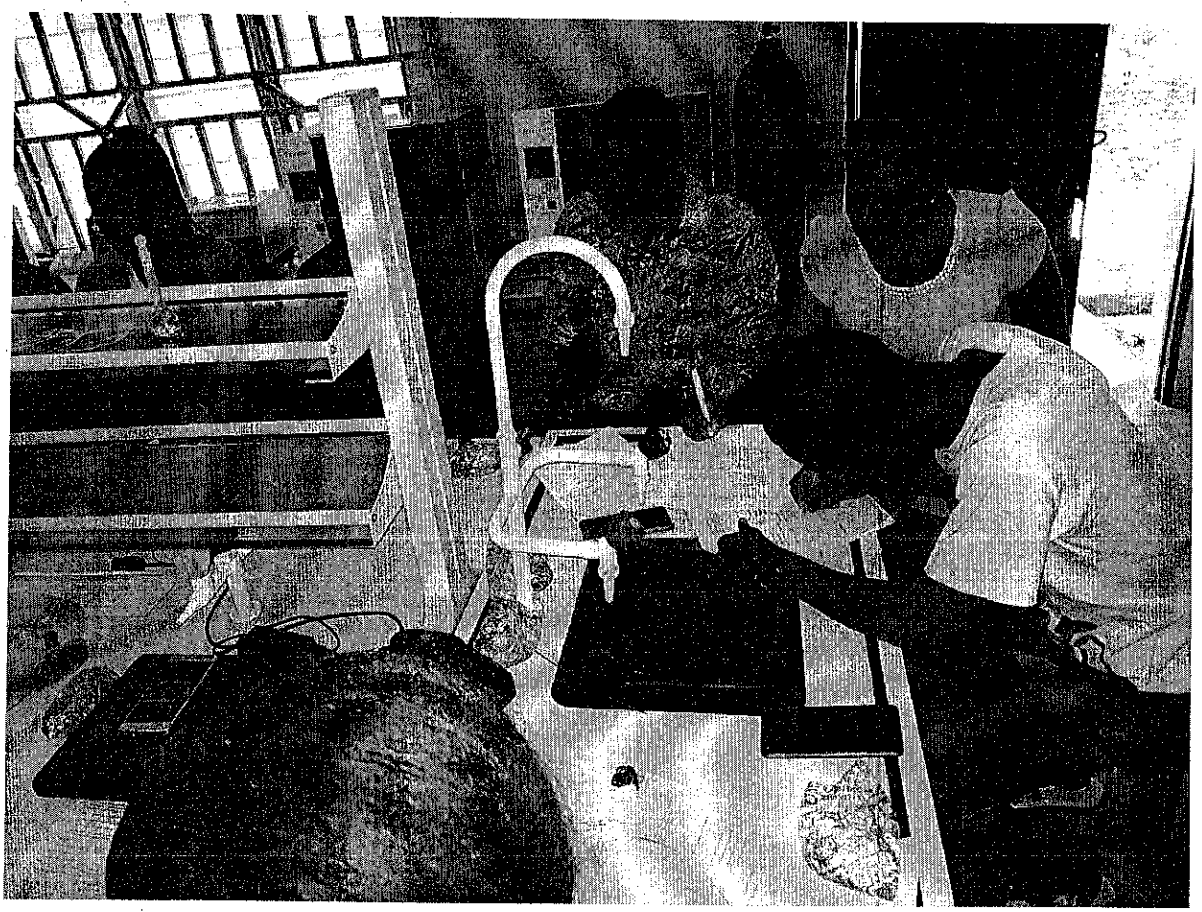
Apart from the fact that balangu was the meat less consumed, it is also the meat that has not been consumed the most by the population.

The results is presented in tables below;

TABLE 4.23: OVERALL ACCEPTABILITY SUMMARY

RANKING	BALANGU FREQ	BALANGU %	KILICHI FREQ	KILICHI %	SUYA FREQ	SUYA % FREQ
NOT TASTED	113	45.2	46	18.4	3	1.2
FIRST	38	15.2	82	32.8	127	50.8
SECOND	31	12.4	90	36	89	35.6
THIRD	68	27.2	32	12.8	32	12.8
TOTAL	250	100	250	100	250	100

Figure 9: Cross section of Sensory Panelist



CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 SUMMMARY

This Study determines the perception of individuals about processed meat products and what influences them in consuming the meat. Results from the data collection shows that the meat product suya is the most preferred among the three. This is due to the level of availability, and the level to which it is readily available and also well known among the members of the community. The meat product balangu was the least preferred and this is because it is not as available in the market as the other meat products and the individuals in the community are not aware of either the existence of the availability.

Factors such as belonging to one social association contributed only little to influencing individuals to consuming the meat product. Majority of the individuals are aware of the availability of the meat products in their surroundings but level of consumption of raw meat and processed meat differs.

The availability of other processed meat products too or other foods products such as asun, pepper soup and others has contributed to the reduction in the consumption patter of suya, kilichi and balangu as sometimes individulas within the community prefer to consume products like pepper soup, asun rather than consume suya and others.

Majority of the individuals from the community also acknowledge the fact that they rather buy the processed meat products as chops rather than buy them as proper processed meat to be consumed at home. The consumption of suya, kilichi, balangu as chop is a reason for its low consumption because the individuals only buy them when they go out for fun fair rather than buy them home to serve as another source of meat.

From the data collected factors like taste, freshness and quality are considered by individuals the most before buying the processed meat while determinants like taste and flavour , quality and affordability may determine if the products are going to be purchase.

Points of purchase from the results were observed that trusted restaurant and supermarket are the major points where individuals get their processed meats. Hawkers and car parks are places where individuals do not pay attention or do not buy a lot of their processed meat products.

5.2 RECOMENDATION

From the observed data it is recommended that;

There should be more production of kilichi and balangu with more availability to the market. The low production and scarcity has limited individuals in purchasing and having access to the meat products,

There should be proper processing to conserve the quality of the and shelf life of the meat products, this is to endure the meat products last for a longer and they can be more available to the market

Individuals should also be made to understand the nutritional importance of these meat products and also that some e.g. the balangu can serve an alternative major meat source to the family and the home instead of the raw meat.

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APPENDIX

APPENDIX: STUDY QUESTIONAIRE

DEPARTMENT OF ANIMAL PRODUCTION AND HEALTH

FEDERAL UNIVERSITY OYE EKITI, EKITI STATE. NIGERIA.

FEDERAL UNIVERSITY OYE EKITI
FACULTY OF AGRICULTURE,
DEPARTMENT OF ANIMAL PRODUCTION AND HEALTH

Questionnaire on quality assessment and acceptability of processed meat products in IkoleEkiti.

Dear Sir/Ma,
This is a research questionnaire aimed at collecting vital information about the effects of infrastructural development on rural household's livelihood in southwest Nigeria. It is strictly for academic purpose. Please respond honestly, as the confidentiality of your response will be highly guaranteed.

Olaleye Oluwatosin (Asc/13/0971)

Thank you

Please tick as appropriate.

Status : Student [ ], Self Employed [ ], Civil Servant [ ]
Income Level : Low income [ ], Average income [ ], High Income [ ].

1. Sex: (a) Male (b) Female
2. Age: ..... (Years)
3. Marital status: (a) Single, (b) Married, (c) Divorced, (d) Widow, (e) Separated
4. What is your household size?.....
5. What is your religion? a) Christianity b) Muslim c) African Traditional Religion
6. State your level of education (a) No formal education (b)Non-formal education (c) Primary education(d) Secondary education (e) Tertiary education (e) Others (Pls. specify) .....
7. What is your primary occupation? (a) Farming (b) Fishing (c) Trading (d) Artisan (e) Civil servant (f) Others (please specify) .....
8. What is your secondary occupation or other source of income? .....

9. Are you a member of any social association? (a) Yes (b) No
10. What is the name of the association? .....

11. What are the benefits derived from the association? (a) Credits facilities (b) subsidized agricultural inputs (c) sales of agricultural produce (d) others (please specify) .....
12. What is your annual income? ₦.....

Awareness of the processed meat products in the study area

13. Are you aware of the processed meat products available in your community? (a) Yes (b) No
14. What are the processed meat products available in your community? (a) Suya (b) Kilichi(c) Balangu (d) Meat pie (d) Pepper soup (e) Stickmeat (f) Asun (g) Others .....
15. What are the kinds of processed meat consumed by you? (a) Suya (b) Kilichi (c) Balangu (d) Meat pie (d) Pepper soup (
e) Stick meat (f) Asun (g) Others (Please specify) .....
16.What is your most preferred processed meat product? (a) Suya (b) Kilichi (c) Balanga (d) Stick meat (e) pepper soup (f) asun (g) meat pie (h) Others .....
17. Do you pay for the processed meat products consumed by you? (a) Yes (b) No
18. What do you look out for in purchasing processed meat products? (a) Price (b) Income (c) Taste (d) Freshness (e) flavour (f)quality (g) Others .....
19. What is the point of purchase of the processed meat products? (a)trusted restaurant (b) hawker (c) market (d) supermarket (e) car park (f) Others.....
20. What was the quantity of processed meat products purchase? (a) 1kg (b) 2kg (c) 5 kg (d) > 5kg
21. How much did you buy it? (₦) .....
23. How much do you prefer this product to be sold? (a) 1kg (₦) ..... (b) 2kg (₦) .....
(c) 5kg (₦) ..... (d) > 5kg (₦) .....
24. Do the processed meat products purchase has label (a) Yes (b) No
25. What determines the kind of processed meat products eaten by you? (a) affordability (b) nutritional constituent (c) availability (d) quality (e) taste and flavour (f) odour (g) packaging (h) Others.....

Factors influencing your choice of acceptability of processed meat products and willingness to pay for the products

Influential Statement	Agree	Undecided	Disagree
The taste is better than the unprocessed meat			
It enhances storage of meat for a period of time			
It is a means of changing the look of meat products			
It enhances market acceptability			
It enhances the shelf-life of meat			
It enhances value addition			
It improves the economic values of meat product			
It exposes the people to different value added meat products			
It boost self-esteem of the people in the community			

GENERAL COMMENT: