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BEEF AND CAMEL MEAT '*KILISHI*'PRESERVATION WITH NATURAL OILS TOWARDS SUSTAINABLE DEVELOPMENT IN AFRICA

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ABSTRACT

The study was conducted at Department of Animal Science, Bayero University, Kano in Nigeria to assess the effect of garlic and cinnamon oils on fatty acid composition of stored beef and camel meat *Kilishi*. Meat from the *Longissimus dorsi* of the hind limb of camel and bull were used for the experiment. *Kilishi* produced from each species was grouped into four parts of 2kg each and treated with garlic, cinnamon, combination of garlic and cinnamon oils (1:1) and control. The products were packed in a brown paper and stored at room temperature from March to September, 2012. Gas Chromatography and Mass Spectrometry (GC-MS) was used to determine fatty acids and organic compound present in the stored *Kilishi*. The result showed no difference among the four treatments and fatty acids identified were Myristic, Pentadecanoic, Palmitic, Stearic, Linoleic and Trans-13-Docosecanoic. Linoleic was present in all the treatments and its concentration ranged between 20.87% and 32.68% compared to others that ranged between 5.92% and 10.32%. The hydrocarbons present were straight chained and include decane, undecane, dodecane, benzene, tridecane, tetradecane, pentadecane, hexadecane, heptadecane, cyclodecane, octane and heptanes It was concluded that addition of garlic and cinnamon oils had no effect on the fatty acid composition of the stored *Kilishi*. It was recommended that garlic and cinnamon oils should be used to extend the shelf life of *Kilishi* during storage.

Keywords: Kilishi, Meat, Longissimus dorsi, Garlic Oil, Cinnamon Oil, Fatty Acids, Room Temperature, Nigeria

INTRODUCTION

The increasing preference for natural preservatives has obliged its inclusion in various meat products to delay oxidative degradation of lipids, improve quality, its nutritional value. and replace synthetic antioxidants (Fasseas *et al*., 2007; Wojdylo *et al*., 2007; Camo *et al.*, 2008). Including garlic and cinnamon oils in the diet has beneficial effects on human health because they protect the biologically important cellular components, such as DNA, proteins, and membrane lipids, from reactive oxygen species (ROS) attacks (Su *et al*., 2007). Synthetic antioxidants have been used to retard or minimize oxidative deterioration of foods, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and tertiary butyl hydroquinone (TBHQ) (Fasseas *et al.*, 2007).

Recently, consumers have rejected synthetic antioxidants because of their carcinogenicity (Altmann *et al.*, 1986; Van Esch, 1986). Many herbs, spices, and their extracts have been added in a variety of foods to improve their sensory characteristics and extend shelf-life (Shahidi *et al*.,1992). Herbs of the Lamiaceae family, mainly oregano (*Origanum vulgare* L.), rosemary (*Rosmarinus officinalis* L.), and sage (*Salvia officinalis* L.), have been reported as having significant antioxidant capacity (Shan *et al*., 2005; Wojdylo *et al*., 2007).

Natural antioxidants are various substances with different chemical characteristics, which are widely present in plants. Antioxidants retard or inhibit oxidation of other substances by inhibiting the initiation or propagation of oxidizing chain reactions (Velioglu *et al*., 1998).

> *The contribution of meat and meat products to food supplies in developing countries is increasing at a higher rate . The total meat production in developing countries rose from 30 million tonnes in 1970 to 69 million tonnes in 1990, and it is projected to reach 105 million tonnes in the year 2000 and 143 million tonnes in 2010, and is expected to rise again in 2020. Developing countries now account for almost half of the total world meat production (FAO, 1994a; FAO, 1994b). Demand for livestock products will continue to rise in developing countries as a result of their rapidly expanding populations and the tendency towards higher incomes in most of these countries.*
>
> *In contrast to developed countries, where the high consumer intake of livestock products has contributed to health problems, the predicted increase in consumption patterns in developing countries over the next few years will be beneficial to the nutritional and health status of the majority of their populations (FAO, 1990; FAO, 1993). Meat and its products provide essential amino acids, minerals and vitamins in a concentrated form, and their fat content can also supply much needed calories. Meat is particulary important in the diets of young children and pregnant women because of its high protein and iron content. In spite of the increasing levels of livestock production in most developing countries, the proportion of meat in the diet of the average consumer remains rather low. This is mainly because the human population grows almost as fast as that of livestock (in Africa it grows even faster), but also because meat is scarce in many places and its cost is comparatively high.*

> *Cost limits the consumption of livestock products. In many developing countries, the average daily income is equivalent to the price of 1 kg of meat. It is therefore not surprising that many consumers can only occasionally afford meat and its products and they are consequently not part of the everyday diet. The average annual per caput consumption of meat is 20 kg, compared with 80 kg in developed countries (FAO, 1993; FAO, 1994d). The latter is calculated on the basis of carcasses (with bones) and edible offal. In the poorest countries, the annual rate of meat consumption per caput is as low as 5 kg. In actual fact, the consumption patterns of most populations are probably even less, since the average figures also include the higher income groups with atypically high consumption. It is therefore clear that a greater consumption of livestock products would be highly desirable towards sustainable development in Africa.*

Kilishi is a popular, traditionally processed ready to eat Nigerian meat product, originally produced from beef and later extended to other ruminant animals. Exploitation of all avenues of meat preservation has been suggested towards meeting the animal protein requirement of the increasing African population (Omojola., 2008). It is a tropical low moisture meat product that is prepared essentially from beef slices, infused in slurry of defatted groundnut paste and spices and sundried (Idowu *et al*., 2010). The ability of *Kilishi* to keep for several months at room temperature is fast making it a house-hold name in Nigeria and Africa as a whole Leistner (1987). *Kilishi* production and storage under conditions free of microbial contamination has been seen as a process usually difficult to achieve in Africa. This is due to the nutrient content of the product which attracts agents of microbiological spoilage and pest (Igene and Akanbi, 1990). Salting, dehydration and packaging are applied in sequence to inhibit deterioration of *Kilishi* caused by microorganisms (Biscontini *et al*., 1996). The increased production and consumption of *Kilishi* makes it imperative to conduct research on quality attribute of *Kilishi* stored in different conditions at room temperature.

The objective of this study was to discuss effect of garlic and cinnamon oils on fatty acid composition of stored beef and camel meat '*kilishi'*.

MATERIALS AND METHOD

'*Kilishi'* Production Methods

Raw meat samples were collected from the metropolitan abattoir in Kano**.** The meat samples collected were from the *Longissimus dorsi* of the hind limb of two different species Cattle and Camel.

Table 1: Composition of Ingredients Used for Slurry (G/Kg)

English Names	Scientific Names	% Composition
Groundnut cake	*Arachis hypogeal*	350
Red pepper	*Capsicum frutescens*	40
Black pepper	*Piper guinease*	11
Cloves	*Eugenia caryophyllata*	5
Ginger	*Zingiber officinale*	24
Alligator pepper	*Afromomum*	5
	Meleginata	
Onion	*Allium cepa*	120
Big pepper	*Capsicum esculentum*	45
Thyme seasoning	*Fagara xanthoxyloides*	5
Salt	*Sodium chloride*	15
Magi seasoning	*Sodium glutamate*	20
Decorticated g. nut		60
Seed		
Water		300

Source: Muhammad and Muhammad, (2007)

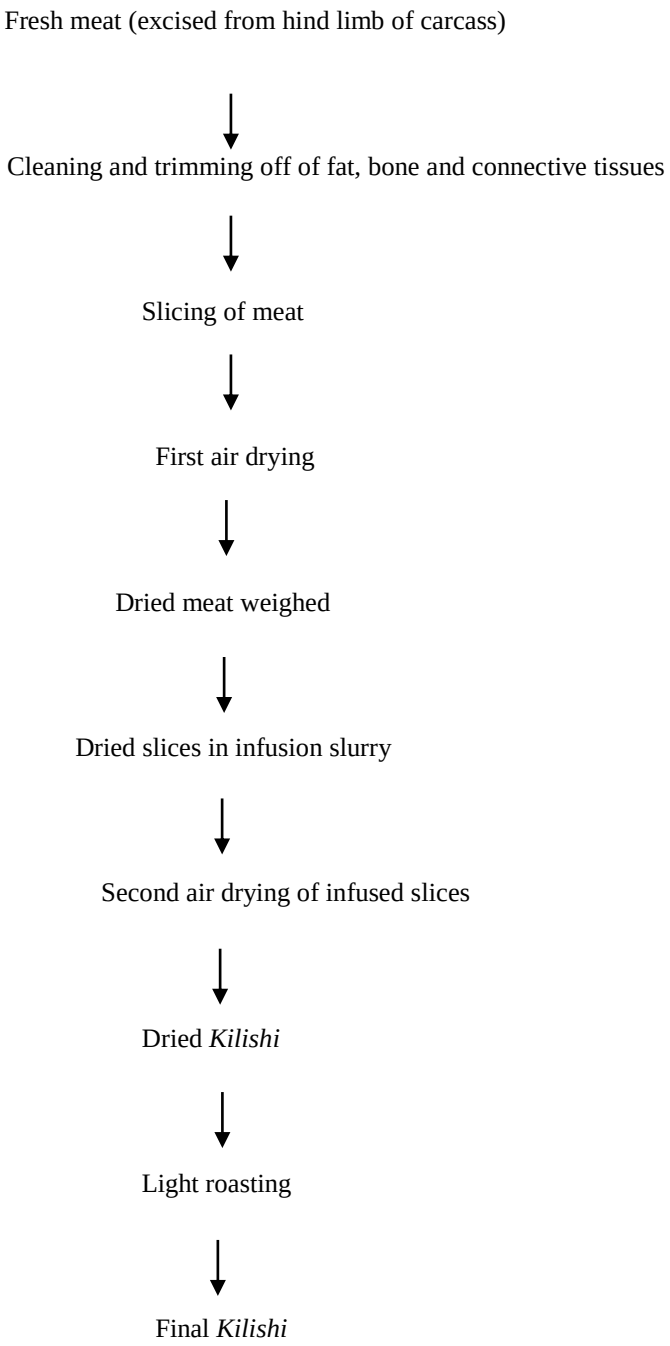

Figure 1**.** The flow chart summarizing *Kilishi* production process (Abubakar *et al*., 2011).

8kg of sample of *Kilishi* processed from each of the species was collected. Cinnamon and garlic oils were added at the rate of 10ml/kg. Garlic (T1), cinnamon (T2), garlic-cinnamon in ratio 1:1 (T3) and untreated products were used as T4. The treatments were replicated three times.

Fatty Acid Analysis

The fatty Acid Analysis was conducted using (GCMS- QP2010 PLUS, SHIMADZU, JAPAN). to outline the Fatty Acid profile. The machine consists of shimadzu GC-17 chromatograph, a shimadzu QP2010 mass spectrometer and a glass-5000 data system. Compounds were separated on a 30m x 0.25 mm i.d. DB-1 capillary column coated with a 0.25um film of dimethyl polysiloxane (100%). The initial column oven temperature was 70^{o}C and held for two minutes after injection then programmed at 10^{o}Cmin^{-1} to 280^{o}C and held for 8 minutes. Split ratio 20:0, the flow-rate was 1.8mL/min, helium was used as the carrier gas and spectrometer conditions were: interface temperature, 250^{o}C; ionization mode, EI^{+} ; electron energy, 70eV; full scan acquisition mode; mass range, 33-450 amu. Compound were identified by using NIST-library, spectra and published MS data.

Experimental Design and Statistical Analyses

The experiment was laid in a 2x2x4 factorial arrangement in a Completely Randomized Design (CRD). The factors were two species (cattle and camel), two forms (raw meat and *Kilishi*) and four treatments (garlic 10ml/kg, cinnamon 10ml/kg, garlic/cinnamon 10ml/kg and control).

RESULTS

Fatty Acid Composition of *Kilishi*

Table 2 shows the area percentage concentration of organic compounds identified by GC-MS in stored beef and camel meat *Kilishi* treated with garlic, cinnamon and combination of garlic and cinnamon oils and control. Saturated fatty acids (SFA): Palmitic, Pentadecanoic, and Stearic acids were common in both camel meat *Kilishi* treated with natural oils and camel meat *Kilishi* without treatment. Linoleic is the only unsaturated fatty acid identified in both treated and untreated camel meat *Kilishi*.

Also in beef *Kilishi*, the SFA: Palmitic, Pentadecanoic and Stearic acids were all found in treated and untreated *Kilishi* except in beef *Kilishi* treated with garlic oil that has Myristic acid in place of Stearic aid. Two types of unsaturated fatty acids Linoleic and Trans-13-Docosecanoic acids were detected in beef *Kilishi* with treatment. Linoleic acid is common to both treated and untreated *Kilishi* but Trans-13-Docsecanoic acid was only found in beef *Kilishi* treated with both garlic and cinnamon oils combination. Comparing camel and beef *Kilishi* treated and untreated with garlic and cinnamon oils, the same types of SFA were common to both while only one unsaturated fatty acid (UFA): Linoleic acid was recorded on camel meat *Kilishi* but two UFA: Linoleic and Trans-13-Docosecanoic acid were found in beef *Kilishi*.

Linoleic was present in all the treatments and its concentration ranged between 20.87% and 32.68% compared to others that ranged between 5.92% and 10.32%. The hydrocarbons were straight chained and include decane, undecane, dodecane, benzene, tridecane, tetradecane, pentadecane, hexadecane, heptadecane, cyclodecane, octane and heptanes as shown in table 3.

DISCUSSION

Hamilton (2008), reported Lauric, Myristic, Stearic, Palmitic as the main saturated fatty acids in meat. The unsaturated fatty acids include Myristoleic, Palmitoleic, Spienic, and Oleic acid. The highest concentration of unsaturated fatty acid (linoleic) recorded in all the treatments is considered to be positive from nutritional point of view (French *et al.*,2000). Thus, the stored beef and camel meat *Kilishi* were healthy for consumption. The unsaturated fats are considered healthiest dietary fats because dietary saturated fatty acids elevate serum cholesterol concentrations, whereas unsaturated fatty acids reduce serum cholesterol concentrations (de Almeida *et al.*, 2006). Therefore, the knowledge concerning the exact fatty acid composition of meat is extremely important for the consumers and processing sector. High concentration of hydrocarbons found in the *Kilishi* may be as a result of its roasting during production. Hamid and Ranjbar, (2012) reported that camel meat has other medical qualities like protecting against cancerous tumors because it contains unsaturated fatty acids like linoleic acid which interact with other unsaturated fatty acids taken from vegetable oils to protect against cancer.

Conclusively, fatty acid composition showed no difference among the four treatments. Haven recorded highest concentration of unsaturated fatty acid (linoleic) in all the treatments which are associated with lowering low density lipoprotein (LDL) cholesterol, total cholesterol and at the same time increasing the production of the "good" cholesterol, high density lipoprotein (HDL) cholesterol in the body. Therefore, stored beef and camel meat Kilishi treated with cinnamon and garlic oils were considered to be positive from nutritional point of view for sustainable development in Africa and this will reduce the risk of heart diseases among Africans.

Table 2: GC-MS Calculated Fatty Acid Percentage Area Concentration of Beef and Camel Meat *Kilishi* Treated with Garlic, Cinnamon and Combination of Garlic and Cinnamon Oils.

	BEEF (CONTENT %)				**CAMEL (CONTENT %)**			
Fatty Acids	**Garlic**	**Cinnamon**	**Garlic + Cinnamon**	**Control**	**Garlic**	**Cinnamon**	**Garlic + Cinnamon**	**Control**
Myristic ($C_{14:0}$)	6.86	NA	NA	NA	NA	NA	NA	NA
Peutadecanoic ($C_{15:0}$)	6.86	6.16	6.57	10.32	5.92	8.40	8.96	6.57
Palmitic ($C_{16:0}$)	6.86	6.16	6.57	10.32	5.92	8.40	8.96	6.57
Stearic ($C_{18:0}$)	NA	6.16	6.57	10.32	5.92	NA	NA	6.57
Linoleic ($C_{18:2}$)	30.67	21.07	26.45	32.68	20.87	30.62	29.15	22.13
Trans-13-Docosecanoic($C_{20:0}$)	NA	NA	2.01	NA	NA	NA	NA	NA

N.A- Not Available

Table 3: GC-MS Calculated Hydrocarbons Percentage Area Concentration of Beef and Camel Meat *Kilishi*Treated with Garlic, Cinnamon and Combination of Garlic and Cinnamon Oils.

	BEEF (CONTENT %)				**CAMEL (CONTENT %)**			
Hydrocarbons	**Garlic**	**Cinnamon**	**Garlic + Cinnamon**	**Control**	**Garlic**	**Cinnamon**	**Garlic + Cinnamon**	**Control**
Decane ($C_{10}H_{22}$)	25.96	13.17	33.52	18.02	24.14	27.68	16.67	19.34
Undecane ($C_{11}H_{24}$)	25.96	13.17	33.52	18.02	24.14	27.68	16.67	19.34

Dodecane ($C_{12}H_{26}$)	1.91	13.17	2.43	1.69	1.85	2.22	0.80	1.92
Benzene ($C_{14}H_{20}$)	15.32	11.20	11.99	13.74	15.95	10.37	14.49	15.98
Tridecane ($C_{13}H_{28}$)	8.93	5.90	12.34	8.17	9.90	9.55	9.65	9.51
Tetradecane ($C_{14}H_{30}$)	1.49	NA	1.59	1.15	2.34	1.92	1.69	NA
Pentadecane ($C_{15}H_{32}$)	1.49	1.13	1.59	NA	1.87	1.92	1.69	1.28
Hexadecane ($C_{16}H_{34}$)	8.93	1.13	12.34	NA	2.34	2.22	2.15	9.51
Heptadecane ($C_{19}H_{40}$)	NA	1.13	NA	NA	2.34	NA	0.80	NA
Cyclodecane ($C_{10}H_{20}$)	NA	NA	NA	7.52	NA	NA	NA	NA
Octane ($C_{11}H_{24}$)	NA	NA	NA	0.77	NA	NA	NA	8.76
Heptanes ($C_{10}H_{22}$)	NA	NA	NA	0.77	NA	NA	NA	NA

NA – Not Available

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Figure 1: Showing map of Nigeria highlighting Kano the study area

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