Effect of Processing Method on Composition and Consumer Acceptability of Camel (*Camelus dromedarious)* Meat and Beef.

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Abstract

The study was carried out to investigate the chemical composition and sensory characteristic of processed camel meat and beef. Fresh meat from hindlimb Longissimus dorsi of camel and bull were processed into kilishi, balangu, and soye. The unprocessed meat was used as control. The meat and meat products were subjected chemical analysis to determine moisture, protein, fat, and mineral contents (Na, K, Ca, Mg, Cu, Fe and Zn). The results showed that raw camel meat had significantly ($p<0.05$) higher moisture content (76.77%) than beef (71.29%). Similarly, camel meat processed into balangu had higher moisture content (73.94%) than that of beef (62.27%). The kilishi of beef and camel meat had the lowest moisture of 9.89% and 10.30%, respectively. Processing method significantly ($p<0.05$) affected protein contents of raw beef from 18.88% to 20.26% in balangu, 19.69% in kilishi and 24.78% in soye. Protein content of raw camel meat was increased significantly ($p<0.05$) from 15.16% to 20.57% in balangu, 17.56% in kilishi and 18.10% in soye. The fat content of camel meat (19.33%) differ significantly ($p<0.05$) from that of beef (15.37%); and the processed meat products showed significantly ($p<0.05$) higher fat contents than raw meat. The ash contents of both beef (4.20%) and camel meat (4.70%) kilishi were significantly ($p<0.05$) higher compared to other products. Camel meat products contain more minerals than beef except for Cu (5.15 mg/g) and Fe (1.43 mg/g). The colour and flavour of beef and camel meat soye were rated very good significantly ($p<0.05$) higher than kilishi and balangu rated between good and satisfactory. The overall acceptability ratings of beef kilishi (7.1) and balangu (7.4) were significantly ($p<0.05$) higher than camel meat kilishi (6.6) and balangu (4.7). However the overall acceptability of soye from both species was rated same and excellent. It could be concluded that beef and camel meat compare favourably in nutrients and consumer acceptability ratings. It was recommended that camel meat be adopted for use in soye, kilishi and balangu making at small scale and commercial production levels.

Keywords: *Camel meat and beef, kilishi, balangu, and soye, processing methods.*

Introduction

Meat and meat products are vital sources of essential protein and other nutrients required for healthy growth and development. The amount of meat consumed by an individual varies with income, social status, economic and political influence and religious beliefs (FAO, 1997). Lathan (1997) stated that \

The quantity of meat consumed in developing countries largely depends on the price of meat in relation to individual income and meat availability.

A wide range of processing techniques are used for different meat preparations. Several processing methods have been identified for meat and include boiling,

frying, roasting, smoking and shredding (Okubanjo, 1988). Cooking methods have been known to affect degree of doneness in meat as well as its desirability and consumer acceptability (lkeme, 1990). In northern Nigeria, *tsire, balangu, kilishi, dambun-nama* and *ragadada* are the commonest meat products (Bube, 2003). Often, *tsire, balangu and kilishi* are collectively referred to as *Suya* (Igene and Abulu, 1984). Earlier study (Alongo and Hiko, 1981) reported detailed description of *Suya* products consumed in northern Nigeria.

Beef, mutton, chevon and of recent camel meat are being used in the production of *Tsire* and *Balangu* that are commonly served or sold along streets, in club houses, at picnics, restaurants and within institutions of learning. These products are now mass-consumed fast foods, whose consumption is invariant with respect to ethnicity, religion, socio-economic factors and sex (Igene and Mohammed, 1983). The consumer attitude to meat shows preference depending on a criteria considered to be important (Apata *et al.,* 2008), such criteria may include species type, age at slaughter and eating quality of meat (Joseph *et al.,*1995). Sensory evaluation is an excellent guide to nutrition and in choice of meat processing method (Larson *et al.,* 1992). The method used in meat processing affects its composition and biological value (FAO, 1997).

Camel meat is low in cholesterol and high in quality proteins of high biological value (Anon, 2008). It provides useful amount of riboflavin and niacin, thiamine, iron, zinc and vitamins A and C (Lathan,1997). Camel carcass provides a substantial amount of meat. The dromedary carcass weighs 400kg or more in males and 300 kg or less in females which vary from location to location and based on plane of nutrition prior to slaughter (Kurtu, 2004; Anon, 2002; Wilson, 1984). In Nigeria, a mean carcass weight of 195 kg was reported for camels slaughtered in Kano metropolitan abattoir (Muhammad and Akpan, 2008). The dromedary can survive, reproduce and produce meat in environmental conditions difficult for other domestic livestock (Dawood, 1995). The camel could go up to 7 days with little or no food and water and can lose a quarter of its body weight without impairing on its normal function (Wilson, 1984) making its husbandry relative to cattle in dry areas, easy.

The consumption of camel meat in Nigeria is low compared to other livestock despite camel meat being cheaper (Muhammad, 2008). An identified limitation to camel meat consumption has to do with its acceptability among meat consumers related to method of processing (Maya, 2004). In most developing countries, meat processing techniques are not well developed (Martin, 2001). The methods used are still rural based on past generation ideas (Okubanjo, 1988). The meat of different animal species has different degree of tenderness and composition. Therefore, a suitable method of processing is necessary to enable the release of desirable meat contents (Aduku and Olukosi, 2000). The objective of this study is to evaluate the effect of different processing methods on chemical composition and assess the consumer preference to differently processed camel meat and beef.

Materials and Methods

Study area

The study was conducted at the Department of Animal Science, Bayero University Kano. Kano State lies between longitude 9° 30' and 12° 30' North and

latitude 8° 42' and 9° 30' East in the semi arid region of Northern Nigeria The State occupies a land area of 20,400 km^2 with a population of over ten million people (Census, 2006). Hausa-Fulani are the major ethnic group in the area and Islam is the dominant religion. The climate of Kano is hot during dry season and cold during harmattan. The ambient temperatue ranges from 16.6°C to 42.8°C in the months of January to June and 23.9°C to 26.7°C in July to December (Anon, 2010). An average monthly precipitation of 0 to 30 mm was recorded in January to June and 780 to 1320 mm in July to December (KNARDA, 2001). Trading is the main occupation of the people living in the metropolis of Kano while in other areas farming is the main occupation.

Meat Processing Methods

Fresh meat (15kg each) from *Longissimus dorci* musle of both adult male camel aged 7 years and a bull aged 6 years (Barnajee, 2005), were obtained from the municipal abattoir and used the study. The ligaments and tendons were carefully removed from selected meat sample and washed twice in clean water and processed into *balangu*, *kilishi* and *soye* as described in the following sub-sections.

Preparation of Balangu

A total of 2.5kg each of fresh camel meat and beef were cut into slices (1cm thick and 20 - 30 cm length) using a sharp knife, the sliced meat was placed over a glowing fire on a wire mesh to roast, similar to what was obtained locally in the study area. Groundnut oil, salt (NaCl), *masoro*, dried ginger, *kanunfari* and other seasonings (Table 1) were added while the meat was roasted over burning charcoal in line with the reports of Farouk *et al.,* (1992). The meat was turned 3 to 4 times at 7 to 10 minutes interval to ensure adequate roasting of both sides of the meat cuts. The roasting process lasted for about 30 minutes.

Preparation of Kilishi.

Another 5kg each of camel meat and beef, was cut and sliced into long pieces of about 0.2 to

Table 1: Proportion of ingredients used in meat preparation.

Ingredient (Hausa name)	Proportion in mixture (g/kg)
Masoro (*Piper guinease*)	12.0
Kanunfari (*Eugenia caryophyllata*)	5.0
Chitta (*Afromomum meleginata*)	5.0
Borkono (*Capsicum frustescens*)	40.0
Tattasai (*Capsicum esculentum*)	45.0
Albasa (*Allium cepa*)	120.0
Citta mai yatsu (*Zingiber officinale*)	24.0
Maggi seasoning	20.0
Thyme seasoning	5.0
Gishiri (NaCl)	15.0
*Decorticated groundnut seeds	6.0
*Kuli - kuli (Defatted groundnut cake)	350.0

*used in kilishi preparation only

Table 2: Chemical composition (%) of raw and differently processed beef and camel meat

	Beef				Camel meat				
	raw	*balangu*	*kilishi*	*soye*	*raw*	*balangu*	*kilishi*	*soye*	SE±
Moisture	71.29 ^{c}	62.27 ^{d}	9.89 ^{g}	30.06 ^{f}	76.77 ^{a}	73.94 ^{b}	10.30 ^{g}	36.91 ^{e}	0.300
Protein	18.88 ^{d}	20.26 ^{bc}	19.69 ^{c}	24.78 ^{a}	15.16 ^{f}	20.57 ^{b}	17.56 ^{e}	18.10 ^{e}	0.191
Fat	15.37 ^{f}	32.51 ^{a}	29.65 ^{b}	29.61 ^{b}	19.33 ^{e}	25.69 ^{c}	24.70 ^{d}	29.10 ^{b}	0.187
Ash	2.20 ^{c}	2.10 ^{d}	4.20 ^{ab}	3.20 ^{b}	2.00 ^{d}	2.30 ^{c}	4.70 ^{a}	3.40 ^{b}	0.167

^{abcdef} means in the same row with different superscript differ significantly ($p<0.01$)

0.4cm thick, 5cm long and 10cm width using sharp knife. The sliced meat was spread out under the sun on a rack (made of sorghum stalks) for 18 hours to dry to less than 40% moisture level (Muhammad and Muhammad, 2007). The meat was screened from dust and flies using nets. The following day, the dried meat was further prepared by smearing it with a slurry made by forming a paste of groundnut cake (ground), dried ginger, *masoro*, *kanunfari* pepper, onions, decorticated groundnut seeds, table salt (Nacl) and water as shown in Table 1. The meat was roasted over a low burning charcoal fire about 15 minutes (Igene, 1983). The *kilishi* obtained was used for the study.

Preparation of Soye

Fresh meat of both species (2kg each) was cut into chunks of 2 x 1 x 3 cm^3. The chunks of meat of camel meat and beef were placed into separate cooking pots containing 3 liters of water and cooked for 10 minutes at 60-70^oC. A medium sized onion ball, salt (NaCI) and thyme were added into the pot (Table 1). The two meat types were then cooked at 90°C for 30 to 45. After cooking the meat chunks were drained for 5 to 10 minutes in a colander and then deep fried in 2.5litres of groundnut oil for 10 minutes to obtain *soye* used in the study.

Proximate Analyses

Both raw and meat products (*balangu*, *kilishi* and *soye*) from the two species of camel and cattle were subjected to chemical analysis to determine the moisture, total protein, total fat and ash contents according to the methods outlined by AOAC (1990). The major elements, Na, K, Ca, Mg, and trace elements Cu, Fe and Zn contents of the different meat products were determined using atomic absorption spectrophotometer.

Sensory Evaluation

The meat products (*balangu*, *kilishi* and *soye*) from the two species of camel and cattle were subjected to sensory evaluation. A sensory evaluation ballot based on a 9-point hedonic scale of 1-very bad, 2-bad, 3-imperfect, 4- sufficient, 5-mediocre, 6-satisfactory, 7-good, 8-very good and 9-excellent was used for data collection (Williams. 1982). The test panel comprised of staff and students, male and female, aged between 25 and 55 years. The panelists were served the meat products one at a time and water was provided for them to rinse their mouth before the next product was served. The panelist's response in term of acceptability, colour, texture, flavour and tenderness were recorded.

Data collection and analysis

The data collected on chemical composition and sensory evaluations were subjected to analysis of variance in a Completely Randomised Design using General Linear Model of the Minitab. Significantly different means were separated using Duncan Multiple Range Test (Steel and Torrie, 1980).

Results and Discussion

The chemical composition of differently processed camel meat and beef are shown in Table 2. The results indicated a significant difference in the moisture content due to species and processing methods. The raw camel meat had significantly ($p<0.01$) higher moisture content (76.77%) than beef (71.29%). It is often quoted that adult mammalian muscle is 75% moisture which varies considerably between species, muscle type and processing method (Casey, 1992). Schontfeld (1989) reported mean moisture content of 63.9 to 65.4% in cooked muscle of lamb, Angora and Boer goats.

Table 3: Mineral composition (mg/g) of differently processed camel meat and beef

	Camel meat				Beef				
Minerals	raw	*balangu*	*kilishi*	*soye*	raw	*balangu*	*kilishi*	*soye*	SE±
Major									
Na	2.02^{g}	2.23^{f}	4.05^{b}	4.66^{a}	1.23^{h}	3.44^{e}	3.85^{c}	3.64^{d}	0.0012
K	10.01^{b}	10.59^{a}	10.13^{b}	7.45^{e}	7.22^{f}	8.38^{d}	9.78^{c}	4.66^{g}	0.0008
Ca	1.89^{d}	2.27^{b}	2.46^{a}	2.08^{c}	1.33^{e}	2.08^{c}	2.27^{b}	1.33^{e}	0.0302
Mg	4.98^{c}	7.77^{b}	7.88^{a}	4.67^{e}	4.03^{f}	4.82^{d}	7.88^{a}	4.66^{e}	0.0008
Trace									
Cu	1.64^{h}	4.37^{c}	2.29^{f}	4.64^{b}	1.91^{g}	3.22^{d}	2.40^{e}	5.15^{a}	0.0008
Fe	1.35^{e}	2.34^{a}	1.67^{b}	1.30^{f}	0.73^{g}	1.30^{f}	1.51^{c}	1.41^{d}	0.0007
Zn	11.39^{b}	12.39^{q}	7.17^{g}	10.86^{c}	8.76^{f}	9.29^{e}	5.31^{h}	10.40^{d}	0.0008

^{abcdefgh}mean within a row with different superscript differ significantly ($p<0.001$)

However, the moisture contents of both raw camel meat (76.77%) and beef (71.29%) were significantly ($p<0.01$) higher than after being processed into *balangu* (73.94 and 62.27%), *kilishi* (9.89 and 10.30%) and *soye* (36.91 and 30.06%). The extent and rate at which moisture is lost from products during processing has been shown to depend largely on temperature and time as well as presence of additives such as salt and polyphosphates (Igene and Farouk, 1990). *Kilishi* is a product of sun-drying and roasting both of which drastically reduce moisture through water loss by convection and conduction. Egbunike and Okubanjo (1999) observed similar drying behaviour in *kilishi* before and after infusion in both oven dried and sundried regimes. A low moisture content of 9.8% and 10.30% were recorded on beef and camel *kilishi* respectively, which were statistically ($p<0.01$) lower than *soye* (30.06 and 36.9%) which in turn is significantly lower than *balangu* (62.27 and 73.94%) of both camel meat and beef products. *Kilishi* processing involved loss of volatile substances from raw meat at initial stage of drying which became rapid due to loss of free water and the final product contained less than 40.0% moisture (Farouk *et al.,* 1992).

The processing methods significantly affected the crude protein content of beef *balangu* (20.26%), *kilishi* (19.69%) and *soye* (74.78%) and camel meat (*balangu* 20.57%, *kilishi* 17.56% and *soye* 18.10%) products compared to that of raw beef (18.88%) and camel meat (15.16%). This is similar to the report of Omojola (2008) that water loss during cooking depend on time, temperature, method of cooking, size of sample, heat penetration, meat composition and increases concentration of fat and protein. The results obtained indicated that though heat treatment denature protein due to possible over heating during processing, the resulting moisture loss tend to concentrate the nutrients in the final products. Oguntona and Akinyele (1995) reported that beef with moderate fat had 63% moisture, 18.2% protien, and 6.0% fat. A crude protein value of 26.6% was reported for lamb's *longissimus* muscle before processing slightly higher than that obtained for raw camel meat (Casey, 1992). DAA (2007) reported an average protein content value of 23.2 g/l00g in lean component of Australian red meat. Raw red muscle meat contains about 20 to 25 g/100g protein and processing changes the concentration to 28 to 36 g/100g due to decrease in water content and concentration of other nutrients.

The total protein content of beef *soye* (24.78%) is the highest which could be

attributed to deep frying in vegetable oil which rapidly affect protein structure and composition compared to the heat treatment involved in *balangu* and *kilishi* with protein content values of 20.26% and 19.69% respectively. However, camel meat *balangu* had higher protein content (20.57%) compared to *kilishi* (17.56%) and *soye* (18.10).

The fat content of raw camel meat (19.33%) was significantly different from that of beef (15.37%). Bube (2003) reported similar fat content value of 27.0% in goat meat *Kilishi* and attributed it to groundnut oil added during processing. The fat content of the beef *balangu* (32.51%) was significantly ($p<0.01$) higher than that of *kilishi* (29.65%) which is statistically at par with that of *soye* (29.61%) product. Weiss (1988) observed that during deep frying meat in groundnut oil it tend to take up the oil which becomes a significant part of the end product. Slightly, lower fat content of 12.1% and 12.3% were reported in mutton *tsire* and *balangu*, respectively (Bube, 2003). In the case of camel meat products, the fat content of *balangu* (20.57%) was significantly ($p<0.01$) than that of *soye* (18.10%) and *kilishi* (18.10%). The processing methods used in the current study involved further addition of vegetable oil which could be a major component of the higher fat contents recorded in the products. In meat, fat is the most variable and ranged from 2% in some free-living animals to 15 to 40% in domesticated animals intensively raised (Olomu, 1995). FAO (1997) reported beef with moderate fat (18g/100g) to contain 63% moisture and 235 kcal of energy.

The ash content of raw camel meat (2.0%) was significantly higher than that of beef (1.2%). Ash is a measure of inorganic contents of dry matter and determine the mineral concentrations. *Kilishi* products of both camel meat (4.7%) and beef (4.2%) had the highest ash contents ($p<0.05$). The mineral composition of processed camel meat and beef are shown in Table 3. The sodium (Na) content of raw camel meat (2.02mg/g) and raw beef (1.23 mg/g) were much lower than in all the products. This could be due to addition of table salt during processing. The potassium content of camel meat *soye* (7.45mg/g) and beef *soye* (4.66 mg/g) was lower than that in other products. Potassium is a major intracellular cation and is involved in osmotic regulation of tissue fluids and in acid-base balance. Animals on free range that graze forage tend to have high potassium level in their tissue compared to browsers (McDowell *et al.,* 1983). The calcium, magnesium, copper, and iron contents of the products increased due to processing. These results are in line with the report of Aduku and Olukosi (2000) that the percentage concentration of minerals in processed meat increased by the addition of salts and seasonings.

Camel meat products contains more minerals than beef products except for copper (5.15 mg/g) in beef *soye* which is higher than that of camel meat *soye* (4.65 mg/g) and iron (1.43 mg/g) of beef *soye* higher than that of camel meat *soye* (1.30 mg/g). These variations could be attributed to species differences associated with mineral contents in feed and flesh.

The sensory evaluation ratings of different meat products are shown in Table 4. The colour of beef and camel meat *soye* were rated 7.8 and 7.5 and *kilishi* rated 7.3 and 7.4, respectively. These ratings were significantly ($p<0.05$) higher than that of *balangu* of both beef and camel meat rated satisfactory (6.0).

The colour of food strongly influences consumer decision to eat or not and form initial means of visual assessment to determine acceptability. An objectionable colour may preclude further evaluation of touch and smell to casual consumer (Srilakshmi. 2002). The texture and tenderness of both beef and camel meat *soye*, *balangu* and *kilishi* showed no significant difference and were rated between satisfactory (6.0) and very good (7.0). The meat texture and tenderness are not easily distinguished by un-trained consumers. Tenderness is one of the important features of meat product. The texture is another important characteristic that determine meat acceptability. Other sensory attributes became less important in tough meat (Miller *et al.,* 1995)

The flavour of camel meat *soye* was rated (8.1) very good compared to *balangu* and *kilishi* of both camel meat and beef. The flavour of camel *balangu* was rated sufficient (4.0) significantly ($p<0.05$) lower than camel meat *kilishi* rated satisfactory (6.4). The flavour is the sum of the olfactory response to aromatic and volatile food substances easily discerned by consumers. It is a combined perception of taste, smell and mouth feel (Leora, 1994). Flavour is a result of chemical stimulation of receptors in both the oral and nasal cavities by variety of different classes of chemicals that are either present in food or are formed during processing (Neilgard *et al.,* 1991). The flavour ingredient may be used to enhance food acceptability (James, 1993).

The overall acceptability rating of camel meat (8.5) and beef (8.0) *soye* of between very good and excellent were significantly ($p<0.05$) higher than camel meat *kilishi* rated satisfactory (6.4). Camel meat *balangu* was rated between 4-sufficient and 5-mediocre and was the lowest rating. Olomu (1995) opined that the acceptability of meat and its products is influenced by factors such species, age of the animal, handling after slaughter and cooking method.

Table 4: Sensory evaluation of definitely processed beef and camel meat.

Parameter	Camel meat			Beef				
	soye	*balangu*	*kilishi*	*soye*	*balangu*	*kilishi*	LS	LSD
Colour	7.8^{a}	6.9^{ab}	7.3^{a}	7.5^{a}	6.0^{a}	7.4^{a}	*	0.42
Texture	6.8	6.7	6.8	6.8	6.5	7.1	ns	-
Tenderness	6.7	7.1	7.4	7.1	5.5	6.5	ns	-
Flavour	7.9^{ab}	7.5^{ab}	7.5^{ab}	8.1^{a}	4.0^{c}	6.4^{b}	*	0.89
Acceptability	8.0^{ab}	7.1^{ab}	7.1^{ab}	8.5^{a}	4.7^{c}	6.6	*	0.91

^{abc}mean within a row with different superscript differ significantly ($p<0.05$); LS = Level of significance.

Conclusion

It was concluded that processing camel meat and beef into *balangu*, *kilishi* and *soye* increased protein, fat and ash concentrations. The concentration of both major and trace minerals are higher in camel meat than beef except Cu content. Processed camel meat products were similar to beef in texture and tenderness and compare favourably in flavour and overall acceptability. *Soye* of both camel meat and beef is the most preferred product. It was It was recommended that camel meat be adopted for use in *soye*, *kilishi* and *balangu* making at small scale and commercial production levels.

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References

A.O.A.C. (1990). Association of Official Analytical Chemists. Official Methods of Analysis, 15th Edition, Washington D.C.

Aduku, O.A. and Olukosi, J.O. (2000). Animal Products, Processing and Handling in the Tropics. Living Books series G.U. Publications, Abuja 96pp.

Alonge, D.O. and Hiko, A.A. (1981) Traditional Methods of Meat Preservation in Nigeria. Proceeding of West African Farmers Federation. March to April, pp 19-21

Anonymous (2010) Kano State. http://en.wikipedia.org/wiki/Kano_State

Anon, (2008). Camel. http://www.answers.com/topic/camel

Anon, (2002). Camel. www.arab.net/camels

Apata, E.S., Soniran, G.O., Taiwo B.B.A., Oke, B.D., Eniolorunda, O.O., Ogungebesan, M,A. and Badejo, V.O. (2008). Consumers' evaluation on eating qualities of some meat types cooked by different methods. **In:** Animal Agriculture Towards Millennium Development in Nigeria. O.A Adeyemi. A,M Ogungbesan, A,O Dada, O.O. Eniolorunda, H.A. Awojobi D.B. Oke and J.A Agunbiade (Eds). Proceedings of the 33rd Annual Conference of the Nigerian Society for Animal Production held at Olabisi Onabanjo University, Ayetoro, Ogun State. 16th 20th March.

Barnerjee, G.C. (2005) ***A Textbook of Animal Husbandry.*** 8th Edition, Oxford and IBH publishing Co. Ltd. New Delhi. Pp 1-250.

Bube, M.M. (2003) Nutritional Evaluation of Meat from Variuos Animal Species Processed by different Methods. Unpublished Ph.D Thesis, Abubukar Tafawa Balewa University, Bauchi. 82pp

Casey, N.H. (1992). Got meat in human nutrition, Proceedings of International Conference on Goats, held at Indian Council of Agricultural Research, New Delhi, March, 1992. pp 582-598.

Census (2006). National population Commission, Abuja, Nigeria.

Dawood A. A. (1995). Physical and sensory characteristics of Najdi-Camel meat. *Meat Science* 39(1):59-69.

DAA (2007). Nutritional composition of red meat. Dietitians Association of Australia. Gale Group.

Egbunike, G.N. and Okubanjo, A.O. (1999). Effects of processing upon the quality of Nigerian meat products. *Livestock Production Science* 59:155-163.

FAO. (1997). Agriculture, Food and Nutrition for Africa. A Resource Book for Teachers in Agriculture. Food and Agriculture Organization, Publication Management Group. 412 pp.

Farouk, M.M., Price, J.F., Salh. A.M. and Burnell, R.J. (1992). Effect of post exsanguinations infusion of beef on composition, tenderness and function properties. Journal of Animal Science .70(9):2773

Gracey, J.F. and Collins, D.S. (1992) Meat Hygiene 9th edition. Education Low Priced Book Scheme, London. 548p.

Igene, J.O. and Abulu, E.O. (1984) Nutritional and Bacteriological Characteristics of *Tsire*-Type *Suya*, A Popular Nigerian Meat Product. *Journal of Food Protection* **47**: 193-

196

Igene, J.O. and Mohammed, I.D. (1983) Consumer Preferences and Atitude to *Suya*: An Indigenous Meat Product. *Annals of Borno* **1**:169-178

Igene, J.O. and Farouk, M.M. (1990) Preliminary studies on the traditional processing of *Kilishi*. *Journal of Science Food and Agriculture* **50**:89-98

Ikeme, A.I. (1990) Meat Science and Technology. 1st Edition Africa FEP Publishers Ltd, Onitsha, 320ppp.

James, G. (1993). Packaging, storage and delivery of ingredients. *Journal of Food Technology* 47(8): 54-68.

Joseph. J.K, Momoh, R.D., Omotosho, O.A. and Ladde, A.A. (1995). Relationship between tested organoleptic qualities and the consumption pattern c selected meat types in three Nigerian cities. *Agro Science.* 1:65-68.

KNARDA (2001) Kano Agricultural and Rural Development Authority. Meteorological station reports. Temperature Record Book, Land Management Unit No. 11:1-3.

Kurtu, M.Y. (2004). An Assessment of the Productivity for Meat and the Carcass Yield, of Camels and the Consumption of Camel in Eastern Region of Ethiopia. *Tropical Animal Health and Production*. 31 (1):65-76.

Larson, E.M., Holm, E.T., Marchello, M.J. and Slander, W.D. (1992). Physical and sensory characteristics of fresh pork leg roast-cooked at low temperatures. *Food science* 57(6):1300-1303.

Lathan, M.C. (1997). Human Nutrition in the Developing World, FAO. Rome. Italy. 508pp

Lawrie, R.A. (1985). Meat Science. 4th Edition, Pergamon Press. 97pp

Leora, C.H. (1994). Overcoming flavour challenges in low fat frozen meat. *Journal of Food Technology.* 48(2): 98-105

Martin, A.M. (2001) The future of the world food system, *Outlook on Agriculture* 301(1):11-19

Maya, E. (2004) Lagosians and Camel. The Sun News Online. December 20, 2004.

McDowell, C.R., Conrad, J.K., Ellis, G.L. and Loosli, J.K. (1983). ***Minerals For Grazing Ruminants In Tropical Regions.*** University of Gainesville: Florida.Miller, F.M., Hower, I.C., Cook, K.D., Guerra, A.L. and Huffman, L. (1995) Consumer aceeptability of beef steak tenderness in home and restaurance. *Journal of Food Science* 60 (50):124-133

Muhammad, B.F. (2008) Camel meat utilization in Kano, Nigeria: Consumers' Perception. *Journal of Science, Management and Technology:* 1(2):1-8

Muhammad, B.F. and Akpan, I.N. (2008) Camel (*Camelus dromedarius*) meat utilization in Kano-Nigeria II: Post-slaughter handling and marketing wholesale meat cuts. *Research Journal of Animal Science* 2 (4): 113-117

Muhammad, B.F. and A.M. Muhammad (2007) Effects of packaging material and storage period on microbial load and organoleptic properties of *Kilishi.* *Tropical Journal of Animal Science.* 10(1&2):217-220.

Neilgard, S., Civille, G. and Carr, T. (1991) Sensory Evaluation Technique. 2nd Ed. CRS Press, Inc. Baca Raton, Florida.

Oguntona, E.B. and Akinyele I.O. (1995) Nutrient Composition of Commonly Eating Foods in Nigeria-Raw, Processed and Prepared. Food

Basket Foundation International. 131 pp

Okubanjo, A. (1988). Beef cooking practices in a segment of an urban Nigeria populace, *Nigerian Journal of Animal production* **15**: 15-22.

Olomu. J. M. (1995). Monogastric Animal Nutrition, Principles and Practices. Living Books Series. 320pp.

Omojola, A.B. (2008) Yield and Organoleptic Characteristics of *Suya* (an intermediate moisture meat) Prepared from three different Muscles of a Matured Bull. *African Journal of Biotechnology* **7**:2254-2257

Srilakshmi, B. (2002). Food Science, 2nd edition, New Age International Ltd. 372pp

Steel, R. G. P. and Torrie, J. H. (1980). Principles and Procedure of Statistics. A Biometrical Approach. McGraw-Hill Books Company Inc., New York. 276 pp

Wilson, R.T. (1984). The Camel. Longman Group Limited, London. 223pp

Williams A.A. (1982). Scoring method used in sensory evaluation analysis of foods and beverages at Long Ashton Station. *Journal of Food Technology.* **17**:163-173

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