Physical and sensory characteristics of organic traditional smoked beef and camel meats

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ABSTRACT

Two - three years old male Camel (*Camelus dromedarious*) and cattle (White Fulani) were used for the determination of physical and sensory characteristics of organic traditional smoked beef and camel meats. Two (2) kg of semi-membranous muscles from each animal which were trimmed off of all external fat, connective tissues and bones were used. The meat samples were cut in sizeable pieces within the weight range of 70 90g of 6 - 8cm, kept in the refrigerator for 24 hours. The fresh meat cuts were boiled for 20 minutes at 100°C and smoke dried for 3 hours at 170°C - 300°C. The physical and sensory properties were evaluated on a complete randomized design. Results showed that camel meat gave the highest significant ($P < 0.05$) value in thermal shortening, cooking loss and shear force compared to beef. Water holding capacity (68.12%) of beef meat was higher than that of camel meat (59.09%). The seasoned smoked-dried beef 'Kundi' products gave the higher acceptability (7.00%), compared to camel products, with (5.90 %) respectively. Smoked beef products appears more tender, juicer with higher water holding capacity and highly preferred than smoked camel meat products by the panelists.

Key word: *Camel meat, beef, semi-membranous, sensory and physical attributes.*

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INTRODUCTION

Meat is nutritive and an excellent source of high quality protein, vitamin B complex and some minerals, especially, iron (Elizabeth, 1994). Because of the high nutritive value of meat, dressed carcass of fresh meat can only remain fresh for a short time before spoilage sets in. In order to avoid spoilage, meats are processed into products (Omojola *et al*., 2004). Processed meat products include those in which the properties of fresh meat are modified by the use of one or more procedure like grinding, chopping, addition of seasoning, heat treatment, smoking and other processing or preservative processes (Ikeme, 1990; FAO, 1995).

Smoking of meat is an old organic agricultural method used to preserved meat and its products. Wikipedia (2002) observed that smoking has a preservative effect on meat preserved and has been used for this purpose since nomadic days. Smoked meat is affected by a combination of drying and deposition of naturally produced chemicals resulting from the thermal breakdown of wood. Klettner (1979) described smoking of meat, as the process of allowing smoke produced freshly from natural wood, twigs or the fruits of trees, sometimes with added herbs and spices to act on the surface of meat and meat products. End point of smoked meat gives desirable products in colour, flavour and aroma (Elizabeth, 1995). Janky *et al* (1978) affirms that smoked meat products are generally preferred over the same products, which has received no smoke processing. To evaluate the quality of smoked products, sensory characteristic are assessed by the panelist. Sensory or eating characteristics includes; tenderness, flavour, colour, juiciness, texture and overall acceptability. It is therefore the aim of this study to evaluate, the physical characteristics and sensory evaluation of fresh and smoked meat products of beef and camel meats.

MATERIALS AND METHODS

Experimental materials: Semi-membranous muscles from hindquarter of two to three years old male Camel (*Camelus dromedarous*) and cattle (While Fulani) were used. The meat was trimmed free off of fat, nerves, blood vessels and excess connective tissues with a sharp knife. Meat chunk was cut into smaller pieces about 7- 9 cm and kept overnight at 4 °C. The meats were later boiled for 20 minutes for 100 °C and smoked dried for 3 hours at temperature ranging between 170°C and 300°C, using charcoal as the heat sources.

Cooking loss: Samples of known weight were taken from both meat types (Camel and White Fulani) and boiled in a moist heat at 100^{0}C to an internal temperature of 72^{0}C.

$$\text{Cooking loss} = \frac{\text{weight before cooking weight after cooking X 100}}{\text{Weight before cooking}}$$

Share force determination: The objective evaluation of tenderness was performed using the modified Warner Braztler share force procedure (Bouton and Harris, 1972). Three cores of 1.0 cm diameter were removed from each boiled meat sample. Each core was sheared at three locations parallel to the orientation of the muscle fibre.

Water holding capacity: This was determined in triplicate by the press method (Tsai and Ockerman, 1981).

Cold Shortening: Cored samples of meat (1cm x 1cm) were stored in refrigerator for 24 hours at 4^{0}C, the percentage difference in length gave the cold shortening.

$$\text{Cold shortening} = \frac{\text{Length of sample before frozen x Length of sample after frozen X100}}{\text{Length before frozen}}$$

Thermal shortening: Cored samples of meat of know length were taken and broiled in oven at 175 ^{0}C for 20 minutes, the percentage difference in length gave thermal shortening.

$$\text{Thermal shortening} = \frac{\text{Length of sample before broiling Length of sample after broiling X 100}}{\text{Length before broiling}}$$

Sensory evaluation: A total number of twenty trained individuals were used. The panelists were male (n-9) and female (n-11) and ranged in age from 27 to 35 years. The panelists were randomly allocated to the four treatments. The panelists were made to rate each of the three replicate of meat samples. Equal bite size from each treatment were coded and served in an odourless plastic plate. Each sample was evaluated independent of the other. The panelists rated the samples on a nine point hedonic scale for tenderness, flavour, colour, juiciness, texture and acceptability.

Statistical Analysis

All data obtained were subjected to analysis of variance (ANOVA) and where statistical significance was observed, the means were compared using the Duncan's multiple range test (DMRT). The SAS package was used for all statistical analysis (SAS, 1999).

Results and Discussion:

Table 1 shows physical characteristics of fresh beef and camel meats. Cooking loss depends on the raw meat quality and is a combination of liquid and soluble matter which is lost from the meat during cooking or smoking. At increasing temperature the water content of the meat decreases, while the fat and protein content increase indicating that the main part of cooking loss in meat is water (Heymann *et al*., 1990).

Table 1. Physical Characteristics of fresh beef and camel meats

Physical	Meat Samples		
Properties	Camel meat	Beef	SEM
Cooking loss %	37.76^a	23.35^b	1.90
Water holding capacity %	59.09^b	68.12^a	0.94
Thermal shortening %	23.00^a	14.83^b	3.10
Cold shortening %	2.40^a	2.20^a	0.19
Shear force kg km^3	7.19^a	4.98^b	1.12

Means in the same row with different superscript are significantly different (P < 0.05).

Cooking loss obtained in this study were comparable with those reported by Aaslyng *et al* (2003) for cooking loss of oven dried beef and 33.2 % - 38.0 % for cooking loss of camel meat reported by Yousif and Babiker (1989). While Okubanjo *et al* (2003) reported 24.0 %, 8.7 % and 17.0 % cooking loss for Bunaji, Gudali and Keteku meat which were lower than the values obtained in this study. The values obtained is however lower than 39.5 % and 43.0 % for cooking loss of roast and braised camel meat reported by Abdelbary (1995). The highest cooking loss observed in camel meat could be due to a greater degree of shrinkage of the muscle fibres and protein coagulation (Asghar and Pearson, 1980).

Water holding capacity is the ability of meat to retain its water during application of external forces such as cutting, heating, grinding and pressing. Water holding capacity could be loss by evaporation from meat surface, as exudates or when muscle is cut (Hedrick *et al*., 1994). Beef had the highest significantly (P <0.05) 68.12% water holding capacity than 59.09% for camel meat. The mean values 59.09% - 68.12% obtained for water holding capacity in this study could be compared with the values 42.2 67.0% reported for water holding capacity of scalded, singed and skinned dressed rabbit reported by Omojola and Adesheyinwa, (2006) and were far greater than values of 1.3 2.0% reported by Babiker and Lawrie (1983) for water holding capacity of hot deboned beef Tornberg (2005) reported that cooking induces structural changes and in turn decrease the water holding capacity of the meat.

Thermal shortening obtained was lower for beef than camel meat. However, that of camel meat was significantly (P < 0.05) higher. The reaction of meat obtained from both muscles to heat for cold shortening was statistically similar. The mean cold shortening obtained fell in the range of the values observed by Fakolade *et al* (2006).

Shear force values reported showed a significant (P <0.05) difference between the values obtained for beef 4.98% and 7.19% for camel meat. The shear force value in this study were higher than 2.92kg km^3 3.15kg km^3 reported by Soniran and Okubanjo (2002) for shear force of physical and sensory characteristic of pork and loin roast cooked at three internal temperatures, but fell within the range of 3.16 kg km^3 6.27kg km^3 reported by Kembi and Okubanjo (2002) for physical properties of raw all-beef and soybean extended beef patties after dehydration.

Camel muscle was reported to have higher connective tissue than beef (Babiker and Yousif, 1990) while contributed to the higher cooking loss obtained for camel muscle. Thus, Babiker and Yousif (1990) concluded that camel meat appeared to be very tough, but in establishing consumer threshold values for muscle tenderness. Miller *et al* (2001) classified beef with Warner Bratzler shear values of 5.7 as being very tough, between 4.9 5.7 as intermediate and below 3.0 as tender. Based on these classifications, camel muscle was observed to be very tough while beef appears to be intermediate, which makes beef more acceptable to consumers. Okubanjo *et al* (2003) deduced that breed has a significant effect on the meat quality; therefore, beef produced the best meat quality compared to camel meat.

Table 2 shows the sensory evaluation of smoked beef and camel meat rated by the panelist. Tenderness which could be described as the ease to which the teeth sink into the meat when chewed is one of the most important contributing factors in sensory attributes (Okubanjo *et al*., 2003). Result obtained (6.23% - 6.50%) for tenderness is similar to that of 5.96 6.48% reported by Soniran and Okubanjo (2002) for tenderness of roasted pork cooked at three internal temperatures. However the values obtained were higher than 3.40 4.90% obtained by Solomon *et al* (1994) for cured pork commonly called Unam Inug, . Abdelbary (1995) noticed that tenderness and juiciness are closely related; the more tender the meat, the more quickly the juice is released when chewed and the juicier the meat appears.

Table 2. Sensory Evaluation of smoked and camel meat

	Meat Samples		
Variables	Camel meat	Beef	SEM
Tenderness	6.23^a	6.50^a	0.23
Flavour	5.90^b	6.30^a	0.56
Colour	6.30^a	6.50^a	0.28
Juiciness	6.40^a	6.53^a	0.40
Texture	5.90^b	6.30^a	0.17
Acceptability	5.90^b	7.00^a	0.29

Means in the same row with different superscript are significantly different (P< 0.05).

The mean values (5.90 6.50%) obtained for smoked products agreed with 5.66 - 7.44% reported by Caceres *et al* (2006) for tenderness observed on the effect of calcium on sensory properties of sausages and 5.03 % - 6.38% for flavour observed in sensory evaluation of the different (Kilishi) products (Omojola *et al.,* 2003). However, the values obtained in this study were lower than (6.41 6.96%) reported by Soniran and Okubanjo (2002) for flavour observed in physical and sensory characteristics of pork roasted at three internal temperature but were higher than 5.04 4.83% for flavour of cooked Gudali meat (Ezekwe *et al.,* 1997).

Colour is the first criterion consumer use to judge meat quality and acceptability (Conforth, 1994). Colour is mainly influenced by the myoglobin content and nature, the composition and physical state of muscle and the meat structure (Giddings, 1977). The values (6.30% - 6.50%) in this study were in agreement with that of 3.00 6.91% for colour obtained from mechanically deboned chicken meat (Perlo *et al*., 2006). Remarkable changes in meat colour occur in smoked meat. Smoked meat loses its reddish colour entirely and turns brown. The reason could be due to the destruction of myoglobin through heat and the decomposition of smoke on the product, for example, phenol. Conforth (1994) reported that colour is mainly influenced by the myoglobin content and nature, composition and physical state of muscle, meat structure and varies form of production factors, such as species, smoking, animal age and the feeding system (Gidding, 1977).

Juiciness of meat depends on the raw meat quality and the cooking method (Magit, 2003). Juiciness of meat is directly related to the intramuscular lipid and moisture content of the meat (Cross *et al*., 1986). Results obtained were in agreement with 4.14 6.53% for juiciness score observed for meat cooked at 80°C, 90°C and 100°C reported by Vasanthi *et al* (2007). Meat juice plays a vital role in conveying the overall impression of palatability to the consumer. Juiciness is also dependent of water holding capacity and cooking loss. The water holding capacity of the meat might influence the juiciness, independent of pH (Hamm, 1972), other factors like concentration of glycogen could result from the reduction in moisture content as a result of the application of heat during the production of Intermediate Moisture Meat (IMM) may also influence the juiciness as an increased concentration of glycogen or nutrients in meat products will increase the juiciness in beef with a normal pH (between 5.5 and 5.75%) (Immonen *et al*., 2000).

Texture of meat products is usually affected by the structure of the solid matrix (Purslow, 1987). Texture of meat could also be affected by variation in composition and structure. Stanley (1983) stated that the major structural factor affecting meat texture is associated with connective tissue and myofibrillar protein. 5.90 6.30% obtained was similar to values of 2.70 6.38% for cooked sausage enriched with calcium (Caceres *et al*., 2006). Babiker and Yousif (1990) observed that fresh camel meat and its products are usually tough due to its high connective tissues.

The values obtained (5.90 7.00%) in this study were in agreement with 3.60 7.30% for acceptability of cured pork reported by Solomon *et al* (1994), 6.56 7.00% for pork roasted at three internal temperature of 65°C, 75°C and 55°C respectively. Ezekwe *et al* (1997) stated that juiciness, flavour and tenderness influence eating quality of cooked meat and meat products and these finding were similar with the results obtained in this study for flavour, juiciness and tenderness of meat products.

CONCLUSION: In this study, it was observed that the panelists preferred smoked beef to smoked camel products and that beef appear to be tendered with lower shear force and more juicer with higher water holding capacity. Smoking method gave the product a new and attractive colour, aroma, flavour and help to kill certain bacteria while slowing down the growth of others, thereby increasing the shelf life of the product.

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