NUTRITIONAL QUALITYAND MICROBIOLOGICAL PROPERTIES OF MEAT FLOSS PREPARED FROM MUTTON

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ABSTRACT
Mutton is an excellent source of biological value with its inherent low fat content, however, it has untapped market as a good potential for value added meat products. Therefore, it is necessary to appraise the nutrient composition of meat floss (MF) from different breeds of ram.
Five kilogram of *Semitendonisus* muscle was harvested from carcasses of four breeds of rams consisting of West African Dwarf (WAD), Yankasa (YK), Uda (UD) and Balami (BA) intensively fattened for ninety days. Cooking loss (CL), water holding capacity (WHC), moisture contents (MC), crude protein (CP) and ether extract (EE) of mutton and freshly prepared meat floss (MF) were determined. Thiobarbituric Acid Reactive Substances (TBARmgMDA/100g) and microbiological counts (MC) (log 10^2cfu/g): Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungal Counts (TFC)) at the seventh day were determined. The CL (38.19%, 39.51%) of WAD and YK mutton were significantly higher ($P<0.05$) while their WHC (61.49%, 59.97%) were lower than UD and BA. The CP (23.16%) and EE (5.85%) of BAM were higher ($P<0.05$). The CP were (46.75%, 48.73%, 47.82%, 49.60%) and EE (25.69%, 25.46%, 25.88%, 27.35%) for WAD, YK, UD and BA, respectively. The TBAR ranged from 1.12-1.17 mgMDA/100g. The mean MC (log 10^2cfu/g) on the MF from WMF was 6.76cfu/g while YMF, UMFand BMF for TAC were 4.38, 3.96 and 3.58cfu/g, respectively. The keeping qualities value of the MF does not exceed the threshold values of stored meat products, therefore, it can be inferred that MF from mutton has a high nutrient and keeping qualities profile.
Keywords: Keeping quality, Mutton, Nutrient profile, *Semitendinosus*

INTRODUCTION
Sheep production is indispensable to meet protein and some domestic needs of people throughout the world as they are sources of income and raw materials (Mapiliyao *et al*., 2012). Mutton has a high biological value with its inherent low fat contents. However, it has received little attention in consumption pattern as compared with other sources of meat such as beef and chevon, therefore has an untapped market value as a good potential for value added meat products. MF is among the popular traditional foods that constitutes an important part of Nigerian meal. Considerable progress has been made in standardization of product profile and mechanization of traditional meat products. In Nigeria, particularly in rural communities and towns, processing of carcass usually takes place under very unhygienic conditions. This coupled with high ambient temperature, high humidity, shortage of portable water and poor handling practices exposes meat products like MF to microbial contamination and rapid deterioration. Therefore, the microbiological testing at various stages of food production is relevant to reveal and understand the characteristic trends in distribution of microbiological contamination (ICMSF, 2011). Information available on meat floss specifically is usually centred on other sources of meat while little or none is available on processed mutton. However, if such information is available, it might bring into limelight the nutritional quality inherent in mutton and also help in changing the consumption pattern of the meat. Therefore, this study aimed at assessing the nutritional and keeping qualities of meat floss prepared from mutton of different breeds of ram.

MATERIALS AND METHODS
Experimental design
The study was a completely randomized design and each treatment was replicated thrice.
Meat sample: source, collection and preparation
The *Semitendinosus* used for this study was harvested from the skinned mutton carcasses of four breeds of rams (BA, UD, YK and WAD breeds) intensively fattened for ninety days. They were cut into chunks with average weight of 100g. Thirty chunks were randomly selected to have three kilograms of fresh mutton for each breed.

Non-meat ingredients

Table1: Composition of cooking and shredding recipes used for meat floss production

Ingredients /seasoning	Scientific/*Botanical names	Quantity (g/100g)
	Cooking Recipe	
Salt	Sodium Chloride	10.00
Maggi (Knorrs®)	Maggi	15.00
Thyme	*Thymus vulgaris* L.	12.50
Curry	*Murraya koenigii* (L.) Spreng.	12.50
Onions	*Allium cepa* L. var. *Cepa*	50.00
Total		**100.00**
	Shredding Recipe	
Red Pepper	*Piper nigrum* L.	35.00
Maggi (Knorr®)	Maggi	30.00
African Nut Meg	*Monodora myristica* (Gaertn.) Dunal	2.50
Ginger	*Zingiber officinale* Rosc.	4.00
Garlic	*Allium sativum* L.	3.00
Cloves	*Syzygium aromaticum* (L.) Merr. et L.M. Perry	2.50
Curry powder	*Murraya koenigii* L.	3.50
Thyme leaves	*Thymus vulgaris* L.	2.50
Salt	Sodium Chloride	5.00
Onions	*Allium cepa* L. var. *cepa*	12.00
Total		**100.00**

Source: Kassim (2013). * All botanical names according to Rehm and Espig (1991)

Production of meat floss

The steps involved in production of the meat floss were spice mixture preparation, meat preparation, cooking, shredding, frying and de-oiling following Kassim (2013). The meat chunks were cooked in a pot on an electirc hot plate (Pifco Japan Model number ECP 2002) with water added at the ratio of 1.5 litres to 1.0 kg of meat and the cooking recipe added at a ratio of 1 g to 100 g of meat. The cooking was done at an internal temperature of 72^{o}C until the broth completely dried on the broiled mutton. The meat samples were removed from the pot and spread on a tray to equilibrate to room temperature. The cooled meat was shredded separately by pounding with a local mortar and pestle with shredding recipe at a ratio of 1.00g to 20.00g meat. The shredded meat was deep-fried in soya oil (pre-heated to 180^{o}C) in the ratio of 1 litre to 500g of meat. The meat was fried at 70 strokes per minute for 20 minutes until they turned golden brown in colour. The products were emptied into a colander, pressure applied to drain oil and obtain a dry spongy product. Upon cooling the meat floss were separated into strands and immediately packed into an air tight container and left at room temperature.

Parameters measured

Meat Quality

Cooking loss (CL)

Cooking loss was determined (following the procedure of Honikel, 1987) in the *Semitendinosus* muscles of each breed and samples were taken in triplicates.

Thermal shortening

This was carried out according to the procedure described by Mahendraker *et al*. (1988). Cores of 0.5 cm in diameter were taken from the *semitendinosus* muscle of each breed. Each breed was replicated thrice and the average taken.

Water holding capacity (WHC)
WHC was evaluated using a method adapted from Hamm (1960), based on meat water loss when pressure is applied on it. This was determined by the press method described by Wierbicki and Deatherage (1958) as modified by Tsai and Ockerman (1981).

Product yield
The product yields of the meat floss were determined by measuring the weight of the MF for each treatment and were calculated as the ratio of cooked weight to raw weight expressed as percentage.

Microbial analysis
The microbial quality determination was carried out on the freshly prepared meat floss. The Total Aerobic Counts (TAC), Total Coliform Counts (TCC) and Total Fungi Counts (TFC) were carried out following the procedure of Garbutt (1997).

Statistical analysis
Data collected were analysed using Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS AND DISCUSSION

The physical measured traits of mutton used in the production of meat floss are presented in Table (2). The CL ($P<0.05$) of *Semitendinosus* from YK (39.59%) and WAD (38.19%) were significantly different than 34.70% and 30.20% obtained for UD and BA, respectively. This same trend could be noticed in their TS with YK (34.67%) and WAD (33.34%) having the highest TS shrinkage than UD (29.62%) and BA (26.40%). WHC is one of the major quality characteristics of fresh meat, as it affects some major characteristics of cooked meat such as product yield, appearance and sensory properties. WHC obtained from *Semitendinosus* muscles of mutton used in this study were between 59.97 and 71.60%. BA and UD had the highest ($P<0.05$) value while WAD and YK had similar ($P>0.05$) values which were the least (Table2). The denaturation and aggregation of sarcomere could be responsible for the shrinkage observed in the thermal shortening of the mutton because the extent of sarcoplasmic and myofibrillar protein during cooking depends on the resistance of the muscle fibres to compression (Sheffler and Gerrard, 2007).

Table 2: Physical properties of raw *Semitendinosus* muscles from different breeds of rams used in meat floss production

Parameter (%)	WAD	YK	UD	BA	SEM
Cooking Loss	38.19^{a}	39.51^{a}	34.70^{b}	30.20^{c}	0.25
Thermal Shortening	34.67^{a}	33.34^{a}	29.62^{b}	26.40^{c}	0.18
Water Holding Capacity	61.49^{c}	59.97^{c}	65.60^{b}	71.76^{a}	0.14

[a, b, c] Means with different superscripts in the same row are significantly different ($P<0.05$) WAD: West African Dwarf; YK: Yankasa; UD: Uda; BA:Balami

Chemical composition of raw *Semitendinosus* muscles from different breeds of rams used for the production of meat floss
The chemical compositions of the mutton used are displayed in Table 3. The moisture content of the muscles ranged from 69.57% to 69.86% while the crude protein contents, ash, ether extracts and cholesterol of the muscles differ significantly ($P<0.05$). It ranged from 22.58% to 23.16%; 1.13%-1.30%, 5.85%to 6.44% and 0.21% to 0.29% for crude protein, ash, ether extracts and cholesterol, respectively. The average chemical analysis values for the *Semitendonisus* muscle in the present study are in agreement with the reported values in food composition tables of National Food Institute, (2009 and Chuaynukool *et al*., 2007). The differences in fat content in the meat samples could be due to the differences in genetic and non-genetic factors as reported by Bogosavljevic-Boskovic *et al*. (2010). The low moisture contents of the meat floss as compared to its raw muscles could be attributed to the fact that MF preparation involves a high thermal processing method and most of the water contained in the meat would have been dried-off during the process. It was observed that MF from BA muscle had the highest nutrient profile especially in crude protein contents, ash and ether extracts. This could be attributed to the fact that it was the muscle that has the highest nutrient profile in the raw state. It could also be as a result of its high water holding capacity because nutrient composition of a muscle

after thermal treatment depend on the ability of the muscle to hold on to its inherent water which contain the nutrients of the muscle. During thermal treatment, water would be lost with some nutrients but a muscle with high water holding capacity would have a low cooking loss thereby retaining most of its nutrients. The high product yield of MF from the mutton could be attributed to the procedure because water holding capacity and cooking loss are inversely correlated (Nasiru *et al*., 2011). The lower product yield of meat floss from WAD muscle might be attributed to the excessive fat separation and water release during cooking (Pietrasik and Shand, 2003). The increase in the ash contents of the MF compared to the raw meat could have been contributed by the added ingredients used during production. Similar observations were reported by Ogunsola and Omojola (2008) who reported that the high ash contents of kilishi is due to individual mineral levels of the spices used to give accumulative mineral level during processing. Also, the average total ash values of MF in the present study is in agreement with the reported values in food composition tables of National Food Institute, (2011) for meat products. The increasing level of cholesterol in processed samples might be as a result of the conversion of other substances from food into cholesterol during thermal degradation (Chizzolini *et al*, 1999).

Table 3: Product yield and chemical composition of freshly prepared meat floss from four *Semitendinosus* muscles of different breeds of rams

Parameter (%)	WMF	YMF	UMF	BMF	SEM
Moisture Content	10.52^{a}	10.49^{ab}	10.63^{a}	10.20^{b}	0.05
Crude Protein	46.75^{d}	48.73^{b}	47.82^{c}	49.60^{a}	0.04
Ether Extract	25.69^{c}	25.46^{d}	25.88^{b}	27.35^{a}	0.03
Ash	7.28^{c}	7.31^{c}	7.96^{a}	7.75^{b}	0.03
Cholesterol mg/g	10.11^{ab}	8.33^{c}	11.33^{a}	9.00^{bc}	0.01
Product Yield	67.07^{b}	68.42^{b}	72.31^{a}	74.44^{a}	0.58

$^{a, b, c}$ Means with different superscripts in the same row are significantly different (P<0.05). WMF = West African Dwarf Meat floss; YMF = Yankasa Meat floss; UMF =Uda Meat floss

Microbial loads of mf produced from different breeds of ram

The microbiological counts (10^{2}cfu/g) and the TBARS (mg/kg) of the meat floss is displayed in Table (4). The result revealed that there were significant differences (P<0.05) in all the microbial assessment among the products. The total aerobic counts (TAC) were 1.13, 0.73, 0.66, 0.60; while the total coliforms counts (TCC) were 0.20, 0.20, 0.36, 0.23 and the total fungal counts were 1.03, 0.46, 0.29, 0.20 for WFM, YMF, UMF and BMF meat floss, respectively. Microbial assessment of food provide a general indication of the microbiological quality of the products. The microoganisms isolated in food could come from different sources such as processing, cooking and the environment. The high fat content also can acts as a medium for the growth of microorganisms (Kumar and Sharma, 2004). The microbial counts recorded for coliforms and fungi were well below the levels of $\log10^{4}$ cfu/g and $\log10^{3}$ cfu/g that could cause microbial spoilage (Jay, 1996). Lipid oxidation is a major cause of food deterioration as it decreases nutritional properties of foods and the generation of potentially toxic reaction products. TBARS values of MF samples were illustrated in Table 4, from which it is apparent that BMF samples exhibit 0.39 mg MDA/kg meat. However, the mean TBARS values of all the MF samples in this study were found to be lower than 2.0 mg MDA/kg, accepted as the critical value of lipid oxidation for meat and meat products (D'agata *et al*., 2010).

Table 4: Microbiological quality (log 10^{2}cfu/g) and Thiobarbituric reactive substances of meat floss prepared from *Semitendinosus* muscles of different breeds of rams

Parameter	WMF	YMF	UMF	BMF	SEM
Total Aerobic Counts	1.13^{a}	0.73^{b}	0.66^{c}	0.60^{c}	0.22
Total Coliform Counts	0.20^{b}	0.20^{b}	0.36^{a}	0.23^{b}	0.24
Total Fungal Counts	1.03^{a}	0.46^{b}	0.29^{c}	0.20^{d}	0.06
TBARS(mg MDA/100g)	0.38	0.37	0.38	0.39	0.03

$^{a, b, c}$ Means with different superscripts in the same row are significantly different (P<0.05). WMF=West African Dwarf Meat floss; YMF = Yankasa Meat floss UMF = Uda Meat floss; BMF = Balami Meat floss

CONCLUSION

The nutritional and keeping qualities of meat floss as revealed in this study indicated that mutton is a meat with high biological value which is inversely proportional to its consumption pattern. It could be recommended that the spices should be subjected to treatment that would reduce the microbial load of the products to avoid introduction of pathogens that might bring about spoilage and contamination of the product.

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