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Original Research Article

Process Standardization of *Kamsa*: a Smoked Dried Meat Product, Using Sensory Evaluation Method

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Abstract

This study was aimed at establishing a standardized method for the processing of a traditional product, *Kamsa*, with consistent qualities, for prospective industrial or commercial purposes. Three samples (K1, K2, and K3) from fresh skeletal muscles of cow were prepared using the most common traditional methods of *kamsa* preparation. For the purpose of comparison, the fourth sample (K4) was prepared from the same meat source but, by modification of established standard methods of food dehydration and preservation. Process standardization was carried out through sensory evaluation by 15 panelists on a nine point hedonic scoring system, with 9 and 1 being extremely liked and extremely disliked, respectively. Results indicated that, among all the *kamsa* samples (K1 to K4) standardized, samples K4 and K1 scored the highest means in all the parameters evaluated, but varied significantly ($P \leq 0.05$) in their aroma. A *t*-test comparison was further carried out between K1 and K4 samples, and the results also showed that K4 was the most preferred sample. It was concluded that the preparation method used for K4 sample could be adopted as a standard method for industrial or commercial preparation of high quality and safe *kamsa*.

Keywords: *Kamsa*, process standardization, skeletal muscle, sensory evaluation, smoke-drying.

INTRODUCTION

Meat can be defined as edible animal flesh, including processed or manufactured products derived from such tissues [1-3]. It had long been known for its nutritive value, and its protein profile consists of all amino acids that have been described as essential in human nutrition [4-6]. Meat is also a highly perishable food which needs proper handling and preservation if it is to have a long shelf life and retain a desirable quality and nutritional values [2, 7].

In Nigeria, the meat supply situation remains critical in spite of the relatively large animal population of more than 22 million sheep and 14 million cattle. The average Nigerian consumes 3.89g/h/d of animal protein, which is less than the 34g/h/d recommended by FAO [8, 9]. The existing conditions for slaughtering meat animals and meat handling, particularly in the rural areas, usually result to quality deterioration and post-harvest losses of meat. Meat is either consumed as a component of kitchen-style food preparations or as processed meat products. The major methods of preserving meat include freezing, smoking, drying, chemical preservation and heat treatment such as canning [10, 11, 2, 12, 13]. Use of an appropriate preservation technique offers opportunity of overcoming the two main constraints to a better supply of livestock products, namely availability and affordability [13, 3]. When processing meat locally, the intention is to cook or partially cook, reduce moisture content, or impart flavour to the meat product. However, a combination of these methods is often used. For instance, hot smoking method is usually adopted in the preparation of popular Nigerian meat products such as *Balangu*, *Tsire*, *Dambun nama*, *Kundi*, *Suya* and *Kamsa* [14-21]. The use of intense drying heat during the processing of these products is necessary in the expulsion of moisture to preserve the product for a longer storage period [3].

Kamsa is common to the North Eastern part of Nigeria. It is a smoked-dried meat product free of additives or seasonings. It is locally processed and stored in earthenware pots for further processing and consumption. The *Kamsa* produced by the local producers is usually made from the meat of the hind quarters of the animal. Due to lack of facilities for its bulk processing, and its high potential for moisture absorption once exposed to high relative humidity [22, 3], there is no trading of the product even in the local markets within the production areas. It is usually produced in households as an inexpensive means of preserving excess meat, or for the preferred flavor it imparts to certain meals. It also serves as a source of good quality protein. To ensure the supply of *Kamsa* to high demand areas in a shelf-stable form, effective processing methods that can be replicated to give a high quality product need to be established. This requires standardization of the existing methods, which will generate fundamental data that can also serve as a basis for a large scale processing. This study was therefore aimed at standardizing the production methods of *Kamsa* using sensory evaluators (taste panelists) to ascertain the consistency in the quality characteristics of the final products.

MATERIALS AND METHODS

Processing of *Kamsa*

Fresh beef from the skeletal muscle of the hind quarters of the slaughtered animal, with an average moisture content of 70% was used to produce the samples utilized in the present study. Three popular traditional methods differing in their processing procedures were identified and selected for the preparation of each of the three distinct samples of *Kamsa*: K1, K2, and K3 (Figures 1a – c). Each of the three samples was prepared with the aid of a traditional *Kamsa* producer who is familiar with the particular method. The three samples varied in strip lengths and thicknesses, drying time and final moisture contents (Table-1). The processing methods also varied in some aspects like the amounts of fat trimmed off from the raw material, distance from the heat source, the intensity of the smoke used and period of exposure to the smoke and heat source (Table-1). Similarly, and for the purpose of comparison (standardization), a method modified from a combination of both the traditional procedures of *Kamsa* preparation and standard food dehydration and preservation principles [23, 1, 24, 12], was used to produce the fourth sample of *Kamsa*: K4 (Figure-1d). The modifications included the use of meat from medium aged animal in good nutritional condition; complete trimming of fat and removal of visible contamination, washing and mopping up of surface moisture, use of more manageable strip sizes, generation of smoke from a semi-enclosed environment using hard wood shavings, measured distance between the source of smoke and the meat strips, and the use of a semi-automatic smoke and heat generator in the control of the entire smoke-drying process.

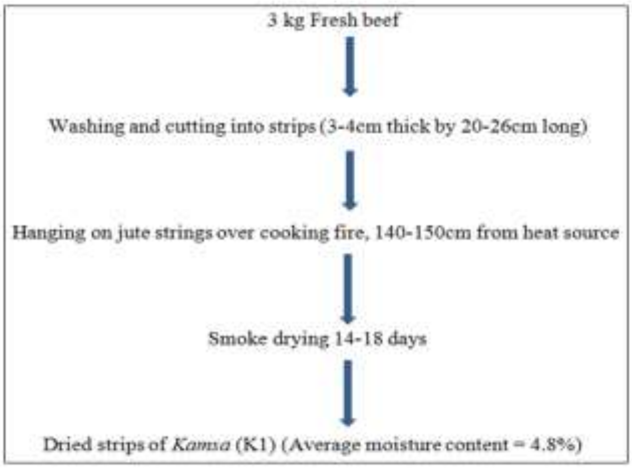

Fig-1a: Flow Chart for Traditional preparation of *Kamsa*, Method 1

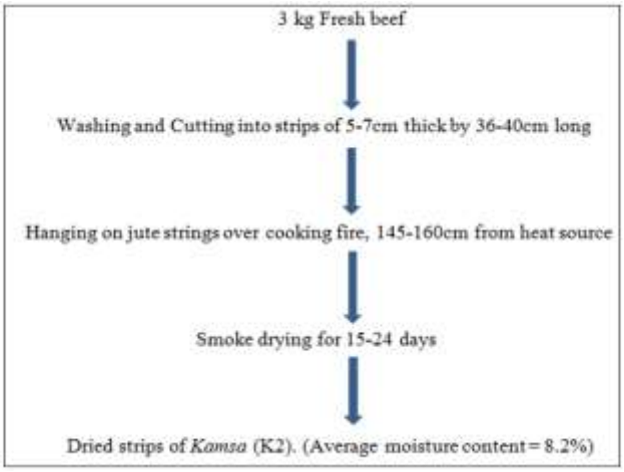

Fig-1b: Flow Chart for Traditional preparation of *Kamsa*, Method 2

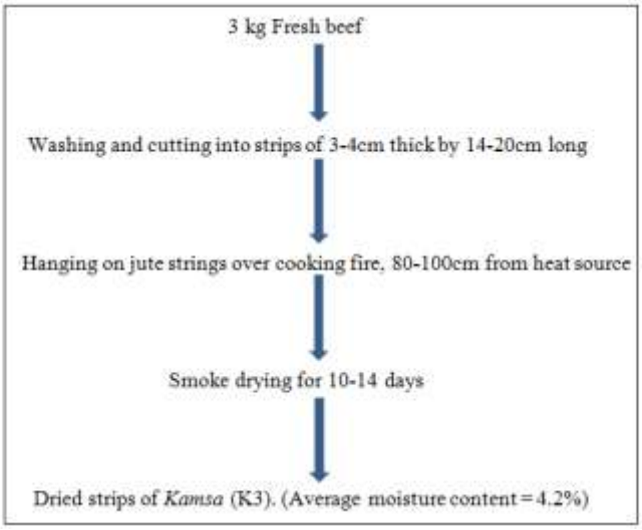

Fig-1c: Flow Chart for Traditional preparation of *Kamsa*, Method 3

Table-1: Summary of the Processing Parameters used in *Kamsa* Preparation in this Study

Sample Code*	Stripe Thickness (cm)	Distance from Heat Source (cm)	Drying Time (Days)	Final Moisture Content (%)
K1	3.0	90	12	4.8
K2	6.0	155	19	8.2
K3	3.0	145	16	4.2
K4	2.5	62	02	6.4

*K1 = Traditional preparation method 1;
K2 = Traditional preparation method 2;
K3 = Traditional preparation method 3;
K4 = Modified / standardized preparation method 4

Sensory Evaluation of the Products (*Kamsa*)

The products from the traditional and modified methods, K1, K2, K3 and K4, respectively, were subjected to sensory assessments by 15 taste panelists. The panelists included adults (males and females) who are very familiar with the quality characteristics of the various types of *Kamsa*, and they were asked to score the samples based on a 9 point hedonic scale, with 9 and 1 being extremely liked and extremely disliked, respectively. The aim was to determine the processing method that produced the best quality and acceptable *Kamsa*. To make the samples safe and suitable for the sensory evaluation, 30g of each of the samples (K1, K2, K3 and K4) were boiled for 20 minutes in 40ml of potable water containing 1g of table salt, in a covered pan. The purpose of the boiling process was to quickly rehydrate the products and make them tender and easy to masticate. The parameters evaluated were texture, taste, aroma, colour and overall acceptability of the products.

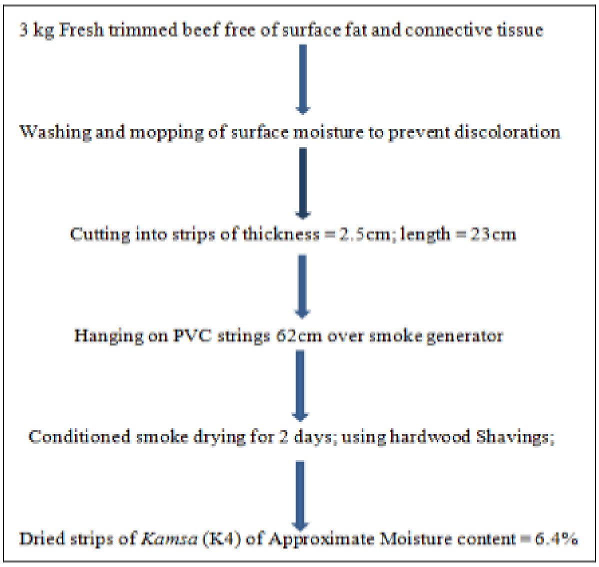

Fig-1d: Flow Chart for Modified preparation of *Kamsa* Method 4

STATISTICAL ANALYSIS

Data obtained from the sensory evaluations were subjected to Uni-variate Analyses of Variance (ANOVA) to generate means that were further subjected to post-hoc multiple comparison test, using Duncan Multiple Range Tests (DMRTs) to determine significant differences between means at 95% ($p \leq 0.05$) confidence intervals [25]. In addition, two samples with the highest and closest mean scores from the parameters tested, were further subjected to another sensory evaluation. The two samples were presented to the same group of taste panelists using different codes but on the same 9 point hedonic scale as previously mentioned. The mean scores from this latter evaluation were subjected to a *t*-test to ascertain which of the two samples was most preferred and recommendable [26].

RESULTS AND DISCUSSIONS

The scores recorded from the sensory assessments of the four *Kamsa* products prepared and used for process standardization in this study are presented in Table-2. From the table, it can be observed that the parameters with the highest mean scores, 8.47 and 8.20, were texture and taste of sample K4, respectively. These values are however, not significantly different ($P \geq 0.05$) from those of sample K1, which are 7.53 and 8.00, respectively. This is because the drying time, temperature, and water activity influenced the final product quality as observed by other researchers including Roquerol *et al.*, [27], Okos *et al.*, [23]; and, most recently, Abdullahi *et al.*, [28] in a deep fried and stored *Sallah* meat. Furthermore, samples K4 and K1 were subjected to the shortest drying times and as sample K4 had the lowest strip thickness, the rate of moisture transfer from the strips during the drying process was higher.

Table 2: Sensory Scores of *Kamsa* Samples used for Process Standardization[1]

Sample Code[3]	Organoleptic Parameters Scored[2]				
	Texture	Taste	Aroma	Colour	Overall Acceptability
K1	7.53 ± 0.62[ab]	8.00 ± 0.73[ab]	6.80 ± 0.65[b]	8.07 ± 0.68[a]	7.40 ± 0.53[ab]
K2	6.47 ± 0.62[c]	7.07 ± 0.57[c]	6.13 ± 0.75[b]	6.93 ± 0.68[cb]	6.67 ± 0.79[b]
K3	6.80 ± 0.65[bc]	7.27 ± 0.68[bc]	6.87 ± 0.72[ab]	7.13 ± 0.96[bc]	6.93 ± 0.68[b]
K4	8.47 ± 0.95[a]	8.20 ± 0.65[a]	7.80 ± 0.99[a]	7.93 ± 0.77[ab]	8.30 ± 0.60[a]

[1]Values are means of 15 scores on the 9 points hedonic scale;
[2]Means bearing similar superscripts in each column are not significantly different ($P \geq 0.05$);
[3]K1 = Traditional preparation method 1; K2 = Traditional preparation method 2; K3 = Traditional preparation method 3; K4 = Modified / standardized preparation method 4

On the other hand, samples K2 and K3 scored the lowest means with regards to texture and taste, and the values were significantly different ($P \leq 0.05$) from those of sample K4 (Table-2). The samples, K2 and K3, had the longest drying times and they were placed farther away from their heat sources. These two factors caused a dense structure in the two samples that resulted in reducing their porosity. This latter observation was in line with those of Potter and Hotchkiss [29] and Menkov and Durakova [30]. This phenomenon made the water absorption capacity of the resultant product very low and tougher in texture, even after rehydration. It has been observed that, the structure, density, and particle size of dehydrated foods play an important role in their water absorption capacities during rehydration, which increases with decreasing particle size [31, 32, 3]. Also, the ease of reconstitution has long been observed to be greatly affected by physical shrinkage and distortion of cells and capillaries during the dehydration process, as well as by chemical or physicochemical changes at the colloidal level [33, 24]. A less dense product will absorb water and reconstitute quicker, and will closely resemble the original material, and therefore becomes more acceptable to consumers [30, 24]. Texture is one of the key attributes of foods, which is used to define product quality and acceptability. Food texture can be defined by the way in which the various constituents and structural elements are arranged and combined into a micro- and macrostructure, and by the external manifestations of this structure, in terms of flow and deformation. Texture measurements are used throughout the food value chain to monitor and control quality, from harvest to assessing the impacts of postharvest handling and processing on shelf life and consumer acceptance. Postharvest handling and processing conditions such as storage temperature have been observed to have a significant influence on the textural properties of meat [34]. Meat texture is, however, usually described in terms of tenderness or the lack of it — toughness. This obviously is related to the ease with which a piece of meat can be cut with a knife or with the teeth.

Similarly, in terms of the product aroma, the highest mean score (7.80) was recorded in sample K4 that had the least processing time (Table-2), though it was not significantly different ($P \geq 0.05$) from that of sample K3 (6.87), but it varied significantly ($P \leq 0.05$) when compared with those of samples K1 (6.80) and K2 (6.13). The difference in aroma could be due to the thicker dimension of K2 and its greater distance from the source of heat and smoke as indicated in Table-1, both of which prolonged the drying time, thereby allowing putrefactive activities to take place before drying process was completed. Putrefaction could be as results of growth and activities of some spoilage microorganisms that were able to degrade the tissue glycogens, while others metabolized the proteins [1]. The observed difference in aroma could also be as a result of breakdown of fat into some volatile fatty acids, since the fats on those samples were not completely trimmed off prior to the drying process, as it is practised in the traditional method of *Kamsa* processing. The objectionable aroma could be due to the combined effects of these two factors. Fat decomposition could be in the form of hydrolytic rancidity because of the greater quantity of saturated fats in red meats [35]. Hydrolytic rancidity is catalyzed by the enzyme lipase in the presence of water, which breaks down glyceride component of a fat into free fatty acids and glycerol, fat oxidation contributes immensely to flavour and odour deterioration, especially in smoked-dried meat [36, 37]. Meat is another food in which the flavor is developed during heating from precursors present in the meat; this occurs in a Maillard-type browning reaction. The overall flavor impression is the result of the presence of a large number of nonvolatile compounds and the volatiles produced during heating.

With regards to the acceptability of the products, sample K4 had the most acceptable aroma and, it was placed at the shortest distance from the source of heat during the smoking operation. This could have provided the heat treatment that is usually sufficient to destroy the lipase enzymes that are responsible for catalyzing hydrolytic rancidity, which affects taste and odour [37] that is especially observable in meats [35].

In terms of colour, sample K1 was scored higher (8.07) than K4 (7.93), although the two means did not vary significantly ($P \geq 0.05$). The lowest mean scores with regards to colour of the products were recorded in samples K2 and K3 (Table-2). The lack of preference shown to the colour of sample K2 and K3 could be as a result of the intensity of the heat and exposure of the meat pigment (or the myoglobin) to oxygen during processing of the two samples. The colour of myogloben in the fresh meat cut from an animal that is properly rested prior to slaughter is usually purple, but upon exposure to oxygen in the air it turns to bright red due to formation of oxymyoglobin [29, 2, 6]. Consequently, the prolonged exposure to air of samples K2 and K3, of 19 and 16 smoking days, respectively, may have resulted to an excessive oxidation of oxymyoglobin, converting it to metmyoglobin, which is responsible for brownish colour of the products. Moreover, other factors like the slowly removal of moisture and lack of adequate heat from the source (due to the placement of the drying products far away from the heat source, Table-1), could have allowed progressive bacterial growth on the meat, which changed the metmyoglobin to a darker and unattractive colour [1, 6]. It is also important to note that the smoking process for K2 and K3 samples was not controlled, and this could have resulted to the darker colour of the products.

Finally, the result of the t-test comparison between the two products, K1 and K4, which have very close mean scores, is presented in Table-3. The two means varied significantly ($P \leq 0.05$), with sample K4 recording the highest scores in all the parameters investigated. This indicates that the procedures used in the preparation of sample K4 in this study could be adopted as a standardized method for safe and high quality *Kamsa* production in Nigeria. There is urgent need therefore, to disseminate this finding among the local and/or traditional *Kamsa* producers in the country.

Table-3: Comparison between the Means of the Two Preferred Samples of *Kamsa*[1]

Sample Code[3]	Organoleptic Parameters Scored[2]				
	Texture	Taste	Aroma	Colour	Overall Acceptability
K1	6.73 ± 0.80^b	7.13 ± 0.96^b	6.47 ± 0.62^b	6.47 ± 0.62^a	7.07 ± 0.77^b
K4	8.07 ± 0.60^a	8.67 ± 0.91^a	7.53 ± 0.62^a	7.33 ± 0.51^a	8.07 ± 0.57^a

[1]Values are means of 15 scores on the 9 points hedonic scale;
[2]Means bearing different superscripts in each column are significantly different ($P \leq 0.05$);
[3]K1 = Traditional preparation method 1; K4 = Modified / standardized preparation method 4

CONCLUSION

The desirable pigments and flavor compounds in meat may undergo both acceptable and unacceptable changes during preparation, depending on the method employed. Thus, improper method of preparation can result in quality losses. This study has proved that the use of proper preparation techniques which include manageable stripe thicknesses or sizes, measured distances from the heat source and controlled drying time or period, can produce good quality *Kamsa*. The control of these parameters during the preparation of sample K4 has resulted to the best quality and safe *Kamsa*, and therefore has been accepted as a standardized method for a commercial *Kamsa* production.

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Conflicts of Interest: The authors declare no conflicts of interest regarding the publication of this paper.

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