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ORIGINAL ARTICLE

Physicochemical and Organoleptic Characteristics of *Kilishi* Sausage as Affected by Storage Duration and Ingredient Formulation

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Abstract

This study tried to appraise the physicochemical and organoleptic characteristics of *kilishi* sausage as affected by storage duration and ingredient formulation. The conventional traditional *kilishi* (TK) and sausage - type *kilishi* at varying percentage of ingredients were processed. Subsequently, the *kilishi* samples were examined chemically and organoleptically. Results obtained showed that the physicochemical and organoleptic parameters evaluated were found statistically significant ($P \leq 0.05$). The lowest trimethylamine, TMA (3.79mgN/100g), total volatile basic nitrogen, TVBN (14.90mgN/100g) and water activity, a_w(0. 74) were recorded in SK7 (115% ingredients) while the highest TMA (15.40 mgN/100g), TVBN (20.50 mgN/100g) and a_w(0.89) occurred in SK2 (85% ingredients). Highest protein (55.84 ± 0.05 %), fat (19.20 ± 0.09 %) and ash (5.58 ± 0.05 %) were obtained from SK7, SK2 and SK7 respectively and the organoleptic attributes of *kilishi* produced using 85% slurry concentration (SK2) of the ingredient mix was rated better ($P \leq 0.05$) than the other *kilishi* samples.

Keywords: Physicochemical, Organoleptic, *Kilishi*, Meat, Ingredients, Sausage.

1. Introduction

Kilishi is a rich nourishing snack and a source of supplementary animal protein formulated using hurdle technology, a concept described by Leistner (1987). The product is traditionally prepared from beef infused with spices and defatted groundnut paste and it has a suitable concentration of dissolved solids that binds the moisture in it sufficiently to inhibit the growth of spoilage organism. Thus it is a ready-to-eat convenience meat product possessing excellent shelf stability at room temperature, making handling and marketing of the product convenient for consumers and retailers (Igene *et al*., 1990; Olusola, 2007; Olusola *et al*., 2012). It is mostly seen as a snack rather than an essential part of diet. It contains about 46% meat and 54% non-meat ingredients. A finished product contains about 50% protein, 7.5% moisture, 18% lipid and 9.8% fibre/ash respectively (Igene, 1988; Igene *et al*., 1993). According to Jones *et al*. (2001), some of the spices used in *Kilishi* processing such as onion, ginger and garlic have medicinal properties as well as being nutritious. The proportion of the ingredient probably indicates their essentiality in *Kilishi* production. Ingredients with high proportions might be major contributors to the physicochemical properties of the *Kilishi* product. Earlier studies on *Kilishi* indicated that high proportion of Tunkusa (traditionally defatted groundnut cake) used in *Kilishi* processing contributed significantly to the physicochemical properties of the *Kilishi* product (Mgbemere *et al*., 2011). The sensory properties of meat have an impact on consumer appreciation of the meat. This also de ermines their perception of its acceptability and quality (Simela, 2005). Sensory properties are pivotal in this respect because consumers need to be entirely satisfied with the sensory properties before other elements become relevant. The acceptability of meat can be predicted from tenderness,juiciness and flavor (Simela, 2003). Tenderness has been identified as the most important factor influencing the acceptability of beef and beef products. Juiciness and flavor have a greater effect on consumer satisfaction as tenderness increases (Miller *et al*., 2001). Consumers discern quality upon consumption of product and determine overall palatability. Palatability can be defined as how well a foodis liked. The morepleasant the food, the greater is the palatability (Sorensen *et al*., 2003). Generally, the more palatable a food is, the more pleasant the eating experience and ultimately the higher the likelihood of a repeat customer (Simela, 2002). This study therefore is aimed at evaluating the physicochemical and organoleptic characteristics of *kilishi* sausage as affected by storage duration and ingredients formulation.

2. Materials and Methods

2.1 Raw Materials Procurement

The fresh beef muscles (*Longissimus dorsi*) used for the study was purchased from butchers at central Abattoir in Owerri, Nigeria. Spices such as ginger (*Zingiber officinale*), alligator pepper, (*Afromomum meleguata*), black pepper (*Piper guineense*), red pepper (*Capsicum frutescens*), sweet pepper (*Capsicum annum*), African nutmeg (*Monodora myristica*) as well as ingredients such as groundnut paste (*Arachis hypogea*), garlic (*Allium sativum*), onion (*Allium cepa*), sugar, salt and magi seasoning were bought from a grocery shop in Owerri, Nigeria.

2.2 Sample Preparation and Processing

2.2.1 Meat Preparation

The muscle of beef (9kg) used for the study was trimmed of all visible fat, bone and connective tissue and then weighed. About 1kg of the resultant lean beef (8.2kg) was sliced into thin sheets of 0.17 - 0.20 cm thick and 60-80 cm long along the fibre direction for the traditional *kilishi* (TK). While 1kg each of the remaining resultant lean beef was comminuted with different percentage of the infusing ingredients to form the sausage-type *kilishi* (SK).

2.2.2 Preparation of Infusing Ingredients

Infusion slurry was prepared following the procedures of Igene (1988) using the ingredients as shown in Table 1. The fresh groundnut paste was prepared from grains of dry uncooked groundnut after extraction of oil by pressing. The various ingredients were ground and mixed thoroughly with water to form a slurry.

2.2.3 Preparation of *Kilishi*

The dried thin sheets of meat were soaked in the infusion slurry for about 30min, after which it was taken out and spread out on flat steel trays on a raised platform till sun dried to prepare the traditional *kilishi*. For the sausage-type *kilishi*, the meat was comminuted with various percentages of the infusing ingredients, spread into thin sheets of approximately 2mm thickness on steel trays, cut into long strips and dried. After drying, the traditional *kilishi* (TK) and respective sausage-type *kilishi* (SK) were roasted in an oven at a temperature of $100^{\circ}c$ for 10-15min. Finally, the finished products were cooled at room temperature, packed and heat sealed in high density polyethylene (HDPE) bags and stored at ambient temperature ($28\pm2^{\circ}c$) for further analysis.

2.4 Storage Stability and Sampling

The traditional *kilishi* and sausage-type *kilishi* were stored for 150 days at ambient temperature and samples were drawn at specified days and subjected to chemical and organoleptic analysis.

2.5 Chemical Analysis

The samples used for the analysis were analysed in duplicate. The moisture, protein, fat and ash contents of the *kilishi* samples were determined using the standard methods of AOAC (2007) and Nielsen (2003). Total volatile basic nitrogen (TVB-N) was determined according to the method of Safari and Yosefian (2006), trimethylamine (TMA) was determined by the Conway micro-diffusion method described by Siripongvutikorn *et al.* (2009), water activity (a_w) was determined according to the method described by Frank *et al.* (2014) and pH according to the method described by Mohamed *et al.* (2011).

2.6 Organoleptic Analysis

Organoleptic attributes of flavour, juiciness, tenderness, pungency and overall acceptability of the *kilishi* samples were evaluated by a 30-member in-house consumer panelist selected from among students and staff of Department of Food Science and Technology of the University. A 9-point hedonic scale was used with 9 for like extremely down to 1 for dislike extremely (Carbonell *et al.*, 2002).

2.7 Statistical Analysis

All the analysis was carried out in triplicates and data obtained were analyzed using analysis of variance (ANOVA) method. Where the variance ratio (F-values) proved significant, Fishers least significant difference (LSD) was used to separate the means.

3. Results and Discussion

3.1 Proximate Composition

The proximate composition of the *kilishi* samples are presented in Table 2. There were significant differences ($P\leq0.05$) in all the proximate parameters evaluated. The moisture content of the *kilishi* samples ranged from 10.02% - 12.02% with SK 6 having the highest moisture content of 12.02% and SK2 the lowest moisture content of 10.02%. The -

Table 1: Composition of infusion mixtures used in *Kilishi* preparation (kg/100kg).

Ingredients	TK	SK1	SK2	SK3	SK4	SK5	SK6	SK7
Ginger (*Zingiber officinale*)	3.30	3.30	2.81	2.97	3.14	3.47	3.63	3.80
Alligator pepper (*Afromomum meleguata*)	1.20	1.20	1.02	1.08	1.14	1.26	1.32	1.38
Black pepper (*Piper guineense*)	3.00	3.00	2.55	2.70	2.85	3.15	3.30	3.45
Red pepper (*Capsicum frutescens*)	2.00	2.00	1.70	1.80	1.90	2.10	2.20	2.30
Sweet pepper (*Capsicum annum*)	2.00	2.00	1.70	1.80	1.90	2.10	2.20	2.30
Onion (*Allium cepa*)	12.00	12.00	10.20	10.80	11.40	12.60	13.20	13.80
Garlic (*Allium sativum*)	0.50	0.50	0.43	0.45	0.48	0.53	0.55	0.58
African nutmeg (*Monodora myristica*)	1.00	1.00	0.85	0.90	0.95	1.05	1.10	1.15
Groundnut paste (*Arachis hypogea*)	31.50	31.50	26.78	28.35	29.93	33.08	34.65	36.23
Magi seasoning	1.50	1.50	1.28	1.35	1.43	1.56	1.65	1.73
Salt	3.00	3.00	2.55	2.70	2.85	3.15	3.30	3.45
Sugar	3.00	3.00	2.55	2.70	2.85	3.15	3.30	3.45
Water	36.00	36.00	30.60	32.40	34.20	37.80	39.60	41.40

TK - Traditional kilishi (100% ingredients); SK1 - Sausage-type kilishi (100% ingredients); SK2 - Sausage-type kilishi (85% Ingredients); SK3 - Sausage-type kilishi (90% ingredients); SK4 - Sausage-type kilishi (95% ingredients); SK5 - Sausage-type kilishi (105% ingredients); SK6 - Sausage-type kilishi (110% ingredients); SK7 - Sausage-type kilishi (115% ingredients)

Table 2: Proximate composition of different processed *kilishi* samples.

Kilishi samples	Proximate Composition (%)			
	Protein	Fat	Ash	Moisture
TK	54.10 ± 0.08^{d}	18.38 ± 0.28^{cd}	4.82 ± 0.01^{b}	11.30 ± 0.01^{ab}
SK1	53.70 ± 0.01^{f}	18.57 ± 0.18^{bc}	5.01 ± 0.01^{bc}	11.78 ± 0.28^{ab}
SK2	51.62 ± 0.14^{h}	19.20 ± 0.23^{a}	4.54 ± 0.05^{c}	10.02 ± 0.14^{c}
SK3	52.30 ± 0.28^{g}	19.03 ± 0.42^{a}	4.68 ± 0.01^{bc}	12.01 ± 0.18^{a}
SK4	52.84 ± 0.24^{e}	18.02 ± 0.11^{d}	4.73 ± 0.11^{bc}	11.66 ± 0.01^{ab}
SK5	54.78 ± 0.08^{c}	18.94 ± 0.16^{ab}	5.22 ± 0.23^{ab}	11.00 ± 0.01^{b}
SK6	55.20 ± 0.14^{b}	17.83 ± 0.44^{d}	5.41 ± 0.16^{ac}	12.02 ± 0.11^{a}
SK7	55.84 ± 0.05^{a}	17.34 ± 0.09^{e}	5.58 ± 0.08^{a}	11.26 ± 0.04^{ab}

$^{a\text{-}h}$*Means with different superscript along the column differ significantly at $P\leq 0.05$*

reduction in moisture content of SK2 is desirable as this can affect the quality of the sample positively in relation toother *kilishi* sample (Apata *et al.,* 2013). Generally, the moisture content of the *kilishi* samples indicates that the *kilishi* samples were sufficiently dried to minimize microbial growth though moisture values of 6.92%, 9.87% and 10.00% were recorded by Jones *et al*. (2001), Apata *et al.* (2013) and Olusola *et al.* (2012) respectively. The protein content of the entire *Kilishi* samples ranged from 51.62% in SK2 to 55.84% in SK7. The range of values obtained with regard to the crude protein content was similar to the values (53.41% - 64.53%) reported by Isah and Okubanjo (2012). However, significant difference (P≤0.05) occurred in the protein content of the *kilishi* samples. SK7 had the highest protein content (55.84%) and SK2 the lowest protein content (51.62%). The high crude protein content obtained can be attributed to the various ingredients utilized in the *kilishi* preparation and is in agreement with report by Igene *et al*. (1993). The fat content of the *kilishi* samples differed significantly ($P \leq 0.05$) and ranged from 17.34% in TK to 19.20% in SK2. Generally, the fat content of the *kilishi* samples werehigh and this can be attributed from the groundnut cake powder which represent a considerable proportion of the product (Igene *et al*., 1990). The ash content is an indicator of the mineral content of the meat. The ash content of the *kilishi* samples ranged from 4.54% in SK2 to 5.58% in SK7. The pattern of ash content observed in this study revealed that the higher the slurry infused into the meat during *kilishi* preparation, the higher the level of ash content in the product. This indicated that most of the ingredients in the slurry might have lost their mineral contents into the slurry hence, into the meat product and this agrees with the report of Elizabeth (1995) who observed that the ash content of any processed meat would be the content of the muscle tissue in addition to that of ingredients used.

3.2 Physicohemical Properties

3.2.1 pH

The effect of storage duration on pH of the *Kilishi* samples is shown in Fig 1. The pH of the *Kilishi* samples ranged from 5.43-6.28 and these were not significantly different ($P \geq 0.05$). The pH values for the *Kilishi* samples were slightly above the maximum accepted limits of 6.0 suggested for fresh meat (Bennani *et al*., 2000; Jones *et al*., 2001). Also, this suggest that the pH is affected by the ingredient mix and processing and is in agreement with the report of Daminabo *et al*. (2013). The pH of traditional *Kilishi* (TK) was low in all the storage days compared to the sausage - type *Kilishi* samples SK1-SK7. This change in the pH of TK relative to SK1-SK7 may be due to the acid which is a common metabolite from a number of bacteria. These may include lactic acid bacteria (LAB), *Enterobacteriaceae* and *Pseudomonas phosphorum* and the basic compounds such as NH_3, TMA and DMA which are developed from the combination of microbial and autolytic actions. This implied that there were higher LAB in TK relative toSK1-SK7 and this is in agreement with the findings of Mgbemere *et al*. (2011).

3.2.2 Water Activity (a_w)

Water activity is the measure of the amount of water in a food that is available for the growth of microorganisms including pathogens. The effect of storage duration on the water activity of the *Kilishi* samples is presented in Fig 2. The result obtained indicates that the water activity (a_w) values of the sample showed no significant difference ($P \geq 0.05$) and ranged from 0.74 - 0.89. The a_w of the *Kilishi* samples decreased as the storage duration increased. The decrease in a_w during storage has been attributed to change in moisture. The reducing water activity may be followed by reductive changes signifying that the rate of deteriorative reactions including microbial growth will be reduced during storage. This result is in agreement with Crapo *et al*. (2010).

3.2.3 Total Volatile Basic Nitrogen (TVB-N)

TVB-N which is a widely used parameter to assess the quality evaluation of some foodsis presented in Fig 3. Total volatile nitrogen contains total amount of volatile nitrogen bases together with nitrogen which is synthesized by reaction with protein. The TVB-N values (mgN/100g) of the *Kilishi* samples were in the range of 8.06mgN/100g to 20.50mgN/100g. These values indicates that TVB-N did not exceed the legal limit of 50mgN/100g muscle and were still under the standard limit (<35mgN/100g) as reported by Siripongvutikorn *et al.* (2009). However, there were significant variations ($P \leq 0.05$) among the *Kilishi* samples. SK2 had the highest content of TVB-N (20.50mgN/100g) compared to the other samples. With regard to the storage duration, the samples increased in their TVBN contents as the storage time increases. This result is in agreement with the report of Ozogul *et al.* (2006).

3.2.4 Trimethylamine (TMA) Value

The effect of storage duration on the trimethylamine values of the *Kilishi* samples are shown in Fig 4. TMA occurs due to the activity of bacterial enzymatic decomposition of trimethylamine oxide (TMA-O) and is a very useful index in characterizing the quality of fresh and processed meat (Arashisar *et al*., 2004). The result obtained shows that there were significant variations ($P \leq 0.05$) among the *Kilishi* samples. The TMA values of the *Kilishi* samples were in the range of 3.79mgN/100g to15.40mgN/100g and this indicates that the TMA values of the samples were still under the standard limit (35mgN/100g). Also, it was observed that the TMA values of the *Kilishi* samples decreases as the storage duration increases. The decrease in value of TMA over storage may be due to the low moisture content of the *Kilishi* and the anti-oxidant compounds derived from the spices in the infusion mixtures used in the *Kilishi* preparation which inhibited the production of TMA from TMAO and this is in agreement with the report of Iheagwara (2013).

3.3 Organoleptic Analysis

The organoleptic evaluation of food products is very important in determining the consumer acceptability. The results of sensorial analysis for the *Kilishi* samples stored at ambient temperature for 150 days are presented in Tables 3 - 6. The results obtained

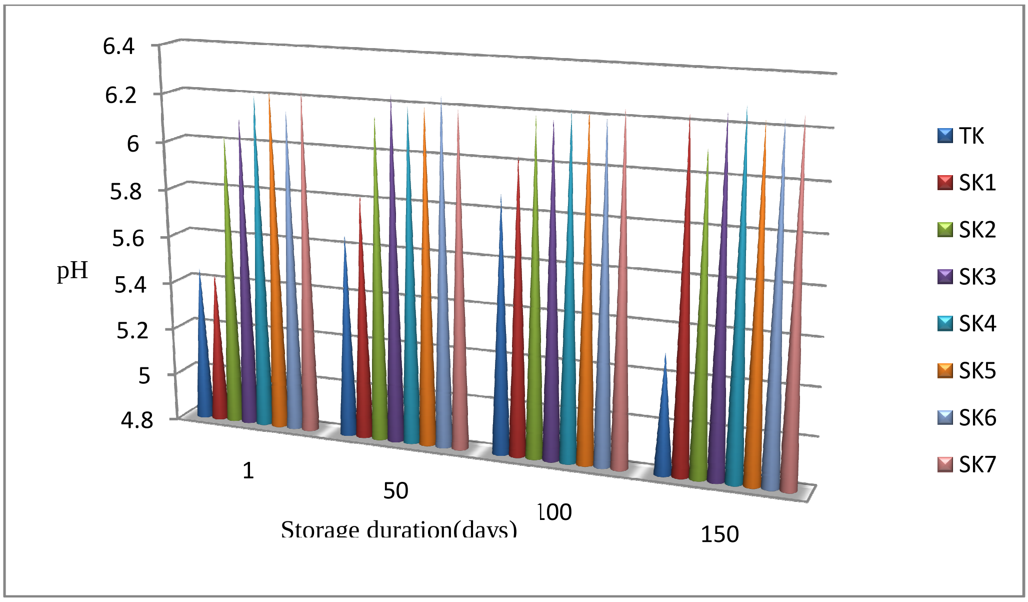

Fig 1: Effect of storage duration on pH of *kilishi* samples.

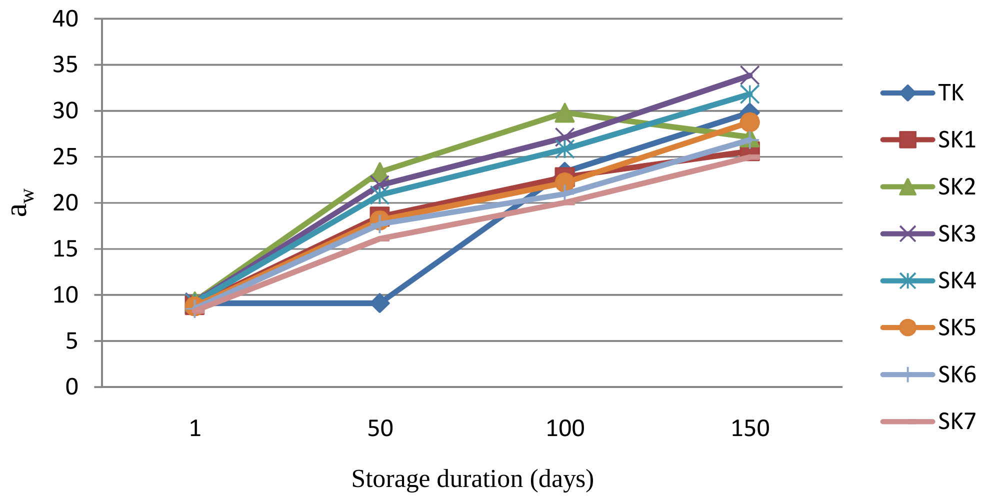

Fig 2: Effect of storage duration on water activity (a_w) of *kilishi* samples.

shows that there were significant variations (P≤0.05) in all the sensory parameters evaluated. With regard to flavour, the highest flavour 8.43±0.56 for day one, 7.60±0.36 for day 50, 6.30±0.47 for day 100 and 5.55±0.31 for day 150 were observed in SK2. Physiologically, the perception of flavour involves the detection of four basic sensations including saltiness, sweetness, sourness and bitterness by the nerve endings or the surface of the tongue (Hedrick *et al*, 1994). This result reveals that the flavour of SK2 was higher probably because the fat content of the product was relatively high and the moisture content was also low. Hence, the high flavour of the product compared to the other *Kilishi* samples was found and this is in conformity with the findings of Olusola *et al.* (2012) and Apata *et al.* (2013). It also supports the observation of Melton (1990) that as the fat of meat increases so does the flavour.

In relation to pungency, there were significant variations (P≤0.05) among the Kilishi samples. -

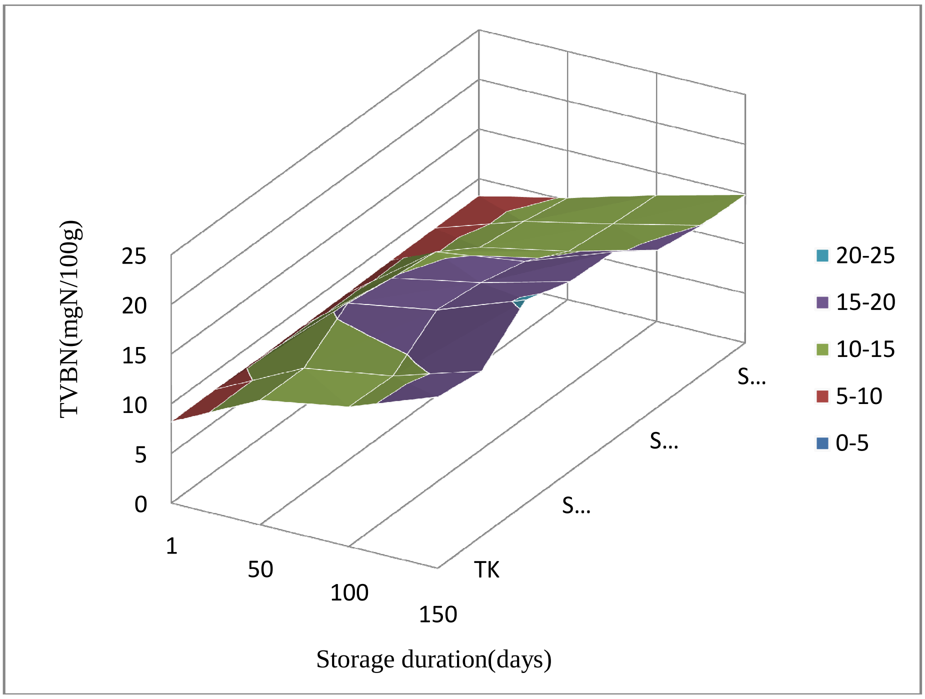

Fig 3: Effect of storage duration on TVBN of *kilishi* samples.

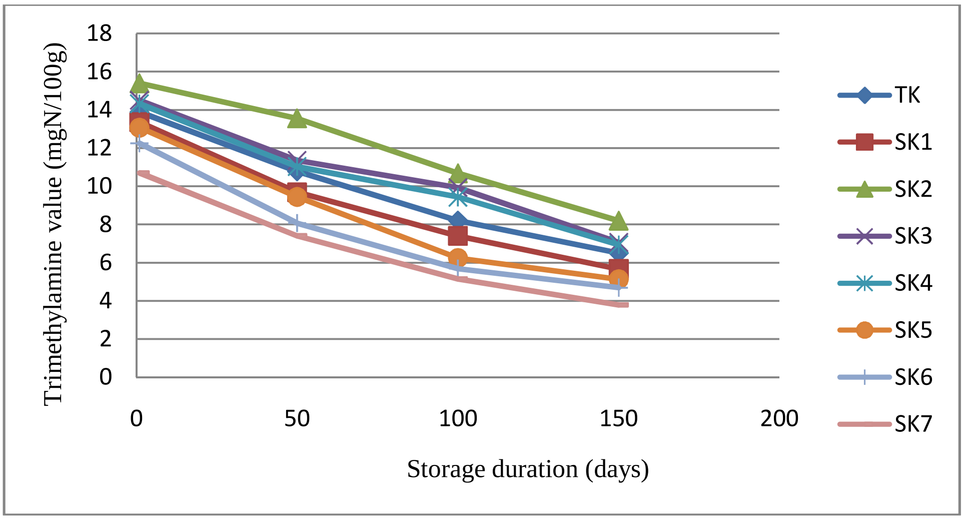

Fig 4: Effect of storage duration on Trimethylamine (TMA) of *kilishi* samples.

According to Olusola *et al.* (2012), the hotness of *Kilishi* is an evaluation of the pungency of the product. The results of pungency as shown in Tables 3 - 6 reveals that SK7 had the highest pungent scores compared to the other *Kilishi* samples in all the respective days of storage evaluated. This suggests that as the percentage of the spices used in the infusing mixtures increases, the pungent level also increases. This agrees with the report of Isah and Okubanjo (2012).

According to Moloney (1999), meat juiciness is an important component of meat tenderness and palatability and it has two major components; the first is the impression of wetness produced by the release of fluid from the meat during the first few chews, while the second is the more sustained juiciness that –

Table 3: Mean sensory scores of *kilishi* samples stored for one day

Kilishi samples	Sensory Parameter				
	Flavour	Pungency	Juiciness	Tenderness	Overall acceptability
TK	7.86 ± 0.52^{f}	7.18 ± 0.34^{e}	7.18 ± 0.45^{b}	7.15 ± 0.51^{f}	7.63 ± 0.28^{f}
SK1	8.06 ± 0.32^{d}	7.65 ± 0.42^{d}	7.13 ± 0.23^{c}	7.25 ± 0.37^{e}	7.75 ± 0.44^{d}
SK2	8.43 ± 0.56^{a}	7.64 ± 0.53^{d}	7.15 ± 0.33^{bc}	$7.53\ \pm0.49^{b}$	8.00 ± 0.78^{a}
SK3	8.15 ± 0.46^{b}	7.78±0'41^{c}	7.23 ± 0.48^{a}	7.62 ± 0.38^{a}	7.93 ± 0.37^{b}
SK4	8.10 ± 0.49^{c}	7.84 ± 0.42^{b}	7.12 ± 0.43^{c}	7.41 ± 0.52^{c}	7.88 ± 0.45^{c}
SK5	8.05 ± 0.34^{d}	7.85 ± 0.32^{b}	7.08 ± 0.23^{d}	7.26 ± 0.37^{e}	7.68 ± 0.49^{e}
SK6	8.00 ± 0.33^{e}	7.98 ± 0.41^{a}	7.00 ± 0.28^{e}	7.33 ± 0.32^{d}	7.50 ± 0.18^{g}
SK7	7.82 ± 0.48^{f}	8.00 ± 0.52^{a}	6.58 ± 0.49^{f}	7.04 ± 0.45^{g}	7.08 ± 0.33^{h}

$^{a-h}$Means with different superscript along the column differ significantly at $P\leq 0.05$

Table 4: Mean sensory scores of *kilishi* samples stored for 50 days

Kilishi samples	Sensory parameter				
	Flavour	Pungency	Juiciness	Tenderness	Overall acceptability
TK	7.30 ± 0.44^{d}	6.84 ± 0.23^{h}	6.41 ± 0.32^{e}	6.62 ± 0.48^{e}	6.71 ± 0.33^{c}
SK1	7.53 ± 0.33^{b}	7.20 ± 0.52^{d}	6.52 ± 0.21^{cd}	6.65 ± 0.36^{de}	6.80 ± 0.44^{b}
SK2	7.60 ± 0.36^{a}	6.92±0.33g	6.68 ± 0.42^{b}	6.76±0.42c	7.10 ± 0.38^{a}
SK3	7.42 ± 0.18^{c}	7.04 ± 0.41^{f}	6.76 ± 0.33^{a}	6.84 ± 0.33^{b}	6.84 ± 0.49^{b}
SK4	7.40 ± 0.24^{c}	7.12 ± 0.28^{e}	6.81 ± 0.22^{a}	6.93 ± 0.47^{a}	6.53 ± 0.21^{d}
SK5	7.38 ± 0.48^{c}	7.43 ± 0.33^{c}	6.54 ± 0.38^{c}	6.68 ± 0.32^{d}	6.41 ± 0.32^{e}
SK6	7.27 ± 0.51^{de}	7.51 ± 0.42^{b}	6.48 ± 0.41^{d}	6.34 ± 0.24^{f}	6.23 ± 0.24^{f}
SK7	7.24 ± 0.38^{e}	7.74 ± 0.38^{a}	6.25 ± 0.35^{f}	6.20 ± 0.43^{g}	6.08 ± 0.32^{g}

$^{a-h}$Means with different superscript along the column differ significantly at $P\leq 0.05$

Table 5: Mean sensory scores of *kilishi* samples stored for 100 days

Kilishi samples	Sensory parameter				
	Flavour	Pungency	Juiciness	Tenderness	Overall acceptability
TK	6.11 ± 0.36^{c}	6.30 ± 0.48^{c}	5.18 ± 0.23^{c}	5.48 ± 0.32^{cd}	5.59 ± 0.21^{c}
SK1	6.18 ± 0.19^{b}	6.27 ± 0.35^{d}	5.20 ± 0.11^{c}	5.52 ± 0.22^{c}	5.68 ± 0.45^{b}
SK2	6.30 ± 0.47^{a}	6.18±0.47f	5.64 ± 0.28^{a}	5.80 ± 0.43^{a}	5.88 ± 0.21^{b}
SK3	6.22 ± 0.51^{b}	6.20 ± 0.35^{ef}	5.43 ± 0.41^{b}	5.63 ± 0.35^{b}	5.70 ± 0.41^{a}
SK4	6.20 ± 0.22^{b}	6.23 ± 0.21^{e}	5.22 ± 0.32^{c}	5.51 ± 0.28^{c}	5.62 ± 0.28^{c}
SK5	6.18 ± 0.18^{b}	6.29 ± 0.31^{d}	5.11 ± 0.27^{d}	5.45 ± 0.34^{de}	5.53 ± 0.38^{d}
SK6	6.07 ± 0.34^{c}	6.35 ± 0.48^{b}	5.08 ± 0.12^{d}	5.40 ± 0.18^{e}	5.50 ± 0.42^{d}
SK7	5.96 ± 0.47^{d}	6.41 ± 0.32^{a}	5.01 ± 0.11^{e}	5.32 ± 0.21^{f}	5.48 ± 0.22^{d}

$^{a-h}$Means with different superscript along the column differ significantly at $P\leq 0.05$

apparently results from the stimulating effect of fat on the production of saliva and coating of fat that builds up in the tongue, teeth and other parts of the mouth. The result of juiciness of the *Kilishi* samples was significantly different ($P\leq0.05$). For day one, SK3 had the highest (7.23±0.48) juiciness score while for day 50, SK4 was juicier (6.81±0.22) than the other *Kilishi*samples. SK2 had the highest juiciness scores of 5.64±0.28 and 5.02±0.43 for day 100 and 150, respectively, compared to the other *Kilishi* samples. However, the juiciness of all the *Kilishi* samples were inversely proportional to the storage duration though the juiciness as detected by the consumer are dependent on the intramuscular lipids and water content of the meat (Olusola *et al*., 2012). The tenderness of meat can be defined as the secondary manifestation of the -

Table 6: Mean sensory scores of *kilishi* samples stored for 150 days

Kilishi samples	Sensory parameter				
	Flavour	Pungency	Juiciness	Tenderness	Overall acceptability
TK	5.32±0.43[cd]	5.43±0.32[b]	4.84±0.21[c]	4.70±0.32[c]	4.48±0.24[d]
SK1	5.40±0.22[b]	5.30±0.25[c]	4.91±0.33[b]	4.78±0.26[b]	4.56±0.33[c]
SK2	5.55±0.31[a]	5.20±0.22[e]	5.02±0.43[a]	4.98±0.41[a]	4.80±0.22[a]
SK3	5.35±0.43[c]	5.24±0.31[de]	4.94±0.45[b]	4.92±0.34[a]	4.68±0.23[b]
SK4	5.30±0.21[d]	5.29±0.42[cd]	4.80±0.31[c]	4.62±0.25[d]	4.61±0.35[c]
SK5	5.24±0.22[e]	5.32±0.26[c]	4.68±0.42[d]	4.50±0.18[e]	4.50±0.22[d]
SK6	5.20±0.36[e]	5.48±0.33[ab]	4.60±0.22[e]	4.42±0.23[f]	4.41±0.26[e]
SK7	5.08±0.24[f]	5.50±0.24[a]	4.53±0.26[f]	4.28±0.33[g]	4.35±0.24[f]

[a-h]Means with different superscript along the column differ significantly at P≤ 0.05

structure of meat and the manner in which this structure reacts to the force applied during biting and the specific senses involved in eating (Moloney, 1999). It is how meat feels in the mouth during manipulation and mastication (Olusola *et al*., 2012). The result of tenderness of the *Kilishi* samples as shown in Tables 3 - 6 shows that there were significant differences (P≤0.05) in the tenderness of the *Kilishi* samples. For day one, SK3 was more tenderly (7.62±0.38) than the other *Kilishi* samples. For day 50, SK4 had the highest tenderness score of 6.93±0.47 compared to others. For days 100 and 150, SK2 had the highest tenderness of 5.80±0.35 and 4.98±0.34 respectively compared to the other *Kilishi* samples. This variation in tenderness of the *Kilishi* samples can be attributed to a large extent on the variations in the ingredients used since the same semitendinosus muscle and processing method were adopted throughout the experiment especially for the sausage-type *Kilishi* samples. Also, this result confirms the report of Moloney (1999) who said that meat juiciness is an important component of meat tenderness and palatability. Similarly, the tenderness of the *Kilishi* samples was inversely proportional to the storage duration.

The mean panel ratings for the overall acceptability of the *Kilishi* sample as shown in Tables 3-6 reveals that there were significant (P≤0.05) differences among the *Kilishi* samples. The result obtained in relation to the overall acceptability indicates that the panelist preferred SK2 greatly compared to other *Kilishi* samples in all the storage days. Among the *Kilishi* samples, SK7 had the least rating in overall acceptability. This result obtained indicates that the level of inclusion of the spices used in the *Kilishi* production affected the consumer preference as the panelist preferred SK2 (8.5% ingredients) than the hot pungent SK7 (115% ingredient). This result is in agreement with the findings of Isah and Okubanjo (2012).

4. Conclusion

Kilishi is a product that is highly relished by consumers. The present study has demonstrated that varying the percentage of ingredients used in the infusion slurry for the *kilishi* production significantly affects the physicochemical and organoleptic characteristics of the *kilishi* product.

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