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# Evaluation of the Chemical and Microbiological Properties of Kilishi Sold in Kano Metropolis

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**Abstract**

The study was conducted to evaluate chemical and microbiological properties of *Kilishi* retailed at some designated locations in Kano Metropolis. The locally prepared *Kilishi* samples were obtained from four locations (A, B, C and D) and the experiment laid in a completely randomised. Data generated were analysed using analysis of variance and significantly different means separated by Tukey HSD post hoc test. The results of local *Kilishi* evaluation revealed no significant (P>0.05) difference in Crude Protein (58.33-64.10%), Ether Extract (8.36-10.17%) and ash (3.93-4.48%) contents due to locations. Also, there were no significant differences in Ca (44.10-55.39 mg/100g), Mg (44.17-55.83 mg/100g), Fe (15.25-17.25 ppm) and Cu (1.36-1.62 ppm). However, significant differences were observed in P, Na, Zn and Mn (P<0.05) due to the locations. The level of Zn (5.00 ppm) was significantly higher in location C while locations B and D had higher values of Mn (3.66 ppm). The microbial analyses revealed the occurrence of *Staphylococcus aureus* in the four locations and S. *epidermidis* was recorded in locations A, B and C. The microbial contamination level of *Kilishi* indicated *Klebseilla pneumonia* with the highest value of $9.2 \times 10^4$ cfu/g. It was concluded that local *Kilishi* had high nutrient contents and the level of contamination was not at the rate that pose threat to public health according to the specifications of International regulatory agencies. Good manufacturing practices, adequate sanitation, proper packaging and storage were recommended to safeguard the health of consumers.

**Key Words**: Kilishi, Ready-to-eat, Meat processing, Meat quality

## Introduction

Meat is the edible part of an animal used as food obtained after slaughter (Lawrie, 1998). According to Hui *et al*. (2001) it is the whole or part of the carcass of animals such as buffalo, camel, cattle, goat, pig, poultry, rabbit and sheep slaughtered other than in a wild state, and intended for human consumption. Meat is vital to the general well-being of the people and impact positively to human nutrition and economic growth (Igwe and Onyekwere, 2007). Fresh meat has a shelf life of 24 hours or less at storage temperatures of 20 to 30°C (Lambert *et al*., 1991). Meat produced into Nigerian ready-to-eat snack products such as *Tsire, Balangu, Dambun-nama* and *Kilishi* in the semi-arid areas were reported to have varying physicochemical and sensory properties particularly texture, flavour, nutritional value and shelf life (Muhammad *et al*., 2011).

*Kilishi,* a traditional dried meat product is made from meat infused with spices and defatted groundnut paste (Muhammad and Muhammad, 2007; Abubakar *et al*., 2011; Olusola *et al*., 2012) and is produced widely in most northern Nigerian States. It has been shown that the quality of *Kilishi* produced by the traditional processors varies from one producer to the other and from one batch to another from the same producer (Olusola, 2006). High ambient temperature, low humidity, shortage of portable water and poor handling practices expose meat products like *Kilishi* to microbial contamination and rapid deterioration (Okonko *et al.*, 2013). The present study evaluated the chemical and microbiological characteristics of Kilishi vended in Kano metropolis.

## Materials and Methods

The experiment was conducted at the Teaching and Research Laboratory of the Department of Animal Science, Bayero University Kano. Kano State is located in the semi-arid area of North-western Nigeria. It has a human population of 9,383,682 comprising of 4,844,128 male and 4,539,534 female (NPC, 2006). The State is the commercial nerve centre of Northern Nigeria. It is located between Latitude 10°33’ and 12° 27’ North of the equator and Longitude 7° 34’ and 9° 29’ east of the Greenwich meridian and as such is part of Sudano-sahelian zone of Nigeria. Kano has a hot semi-arid climate which exhibits a tropical wet dry season with a rainfall distribution ranging from 600 to 1200 mm and an ambient temperature of between $19.6^0$C in December to January to $40^0$C in March to April (Olofin, 1987; KNSG, 2004). Air humidity varies between the wet and dry seasons with a range of 17 to 64% for the average daily low and high levels (Weatherspark, 2013).

### Sample Collection and Analyses

The experimental lay-out for the study was a completely randomised design. Locally produced *Kilishi* samples were obtained from four designated retail outlets in Kano metropolis which include the Main Abattoir, Agadasawa, Kasuwar Mata Fagge and Jakara. The *Kilishi* retailed in the Main Abattoir are brought from Malikawar Garu, a village known for the production of the product in Kano State. The locations were identified as A, B, C and D respectively. Sampling was conducted according to availability and hygienic practices of processors and the environment. Triplicate samples were taken to the laboratory in hygienically sealed containers for chemical and microbiological analyses. The *Kilishi* samples were analysed for chemical constituents (moisture, protein, fat and total ash) according to the procedure of AOAC (2007). The samples of were also assessed for their microbiological quality according to standard procedures (AOAC, 2007; APHA, 1992; Atlas *et al.*, 1995). The isolated colonies that appeared after incubation were counted with the aid of a colony counter (Prescott *et al*., 2002).

### Statistical Analysis

The data obtained were analysed using the means of three replicates of each sample. The data generated from the results of the chemical analysis of the *Kilishi* samples were analysed by analysis of variance (ANOVA) using the IBM SPSS Version 20.0 (2011).

### Results

The results of the chemical analysis of *Kilishi* samples obtained from designated retail outlets in Kano metropolis are presented in Table 1. There were no significant differences among the parameters evaluated. In terms of moisture content, samples from Agadasawa had the highest value. The protein content of *Kilishi* on sale at the Kano main Abattoir brought from Malikawar Garu recorded a numerically higher level of protein. The result of the analysis of fat indicated that Kilishi samples retailed at Jakara contained the highest level. This location also recorded a relatively higher content of total ash.

The results of the analysis of mineral composition of *Kilishi* on sale in Kano metropolis are presented in Table 2. There were no significant ($P<0.05$) differences in the levels of Ca and Mg (mg/100g) among the samples. However, the contents of P and Na (mg/100g) differed significantly ($P<0.05$) among the treatment groups. Agadasawa recorded the highest value of P while the least was observed in the Kano Main Abattoir. The content of Na was significantly ($P<0.05$) higher in Jakara and Kasuwar Mata Fagge had the lowest value.

The composition (ppm) of trace minerals in Kilishi on sale at major outlets in Kano Metropolis is presented in Table 3. There were no significant (P<0.05) differences in the contents of Fe and Cu (ppm) among the samples analysed for the study. However, the contents of Zn and Mn (ppm) differed significantly (P<0.05) among the treatment groups. Significant (P<0.05) difference was observed in the level of Zn as samples from Kasuwar Mata Fagge had the highest value while those from the Main Abattoir recorded the lowest. Furthermore, significant (P<0.05) difference was observed in the contents of Mn as samples from Agadasawa and Jakara had similar higher values while lower levels were observed in the Main Abattoir and Kasuwar Mata Fagge.

Table 4 shows the occurrence of microbiological organisms in the *Kilishi* samples screened for analysis from the selected retail outlets in the study area. *Staphylococcus aureus* had the highest occurrence rate followed closely by its counterpart (*Staphylococcus epidermidis*) which was isolated in 3 locations. These are part of the normal human flora frequently found in the nose, respiratory tract, and on the skin. They are responsible for a number of common infections. *Proteus vulgaris* and *Klebseilla pneumoniae* were isolated in two common locations (A and D). Furthermore, the presence of *Candida spp.* and *Salmonella enteritica* was confirmed in retail outlet B. A pathogenic microbe, *Enterobacter spp*. was however isolated in only one selling point (D).

Table 5 shows the microbial load of *Kilishi* obtained from the designated retail outlets in Kano metropolis. Microbiological organisms that pose threat to public health were isolated from all the samples collected for the study. These organisms were detected at levels potentially hazardous to public health as per as ready-to-eat (RTE) snack meat products such as *Kilishi* are concerned. The presence of some of them (e.g. *Salmonella and Escherichia coli*) in RTE is unacceptable. For example, *Salmonella* test results are either satisfactory (*Salmonella* not detected) or unsatisfactory (*Salmonella* detected). There is no 'borderline' result for a *Salmonella* test.

## Discussion

### Chemical Composition of the Traditionally Prepared Kilishi Retailed in Kano Metropolis

Different levels of moisture in *Kilishi* have been reported by many researchers. Moisture values of 6.92%, 9.87%, 10.00% and 12.5% were recorded by Jones *et al.* (2001), Apata *et al* .(2013), Olusola *et al.* (2012) and Abbo, and Raji (1999) respectively. Other values reported include 10.02 - 12.02% (Iheagwara and Okonkwo, 2016) and 11.6 to 12.1% (Mgbemere *et al.* 2011). Lower moisture contents of 7.5% and 4.2% were

recorded by Igene *et al.,* (1990) and Abubakar *et al.* (2011), respectively in Northern Nigeria with a drier climate. A moisture content of 12.8 ±0.51 to 13.7±0.47 was reported by Daminabo *et al.* (2013). The low moisture content of *Kilishi* indicates that the product has been sufficiently dried.

Several research findings have revealed different levels of protein in *Kilishi*. Values ranging from 55.47 to 62.33% were reported by Olusola *et al.* (2012). The work of Daminabo *et al.* (2013) on beef *Kilishi* samples from Abuja recorded a protein level of 60.6±0.11 to 60.9±0.16%. The finding of Mgbemere *et al.* (2011) revealed a crude protein range of 51.62% to 55.84%. Abbo and Raji (1999) reported a protein content of 51.3%. Igene *et al.* (1990) reported a value of 50.02% protein for traditional *Kilishi* after roasting. The high protein content obtained in the current study compares favourably with previous reports.

The fat content of *Kilishi* has also been examined by many researchers such as 25.36, 25.23, 17.8 and 17.34 to 19.20% respectively by Jones *et al.* (2001), Igene (1988), (Igene *et al.*, 1990) and Mgbemere *et al.* (2011). The fat content of *Kilishi* in the current research (8-10%) was lower than previous reports.

The value of ash in *Kilishi* was reported to range from 4.54 to 5.58% (Mgbemere *et al.*, 2011). An ash content of 6.72+0.13% was reported by Jones *et al.* (2001) while Igene *et al.* (1990) reported a value of 9.6%. Abbo and Raji (1999) reported an ash value of 7.2%. An ash content of 9.9% was similarly obtained by Igene *et al.* (1990). Daminabo *et al.* (2013) reported the ash content of Kilishi from Abuja as 7.4±0.29 to 7.6±0.28. The total ash content of the Kilishi samples examined in the current study was lower than the ones reported in the literature possibly as a result of differences in preparation method and non-meat ingredient formulations.

Meat from all species contains approximately 1% mineral. The use of different ingredients such as such as spices, flavourings and defatted groundnut cake in the production process could influence the mineral content of traditionally processed meat preparations like *Kilishi* (Mbofung, 1993). The result of the mineral analysis of *Kilishi* by Jones *et al.* (2001) revealed that it contained Ca 55.69±7.23 (mg/100g), Mg 123.98±13.93 (mg/100g) and P 392.42±59.88 (mg/100g). The current study recorded virtually similar levels of these minerals.

**Microbiological Quality of Kilishi on Sale in Kano Metropolis**

*Kilishi* as a snack meat product is mostly sold by hawkers in streets, on the road side, bus stops, market places and other areas of business attraction (Okwori *et al.,* 2009). *Kilishi* samples

retailed in the study area were found to be contaminated by organisms that pose threat to public health. These include *Staphylococcus aureus, Staphylococcus epidermidis, Proteus vulgaris, Klebseilla pneumoniae, Escherichia coli, Candida* spp., *Salmonella enteritica* and *Enterobacter* spp. The microbial contamination that was detected in the locations for sample collection could be traced to unhygienic processing and low level of sanitation.

The contamination of ready-to-eat meat products is a common phenomenon in Nigeria that has been reported by many researchers (Chukwu and Imodiboh, 2009; Fonkem *et al.*, 2010; Salihu *et al.*, 2010; Iheagwara and Okonkwo, 2016). Odey *et al.* (2013) isolated *Staphylococcus aureus, Escherichia coli, Streptococcus spp, Salmonella* spp*, Bacillus* spp*, Pseudomonas* spp and *Proteus* spp. from selected *Kilishi* samples on sale at Calabar, Cross River State, Nigeria. Okonko *et al.* (2013) isolated *Bacillus* species, *Staphylococcus aureus* and *Escherichia coli* in *Kilishi* samples from Port Harcourt, Rivers State. Similarly, Edema *et al*. (2008) isolated *Bacillus cereus, Staphylococcus aureus* and *Salmonella* spp from *Kilishi* samples retailed at some selected cities in South western Nigeria. It was reported that commercial *Kilishi* samples from Port Harcourt (Okonkwo *et al.*, 2013), FCT (Abuja) (Daminabo *et al.* 2013) and Calabar (Odey *et al.*, 2013) had better microbial quality than that obtained from Kano. This may result from differences in meat handling practices, *Kilishi* ingredients and manufacturing process and variation in environmental factors such as temperature and humidity (Abdullahi *et al.*, 2016). In yet another study, Fonkem *et al.* (2010) isolated *E. coli* and *Staphylococcus aureus* from Cameroonian *Kilishi*. Shamsuddeen (2009) reported the presence of *E. coli, Salmonella* species, *Staphylococci* and *Clostridium perfringens* in spices used in the production of *Kilishi.*

There has been a debate concerning the acceptability limit for the total viable counts in ready-to-eat meat products. A range of 5.4 - 8.0 log10 was reported as the acceptable level of microbial load of ready-to-eat food products by Jones *et al.* (2001). London Health Protection Agency (2009) put $<10^6$cfu/g as satisfactory limit, and $10^6$ to $<10^7$cfu/g as acceptable range. The International Commission on Microbiological Specifications for Foods (ICMSF, 1996) reported the limits for total aerobic bacterial and fungal counts to be in the order of $\leq 10^3$ as acceptable and $10^4$ to $10^5$ tolerable for ready to eat foods. The levels of microbiological contamination revealed in the current research even though some at tolerable limits could still be of public health concern as conditions favouring growth and proliferation prevails in most of the retail outlets.

## Conclusion and Recommendations

It was concluded that Kilishi, though a highly nutrient dense ready-to-eat meat product could be contaminated at the retail outlets. Good manufacturing practices, proper packaging and storage were recommended to safeguard the health of consumers.

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Table 1. Chemical composition (%) of Kilishi from some retail outlets in Kano metropolis.

| Location | Parameters | | | | |
|---|---|---|---|---|---|
| | Moisture | Protein | Fat | Total ash | SEM |
| Abattoir | 7.06 | 64.10 | 10.07 | 4.23 | 0.55 |
| Agadasawa | 8.29 | 58.76 | 9.36 | 3.93 | 5.36 |
| Fagge | 7.10 | 58.33 | 8.35 | 4.01 | 0.73 |
| Jakara | 7.99 | 61.29 | 10.17 | 4.48 | 0.44 |

Table 2. Major Mineral composition (mg/100g) of Kilishi at major retail outlets in Kano metropolis.

| Location | Mineral | | | |
|---|---|---|---|---|
| | Ca | P | Mg | Na |
| Abattoir | 44.10 | 364.82$^{c}$ | 124.17 | 112.01$^{bc}$ |
| Agadasawa | 44.87 | 388.89$^{a}$ | 125.00 | 112.24$^{ab}$ |
| Fagge | 44.87 | 377.78$^{b}$ | 125.83 | 111.91$^{c}$ |
| Jakara | 55.39 | 383.33$^{ab}$ | 124.17 | 112.44$^{a}$ |
| SEM | 7.02 | 58.44 | 14.04 | 9.05 |

Means with different superscripts in the same column differ significantly (P<0.05). Ca=calcium; P=phosphorus; Mg=magnesium; Na=sodium;

Table 3. Minor Mineral composition (ppm) of Kilishi retailed at major outlets in Kano metropolis.

| Location | Mineral | | | | SEM |
|---|---|---|---|---|---|
| | Fe | Zn | Cu | Mn | |
| Abattoir | 17.25 | 3.21$^{b}$ | 1.35 | 2.20$^{b}$ | 0.78 |
| Agadasawa | 15.50 | 4.29$^{ab}$ | 1.35 | 3.66$^{a}$ | 0.51 |
| Fagge | 15.25 | 5.00$^{a}$ | 1.35 | 2.20$^{b}$ | 0.33 |
| Jakara | 16.75 | 3.57$^{ab}$ | 1.62 | 3.66$^{a}$ | 0.37 |

Means with different superscripts in the same column differ significantly (P<0.05). Fe=iron; Zn=zinc Cu=copper; Mn=manganese.

Table 4. Occurrence of indicator micro-organisms in *Kilishi* at some selling outlets in Kano metropolis.

| Location | Indicator Organism | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Staphylococcus aureus* | *Staphylococcus epidermidis* | *Proteus vulgaris* | *Klebseilla pneumoniae* | *Escherichia coli* | *Candida spp.* | *Salmonella enteritica* | *Enterobacter spp.* |
| A | ++ | + | + | + | + | - | - | - |
| B | + | + | - | - | - | + | + | - |
| C | + | + | - | - | + | - | - | - |
| D | + | - | + | + | - | - | + | + |

++= Occurring in two places

Table 5. Location analysis of microbial load of Kilishi sold in Kano metropolis.

| Location | Microbial isolate | Colony count (cfu/g) |
|---|---|---|
| A | *Staphylococcus aureus* | $6.6 \times 10^4$ |
| | *Staphylococcus epidermidis* | $7.0 \times 10^4$ |
| | *Proteus vulgaris* | $2.7 \times 10^4$ |
| | *Klebseilla pneumonia* | $5.9 \times 10^4$ |
| | *Escherichia coli* | $4.4 \times 10^4$ |
| B | *Staphylococcus aureus* | $6.2 \times 10^4$ |
| | *Staphylococcus epidermidis* | $4.9 \times 10^4$ |
| | *Candida spp.* | $5.7 \times 10^4$ |
| | *Salmonella enteritica* | $2.9 \times 10^4$ |
| C | *Staphylococcus aureus* | $4.7 \times 10^4$ |
| | *Staphylococcus epidermidis* | $6.7 \times 10^4$ |
| | *Escherichia coli* | $9.8 \times 10^4$ |
| D | *Staphylococcus aureus* | $2.9 \times 10^4$ |
| | *Enterobacter spp.* | $7.2 \times 10^4$ |
| | *Proteus vulgaris* | $8.2 \times 10^4$ |
| | *Salmonella enteritica* | $3.9 \times 10^4$ |
| | *Klebseilla pneumonia* | $9.2 \times 10^4$ |