Quality evaluation of jerky (Kilishi) produced from chicken, duck and turkey meat

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Received 12/05/2026
Accepted 30/06/2026

Abstract

This study was carried out to evaluated the quality attributes of broiler *Kilishi*, produced from fresh meat of three avian species: broiler chicken, duck, and turkey. The research aimed to compare the *Kilishi* for chemical characteristics. The *Kilishi* samples were prepared using fresh cuts of 5 kg from the three avian species, marinated with spices and groundnut cake, sun-dried for 6 hours and later roasted for two hours for each sample. The prepared samples were analysed for their nutritional profiles. The results showed that there were significant differences in the nutritional composition of the *Kilishi* made from the three avian spices. Turkey *Kilishi* (TK) had the highest protein content (66.2 g/100 g), while Duck *Kilishi* (DK) exhibited the highest fat (10.2 g/100 g) and ash content (15.3 g/100 g). TK had the highest moisture content (9.75 g/100 g). Results of mineral analysis revealed that TK had the highest calcium content (83.5 mg/100 g), while DK had the highest phosphorus and magnesium levels (1698 mg/100 g and 208.7 mg/100 g, respectively). Fatty acid analysis indicated that DK had the highest saturated fatty acid (43.4 g/100 g), while Chicken *Kilishi* (CK) exhibited higher levels of polyunsaturated fatty acids (4.41 g/100 g). The vitamin composition showed CK had the highest niacin (16.8 mg/100 g) and vitamin A (21.0 IU), while DK had the highest choline content (92.7 mg/100 g). The essential amino acid profile revealed that CK had the highest leucine (6.01 g /100 g) and lysine (4.19 g/100 g) content. The findings provide an insights into poultry *Kilishi* production, with potential benefits for poultry producers, processors and consumers.

Keywords: *Kilishi*, Chicken, Duck, Turkey, Polyunsaturated fatty acid, Marinates, Nigeria

INTRODUCTION

Meat is an edible part of animals that comprised principally of fat, muscle, connecting tissues and used as food (Iheagwara and Okonkwo, 2016). According to Hui *et al.* (2001) meat is an edible *post mortem* component originating from live animals. The authors further stated that 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. Beef generally refers to the meat of a heifer, cow, bull, young bull, bullock and steer (Emokaro and Amadasun, 2012). Meat is one of the most popular and nutritious food items which come from flesh of animals that are suitable as food (Forrest *et al*., 2001). Meat is rich in quality protein, significant amount of minerals, appreciable essential vitamins as well as enough fat for energy production (Ahmad *et al*., 2018). Meat preservation is highly sophisticated that requires reliable and constant power supply that is only found in developed countries. This implies that in developing countries, there is need for appropriate technologies that are affordable, simple and applicable that suit the local environment in terms of social and economic conditions (Ogunsola and Omojola, 2008).

Kilishi is one of the processed meat products that is highly marinated with spices and liquid groundnut cake mixture (Mgbemere *et al*., 2011). *Kilishi* is prepared by partially drying thin sheets of lean beef in the sun followed by addition of some ingredients before a second period of sun drying and then partial roasting (Igene *et al*., 1990; Musonge and Njolai, 1994). *Kilishi* is a processed meat product that is made using lean beef meat type that has an intermediate moisture content with varying constituents of protein, moisture, lipid, fibre and ash although it depends on the quantity of meat used (Mgbemere *et al.,* 2011), The development of an ingredient-mix dried Poultry snack (*kilishi*) with high nutritional value would greatly limit consumer dependence on beef. The in-depth understanding of the optimum processing technique for producing a poultry *kilishi* would aid in the development of a functional product with a high nutritional composition that can improve the health of the consumers (Mayowa *et al*., 2022).

MATERIAL AND METHODS

The experiment was conducted at Livestock Teaching and Research Farm, Department of Animal Science Federal University Dutsin-Ma, Katsina State. The farm is situated within the latitude $12^{0}27'$ 18' North and $7^{0}29'29'$ East and 605 meters above sea level with an annual rainfall of 700 mm and situated in the Sudan Savannah ecological zone (Abaje *et al*., 2012; Tukur *et al*., 2013).

Experimental materials

Ingredients; spices, black pepper, clove, alligator pepper, hot pepper, sweet pepper, onion, ginger, garlic African nutmeg, were purchased at local market in Katsina, Katsina State. Likewise, ingredients like salt, sugar, maggi seasoning were also purchased at local market. De-fatted groundnut cake and water were purchased from local

groundnut cake processor and water vendor respectively (Table 1). Digital weighing scale, sharp knife, corn stalk bed, wire mesh was also used for weighing, meat trimming and spreading of sliced meat respectively.

Meat preparations

Fresh meat from breast and drumstick of each of the three avian species were used for this study. The meat was trimmed free of fat and excess connective tissues. Fresh meat obtained from these avian species were cut into smaller portions of about 150 – 200 g and cut into very thin slices in continuous sheet. The pieces of sliced meat were then thinly spread on silver trays and sun dried for 8 hours. The dried pieces were kept in airtight containers for the next processing step (Muhammad and Muhammad, 2007; Ogunsola and Omojola, 2008).

Preparation of infusing slurry

The method described by Iheagwara and Okonkwo (2016) was adopted with slight modifications. Each spice was ground into powder using a blender. Onions were sliced into small thin cubes. De-fatted groundnut cake, water and salt were also used. All the infusing ingredients were measured using digital scale and were mixed up thoroughly to achieve an even distribution. The thoroughly mixed ingredients were poured into water and stirred.

Kilishi preparation

The pieces of dried meat were soaked in the slurry prepared for an hour, after which they were removed and carefully spread out one by one on trays. A closed space mosquito net was thinly spread over the closely touching trays to keep off houseflies from perching on the meat slices, then left to dry for 5 hrs. After 5 hours, the infused meat slices were slightly roasted for 5 minutes to heat-seal the ingredient in the product. After cooling in the tray, the products were packaged. The digital weighing scale was used in the weight of the prepared *kilishi*.

Experimental design

Completely randomised design (CRD) was used in this study, in which meats from the matured male chicken, duck and turkey, were used for this study.

Table 1: Proportion of ingredients used in the preparation of *Kilishi*

Ingredients	Proportion of mixture (g/Kg)
Black pepper	15
Clove	10
Alligator pepper	10
Hot pepper	45
Sweet pepper	50
Onion	130
Ginger	25
Garlic	15
African nutmeg	5
Seasonings	45
De-fatted groundnut cake	350
Sugar	10
Water	400
Common salt	10

RESULTS AND DISCUSSION

Chemical composition of *kilishi* produced from three avian species

The Nutritional composition of the *kilishi* made from the three avian species (chicken, duck and turkey) are presented in Table 2. The species from the produced *Kilishi* affected all the proximate parameters evaluated.

Results showed that moisture content was significantly different among the three avian species. The moisture content of the jerky (*kilishi*) ranged from 8.69 g/100 g to 9.75 g/100 g with TK having the highest moisture content of 9.75 g/100 g and CK having the lowest moisture content of 8.6 g/100 g. This difference may be attributed to the different meat type used in the *kilishi* production. However, USDA (2006) reported higher moisture content of chicken, turkey and duck, 74.4 g/100 g, 72.5 g/100 g and 70.8 g/100 g, respectively. This contradicted the finding of this research owing to the fact that it is *kilishi* not a fresh meat. The reduction in moisture content of CK is desirable as this can affect the quality of the sample positively in relation to other *kilishi* samples (Apata *et al.,* 2013).

There was significant difference in the protein content of the *kilishi* type. The protein content of the jerky (*kilishi*) ranged from 65.1 g/100 g in DK to 66.2 g/100 g in TK with TK having the highest value of 66.2 g/100 g. This difference may not be unconnected with the meat type as well. TK had the highest value of 66.2 g/100 g while DK had the lowest of 65.1 g/100 g. USDA (2006) reported a protein content of chicken, turkey and duck meat as 12.1 g/100 g, 13.7 g/100 g, 12.8 g/100 g respectively. The difference between the finding of this research may be due to condiment used as coating material.

The ash content of the jerky (*kilishi*) evaluated ranged from 14.3 g/100 g in TK to 15.3 g/100 g in DK and it differed significantly. DK had the highest value of 15.3 g/100 g while TK had the lowest value of 14.3 g/100 g which may be attributed to the meat type used in the preparation of *Kilishi*. The ash content of chicken, turkey and duck is 1.0 g/100 g, 0.8 g/100 g and 1.2 g/100 g respectively (USDA, 2006). The aforementioned results contradicted the finding of this research due to condiments used in the preparation of *kilishi* which also contain ashes. The Ash content is an indicator of the mineral content of the meat.

Table 2: Nutritional Composition (g/100 g) of *Kilishi* made from three avian species

Parameters	Avian Species			SEM	GM
	CK	DK	TK		
Moisture	8.69^{c}	9.38^{b}	9.75^{a}	0.04	9.27
Protein	65.5^{b}	65.1^{c}	66.2^{a}	0.051	65.6
Ash	14.5^{b}	15.3^{a}	14.3^{b}	0.055	14.7
Fat	9.35^{c}	10.2^{a}	9.76^{b}	0.046	9.77

^{abc}Means with different superscripts in the same row differ significantly ($p<0.05$); CK = Chicken Kilishi, DK = Duck kilishi, TK = Turkey Kilishi, SEM = Standard Error of Mean, GM = Grand Mean

The fat content of the jerky (*kilishi*) differed significantly and ranged from 9.35 g/100 g to 10.2 g/100 g. DK had the highest value. The differences may be attributed to the species used in the *kilishi* production, animal age and management. The fat content of chicken is 11.1 g/100 g, turkey is 11.9 g/100 g and duck is 13.8 g/100 g (USDA, 2006). This corroborated the finding of this research that duck meat had higher fat but the difference in value may be due to the condiment used in the *kilishi* production.

The mineral compositions of *kilishi* made from the three avian species (chicken, duck and turkey) are presented in Table 3 Results show significant differences among the parameters evaluated with the exception of zinc in which *kilishi* type showed non- significantly differences.

Results showed significant difference in the mineral contents of the *kilishi* prepared from the three avian species. The content of calcium ranged from 70.6 mg/100 g to 83.5 mg/100 g, with TK having the highest value (83.5) and the least was obtained from DK (70.6). The calcium content of chicken *kilishi* is 29.6 mg/100 g as reported by Emmanuel *et al*. (2020). It was lower than the value obtained in this study. The significant differences among the parameters evaluated may be due to the type of meat used for the *kilishi* production which significantly influenced the calcium content of the *kilishi*. Values obtained for the variety of *kilishi* in this study were higher than what was reported by Muhammad *et al*. (2010), who obtained 2.46 mg/g in camel *kilishi* and Ndife *et al*. (2022), who reported 46.1 mg/100 g. The variations may be due to the differences in species used for the production of the *kilishi*.

Phosphorus content of the *kilishi* produced from the avian species showed significant differences. Phosphorus content obtained from the samples ranged from 1525 mg/100 g to 1698 mg/100 g, with the highest value recorded in DK (1698) while the lowest was obtained in TK (1525). The variations observed may not be unconnected with the meat type. Emmanuel *et al*. (2020) reported 781 mg/100 g of Phosphorus in beef jerky which is lower than the findings of this research.

There were significant differences in magnesium content among the *kilishi* from the three avian species. Magnesium content obtained from the jerky (*kilishi*) ranged from 177 mg/100 g to 209 mg/100 g. The highest value of 209 was obtained in DK while the lowest was value recorded in TK (177). The findings of this research was higher than 26.5 mg/100 g reported by Ndife *et al*. (2022) and 7.88 mg/g reported by Muhammad *et al*. (2010) in camel *kilishi* while Emmanuel *et al*. (2020) reported 81.6 mg/100 g in beef *kilishi*. The difference may be due to the difference in species used for the production of the *kilishi*. Magnesium is an essential component of all cells and is necessary for the functioning of enzymes involved in energy utilization and it is present in the bone (Ayodele *et al.,* 2019).

The potassium content obtained from the jerky (*kilishi*) ranged from 2085 mg/100 g to 2451 mg/100 g. CK had the highest value of 2451 mg/100 g while DK had the least value of 2085 mg/100 g. There were significant differences among the evaluated parameters signifying the meat type used for the *kilishi* preparation. Emmanuel *et al*. (2020) reported 985 g/100 g in beef *kilishi* which contradicted the findings of this research. Camel *kilishi* is reported to have had 10.1 mg/g of potassium (Muhammad *et al*., 2010). The difference may be due to the difference in species used for the production of the *kilishi*.

The content of sodium obtained from the jerky (*kilishi*) ranged from 249 mg/100 g to 280 mg/100 g. CK had the highest value among the three parameters. There were significant differences among evaluated parameters which may connected with the different meat type used for the production of the *kilishi*. Ndife *et al*. (2022) reported 31.7 mg/100 g of Sodium in chicken *kilishi* which was lower than the finding (280 mg/100 g) of this research. Muhammad *et al*. (2010) reported 3.85 mg/g of sodium in beef *kilishi* which slightly differ with 320 g/100 g of sodium reported by Emmanuel *et al*. (2020). Sodium regulates the water content of the body, as well as aiding in transporting CO_2 and maintains osmotic pressure of bodily fluids (Ahmad *et al.,* 2018). The low sodium content might be beneficial since a low sodium diet has been reported to be beneficial in the prevention of high blood pressure (Ogunsola and Omojola, 2008).

Iron content obtained from jerky (*kilishi*) ranged from 15.3 mg/100 g to 16.3 mg/100 g and highest value was obtained from CK. There were significant differences among the evaluated parameters signifying difference in avian species used in the production of the *Kilishi*. Ndife *et al*. (2022) reported 2.06 mg/100 g of iron in Chicken *kilishi* while Muhammad *et al*. (2010) found 1.67 mg/g of iron in camel *kilishi*. Emmanuel *et al*. (2020) reported 8.62 mg/100 g of iron in beef *kilishi* which differ with the findings of Muhammad *et al*. (2010) which was 1.51 mg/g. Iron is required for the synthesis of haemoglobin and myoglobin, which are oxygen carriers in the blood and muscle respectively (Mirade *et al.,* 2020). The rec-

Table 3: Mineral composition (mg/100 g) of *kilishi* made from the three Avian species

Parameter	CK	DK	TK	SEM	GM
Calcium	74.9[b]	70.6[c]	83.5[a]	0.098	76.3
Phosphorus	1634[b]	1699[a]	1525[c]	0.38	1619
Magnesium	199[b]	209[a]	177[c]	0.39	195
Potassium	2451[a]	2085[c]	2116[b]	2	2217
Sodium	280[a]	249[c]	268[b]	0.52	266
Iron	16.3[a]	15.9[ab]	15.3[b]	0.125	15.8
Zinc	17.3	17.3	16.5	0.16	17.0

[abc]Means with different superscripts in the same row differ significantly ($p<0.05$); CK = Chicken Kilishi, DK = Duck kilishi, TK = Turkey Kilishi, SEM = Standard Error of Mean, GM = Grand Mean

ommended daily allowance of iron ranged from 8-18 mg /100 g as stated by Yang *et al*. (2009) implying that all three parameters are good source of iron. The zinc content obtained from the result showed there was non-significant difference among the *kilishi* type evaluated. Values observed ranged from 16.5 mg/100 g to 17.3 mg/100 g with the CK having the highest value among the parameters evaluated.

CONCLUSION

This study evaluated the quality attributes of *Kilishi* produced from chicken, duck, and turkey meat, focusing on nutritional, mineral, and fatty acid composition. The results revealed significant variations in the proximate composition, with) having the highest protein content (66.2 g/100 g), while duck *Kilishi* (DK) had the highest fat (10.2 g/100 g) and ash content (15.3 g/100 g). The moisture content was lowest in chicken *Kilishi* (CK), indicating potential for longer shelf life.

The mineral analysis showed that TK had the highest calcium content (83.5 mg/100 g), while CK had the highest potassium content (2451 mg/100 g).

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