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MEAT QUALITY TRAITS OF INDIGENOUS CHICKEN, GUINEA FOWL AND DUCK

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ABSTRACT

This study was carried out to determine the meat quality traits (nutritive value and sensory properties) of abandoned and less consumed indigenous chicken, guinea fowl and duck at the experimental unit of Department of Animal and Environmental Biology, Adekunle Ajasin University, Akungba-Akoko Nigeria. A total number of ninety (90) birds comprising of thirty (30) indigenous chicken, guinea fowl and duck were raised under the same management condition. Crude protein, fat content, nitrogen free extract, ash and moisture content of the meat of the birds were analyzed. Taste, flavour, colour, tenderness, juiciness, texture and overall acceptability were also appraised. Data obtained was subjected to analysis of variance (SAS, 2010). Results showed that crude protein in the meat of guinea fowl (33.80 ±0.87 %) was significantly ($p< 0.05$) higher than that of indigenous chicken (31.12 ±0.30 %) and duck (27.75± 2.70 %). Guinea fowl meat had the lowest fat content (11.75 ± 1.54%) followed by chicken while the highest fat content was found in duck. The ash content of the meat was found highest in indigenous chicken (2.92 ± 0.39%) while duck meat had the least ash content (2.02 ± 0.14%). Guinea fowl had the highest crude fibre (0.43 ±0.01%) followed by duck (0.21 ±0.01%) while the least crude fibre was found in chicken. Native chicken had the highest ranking for taste followed by guinea fowl and duck. The flavour of native chicken and duck were similar. Native chicken had the highest ranking for tenderness. In conclusion, Guinea fowl and indigenous chicken had high crude protein and less fat content which make them healthier for consumption.

Key words: birds**,** crude protein, fat content, juiciness, meat, tenderness

INTRODUCTION

The demand for protein for human consumption is increasing with continuous increase in human population. Meat consumption is increasing rapidly and consumer preference for meat are changing to higher quality products (Valavan *et al*., 2016). Poultry meat are among the most valuable sources of protein available for human consumption. It plays an important role in human nutrition throughout the world (Islam *et al*., 2012). The value of poultry meat is determined by its nutrients content (Penkov *et al*., 2017). Poultry meat is valued for its nutritional properties as it is a good source of essential amino acids, B vitamins and minerals. The quality of the poultry meat can be assessed by several attributes primarily the sensory (colour, tenderness, flavour, juiciness) and proximate analysis (Khawaja *et al*., 2013). Evaluation of chemical parameters such as fat, protein, and ash content of poultry meat are essential to determine its nutritive value (Kadim *et*

al., 2005).According to Olivera *et al*. (2016), poultry meat is made up of over 25 % protein although this varies with age, breeding environment and anatomical cut. Despite the recent increases in the preference of poultry meat for consumption, traditional poultry species has been neglected.

Broilers which can be raised within 8 weeks are the most predominantly available chicken species. The meat of layer birds after completing their laying cycles is considered tough due to increased collagen content as compared to broilers (Munira *et al*., 2006). More than providing energy, the lipids in broiler meat also contributes to the sensory properties such as flavour and juiciness (Overland *et al.,* 2011). However the presence of lipids in food especially cholesterol and saturated fatty acids is been advocated against. According to the Food and Agriculture Organization FAO (2008), there is need for the substitution of saturated fatty acids (SFA) with poly unsaturated fatty acids (PUFA) in human food. The organoleptic traits especially colour and flavour constitute the most cherished attributes of meat that attract consumers to accepting any type of meat (Apata and Akinfemi 2010).

Valavan *et al*. (2016) reported that the crude fibre content and ash content was higher in native chickens than Cobb broiler chicken. Mohamed *et al*. (2011) also reported that guinea fowl had higher crude protein, more essential amino acids, vitamins, low fat, low sodium content and lower cholesterol contents than broilers. However, literature on the comparative study of the proximate composition and organoleptic traits of indigenous chicken, duck and guinea fowl meat are scarce. This study therefore investigated the proximate composition and organoleptic traits of the indigenous chicken, guinea fowl and duck meat.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the experimental unit of the Department of Animal and Environmental Biology, Adekunle Ajasin University Akungba-Akoko, Ondo State. Akungba–Akoko is located in Akoko South West Local Government Area of Ondo state, Nigeria. The area lies in the south western region of Nigeria (7º 28ˈ and 5º43ˈ) according to Geographical Positioning System (GPS) and has the following environmental condition: ambient temperature of 27 ºC and relative humidity of 46mm Hg.

Experimental animals and management: A total number of ninety (90) birds comprising of thirty (30) indigenous chicken, guinea fowl and duck were raised under the same management condition for a period of 12 weeks. They were fed with commercial pelleted diet; the diet used contained 17% Crude protein, 7% fat, 10% Crude fibre, 1.0% Calcium, together with available phosphorus of 0.35% and 2550Kcal/kg metabolisable energy. Clean water was also supplied to all the birds ad- libitum.

Data Collection: At 12 weeks, they were weighed and slaughtered. They were properly bled and dressed. Meat samples were collected from the carcass of indigenous chicken, guinea fowl and duck and taken to the Central Research Laboratory, Faculty of Science of the University. Proximate analysis was carried out on the meat samples to determine the crude protein, fat content, moisture content ash content and the nitrogen free extract using the method described by AOAC (2005).

Determination of moisture

Moisture was determined by subjecting the sample to oven drying method. A clean well dried crucible was weighed (W1). Sample was accurately weighed with the crucible (W2). The crucible was placed in an oven at a temperature above boiling point of water (105ºC for 3 hours). The crucible was placed in the desiccator for 30 minutes to cool.

After cooling, it was weighed again (W3). The % moisture was calculated using Equation 1

$$\text{Moisture (\%)} = \frac{W_2 - W_3}{W_2 - W_1} \text{ X } 100 \quad (1)$$

Where W_1 = Weight of empty crucible, W_2 = Initial weight of crucible with sample, W_3 = Final weight of crucible with sample.

Determination of crude protein

Protein in the sample was determined by Kjeldhal method. 5 g of dried meat sample was taken in digestion flask. 30ml of concentrated H_2SO_4 and a pinch of catalyst moisture were added to the digestion flask and was placed in digestion chambers until complete digestion took place. The digest was cooled and transferred to 100ml flask and distilled water was added. 5ml of digest was introduced into distillation tube, 2 drops of phenolphtalein indicator and 10ml of 40% NaOH were added and allowed for distillation. Free NH_3 produced was collected into a conical flask containing H_2SO_4 and was titrated against NaOH. % Nitogen was calculated using Equation 2. Thereafter, % Crude Protein was estimated using equation 3

$$\text{\% Nitrogen} = \frac{(S - B) \text{ x } N \text{ x } 0.014 \text{ x } D}{\text{Weight of sample x } V} \text{ X } 100 \quad (2)$$

Where S=Sample titration reading, B= Blank titration reading, N- Normality of NaOH, D= Dilution of sample after digestion, V =Volume taken for distillation

$$\text{\% Crude Protein} = 6.25 \text{ x } \text{\% N} \quad (3)$$

Determination of crude fat

Crude fat was determined by ether extract method using Soxhlet apparatus. 5g of moisture free sample was taken in a dried fat free extractor thimble, plugged with fat free cotton and then introduced into the extraction tube. The receiving beaker was weighed, cleaned, dried and then filled with 50-70ml of petroleum ether and fitted into the apparatus for the extraction process. After siphoning, extract with ether washing was transferred into clean glass dish and ether was evaporated on water bath. The dish was placed in an oven at 103^{o}C for 30minutes to complete evaporation of solvent and cooled in a desiccator and the weight taken as W3. Crude fat was calculated as:

$$\text{\% Crude fat} = \frac{W_2 - W_3}{W_2 - W_1} \text{ X } 100 \quad (4)$$

Where W_1 = Weight of empty thimble, W_2 = weight of thimble with sample, W_3 = weight of defatted sample and crucible

Determination of crude fiber

A moisture free ether extracted sample was first digested with dilute H_2SO_4 and then with dilute NaOH solution. 2g of sample (W_0) was weighed and transferred to crucible and the crucible was heated in digestion unit with 200ml dilute and then with 200ml alkali for 30 minutes each. The sample was dried in an oven at 105^{o}C for 1 hour and allowed to cool in a dessicator and weighed (W_1). It was kept in muffle furnace at 55^{o}C for 3 hours and was cooled in dessicator and weighed again (W_2). The crude fiber was estimated with equation 5.

$$\text{\% Crude fiber} = \frac{W_1 - W_2}{W_0} \text{ X } 100 \quad (5)$$

Determination of Ash

Clean empty was placed in a muffle furnace for 1 hour, cooled in desiccator and weighed as W1. 5g of sample was taken in crucible and weighed as W2. The sample was ignited over a burner with the help of blow-pipe until it is charred. Then the crucible was placed in a muffle furnace at 550^{o}Cfor

3 hours. The appearances of grey white ash indicate complete oxidation of all organic matter in the sample. The crucible was then cooled and weighed as W3. The percentage ash was estimated with equation 6.

$$\% \text{ Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times 100 \quad (6)$$

Evaluation of organoleptic traits

Samples for sensory evaluations were taken from the thigh muscle and cooked to a temperature of 75°C. Adult trained individuals were used as sensory panelist to assess the cooked meat samples. Equal bite size from each of the three indigenous poultry species (chicken, guinea fowl, and duck) was coded and served in an odourless plastic plate. Each sample was evaluated independent of the other. The samples were evaluated on a 7-point hedonic scale for colour, flavour, taste, juiciness, tenderness, texture and overall acceptability. The ranking on the 7- point hedonic scale was arranged in a descending order from 7 to 1, where Excellently Desirable =7, Desirable = 6, Fairly Desirable = 5 , Fairly Undesirable = 3 , Undesirable = 2 and Poorly Undesirable = 1

Statistical analysis: Data obtained from the measurements was analyzed using SAS 2010.

RESULTS

The crude protein of meats in this study ranged between 27.75± 2.70 % to 33.80 ± 0.87 %. Crude protein in the meat of guinea fowl (33.80 ±0.87 %) was significantly ($p< 0.05$) higher than that of indigenous chicken (31.12 ±1.30 %) and duck (27.75± 2.70 %) as presented on Table 1. Guinea fowl meat had the lowest fat content (11.75 ± 1.54%) followed by chicken (15.31± 1.57%) while the highest fat content was found in duck (17.12± 0.50%). There was no significant difference ($p>0.05$) in the moisture content of indigenous chicken, duck and guinea fowl in this study.

The ash content of the meat was found highest in chicken (2.92 ± 0.39%) as shown on Table 1. Ash content differs between guinea fowls and chicken, the ash content in chicken was slightly higher than that of guinea fowl. However, duck meat had the least ash content (2.02±0.14%). Guinea fowl had the highest crude fibre (0.43 ±0.01%) followed by duck (0.21 ±0.01%) while the least crude fibre was found in chicken. Duck meat had the highest nitrogen free extract when compared with guinea fowl and chicken.

TABLE 1: Proximate composition of native chicken, duck and guinea fowl (Mean ± SEM)

Composition (%)	**Chicken**	**Duck**	**Guinea fowl**
Crude Protein	31.12 ± 1.30^{b}	27.75 ± 2.70^{c}	33.80 ± 0.87^{a}
Fat content	15.31 ± 1.57^{b}	17.12 ± 0.50^{a}	11.75 ± 1.54^{c}
Crude fibre	0.17 ± 0.01^{c}	0.21 ± 0.01^{b}	0.43 ± 0.02^{a}
Moisture	16.18 ± 0.77	17.65 ± 2.67	16.27± 5.64
Ash content	2.92 ± 0.39^{a}	2.02 ± 0.14^{c}	2.69 ± 0.16^{b}
Nitrogen Free Extract	17.14 ± 1.51^{b}	21.87 ± 2.76^{a}	16.60 ± 2.53^{b}

The mean values for sensory properties of indigenous chicken, duck and guinea fowl meat are presented on Table 2. There was no significant difference ($p>0.05$) in the meat colour of native chicken, duck and guinea fowl. However, significant differences ($p<0.05$) exist in taste, flavour, tenderness, juiciness and overall acceptability of the meats. Indigenous chicken meat had the highest ranking for taste followed by guinea fowl and duck. The flavour of indigenous chicken and duck meat were similar and higher than that of duck meat. In the same vein, indigenous chicken meat had the highest ranking for tenderness followed by duck meat while guinea fowl meat had the least ranking for tenderness as presented on Table 2. Guinea fowl and indigenous chicken meat had similar ranking for juiciness. Duck meat had the highest ranking for juiciness, which may be attributed to the high fat content of duck meat. Indigenous chicken had the highest ranking for overall acceptability. The ranking of guinea fowl in overall acceptability followed that of indigenous chicken while duck meat had the least ranking in overall acceptability

TABLE 2: Sensory properties of native chicken, duck and guinea fowl (Mean ± SEM)

Parameters	**Chicken**	**Duck**	**Guinea fowl**
Colour	6.54 ± 0.12	6.34 ± 0.35	6.48 ± 0.33
Taste	6.77 ± 0.01^{a}	5.69 ± 0.19^{c}	6.23±0.05 ^{b}
Flavour	5.33 ± 1.67^{a}	4.88± 1.23^{b}	4.68± 0.07 ^{a}
Juiciness	5.34 ± 0.34^{b}	6.11± 0.62^{a}	5.65±0.21^{b}
Tenderness	6.65±0.35 ^{a}	5.67±0.51^{b}	4.96±0.15 ^{c}
Acceptability	6.94 ±0.17 ^{b}	5.02±0.31 ^{c}	6.87± 0.21^{a}

DISCUSSION

Crude protein in the meat of guinea fowl was higher than that of indigenous chicken. This corroborates the report of Penkov *et al.* (2017) that guinea fowl meat contain higher protein content than chicken meat. The percentage crude protein of meats of poultry species in this study was higher than the percentage reported for broilers (22.47± 0.54%) by Hassan *et al*. (2019). The crude protein of guinea fowl and indigenous chicken meat in this study was also higher than that of Arbo arce broiler (29.92±0.10%) and Marshall broiler chicken (28.99±0.16%) reported by Sogunle *et al*. (2010). The ash content, indicating the mineral content of the meat was found highest in indigenous chicken in this study. Fuzhu and Zhuye (2008) also found that ash components were also higher for native chicken. Choe *et al*. (2010) found that crude ash contents measured in Korean native chicken were higher than those of commercial broilers. Contrary to the report of Musundire *et al*. (2017) that ash content did not differ between guinea fowls and chicken, the ash content in chicken found in this study was slightly lower than that of guinea fowl.

According to Penkov *et al.* (2017), guinea fowl meat contain lower fat content than chicken meat. Choe *et al*. (2010) also found that crude fat contents of Korean native chicken was lower than that of commercial broilers. Valavan *et al.* (2016) reported that the crude fat content was lower in

native chickens compared with broilers. Wattanachant *et al.* (2004) determined the differences between the Thai native chicken and Broiler (Ross) through physio-chemical analyses and reported the superiority of the native Thai chicken over the broilers. Duck meat had the highest nitrogen free extract when compared with guinea fowl and chicken. This may be attributed to the high fat content of duck meat

Meat from indigenous chicken, guinea fowl and duck have similar value for colour. The colour of meat predominantly depends on the chemical state of myoglobin (Brewer, 2004; Mancini and Hunt, 2005), which is affected by the partial pressure of O_2, the concentration of hydrogen ions (pH), temperature, light access, tissue structure, the presence of substrates and co-factors, the activity of reducing enzymes and lipid oxidation (Mancini and Hunt, 2005). Meat colour, one of the most important criteria in initial selection by the consumer, is related to the concentration of pigments, mainly myoglobin, and the chemical state of the myoglobin on the surface of the meat, the structure and physical state of muscle proteins (Beriain *et al*, 2000). Duck meat had the highest ranking for juiciness, which may be attributed to the high fat content of duck meat. Small amounts of intramuscular fat which are necessary to lubricate the muscle fibres contributed to the juiciness of the cooked meat. Meat tenderness is one of the most important physical and sensory characteristic of meat (Bizkova and Tumova, 2010). Meat tenderness depends mainly on the post-mortem changes affecting myofibrillar proteins and on the connective tissue that represents the toughness (Arino *et al*., 2006)

CONCLUSION

The meat of guinea fowl contains more crude protein and fibre and less fat content than indigenous chicken and duck. Duck meat had the highest fat content and nitrogen free extract. There was no difference in the moisture content of indigenous chicken, duck and guinea fowl meats. Indigenous chicken meat had high ash content indicating high mineral content. The high crude protein, fibre and low fat contents of guinea fowl and indigenous chicken make them healthy for human consumption.

Indigenous chicken meat had higher ranking for taste, flavour and tenderness. Guinea fowl and indigenous chicken had similar ranking for flavour. In terms of juiciness, duck meat had the highest value. Guinea fowl meat had the least ranking for tenderness. The meats from guinea fowl, duck and indigenous chicken were similar in colour. In overall acceptability,guinea meat fowl is the most preferred followed by indigenous chicken meat while duck meat is less preferred.

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