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Evaluation of Carcass and Sensory characteristics of Nigerian Indigenous Chickens and their Crossbreds raised in Derived Savannah Environment of Nigeria

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Abstract
The carcass and sensory attributes of normal feather, naked neck, kuroiler, and kuroiler normal feather crossbred and kuroiler naked neck chickens was evaluated. Fifty-four (54) birds (matured cocks and hens) were used for this study that comprises of normal feather (NF) (4 male, 14 female), Kuroiler (KR)(4 male, 14 female), naked neck (NN) (4 male, 14 female) were obtained from existing chicken population stock at Animal Breeding Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. One hundred and thirty-eight day-old chicks were generated: naked neck (NN) 23 (NN x NN), normal feather (NF) 26 (NF x NF), Kuroiler (KR) 24 (KR x KR), Kuroiler normal feather crossbred 29 (KR x NF) and Kuroiler naked neck crossbred 36 (KR x NN). Progenies produced were maintained under similar environment for 12 weeks, and then slaughtered to analyze their carcass qualitative and organoleptic characteristics. Significant (P<0.05) of live weight, bleed weight, pluck weight, eviscerated weight, chest weight, wing weight, shank weight, drumstick and back weight respectively were more kuroiler chickens than its counterpart genotypes while thigh weight was more heavier in NN x NN chickens. Relative to the effect of sex, heavier carcass attributes were obtained in males than in females of all genotypes.Kuroiler naked neck crossbred (KR x NN) chickens had the highest scores for colour, juicy, tenderness and generally acceptable than those of normal feather, naked neck, kuroilers and kuroiler normal feather crossbred chickens. The panels found that naked neck meat had better favour (6.31) than its counterparts chickens. Carcass attribute was better for kuroiler chickens while kuroiler naked neck crossbred chickens displayed more sensory characteristics than other genotype. It is concluded that meat quality attributes was better for kuroiler chicken while crossbred from kuroiler naked neck hadenhanced sensory attributes among the chickens' genotypes considered.
Keywords: Naked neck, normal feather chickens, kuroiler, crossbred, carcass, sensory

Introduction

Poultry meat is considered as healthy, nutritious, safe and affordable choice among the available meat sources regardless of economic status of the consumer (Padhiand Chatterjee, 2013).The information on some of the carcass quality factors like eviscerated yield, abdominal fat, giblet and proportion of various cuts is important from consumer's point of view as well as for benefits to producers by predicting the yields and to assess the economic return. Carcass quality traits of exotic germplasm used for backyard poultry farming are available in literature (Ahmed *et al.,*2006; Mondal *et al.,* 2007).

Intensive poultry meat industry relies on commercial animals (hybrids) obtained from few selected lines; this results in a loss of biodiversity and limits the preservation of several local populations to hobby or fancy farmers (Cassandro *et al*., 2015). Local chicken breeds may, however, represent a source of genes for future breeding strategies and research (De Marchi *et al.,* 2006), and their conservation has become an important issue for the international scientific community (FAO, 2007). The indigenous chicken possesses great potentials for genetics improvement through breeding programme such as selection and crossbreeding (Adedeji *et al.*, 2018). An indigenous chicken is a supply of heterogeneous genetic material which differs in adult body size, plumage and weight which are often found in an extensive

system of poultry or scavenging freely (Ajayi, 2010).The dual-purpose breed ''Kuroiler chickens'' (KR) is explicitly bred for simultaneous use of cockerels in meat, and hens in egg production. This enables the switch from highly specialized hybrids, where usually one sex is favoured for production, to a well-balanced (slow-growing) dual-purpose breed, where both sexes are utilized, resulting benefits to animal welfare.

Among the various aspects in poultry science, improvement in genetic makeup by various breeding methods, such as crossbreeding to improve the carcass characteristics and meat quality is an important aspect. Crossbreeding has been a major tool for the development of present-day commercial breeds of chickens (Devankar *et al.*, 2018) and could likewise be used to improve the rural chicken. Comparatively, little research and development work has been crossbred poultry have higher feed efficiency and lower mortality as compared to purebreds and these two factors play a very important role in increasing profits in poultry production (Arora *et al*., 2011). The meat colour, aroma, flavour are essential sensory traits (Ekka *et al*., 2017). Poultry meat is of good quality if it fully meets consumer expectations and modern consumers seek meat that is low in fat, tender and juicy with good flavour and aroma (Haščík *et al.*, 2014). However, pacify studies are currently available in the literature investigating the characteristics of meat quality features of crossbred chickens originated from the mating of Nigerian indigenous local breeds with slow-growing commercial lines. Therefore, the aim of this study was to compare the Nigerian Indigenous chicken breeds, a slow-growing line, and their cross for carcass and sensory quality traits.

Materials and Methods

Experimental Site

The experiment was carried out at the Animal Breeding Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Ogbomoso is situated in the derived savannah zone of Nigeria on longitude 4^{o} 15' east and latitude 8^{o} 15' north east of the Greenwich meridian. The altitude is between 300m and 600m above the sea level. The mean annual rainfall and temperature are 1247 mm and 27^{o}C respectively (BATC, 2006).

The Experimental Animals and Management

The total number of 54 birds (matured cocks and hens) were used for this study that comprises of normal feather (NF) (4 male, 14 female), Kuroiler (KR)(4 male, 14 female), naked neck (NN) (4 male, 14 female) were obtained from existing chicken population stock at Animal Breeding Unit of Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso**.** One hundred and thirty-eight day old chicks were generated: naked neck (NN) 23 (NN x NN), normal feather (NF) 26 (NF x NF), Kuroiler normal feather crossbred 29 (KR x NF) and Kuroiler naked neck crossbred 36 (KR x NN). The experimental birds were managed strictly under intensive system of management. The age of the birds was between 18 weeks to 24 weeks for the hens and 18 weeks for the cocks. The birds were wing tagged individually for identification purpose. Cocks and hens were tagged individually in an open sided poultry house providing a two-tier galvanized battery cage space of 1800 square inches. Each bird was confined in a cell space of 15 by 7.5 inches. Medication and vaccination such as Lasota, Gumboro and Fowl pox was done as required.

Feed and Feeding of Parent Stock

The cocks were fed *ad libitum* with commercial breeders grower mash containing 16%crude protein and 2600 kcal/kg metabolizable energy. Hens were also fed commercial layers mash containing 16% crude protein and 2800 kcal/kg metabolizable energy. Clean and cool water were also supplied *ad libitum.*

Experimental Mating

Artificial Insemination (AI) method was used in mating the hens. The massage technique was used to collect semen from the cocks; the cocks were trained for two weeks for semen collection by applying pressure at the back towards the tail forty times before sperm production. Feathers around the cock's vent were trimmed at two weeks interval and semen collection from the cock started at 22 weeks of age after the collection of the semen it was immediately inseminated into a doughnut shape in the left vent of the hen. This was done twice in a week in the evening. For each hen, 0.1ml of undiluted fresh semen was used for insemination each time with an inseminator.

Mating Design

The mating design is as shown below:
Normal feather (sire) x Normal feather (dam): NF x NF
Naked neck (sire) x Naked neck (dam): NN x NN
Kuroiler (sire) x Kuroiler (dam): KR x KR
Kuroiler (sire) x Normal feather (dam): KR x NF
Kuroiler (sire) x Naked neck (dam): KR x NN

Egg Collection and Incubation

Eggs from artificial inseminated hens were collected along genotypes' lines and allow accruing in a cool room having 25^{o}C for five days before transfer to the hatchery for incubation. Eggs were set in a cabinet-type incubator at a commercial hatchery in Ibadan, Oyo State Nigeria and set along genotypes' lines at a temperature between 27-39^{o}C and a relative humidity of 55 to 56% for18 days, then the temperature and relative humidity increased to 29-40^{o}C and 70-75% respectively from 19th day to hatching time. The eggs were turned automatically through 90^{o}in the incubator. Candling was carried out on the 5thand 18thday of the incubation for the identification of fertile eggs and clear eggs using a candler fixed with a neon florescent tube carried out in a dark room.

Management of the Chicks

All chicks resulting from each genotype's lines were properly identified at day old by wing tagged with industrial aluminum galvanized tag at two weeks for proper identification. All chicks were raised under the same intensive management system. Vaccination and medication programs were duly observed from day old. The day old chicks were transferred to a separate and previously disinfected brooders pen. Every batch was brooded for six weeks.

Feed and feeding of the chicks

The chicks were fed *ad libitum* on a commercial chick mash from day old to six weeks of age containing 22 %crude protein and 2900 kcal/kg metabolizable energy. Thereafter, they were fed on a commercial grower mash till 12 weeks.

Data Collection

Carcass Evaluations

A total of 60 birds (10 from each genotype and 5 from each sex) were manually slaughtered. After slaughter, birds were manually de-feathered and eviscerated, and the carcasses were then immersed in chilled water for 1 hour. Upon removal from the chiller, carcasses were hanged for dripping and then cut up in different parts for further analyses. Empty carcass, breast, thigh, wing, drumstick, neck, liver, heart, gizzard, intestine, ribs and back were weighed all in gram and their yield calculated as a percentage of live weight at slaughter.

Sensory Evaluations

Sensory panel test on breast and thigh samples was separately performed by roasting the samples without salt or spices (Castellini *et al*., 2002). The cooked samples were immediately sliced into pieces and was offered to panelists (n = 15). For each sensory characteristic, participants were instructed to score the intensity of evaluation on a nine-point hedonic scale (1 for extremely dislike, 2 for dislike very much, 3 for moderately dislike, 4 for slightly dislike, 5 for neither like nor dislike, 6 for slightly like, 7 for moderately like, 8 for like very much and 9 for extremely like). The parameters evaluated included colour, flavour, juiciness, tenderness and overall acceptability.

Data analysis

Data generated were subjected to analyze of two-way analysis of variance applying the General Linear Model procedure of SAS software (SAS, 2009) while the means were separated using Duncan procedure of the same software. The model adopted is as shown below:

$Y_{ijk} = \mu + G_i + S_j + (G \times S)_{ij} + \varepsilon_{ijk}$

Where,

Y_{ijk}= Observation of dependent variable recorded on i^{th}genotype of j^{th}sex

μ = Population mean

G_i = Effect of i^{th}genotype (i =1, 2, 3, 4)

S_j= Effect of j^{th}sex (j=1, 2)

$G_i \times S_j$= Interaction between genotype and sex

ε_{ijk}= Residual error of k^{th} observation recorded on i^{th} genotype and j^{th}sex NID ~ 0, σ^2

Results

Carcass Characteristics

The least square means of carcass characteristics of normal feather, naked neck, kuroiler normal feather crossbred, kuroiler naked neck crossbred and kuroiler chickens is as shown in Table 1. Significant ($P<0.05$) effect existed between the genotypes and carcass characteristics measured. The results showed that KR x KR chickens had highest values of 1674.00 g, 1530.00 g,1622.00 g, 1150.00 g, 287.67 g, 142.67 g, 59.83 g, 163.00 g and 252.83 g for live weight, bleed weight, pluck weight, eviscerated weight, chest weight, wing weight, shank weight, drumstick and back weight respectively than its counterpart genotypes while thigh weight was more heavier in NN x NN chickens. Relative to the effect of sex, heavier live weight, live weight, bleed weight, pluck weight, eviscerated weight, chest weight, wing weight, shank weight, drumstick, thigh weight and back weightwere obtained in males than females of all genotypes.

Sensory Characteristics

The least square means of sensory evaluation of breast meat of Nigerian indigenous chickens and their crossbred progenies is presented in Table 2. Different sensory breast meat scores were obtained among normal feather, naked neck, kuroilers, kuroiler normal feather crossbred and kuroiler naked neck crossbred chickens. There were significant ($P<0.05$) variation between the chickens' genotypes and sensory characteristics evaluated. The result indicated that kuroiler naked neck crossbred meat received highest scores for colour (5.38), juiciness (5.75), tenderness (6.00) and acceptability (4.33) this implies that the breast meat of kuroiler naked neck crossbred meat was highest in colour, juicy, tenderness and generally acceptable than those of normal feather, naked neck, kuroilers and kuroiler normal feather crossbred chickens. The panels found that naked neck meat had better favour (6.31) than its counterparts chickens.

Discussion

In the present study, the kuroiler chicken had heavier weights for live weight, bleed weight, pluck weight, eviscerated weight, chest weight, wing weight, shank weight, drumstick and back weight breasts than naked neck, normal feather, kuroiler normal feather crossbred and kuroiler naked neck crossbred chickens. These differences are probably due to genetic constituents differences among breeds. The findings of present study are in agreement with previous studies by Nweke-Okorocha *et al*.(2020) that reported varied carcass characteristics in Naked neck, Normal feathered, Frizzle feathered and Noiler as influenced by breed and sex. Similarly, Adamu *et al*. (2021) observed varied carcass characteristics in different chickens of normal feathered, frizzled feathered and naked neck chickens in the semi-arid zone of Nigeria. These authors claimed that variations in the carcass components were due to variation in the genetic stocks of chickens used in the studies. Akpan *et al.* (2018) found Marshall x naked neck crossbred chickens was better than Marshall, naked neck, normal feather and Marshall x normal-feathered chickens. Chigoma and Tanganyika (2017) reported variations in the carcass components ofin normal feathered indigenous Malawian chickens. Sahomen *et al.* (2012) reported variations in the carcass components and sex differences in normal feathered, frizzled feathered and naked neck chickens. Isidahomen and Njidda (2012) found carcass characteristics varied among naked neck, frizzled and normal feathered indigenous chickens in southern Nigeria corroborated with this current findings on variations in the carcass components of normal feather, naked neck, kuroiler, kuroiler normal feather and kuroiler naked neck chickens. Biazen *et al.*(2013) reported genotype variations in respect to carcass evaluation for Koekoek, Kuroiler, Sasso and one Ethiopian indigenous (Horro) genotypes in Ethiopia while the Kuroiler chicken outsmarted other genotype which was in agreement to current finding.

Regarding sensory evaluation, the breast meat of kuroiler naked neck crossbred chicken received colour, juiciness, tenderness and general acceptability scores than those of normal feather, naked neck, kuroiler naked neck and kuroiler normal feather crossbreds chickens. Better flavour of chicken breast might be due to increased fat levels in the meat however, the differences in juiciness might be attributed to higher content of water and intramuscular fat. The sensory results obtained are consistent with the findings of Fadare *et al.* (2019) who reported that the unique variations colour, juiciness, tenderness and general acceptability of indigenous chickens are preferred than guinea fowl and duck. Moreover, the results of Uddin *et al*. (2021) confirmed the specificity of meat characteristics of naked neck and non-descriptive deshi chicken meat and demonstrated the potential benefit of cross-breeding to improve production traits of crossbred without compromising the peculiar quality of its meat that was in agreement with this current findings. Sogunle *et al.* (2010) found variations in sensory properties of meat from broiler chickens of different origin that consistent to the present study. Olawuyi *et al.* (2019) reported variations in organoleptic properties with the highest tenderness of thigh muscles was established in FUNAAB alpha chickens and the highest aroma score in Ross chickens that corroborated with current findings.

Conclusion

It is concluded that variation exists among different genotypes of chickens and their sexes. Carcass traits of crossbred of kuroiler naked neck were comparable with those of normal feather naked neck and kuroiler normal feather crossbred chickens. However, kuroiler chickens showed better carcass characteristics and male birds had better carcass traits than females while kuroiler naked neck meat scored highest for sensory evaluation.

Table 1: Least square means of carcass characteristics of pure and crossbred progenies of Nigerian indigenous chickens and Kuroiler birds

Parameter	Obs	LW (g)	BW (g)	PLK (g)	EW (g)	CH (g)	WL (g)	SHK (g)	DMS (g)	TL (g)	BCK (g)
Genotype											
NF x NF	26	834.67^{d}	734.58^{d}	808.58^{d}	545.58^{d}	125.92^{c}	76.17^{d}	32.00^{c}	81.67^{d}	87.83^{d}	114.33^{c}
NN x NN	23	1311.07^{b}	1273.00^{b}	1195.00^{b}	913.25^{b}	262.13^{ab}	114.88^{b}	35.00^{b}	126.50^{b}	131.00^{a}	99.75^{d}
KR x KR	24	1674.00^{a}	1530.00^{a}	1622.00^{a}	1150.00^{a}	287.67^{a}	142.67^{a}	59.83^{a}	163.00^{a}	117.67^{b}	252.83^{a}
KR x NF	29	970.32^{c}	934.89^{c}	872.71^{c}	595.36^{c}	142.82^{b}	82.57^{c}	33.54^{c}	89.43^{d}	96.29^{c}	135.39^{b}
KR x NN	36	951.34^{c}	922.96^{c}	859.96^{cd}	593.19^{c}	142.24^{b}	86.80^{c}	38.32^{b}	93.64^{c}	90.64^{c}	119.83^{c}
±SEM		23.90	21.45	28.65	30.42	23.89	5.67	3.23	12.32	8.78	19.06
Sex											
Female	73	1034.00^{b}	976.15^{b}	969.80^{b}	698.38^{b}	181.75^{b}	92.04^{b}	32.01^{b}	97.44^{b}	105.26^{b}	147.98^{b}
Male	65	1263.00^{a}	1182.00^{a}	1174.00^{a}	820.92^{a}	202.56^{a}	109.20^{a}	47.46^{a}	124.26^{a}	128.11^{a}	180.87^{a}
±SEM		30.90	23.89	34.78	9.88	22.94	5.45	2.84	5.66	4.76	7.88

^{abcd}: Means along the same column at each subclass with different superscripts are significantly ($P<0.05$) different

NF x NF = Normal feather, NN x NN = Naked neck, KR x KR = Kuroiler, KR x NF = Kuroiler Normal feather crossbred, KR x NN = Kuroiler Naked neck crossbred, LW = Live weight, BW =Bled weight, PLK = Pluck weight, EW = Eviscerated weight, CH = Chest weight, WL = Wing weight, SHK = Shank weight, DMS = Drumstick, TL = Thigh weight, BCK = Back weight.

Table 2: Least square means of sensory evaluation of breast meat of Nigerian indigenous chickens and their crossbred progenies

Genotype	Obs	Colour (%)	Flavour (%)	Juiciness (%)	Tenderness (%)	Acceptability (%)
NF x NF	15	3.42 ±0.62^{b}	4.26±0.56^{b}	3.74±0.22^{b}	5.42±0.12^{b}	3.47±0.33^{c}
NN x NN	15	4.44±0.21^{ab}	6.31±0.54^{a}	4.56±0.34^{ab}	5.81±0.22^{ab}	3.88±0.23^{b}
KR x KR	15	4.57±0.55^{b}	4.29±0.34^{b}	3.50±0.21^{c}	5.62±0.56^{ab}	4.06±0.38^{ab}
KR x NN	15	5.38±0.78^{a}	4.50±0.23^{ab}	5.75±0.29^{a}	6.00±0.34^{a}	4.33±0.11^{a}
KR x NF	15	3.25±0.11^{ab}	4.33±0.27^{ab}	3.67±0.51^{b}	5.83±0.61^{ab}	3.36±0.02^{c}

^{abc}: Means along the same column with different superscripts are significantly (P<0.05) different
Obs = Number of observation, NF x NF = Normal feather, NN x NN = Naked neck, KR x KR = Kuroiler, KR x NF = Kuroiler Normal feather crossbred, KR x NN = Kuroiler Naked neck crossbred

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