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Research Article

Morphology, Carcass Quality and Composition of the Helmeted Guinea Fowl Numida Meleagris, in Nigeria

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Abstract

The helmeted Guinea fowl is most prevalent of bird species in the family of pheasants in Nigeria. There seems to be an increase in the production, marketing and distribution of this bird due to increasing demand for poultry products. Twenty (20) guinea fowls were sampled from livestock markets in Edo and Delta States, and were examined for their physical and carcass characteristics, by measuring the indices of morphology and by chemical analyses. The average body length of the bird was 56.6 ± 2.37 cm and height 25.6 ± 1.6cm, wing lengths 19.3 ± 1.39cm and neck length 13.3 ± 1.15cm. Average live weight recorded was 0.848g, while average slaughter and dressed weights were 0.733g and 0.639g respectively while dressing percentage was 75.6%. Guinea fowl meat odor was pleasant, meat color was white, the lean well textured and delicate with distinctive game flavor. Proximate analysis of dressed carcass indicated average crude protein content of 32.54%, mean ether extract value of 18.6%, while mean ash content was 1.87%. It was found a good source of low-fat functional meat. This study recommended that guinea fowl production and consumption should be promoted as an alternative and as supplementary to other poultry species in Nigeria.

Keywords: Guinea Fowl; Carcass Characteristic; Chemical Composition; Meat Yield

Introduction

Guinea fowl belongs to the pheasant family. The bird is believed to have originated from the Guinea coast of Africa whence the name, Guinea fowl, was derived. Various species of the bird are found across the African continent! Among them are the white breasted guinea fowl, *Agelastes meleagrides*, black breasted guinea fowl *Agelastes niger*, plumed guinea fowl *Guttera plumifera*, crested guinea fowl *Gutlera puckerani*, the vulturine guinea fowl *Acyllium vulturlnum*, and the helmeted guinea fowl Numida meleagris [15]. In West Africa the grey or black breasted and helmeted species are common in the areas bordering the Sahara; while the helmeted guinea fowl is most prevalent in Nigeria [18]. The bird is enlisted among the world`s genetic resources requiring development through research [8]. Although the scale of commercial production of guinea fowl in the country, is very low compared to broiler and layer birds, the awareness of the food value of this bird is steadily on the increase; the meat and eggs are popular and highly relished across the country [18,19].

In Nigeria, guinea fowls are sold in large numbers at major livestock markets in towns and cities. Most of the birds are transported from the Northern region of the country, while a few are reared in the south. For example, Songhai Demonstration Farms in Sapele, Delta state in the south, produce an appreciable number of the birds annually, for marketing and distribution to consumers, while the Wildlife Experimental farms, in the University of Benin in Edo state, operate Guinea fowl units where a sizable number are reared for experimen-

tal purposes. The variability in production systems and the specific factors which may affect the carcass quality, composition and food value of the bird, are therefore not clearly evident. Much knowledge about the guinea fowl has been due to studies undertaken during the last two decades. It is necessary to update information on this species as there seems to be increase in production and demand for the bird.

Hence this study was undertaken to serve the purpose of routine evaluation of food animal resources available to consumers in Nigeria and elsewhere in the tropics. This study focused on the guinea fowl, and presents an update review and current information, on the food value of the bird among other poultry species. The objectives were to examine the physical characteristic by observation and body measurements of live birds arriving at the marketing centers; assess characteristics of their carcass; and determine by chemical analysis the proximate composition and quality of the meat.

Materials and Methods

Source of guinea fowls

Twenty (20) guinea fowls examined were purchased randomly from main Livestock Trade Depots in Edo-Delta - Pessu and Igbudu markets in Warri, and Aduwawa and Oliha markets in Benin-City. The birds were purchased in batches of four (4) birds each over a period of two (2) months. Birds were transported in cages from the markets to the Poultry slaughter unit, University farm project, Benin-City, where measurements were undertaken.

Body measurements

Morphological features of live birds were examined! These included live weight (LW) of each bird which was measured using a physical balance and recorded in grams. Other indices of morphology were plumage, and sizes of body parts which were measured using a centimeter tape. Thus data on weight of birds, length of body, longitudinal and latitudinal circumferences, height, neck length, neck circumference, and length of lap and wings were obtained.

Carcass measurements/analysis

The birds that were earmarked for slaughter were deprived of feed for a period of 24 hours, but clean tap water was given. This was to ensure easy cleaning of carcass during evisceration according to recommendation [12]. Each bird was slaughtered by positioning bird laterally and cutting through the jugular with a sharpened knife. Following bleeding the carcass was weighed and the value recorded as carcass or slaughter weight (SW). Thereafter carcass was immersed in hot water for a few minutes to loosen the feathers. Then feathers were hand plucked from carcass and discarded. The head and limb terminals (toes and nails) were severed and also discarded along with feathers as external offals (EO). Then plucked carcass was weighed and recorded as plucked or defeathered carcass weight (CW). Thereafter a longitudinal incision was made on the abdomen to expose the visceral (internal) organs. These were removed to obtain eviscerated or dressed carcass, which was weighed and recorded as dressed weight (DW). The internal organs - the alimentary canal, liver, kidneys and lungs and other visceral organs, were identified and weighed separately, and then recorded as organ weight (OW). The weight of each organ was also expressed in relation to live weight (ROW) of the bird, while the summation of organ weights was recorded as internal offals (IO). The indices of carcass quality were thus determined by calculations based on the following standard equations

Carcass % = Carcass Weight/live weight x 100

Dressing % = Dressed Weight/live weight x 100

Relative Organ Weight = Organ Weight/live weight x 100.

Chemical analyses

Samples of dressed carcass were weighed and oven-dried and prepared for proximate analysis. The oven was set at a temperature of 105°C to dry for 24 hours. Then samples were removed from oven and then desiccated to cool and reweighed to determine dry matter (DM) content. Dried samples were milled into powder and then packaged in air-tight, water-proof sample pouches, labeled and stored in metal cabinet, until required for bench work. Proximate analysis was performed for crude protein, ether extract and ash. Conventional analytical techniques described by Association of Official Analytical chemists [1] were used for all determinations.

Crude Protein: A portion (2g) of each sample was transferred to a Kjedhal flask. Then an amount (20ml) of conc. sulphuric acid (H_2SO_4) and 1g of selenium catalyst were added. The solution was then heated until it became colorless. The process converts protein nitrogen to ammonia in the form of ammonium sulphate. Sodium hydroxide (NaOH) was added to the digest to liberate the ammonia; which was distilled off, collected into about 5ml of boric acid and determined by titration. Based on the assumption that the nitrogen content of protein is 16%, the crude protein (CP) content of sample was computed

by multiplying nitrogen content determined by the classical factor (6.25), according to the following equations and calculations

Stage 1: (-NH2) + H2SO4 - (NH 4)2SO4 + CO2 + O2

Stage 2: (NH4)2SO4 + NaOH - NaSO4 + 2NH3+ H2O

% N = Va x VF x MWN/100 Ws x aliquot. %CP = %Nr x6.25

Where: Va - volume of acid used in titration, VF - volume of volumetric flask used for digestion. MWN - molecular weight of nitrogen (0.00014), Ws - weight of sample.

- **Ash Content:** Two (2g) of sample was measured into a previously weighed and ignited crucible, then placed in muffle furnace and heated at 560°C for 6 hours to ash indicating combustion of the organic matter in the original sample. Following, the residue (ash) was removed from the furnace, cooled in a desiccator and weighed. The ash content is expressed thus: weight of ash/weight of sample x 100/1.
- **Ether Extract:** Fats and fatty substances are characterized by their solubility in the series of organic solvents and this phenomenon was utilized in determining the lipid content of the various samples, crude lipid was determined by solvent extraction with petroleum ether in a Tecator Soxhlet extractor. Then the solvent was distilled off and the residue was dried for over an hour in a vacuum oven set at 72°C. Following, residue was cooled, desiccated and weighed. The drying and weighing process was repeated severally until a constant weight was attained. Thus ether extract (EE) content of sample was calculated using this equation: % Ether extract = weight of oil/weight of sample x 100/1.
- **Nitrogen free extract:** This comprises the soluble carbohydrate component of organic matter in sample was determined by arithmetic: the summation of the values of ash, crude protein, ether extract and crude fiber components of the samples; and subtraction of this sum from the total dry matter content of sample - %NFE = % DM - % (CP + CF + Ash + EE). The NFE value is an approximation because it includes the cumulative errors of the other determinations and thus also expressed as a proportion of total dry matter (DM).
- **Statistical analysis:** Variance analysis was performed for the data obtained from measurements. Means were separated and compared by Duncan's Multiple Range Test.

Results

Morphology and carcass characteristics of guinea fowl

The guinea fowls commonly found and consumed in Nigeria and which we examined in this study had variable plumage colors. There were those that were pure white or grey with black and white spots; and others that were black and dotted with white. Body measurement and carcass characteristics of mature guinea fowls are shown in table 1. The average body length was 56.6 ± 2.37 cm and height 25.6 ± 1.6cm, wing lengths 19.3 ± 1.39cm and neck length 13.3 ± 1.15cm. Carcass and dressing percentages of the guinea fowl were high being 73.30 ± 1.27 and 75.60 ± 2.75 respectively implying that is a good source of Animal Protein. The liver was the largest internal organ, with a Relative organ weight (ROW) of 16.8 ± 1.29. The sizes of the Crop and GIT followed with ROW values of 11.2 ± 1.06 and 2.97 ± 1.72 respectively (Table 2).

No	Body Length (cm)	Long circ (cm)	Lat Circ (cm)	Height (cm)	Neck Length (cm)	Neck Circ (cm)	Wing Length (cm)	Wing Circ (cm)
B1	49.0	90.0	38.0	23.0	12.0	8.0	19.0	6.0
B2	60.0	98.0	43.0	28.0	14.0	10.0	19.0	9.0
B3	54.0	92.0	39.0	23.0	13.0	9.0	20.0	7.0
B4	58.0	95.0	42.0	24.0	13.0	10.0	19.0	9.0
B5	62.0	99.0	45.0	30.0	15.0	11.0	19.0	8.0
B6	57.0	96.0	40.0	24.0	13.0	10.0	19.0	9.0
B7	51.0	90.0	40.0	23.0	12.0	9.0	19.0	7.0
B8	61.0	99.0	46.0	27.0	14.0	12.0	20.0	9.0
B9	54.0	95.0	44.0	25.0	13.0	11.0	19.0	8.0
B10	60.0	97.0	46.0	29.0	14.0	12.0	20.0	10.0
Mean	56.6	95.1	42.3	25.6	13.3	10.2	19.3	8.2
S.D	± 2.38	± 3.08	± 2.06	± 1.6	± 1.15	± 1.01	± 1.39	± 0.91

Table 1: Body Measurement of Guinea Fowl (cm).

Key: B1 to B10 represent the number assigned to each Guinea fowl bird.

Number	Live Weight (kg)	Slaughter Weight (kg)	Carcass Weight (kg)	Dressed Weight (kg)	Weight of Internal organ(g)	Dressing (%)
B1	0.784	0.765	0.658	0.558	84.61	71.79
B2	0.850	0.837	0.725	0.637	85.58	75.29
B3	0.855	0.829	0.759	0.685	88.37	80.23
B4	0.797	0.781	0.668	0.568	84.81	72.15
B5	0.897	0.876	0.764	0.666	84.44	74.44
B6	0.841	0.804	0.773	0.693	91.66	82.14
B7	0.788	0.769	0.661	0.562	83.54	70.90
B8	0.962	0.948	0.836	0.736	86.46	77.89
B9	0.806	0.777	0.690	0.595	85.80	74.04
B10	0.902	0.883	0.796	0.697	86.67	77.18
Mean	0.848	0.827	0.733	0.639	86.19	75.67
S.D	± 0.281	± 0.288	± 0.271	± 0.253	± 2.94	± 2.75

Table 2: Live Weight and Carcass Measurement of Guinea Fowl.

Key: B1 to B10 represent the number assigned to each Guinea fowl bird.

Live weight	Head	Heart	Gizzard	Liver	Crop	GIT
0.85	3.85	0.44	2.03	1.68	1.12	2.97
± 0.29	± 1.96	± 0.66	± 1.42	± 1.29	± 1.06	± 1.72

Table 3: Relative organ weight of the Guinea fowl.

Chemical Composition of Guinea Fowl Meat

The dry matter of guinea fowls meat contained the following range of approximate values of nutrients: crude protein range 26.58 - 39.51%, with mean value of 32.54%; ether extract 16.54 - 20.46 with mean value of 18.6%; Ash 1.80 - 1.92 with mean value of 1.87%; Nitrogen free extract 39.29 - 53.07 with mean value of 46.93% (Table 4).

Discussion

Origin of guinea fowl

The guinea fowl is a native of Africa; and many species of wild guinea fowl are found in Nigeria, The common domesticated guinea fowls, Numida meleagris, descended from one of these wild species. It is labeled as one of the best exterminators of pest insects [5,20]. They exist in the grass land areas spreading from the derived savanna to the northern guinea savanna vegetation zones whence they are transported and distributed across Nigeria and sold to consumers. The guinea fowls do present a variety of plumage colors; there are those that are pure white or grey with black and white spots, and others that were black and dotted with white [7]. The helmeted guinea fowl which were found in Aduwawa and Oliha markets in Benin-city, Pessu and Igbudu livestock markets in Warri, Delta, and examined in this study were grey and black plumage with dots of white. In consonance with previous reports [7,13] we found that the male and female sexes were almost identical in appearance although females had spots over their breast and their buff color was unmarked. The rest of the body had mottled pattern. The adults were helmeted but the wattles of the males were larger than the female's.

Morphological features of guinea fowl

In animal systems and studies both experimental work and in practice, body measurements are taken on live animal for a variety of reasons. Overall body measurements indicate the way in which the animal is changing shape; and the records are useful in predicting live weight and carcass composition [6].

Number	Crude protein	Ether extract	ASH	Nitrogen free extract
B1	29.37	17.52	1.88	51.23
B2	28.50	16.55	1.84	53.07
B3	26.58	20.46	1.80	51.16
B4	38.70	19.5	1.92	39.88
B5	39.51	19.3	1.90	39.29
Mean	32.54	18.6	1.87	46.93
S.D	± 2.55	± 1.92	± 0.61	± 3.06

Table 4: Proximate Composition of Guinea Fowl Meat (g/100g DM).

Key: B1 to B5 represent the number assigned to each Guinea fowl bird.

Live weight measurement is one of the widely used techniques in determining the growth rates of animals and in predicting the body compositions and the rate at which various tissues have grown. The live weight records are used to predict the expected tissue deposition in the carcass of the animal when it is slaughtered. The records indicate when the terminal points for the production cycle is approaching; and show when the animal reaches or crosses the optimal live weight which is commensurate with grading criteria; that is, the time and weight the animal expectedly attains the suitable body composition that meets the various grading requirements for the animal or its carcass/meat [11]. This means that live weight at maturity is time-bound; and hence live weight records form the basis for decisions on feed adjustments/formula, and on the appropriate time to market the animal for maximum profit and for consumer satisfaction [12].

At the outset of this study the birds on arrival at the laboratory were denied feed for two reasons viz: firstly, to enable ease of cleaning of carcass during evisceration and to have accurate organ weight (alimentary canal) measurement. Secondly, feeding prior to slaughtering would naturally add bulk to the digesta in the GIT and thus impact higher values of live weight (LW) and slaughter weight (SW) of the bird; while inaccurate values would result from measurements and computations of relative organ weight (ROW) and dressing percentage, since the digesta is of no value and would normally be discarded. It is the dressing percentage that is the prime index of carcass quality [9,12].

Carcass characteristics of guinea fowl

The weight of dressed carcass and its composition are the determinants of the carcass quality, which can be defined as the proportion of major tissues, bones muscles and fat [9,12]; and the market value of the carcass and meat is dependent on this proportion. It is of interest that Nutritionists are currently preoccupied with the subject of diet and disease which has led inevitably to the concept of meat quality being synonymous with minimal levels of fatty tissue. On the basis of this concept guinea fowl meat can well be described as a good quality meat, as it has an appreciable muscle mass with minimal levels of fatty tissue, which are the desirable characteristics of meat for nutritional dietetics.

The guinea fowl usually attain maturity at ten weeks; the carcasses at this stage weigh between 0.5-1.0 kg; which make them suitable table birds for the average family [13,16,17,20]. In the evaluation of poultry carcass the terminal processes involve cutting/splitting the carcass into meat cuts for consumer use [9,12]. In this study, this was achieved by first removing the leg sinews and drawing them out from the entire limb. Then the legs were cut out from below the knee joint; while the wings and head were removed from the body. Finally, the carcass was sectioned into standard poultry cuts - laps, drumstick, wings, breast, and back- for preparing food dishes. Carcass evaluation results indicated that carcass and dressing percentages of the guinea fowl were high, 73.30 ± 1.27 and 75.60 ± 2.75 respectively (Table 4). This means that for guinea fowl, edible meat mass is significantly higher than the offals; thus less waste would be generated from slaughtering and processing; suggesting that the bird is an economic source of animal protein. Moreover, the samples of guinea fowl meat examined in this study, were well textured and delicate white lean/flesh, and presented sweet smelling odor with distinctive game flavor. The lean: bone ratio of the various meat cuts (Table 4) indicated that guinea fowls have appreciable value as an alternative poultry species, capable of substituting and/or complementing chicken and turkey as important birds for animal protein supply in Nigeria.

Chemical composition of guinea fowl meat

Chemical analyses indicate that guinea fowl meat is a high protein, low fat and mineral dense meat (Table 3). Of interest is the protein content (32.5% CP) measured for the guinea fowls in this study, is comparatively higher than the 19.6% CP required of a

protein source [21]. It was also significantly higher than the values reported for chicken-19.20%, turkey-22.20%, ducks-24.0% and quails-31.10% [19,21]. Like the quail, guinea fowl is not a fatty meat; the average fat content measured in this study for guinea fowl, was 18.6%, a value which is lower than values reported for duck-39.3% fat, pork-31.01%, broiler-30.46%, indigenous domestic fowl-26.62%, and the old layer-6.32% [18,19]. Thus like the quail guinea fowl is potentially a low cholesterol meat; and therefore falls in the class of animal protein recommendable, in nutrition and dietetics, to the obese and the elderly [18,19]. The guinea fowl meat examined in this study contained 1.87% Ash! In comparison, the Ash values reported for beef-1.10% and turkey-0.91% [19, 21], indicate that guinea fowl is superior to other livestock as sources of bio-minerals.

Economic value of guinea fowl

Guinea fowls are believed to have originated from Guinea whence the name was derived; and now are among popular poultry species in the African continent and in parts of Europe and the Carribean. There are over 50 million semi-domesticated guinea fowls in Nigeria; constituting about 25% of the entire domestic poultry population in the country, making it a valuable source of animal protein which is socially acceptable [5]. Guinea fowls have long been recommended as viable for small scale poultry production [3,14,15,17,20]; and for use in scientific research, especially in physiology studies [21]. The birds are less expensive to purchase by a beginner and are less of financial risk to maintain on the farm [14]. The guinea fowls are always more capable of coping with the effects of dry weather conditions prevailing in the Northern Guinea Savanna and Sahelian ecological zones than other domestic poultry! The birds are apparently free from the poultry diseases that are worrisome to most farmers and scientists! And they are sold and consumed by various tribal groups in Nigeria! And many urban dwellers consider the guinea fowl meat as alternative to game/bush meat. Also of interest are the reports that the flesh of young guinea fowl is tender and has a fine flavor and very high acceptance value [2,3,4,13,16,17]. In addition, the guinea fowl egg commands premium market prices because of gammy flavor and better storage ability it has than the domestic fowl egg. The guinea fowl egg shell is thick and does not crack easily like domestic fowl egg. There were reports that consumption of guinea fowl eggs tend to enhance virility and sexual potency [5,10].

Conclusion and Recommendation

In Nigeria the rearing of guinea fowl for domestic and commercial purposes is evidently more common in the North than in the south! But across the country, there is not enough awareness given to the economic value of the bird. This study has revealed that the guinea fowl is a good source of protein! The meat is also a low fat, while it is dense in minerals. It is a relatively medium size species; and its weight could be of advantage in reducing the cost of production, transportation, marketing and its utilization as supplement to other poultry species. Therefore this study recommends intensive research on genetic improvement of the species, and on the behavior, welfare and husbandry techniques, to encourage increased production and large-scale commercial farming of the pheasant in Nigeria.

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