Acta Scientific Veterinary Sciences (ISSN: 2582-3183)

Volume 4 Issue 11 November 2022

Research Article

Compositional and Carcass Analysis of the Domestic Speckled Pigeon, Columba Guinea, in Nigeria

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Received: June 27, 2022

Published: October 17, 2022

Abstract

A total of 25 domestic pigeons, Columba guinea, were examined for their physical characteristics, carcass and chemical composition. The pigeons showed stout compact body with small head, short neck, short slender bills and legs with fleshy cares, moderately large wings, and variable plumage. Average live weight (LW) recorded for a pigeon was 279.74g; while carcass (CW) and dressed weights (DW) were 236.01 and 165.78g respectively. Carcass and dressing percentages were 86.37% and 59.25% respectively, indicating appreciable lean meat content. Moisture content (MC) and dry mater (DM) percentage values were 72.17% and 27.83% respectively. Protein content (CP) of fresh meat (wet basis) was 18.90%, ash contents was 4.54% and the ether extract revealed a low fat content of 1.87%, which recommends the meat as useful to dietetic persons. Pigeon meat presented cherry red color,a characteristic chicken odor and aroma, firm texture and tough consistency. The pigeon offers potential for commercial production to complement other poultry species and increase animal protein supplies in developing countries.

Keywords: Speckled Pigeon; Physical; Chemical Composition; Carcass Characteristics; Meat Quality

Introduction

One of the major economic problems facing developing countries is the production and supply of adequate animal protein to combat protein inadequacies which is evident in many parts of the tropics. Recent attempts to address this problem include research efforts aimed at examining and developing protein rich food resources, including unconventional or lesser known food animals, as suggested by FAO [9]. In Nigeria, the speckled pigeon, Columba guinea is one of the unconventional poultry species; and it is the most commonly domesticated among species of pigeon, although yet unpopular! It is found all year round in virtually all regions in the country, breeding occurs during the dry season, and is a great delicacy among the rural populace across the country and elsewhere in the tropics. Creating awareness of the nutritional importance of pigeon and encouraging interest in pigeon farming is the premise of this study! Unlike conventional poultry species, pigeon farming is a low cost enterprise; just as presently, the bird is reared only at rural enterprise level but sold along with other poultry species in open markets. The meat is potentially a low fat, lean meat, recommendable in nutritional dietetics according to Olomu [18]. Hence this study was conducted with the objectives to evaluate the chemistry and structural composition of the pigeon; and to present updated information on its taxonomic features and potential value. In this regard, proximate compositional analysis, anthropometric measurements and methods for carcass and meat evaluation were applied.

Materials and Methods

Location of study

This study was undertaken in Benin-City, in the south-south region of Nigeria; and located between longitude 6°04"E and 6°43'E

and latitude 5°44"N and 7°34'N. The region has a humid tropical climate! Annual average rainfall ranges from 1500mm (59") upland in the north to 2800mm (98") in the coastland, down the south! The average temperature is about 25°C (77°F) in the rainy season and about 28°C (82°F) in the dry season. The vegetation is predominantly swamp forest in the south and rain forest in the north and central districts of the region. Thus naturally, the environment is suitable for breeding and rearing of pigeons.

Source of pigeons

Domesticated and wild pigeons can be found in virtually all parts of the country! But the domestic pigeon is reared and sold for meat in Nigerian markets. A total of twenty-five (25) matured speckled pigeons were purchased randomly from the poultry markets in different animal trade centers located in two major cities (Aduwawa and New-Benin markets in Benin-city; and Pessu and Igbudu markets in Warri) in the Nigerian south-south region.

Physical measurements

Twenty (20) matured birds were sampled from the pigeon units. Morphological features were examined according to procedure described by Dana., *et al.* [6]. Measurements were taken for live weight, using an electronic balance; and sizes of body parts, using a centimeter tape. The mean values for the different measurements - average weight of birds, body length, wing length and limb length, were computed and recorded.

Carcass measurements

Routine laboratory methods of carcass analysis were followed. Birds were slaughtered by cutting the neck with a sharp knife and letting to bleed. Following bleeding slaughter weight (SW) was taken for each carcass. Then the feathers, head, nails and cornified epidermis around the limbs, representing the external offals (EO), were removed to obtain defeathered carcass, which was then weighed and recorded as carcass weight (CW). Defeathering was performed by immersing undressed carcass in hot water for about 2 minutes, to loosen the feathers and to make them easy to easy to remove by hand-plucking.

The defeathered carcass was eviscerated and dressed, by cutting open the abdomen to remove the internal (visceral) organs, representing the internal offals (IO). Eviscerated organs included the alimentary canal, liver, kidneys, lungs and associated tissues. These were identified and weighed separately to determine the organ weight (OW). Each organ weight was expressed in relation to live weight of the bird and recorded as relative organ weight (ROW). Then dressed carcass was weighed and recorded as eviscerated or dressed weight (DW). Thus the indices of carcass quality were determined by calculations based on the following standard equations

Carcass percentage (%) = Carcass Weight/Live weight x 100

Dressing percentage (%) = Dressed Weight/Live weight x 100

Relative organ weight (%) = Organ Weight/Live weight x 100

Carcass chemical analysis

Proximate analysis was performed for both fresh and the dried dressed pigeon. For moisture, samples of fresh dressed carcass were first weighed and then placed to dry in a DHG-9202 thermostatic drying oven set at 105°C for 24 hours. Thereafter, the samples were placed in a desiccator to cool and then reweighed. It was necessary to perform the drying, cooling and weighing processes for samples at repeated intervals of 4 hours until a constant weight was maintained, which was recorded and hence percentage moisture content (%MC) was calculated for each sample as follows

% MC = Weight of fresh samples - Weight of dried samples x 100/Weight of fresh samples

The dry matter content of pigeon was thus derived by computation. The main components of fresh sample and dry matter (crude protein, ether extract/fats, ash and nitrogen-free extract/soluble carbohydrates) were determined separately using the standard methods of proximate analysis described by the Association of Official Analytical chemists [2]. The dried samples were milled into powder first with pestle and mortar and then with electronic Sorex blender. The milled samples were packaged in water-proof sample pouches, zipped, labeled and kept in cool storage, until required for analysis.

Crude Protein: A portion (2g) of each sample was transferred to a Kjedhal flask. Then an amount (20ml) of conc. sulfuric 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 sulfate. 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 x 6.25

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 Gallenkamp muffle furnace, size 2, set 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 was thus expressed arithmetically as 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 dressed pigeon carcass. 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. The data was analyzed using SAS (System Analysis Software) and means were separated and compared by Duncan's Multiple Range Test.

Results

Physical characteristics of the speckled pigeon

The speckled pigeon showed plumage color was variable among the pigeon population! Some birds were all-white or all-black or brown, while others had a mixed plumage including grey-brown, black-brown, grey-black, white-grey and white, black. An average matured pigeon measured a body length (cm) of 23.20 ± 0.35 and width of 19.60 ± 0.15, while the lengths of the wings and shank were 21.60 ± 1.84 and 10.50 ± 0.02 respectively (Table 1). Carcass and Dressing percentages measured for the birds were high, averaging 84.37% and 59.25% respectively. This implies that the domestic pigeon is an economic source of animal protein. The liver is the largest internal organ and measured a relative organ weight (ROW) of 1.95%; then the alimentary canal with a length of 68.70 ± 0.37 cm and relative weight of 1.59%.

Chemical Composition and Quality characteristics of Pigeon meat

Pigeon meat measured high moisture content (MC) being 72.17 ± 1.16%, while dry matter (DM) was 27.83 ± 2.59, crude protein (CP) was 18.90 ± 1.59 on wet basis, while the value was 69.98 ± 0.40 on dry basis. Fat and ash on wet basis were 1.87 ± 0.53 and 4.54 ± 0.26 while the values on dry basis were 1.64 ± 0.59 and 16.40 ± 0.65 respectively (Table 4).

Discussion

Origin of pigeons

Pigeon and dove constitute the Columbidae family of birdsan that include about 310 species! The family is widely distributed around the world, although they may be not found in arid regions such as the Sub-Sahara desert, or in Antarctica and its surrounding islands, and the high arctic. Reports indicate that the most prevalent variety is found in the Indo-Malaya and Australia ecological zones [4].

Parameters	Measurement (cm)/Observation.
Plumage color	Variable (pure and mixed)
Body length	23.20 ± 0.35
Body girth	19.60 ± 0.05
Wing length	21.60 ± 1.84
Shank length	10.50 ± 0.02
Alimentary Canal length	68.70 ± 0.37

Table 1: Mean Values of Body Measurements of the Nigerian Pigeon a b c d C ±.

Parameters	Weight (g)
Live weight	279.74 ± 12.81
Slaughter (carcass) weight	236.01 ± 8.18
Carcass percentage (%)	84.37 ± 2.21
Plucked weight (partly dressed)	207.99 ± 9.08
Eviscerated weight (fully dressed)	165.75 ± 7.75
Dressing percentage (%)	59.25 ± 2. 96
External offals (feathers + head)	50.04 ± 1.50
Internal offals (viscera)	20.18 ± 0.84

Table 2: Average live weight and carcass measurements of the speckled pigeon.

Organ	Weight (g)	Relative Organ Weight (%)
Head	15.99 ± 0.18	5.72
Liver	5.45 ± 0.31	1.95
Heart	2.78 ± 0.15	0.99
Kidney	0.14 ± 0.08	0.14
Gizzard	4.52 ± 0.20	1.62
GIT	4.45 ± 0.15	1.59
Lungs	2.84 ± 0.02	1.02

Table 3: Relative organ weight.

Contents	Wet Basis (%)	Dry Basis (%)
Crude Protein	18.90 ± 1.59	69.98 ± 0.40
Fat	1.87 ± 0.53	6.64 ± 0.59
Ash	4.54 ± 0.26	16.40 ± 0.65
Moisture Content	72.17 ± 1.16	
Dry Matter		27.83 ± 2.59

Table 4: Characteristics and chemical composition of pigeon meat.

Visual Observation

Carcass/Meat Quality

Meat Color Odor: Bright Cherry - red Chicken odor

Texture: Firm and succulent

Breast: More Lean meat than bone

Lap: More bone than lean meal

Physical characteristics of pigeons

Pigeons and doves exhibit considerable variations in size! The largest species the crowned pigeon of New Guinea, is reportedly nearly turkey-sized, and weighs 2.0 - 4.0kg (4.4 - 8.8lb), whereas the smallest species is the New World ground-dove (Columbina sp) which is about the size of a sparrow and weighs 22.0g [4] Shannon., *et al*. 2008). A median size species, the arboreal spec Marquesan imperial pigeon, measures 50cm (19 in) in length and weighs about 1.0 kg (2.0lb), while a dwarf species, the fruit dove, has a marginally smaller total length 13cm (5.1 in), than any other species from this family [4]. The pigeons examined in this study presented a stout compact body with small head, short neck, short slender bills and legs with fleshy cares, and moderately large wings, corroborating previous reports [4]! They feed on seeds, fruits and leaves from plants. We observed in the pigeons the characteristic head bobbing previously reported by Frost, 1978 and Necker, 2007, and sited by Okeno., *et al.* [16]. This occurred during the transit period between market and the laboratory! And that behavior has been attributed to the pigeon`s natural desire to keep their vision constant, influenced by changes in environment. They indicated that pigeons would not bob their heads when the conditions of their surroundings were constant.

In this study, the physical measurements for the pigeon were average live weights- 279.74g, slaughter weight- 236.01g and eviscerated/dressed weight- 165.75g. This indicates a relatively smaller size bird when compared to the domestic fowl, which reportedly measured on the average 1800.90g, 1765g and 1290g respectively [8]. However the pigeon has the advantage of ease of transportation, lower production cost and ease in processing.

Carcass characteristics and meat quality

The carcass and dressing percentages obtained in this study were 84.4% and 59.3% respectively, indicating that the pigeon carcass contain appreciable amount of lean meat. In fact the breast revealed more meat than bone! And has meat odor similar to that of the chicken. Pigeon meat appeared bright cherry-red in color, unlike conventional poultry, e.g., broiler which offers white meat. This should be of definite interest to the Nigerian consumer whose preference for meat color is usually bright cherry-red or slightly dark-red. Also we found a firm texture and tough consistency of the meat. Generally, consumers tend to prefer meat that has a firm texture but soft consistency [11]. However there are indications that the toughness of pigeon meat can be reduced by processing [5].

Chemical composition of pigeon meat

Results showed that pigeon meat contained values of dry matter, crude protein, ash, fat, comparable with those of indigenous birds and conventional poultry species. We found in the pigeon meat 18.90% crude protein, 1.87% fat, 4.54% ash and 72.17% moisture content. Comparatively, chicken reportedly contains 14.0% crude protein, 7.1% fat, 0.78% ash and 68.4% moisture; and turkey contains 22.1% crude protein, 10.0% fat, 0.98% ash and 66.9% moisture content [18]. The water content of meat varies between 40%

in pork and over 70% in chickens; whereas the range of values for crude protein in animal protein sources was given as 13-23%. This study has shown that pigeon meat (72.17% MC and 18.9% CP) falls within those ranges. Chemical analysis also showed a low-fat content (1.87% EE) in pigeon meat (Table 1). This is significant, unlike conventional poultry species pigeon provides a low fat, lean meat, recommendable in nutritional dietetics according to reports [3,18].

Importance of pigeon birds

Pigeons are economically important birds! Previous reports indicated that pigeons were used for different purposes, on the basis of which they are majorly categorized into three, viz: i. Exhibition class - the pigeons selected for the colorful patterns of their plumage and used in different exhibitions; ii. Performance class - these include the aerial pigeons, (tumblers and acrobats) and the homing pigeons used in delivering messages to specific destination; and iii. Meat production class – these refer to the squab pigeons which serve as a cheap source of meat for humans, and are used as a substitute for chicken [3].

The pigeons are easily accessible, and cost of production is low compared to other domesticated birds. In this study we observed variable and colorful patterns in the plumage of the speckled pigeon. Studies on the indigenous domestic fowl indicated that plumage modifier genes and egg quality indices were related [7]. The understanding of such information can be exploited in research into the features and product quality of the pigeon for economic advantages. The pigeon offals excluding the alimentary canal and the feathers were reported to have high nutrient value, and are used as meat by some consumers in the tropics [12,18]. Pigeon meat can be processed as canned meat, frozen, smoked, freeze dried, packaged precooked and used as meat in drinking soup. Thus, this lesser known poultry species can add variety to the diets of humans and also help to provide income for people who venture into pigeon production [18].

The need to expand the animal protein resource base in developing countries and, to explore unconventional food animals in order to complement the existing livestock and poultry species, is clearly evident in this decade, and has been the subject of interest to researchers working on indigenous domestic birds across the globe [1,13,16,17]. For example, it was reported that only 4.82% of the 10g of animal protein out of a total of 55g of dietary protein required daily by humans as recommended by the Food and Agricultural Organization was supplied and available to an average consumer in Nigeria [9,18]. In 2004, the National planning commission of Nigeria put the poultry population in the country, at 119.0 million. Today the population figures for both poultry and other livestock have not increased significantly. Evidently, whereas the human population is increasing steadily since the past decade, the Nigerian food balance sheet indicates that protein intake by the human populace is still grossly inadequate [15].

The poultry industry is considered very important in supplying high quality animal protein useful in combating malnutrition which seems to remain a serious problem in developing countries [14,18]. All classes of poultry meat are widely accepted as a good source of high quality protein, mineral and vitamins. In this regard pigeon meat shows promise. The need for more studies on the high genetic potential animals and lesser known species is hereby suggested and encouraged by this study! This would enhance increase in the poultry population through investment in more economical and low cost unconventional species, such as the pigeon, to complement the existing, high cost poultry species. Interest on animal welfare, including the provision of essential housing, feeding and health care, and the adoption of appropriate management system for the species is necessary. For example, unlike conventional poultry species, the cost of production of the pigeon is low; hence it is a cheap source of protein. Also, it is potentially a low fat, lean meat, highly recommendable in nutritional dietetics [18].

Hence a certain level of public awareness requires to be created regarding the food value of the pigeon and its economic potential as a viable and worthy enterprise. In fact there are indications that an adult pigeon is prolific! It lays two eggs and produces a pair of squabs (young pigeon) every four weeks during a breeding season lasting several months. Squabs grow rapidly although are slow to Hedge and are ready to leave the nest at 26 to 30 days weighing about 500g (18oz). In addition, squab is rich in protein, with a CP content of 67.98% DM and 18.9% fresh weight, as previously reported [5]. In this regard efforts in research and extension, are necessary to encourage its production as a worthy poultry enterprise, and also to encourage consumption of the pigeon as a source of healthy meat in tropical continental diet. The advantage of this

would be to help fill up the deficit in supply of animal protein and reduce the cost of meat available to the growing human populace.

Conclusion and Recommendation

The speckled pigeon is the commonly domesticated species in Nigeria! And among other poultry birds, it is sold for consumption in poultry markets. The protein content in pigeon is comparable to those of the chicken and turkey! It is a low fat, lean meat, which also makes it a protein of high dietetic and nutritional value. Pigeon meat, also known as squab, is rich in protein and should therefore be considered as an alternative or supplement to other poultry meat. It is consumed in Nigeria and other parts of the world! But it requires increased public awareness to increase the production and consumption rates. Due to its relatively small size and weight of the pigeon, it has economic advantage of low production cost, including transportation and management of birds as well as processing. Research programs on improvement of the pigeon, including research on the factors of production and on the potential value of the feathers, offals and squabs, and on consumer acceptance are strongly recommended of the pigeon by this study.

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