Carcass characteristics and meat quality of Japanese quails as influenced by *Canarium schweinfurthii* (Atili)-based diets

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ABSTRACT

This study evaluated the effect of *Canarium schweinfurthii* (Atili) based diets on carcass characteristics and meat quality of Japanese quails. One hundred and twenty day-old quail chicks were used. Initial weights were taken and quails were randomly allotted to five dietary treatments thus: 0% (T1), 2.5 % (T2) 5% (T3), 7.5% (T4) and 10% (T5) graded-levels of Atili leaf meal (ALM). Each treatment had 30 chicks with 3 replicates of 10 birds. Data obtained was subjected to analysis of variance. The defeathered weight, eviscerated weight and carcass weight were significantly different, with quails fed 5.0% Atili based diet having the highest value (94.46%) and least values obtained in quails fed 2.5% Atili-based diet. The head weight was significantly higher in quails fed 5.0% Atili-based diet (5.23%) with least value in quails fed 2.5% Atili-based diet (3.97%). The neck weight was higher in quails fed 10.0% Atili based diet (5.44%) with least value in quails fed 2.5% Atili-based diet (3.58%). Breast, drumstick and thigh weights were significantly higher in quails fed 5.0% Atili-based diet (25.62%, 6.94% and 9.69% respectively). Quail meat from birds fed 5.0% Atili-based diet had the highest pH, water holding capacity and oxidative rancidity (7.00, 53.33% and 2.27mg/kg respectively). Meat from birds fed 5.0% Atili-based diet had the least values for cooking loss in all the muscle types. In conclusion quails can be fed with Atili leaf meal up to 5.0% due to higher values obtained from both the carcass characteristics and meat quality.

Keywords: Carcass characteristics, Meat quality, Japanese quails and Quail meat

1.0 INTRODUCTION

The poultry industry in the developing countries is facing some challenges, one of which is increase in the cost of feed because of high prices of protein and energy sources (Abbas, 2013). According to Adelowo *et al*. (2019) the rapid growth of human and livestock population creating increased needs for food and feed in the less developed countries, demands that alternative feed resources must be identified and evaluated. In Low-Income Food-

Deficit Countries (LIFDCs), surplus of cereals is generally not available; therefore, it's not advisable to develop a wholly grain-based feeding system. The recommended policy is to identify and use locally available feed resources to formulate diets that are as balanced as possible (Guèye and Branckaert, 2002). Hence, the need, to explore the use of non-conventional feed sources that have the capacity to yield the same output as conventional feeds, and perhaps at cheaper cost. In essence, any similar high protein ingredient which could partially or completely be used as a substitute for soyabean meal or fishmeal is desirable.

There is therefore need to research into the use of non-conventional feed resources. Example of such is *Canarium schweinfurthii,* it belongs to the family *Burseraceae* and the genus *Canarium* (Keay, 1989). *Canarium schweinfurthiii* (Atili) trees are rich in phenolic substances having significant biological properties, the most important of which is oleuropein. Oleuropein is the heterosidic ester of elenolic acid and hydroxytyrosol (Mujić *et al.,* 2011). The most important natural source of this compound is the Atili leaf (Govaris *et al.,* 2010). Studies on *Canarium schweinfurthiii* (Atili) leaf demonstrated that it includes some medical compounds having antihypertensive, antiatherogenic, cardioprotective, hypocholesterolemic, hypoglycemic, antimicrobial, antiviral, antitumor, anti-inflammatory and antioxidant properties (Mujić *et al.,* 2010; Bahsi *et al.,* 2016). *Canarium schweinfurthiii* is a large, evergreen forest tree with its crown reaching to the upper canopy of the forest, it belongs to the family Burseraceae and the genus *Canarium*. From a global perspective, the quest to reduce the use of drugs in animal production is on the increase. Therefore, plant extracts rich in bioactive compounds with anti-microbial, antioxidant, and anti-inflammatory properties are promising alternatives to antibiotics (Lillehoj *et al.,* 2018).

Therefore, this study was designed to evaluate the effects of *Canarium schweinfurthii* (Atili-based) diet on carcass characteristics and meat quality of Japanese quails.

2.0 MATERIALS AND METHODS

2.1 Experiment site

The study was carried out at the Livestock Investigation Department of the National Veterinary Research Institute (N.V.R.I.), Vom, Plateau State. No ethical approval was requested for this study, because it did not include the use of any known toxic substance or the use of any unstandardized procedure.

2.2 Experimental animals

One-hundred-and-twenty-day old quail chicks were obtained from Poultry Division, Livestock Investigation Department of the National Veterinary Research Institute (N.V.R.I.), Vom, Plateau State were used and weighed at the beginning of the experiment to obtain the initial weight and randomly

allotted in a completely randomized design to 5 dietary treatments of 0% (T1), 2.5 % (T2) 5% (T3), 7.5% (T4) and 10% (T5) graded levels of *Canarium schweinfurthii* (Atili) leaf meal (ALM). Each dietary treatment had 30 chicks with 3 replicates of 10 birds.

2.3 Experimental feed

The diets were isonitrogenous and isocaloric to meet the recommended crude protein and Metabolizable energy requirements as stated by NRC (1994). Feed was provided in treatment specific troughs daily and water were given *ad libitum.*

2.4 Parameters measured

2.4.1 pH

The pH value of raw and cooked meat samples were determined by weighing 10 grams of sample into a blender with 90ml of distilled water and homogenised until smooth slurry was formed. The digital pH meter was placed in a buffer solution in order to allow equilibrium for two minutes before placing it into prepared slurry. An average of three readings taken gave the pH value according to method described by AOAC (2000).

2.4.2 Water holding capacity

Water Holding Capacity (WHC) was determined according to Wardlaw, Maccaskill, and Acton (1973). Minced meat (20 g) was placed in a centrifuge tube containing 30 ml of 0.6 M NaCl and was stirred with glass rod for 1 min. The tube was then kept at 4 ± 1 °C for 15 min, stirred again and centrifuged at 3000g (R-24, Remi Instruments, India) for 25 min. The supernatant was measured and WHC was expressed in percentage.

2.4.3 Analysis of oxidative rancidity (Lipid oxidation)

Thiobarbituric acid value (TBA) was estimated by modified methods of Buege and Aust (1978). Three mls each of glacial acid and 1% TBA solution were added to test tubes appropriately labelled blank and tests. 0.6ml of distilled water was added to the blank, while 0.6ml of the homogenised sample was added to each of the tests tubes. These were thoroughly mixed, incubated in a boiling water bath for 15 minutes, then allowed to cool, after which they were centrifuged and their supernatants collected. The supernatant from the blank was used to zero the spectrophotometer (preset at 532nm) before reading the absorbance of the supernatant from the test solutions. The amount of TBARS was expressed as milligrams of malondialdehyde per gram of sample.

$$TBA = \frac{O.D \times V \times 1000}{A \times v \times l \times Y}$$

Where:

O.D = Absorbance of test at 532nm.

V= Total volume of the reaction mixture = 6.6mL

A= Molar extinction coefficient of the product, and according Buege and Aust (1978) is equal to $1.56x10^5$

I= Length of light path =1cm.

Y= mg of tissue in the volume of the sample used.

v= volume of tissue extract used =0.6ml

2.4.4 Cooking loss

The weight of meat was recorded before and after cooking and the loss was expressed as percentage

$$\text{Cooking loss} = \frac{\text{Weight of raw meat} - \text{Weight of cooked meat}}{\text{Weight of raw meat}} \times 100$$

2.4.5 Sensory evaluation

A total of 20 trained individuals aged between 20 and 40 years were used to assess two replicates of the prepared sausage. The samples were evaluated using a 9-point hedonic scale for flavor, colour, juiciness, tenderness, and overall acceptability The scale had a maximum score of 9 while the lowest score of 1 was assigned to the poorest condition (Mahendraker *et al.*, 1988).

2.5 Statistical Analysis

Data obtained from the experiment were analysed using the statistical analysis of variance (ANOVA) procedure of SAS 2010 and significant level of p=0.05 was used. The treatment means were compared using the New Duncan multiple range test of the same software.

3.0 RESULTS

Table 1 shows the effect of Atili-based diet on live weight and carcass characteristics of quails. The defeathered weight, eviscerated weight and carcass weight were significantly different with quails fed 5.0% Atili based diet having the highest value 94.46%, 79.54% and 67.07% respectively with least values obtained in quails fed 2.5% Atili based diet.

Table 1: Effect of Atili-based diet on live weight and carcass characteristics of quails

Parameters (g)	Control	2.50% Atili-based Diet	5.00% Atili-based diet	7.50% Atili-based diet	10.00% Atili-based diet	SEM
Live weight	153.42^{ab}	166.25^{a}	136.73^{b}	144.70^{ab}	158.37^{ab}	4.11
Bled weight	96.21	94.62	95.85	94.1	93.8	0.41
Defeathered weight	91.63^{ab}	92.17^{ab}	94.46^{a}	90.00^{b}	90.97^{ab}	0.55
Eviscerated weight	72.73^{b}	69.33^{b}	79.54^{a}	72.14^{b}	73.29^{ab}	1.11
Carcass weight	62.17^{ab}	58.51^{b}	67.07^{a}	56.02^{b}	61.30^{ab}	1.31

$^{a, b, c}$ *means with different superscripts on the same row differ significantly (P<0.05)*

SEM=Significant Error of Mean.

The effect of Atili-based diet on relative weight of offals of quails is shown in Table 2. The shank, heart, full gizzard and liver weights shows no significant differences. The head weight was significantly higher in quails fed 5.0% Atili based diet (5.23%) with least value in quails fed 2.5% Atili based diet (3.97%). The neck weight was higher in quails fed 10.0% Atili based diet (5.44%) with least value in quails fed 2.5% Atili based diet (3.58%). The intestinal weight was higher in quails fed 2.5% Atili based diet (7.10%) with least value in quails fed 5.0% Atili based diet (3.48%). Table 3 presents the effect of Atili-based diet on relative weight of primal cuts of quails. Breast, broomstick and thigh weights were significantly higher in quails fed 5.0% Atili based diet (25.62%, 6.94% and 9.69% respectively) with least values in quails fed 2.5% Atili based diet (21.38%, 5.13% and 7.59% respectively). The back and wings showed no significant difference.

Table 2: Effect of Atili-based diet on relative weight of quail offals

Parameters (g)	Control	2.5% Atili-based diet	5.0% Atili-based diet	7.5% Atili-based diet	10.0% Atili-based diet	SEM
Head weight	4.38^{b}	3.97^{b}	5.23^{a}	4.22^{b}	4.24^{b}	0.13
Neck weight	3.99^{bc}	3.58^{c}	5.18^{ab}	5.25^{ab}	5.44^{a}	0.22
Shank weight	1.64	1.49	1.84	1.68	1.73	0.05
Heart weight	0.99	0.87	1.11	0.89	0.88	0.04
Full gizzard weight	3.13	3.46	2.77	2.85	2.96	0.11
Liver weight	2.41	3.03	2.28	2.17	2.33	0.14
Intestinal weight	4.88^{ab}	7.10^{a}	3.48^{b}	5.23^{ab}	5.57^{ab}	0.38

$^{a, b, c}$ *means with different superscripts on the same row differ significantly (P<0.05)*

SEM=Significant Error of Mean.

Table 3: Effect of Atili-based diet on relative weight of primal cuts of quails

Parameters (g)	Control	2.5% Atili-based diet	5.0% Atili-based diet	7.5% Atili-based diet	10.0% Atili-based diet	SEM
Breast weight	24.23^{ab}	21.38^{c}	25.62^{a}	22.55^{bc}	24.42^{ab}	0.46
Back weight	19.84	17.71	18.68	16.09	17.95	0.54
Drumstick weight	6.22^{ab}	5.13^{c}	6.94^{a}	5.73^{bc}	5.95^{bc}	0.17
Thigh weight	8.45^{ab}	7.59^{b}	9.69^{a}	9.04^{ab}	8.76^{ab}	0.25
Wings weight	5.34	4.90	6.00	5.56	4.85	0.18

$^{a, b, c}$ *means with different superscripts on the same row differ significantly (P<0.05)*

SEM=Significant Error of Mean.

Table 4 shows the effect of Atili-based diet on meat quality of quails. Significant differences were observed for pH, water holding capacity and oxidative rancidity. Quail meat from birds fed 5.0% Atili based diet had the highest pH, water holding capacity and oxidative rancidity (7.00, 53.33% and 2.27mg/kg respectively). The cooking loss from breast, drumstick and thigh muscles showed no significant difference but quail meat from birds fed 5.0% Atili based diet had the least values for cooking loss in all the muscle types.

Table 4: Effect of Atili-based diet on quail meat quality

Parameters	Control	2.5% Atili-based diet	5.0% Atili-based diet	7.5% Atili-based diet	10.0% Atili-based diet	SEM
pH	6.87^{b}	6.90^{b}	7.00^{a}	7.00^{a}	6.90^{b}	0.02
Water holding capacity (%)	41.67^{c}	43.33^{bc}	53.33^{a}	46.67^{b}	20.00^{d}	3.04
Oxidative rancidity (mg/kg)	1.47^{b}	1.21^{b}	2.27^{a}	1.11^{b}	1.15^{b}	0.12
Breast cooking loss (%)	27.00	25.30	22.41	26.54	23.42	2.32
Drumstick cooking loss (%)	13.43	15.82	9.59	18.16	13.99	1.22
Thigh cooking loss (%)	14.50	15.28	12.37	12.67	13.06	1.63

$^{a, b, c}$ *means with different superscripts on the same row differ significantly (P<0.05)*

SEM=Significant Error of Mean.

4.0 DISCUSSION

Similar observations were seen in Table 2 for Head weight, Shank and Heart weights respectively on relative live weight of quail offals. However, relative weight of primal cuts of quails, Drumstick weight, thigh weight, breast weight and wings weight was higher in quails fed diet T3 at (5.0%) graded level of inclusion. This suggests that inclusion of Atili-based diet at 5.0% level could bridge the existing gap between the conventional feeding stuff thereby reducing the cost of over -depending on the said feeding stuff, this will result in minimizing cost of feed production and maximizing production of poultry birds as required to meet the demand of poultry meat consumption in Nigeria and other countries of the world.

The absence of variation observed in relative weight of quail carcass characteristics in Bled weight and offals (the shank, heart, full gizzard weight and liver weight), primal cuts of quails (Back weight and wings weight) could be attributed to the nutrient availability of the Atili-based diets which produced uniform sizes of the birds (P>0.05). However, significant effect (P<0.05) recorded on some parameters evaluated at different level of inclusion across the treatment may probably because the inclusion levels of the test ingredients did not reach the threshold level that could have affected the weight of the various visceral organs and cuts parts (Alu *et al.,* 2018).

There was significant variation in pH values, water holding capacity and oxidative rancidity across treatment levels. A pH of 6.87 was observed and falls within the same range value of 6.17 and 6.00 reported by some authors (Genchev *et al*.,2008). This can be attributed to equal sanitary measures during slaughter which might increase the microbial load leading to a higher pH. Cooking loss of meat from breast, drumstick and thigh muscle revealed no significant difference (P>0.05). Control diet had the highest cooking loss for breast while meat obtained from 5.0% Atili-based diet had the lower cooking loss of (22.41%). This may be seen as pH reduced the water holding capacity. Atili-based diet at 5.0% level of inclusion recorded highest water holding capacity WHC than the control diet which is in consonant with the report of Naveena and Mendiratta (2001). The water holding capacity as presented in Table 4, showed significant difference ($p < 0.05$) across the treatments. This result contradicts the finding of Samson et. al., 2019 on meat quality of Japaneses quail feed graded levels fermented mango kernel meal. Which shows that water holding capacity remain constant and indicated that quail meat has high water holding capacity. With this result, variance in nutrient composition of mango kernel meal, processing method and microbial activities could be responsible for the differences in the result of this present findings.

5.0 CONCLUSION

The carcass evaluation and meat quality of Japanese quails fed (Atili-based) diet in this experiment shows that the birds assigned 5.0% based diet recorded highest values and produced reasonable meat quality which is associated with De-feathered weight, eviscerated weight and carcass weight.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interests.

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