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Effect of age on physico-chemical, cholesterol and proximate composition of chicken and quail meat

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A study to evaluate the effect of age on physico-chemical, cholesterol and proximate composition of chicken and quail meat was evaluated. One hundred poultry bird comprising of 50 chickens (Harco black) and 50 quail Japanese were randomly allocated based on a completely randomized design. Birds were kept for 20 weeks and fed with compounded feeds *ad libitum*, and at 4, 8, 16 and 20 weeks, 5 birds each were randomly selected, and the thigh and breast were evaluated for the physic-chemical, cholesterol and proximate composition. Results reveal that, crude protein content was significantly higher in chicken breast (21.48) at 4 weeks and at 16 weeks in quail breast (21.93), ether extract was highest in the thigh of both chicken and quail (6.33 and 5.06) at 4 weeks of age and thereafter it decreased with increase in age of birds, respectively. Ash content was significantly (P<0.05) higher at 8 weeks for quail breast (1.73) and at 20 weeks for chicken breast (1.76) and the moisture content was significantly higher at 4 weeks for both quail (79.19) and chicken (76.51) thigh. Physiochemical analysis revealed that, the thermal and cold shortening were highest at 16 weeks of age for both quail and chicken meat (26.9 and 43.10), respectively. The cooking loss was highest (P<0.05) at eight weeks for chicken (91.30) and at four weeks for quail (90.80), water holding capacity was highest (P<0.05) (43.10) at 16 weeks in chicken meat. Cholesterol content was lowest at 16 weeks of age as compared to 4 and 20 weeks in chicken breast, whereas quail breast revealed higher values eight weeks of age. The breast of both birds (chicken and quail) had the best values for protein and ash content but highest in cholesterol content, while the thigh had the lowest cholesterol value but highest ether extracts content for both samples.

Key word: Cholesterol, thigh, breast, chicken and quail meat.

INTRODUCTION

Meat can be described as the edible flesh of domestic animals (cattle, sheep, goats, pigs, wild life and poultry). It is a food item that is not only very rich in nutrients but tastier and pleasantly more aromatic than any other type of ready to eat food. In recent times, eating of meat has been under heavy attack by Western societies because it is said to contain fat and cholesterol which can cause high blood pressure and heart attack. The data from FAO (2009) showed that Nigeria had a per capita meat consumption of 8.8 kg in 2009, meaning that Nigeria is

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among the 12 poorest nations in animal protein consumption (NIAS/ASAN Information Bulletin No. 1, 2013). In order to increase the consumption of protein in Nigeria diet, other animals of low cholesterol and fat can be introduced for example, rabbit and poultry. The poultry industry is one of the largest and fastest growing agro-based industries in the world; this could be attributed to an increasing demand for poultry meat and egg products (Bolan et al., 2010). Increasing demand for chicken meat could be due to its acceptance by most societies and its relatively low cholesterol content as compared to other domesticated livestock like cattle, sheep, goat and pigs. Eltanany and Distil (2010) reported that, at present, chicken species are considered an important source of human food around the globe, as well as a model organism for research. The consumption of chicken meat increased as a result of its low price, easy processing, high nutritive value, high protein content, readily available fats, low cholesterol content with tender and fine-fibre (Fletcher, 2002). Eating of chicken has become synonymous with eating healthy, and it is a common assumption that chicken and fish make up the gamut of healthy protein. Although, there are several alternatives to chicken that offers flavour on their own viz., rabbit, venison, bison and quail. Chicken meat contain less cholesterol and fat content as compared to red meat, but have higher cholesterol than other poultry meat like quail. In recent years, quail meat has been gaining more popularity among consumers. Generally, quails are small to medium sized birds, belonging to the same biological family of chicken and pheasants (Phasianidae), given the overall similarity in physical characteristics and behaviour (Bolan et al., 2010). Quails, most commonly bred for human consumption, belong to the species *Corturnix coturnix Japonica.* In the beginning of the 20th century did commercial production of quail start in Japan and from there it spread first to China and soon after to Europe. Quail meat has been known for centuries, and there are even biblical quotations of their use as a meat source. White meat, including quail meat is considered superior to red meat because it contains low fat content, low cholesterol and high amount of iron (Jaturasitha et al., 2004), consumers also acknowledge the relatively low price, the typically convenient portions, and the lack of religious restriction against its consumption. Quail is one of the leanest types of poultry and a good source of protein and minerals such as sodium, potassium and Iron. The aim of this study was to determine the physico-chemical, cholesterol and proximate status of breast and thigh of chicken meat when compared with quail meat at 2, 8, 16, and 20 weeks of age.

MATERIALS AND METHODS

Animal used

Fifty (50) days old chicks of Harco black and 50 days old chick of quail were purchased from reputable hatchery. They were fed *ad libitum* from day old with compounded chick mash for up to four weeks and then compounded finisher from four weeks till 20 weeks, all vaccinations necessary was given. Five birds each from chicken and quail birds at 4, 8, 16 and 20 weeks of age were randomly selected and slaughtered. Breast and thigh from both birds were cut primally and evaluated for physico-chemical, cholesterol and proximate status.

Physico-chemical analysis

Cooking loss for both the chicken and quail birds at 4, 8, 16 and 20 weeks was measured according to the methods used (Fakolade, 2008), water holding capacity of both meat samples was determined with press method as slightly modified by Suzuki et al. (1991), the thermal shortening, was carried out by measuring the initial meat length from the final over the initial multiplied by 100. The cold shortening measured the difference between the initial weight from the final weight over the initial weight, multiplied by 100, according to Tenin et al. (2000)

Cholesterol status

One gram of food sample was weighed into a 250 ml beaker, 50 ml of hot ethanol added, followed by the addition of 150 ml of ethanol and diethyl ether in ratio 1.1. The mixtures was placed inside a water bath set at 600°C for thorough homogenization and brought to boiling for 5 min, the mixture was filtered and the precipitate was washed once with warm 95% ethanol, and 2 ml of 40% NaOH was added and boiled on the bath for 2 h to 1/5 of the original volume. 100 ml of saturated solution of $Ca(OH)_2$ was added filtered and dried at 80°C and the precipitate was mixed with 100 ml of diethyl ether added to it to extract all the cholesterol for 30 min. The diethyl ether was later filtered off and washed with either which was later evaporated on water bath. The dry sediment was dissolved in 10 ml chloroform, 2 ml of acetic acid anhydride and 4 drops of 96% H_2SO_4 and placed in the dark for 30 min, prior to reading on a Spectronic 2ID Spectrophotometer. The absorbance of the sample extract as well as working standard solutions was read on a Spectronic Spectrophotometer at a wavelength of 625 nm.

$$\text{Cholesterol in mg/100 g} = \frac{\text{Absorbance of sample extract x gradient factor x dilution factor}}{\text{Weight of sample taken}}$$

Proximate composition

The proximate composition of quail meat was determined according to AOAC method (2000). The protein content was determined by the Kjeldahl method and the lipid content was determined by the Soxhlet method. The ash content was determined by ashing the samples overnight at 550°C. Moisture content was determined by drying the samples overnight at 105°C. The carbohydrate content was calculated by difference (total mass of moisture, total fat, ash and protein substrate from the mass of the food).

Statistical analysis

All data obtained was subjected to analysis of variance as a factorial design and when statistical significance was observed, the means was compared using the Duncan's multiple range (DMR) test (SPSS). The SAS (1999) software package was used for all statistical analysis.

Table 1. Feed composition of grower and layer mash for chickens and quail bird.

Ingredient	Chick (kg)	Grower (kg)
Maize	45	48
Soya	34	25
Wheat offal	13.10	08
Palm kernel cake	-	07
Bone meal	3	04
Fish meal	-	-
Oyster shell	4.2	07
Lysine	0.1	0.2
Methionine	0.1	0.2
Premix	0.25	-
Grower premix	-	0.25
Layer premix	-	-
Salt	0.25	0.4
Percentage energy	2650 ME Kcal	2500 MEKcal
Percentage crude protein	20%	15%

Table 2. Proximate composition of thigh and breast of quail at 4, 8, 16 and 20 weeks (%).

Variable	4 Weeks		8 Weeks		16 Weeks		20 Weeks		SEM
	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	
Protein	17.22^{c}	20.44^{b}	20.89^{b}	21.40^{b}	19.34^{c}	21.93^{b}	18.62^{c}	24.45^{a}	1.29
Ether extract	5.06^{a}	3.40^{b}	4.00^{b}	3.70^{b}	3.93^{b}	3.90^{b}	3.90^{b}	3.35	0.69
Ash	0.73^{c}	1.05^{b}	0.97^{c}	1.14^{b}	1.11^{b}	1.50^{a}	1.47^{a}	1.73^{a}	0.17
Moisture	79.19^{a}	77.32^{a}	72.78^{b}	73.40^{b}	72.62^{b}	71.68^{b}	72.32^{b}	70.18^{c}	1.51

$^{abcd;}$Mean on the same row with different superscript are significantly different ($P < 0.05$).

Table 3. Proximate composition of thigh and breast of chicken at 4, 8, 16 and 20 weeks (%).

Variable	4 Weeks		8 Weeks		16 Weeks		20 Weeks		SEM
	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	
Protein	18.03^{b}	18.05^{b}	19.46^{b}	21.48^{a}	20.13^{a}	20.32^{a}	20.50^{a}	20.91^{a}	1.29
Ether extract	6.33^{a}	4.17^{c}	4.83^{b}	4.11^{c}	4.80^{b}	4.05^{c}	4.70^{b}	3.90^{c}	0.69
Ash	0.73^{b}	0.96^{b}	0.98^{b}	1.05^{b}	1.23^{a}	1.31^{a}	1.27^{a}	1.76^{a}	0.17
Moisture	75.93^{a}	76.51^{a}	72.42^{b}	72.12^{b}	71.58^{b}	72.41^{b}	64.68^{c}	64.33^{c}	1.51

^{abcd}Mean on the same row with different superscript are significantly different ($P < 0.05$).

RESULTS AND DISCUSSION

Changes in nutritional habits and increase in awareness of consumers have resulted in the growth of consumption of chicken (Vukasovič, 2011). In the present study, the proximate composition (Tables 1, 2 and 3) of quail and chicken at 4, 8, 16, and 20 weeks of age, revealed that the protein content were significantly higher in breast meat (24.45%) at 20 weeks and the least value was observed in the thigh at 4 weeks (17.22%) for quail, whereas the breast of chicken at 8 weeks had significantly higher value of 24.48% and the thigh and breast at both 16 and 20 weeks revealed no significant ($P>0.05$) difference in chicken meat. The values obtained at 4 weeks had the least value of 18.03% for thigh and 18.05% for breast of chicken meat. The results of the present study were higher than the values reported (17.48 to 18.99%) by Boni et al. (2010) who compared

Table 4. Cholesterol status of thigh and breast quail and chicken bird, at 4, 8, 16 and 20 weeks (%).

Variable	Quail (mg/100 g)		Chicken (mg/100 g)		SEM
	Thigh	Breast	Thigh	Breast	
Week 4	64.13^{b}	67.19^{b}	62.16^{c}	70.69^{a}	2.24
Week 8	67.90^{b}	73.70^{a}	62.78^{c}	71.30^{a}	2.24
Week 16	62.77^{b}	69.14^{a}	61.47^{c}	69.91^{a}	2.24
Week 20	62.33^{c}	68.24^{b}	61.45^{c}	72.45^{a}	2.24

^{ab}Mean on the same row with different superscript are significantly different (P < 0.05).

Table 5. Physico-chemical properties of quail meat when compared with chicken meat at 4, 8, 16 and 20 weeks (%).

Parameter	Chicken				Quail				SEM
	4	8	16	20	4	8	16	20	
Thermal shorten (%)	6.30^{e}	14.90^{c}	20.70^{b}	14.3^{c}	7.90^{e}	20.70^{b}	26.90^{a}	10.10^{d}	2.63
Cooking loss (%)	91.3^{a}	79.40^{b}	36.10^{c}	30.20^{c}	90.80^{a}	87.40^{b}	35.40^{c}	30.30^{c}	3.91
Cold shortening (%)	14.40^{c}	34.50^{b}	38.80^{b}	40.10^{b}	12.30^{c}	41.50^{a}	43.10^{a}	48.10^{a}	3.31
Water holding capacity (%)	2.60^{c}	2.40^{c}	1.60^{d}	1.30^{d}	2.20^{c}	2.60^{c}	3.70^{b}	5.60^{a}	1.81

^{abcd}Mean on the same row with different superscript are significantly different (P < 0.05).

meat quality characteristic between young and spent quails and 14.73% for chicken and 21.76% for quail as reported by SkipThePie.org (2012), and 13.7 and 18.6% reported by Odunsi and Kehinde (2009). The protein content tends to increase from 4 to 20 weeks in both birds. Protein content of breast was higher than the thigh for both quail and chicken meat. The ether extracts decreased with the increase in age in both quail and that thigh had the higher values than the breast.

The values observed for ether extracts for both birds was lower than the values reported by Ghenchev et al. (2008) on performance and body composition of Japanese quail fed different dietary nutrients in Nigeria humid tropical environmental, and 15.75% for chicken and 4.53% quail of chicken breast and quail meat (SkipThePie.org, 2012). From the table, it is evident that the ash content increased with increase in the age of the birds but it appears that the breast at 20 weeks had the highest value as compared to other samples. However, the mineral content of the breast muscle was higher than the thigh of both birds, but quail muscles appears to have more mineral than the chicken for both thigh and breast. The values obtained were within the range of 1.44 – 1.52% reported by Boni et al. (2010). For both samples, the moisture content decreases as the age increased. This could be attributed to growth and maturity of muscle of the birds (Boni et al., 2010).

Table 3 shows the cholesterol level obtained in the thigh and breast of quail and chicken, the breast of both bird were observed to have highest cholesterol values than the thigh. But the chicken breast had highest values (P<0.05) than quail breast at 4 and 20 weeks with no significant different (P>0.05) at 8 and 16 weeks obtained in the study which were lower than the value obtained (103.62 - 207.21 mg/100g) as reported by Al–Hasani et al. (1993). The thigh had the lower cholesterol level but highest ether extract in Tables 1 and 2, while breast had low ether extract and high cholesterol level.

The physiochemical properties (Tables 4 and 5) of birds increased as the age of both birds increased. Values of cooking loss observed was higher than values (19.9 - 42.5%) reported for thigh and breast quail, chicken and geese by Akinwuni et al. (2009) and 7.36 – 23.10% cooking loss values for male and female Japanese quail reported by Odunsi and Kehinde (2009). Meat with less cooking loss will invariably give higher yield per unit cut. The thermal shortening for both bird increases from 4, 8, and 16 weeks while at 20 weeks, but reduced. The values obtained were lower than 4.04 - 47.80% reported by Akinwumi et al. (2009). Water holding capacity decreased in both birds' with increase in ages. There appear to be an inverse relationship between WHC and the cooking loss. In this study, as the cooking loss decrease with age, the water holding capacity increases in chicken but decreases in quail meat. Water holding capacity is usually caused by electrostatic repulsion between the myofibrils, or in some cases (with salts or at low or high pH) even a partial solubilization of filaments, the latter being due to the repulsions between individual molecules.

Conclusion

Quail meat could help to increase meat consumption,

having low fat content, higher moisture and protein content, lower cholesterol level and higher water holding capacity in the breast meat at 20 weeks. This attributes suggest that quail meat is nutritious, tasty and palatable than chicken meat.

Conflict of interests

The author did not declare any conflict of interest.

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