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Cholesterol and Fatty Acid Content of Guinea Fowl (*Numida meleagris*) Egg*

Tunde Oguntona‡ & B. L. Hughes

Department of Poultry Science, College of Agricultural Science, Clemson University, Clemson, South Carolina 29634, USA

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ABSTRACT

The cholesterol and fatty acid composition of guinea fowl eggs laid during the eighth, twelfth and sixteenth weeks of lay were determined. Over the three periods mean cholesterol content was 552 *mg and* 1599 *mg*/100 *g for whole egg and yolk, respectively. Cholesterol levels in the yolk ranged from* 1528 *to* 1830 *mg*/100 *g. Fatty acids were determined by gas chromatography. The major unsaturated fatty acid was oleic acid* (C 18:1) *while the major saturated fatty acid was palmitic acid* (C 16:0). *Myristic acid* (C 14:0) *was present in measurable quantities and with arachidonic acid* (C 20:4) *constituted the fatty acids present in the least amounts. Overall* 49% *of the fatty acids were saturated while* 51% *were unsaturated. There was no significant* ($P > 0{\cdot}05$) *difference in the fat composition of the eggs laid during the three periods.*

INTRODUCTION

The guinea fowl is rapidly becoming important as a gourmet food in Europe (Anon., 1986) and the USA (Hughes & Jones, 1980). Among the many people

* Technical Contribution No. 2778 of the SC Agricultural Experiment Station, Clemson University.

‡ Present address: Department of Animal Sciences, Faculty of Agriculture, University of Maiduguri, PMB 1069, Maiduguri, Nigeria.

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of the African Savannah, however, the meat and the eggs of this bird have been well known food items for centuries (Williamson & Payne, 1978). Recent estimates suggested that there were over 40 million domesticated guinea fowl in Nigeria alone and that both the meat and the eggs were relished by all categories of the population without any taboos (Ayeni & Ayanda, 1982). This was confirmed in food intake surveys in Nigeria (Oguntona, 1982; Oguntona & Oguntona, 1985) where significant intakes of these products, by many subjects, were encountered. The nutrient values for guinea fowl eggs have always been taken to be the same as that of the chicken in these studies because, although there were some published data on the composition of the guinea fowl meat itself (Ivashchenko *et al.*, 1978; Hamn *et al.*, 1982), no such data were available for guinea fowl eggs.

Recent reports have shown that nutrient (and especially cholesterol) compositions of some other birds' eggs were significantly different from that of chicken (Somes *et al.*, 1977; Peterson *et al.*, 1978; Simmons & Somes, 1982). In view of this and the increased public concern over cholesterol and fat levels in eggs (Yudkin, 1975; Vitale, 1982), the present studies have been conducted to determine the cholesterol and fatty acid contents of guinea fowl eggs.

MATERIALS AND METHODS

Egg samples

Eggs used in this study were collected from the guinea fowl flock at Clemson University's Morgan Poultry Centre. The birds were hatched and reared at the centre and were housed in individual cages. They were given standard breeder's ration and water *ad libitum*. Egg collection and preparation procedure were similar to those of earlier workers (Simmons & Somes, 1982). Ten guinea fowl hens that were 2 months into production were randomly chosen and all the eggs laid by these hens during the 8th, 12th and 16th weeks of lay were collected. Eggs were collected within 24 h of lay and stored at 5°C for no longer than 24 h before being weighed and hard boiled. After 8 min of boiling, the eggs were immediately removed from the hot water and allowed to cool at room temperature and shelled. Yolks and albumen were separated, weighed (to the nearest 0·1 g) and oven-dried at 77°C to constant weight (Simmons & Somes, 1982), then stored at −15°C until required for analysis. For fat and cholesterol determinations, samples from each hen were pooled for each of the periods. For the fatty acids determinations, however, samples from all the ten hens were pooled for 8, 12 and 16 weeks, respectively, before being sub-sampled for analysis.

Chemical analysis

Lipid extraction

Total lipids were extracted with chloroform:methanol (2:1 v/v) to which 0·05% butylated hydroxy toluene (BHT) had been added (Radin, 1981). The extract was washed with 5 g of KCl, centrifuged for 20 min and dried by adding 10 g of anhydrous Na_2SO_4. After filtering, the extract was made up to 50 ml with chloroform. Extracts so prepared were used for fat, cholesterol and fatty acid determinations.

Fat determinations

Ten gram aliquots of the extract were measured into weighed aluminum boats and dried over a slow heat to constant weight (Folch *et al.*, 1957) to determine the percentage fat content.

Cholesterol determination

Cholesterol was determined by a modification of the Liebermann–Burchard reaction (Huang *et al.*, 1961). One litre of cholesterol colour development reagent was prepared by mixing (cooled) 300 ml glacial acetic acid, 60 ml acetic anhydride and 100 ml conc. H_2SO_4. Twenty grams of dried anhydrous sodium sulphite and 10 g of 2,5-dimethylbenzene sulphonic acid were also added and thoroughly mixed. To each of three 15 × 125 mm screw cap test tubes labeled as blank, yolk and standard was added 5 ml of acetic anhydride–sulphonic acid mixture. Then 0·2 ml of double distilled water, 0·2 ml of the yolk extract and 0·2 ml of cholesterol standard (1 ml cholesterol/1 ml acetic acid) was added slowly to corresponding test tubes. The tubes were then placed in a water bath at 25°C for exactly 20 min, cooled and absorbance measured at 570 nm within 5 min in a spectrophotometer (Baush and Lomb, Rochester, NY). Cholesterol concentration in the extract was calculated according to Beer's Law.

Fatty acids composition

An aliquot of the liquid extract was esterified with boron trifluoride–methanol (BF_3–methanol) reagent (Metcalfe & Schmitz, 1961) to prepare methyl esters of fatty acids. The fatty acid methyl esters were then analysed by GLC (Hewlett Packard HP 5890, Integrator 332A) fitted with a stainless steel (1·8 mm) column (Superlco, Inc., Bellefonte, PA) and packed with a 10% SP-2330 cyanosilicone on 100/120 mesh Chromosorb W. AW. Fatty acids were separated using the following temperature programming conditions: 170 C initial temperature held for 2 min then increased at 5 C/min until 210 C final temperature, held at 210°C until elution of all components (12 min) to give a total run time of 22 min. Gas parameters

consisted of compressed air 400 ml/min, hydrogen 32 ml/min and nitrogen 18 ml/min. Fatty acids were calculated using C 13:0 as an internal standard.

Data on fat and cholesterol content were subjected to analysis of variance (Steel & Torrie, 1960) to detect differences between eggs laid during the 8th, 12th, and 16th weeks, respectively.

RESULTS AND DISCUSSION

Table 1 gives the mean weight, fat and cholesterol contents of the guinea fowl eggs. The mean weight of about 40 g reflected the smaller size of guinea fowl eggs compared with chicken eggs (50 g). The proportion of yolk to egg (approximately 35%) was similar to that of the chicken (Feeley *et al.*, 1972).

There was no significant difference in the fat content of the eggs laid during the three periods examined in this study. The mean fat content was 12·1%. This value is about 1% higher than the fat content (10·9%) found in chicken eggs (Tolan *et al.*, 1974; Posati *et al.*, 1975) but similar to that (11·8%) found in turkey eggs (Posati *et al.*, 1975). Fat contents of the eggs of other exotic birds like quail (14·4%), goose (13·3%), ducks (14·5%) were much higher (Posati *et al.*, 1975) than that of the guinea fowl. Overall, the mean cholesterol content of whole guinea fowl eggs was 552 mg/100 g. In the yolk, cholesterol levels ranged from 1528 to 1830 mg/100 g with a mean of 1599 mg/100 g. There were no significant ($P > 0{\cdot}01$) differences between the values from one period to the other. Values for cholesterol content of chicken eggs have ranged from 450 mg per 100 g (Tolan *et al.*, 1974) to 504 mg/100 g (Feeley *et al.*, 1972). Araucana eggs have been reported (Somes *et al.*, 1977) to contain from 560 mg to 713 mg per 100 g whole egg. Results

TABLE 1
Weight, Fat and Cholesterol Composition of Guinea Fowl Eggs[a]

Period	*Weight (g)*			*Fat (%)*	*Cholesterol (mg/100 g)*		
	Whole egg	*Yolk*	*Albumen*		*Yolk*		*Whole egg*[b]
					Range	*Mean*	*Mean*
8th week	40·80	14·06	19·29	12·3	1560–1830	1602	552
12th week	41·16	14·29	20·00	11·9	1528–1796	1573	547
16th week	41·15	14·25	19·93	12·1	1550–1821	1605	556
Mean	41·04	14·20	19·74	12·07		1599	552
± S.E.	4·46	2·90	2·68	0·44		199·0	16·5

[a] Values calculated on wet (boiled) weight basis.
[b] Eggs without shells.

TABLE 2
Fatty Acid Content of Guinea Fowl Eggs (% Total Fatty Acids)

	Fatty acids						
	Saturated			*Unsaturated*			
	C14:0	*C16:0*	*C18:0*	*C16:1*	*C18:1*	*C18:2*	*C20:4*
Range	traces–0·52	31·94–34·11	15·50–16·16	1·19–2·14	27·93–29·13	16·24–17·84	3·05–4·60
Mean	0·46 ± 0·30	32·74 ± 1·2	15·78 ± 0·94	1·76 ± 0·86	28·23 ± 4·7	16·88 ± 3·5	4·05 ± 1·0
Chicken egg[a]	traces	28·6	9·3	4·2	42·9	11·1	0·8

[a] Values from Paul & Southgate (1978).

from the present study show that the cholesterol content of guinea fowl eggs is higher than in chicken eggs but lower than in araucana eggs.

The fatty acid composition of the guinea fowl egg is given in Table 2. The two most abundant fatty acids in guinea fowl eggs were palmitic and oleic acids. The myristic acid (C 14:0) content was very low and in some samples only traces could be detected. Palmitoleic acid (C 16:1) content was also low but measurable quantities were found in every sample. Total saturated fatty acids was less (49%) than the total unsaturated fatty acids (51%) in guinea fowl eggs. A similar fatty acid pattern has been reported for the chicken egg (Posati *et al.*, 1975) although stearic acid (C 18:0) content of the guinea fowl egg appears to be higher, while oleic acid appears to be lower. The fatty acid content of the chicken egg (Paul & Southgate, 1978) has been included in Table 2 for comparison.

A significant feature of the fatty acid content of the guinea fowl egg is the high level of the two polyunsaturated fatty acids: linoleic and arachidonic acids. Linoleic acid (C 18:2) content of guinea fowl eggs was about 150% of the values reported for chicken eggs while arachidonic acid (C 20:4) in the guinea fowl egg was about five times that of the chicken egg. Earlier studies have shown that polyunsaturated fatty acids in the eggs of birds like quail, turkey, goose, and duck were also generally higher than that of chicken eggs (Posati *et al.*, 1975).

Several factors like breed, strain and age of hens have been shown to affect the composition of egg lipids and fatty acids. In the data on chicken egg quoted by Posati *et al.* (1975), eggs from the single comb White Leghorn hen were used. Egg samples were from within a normal (mid-lay) laying cycle. Similar precautions have been taken in the choice of guinea fowl hens used in the present study by utilising eggs which, from experience (Oguntona & Zubair, 1987), were laid half-way through their short laying period. This might also explain the little variation found in the values within the three

periods examined in this study. In conclusion, the fat, cholesterol and fatty acid contents of guinea fowl eggs appear to be higher than in chicken eggs, lower than in quail, ducks and geese eggs but similar to the amount in turkey eggs.

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