Indian Journal of Animal Sciences 73 (1): 93-00, January 2003

Effect of age on total lipid and cholesterol of hen eggs

R A OLOYO[1]

Federal Polytechnic, P. M.B. Ilaro, Ogun State, Nigeria

Received: 14 December 2001, Accepted: 17 July 2002

ABSTRACT

Duplicate groups each of 500 laying hens of 2 age groups (6 and 20 months old) were used to study the effect of age on total lipid and cholesterol of eggs. The laying hens were fed with a practical-type layer's ration and were maintained under commercial egg production conditions. Average egg weight, yolk weight, total lipid (g) and total lipid (mg.g-1 yolk) were significantly ($P<0.05$) higher in the older birds, whereas, cholesterol (mg), cholesterol (mg. g^{-1} yolk) and cholesterol (mg.g^{-1} total lipid) were higher (($P<0.05$) in the younger birds. While egg size and yolk weight were positively but not significantly correlated ($P>0.05$) with the total lipid (g), both parameters were negatively and significantly correlated ($P<0.05$) with total lipid and cholesterol expressed as fractions of yolk weight.

Key words: Age, Cholesterol, Hen's egg, Lipid, Practical-type feed

Egg, among the foods of animal origin is a particularly rich source of cholesterol, and hence its consumption puts the consumer at the risk of developing atherosclerosis (Stampler 1978). Most studies made on factors affecting egg cholesterol concentrations were made under closely monitored experimental conditions (Wood *et al.* 1961), Dua *et al.* 1967, Turk and Barnett 1972, Nockels 1973, Hevia and Visek 1979). Experimental conditions generally differ from commercial farm conditions, where purified diets are used as against the use of practical-type rations based on locally available feed ingredients commercially. Results of such studies therefore, may be less beneficial to egg consumers, as the results may not necessarily reflect the yolk cholesterol content of eggs available in the market for public consumption. This study is aimed to identify the effect of age of bird and egg size on egg yolk cholesterol and total lipid contents of eggs produced by hens fed with locally available commercial layer's ration and managed in a commercial egg production farm.

MATERIALS AND METHODS

Commercial laying hens (1000) for each 6 and 20 months age groups were used. Birds in each age group were randomly divided into 2 equal batches such that each treatment batch had 2 replicates consisting of 500 birds each. The birds were housed in battery cage units and kept under intensive commercial egg production conditions. Experimental birds were maintained on layers' ration (Table 1) whose cholesterol

Present address: [1]Chief Lecturer, Department of Science Laboratory Technology.

Table 1. Composition of layer's ration

Ingredient	Diets (%)
Yellow maize	56.01
Groundnut cake	13.57
Fish meal	4.52
Brewer's grain	9.05
Bone meal	3.50
Cassava flour	4.00
Oyster shell	6.20
Salt (NaCl)	0.30
Vitamin/Mineral premix+	0.10
DL-Methionine	0.25
Palm oil	2.50
Total	100.00
Cholesterol (%)	0.64
Calculated Analysis:	
Crude protein (%)	16.10
Metabolizable energy, ME (Kcal/kg	2826.88
ME/CP	175.58
Fat (%)	5.87
Crude fibre (%)	4.91
Calcium (%)	3.50
Phosphorus (%)	0.87

+Vitamin/mineral premix supplied the following vitamins and mineral elements per kg of diet: Vitamin A, 11000 u.u.; Vitamin D_3, 2100 u.u; Vitamin E, 25 mg; Menadion sodium bisulphite (Vitamin K), 2.5 mg Vitamin B_1, 2.5 mg; Vitamin B_2, 6mg; Niacin, 35 mg; Calcium d-pantothenate, 10 mg; Vitamin B_6, 3.5 mg; Vitamin B_{12}, 0.02 mg; Folic acid, 0.8 mg; Biotin, 0.05 mg; Choline chloride 450 mg; Vitamin C, 150 mg; Manganese, 30 mg; Iron, 50 mg; Zinc, 30 mg; Copper, 5 mg; Cobalt, 0.5 mg; Iodine, 0.4 mg; Selenium, 0.10 mg.

content was similar to that used to reproduce hypercholesterolemic condition in chickens (Fisher and Griminger 1967) for 6 weeks. Feed was supplied to birds twice daily and fresh clean water was available at all times.

The first 2 weeks of the feeding period constituted a preliminary feeding period. During the last 4 weeks, weekly record on feed intake, body weight gain, egg production and egg weight were maintained. In addition, 90 eggs were randomly selected from each of the treatment batches (45 eggs/replicate). All eggs collected were weighed individually and then grouped into 4 main weight ranges, that is, 35-44g, 45-54g, 55-64g, and 65-64g as often classified in the Nigerian markets. All the eggs were carefully broken to separate albumen from the yolk; the yolk was then weighed. All weighed yolks in each group were mixed in the homogeniser and 6 replicate samples of the homogenised mixture in each group were mixed in the homogeniser and 6 replicate samples of the homogenised mixture in each group were used for the determination of total lipid (Folch *et al.* 1957) and cholesterol (Kim and Goldberg 1969) contents. Eggs of similar weights were taken to delete any possible interaction of egg weight with yolk lipid and cholesterol (McNaughton 1978) and to find the effect of egg size on these lipids if any.

Results obtained were subjected to statistical analysis (i.e. t-test, regression and correlation analysis and analysis of variance) as per Steel and Torrie (1960). Means that were significantly different after ANOVA were compared by the multiple range test of Duncan (1955).

RESULTS AND DISCUSSION

Performance of laying hens (Table 2) indicated that with the exception of per cent egg production other performance indices examined were significantly affected by age ($P<0.05$). The 20-month-old birds old birds were heavier; consumed more feed, had better weight gain and laid bigger-size and heavier eggs than the 6-month-old ones.

Effects of age of hen and egg size on yolk weight, total lipid and cholesterol are shown in Table 3. All the 3 parameters were significantly affected by age of bird, where older birds had higher yolk weight, total lipid and total lipid expressed as a fraction of yolk weight; and the reverse was the case for cholesterol when expressed in absolute term and as fractions of yolk weight and total lipid. The nonsignificantly ($P>0.05$) different per cent egg production between the older and younger birds coupled with the significantly higher feed intake in the former group might have resulted in more lipid deposition as body fat and in the bigger and nonsignificantly ($P>0.05$) fewer eggs laid by the older birds. This vies is supported by earlier reports of ARC (1975). Since the practical feed given to the laying hens was hypercholesterolemic, significantly higher cholesterol in eggs laid by the younger birds is suggestive of inability of the birds to effectively metabolise the cholesterol as does the older birds (Wood *et al.* 1961). The remarkably lower content of cholesterol in the eggs collected from the older birds when expressed as fractions of yolk weight and total lipid might be due to dilution effect.

Yolk weight and the lipids (i.e. total lipid and cholesterol) expressed as fractions of yolk weight were significantly ($P<0.0.5$) affected and correlated with the egg size (Tables 3 and 4). Regression equations describing the relationships between egg size and the parameters are given in Table 5. While yolk weight was positively correlated with egg size, total lipid and cholesterol as fractions of yolk were negatively correlated with egg size. Significant positive correlation between yolk weight and egg size tended to suggest that the higher yolk weight in the older birds might be due to bigger-

Table 2. Performance of laying hens of the 2 age groups*

Parameter	Age group		±SEM
	6 months	20 months	
Initial live weight/bird (g)	1758.00	1974.00	108.00
Daily feed intake/bird (g)	100.69	128.41	13.86
Daily weight gain/bird (g)	0.96	1.38	0.21
Egg production (%)+	69.10	68.80	0.15
Average egg weight (g)	53.11	58.09	2.49

*Means in the same row with no common superscripts differ significantly ($P<0.05$).

+ Egg production (%) = $\frac{\text{Number of eggs laid}}{\text{Number of days in observation period}} \times 100$

Table 3. Effects of age of hen and egg size on mean yolk weight, total lipid and cholesterol.

Parameter	Age main effect+			Egg size main effects++				
	6 months	20 months	±SEM**	35-44g	45-54g	55-64g	65-74g	±SEM
Mean yolk weight (g)	16.90^{t}	18.60^{s}	0.850	14.90^{c}	16.81^{b}	16.98^{b}	20.70^{a}	1.213
Total lipid (g)	3.37^{t}	4.78^{s}	0.705	4.12	3.99	4.06	4.13	0.032
Total lipid (mg.g^{-1} yolk)	199.41^{t}	256.99^{s}	28.790	276.51^{a}	237.36^{b}	239.10^{b}	199.52^{c}	15.720
Cholesterol (mg)	288.82^{s}	213.87^{t}	37.475	239.1	236.3	240.1	238.4	0.805
Cholesterol (mg.g^{-1}yolk)	17.09^{s}	11.50^{t}	2.795	16.05^{a}	14.06^{b}	14.14^{b}	11.52^{c}	0.929
Cholesterol (mg.g^{-1} total lipid)	85.70^{s}	44.74^{t}	20.480	58.03	59.22	59.14	57.72	0.382

+Age main effect means in the same row with no common superscripts (i.e.s, t) differ significantly ($P<0.05$); ++Egg size main effect means in the same row with no common superscripts (i.e.a-c) differ significantly ($P<0.05$); **SEM, Standard error of the mean.

Table 4. Correlation coefficients of relationship among parameters

	Egg size (g)	Yokd weight (g)	Total lipid (g)	Total lipid (mg.g-^{1}yolk)	Cholesterol (mg)	Cholesterol (mg/g-^{1}yolk)	Cholesterol (mg.g-^{1}total lipid)
Egg size (g)	1						
Yolk weight (g)	0.935*	1					
Total lipid (g)	0.200	0.267	1				
Total lipid (mg.g-^{1} yolk)	-0.941*	-0.976*	-0.057	1			
Cholesterol (mg)	0.136	-0.103	0.592	0.199	1		
Cholestrol (mg.g-^{1} yolk)	-0.938*	-0.992*	-0.143	0.996*	0.174	1	
Cholestrol (mg.g-^{1} total lipid)	-0.171	-0.375	-0.911*	0.168	-0.206	0.260	1

*Significant (P<0.05).

size eggs laid by the group. In addition, while yolk weight was positively but non-significantly (P>0.05) correlated with total lipid expressed in absolute term, it was significantly (P<0.05) and negatively correlated with total lipid and cholesterol when both were expressed as fractions of yolk weight. The nonsignificant effect of egg size on the total lipid

Table 5. Trend lines and coefficient of estimations for relationships between parameters and egg size.

Parameter	Regression equation*	R^2
Mean yolk weight (g)	y=0.1757×+7.7719	0.874
Total lipid (g)	y=0.001×+4.0205	0.040
Total lipid (mg.g^{1} yolk)	y=-2.2923×+363.05	0.886
Cholesterol (mg)	y=0.0027×^{2}-0.2827×+245.37	0.058
Cholesterol (mg.g^{-1} yolk)	y=-0.1351×+21.305	0.881
Cholesterol (mg.g^{-1} yolk total lipid)	y=-0.0065×^{2}+0.7011×+40.513	0.999

*y= parameter; ×=mean egg size (g).

(g) and cholesterol (mg) seemed to suggest that the amount of the lipid deposited in the egg was similar regardless of the size of the egg, and that the significant decrease in the lipid content when expressed as fraction of yolk weight was therefore a dilution effect. The largest egg size group, that is, 65-74 g had the least of total lipid and cholesterol expressed as mg/g yolk. This observation agreed with earlier report by Oloyo (2001) that the amount of cholesterol deposited in the egg is the same irrespective of its size, but was a function of the cholesterolemic agents in the diet.

REFERENCES

Agricultural Research Council. 1975. *The Nutrient Requirements of Farm Livestock.* No. 1 Poultry London.

Dua P N, Dilworth B C, Day E J and Hill J E. 1967. Effect of dietary vitamin A and cholesterol on cholesterol and carotenoid content of plasma and egg yolk. *Poultry Science* **46**: 530-31.

Duncan D B. 1955. Multiple range and multiple F test. *Biometrics* **11**: 1-42.

Fisher H and Griminger P. 1967. Cholesterol -lowering effects of certain grains and oats fractions in the chick. *Proceedings of the Society for Experimental Biology and Medicine* **126**: 108-11.

Folch J, Lees M and Stanley G H C. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry* **226**: 497-509.

Hevia P and Visek W J. 1979. Dietary protein and plasma cholesterol in chickens. *Journal of Nutrition* **109**: 32-38.

Kim E and Goldberg M. 1969. Serum cholesterol assay using a stable Liebermann-Burchard reagent. *Clinical Chemistry* **15**: 1171-79.

McNaughton J L. 1978. Effect of dietary fiber on egg yolk, liver and plasma cholesterol concentrations on the laying hen. *Journal of Nutrition* **108**: 1842-48.

Nockels C F. 1972. The influence of feeding ascorbic acid and sulphate on egg production and cholesterol content of certain tissues of the hen. *Poultry Science* **52**: 373-78.

Oloyo R A. 2001. Effect of diet on total lipid and cholesterol of hens eggs. *La Rivista Italiana Delle Sostanze Grasse* (In press)

Stampler J. 1978. Dietary and serum lipids in the multifactorial etiology of artherosclerosis, *Archive of Surgery* **113**: 21-25.

Steel R G D and Torrie J H. 1960. *Principles and Procedures of Statistics. McGraw*-Hill Book Co., Inc., New York.

Turk D E and Barnett B D. 1972. Diet and egg cholesterol content. *Poultry Science* **51**: 1881.

Wood J D, Biely J and Topcliff J E. 1961. The effect of diet, age and sex on cholesterol metabolism in While Leghorn chicken. *Canadian Journal of Biochemistry and Physiology* **39**: 1705-15.