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A Comparative Study on the Cholesterol Content of Products Fractionated from Egg Yolk of Some Birds

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Abstract: Egg yolk of Duck, Local breed hen and Broiler were fractionated into plasma, granules and dilapidated fractions using centrifugation. These fractions were compared for this study. Granules showed reduction in cholesterol with an associated two fold increase in values for whole yolk in all the birds. Generally delipidated yolk fraction exhibited the lowest cholesterol value. In decreasing order, cholesterol content in the fractionated products of the birds' egg yolk was: Broiler > Local breed hen > Duck. The percentage lipid and cholesterol content revealed by granules suggest the use of fractionated products as a replacement for whole egg yolk which is rich in cholesterol. These results suggest that Ducks' egg yolk and fractionated products can be used as a replacement for broiler, due to the low cholesterol content.

Key words: Egg yolk, cholesterol content, protein, lipid

Introduction

The major constituents of egg yolk are proteins and lipids. These fractions play important role in cosmetic formulations and food processing industry and they also act as bioactive compounds in pharmaceutical products (Szukay, 1983)

Egg yolk contains about 50% solids with a lipid to protein ratio of about 2:1 (Chung and Ferrier, 1991). Lipid fraction is the most plentiful constituent in egg yolk solids and the major component of yolk lipid are triacylglycerol (TG) which is the predominate neutral lipids, followed by various phospholipids (PH) (consisting of phosphatidyl choline or lecithin) and cholesterol (Gebhardt and Matthenos, 1991).

Attempts have been made to lower the relatively high cholesterol content of egg yolk products due to concern over relationships between cholesterol and coronary heart disease, Arterosclerosis. These include alterations in the hen's diet to induce compositional changes in the egg yolk (Awad and Smith, 1996; Awad *et al*., 1997; Burfey and Valdera, 1989) supercritical extraction with carbon-dioxide (Froning *et al*., 1990), organic solvent extraction (Chung and Ferrier, 1991; Horikoshi *et al*., 1993). Marketing of low-cholesterol egg blends containing egg white and vegetable oil (Baker and Darfler, 1977)

Egg yolk can be fractionated into plasma and relatively more water soluble fraction and granules using centrifugation. Plasma (yolk) contains low-density lipoprotein (LDL) and livetin (water-soluble globular protein). Granule consist of Lipovitellin, the phosphoprotein phosvitin High-density lipoprotein (HDL) and low density lipoprotein-g (LDLg) (Burley and Cook, 1961).

However, use of fractionated components other than yolks and white is limited (Blackwelder and Pike, 1990). The objective of this work is to fractionate whole egg yolk and compare the cholesterol content using different birds.

Materials and Methods

Materials: Fresh large eggs of broiler were obtained from a poultry farm while eggs of duck and local breed hen were purchased locally and stored at 4°C.

Plasma and granule fractions from egg yolk: Fractionation of yolk into plasma and granules was accomplished using an adaptation of the procedure of Horikoshi *et al.* (1993). The eggs of duck, local breed hen and broiler were carefully broken separately and the albumen was separated and the chalaza removed from the egg yolk. 50ml of pooled egg yolk after separation from the albumen was diluted with 400ml of distilled water. The mixture was mixed thoroughly using a magnetic stirrer and was centrifuged at 1,600 x g for 10 min at 10°C. The plasma fraction was decanted and the granule was removed by spatula from the centrifuge tubes. Both fractions were stored at 4°C prior to analysis.

Delipidated Yolk Fraction

Delipidated egg yolk fraction was prepared using an adaptation of the procedure described by Aulisio and Shelokov (1967). Equal volumes of egg yolk without albumen and 0.16M sodium chloride solution was placed in a screw-cap tube. The mixture was mixed thoroughly by shaking and double volume of chloroform was added. The tube was inverted several times and left at room temperature for 30mins. The inversion was repeated 4 times at 30mins interval. The mixture was left overnight at 4°C.

The mixture was centrifuged the following morning at 2000 rpm for l0min. The upper clear Saline layer was pipetted off. The middle layer of depigmented yolk debris

Table 1: Total Lipid (g) of Products fractionated from egg yolk

Animal sources	Plasma	%Lipid	Granules	%lipid	Delipidated egg yolk	Whole egg yolk
Duck	0.2	66.7	0.1	33.3	1.8	1.1
Local breed hen	0.4	66.7	0.2	33.3	3.9	2.3
Broiler	1.2	70.5	0.5	29.5	2.9	1.4

Table 2: Total cholesterol (mg) of products fractionated from egg yolk of duck, local breed hen and broiler

Animal source	Plasma	Granules	Delipidated egg	Whole egg yolk
Duck	16.4±7.1	73.8±7.1	9.2±3.1	106.2±3.1
Local breed hen	38.3±2.3	96.0±5.7	11.2±0.6	184.0±10.7
Broiler	80.6±3.1	97.2±10.3	10.2±2.3	168.6±8.2

Data are expressed as means ±SD (n=4).

and the lowest pigmented chloroform layer was discarded leaving the saline layer (delipidated fraction). This fraction was kept at 4°C prior to analysis.

Total lipid and cholesterol in yolk fractions: Determination of total lipid from the samples was accomplished using a modified version of the procedure described by Folch *et al.* (1956) using a mixture of chloroform and methanol (2.1v/v) and a sample to solvent ratio of 1:20 (w/v).

The total cholesterol was determined using a modified form of Lieberman-Burchard method (Stroev and Makarera, 1989). The method is based on the dehydration of cholesterol followed by a coupling of two dehydrated cholesterol molecules to yield biocholestadiene. Bicholestadiene, in the presence of acetic acid and sulphuric acid gives sulphonated derivatives, coloured purple. Bicholestadiene absorbs light at wave length of 530nm.

Sample preparation was performed by dispersing 0.2g of granules, plasma, dilapidated egg yolk and liquid yolk in 2.0ml of 1M NaCl solution. Samples were analyzed for cholesterol content as follows, 0.1 ml of the samples were separately pipetted into 3.0ml of glacial acetic acid. 2.0ml of colour reagent was added along the side of the test tubes.

The steps above were repeated using 0.1ml of standard cholesterol (1mg/ml) and distilled water respectively. A duplicate reading of the absorbance was taken at 530nm using a colorimeter.

Results and Discussion

Total lipid data were compared for plasma and granules (Table 1) fractionated from egg yolk of duck, local breed hen and Broiler. Data were also included for dilapidated and whole egg yolk. Fractionation of the whole egg yolk resulted in 66.7% lipid in plasma and 33.3% in granules in Duck and Local breed hen with an exception in Broiler, where the plasma and granules contain 70.5% and 29.5% respectively. Percent lipid values were similar to values reported by Saari *et al.* (1964) for water washed granule and plasma fractions, 34% and 81% respectively.

The general analysis shows that lipid values for plasma are higher than granules in all the birds. Broiler exhibited the highest lipid value (1.2g) when compared to other birds. This suggests that most of the lipid in whole egg yolk is associated with the plasma fractions. An overview of data indicates that, dilapidated egg yolk have the highest lipid value (3.9g) in all the birds when compared to the whole egg yolk and other fractionated products.

Total cholesterol value were compared for plasma and granules fractionated from the egg yolk of the birds. Granules exhibited high cholesterol value when compared to the plasma values. The whole egg yolk data, revealed that, local breed hen has the highest value, (184±10.7mg) followed by Broiler (168.6±8.2mg). Duck has the lowest value (106.2±3.1mg).

Dilapidated egg yolk fraction of the birds exhibited the lowest cholesterol value (Table 2) when compared to the whole egg yolk. This indicates that dilapidated yolk may have lost some of its cholesterol as a result of centrifugation. Fractionated products of Broiler (Plasma and granules) showed a reduction in cholesterol and lipid with an associated two fold increase in values for whole egg yolk.

The cholesterol content of the yolk product in duck was lower than broiler which is frequently consumed.

Conclusion: The high cholesterol content of broiler's egg yolk can be lowered by altering the composition of the diet to induce compositional changes in the egg yolk.

Further investigation should address the reduction of cholesterol content in the egg yolk of birds.

The low cholesterol value exhibited by duck in its whole egg yolk and other yolk products suggest that it can replaced Broiler's egg yolk which is used in many food products.

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