ESTIMATION OF CHOLESTEROL CONTENTS IN BREAST AND THIGH MUSCLES OF DIFFERENT STRAINS OF CHICKEN (*GALLUS DOMESTICUS*)

Tanzeela Talat, Bashir Mahmood Bhatti and A. Rehman
Feeding Testing Laboratory, Poultry Research Institute, Shamsabad, Murree Road, Rawalpindi, Pakistan.

ABSTRACT

This study was undertaken to measure cholesterol contents in breast and thigh muscles under raw, boiled and roasted condition and also serum cholesterol contents of Rhode Island Red (RIR), broiler, Fayoumi (Fy) and cross birds (RIR X Fy) chickens. The results revealed that serum cholesterol contents were lowest in cross birds (86.54 mg/dl) and highest (130.72 mg/dl) ($P<0.01$) in RIR birds. There was non signficant difference between broiler (107.58 mg/dl) and Fayoumi birds (123.92 mg/dl). It was further revealed that there was significant ($P<0.05$) difference in cholesterol contents between breast and thigh muscles within the strain. Boiling and roasting caused significant reduction in cholesterol contents. Comparatively roasting was found to be more effective in causing marked reduction in cholesterol contents. The normal pattern of variation in cholesterol contents between breast and thigh muscles was invariably maintained under both treatments in all breeds/strains. The cross birds (RIR X Fy) had lowest serum cholesterol concentration (86.54 mg/dl) ($P<0.01$) and lowest muscle cholesterol concentration (41.80 mg/dl) ($P<0.05$) as compared with other breeds/strains due to genetical manipulation and thus are important from public health point of view.

Keywords: Cholesterol estimation, breast, thigh, serum, chicken

INTRODUCTION

Poultry products such as eggs and poultry meat are considered to be superior animal protein sources for their high biological value (Powrie, 1973). Eggs and poultry meat are therefore, being treated as essential component of daily food intake all over the world. Among poultry products, an average 50 gm egg contains 230 mg cholesterol (Mountney, 1976). In view of importance of eggs in human diet, cholesterol contents of eggs remained subject of investigation to reduce level to make them safer for human use. It is, however, documented that cholesterol contents of eggs besides its genetical basis (Edwards *et al*, 1960; Collins *et al*, 1968) can be modified through manipulation of dietary components such as palm oil etc (Piliang, 1994), dietary copper (Bakalli; *et al*, 1995), and probiotic supplementation (Mohan *et al*, 1995). There is, however, no direct relationship between plasma and egg yolk cholesterol concentrations (Suchy *et al*, 1995). Dietary protein level when increased, it decreased serum total cholesterol concentration (Rukmangadhan *et al*, 1992). There is marked reduction in cholesterol concentration (mg/100 gm; wet sample) such as 31.13 for manufactured chicken breast; 57.35 for raw like chicken product and 60.02 for chicken sausages and 60.46 for chicken bologna (Rinco *et al*, 1997).

Poultry meat, being white meat, is recommended in diet of cholesterol shy personnel for, presumably, low cholesterol contents (Demby and Cunningham, 1980) as compared with other meats.

This study was, therefore, undertaken to estimate cholesterol contents in breast and thigh muscles and serum of commercial and rural chickens such as Rhode Island Red (RIR), broiler, Fayoumi (Fy), and cross chickens (Rhode Island Red X Fy.) for relative comparison.

MATERIALS AND METHODS

In order to study cholesterol contents in muscles and serum of chickens, four different chicken (commercial and rural) strains were selected which included Rhode Island Red (RIR), broiler, Fayoumi, and cross (RIR X Fy), as meat of these birds is commonly used. The birds included in the study were maintained at Breeding Section of Poultry Research Institute, Rawalpindi. They were housed under deep litter system. They were provided feed and water *ad libitum*. The feed offered was commercial mash which contained 8% moisture; 17% crude protein; 6% crude fibre; and 5% crude fat etc. The average temperature in sheds ranged between 70° to 80° F. The water was tested for any bacterial contamination and was found to be free from any such contamination. The treatments tested included analysis of breast muscle, thigh muscle and serum from all the four strains of similar age. Five muscle samples, 1gm/each skinless poultry meat were taken from each location and analyzed for cholesterol contents and then raw muscle samples were boiled at 100 degree F° till cooked and analyzed for cholesterol contents. The second set of five raw muscle samples

from each strain was subjected to steam roasting till cooked. Roasted muscle samples were then analyzed for cholesterol contents. The data thus collected was subjected to statistical analysis (Steel and Torrie, 1980) to test cholesterol contents in breast, thigh muscle and serum of different chicken strains and effect of boiling and roasting on the availability of cholesterol in muscles. The cholesterol contents in muscles and serum were analysed in Feed Testing Laboratory of the Institute using Liebermann-Burchard reaction method (Liebermann, 1985).

RESULTS AND DISCUSSION

The results of trial are given in Tables 1 and 2. The findings indicated on an average 62.20, 49.75, 58.44 and 41.80 mg/dl cholesterol contents in raw muscles (combined breast and thigh muscles) of RIR, broiler, Fayoumi and cross birds, respectively. When data was subjected to statistical analysis and evaluated using LSD value of 17.63, it was revealed that serum cholesterol contents of 86.54 mg/dl, being lowest in cross birds, were significantly different ($P<0.01$) from all other chicken strains. There was no difference in serum cholesterol contents in broiler (107.58 mg/dl) and Fayoumi (123.92 mg/dl) chickens. The serum cholesterol contents in RIR chicken (130.72 mg/dl) were significantly ($P<0.01$) higher than other three strains (Table 2). The results confirm genetical basis of cholesterol control and its possible manipulation through cross breeding which is in line with findings of Edwards *et al.* (1960) and Collins *et al.* (1968). The results further revealed that within the strain, there was difference in cholesterol contents when tested from breast and thigh muscles despite significant difference among strains. The average cholesterol contents in breast and thigh muscles were 68.33 and 56.07 mg/dl in RIR; 51.90 and 47.60 mg/d in broiler; 61.88 and 55.00 mg/d in Fayoumi; and 43.31 and 40.29 mg/d in cross birds.

The statistical analysis revealed that there was significant ($P<0.05$) difference in cholesterol contents in breast and thigh muscles within the strain. A consistent significant difference in cholesterol contents of breast and thigh muscles in all strains of chickens may be attributed to the level of blood supply to these parts of body.

When raw muscles were subjected to boiling and roasting treatments, there was marked reduction in cholesterol contents due to roasting as compared with boiling which is in agreement with Rinco *et al.* (1997). The treatment effect was found to be significant ($P<0.05$) as is obvious from values and analysis done (Tables 1 & 2) which is attributable to dietary and genetical reasons (Rukmangadhan *et al.*, 1992; Mohan, *et al.*, 1995; Bakalli *et al.*, 1995). The difference in treatment effect may be explained due to intensity of temperature to which muscle tissues were exposed. There was presumably more draining away of cholesterol contents from muscle tissues during roasting. Interestingly, under both the treatments, the pattern of variation in cholesterol contents was invariably maintained which may be ascribed to the gradient of temperature absorbed by muscle tissues at different regions of body. The strain of chickens which showed highest serum cholesterol showed higher cholesterol contents in muscles and similarly strains with lowest serum cholesterol also had lowest cholesterol contents in muscles. This showed that level of cholesterol in breast and thigh muscles was dependent on level of serum cholesterol in the respective bird strains though this relationship has not been reported (Suchy *et al.*, 1995). This study, further, suggested that roasting was a preferrable method for cooking of chicken meat from the point of view of cholesterol contents. The nutritive value of poultry meat is documented not to be changed due to roasting. There is 31.5 percent protein in roasted chicken white meat which is higher than cooked beef and lamb meat (Mountney, 1976). Practically as based on this study, cross birds being low in cholesterol contents are important from public health point of view.

Table 1: Cholesterol level in breast and thigh muscles of different chicken strains in raw, boiled and roasted conditions.

Breed/Strain	Location [b]	Treatments effects [a] (Mean values calculated from observations of five replicates, mg/dl)		
		Raw	Boiled	Roasted
RIR	Breast	68.33	19.48	10.03
	Thigh	56.07	16.36	7.67
	Mean	62.20	17.91	8.85
Broiler	Breast	51.90	12.00	6.94
	Thigh	47.60	8.10	6.01
	Mean	49.75	10.05	6.4
Fayoumi (FY)	Breast	61.88	13.87	9.08
	Thigh	55.00	8.57	7.03
	Mean	58.44	11.22	8.05
Cross (RIR X Fy)	Breast	43.31	9.41	5.11
	Thigh	40.29	7.71	4.86
	Mean	41.80	8.55	4.98

a =treatment effect was significant ($P<0.05$); b= there was significant difference in cholesterol contents at different locations within breed/strain and treatment effect interaction was significant ($P<0.05$).

Table 2: Cholesterol level in different chicken breed/strains

Breed/strain	Mean values based on observation of five replicates under each breed/strains (mg/dL)
RIR	130.72 *
Broiler	107.58
Fayoumi (Fy)	123.92
Cross (RIRXRy)	86.54

* = Mean values among breeds/strains were markedly different (P<0.01); LSD = 17.63 mg/dl at (P<0.01)

ACKNOWLEDGEMENT

The authors are grateful to Mr. Tahir Masud Bajwa for assistance and Messrs Ahmad Nawaz Khan and Malik Khizar Hayat, Statistical Officers of the Institute for statistical treatment of data.

REFERENCES

Bakalli, R.I., G.M. Pesti, W.L. Ragland and V. Kongufca, 1995. Dietary copper in excess of nutritional requirement reduces plasma and breast muscle cholesterol of chickens. Poult. Sci., 74(2) 360-365.

Collins, W.M., A.C. Khan and A.E. Teeri, 1968. The effect of sex linked barring and rate of feathering genes and of stock upon egg cholesterol. Poult. Sci., 47: 1518-1526.

Demby, J.H. and F.E. Cunningham, 1980. Factors affecting composition of chicken meat. A Literature Review, World Poult. Sci. J., 36: 25-63

Edwards, H.M. (Jr), J.C. Driggers, R. Dean and J.L. Carmon., 1960. Studies on the cholesterol content of eggs from various breeds and strains of chicken. Poult. Sci., 39: 487-489.

Liebermann, C., 1985. Determination of cholesterol in blood serum. Chem. Ber., 18 : 1803

Mohan, B., R. Kadirvel, M. Bhaskaran and A., Natarajan, 1995. Effect of probiotic supplementation on serum/yolk cholesterol and on egg shell thickness in layers. Br. Poult. Sci., 36(5): 799-803.

Mountney, G.J., 1976. Chemical and Nutritive Characteristics, In : Poultry Products Technology, A.V.I. Publication, Westpost, Conn.

Piliang, W.G., 1994. Palm oil as energy source and its effect on cholesterol content in chicken. In: Sustainable animal production and the environment. Proceedings of the 7th AAAP Animal Science Congress, Bali, Indonesia, 11-16 July, 1994 volume 2: Indonesian Soc. Anim. Sci., pp: 287-288.

Powrie, W.D., 1973. Chemistry of Eggs and Egg Products. In: Egg Science and Technology, AVI Publication.

Rinco, A.M., F.C. dE, DE., Padilla, C.A., DE. Vizcarrondo and E. Martin, 1997. Cholesterol content in chicken meat and chicken products. Archivos Latinoamericanos de Nutricion, 47(1): 81-84.

Rukmangadhan, S., R.A. Rajini, D. Narahari, N. Ramamoorthy and R. Kumararaj, 1992. Influence of dietary energy and protein levels in serum protein and total cholesterol units in female ducklings. Cheiron, 21(1/2): 16-18.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics, 2nd Ed. McGraw Hill Book Co. Inc. New York, USA.

Suchy, P., I. Ingr and E. Strakova, 1995. Relationship between cholesterol concentration in eggs and the blood plasma of hens. Zivocisna Vyroba, 40(1): 11-14.