

*Original Research***Thyroid Hormones and Lipid Profile in Commercial Laying Chicken****P. B. Sonavane¹, S. H. Dalvi², R. B. Ambade³, Percy E. Avari⁴ and Kumarasamy, J.⁵**

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Abstract

The present study was conducted on sixty White Leghorn BV-300 strain commercial layer birds which were in their different phase of laying. The blood biochemical constituent's viz. triglyceride, total cholesterol, LDL, and HDL cholesterol and thyroid hormones were estimated. The triiodothyronine has shown significant ($p < 0.01$) increased from 21st to 30th week of the age when bird start laying. Highest level of thyroxine was observed on last phase of laying without any definite trend during entire laying phase of chicken. The lowest value of triglycerides was obtained at 21st - 30th week of age of layer birds. The levels of triglycerides significantly increased ($p < 0.01$) at last phase of laying but there was non-significant fluctuation in the level of total cholesterol during the entire laying phase of chicken. Also the HDL and LDL cholesterol levels during different phases of laying did not showed any definite pattern. There was non-significant fluctuation in the levels of HDL and LDL cholesterol concentration during the entire laying phases of chicken. Barring total cholesterol, LDL and HDL cholesterol relationship, all other relationships were statistically non-significant.

Key words: Lipid Profile, Layer Birds, Triiodothyronine (T₃), Thyroxine (T₄)

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Introduction

Poultry is one of the largest growing agricultural sectors in India today. The production of the eggs and broilers has been rising at the rate of 8 to 10 % per annum. India is now 5th largest producer of eggs (APEDA, 2012). Monitoring the biochemical indicators in blood is now routine part of experimental papers in the area of veterinary medicine and animal husbandry. However there is still lack of information on biochemical and hormonal profile in layer birds. Evaluation of blood biochemistry in birds allows for

identification of metabolic alterations due to many endo-exogenous factors. Investigations of hormonal control of growth and /or metabolism in poultry have predominantly performed using chicken (Scanen, 2009). Not only such studies focus on the chicken as an important agricultural animal but also the chick embryo has long been model for developmental biology. The importance of thyroid hormones in adaptation to heat stress is related to the central role that thyroid hormone to play in the regulation of metabolic rate of bird (MacNabb, 1988). The amount of adipose tissue in the chickens is related to thyroid status. The blood serum proteins, calcium, phosphorus and lipid in laying hens are about 2, 3 and 4 fold respectively higher than non-laying hens (Imasuen, J. A., 2012). Egg yolk is considered one of the richest sources of cholesterol. The lipoproteins found in the yolk of the egg are synthesized in the blood stream from which they are believed to be passed more or less intact into egg yolk.

Materials and Methods

The experiment was performed on sixty White Leghorn BV-300 strain commercial layer birds which were in their different phase of laying at Prabhat Poultry Farm, Rajanpada, Alibaug, Maharashtra. The layer birds were housed in California cage system. They were fed with commercial layer feed. The layer birds were divided into 5 groups with 12 birds in each group as Group I - 20th to 30th, Group II- 31st to 40th, Group III, 41st to 50th, Group IV- 51st to 60th, and Group V– 61st to 70th week age. The experiment was performed in summer when maximum and minimum temperature was 32°C, 26°C respectively and relative humidity 72 %. All the birds were kept under same hygiene and managerial and environmental conditions. The blood samples were collected from each bird by jugular venipuncture at morning in sterile tube and serum samples were separated and stored at -20° c until analysis.

Biochemical constituents in viz, triglyceride, total cholesterol, LDL, and HDL cholesterol were estimated by using biochemical autoanalyser (Robonic spectrophotometer) and kits were supplied by (ROBONIC (INDIA) PVT. LTD. Plot No.A-374, TTC, MIDC Industrial Area, Navi Mumbai – 400710, INDIA) and thyroid hormones were estimated by radioimmunoassay at Radiation Medicine Centre, BARC, Parel Mumbai-12 using the kits supplied by Board of Radioisotope Technology (BRIT), Bhabha Atomic Research Centre, Mumbai.

Statistical Analysis

Analysis of variance of the data was done by using Completely Randomized Design (CRD) and to study relationship Correlation of Coefficient was calculated according to Snedecor and Cochran (1994).

Results and Discussion

Mean serum thyroid hormone levels and lipid profile during different laying phases in chicken are depicted in Table 1.

Table 1: Mean serum thyroid hormone levels and lipid profile during different laying phases in chicken

Parameter	Age in weeks				
	21-30	31-40	41-50	51-60	61-70
T3 (ng/ml)	0.99 ^c ±0.07	1.39 ^b ±0.10	1.33 ^b ±0.08	1.80 ^b ±0.13	1.48 ^a ±0.13
T4 (ng/ml)	11.95±0.99	12.79±2.04	11.87±1.11	10.81±0.94	13.26±0.85
T3:T4	0.089 ^c ±0.034	0.125 ^b ±0.012	0.123 ^{bc} ±0.014	0.173 ^a ±0.013	0.117 ^{bc} ±0.014
Triglycerides (mg/dl)	752.19 ^c ± 35.71	958.67 ^b ± 54.27	1068.41 ^{ab} ± 52.47	1098.85 ^{ab} ± 63.02	1161.84 ^a ± 47.41
Total Cholesterol (mg/dl)	140.88 ^{NS} ± 0.10	140.85 ^{NS} ± 8.53	139.86 ^{NS} ± 4.83	151.89 ^{NS} ± 5.99	144.89 ^{NS} ± 5.69
LDL-C (mg/dl)	120.98 ^{NS} ±7.55	117.77 ^{NS} ±6.36	112.93 ^{NS} ±5.40	130.34 ^{NS} ±4.54	122.66 ^{NS} ±5.52
HDL-C (mg/dl)	14.36 ^{NS} ±2.31	14.30 ^{NS} ±1.69	14.62 ^{NS} ±1.80	12.11 ^{NS} ±1.13	14.64 ^{NS} ±1.31

NS: Non significant, Values with different superscript differ significantly

Thyroid Hormones

Tri-iodothyronine (T₃)

The triiodothyronine has shown significant increased from 21st to 30th week of the age when bird start laying. The level was 0.99 ± 0.07 ng/ml at first phase of laying cycle and shown significant increased to 1.39 ± 0.10 at 31st to 40th week age group of the layers. The levels then remained steady upto 51st-60th week of age without any significant change. The level then declined significantly at last phase of laying. Levels of T₃ was ranged between 0.99 ± 0.07 to 1.80±0.013 ng/ml with minimum level at start of first laying phase i.e. 21st to 30th week of age. The maximum level of 1.80 ng/ml was obtained at 51st to 60th age group. Though there was no definite trend of T₃ levels observed in the present study during different layer phases, the level of T₃ rise significantly (p<0.01) from the first laying phase to next laying phases. The concentrations of serum T₃ from 21st to 30th week age, 41st to 50th week of age and 51st to 60th week of age are in consistence with the finding of Melesse *et al.* (2011) in Lohmann Brown (LB) and White Leghorn (WL-dw) layer birds kept at high ambient temperature (30 to 32°C) but lower than the birds kept at normal ambient temperature. The 30 to 32 °C was the normal ambient temperature during summer season at the place of our experiment. Also the values of present study is also consistence with the values reported by Behrad *et al.* (2011) in different age of layer breeder i.e. from 22nd week age to 34th week of birds. With regards to age, the value of T₃ was significantly increased from 21st week when birds start laying and then remained constant with non-significant increase at 51st to 60th week of age. Melesse *et al.* (2011) reported reduction in plasma level of T₃ considerably by 41% at heat stress (temp. 30 to 32°C). The importance of thyroid gland hormone in adaptation of heat stress is related to the central role that thyroid hormone plays in regulation of metabolic rate of birds during growth and egg production. In our study high ambient temperature during summer might have depressed the activity of the thyrotrophic axis is layer hen as reflected in lower serum T₃ concentration. Also the overall levels of the thyroid hormones during different phases of laying cycle i.e. from 21st to 70th week of age is in agreement with the other author who have reported a depressed thyroid activity exposed to either acute to chronic type of heat

stress (Bringmon *et al.*, 1991; Yadar and Plavnik, 1999; Maak *et al.*, 2003; Tao *et al.*, 2006). The lower T_4 concentrations observed in the present study may suggest improved adaptability to long term heat exposure. Thyroid hormones are of almost important in heat adaptation process allowing the adjustment of metabolic rate in favour of the body heat balance. With further study the T_3 level in blood could be used on a criterion to select thermo-tolerance commercial chicken breeds in hot climate.

Also significant ($P < 0.01$) increased in the levels of T_3 at 31st to 40th age of week of laying bird may be because of increased in activity of monodeiodinase enzyme reported in other animal during growth period may be related with increased in production during this age period i.e. 31st to 40th week of age of birds and then peak production during 51st to 60th week of age. This indicates definite correlation of T_3 with the production in layer birds.

Thyroxine (T_4)

The mean $\pm$ SE level of thyroxine were 11.95 ± 0.99 , 12.79 ± 2.04 , 11.87 ± 1.11 , 10.81 ± 0.94 and 13.26 ± 0.85 ng/ml at 21st - 30th, 31st - 40th, 41st - 56th, 51st - 60th and 61st - 70th week of age of layers respectively. Highest level of 13.26 ± 0.85 ng/ml reported on last phase of laying without any definite trend during entire laying phase of chicken. The minimum concentration of 10.81 ± 0.94 ng/ml at 31st to 40th wk of age and maximum concentration of 13.26 ± 0.85 ng/ml is obtained at last phase (61st - 70th wk of age) of laying. There was non-significant difference in the level of T_4 in all laying phases of chicken. The T_4 values of the present study are in an agreement with the value reported by Behrad *et al.* (2011) from 22nd wk to 34th wk age of layer breeders. As regards to results, age has no any positive effect T_4 concentration. In contrast to T_3 levels in our study T_4 had shown slight non-significant increased at 61st - 70th group age of the layers i.e. last laying phase of the birds. This indicates inverse relationship of T_3 and T_4 . As at last phase of laying production declines and less conversion of T_4 to more biologically active T_3 the levels of T_4 might have increased. In this experiment the change in T_4 level were not similar to other animals but is agreement with the other reports in chicken. Ladmakhi *et al.* (1997) reported significant increase in the level of plasma T_4 concentrations in control fed upto 6th week of age in boilers and it is inversely related with the level of T_3 . The levels of T_4 are not agreement with the previous reports of Arzour *et al.* (2013). They reported that T_4 increased consistently with age in broilers and white leghorns.

Considering the metabolic role of thyroid hormones in the body which are involved in the growth and development of young organisms, as well as economizing on the energy in the chicken when the organism need a great of energy during production, the rise of T_3 at age 20th week onward in our study is expected. It is well established that T_3 plays a more dominant role in biooxidation process in cell than does T_4 (Darras *et al.*, 2000; Stojevic *et al.*, 2000 and Thrall, M. A., 2004). Although it seems that age and

phase of egg laying were the most important affecting factor on serum thyroid hormone concentration, only T_3 concentration significantly increased from 21st to 30th week of age in layer bird when they start laying indicate that the predominant role of T_3 in birds metabolism with relation to increase production. (Thrall, M. A., 2004; Stojevic *et al.*, 2000) have reported the age dependent (3rd to 6th week) increased in concentration of T_3 and T_4 hormone. Luger *et al.* (2001) have concluded that plasma T_4 concentration continuously increases with age in healthy boilers. There increased evident that T_4 necessary for growth in broilers.

T_3 : T_4 Ratio

There was significant increase ($p < 0.01$) in the ratio of these hormones from 21st -30th week of age to 31st -40th week of age of the layers when they just start laying. The ratio remained constant onward till 50th week age and then showed peak at 51st -60th week age of the birds. There was significant decreased ($p < 0.01$) in the ratio at last laying phase.

Lipid Profile

Triglycerides

The lowest value of triglycerides was obtained at 21st - 30th week of age of layer birds and then there was significant ($p < 0.01$) increased in the level of triglyceride at 31st - 40th week and then value shown increasing trend with increased age of the bird. There was significant increased. ($p < 0.01$) in the level of triglycerides from 21st - 30th week age and then levels remained steady till 51-60 week of age of birds. The levels of triglycerides then significantly increased ($p < 0.01$) at last phase of laying i.e. 61st - 70th week of age. The drastic increased in the triglycerides levels at the onset of egg production may be due to estrogen secretion which increases metabolism. The synthesis of lipoproteins occurs in liver and is dramatically stimulated by estrogen. Age related changes with tendency of blood cholesterol and triglycerides to decrease significantly during fattening period but in our study the levels of triglycerides showed significantly increased trend from start of laying through entire laying period of the birds.

Total Cholesterol, LDL& HDL-Cholesterol

The cholesterol level during different phase of laying did not showed any definite pattern. Also there was non-significant fluctuation in the level of total cholesterol during the entire laying phase of chicken. There was non-significant increase in the levels of serum total cholesterol at 51st to 60th (151.89 ± 5.69 mg/dl) week of age and then it comes down to 144.89 ± 5.69 mg/dl at 61st - 70th week age during last phase of laying.

The LDL-C levels during different phases of laying did not showed any definite pattern also there was non-significant fluctuation in the level of LDL-C concentration during the entire laying phases of chicken.

There was non-significant decrease in the levels of serum LDL-C till 41st to 50th (112.93 ± 5.40 mg/dl) week of age and then it again increased to 130.93 ± 14.54 mg/dl at 51st to 60th week of age. The HDL-C levels during different phases of laying did not showed any definite pattern. Also there was non-significant fluctuation in the level of HDL during the entire laying phases of chicken. There was non-significant constant range of level of HDL concentration till 41st to 50th week of age (14.62 ± 1.80 mg/dl) then it comes down at 51st to 60th week of age (12.11 ± 1.13 mg/dl) and again increased to 14.64 ± 1.31 mg/dl at 61st to 70th week of age during last phase of laying cycle.

Correlation of Thyroid Hormones with Lipid Profile during Different Phases of Laying Chicken

The inter correlation matrix of T₃ and T₄ with lipid profile viz. total cholesterol, triglycerides, LDL-c, HDL-c related that T₃ was negatively correlated with T₄ ($r = -0.269$) and HDL cholesterol ($r = -0.723$) and positively correlated with total cholesterol ($r = 0.838$), triglyceride ($r = 0.293$). All the relations were statistically not significant. T₄ is positively correlated with triglyceride ($r = 0.155$), HDL-c ($r = 0.751$) and negatively correlated with total cholesterol ($r = -0.443$) and LDL-c ($r = -0.371$). All the relationships were statistically non-significant. Barring total cholesterol and LDL-c and HDL-c relationship all relationships were statistically non-significant. Total cholesterol was positively correlated with TG ($r = 0.488$) and LDL ($r = 0.881$) and negatively correlated with HDL ($r = -0.888$). There was significant positive relationship ($p < 0.01$) of total cholesterol, HDL-C, LDL-C. The literature regarding the relation of thyroid hormone with lipid profile during different laying phases in poultry could not be traced. It is suggested for conducting more investigations on the dynamics of thyroid hormones concentration and lipid metabolism in view of their involvement in the growth and production.

Conclusion

Present experiment showed that there are definite correlations of thyroid hormones with age in commercial layer birds. Triglycerides levels differ significantly from start of laying through entire laying period indicating relation of serum lipid profile with age in laying chickens. Further detailed study is warranted to correlate the levels of thyroid hormones with production and composition of the egg.

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