ESTIMATION OF SERUM ALKALINE PHOSPHATASE, CHOLESTEROL, CALCIUM AND PHOSPHORUS DURING PRE-LAYING AND LAYING CONDITIONS IN DIFFERENT STRAINS OF CHICKENS

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ABSTRACT

In order to estimate serum alkaline phosphatase, cholesterol, calcium and phosphorus during pre-laying and laying reproductive conditions, 60 hens of Desi, Fayoumi, Cross (Rhode Island Red X Fayoumi) and Nick Chick strains were maintained for one year. Five random blood samples from each strain were collected and analyzed during both pre egg laying and egg laying physiological conditions. It was observed that alkaline phosphatase activity increased significantly ($P<0.05$) during laying condition. Serum cholesterol remained unaffected by both the strain difference and laying condition. Serum calcium and phosphorus levels increased ($P<0.05$) during laying condition. The interaction of strain and stage of laying condition was found to exert significant ($P<0.05$) effect on serum calcium levels. The study showed that the availability of calcium and phosphorus in requisite quantities be provided in diet of laying hens to ensure sustained and quality egg production.

Keywords: Serum, alkaline phosphatase, cholesterol, calcium, phosphorus, laying, chickens

INTRODUCTION

Egg production in chickens is dependent on certain physiological changes in the body of the birds (North and Bell, 1990). In the process of egg production, the availability of dietary calcium and phosphorus is critical. During the process of shell formation, there is an increase in activity of alkaline phosphatase in the blood of the laying hens. The supply of calcium should be viewed in terms of evidence that there are cycles related to calcium metabolism and feeding in laying hens and supply of calcium to laying hens needs to reflect this to increase efficiency of utilization of calcium (Correa-Cardona, 1999). Plasma oestradiol and cholesterol are reported to have a relationship with quality of egg shell in laying hens (Rezac *et al.*, 2000). It is also noted that variation in molar Ca: P ratio in bone has little effect on breakage resistance competence and that there could be adjustment in dietary calcium and phosphorus against current recommendations (Williams *et al.*, 2000). It is an established fact that amounts of calcium and phosphorus required by laying hens depend on their stage of egg production (Chah and Moran, 1985). Genetical differences in mean levels of plasma alkaline phosphatase has been noted (Bell and Freeman, 1971).

This project was undertaken to study effect of stage of egg production on serum levels of alkaline phosphatase, cholesterol, calcium and phosphorus in four different strains of chickens including Desi, Fayoumi, Rhode Island Red X Fayoumi and Nick chick.

MATERIALS AND METHODS

The experimental birds i.e. Desi, Fayoumi, Nick Chick and Cross (Rhode Island Red X Fayoumi) 15 each were maintained from September, 2000 to September, 2001 in Breeding Section of Poultry Research Institute, Rawalpindi. These birds were housed in open sheds. Right from the pre egg laying stage (18-24 weeks) till end of experiment at egg laying stage (30-70 weeks), they were fed test ration prepared in the Nutrition Division of the Institute. The ration contained 16.0 per cent crude protein, 6.0 per cent crude fibre, 5.0 per cent fat, 8.0 per cent moisture, 3.0 per cent calcium and 0.5 per cent phosphorus; throughout the study period the feed and water were available *ad libitum*. Feed was tested for aflatoxin B_1 in Feed Testing Laboratory of the Institute and was found to contain about 11 ppb (part per billion) which was within safe level, as per recommendations of FDA (1989). Five blood samples (33% of total birds) were collected from each group of Desi, Fayoumi, Nick

Chick and Cross (RIR X Fy) hens at both pre egg laying and egg laying stages for the estimation of serum alkaline phosphatase, cholesterol, calcium and Phosphorus. Alkaline phosphatase was estimated by enzymatic kinetic test (Haussamant and Clin, 1977). Inorganic phosphorus in serum samples was determined by photometric UV test (Thomas, 1992). Enzymatic calorimetric test was used for the determination of cholesterol concentration (Thomas, 1992) and colorimetric method for determination of serum calcium (Barnett, 1973). The data collected in respect of each blood parameter were subjected to statistical analysis (Steel and Torrie, 1980) to draw inferences regarding biochemical changes during pre egg laying and egg laying stages of hens.

RESULT AND DISCUSSION

The findings relating to pre egg laying and egg laying stages are given in Table 1. It was found that mean alkaline phosphatase (ALP) values (984.003 µ/l) were significantly (P<0.05) low during pre egg laying stage as compared with egg laying stage during which values as high as 1464.84 µ/l were noticed. Further, ALP values under both pre egg laying and egg laying stages were low (724.983 and 941.51 units) in Desi chickens than other three strains including Fayoumi, Cross (RIR X FY) and Nick Chick hens. There was, however, no significant difference among Fayoumi, Cross and Nick Chick strains. Interaction between productive stages and strains was also non significant which implies independent effect of stage of egg laying and strain of birds. the overall higher values of ALP during egg laying stage in all strains are attributable to increased activity of ALP due to calcification process involved during shell formation. These latter findings are in line with those of Bell and Freeman (1971) and North and Bell (1990).

It was noticed that stage of egg laying did not affect mean serum cholesterol levels (107.47 Vs 120.95 mg/dl) as was earlier reported by Rezac *et al.* (2000). Further, there was no difference in serum cholesterol level among all the four strains i.e., Desi, Fayoumi, Cross and Nick Chick, which implies that laying condition did not exert any extra demand on the cholesterol biosynthesis and its release in the blood circulation.

The mean serum calcium levels were found to be significantly (P<0.05) higher (5.65 mg/dl) during laying stage as compared to pre laying stage (2.92 mg/dl), as was also reported by Chan and Moran (1985). There was no difference among four strains of hens both during pre egg laying stage and laying stage but interaction of stages with strains of chickens resulted in higher values during laying stage. The strains of birds were found to be equally affected by the stage of egg laying during which there was mobilization of calcium for shell formation.

The mean values of serum phosphorus were significantly (P<0.05) low (5.32 mg/dl) during pre egg laying stage as compared to laying stage (6.95 mg/dl). There was no difference (P0.05) in mean serum phosphorus values among all four strains both during pre egg laying and egg laying stages of reproduction. There was no significant (P<0.05) interaction effect between stages and strains which shows that all variation in serum phosphorus levels was due to stage of egg laying only. The variation in serum phosphorus levels is correlated with serum calcium levels, as both elements are involved in the process of shell formation which also concomitantly increased alkaline phosphatase activity in the blood. In view of increased activity of calcium and phosphorus in serum and concomitant increase in activity of alkaline phosphatase, it is suggested that availability of calcium and phosphorus in requisite quantities be ensured in diet of laying hens to ensure sustained and quality egg production.

Table 1: Mean ± SE values of serum alkaline phosphatase, cholesterol, calcium and phosphorus during pre egg laying and egg laying stages in different strains of chickens

Blood Parameters	Strains of Chickens								Mean Values		Remarks
	Desi		Fayoumi		Cross (RIR X Fy)		Nick Chick				
	Pre-laying	Laying	Pre-laying	Laying	Pre-laying	Laying	Pre-laying	Laying	Pre-laying	Laying	
ALP (µ/L)	724.983 ±177.681	841.51 ±322.91	1117.557a ±64.14b	1653.04 ±435.18	1024.853a ±118.702	1656.50 ±510.87	1068.597a ±14.895	1608.32 ±424.86	984.003	1465.84	P<0.05
Cholesterol (mg/dl)	104.916 ±10.491	108.69 ±14.31	107.813 ±24.086	116.753 ±12.50	115.696 ±10.885	115.007 ±29.17	101.446 ±13.274	143.33 ±32.028	107.47	120.95	N.S
Calcium (mg/dl)	2.58 ±0.372	4.887 ±0.521	3.42 ±0.136	5.173 ±0.233	2.92 ±0.856	5.966 ±0.912	2.756 ±0.581	6.566	2.92	6.56	P<0.05
Phosphorus (mg/dl)	5.333 ±0.292	6.103 ±0.055	5.23 ±0.915	8.05 ±1.736	4.758 ±0.136	6.830 ±0.223	5.953 ±1.058	6.817 ±0.616	5.32	6.95	P<0.05

a = there is no difference (P<0.05)

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