CHANGES IN CONCENTRATIONS OF VARIOUS BLOOD PLASMA PARAMETERS AND HORMONES AS INFLUENCED BY INDUCED MOLT IN WHITE LEGHORN LAYERS

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ABSTRACT

Spent layers of 128 weeks age from a White Leghorn (Babcock) layer flock were induced to molt by withdrawal of feed for 14 days. The birds lost approximately 29.64% of their body weight. The blood samples were collected at pre-molt, post-molt and peak production stages. Maximum concentrations of cholesterol and glucose were observed at pre-molt and minimum at post-molt stage. Urea, protein and globulin showed maximum concentration at post-molt and minimum at peak production. Concentration of albumin was maximum at peak production and minimum at post-molt stage. Feed deprivation was followed by ovarian atrophy which significantly decreased the oestradiol (51.9 ± 1.2 pg/mL) and progesterone (13.5 ± 0.8 mg/mL) concentration at the post-molt stage and a significant increase (164.6 ± 4.6 pg/mL) and (27.1 ± 1.0 ng/mL) was observed, respectively at the peak production stage. It was concluded from this study that molting process significantly affect the concentrations of various biochemical and hormonal parameters indicating that the changes are related to various stages of molt and have substantial impact on the egg production.

INTRODUCTION

The phenomenon of molt consists of the orderly replacement of feathers which is accompanied by the total regression of the reproductive organs and cessation of the lay. In non-domesticated species, a prenuptial molt occurred prior to the breeding season, while the postnuptial molt occurred between the end of the reproductive season and the onset of the autumn or the autumn migration. In the domestic fowl, molt occurs approximately after one year of egg production. The birds can be subjected to molt by feed and water restriction, decreased day length, or by administration of thyroxin, or large doses of progesterone. Induced molting has been studied successfully in the past three decades as a method to improve economic productivity of the birds (Brake, 1993). Short-term fasting caused most immediate mobilization of hepatic carbohydrate reserves to liberate free glucose to the plasma in support of the metabolic needs of certain tissues. Both protein and fatty acid catabolism were increased greatly during periods of starvation (Langshow *et al.*, 1970). The greatest energy loss was due to fat depletion and to some extent body protein metabolism. As protein metabolism increases, glycogenic amino acids were converted to denovo carbohydrate substrates (Sturkie, 1986). Ovarian progesterone and estrogen secretion decreased with the onset of molt but the thyroxin concentration increased during the molting period (Scanes *et al.*, 1979).

More information is needed, especially as regard of induced molt on the haematochemical profile of the layers. The following experiment was conducted to evaluate the concentrations of various blood parameters at premolt, postmolt and peak production stages.

MATERIALS AND METHODS

One hundred seventy four commercial (Babcock) egg laying hens at the completion of second production cycle reared under various light and feed restriction regimes (Haq, 1995) were induced to molt. In the second molt, the birds in premolt stage were provided with *ad libitum* feed and clean water. The light was round the clock in the last three days of the premolt stage (Table 1).

In the premolt period the birds were given a dewormer, Oxafax (Welcome Pak., Ltd.) and an antibiotic, N.C.O. MIX W/S (Neomycin-Chloramphenicol-Oxytetracycline; Better Traders). The birds were given Newcastle disease and infectious bronchitis vaccine. In the molting period vitamins, minerals and electrolytes were administered to combat the molting stress.

Table 1: Molting schedule of birds

Days	Water	Feed	Light (h)
		Premolt phase	
1 to 4	*Ad libitum*	*Ad libitum*	16
5 to 7	*Ad libitum*	*Ad libitum*	24
		Molt phase	
1 to 4	No	No	6
5 to 14	*Ad libitum*	No	6
15 to 21	*Ad libitum*	Ground corn 45 g/bird	
22 to 49	*Ad libitum*	Pullet grower 65 g/bird	6
50 onwords	*Ad libitum*	Layer mash	12

The blood was obtained directly from the wing vein of the birds and heparin was used as an anti-coagulant. Blood samples were centrifuged for 3-5 minutes at 2000 rpm. Plasma was collected and small aliquots were stored at -20°C until analysis. The plasma samples thus obtained were analyzed by Kit method (Rondox) for blood chemistry and hormonal estimation was done by Serono Diagnostic kits.

RESULTS AND DISCUSSION

In the present study plasma cholesterol, glucose and progesterone concentrations were maximum at premolt and minimum at post-molt stage whereas reverse was true for urea concentration (Table 2).

The results are substantiated by the findings of Cheshmedzhieva and Dimov (1989) who have reported that induced molting inhibited indigenous cholesterol synthesis. Akram (1995) reported that cholesterol concentration significantly decreased in post-molt stage. Increased levels of thyroid hormones and regression of ovarian cells might have also contributed towards lowering of cholesterol concentration at post-molt stage. Significantly high levels of cholesterol were observed at peak production stage which may be related to lipoprotein complex, transporting lipids being synthesized in the liver (Sturkie, 1986). However, Haq (1995) has reported that feed restriction of the growing period resulted in significant increase in the cholesterol concentration at 20 weeks of age.

Decreased glucose concentration at postmolt stage could be due to that short-term fasting caused almost immediate mobilization of hepatic carbohydrate reserves to liberate free glucose to the plasma in the support of metabolic needs by hepatic glycogenolysis but not directly by muscle glycogenolysis. Thus, even though body weight was reduced during starvation, its greatest energy loss was due to the fat depletion and to some extent body protein mobilization (Hazelwood and Lorenz, 1959; Brady *et al.*, 1978). Decreased progesterone concentration at this stage (Table 2) might be responsible for changes in the glucose, protein and cholesterol concentrations. Akram (1995) also found maximum glucose concentration at pre-molt stage whereas Haq (1995) observed that feed restriction of the growing period resulted in the decrease blood glucose levels.

Plasma urea concentration showed significant increase at post-molt stage (Table 2). Akram (1995) reported that under various stages of molt and production, maximum concentration of urea was observed at end of production and minimum at pre-molt stage. Breakdown of proteins during stress would have produced ammonia by domination of amino acids in the liver which might have converted to urea. There may be another assumption that urea concentration remained high due to less degradation because when the birds are starved there is least excretion of nitrogen.

Protein and globulin concentrations were maximum at post-molt and minimum at peak production stage whereas albumin and oestradiol concentrations were maximum at peak production and minimum at post-molt stage (Table 2). Haq (1995) stated that serum protein was significantly higher in birds grown on 85 per cent of feed requirement. Akram (1995) reported minimum protein concentration at peak production. Plasma protein levels were maintained during fasting period until body protein stores were markedly depleted. Thus after the depletion of fat reserves and breakdown of protein, protein catabolism increased to fulfill requirement of energy needs and other essential mechanism commencing in the body.

Significant decrease in the concentration of albumin was observed at postmolt stage. The albumin might

Table 2: Effect of induced molt on the concentration of various blood parameters (Mean±SE) of commercial layers.

Parameters	Pre-molt	Post-molt	Peak production
Cholesterol (mg/dL)	174.0±2.1a	86.9±1.4c	119.7±3.3b
Glucose (mg/dL)	113.7±2.7a	79.5±2.0c	95.4±2.3b
Urea (mg/dL)	9.8±0.1c	16.0±0.2a	12.7±0.2b
Protein (g/dL)	6.9±0.3b	7.1±0.3a	6.4±0.2c
Albumin (g/dL)	2.3±0.3b	2.0±0.1c	2.4±0.2a
Globulin (g/dL)	4.6±0.2b	5.2±0.2a	4.1±0.2c
Progesterone (ng/mL)	29.8±1.5a	13.5±0.8c	27.1±1.0b
Oesteradiol (pg/mL)	71.9±3.6b	51.9±1.2c	164.6±4.6a

Values with different letters in a row differ significantly ($P<0.05$)

have been utilized to supply energy to the body because it is easily digested and utilized by the body. Low levels of albumin were observed when there was excessive loss of protein either internal loss or increased protein breakdown for gluconeogenesis (Benjamin, 1985). Akram (1995) observed that minimum concentration of plasma albumin at post-molt stage.

Maximum concentration of globulin was observed at post-molt stage. Akram (1995) reported maximum concentration at post-molt and minimum at peak production stage. Increased level of globulin reflected that immune system was quite active at the post-molt stage due to which low mortality was observed during the experiment. The increased level of globulin might be due to the rapid utilization of albumin which is easily degraded and available to the body. Thus, decrease albumin concentration consequently resulted in an increased concentration of globulin.

Significant decrease in the concentration of progesterone was observed in the post-molt stage. The results of this study are in line with the findings of Kono *et al.* (1986), they reported that plasma progesterone concentration was reduced in molting period and increased in post-molt period. Porter *et al.* (1991) observed low levels of progesterone concentration by day third of the feed restriction. Dickerman *et al.* (1992) found that plasma progesterone concentration reduced during molting process. Vanmontfort *et al.* (1994) concluded that feed deprivation for 10 days significantly depressed the progesterone concentration. Akram (1995) investigated that plasma progesterone concentration was maximum at pre-molt and minimum at post-molt stage.

Kono *et al.* (1986) found that plasma oestradiol concentration was slightly reduced in the post-molt period and increased rapidly at the peak production stage. Porter *et al.* (1991) observed low levels of oestradiol concentration by day third of the feed restriction. It was found that oestradiol concentration was higher when egg production was higher (Izumi *et al.*, 1992). Hence oestradiol concentration is directly proportional to egg production. Akram (1995) reported maximum oestradiol concentration at peak production and minimum at post-molt stage.

Ovarian oestrogen secretion decreased with the onset of the molt, this might be due to the regressed cells of the ovary and oviduct. Oestrogen and progesterone concentration were significantly higher at peak production as compared to the pre-molt stage.

Increased production of oestrogen and progesterone was also followed by decreased level of cholesterol during three stages indicating its utilization in the synthesis of these hormones. A high level of oestrogen at peak production may be able to modify the concentration of cytoplasmic progesterone receptors in the reproductive tract (Pageaux *et al.*, 1983). Increased levels of oestradiol 17 ß enhances the growth of oviduct, induces synthesis of ovalbumin (Sturkie, 1986).

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