Diet manipulation and post-moulting responses in caged commercial laying hens

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Abstract

Two hundred and fifty caged commercial laying hens were induced to moult through a 15-day feed and water withdrawal programme. Immediate and subsequent effects on egg production and follicular developments were monitored. Results showed that moulted hens attained over 60% egg production after 6 weeks of feeding with increasing egg weight. Post-moulting egg quality values were similar but globulin were significantly increased ($P < 0.05$). Changes in liver and oviduct weights were significant ($P < 0.05$) while gizzard, heart, lung and kidney showed no significant ($P > 0.05$) effects. Fasting produced atretic follicles even though follicular number was not appreciably influenced. Follicles were larger with a yellow-yolky appearance during laying than at the fasting period. Mortality of 2.4% was recorded throughout the experimental period. Moulting is a feasible strategy for maintaining egg production in aged, low-producing commercial layers.

Keywords: Force moulting, diet, layers, egg production

Introduction

Moulting, a physiological process of feather shedding which is accompanied by a period of rest from egg production, can be induced through the manipulation of photoperiod or nutrition. Poultry housing design in the tropics is the open-sided type which is therefore incompatible with the use of photoperiod as a means of inducing moulting.

Ensmiger (1980) reported on different nutritional methods of inducing birds to moult. Furthermore, a forced-moult of 16 days through the provision of 45g of feed per hen at 2 day intervals and reduction of photoperiod to 8 hours was employed by Su *et al.* (1995) while

Dhir *et al.* (1994) deprived hens of feed for a period of 13 days. Most of the reports available are restricted to the temperate regions, on breeder hens, and have variable results.

In as much as moulting is not commonly practiced in the tropics and a decrease in laying rate has been turned around through induced moulting (Decuypere and Verheyen, 1986; Wakeling, 1977), this trial aimed at assessing the post-moulting effects on aged, low producing commercial layers using dietary manipulation.

Materials and methods

Two hundred and fifty commercial laying hen (82 weeks old) of Black Harco strain were picked from a flock reared and managed at the University Teaching and Research Farm. The individually caged birds were induced to moult using a combination of feed and water withdrawal for 3 days, feed withdrawal alone for 2 days; provision of ground maize at 30g/hen/day for 2 days; water alone for 3 days; ground maize + 0.025g/kg layers premix for 2 days and finally, water alone for 3 days. At the end of the 15 days period, 10 birds were randomly bled from the wing web section and serum total protein and albumin were determined for each bird (Jain, 1986). Globulin was obtained by difference and albumin/globulin ratio was calculated. The birds were weighed, sacrificed and cut open, then gizzard, liver, heart, spleen, kidney, lungs and oviduct removed and weighed. Oviduct length was measured with a tape rule. Each ovary of the sacrificed birds was freed of adhering fat, weighed and total follicles counted with a hand lens. The ovarian follicles

were obtained by immediately placing the ovaries in a normal saline solution. Follicles were dissected from ovary and cleared of interstitial tissue using forceps and a pair of scissors. The diameter of each follicles was taken with vernier caliper and classified into the following ranges 0-0.5; 0.5-1.0; 1.0-1.5; 1.5-2.0; 2.0-2.5; 2.5-3.0; 3.0mm and expressed as percentage (frequency of occurrence). The remaining birds were then placed *ad libitum* on a formulated layers' diet (18% crude protein and 10.7 MJ/kg ME calculated values) comprising 44.25% maize, 20% soyabean meal, 20% wheat offal, 3% fish meal, 10% oyster shell, 2% bone meal, 0.25% vitamin-mineral premix for a period of 6 weeks after which all the measurements were repeated. Daily egg production was noted while average feed intake, egg weight and egg quality indices (haugh unit, yolk index and shell thickness) were monitored weekly. Data generated were analysed using a student's T test and significant differences evaluated (Gomez and Gomez, 1984).

Table 1 Changes in bodyweight (kg), organ weights (g), serum protein (g/dl), and oviduct length (cm) of caged hens during fast and after feeding

Measurements	Fasted layers	After 6 weeks of feeding	SEm
<i>Weights</i>			
Body weight	1.17 ^a	1.63 ^b	0.25
Gizzard	39.66	31.62	13.2
Heart	6.20	8.48	2.48
Kidney	8.54	8.97	0.30
Lung	5.85	9.62	3.95
Liver	14.27 ^a	43.52 ^b	1.41
Oviduct	9.83 ^a	76.45 ^b	9.80
Spleen	11.35 ^b	10.11 ^a	0.01
<i>Length</i>			
Oviduct	35.00 ^a	67.50 ^b	5.75
<i>Serum</i>			
Total protein	4.84 ^a	6.71 ^b	0.28
Albumin	1.40 ^a	1.97 ^b	0.39
Globulin	3.44 ^a	4.74 ^b	1.24
Albumin: Globulin	0.48	0.43	0.09

^{a,b}Means without superscripts on the same row are similar ($P>0.05$)

Post-moulting responses in layers

Results and discussion

Partial shedding of primary feathers started on the 8th day of moult, continuing till about 20th day. Body weight, organ weights and serum protein values are indicated in Table 1. Body weight increased by 40% after 6 weeks of feeding. Gizzard, heart, lung and kidney exhibited no variations. Liver and oviduct weight increased ($P<0.05$) while spleen weight decreased. The oviduct length of 67.5cm recorded during the feeding period was close to 70.0cm (Aitken, 1971) or 61.5-66.5cm (Su *et al.*, 1995) compared with 35cm recorded at fasting when egg production was nil. Total protein, albumin and globulin values were higher during the feeding period compared with values immediately after fast thereby revealing a dependency on availability of feed nutrients. It was apparent that the increased physical and physiological activities during egg laying occasioned the increment in the weight of some organs.

Data on follicular measurements (Table 2) revealed that fasted layers had a lower ($P<0.05$) weight of counted follicles, similar ($P>0.05$) follicular number and fewer yellow-yolky follicles but a higher proportion of small sized follicles which decreased in number after 6 weeks of feedings. The findings are consistent with those of Hocking *et al.* (1989) and Brake and Thaxton (1979) that a forced moult induced weight loss of the reproductive organs. A positive relationship between number of follicles and body weight was reported by Hocking *et al.* (1987) which was not overtly demonstrated in this study.

Egg production which ceased at the onset of moult commenced after six days of introducing

the layers' diet and thereafter showed a consistent and rapid increase attaining over 60% by the 6th week (Figure 1). Feed intake, Haugh unit and egg weight also gradually increased with time. Values for yolk index varied between 0.39-0.42 while shell thickness ranged from 0.33-0.35cm with no incidence of egg cracks during the period of study. Reports (Dhir *et al.*, 1994; Herremans *et al.*, 1989) showed that subsequent performance, laying persistence and egg quality are influenced by the method or extent of moulting. Normally, egg production decreases as a hen ages and this has been attributed to a reduction in the rate at which follicles enter the final phase of rapid growth or increased rate of follicular atresia (Williams and Sharp, 1978). Visual observations revealed a higher incidence of atretic follicles during the period of fast. The effect of moulting appears to be a rejuvenation of the birds to a younger state thereby, re-initiating the development of ovarian follicles for another phase of egg laying. This may also partially explain the absence of atretic follicles during egg production.

The moulting programme employed resulted in a mortality of only 2.4% throughout the study which was within acceptable limits.

The growing increment in net replacement cost of layers and the fact that pullet day old chicks alone constitute about 30% of pullet rearing costs in Nigeria, should encourage force-moulting as a means of keeping birds in-lay in the 2nd year. Poor laying hens due to stress or old age can be returned to production with larger sized eggs as rapidly as possible and concurrently, prolonged productive performance will be realized.

Table 2 *Changes in follicular morphology of caged laying hens during fasting and after feeding*

Measurement	Fasted layers	After 6 weeks of feeding	SEm
Follicular weight (g)	14.51 ^a	29.34 ^b	2.1
Total follicles counted	53.20	43.30	17.87
Yellow-yolky follicles	1.17 ^a	6.0 ^b	1.48
White follicles	52.0 ^b	37.3 ^a	10.73
Proportion (%) of follicles of varying diameter (mm)			
0.0-0.5	44.90	39.55	6.24
0.5-1.0	21.09 ^b	11.33 ^a	4.15
1.0-1.5	15.00 ^b	11.75	2.12
1.5-2.0	9.00	9.04	0.78
2.0-2.5	5.00 ^b	11.21 ^a	1.48
2.5-3.0	2.82 ^b	8.50 ^a	2.14
> 3.0	0.62 ^b	8.50 ^a	2.14

^{ab}Means without superscripts on the same row are similar (P>0.05)

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