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Full Length Research Paper

Morphological characteristics and egg production of forced-moult layers under different moult induction techniques

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A study was conducted to investigate the morphological characteristics and egg production of forced-moult layers. Different feeding patterns designated T1, T2 and T3 representing *ad libitum* supply of feed and water, no feed but water given *ad libitum* and no feed or water, respectively, were used to induce moult. T1 served as the control. One hundred and twenty 84-week old layers in their 64 weeks in lay were randomly assigned to each treatment, which was replicated 4 times with 30 hens per replicate. Forced-moult treatments were imposed for 10 days, after which the moulting hens were fed moult diet for 50 days and returned to the same feed as the control. The results of the study revealed that morphological characteristics following moult induction included loss of feathers, dullness of the eyeballs, shriveling and paleness of the comb, wattle and ear lobes. Also the moulting birds emaciated with T2 and T3 losing 18.18 and 25.97%, respectively, of their initial body weights by day 7 of moult induction. The forced-moult groups T2 and T3 stopped egg production by 6 days of moult induction and resumed egg production by day 25. T2 and T3 attained a peak egg production of 71% by the second month following resumption of lay. On the other hand, in the T1 egg production progressively decreased with age.

Key words: Egg production, layers, forced-moult, morphology.

INTRODUCTION

Changes in body morphology are associated with moulting hens. Loss of wing feathers is a morphological characteristic signaling the beginning of moulting. Spearman (1971) reported that feather loss starts with the wing, spreading to the body then to the head and neck. On the other hand, feather loss was reported to begin from the head, to the neck, breast, back, belly, wing and tail (North, 1972; Etches, 1996). Rose (1997) reported that feather loss begins at approximately 15 days following moult induction. Body weight loss ranging from 24 to 31% has been reported in moulting birds (Brake and Thaxton, 1979b; Cater and Ward, 1981; Baker et al., 1983; Andrews et al., 1987; McCormick and Cunningham, 1987). Brake and Thaxton (1979b) observed significant body weight loss in "Nick" hens by the tenth day of forced-moult. Twenty five percent of total body weight loss was directly attributed to regression of the liver, ovary and oviduct (Brake and Thaxton, 1979b; Andrews et al., 1987). However, much of the body weight loss could be consequential to the reduction in adipose tissue, labile protein and/or other visceral organs.

Birds that are out of lay and moulting hens were observed to show some other morphological characteristics such as loss of comb and wattle colour (Brake and Thaxton, 1979a). Shriveled comb and wattle, stiff abdomen and pelvic bones, small, dry vent were reported for hens that are out of lay (Oluyemi and

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Roberts, 2000; Kekeocha, 1984; Obioha, 1992). These authors also reported the bleaching of vent, eye ring, ear lobe, beak and shank in laying birds. Chalky appearance of comb, wattle and shank of moulted birds prior to resumption of egg production was observed (Brake and Thaxton, 1979a). In modern strain of layers, moulting and laying are not mutually exclusive, hence moulted birds will start egg production before feather growth is fully completed (Etches, 1996; Rose, 1997). Induced moult was reported to increase subsequent egg production from 64 to 77% or more (Alodan and Mashaly, 1999). The objectives of the study were to evaluate the morphological characteristics of forced-moult layers as well as post-moult egg production.

Materials and methods

Location of Study

The experiment was conducted in the Poultry Unit of the Teaching and Research Farm and the laboratory of the College of Animal Science and Animal Health, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

Experimental animals

A total of 360 Isa Brown commercial layers aged 84 weeks and 64 weeks in lay were used for the study. The hens were managed in deep litter in an open-sided poultry house. They were fed commercial layer's mash containing about 16% crude protein for 2 weeks before the induction of moult and after moulting.

Experimental design and procedures

The experiment was a completely randomized design with feeding patterns as the treatment. The feeding patterns were as follows:

1. Layer's mash and water supplied *ad libitum* (T1, control)
2. No feed but water supplied *ad libitum* (T2)
3. No feed, no water (T3)

Each treatment was replicated 4 times with 30 birds per replicate making a total of 120 hens per treatment. The feeding patterns used to initiate moulting were imposed for 10 days. From day 11 to 50, the forced-moult groups (T2 and T3) were fed moult ration containing about 10% crude protein at the rate of 60 g $bird^{-1}$ day^{-1}. Thereafter, the forced moult groups were returned to the same feeding patterns as the control throughout the experimental period.

Determination of morphological characteristics

Changes in the morphology (feather, comb, wattle, ear lobes, eyeballs, vent, beak and shanks) of the hens were determined by visual observation of the hens. The space between the abdomen and pelvic bone was determined using the fingers. Body weight was measured at 7-day intervals over a period of 56 days using an electronic weighing balance. Changes in body weight and percent body weight loss were also recorded.

Egg production records

Percent hen-day egg production was recorded prior to moult induction, during induction and over a period of 9 months post-moult.

Statistical analysis

The data generated were analysed using analysis of variance (ANOVA). Significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Behaviour of the birds during forced-moult

Generally changes were observed in the behaviour of the hens during the period of moult induction. With the removal of feed and water during forced-moult, the birds became agitated and noisy. After the first day of moult induction, they resorted to eating litter materials, pecked, broke and drank any egg laid prior to moult induction.

From day 4 of moult induction, movement of the birds was significantly reduced and sitting posture was common among the forced-moult groups. Thus the moulting birds spent more time sitting passively and dozing whereas the control group remained active. The reduced activity of the forced-moult groups observed in this study could be as a result of reduced energy and/or increased physiological stress induced by forced-moult procedures of starvation. Following introduction of moult ration, the forced-moult groups gradually returned to normal active life.

Morphological changes

From day 10 of moult induction, feathers of affected birds started to drop, their eyeballs and eye rings became dull. Also, the comb, wattle and ear lobes became shriveled and pale. The vent became shriveled and dry with the space between the pelvic bone and abdomen narrowed. The beak and shanks showed yellowish tints. These morphological changes occurred between days 7 and 10 and were earlier than 12 days reported by Brake and Thaxton (1979a) for moulting birds. These conditions lingered until day 35 of re-feeding with moult ration when the colour of the comb and wattle brightened and the vent became moist.

By day 56, when period they had been re-introduced to layers ration, the space between the pelvic bone and abdomen became wider and pliable. By this time the plumage had become smoother and appeared normal, although not all the wing feathers had grown to their full length. These changes in morphology observed in the

Table 1. Body weights (kg) of birds during moult-induction period.

Moult period (days)	Feed and water (T1)	No feed, water supplied (T2)	No feed and water (T3)
0	1.54±0.02	1.54±0.03	1.54±0.02
7	1.51±0.02[b]	1.26±0.04[a]	1.14±0.02[a]
14	1.52±0.02[b]	1.31±0.01[a]	1.34±0.04[a]
21	1.59±0.02	1.53±0.04	1.51±0.05
28	1.56±0.03	1.50±0.04	1.48±0.04
35	1.59±0.03	1.54±0.03	1.50±0.03
42	1.55±0.02	1.54±0.04	1.51±0.03
49	1.58±0.04	1.55±0.03	1.55±0.03

Means in a row with different superscripts are significantly different (P< 0.05).

Table 2. Hen-day percent (%) egg production of the birds in the different treatments during pre and post-moult.

Production period	Feed and water (T1)	No feed, water supplied (T2)	No feed no water (T3)
Pre-moult	50.56±1.64	51.20±2.68	51.61±0.72
Moult induction	50.17±7.34[b]	0.00±0.00[a]	0.00±0.00[a]
Post-moult			
Resumption of lay	51.72±7.97[b]	1.20±0.34[a]	0.76±0.27[a]
5% (9days) after resumption of lay	53.43±6.08[b]	5.52±0.55[a]	4.78±0.30[a]
Month 1 after resumption of lay	50.21±4.15[b]	30.86±1.37[a]	27.65±1.17[a]
2 " "	51.39±4.83[a]	71.50±1.91[b]	71.37±3.23[b]
3 " "	53.90±4.59[a]	73.56±1.49[b]	71.25±1.58[b]
4 " "	51.54±5.97[a]	74.36±2.92[b]	72.76±1.21[b]
5 " "	51.79±5.14[a]	70.48±2.14[b]	67.99±1.28[b]
6 " "	46.48±2.87[a]	69.56±2.69[b]	65.42±4.32[b]
7 " "	38.05±3.57[a]	64.88±1.72[b]	63.10±4.68[b]
8 " "	38.22±2.18[a]	63.70±1.75[b]	59.23±8.48[b]
9 " "	35.10±3.36[a]	57.14±2.40[b]	54.38±4.51[b]

a, b, Means in row with different superscripts are significantly different (P< 0.05).

moulting birds during forced-moult period were similar to the observations of Kekeocha (1984) and Obioha (1992) for old none laying hens.

The body weights of the birds in the control group (T1) fluctuated throughout the experimental period. The body weights of T2 (no feed but water supplied *ad libitum*) and T3 (no feed no water) were significant lower (P<0.05) than that of T1 at days 7 and 14 of moult induction as shown in Table 1. Within 7 days of feed and water restrictions, the forced-moult groups T2 and T3 had lost approximately 280 g (18.18 %) and 400 g (25.97%), respectively of their initial body weights. The significantly low body weight values of the forced–moult group (T3) by day 7 of moult induction were as a result of the severity of feed and water withdrawal. By day 14 of forced-moult and following re-feeding with moult ration, T2 and T3 began to regain their lost weights. By this time, T2 gained 50 g (3.80 %) while T3 gained 200 g (14.93 %). The higher weight gain in T3 could be attributed largely to compensatory growth of the body tissues, since the birds in this group suffered greater physiological stress consequent upon total feed and water withdrawal.

By day 35, the T2 group had returned to their initial pre-moult body weight while in T3 body weight fluctuated and approximated the initial weight by day 49. The body weight loss observed in this study corroborates the report of several researchers (Brake and Thaxton, 1979 a,b; Andrews et al., 1987; Etches 1996; Rose, 1997; Odunsi et al., 2002) who observed significant body weight loss during forced-moult. The body weight loss ranging from 18.18 to 25.97% recorded for the forced–moult groups T2 and T3, respectively fall within the expected range in body weight loss for profitable moult programmes. The significant (P<0.05) low body weights of the forced moult groups on days 7 and 14 of moult-induction period indicate that starvation is a major component of moult-induction techniques. This is in line with the reports of Wakeling (1977) and Jacquet et al. (1993). The weight loss of T2 (280 g) and T3 (400 g) in this study was different from 500 g weight loss observed by Hurwitz et al. (1995) in moulting birds. However, the post-moult weight gain of the forced-moult group T3 (200 g) fall within the range 200 – 300 g recorded by Etches (1996).

Egg production

Before moult-induction average hen-day percent egg production of the birds ranged between 50.6 to 51.6%. The forced-moult groups T2 and T3 stopped egg production on 6 and 3 days, respectively. They resumed egg laying at day 25 following cessation of lay and thereafter attained 5% production by day 9. The control group showed no cessation of lay but egg production fluctuated and declined progressively with age (Table 2). Egg production peaked at 71% in the forced-moult groups by the second months after resumption of lay and thereafter hen-day percent egg production in the forced-moult hens were significantly ($P<0.05$) higher than that of the control. After the peak, T2 and T3 showed persistency ranging between 71 and 73% in egg production. By month 9 after resumption of lay, T2 and T3 were producing eggs at a rate of 57.1 and 54.4 %, respectively, while T1 was producing at the rate of 35.1 %. This confirms the reports that egg production is improved by forced-moult (Baker et al., 1983; Bell, 2003).

Conclusion

Morphological changes observed in moulting hens were similar to those observed in old non-laying hens. Major morphological characteristics exhibited by the moulting birds are loss of feathers, changes in wattle, comb, ear lobes, abdominal region, vent as well as loss of body weight. Forced-moult improved egg production in the second laying year.

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