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Recovery Pattern of Abdominal Fat, Visceral Organs, and Muscle Tissues in Induced Molting Hens

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강제환우계에서 복강지방, 장기, 근육조직의 변화

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ABSTRACT : To observe the effect of induced molting on the recovery patterns of abdominal fat, visceral organs, and muscle tissues in spent laying hens after induced molting, three hundred sixty 77-wk-old, Babcock White hens were divided into 36 experimental units of 10 hens each and subjected to molt induction for seven wk. The post-molt production phase was spread over 84 to 126 wks of age. Thirty-six birds were randomly slaughtered and dressed at the pre-molt, 5% egg production, peak, and end phases of egg production. The body weight, abdominal fat, relative weight and length of visceral organs were measured. Proximate compositions of breast and thigh muscles were analyzed at each stage. The body weight was found to be minimal at the 5% egg production stage, but increased as the egg production increased for the rest of production. The pattern of abdominal fat change was very similar to that of body weight. The relative weight of the liver decreased to the lowest at the start of post molting stage, but peaked at the end phase of egg production ($P<0.05$). However, the heart and gizzard were observed to reach their maximum weight at the 5% egg production ($P<0.05$), whereas they were similar to those of the pre-molt phase for the rest of the production stages. Both intestine and reproductive tracts were found to be significantly smaller at 5% egg production than at the other stages; however, their sizes increased gradually, reaching peak at the end phase of egg production ($P<0.05$). Fat contents in breast and thigh muscles decreased significantly to the lowest at the start of the post-molt stage, but increased to the highest at the end phase of egg production ($P<0.05$). Thus, the present study indicated that the molting process reduced body weight by decreasing the weights of abdominal fat and other visceral organs. Molting also influenced the breast and thigh muscle composition by decreasing fat content.

(Key words : induced molting, laying hens, abdominal fat, visceral organs, breast and thigh muscle)

INTRODUCTION

Induced molting is a complex mechanism used to rejuvenate spent laying hens for another production cycle. Many researchers have tried to investigate the optimum changes in abdominal fat content, weight and length of visceral organs, as well as composition in breast and thigh muscle of spent laying hens (Brake and Thaxton, 1979; Hoyle and Garlich, 1987; Aattia et al., 1994; Akram et al., 1997a, b; Akram, 1998). Body weight loss ranged from 10 to 35 percent depending upon the duration of fasting and restricted feeding (Akram et al., 1997a, b). Brake and Thaxton (1979) reported that approximately one-fourth of body weight loss could be attributable to the decrement of various organ weights after induced molting. Such weight loss was presumably due to the reduction of adipose tissue and labile protein reserves. The length of oviduct and weight of

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shell glands were also reduced during the molting (Hoyle and Garlich, 1987; Attia et al., 1994). There was a 65 percent decrement in uterine lipids accompanied by 35, 61, 90 and 84% reduction in body, liver, ovary and oviduct weights, respectively (Baker and Brake, 1981).

However, molting did not influence the percentage of carcass moisture, fat, and protein contents during the recovery in spent laying hens (Hoyle and Garlich, 1987). Lilburn et al. (1993) also indicated some decrement in oviductal protein concentration in the turkey breeder hens during forced molting. In contrast, Cleaver et al. (1986a, b) observed a significant weight changes in liver, dry matter and ash contents between the pre- and post-molt stages in turkey hens. Induced molting is known to inhibit the indigenous cholesterol synthesis, which leads to the reduction of cholesterol concentrations in egg yolk and chicken meat (Cheshmedzhieva and Dimov, 1989). Induced molting also resulted in the reduction of breast and thigh meat fat, but increased protein content proportionally by the mobilization of extra fat (Akram, 1998). Nevertheless, the results regarding induced molting were not enough to explain these complicated changes in modern strains of laying hens under different growth conditions.

Thus, this study was conducted to investigate the subsequent changes in abdominal fat content, weight and length of visceral organs, and proximate composition of breast and thigh muscle in spent laying hens resulting from induced molting.

MATERIALS AND METHODS

Three hundred and sixty Babcock white laying hens at 77 weeks of age were divided into 36 experimental units of 10 hens each and were subjected to molt induction for seven weeks (Akram et al., 1998). Thirty-six birds with three replicates in each stage were randomly selected, slaughtered and dressed at pre-molt, 5% egg production, peak and end phases of egg production to monitor the changes in abdominal fat content, weights and lengths of visceral organs, and proximate composition of breast and thigh muscles. After the completion of induced molting, a 12 h light : 12 h dark cycle was provided and increased further by 30 min per wk up to 16 h light at the peak production stage. A diet containing 16% CP and 2,800 kcal ME/kg was fed *ad libitum* during the post-molt production phase from 84 to 126 wk of age.

Body weight and abdominal fat were measured at each stage. The abdominal fat(%) was calculated relative to that of body weight. Relative weights (g/100g BW) of the liver, heart, gizzard, intestine and reproductive tracts were recorded at each stage. In addition, relative lengths (cm/100g BW) of intestine and reproductive tracts at each stage were measured. Samples were drawn from breast and thigh muscles of each bird. The data collected on abdominal fat, visceral organs, breast and thigh muscle at four different egg production stages were subjected to statistical analysis using SAS(1996).

RESULTS AND DISCUSSION

1. Body weight, abdominal fat, breast and thigh muscle fat

Body weight and abdominal fat content of the hens exhibited significant differences between the pre- and starting of the post-molt stage ($P<0.05$). Maximum weight gain was achieved at the end phase of egg production, but it was minimum at the 5% egg production stage (Fig 1). This result corresponded to the report of Zubair and Leeson (1994) that stated a 30% body weight reduction during molting required from 9 or 13 days in extremely cold and hot weather, respectively. This trend was also supported by the result of Akram(1997a, b) indicating that post-molt body weight was reduced to 73%, but increased from the onset of laying and maximized at the end of the second egg production stage. Abdominal fat content was the lowest at 5% egg production stage, but the highest at the end phase of egg production. These results demonstrated a positive correlation between body and abdominal fat weight that might be influenced by fasting during the molting. These results were also similar to the findings of Brake and Thaxton (1979) who reported approximately one-fourth of body weight loss and 69.34% abdominal fat reduction during molting. Fat content in the breast and thigh muscle was significantly different at each stage ($P<0.05$). It was notably lowest in those muscles at 5% egg production stage, but reached its highest at the end phase of egg production. These results correlate with the reports of starvation, caused the loss of excess adipose tissue deposits

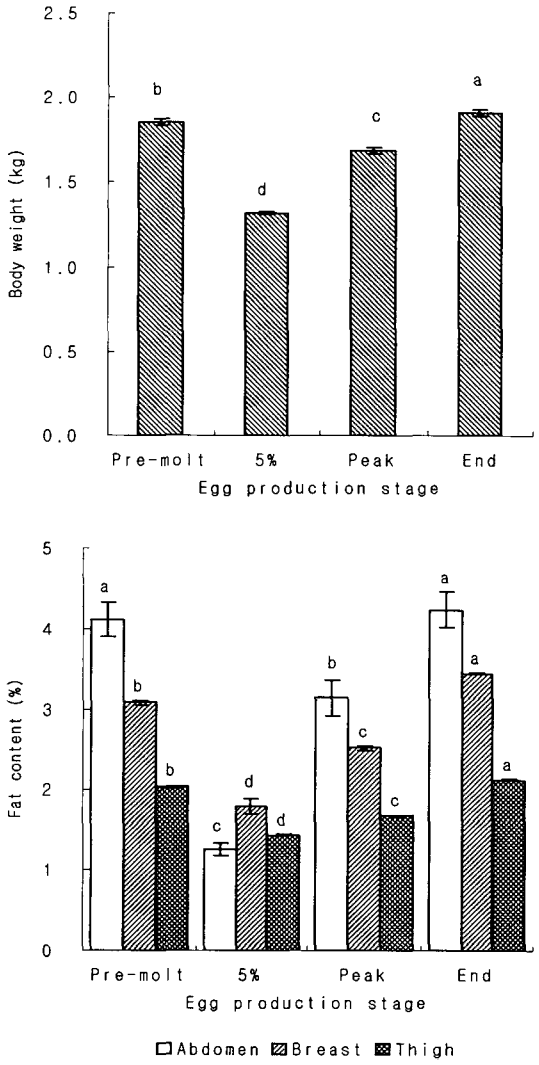

Fig. 1. Body weight, abdominal fat, breast and thigh fat content (Mean±SE) at each production stage after induced molting in spent laying hens.
[a-d] Means with the different superscripts differ significantly ($P<0.05$).

(Brake and Thaxton, 1979; Zubair and Leeson, 1994). The results of this experiment were similar to the results of Akram (1998) showing that fat content decreased from the start of post-molt stage, which resulted in increasing of protein levels.

2. Liver, heart, and gizzard

The mean relative weight (g/100g BW) of the liver, heart and gizzard in spent laying hens reflects significant changes between

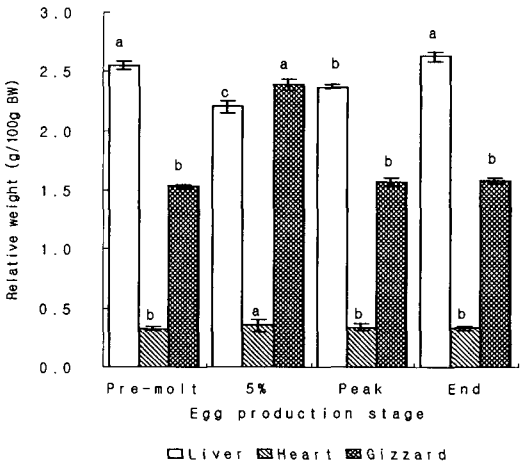

Fig. 2. Relative weight of giblets (Mean±SE) at each production stage after induced molting in spent laying hens.
[a-c] Means with the different superscripts differ significantly ($P<0.05$).

the pre- and starting of the post-molt stage ($P<0.05$). Maximum liver weight was noted at the end phase of egg production, but reduced to the minimum at the 5% egg production stage (Fig. 2). Decreased liver weight at the start of post-molt could result in a compensatory growth, which reached its maximum at the end phase of egg production. These results were supported by the reports of Brake and Thaxton (1979) who confirmed a significant decrease in both absolute and relative liver weight during forced molt. The relative weights of the heart and gizzard were found to be the highest at 5% egg production stage, but the the lowest at the pre-molt phase ($P<0.05$). This reverse trend might be due to reduction in over all body weight between stages.

3. Intestinal and reproductive tracts

The relative weight and length of the intestinal and reproductive tracts showed significant changes between the pre-molt and 5% egg production stage ($P<0.05$). Maximum weights and lengths of intestinal and reproductive tracts were observed at the end of production, but were at their minimums at 5% egg production (Fig. 3). Similarly, Brake and Thaxton (1979) also reported that approximately one-fourth of body weight loss could be attributable to the decreases of 53.78 and 73.00% in both intestine and oviduct weight during the molting.

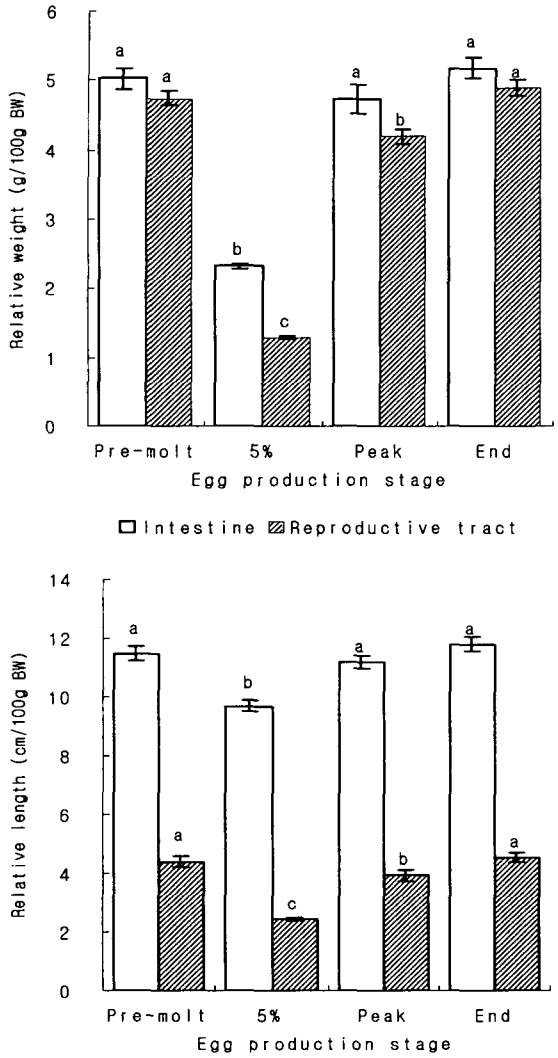

Fig. 3. Relative weight and length of visceral organs (Mean± SE) at each production stage after induced molting in spent laying hens.

[a-c] Means with the different superscripts differ significantly ($P<0.05$).

The results of this experiment involving this increased weight of the intestinal tracts, may be attributed to a possible underlying requisite for re-alimentation after induced molting. These results suggest that those organs were regressed in size and weight by fasting and cessation of lay during molting, but recovered from the start of the production stage.

Thus, the results of this study confirmed that molting is a complex process in spent laying hens which influenced their abdominal and muscle fat content, as well as the weight and length of their visceral organs by decreasing fat content.

적 요

산란노계에서 강제환우가 체중, 복강지방, 장기, 근육조직의 변화에 미치는 영향을 고찰하고자 77주령 산란계 360수를 7주간 강제환우를 시행하였다. 강제환우전, 산란율 5%, 산란피크, 실험종료 시기인 126주령에 단계별로 각각 36수씩 희생시킨 후에 체중, 복강지방, 장기 및 번식기관의 길이와 무게를 조사하였으며, 가슴과 다리근육에서 지방함량을 분석하였다. 체중은 산란 5% 시기에 제일 낮았으며 산란율이 증가하면서 실험 종료시기에 극대화되었다. 복강지방도 체중의 변화와 비슷한 경향을 보였다. 간의 체중에 대한 비율도 강제환우 후에 제일 낮았지만 실험 종료시에 현저하게 높았다($P<0.05$). 심장과 근위의 무게는 산란율이 5%에 도달하였을 때 제일 높았지만, 그 후에는 강제환우 이전과 동일한 경향을 보였다. 산란율이 5%에 도달한 시점에서 장기와 번식기관의 무게는 다른 시기에 비하여 현저하게 낮았지만 산란율이 높아지면서 그 무게가 증대되었으며 실험 종료시에 제일 높게 나타났다($P<0.05$). 가슴과 다리근육의 지방함량도 산란율이 5% 도달시에 제일 낮게 나타났으며, 실험 종료시에 현저하게 높았다($P<0.05$).

본 실험의 결과 산란노계에서 강제환우 전후시기에 체중, 장기, 근육의 변화의 주요 원인은 주로 복강지방과 다른 장기 및 근육에서 지방의 함량감소에 기인하였음을 확인하였다.

(색인어 : 강제환우, 산란노계, 복강지방, 장기, 가슴 및 + 다리 근육)

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