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# Effect of 1-Day-Old Body Weight on Subsequent Performance, Behavior and Egg Quality Traits in Laying Hyline-White Hens Kept in Cages

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**Abstract:** One of the main goals of chicken breeders is to improve laying performance and therefore, reliable predictors are required. In this study, the effect of 1-day-old chicks body weight (BW) on the laying performance, behavior and egg quality traits of laying Hyline-white hens was examined from 20-40 weeks. A total of 180 chicks were separated into three categories based on their 1-day-old BW (light, L; medium, M; and heavy, H), with six replications per group, each of which consisted of 10 chicks. It was found that the H group birds had the highest BW across all experimental periods and the highest feed consumption, but they also had the best overall feed efficiency. At 30 and 40 weeks of age, the H group hens produced significantly fewer eggs than the M or L group hens. In addition, there were a significantly higher percentage of birds engaging in eating, drinking, walking, standing, sitting, foraging and dust bathing behaviors and a significantly lower percentage engaging in perching and preening behaviors in the H group. Abnormal behaviors, such as feather pecking and aggression, were recorded more frequently in both the M and H group birds. There was no significant difference in any of the external and internal egg quality measurements, with the exception of egg weight and albumen weight, which were significantly higher in the H group. Therefore, it can be concluded that H group laying hens had the best body weight, feed intake and efficiency and egg quality and production. Therefore 1-day-old BW can be used as a reliable predicator of performance, behavior and production traits in laying hens.

**Key words:** Body weight · Laying hens · Performance · Behavior and egg quality traits

## INTRODUCTION

As in other animal sectors, the main goal of chicken production is to obtain the desired yield at the lowest cost. Superior management has been shown to increase production and reduce the extent of feather pecking, cannibalism and subsequent mortality. Body weight (BW) management has been shown to be the most critical component for maximizing returns from laying hens and both genetic factors [1] and environmental conditions have been shown to contribute to variation in BW across a range of poultry populations.

Selection over the past four decades has resulted in a decline in BW in the current commercial strains of laying hens [2] as well as a reduction in feed consumption alongside a concurrent increase in feed efficiency [3]. To achieve early maturity and egg production, it is very important that hens have the correct BW and uniformity during the growing period. There is also a need to understand the relationship between the initial BW and behaviors, productivity and welfare improvement. An increase in BW has been correlated with a decrease in egg production and an increase in both egg weight and feed consumption because heavy birds consume more feed and lay larger eggs with larger egg yolks than light hens [4]. It has also been shown that the uniformity of the flock at the beginning of and during the laying period is the main factor that increases egg production [5]. However, little research has been conducted to investigate the effects of BW on laying hen. The major emphasis of research on laying hens has been solving practical problems, rather than developing an understanding of some of the principles through a systemic scientific approach [6].

Avian eggs contain a natural balance of essential nutrients for humans and egg quality is important for consumer appeal, which, in turn, affects the economic success of the producer. Egg quality includes a number of

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aspects relating to the shell (external quality) and the albumen and yolk (internal quality) [7]. Egg weight is related to productivity [8] and at the beginning of the laying period, one of the most important factors determining egg weight is the BW of the hen at the age of sexual maturity [4]. In addition, the chemical composition of the pullet body at the beginning of the laying period is also important because, at peak production, laying hens use their body tissues and have a reduced desire to feed. Therefore, it is important to use good quality pullets that have reached sexual maturity [9]. The internal egg quality is largely determined by the albumen, the thinning of which is a sign of reduced quality [10]. Overall, egg quality has a genetic basis and so varies between strains of hens [11] , but it is also influenced by the housing system under which the hens are kept [12]. It has also been shown that the age of the laying hens affects egg quality, with Silversides *et al*. [11] showing that as the age of the hen increases, the egg, albumen and yolk weights increase while the albumen height decreases; Fletcher *et al.*[13] reported that it is the increase in egg yolk that has the greatest effect on egg weight, whereas albumen weight is less influenced by age. Additional factors, such as disease, disturbance and stress, can also affect egg quality and interact with each other and the factors mentioned above, making it difficult to diagnose the causes of egg quality issues in some instances.

Behavioral responses are useful practical indicators for assessing the degree to which poultry have adapted to the production environment, as they can be monitored rapidly and non-invasively [14]. Housing in cages has been shown to increase fear [15] or stereotyped behaviors [16] or to inhibit the performance of some behaviors in the behavioral repertoire [17]. It has been shown that there can be large differences in behavioral profiles between commercial layers [18] and so selection of the correct BW for the layers may reduce some of these risks. In addition, selection against harmful behaviors, such as cannibalism and feather pecking, can improve the adaptation of laying hens to the social environment, thereby improving their well-being [19]. Non-aggressive feather pecking causes damage to and occasionally removal of the feathers of companion birds [20] and can sometimes lead to cannibalism [21] , while aggressive feather pecking, which has a genetic origin [22] , can result in damage to the skin and other parts of the bodies of other birds [23].

In this study, the relationship between 1-day-old BW and the productivity and welfare of laying hens was examined. To do this, Hyline-white hens raised in a poultry house with a cage system were separated into three BW groups and their performance, behavior, production and internal and external egg quality traits were quantified during the different laying periods.

## MATERIALS AND METHODS

**Experimental Materials and Procedures:** The present study was carried out at the South Valley University Research Farm, Qena, Egypt, with approval by the ethics committee on Research Animals. Standard feeding, drinking, lighting conditions and animal densities were used throughout the experiment.

One hundred and eighty 1-day-old Hyline-White unsexed chicks were obtained from a commercial hatchery and housed in a tropical environmentally controlled cage system. All birds were fed manually with a standard starter diet to 4 weeks of age, a grower diet to 18 weeks of age and a layer diet from 18 weeks of age onward. Feed and water were available ad libitum. All of the chicks were weighed and sorted into three groups (light, L; medium, M; and heavy, H; n = 60/group) based on their 1-day-old BW (Table1). There were six replicates per group, each consisting of 10 chicks. Each group was reared in conventional pullet rearing cages. Chicks were reared with 60 birds per cage (1 bird/200 $cm^2$) until 5 weeks of age, 30 birds per cage from 6 to 18 weeks (1 bird/400 $cm^2$) and approximately 8 laying birds per cage from 19 to 40 weeks at the end of the experiment (1 hen/375 $cm^2$). The indoor temperature was 24°C ± 2°C, the humidity was 50% and the photoperiod was 16L:8D throughout the experiment. All groups were managed in a similar way.

**Performance and Egg Quality:** The BW of each individual was recorded every 10 weeks starting at week 20 and feed consumption (weekly) was recorded throughout the study period. Feed efficiency was calculated by dividing the feed consumption by the total egg weight produced during the time that feed consumption was measured.

Table 1: Body weights (g) of 1-day-old Hyline-White chicks

| | Weight (g) | | |
|---|---|---|---|
| Groups | Mean ± SD | Range | No. birds |
| Light (L) | 33.2±1.03 | 30.3-34.5 | 60 |
| Medium (M) | 35.9±0.8 | 34.6-37.5 | 60 |
| Heavy (H) | 39.2±1.2 | 37.6-41.8 | 60 |

Table 2: Behavioral ethogram of laying hens according to Guo *et al.* [25].

| Behavior | Description |
|---|---|
| Eating | Continuously pecking the feed from the food trough |
| Drinking | Continuous ingestion of water from drinking nipples |
| Walking | Taking at least one step in any direction |
| Body care | Preening and dust bathing behavior on the cage floor |
| Resting and sleeping | Standing in an idle posture, sitting with open eyes and sleeping |
| Pecking | Pecking at the feathers, neck, head, tail or claw of another bird; gentle pecks aimed at the beak or at parts of the body of another bird; pecking at the cage, trough or perches |
| Aggression | Aggressive pecking toward other birds |
| Brooding | Lying down, bringing an egg and placing it under its breast |
| Other activities | Flapping, pandiculation, ruffling, beak cleaning and defecation |
| Gentle feather pecking | Gentle pecking at the feathers of another bird without breaking or removing feathers |
| Aggressive behavior | One or more severe pecks at the head of another bird; fighting with another bird |
| Pecking at enclosure | Pecking at the wall, floor or roof of the cage/floor pen without scratching the wired cage floor or litter in the floor pen |

Daily egg production, which was expressed as hen-day egg production (i.e., no. eggs/no. live hens/day) was recorded for each group. The following egg quality parameters were measured monthly: egg weight, yolk weight, egg shell weight, albumen weight and albumen height. These parameters were calculated following the methods described by Yoruk *et al*. [24] using 30 randomly selected eggs per treatment that had been stored at room temperature for 24 h.

**Behavioral Observations:** Behavioral observations were performed from 20 to 40 weeks using scanning techniques. Three replicates per group, were scanned by an observer. The observations were made at 1 min intervals over a 15 min period in the morning (9-12 AM) of each day. Each scan consisted of scoring the number of hens that were eating, drinking, standing, walking, sitting, foraging, perching, preening, dust bathing, body shacking, feather pecking, pecking at enclosure or carrying out other behaviors [25]. Hens were accustomed to the presence of the observer on the first day and the other data were used for the analysis.

**Behaviors Were Then Grouped into the Following Categories:** Consummatory (eating and drinking), comfort or maintenance (preening), inactive (standing and sitting), stereotyped (pecking at enclosure, feather pecking and body shaking), locomotor (walking) and other behaviors. The percentage of birds engaging in each of these behaviors was then calculated (Table 2).

**Statistical Analysis:** The data were analyzed using SPSS (Statistical Package for the social sciences) version 16 for window. One way analysis of variance (ANOVA) was performed and means were compared using Duncan's multiple range tests. A significance level of $p < 0.05$ was used for all analyses.

## RESULTS

The changes in BW that were observed during the experimental period are presented in Table 3. In all experimental periods, laying hens in the M and H groups were significantly heavier than those in the L group ($p < 0.05$), with H group hens being the heaviest. The 1-day-old BW had a significant effect on BW at 20, 30 and 40 weeks (Table 3). The L group hens also ate significantly less than the M and H group hens ($p < 0.05$), but there was no significant difference in feed consumption between the M and H groups at 30 and 40 weeks. Feed efficiency was significantly higher for H group hens at 20, 30 and 40 weeks (Table 3).

In terms of egg yield, the L and M groups produced significantly more eggs than the H group in all experimental periods ($p < 0.05$), but there was no difference between these groups (Table 3). The peak yield of the H group hens did not reach those of the other groups.

In terms of behavior, the percentage of birds engaging in eating and drinking behaviors was significantly higher in the H group compared with the other groups in all experimental periods ($p < 0.05$; Table 4), showing that consummatory behaviors were significantly affected by BW. The 1-day-old BW also had a significant effect on both walking and standing behaviors, with a significantly higher percentage of birds engaging in walking behaviors in the H group than in the other groups ($p < 0.05$) and a significantly higher percentage of birds exhibiting standing behavior in both the L and M groups than in the H group (Table 4).

Table 3: Effects of 1-day-old body weight on the performance of Hyline-White laying hens at 20-40 weeks of age in cages

| Group | Body weight (g) | Daily feed intake (g) | Feed efficiency (g of food: g of egg) | Hen-day egg production (%) |
|---|---|---|---|---|
| *At 20 weeks* | | | | |
| L | 1328[a] | 71.6[a] | 2.23[a] | 88.1[b] |
| M | 1727[b] | 76.3[b] | 2.35[a] | 91.1[b] |
| H | 1802[c] | 84.6[c] | 2.59[b] | 81.7[a] |
| SEM | 1.14 | 0.25 | 0.012 | 0.02 |
| p-value | 0.0001 | 0.0001 | 0.002 | 0.01 |
| *At 30 weeks* | | | | |
| L | 1565[a] | 85.8[a] | 1.80[a] | 90.7[b] |
| M | 1797[b] | 98.2[b] | 2.05[b] | 87.2[b] |
| H | 1894[c] | 100.6[b] | 2.99[c] | 78.0[a] |
| SEM | 2.02 | 0.33 | 0.03 | 0.03 |
| p-value | 0.0001 | 0.0002 | 0.0001 | 0.001 |
| *At 40 weeks* | | | | |
| L | 1651[a] | 92.7[a] | 1.72[a] | 77.2[b] |
| M | 1911[b] | 103.5[b] | 1.96[b] | 75.2[b] |
| H | 2031[c] | 103.0[b] | 2.39[c] | 65.5[a] |
| SEM | 2.35 | 0.36 | 0.009 | 0.03 |
| p-value | 0.0001 | 0.0002 | 0.0001 | 0.001 |

L, light; M, medium; H, heavy; SEM, standard error of the mean. [a-d] Values in the same group and column with different superscript letters are significantly different (ANOVA, $p<0.05$).

Table 4: Effects of 1-day-old body weight on subsequent behaviors of Hyline-White laying hens in cages

| | Behavioral patterns | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Consummatory behaviors | | Locomotor behaviors | | | | | Body care behaviors | | | Stereotypical behaviors | | |
| Group | Eating | Drinking | Walking | Standing | Sitting | Foraging | Perching | Preening | Dust bathing | Body shaking | Feather pecking | Pecking at enclosure | Aggressive behavior |
| *At 20 weeks* | | | | | | | | | | | | | |
| L | 20.1[a] | 4.51[a] | 4.82[a] | 23.4[b] | 1.61[a] | 16.8[a] | 4.72[b] | 1.51[a] | 0.52[a] | 0.00 | 1.92[a] | 7.50[b] | 0.10[a] |
| M | 18.6[a] | 3.22[a] | 5.21a | 23.5b | 1.02a | 20.9[b] | 0.91[a] | 2.83[b] | 0.71[b] | 0.00 | 5.01[b] | 6.41[ab] | 2.61[b] |
| H | 25.1[b] | 6.31[b] | 8.94b | 19.5a | 3.83b | 34.6c | 0.56[a] | 2.80[b] | 0.73[b] | 0.00 | 4.50[b] | 5.13[a] | 5.72[c] |
| SEM | 0.03 | 0.02 | 0.06 | 0.13 | 0.02 | 0.31 | 0.01 | 0.02 | 0.01 | 0.00 | 0.02 | 0.01 | 0.04 |
| p-value | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NS | 0.001 | 0.001 | 0.001 |
| *At 30 weeks* | | | | | | | | | | | | | |
| L | 16.7[a] | 6.57[a] | 12.1[a] | 31.1[b] | 5.48[b] | 19.72[a] | 3.92[b] | 1.38[a] | 0.91[a] | 0.00 | 1.65[a] | 11.0[c] | 0.04[a] |
| M | 15.5[a] | 4.67[a] | 13.2[a] | 32.3[b] | 3.43[a] | 21.70[b] | 0.75[a] | 2.54[b] | 1.26[b] | 0.00 | 4.33[b] | 9.39[b] | 1.20[b] |
| H | 20.9[b] | 9.20[b] | 20.2[b] | 25.9[a] | 12.0[c] | 37.55[c] | 0.42[a] | 2.58[b] | 1.23[b] | 0.00 | 3.92[b] | 7.49[a] | 2.64[c] |
| SEM | 0.06 | 0.04 | 0.14 | 0.11 | 0.03 | 0.42 | 0.01 | 0.01 | 0.01 | 0.00 | 0.02 | 0.02 | 0.01 |
| p-value | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NS | 0.001 | 0.001 | 0.001 |
| *At 40 weeks* | | | | | | | | | | | | | |
| L | 18.4[a] | 3.91[a] | 4.53[a] | 30.85[a] | 2.97[b] | 11.53[a] | 3.83[b] | 1.73[a] | 0.20[a] | 0.00 | 1.47a | 5.08[b] | 0.05[a] |
| M | 17.1[a] | 2.82[ab] | 4.92[a] | 31.99[ab] | 1.86[a] | 19.92[b] | 0.71[a] | 3.19[b] | 0.28[b] | 0.00 | 3.87[b] | 4.34[b] | 0.14[a] |
| H | 24.0[b] | 5.41[ac] | 8.46[b] | 25.72[ac] | 7.05[c] | 24.74[c] | 0.39[a] | 3.23[b] | 0.26[ab] | 0.00 | 3.48[b] | 3.45[a] | 0.32[b] |
| SEM | 0.07 | 0.04 | 0.05 | 0.12 | 0.02 | 0.16 | 0.01 | 0.01 | 0.00 | 0.00 | 0.02 | 0.21 | 0.00 |
| p-value | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NS | 0.001 | 0.001 | 0.001 |

L, light; M, medium; H, heavy; SEM, standard error of the mean; NS: Non Significant differences between the means.

[a-c] Values in the same group, age and column with different superscript letters are significantly different (ANVOA, $p<0.05$).

Table 5: Effects of 1-day-old body weight on egg quality traits in Hyline-White laying hens at 20-40 weeks of age in cages

| | Egg quality | | | | |
|---|---|---|---|---|---|
| Group | Egg weight (g) | Yolk weight (g) | Egg shell weight (g) | Albumen weight (g) | Albumen height (mm) |
| *At 20 weeks* | | | | | |
| L | 43.1[a] | 9.35 | 4.88 | 29.26[a] | 9.38 |
| M | 45.5[b] | 9.86 | 5.04 | 31.16[b] | 9.19 |
| H | 46.3[c] | 9.60 | 4.77 | 32.46[b] | 9.59 |
| SEM | 0.26 | 0.14 | 0.04 | 0.57 | 0.05 |
| p-value | 0.001 | 0.1319 | 0.2729 | 0.002 | 0.0553 |
| *At 30 weeks* | | | | | |
| L | 51.9[a] | 13.77 | 5.36 | 33.06[a] | 8.79 |
| M | 56.2[b] | 14.57 | 5.54 | 36.26[b] | 8.19 |
| H | 57.8[b] | 14.57 | 5.24 | 35.96[b] | 8.39 |
| SEM | 0.29 | 0.13 | 0.04 | 0.52 | 0.06 |
| p-value | 0.001 | 0.0523 | 0.2314 | 0.001 | 0.0603 |
| *At 40 weeks* | | | | | |
| L | 55.1[a] | 15.47[a] | 5.70 | 34.16 | 8.19 |
| M | 56.2[a] | 16.37[b] | 5.89 | 34.06 | 8.17 |
| H | 57.9[b] | 16.77[b] | 5.58 | 34.56 | 8.19 |
| SEM | 0.35 | 0.17 | 0.06 | 0.65 | 0.05 |
| p-value | 0.005 | 0.0004 | 0.3225 | 0.2933 | 0.8132 |

L, light; M, medium; H, heavy; SEM, standard error of the mean.

[a-d] Values in the same group, age and column with different superscript letters are significantly different (ANOVA, $p<0.05$).

The percentages of hens engaging in both sitting and foraging behaviors were also significantly higher in H group hens than in the other groups ($p < 0.05$); the 1-day-old BW had a significant effect on perching, preening and dust bathing behaviors, with a higher percentage of perching behavior in the L group than the H group ($p < 0.05$) but a higher percentage of preening behavior in the H group across all experimental periods and a higher percentage of dust bathing behavior in the M and H groups at 20 and 30 weeks. There was no significant difference between treatment groups for body shaking behavior, however, as this behavior was not observed. Feather pecking was also significantly affected by 1-day-old BW, with a higher percentage of occurrence in M and H group hens than in L group hens; pecking at the enclosure was significantly higher in L group hens at 30 and 40 weeks than in the other groups ($p < 0.05$) (Table 4). In addition, a higher percentage of birds engaged in aggressive behaviors in the H group at 20-40 weeks ($p < 0.05$; Table 4).

Egg quality characteristics were not significantly affected by 1-day-old BW (Table 5), with no significant differences in yolk weight (except at 40 weeks), egg shell weight, or albumen height between groups during the experimental period. However, egg weight was significantly higher in the H group than in the other groups at 20 and 40 weeks; albumen weight was significantly higher in both M and H group hens at 20 and 30 weeks than in L group hens ($p < 0.05$) (Table 5).

## DISCUSSIONS

In the present study, the effect of 1-day-old BW on the performance, behavior and egg laying traits of laying Hyline-white hens was assessed. It was found that the H group had a higher feed consumption and feed conversion ratio than the L group even for similar egg weights, which may be related to the higher maintenance requirements and abdominal fat ratios of H group hens. By contrast, the lower feed consumption of L group hens can be explained by the lower egg weights that were produced. Leeson and Summers [9] previously noted that there is a significant positive relationship between feed consumption and BW in hens and differences in feed intake and feed efficiency in relation to changes in BW have also been demonstrated [26]. In the present study, H group layers had the lowest peak egg yield, supporting previous reports of a negative correlation between egg yield and BW [27]. While, Dunnington and Siegel [28] showed that egg production was 50% lower in lighter

hens, possibly due to their lower fat content. However, Kirikci *et al*. [29] found that BW had no effect on egg production, while Akbas and Takma [30] demonstrated a positive relationship between egg production and BW. Despite their lower productivity, H group hens laid larger eggs, however, at least partly due to the positive correlation between BW and egg weight [31].

The expression of natural behaviors in chickens is known to be influenced by genetics [32]. However, the use of cages has also been criticized for restricting the expression of these behaviors. Therefore, in this study, the behaviors of the three groups of laying hens kept in a cage housing system were studied to assess the effect of 1-day-old BW on their welfare. A high percentage of birds in the H group engaged in eating behaviors, likely due to higher BW birds requiring a higher nutrient intake, which increases feeding motivation. This contrasts with the findings of Cook and Xin [33] , who found no significant differences between BW groups for any of the feeding behavior parameters recorded during their trials. A higher percentage of birds in group H also engaged in drinking, which could be attributed to the positive correlation between drinking and feeding [34]. These findings agree with those of Bessei [35] but differ from those of Guo *et al*. [25] who found no significant difference in the feeding and drinking behaviors of different BW birds.

The percentage of birds engaging in walking reflects the hens' level of activity. Thus, the greater percentage of walking that was observed in H group layers may indicate a higher level of frustration in the cage environment. In addition, more hens in the H group engaged in sitting, foraging, preening and dust bathing, while a higher proportion of the L group exhibited perching behavior, all of which also indicate increased activity. These results agree with those of Carmichael *et al*. [34], who observed similar behaviors in ISA Brown hens in a perchery system. The complete absence of body shaking in this experiment may not relate to the amount of space that was available in the cages [36] but, rather, may be because these behaviors simply did not occur during the observation periods.

Feather pecking was performed more frequently by M and H group hens than by L group hens. This could be related to more preening being required due to more feathers being out of place or to the absence of a litter substrate for foraging and dust bathing [37] ,resulting in redirection of foraging [38]. The higher frequency of pecking at the enclosure observed in the L group layers could be considered as displaced foraging behavior, as observed by Duncan and Wood-Gush [39].

In all experimental groups, the hens spent most of their time standing and eating, possibly due to the restricted space in the cages. The higher frequency of feather pecking that was observed could be related to the absence of foraging material in the cages, indicating that the hens were frustrated. These results correspond with previous findings for laying hens [40] and broiler chicks [41] and they support Aerni *et al*. [42] who recommended that ground pecking is a key behavior that helps to minimize feather pecking and cannibalism. Aggressiveness is primarily influenced by the number of birds in the immediate vicinity of a resource and by differential plumage markings [43]. However, in this study, aggression was found to be higher in H group hens, while Bilci and Keelin [44] found a significant negative association between the number of aggressive pecks received and BW. We cannot exclude the possibility that heavier birds attracted more aggressive pecks.

In the present study, there were no significant differences in the examined egg quality parameters between the treatment groups. However, egg weight was lower in the L group, supporting the hypothesis that egg weight is dependent on the BW of hens. Summers and Leeson [4] similarly reported that an increase in BW resulted in an increase in egg weight, while Guo *et al*. [25] found no significant relationship between the two, indicating that the pre-laying BW did not affect the post-laying calcium absorption and rejuvenation of the oviduct [45]. In the present study, there was also no significant difference in shell weights between the experimental groups, which is surprising because it has previously been shown that egg shell quality varies significantly according to the BW of the laying hens [46]. However, the shells were better quality later in production, likely because increased activity benefits calcium metabolism.

H group hens were heavier and laid larger eggs with a higher albumen weight than L group hens, which is in general agreement with the findings of Scott and Silversides [47], who found that BW had no significant effect on yolk weight but a significant effect on albumen weight. By contrast, Leeson *et al*. [5] noted that BW did not affect albumen weight. Albumen height, however, was not significantly different between experimental groups, which contrasts with the findings of Silversides *et al*. [11].

## CONCLUSION

In conclusion, this study showed that L group hens had higher peak yields and lighter eggs ,laying hens had the best feeding efficiency ,while H group hens had a higher feed consumption and feed conversion ratio,

laying hens had the best egg quality and the L and M group laying hens had the best egg production. The findings also indicate that the flock should not be allowed to become heavier at the beginning of egg production in order to attain a higher performance later in the production cycle. Overall, the L group light BW hens may be preferable to medium and heavy hens because they will have a lower feed consumption, higher egg production and improved feed conversion ratio, resulting in an increased profit. Differences in behavior were also observed between the groups and may affect the performance of laying hens. Furthermore, this demonstrates that the initial BW should be considered when managing the production of hens.

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