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Effect of Strain and Storage Period on Some Qualitative and Quantitative Traits of Table Eggs

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***Abstract*—**This study include the effect of strain and storage period and their interaction on some quantitative and qualitative traits and percentages of the egg components in the eggs collected at the start of production (at age 24 weeks). Eggs were divided into three storage periods (1, 7 and 14) days under refrigerator temperature (5-7)^{0}C. Fifty seven eggs obtained randomly from each strain including Isa Brown and Lohman White. General Linear Model within SAS programme was used to analyze the collected data and correlations between the studied traits were calculated for each strain.Average egg weight (EW), Haugh Unit (HU), yolk index (YI), yolk % (HP), albumin % (AP) and yolk to albumin ratio (YAR) was 56.629 gm, 87.968 %, 0.493, 22.13%, 67.74% and 32.76 respectively. Egg produced from ISA Brown surpassed those produced by Lohman White significantly (P<0.01) in EW (59.337 vs. 53.921 g) and AP (68.46 vs. 67.02 %), while Lohman White surpassed ISA Brown significantly (P<0.01) in HU (91.998 against 83.939 %), YI (0.498 against 0.487), YP (22.83 against 21.44%) and YAR (34.12 against 31.40). Storage period did not have any significant effect on EW and YI. Increasing the storage period caused a significant (P<0.01) decrease in HU. A non-significant increasing in YP and significant decreasing in AP % due to increasing storage period caused a significant increasing in YAR. The interaction between strain and storage period affect EW, HU and YI significantly (P <0.01), while its effect on YP, AP and YAR was not significant. Highest and significant (P<0.01) correlation was recorded between YP with YAR (0.99) in both strains, while the lowest values were between AP with YAR and being -0.97 and -0.95 in ISA Brown and Lohman White, respectively. The conclusion: increasing storage period caused a few decreasing in egg weight and this enabling the consumer to store eggs without any damage. Because of using the albumin in many food industries, so it is very important to focus on its weight. The correlations between some of the studied traits were significant, which means that selection for any trait will improve other traits.

***Keywords*—**Quality, Quantity, Storage period, Strain, Table egg

I. Introduction

THE industry of poultry is one of the pillars of the economies of many countries because of its benefit in fast capital turnover and to secure food sources of high nutritional value for humans including white meat and egg. Egg is one of the most important sources of animal protein; which is better than other proteins because it is easy to digest, transport, storage, and marketing. This industry depend heavily on poultry, so the researchers focus in their work on developing specialized and commercial strains of chickens by following a new strategies [1].

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Several chemical and physical modifications occur inside an egg during the storage period including thinning of the albumen and flattening of the yolk. Egg as a food product is subject to damage and its quality can be lost rapidly during the period between the storage and consumption being affected by environmental conditions such as temperature, moisture and storage period [2]. Scott and Silversides [3] demonstrated that longer storage periods of eggs resulted in lower albumen weight and albumen height. Tumova et al. [4] showed that strain and genotype significantly affected the egg shape index, yolk and albumen quality and yolk index. Zita et al. [5] reported that genotype also affected mainly egg weight. Some of the authors including Hermiz et al. [6] have also shown significant correlation between egg weight and egg quality parameters including yolk percentage, yolk weight and albumin weight. This research aims to study, compare and evaluate some quantitative and qualitative traits of eggs in two strains of laying hens (Isa Brown and Lohman White) as well as the effect of different storage periods on the changes that occur in the studied traits, in order to be used as indicator in clarify some characteristics of table egg and could be used in relating with genetic programs to improve the quality of table eggs.

II. Materials and Methods

This experiment was conducted at the Department of Animal Resources/ College of Agriculture - University of Salahaddin-Erbil over the period from September 2009 to the end of November 2009 to study the effect of strain, storage period and their interaction on some quantitative and qualitative traits and percentages of the egg components in the eggs collected at the start of production (at age 24 weeks). Eggs were divided into three storage periods (1, 7 and 14) days under refrigerator temperature (5-7)^{o}C. Fifty seven eggs obtained randomly from two strains (Isa Brown and Lohman White) to evaluate some external and internal egg quality characters. The eggs were weighed on a sensitive scale to the nearest 0.1 g. Each egg was broken out on a table and its contents poured into a flat plate in order to measure the yolk height and diameter and albumen height. The yolk was separated from the albumen and then weighed, while the albumen weight was detected by subtracting the weights of yolk and eggshell from egg weight. The quality characters of the egg were estimated using the following formulas [7]:

Yolk Index = [yolk height (mm) / yolk diameter (mm)],
Yolk % = [yolk weight (g) /egg weight (g)] x100,
Albumen% = [albumen weight (g)/egg weight (g)] x100,
Yolk/Albumen = [yolk weight (g) / albumen weight (g)] x100,
While Haugh unit was estimated using the following formula [8]:*Haugh unit (H U) = 100 log (H + 7.57 – 1.7w 0.37)*

General linear model (GLM) within SAS Program [9] was used to investigate the effect of strain, storage period and their interaction on studied traits. Duncan Multiple Range Test [10] was conducted to diagnosing the significant differences between the means of the levels of each factor. Correlation coefficients between the studied traits were estimated for each strain individually.

III. Results and Discussion

A. Egg weight, Haugh Unit and yolk index

The average egg weight was 56.629 g (Table 1) and it was heavier than that found in previous study in Iraq [11]. The egg produced from ISA Brown (59,337 g) surpassed significantly (P <0.01) those produced by Lohman White (53,921 g) (Table 1). This result confirmed that found earlier by [12] using local Iraqi chickens and compared with some imported breeds, as well as those reported previously using several strains [5] and [13]. Egg weight decreased insignificantly with increasing storage period from 1 to 7 and 14 days (Table 1). Also Samli et al. [14] didn't found any significant effect of storage period on egg weight. On the other hand, [13] and [15] found significant decrease in egg weight with increasing storage period in several breeds and strains. Egg weight affected by the interaction between strain and storage period significantly (P <0.01), where egg weight in Isa Brown decreased significantly from 61.184 g to 58.589 and 58.237 g with increasing storage period from 1 day to 7 and 14 days respectively, and at the same time were all significantly heavier than those recorded in Lohman White at all storage periods (Table 1). This result was not consistent with that found by [13] who claimed that the interaction between strain and storage period didn't affect egg weight significantly.Haugh Unit averaged 87.968% (Table 1) and lies within the favorite range (72-100) as claimed by several researchers [16] and [17]. Haugh Unit measured in this study influenced significantly (P<0.01) by the strain and being 83.939 and 91.998 for Isa Brown and Lohman White respectively (Table 1). H.U. measured for Isa Brown (83) was similar to its value measured in White Leghorn (80.60) bred in the field of Agricultural College- University of Baghdad [11]. While the value of Lohman White was close to those found by [18] and [19]. Haugh Unit decreased significantly (P <0.01) from 92.327 at one day storage to 85.496 and 86.081 at 7 and 14 days of storage (Table 1). Earlier study reported that increasing storage period decreased Haugh Unit significantly in different breeds and strains [20]. The interaction between strain and storage period affect Haugh Unit significantly (P <0.01), and the highest H.U. (93.484) was calculated in the egg stored for one day and the lowest (79.024 and 79.308) were calculated in the egg stored for 7 and 14 days respectively in Isa Brown strain. Whereas H.U. values calculated in the egg of Lohman White for all storage periods were close together (Table 1). This result confirms earlier finding by [13] using four breeds and four storage periods (1, 7, 14, and 21 days). The overall mean of yolk index was 0.493 (Table 1) and was higher than that found by [18] in eggs of Iraqi local chicken.

Yolk index recorded for Lohman White (0.498) was significantly (P <0.01) higher than that for Isa Brown (0.487) (Table I). Also Al-Shawi [19] found similar results using four lines of Iraqi local chicken at age of 23 weeks. Storage period didn't affect yolk index significantly and were close together in the egg stored for 1, 7 and 14 days and being 0.495, 0.489 and 0.493 respectively (Table 1). These values lies within the index values measured in fresh eggs (0.44-0.55) by many researchers [21] and [22]. It was shown from Table (1) that the interaction between strain and storage period affect yolk index significantly (P <0.01), where the highest (0.504) and lowest (0.475) values were recorded for the eggs stored for 7 days in Lohman White and Isa Brown respectively.

B. Percentages of yolk, albumin and yolk to albumin ratio:

The percentages of yolk weight to egg weight, albumin weight to egg weight and yolk weight to albumin weight were 22.13, 67.74 and 32.76% respectively (Table 2). Cunningham et al. [16] noticed that albumin percentage in large eggs was higher than that in small eggs.

Strain affect all percentages studied significantly (P <0.01), where Lohman White surpassed ISA Brown in the percentages of yolk weight to egg weight (22.83 against 21.44%) and yolk weight to albumin weight (34.12 against 31.40%), while ISA Brown surpassed Lohman White in the percentage of albumin weight to egg weight (68.46 against 67.02%) (Table 2). Earlier studies found significant differences in these parameters in different breeds and strains [5], [15] and [20].

The effect of storage period was not significant on yolk %, while the effect was significant in albumin % and yolk weight to albumin weight ratio. Scott and Silversides [3] and Silversides and Scott [15] noticed that increasing storage period will decrease albumin percentage and increase yolk percentage significantly.

Although there were significant differences according to Duncan test between the eggs of both strains stored for various periods in the percentages mentioned above, but the interaction between strain and storage period didn't revealed to the significant level in all percentages included in the study. This result confirms that found by [3] who reported that there were no significant effect for the interaction between breeds and storage period in studied traits.

C. Correlation between studied traits:

By calculating the correlation coefficient between all the studied traits including egg weight, its components and their percentages, The highest value (0.99) (P <0.01) was recorded between the percentages of yolk with yolk weight to albumin weight in both strains, while the lowest value was between the percentages of albumin with yolk weight to albumin weight and being -0.97 (P <0.01) and -0.95 (P <0.01) in ISA Brown and Lohman White, respectively (Tables 3 and 4). Several studies reported a significant correlation between egg weight and its components [3], [6] and [15].

TABLE I
MEAN SQUARES, TEST OF SIGNIFICANCE AND MEANS ± STANDARD ERRORS (S.E.) FOR THE FACTORS AFFECTING EGG WEIGHT, HAUGH UNIT AND YOLK INDEX

Effects	d.f. or No.	Egg Weight (g) Mean squares or Means ± S.E.	Haugh Unit % Mean squares or Means ± S.E.	Yolk Index Mean squares or Means ± S.E.
Overall mean	114	56.629 ± 0.41	87.968 ± 0.72	0.493 ± 0.002
Strains:	1	835.927 **	1851.08 **	0.00314 **
Isa Brown (I)	57	59.337 ± 0.53 a	83.939 ± 1.13 b	0.487 ± 0.003 b
Lohman White (L)	57	53.921 ± 0.37 b	91.998 ± 0.47 a	0.498 ± 0.002 a
Storage Period (day):	2	6.369	544.715 **	0.00036
1	38	57.097 ± 0.88 a	92.327 ± 0.58 a	0.495 ± 0.002 a
7	38	56.450 ± 0.61 a	85.496 ± 1.30 b	0.489 ± 0.003 a
14	38	56.339 ± 0.61 a	86.081 ± 1.38 b	0.493 ± 0.003 a
Interaction	2	54.749 **	767.559 **	0.00309 **
I X 1	19	61.184 ± 0.89 a	93.484 ± 0.65 a	0.499 ± 0.003 ab
I X 7	19	58.589 ± 0.84 b	79.024 ± 1.34 b	0.475 ± 0.005 c
I X 14	19	58.237 ± 0.91 b	79.308 ± 1.46 b	0.489 ± 0.004 b
L X 1	19	53.011 ± 0.76 c	91.170 ± 0.91 a	0.492 ± 0.004 b
L X 7	19	54.311 ± 0.57 c	91.968 ± 0.72 a	0.504 ± 0.002 a
L X 14	19	54.540 ± 0.54 c	92.855 ± 0.79 a	0.498 ± 0.003 ab
Residual	108	11.132	20.016	0.00023

Means having different letters within each factor/column differ significantly (P<0.05) according to Duncan (1959).
** = (P<0.01)

TABLE II
MEAN SQUARES, TEST OF SIGNIFICANCE AND MEANS ± STANDARD ERRORS (S.E.) FOR THE FACTORS AFFECTING PERCENTAGES OF ALBUMIN, YOLK AND YOLK TO ALBUMIN RATIO

Effects	d.f. or No.	Yolk % Mean squares or Means ± S.E.	Albumin % Mean squares or Means ± S.E.	Yolk / Albumin Mean squares or Means ± S.E.
Overall mean	114	22.13 ± 0.16	67.74 ± 0.17	32.76 ± 0.31
Strains:	1	54.9895 **	59.4441 **	210.525 **
Isa Brown (I)	57	21.44 ± 0.21 b	68.46 ± 0.26 a	31.40 ± 0.42 b
Lohman White (L)	57	22.83 ± 0.19 a	67.02 ± 0.19 b	34.12 ± 0.38 a
Storage Period (day):	2	6.3722	12.7432 *	28.243 *
1	38	21.66 ± 0.31 b	68.40 ± 0.33 a	31.77 ± 0.59 b
7	38	22.42 ± 0.23 a	67.32 ± 0.25 b	33.36 ± 0.45 a
14	38	22.32 ± 0.26 ab	67.50 ± 0.36 b	33.15 ± 0.53 a
Interaction	2	6.1916	7.9381	23.591
I X 1	19	20.52 ± 0.35 c	69.65 ± 0.41 a	29.53 ± 0.66 c
I X 7	19	21.84 ± 0.29 b	67.82 ± 0.34 b	32.26 ± 0.58 b
I X 14	19	21.95 ± 0.36 b	67.92 ± 0.48 b	32.42 ± 0.67 b
L X 1	19	22.81 ± 0.35 ab	67.15 ± 0.31 b	34.01 ± 0.66 ab
L X 7	19	23.00 ± 0.30 a	66.83 ± 0.32 b	34.46 ± 0.60 a
L X 14	19	22.68 ± 0.36 ab	67.08 ± 0.37 b	33.88 ± 0.71 ab
Residual	108	2.1369	2.6881	8.395

Means having different letters within each factor/column differ significantly (P<0.05) according to Duncan (1959).
** = (P<0.01) * = (P<0.05)

TABLE III
SIMPLE CORRELATION COEFFICIENT BETWEEN STUDIED TRAITS IN IS A BROWN

	Haugh unit	Yolk Index	Yolk %	Albumin %	Yolk / Albumin
Egg weight	0.03	-0.06	-0.70 **	0.73 **	-0.71 **
Haugh unit		0.47 **	-0.14	0.18	-0.15
Yolk Index			-0.29 *	0.24	-0.27 *
Yolk %				-0.94 **	0.99 **
Albumin %					-0.97 **

** = (P<0.01) * = (P<0.05)

TABLE IV
SIMPLE CORRELATION COEFFICIENT BETWEEN STUDIED TRAITS IN LOHMAN WHITE

	Haugh unit	Yolk Index	Yolk %	Albumin %	Yolk / Albumin
Egg weight	0.03	-0.08	-0.21	0.19	-0.21
Haugh unit		0.27 *	-0.09	0.14	-0.10
Yolk Index			-0.38 **	0.31 *	-0.36 **
Yolk %				-0.91 **	0.99 **
Albumin %					-0.95 **

** = (P<0.01) * = (P<0.05)

IV. CONCLUSION

From the results of this study, it was observed that storing eggs for 14 days in the refrigerator will decrease egg weight slightly, so the producer and consumer can store the eggs for 14 days without any damage or corruption. Because of using the albumin in many food industries, so it is very important to improve and increase its weight. It was shown that albumin was higher in Isa Brown, so it is very necessary to provide egg of this strain for these industries in order to increase their income. The correlations between some of the studied traits were significant, which means that selection for any trait will improve other traits.

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