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Effect of Storage Time, Egg Weight and Moisture Loss on Hatchability Parameters of Baladi Chicken Eggs

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Abstract. A total of 625 Baladi chicken eggs were used to study the effect of storage time, egg weight on moisture loss, fertility, embryonic mortality and fertile hatchability. The influence of pre-incubation, first and second week of incubation moisture loss (ML1, ML2, ML3) were also investigated. The results revealed a significant storage time effect on moisture loss, fertility and fertile hatchability. As days of storage time increased (0, 3, 6 and 9 days), the fertility (93.23, 86.60, 74.32 and 73.04%) and fertile hatchability (88.60, 80.41, 75.75 and 77.01%) decreased while the pre-incubation moisture loss increased (00, 14.88, 28.88 and 49.16 mg/egg/d). However, the effects of storage time on the first and second week of incubation moisture loss and embryonic mortality were inconsistant. The results also showed that egg weight had a significant effect on moisture loss. The higher the egg weight (> 46 gm) the higher the pre- and during incubation moisture loss (ML1: 26.10, ML2: 198.88 and ML3: 219.51 mg/egg/d). The pre-incubation moisture loss influence on fertile hatchability was also found to be significant. The higher the moisture loss percentage (< 0.1, 0.1–0.75 and > 0.75%) the lower the fertile hatchability (89.29, 78.08 and 76.4%). The moisture loss during the first week had no consistant effect on hatchability parameters, while that of the second week had no effect upon the studied traits.

Introduction

Egg traits like weight and shell quality, duration of storage and moisture loss prior as well as during incubation seem to have influence on hatchability parameters of the chicken eggs [1–13]. However the results were conflicting concerning the interrelationships between various egg characteristics, storage conditions and hatchability parameters. Hatching eggs of various strains and breeds of chickens were used in the previous works but no similar studies were performed on Baladi chicken eggs which are characterized by their low weight and thin shells compared with those of standard breeds [14].

The present studies were therefore conducted to assess the effect of storage time, egg weight, pre- and during incubation moisture loss and their interrelationsips on hatchability parameters of Baladi chicken eggs. The traits taken into consideration are the following; moisture loss, fertility, embryonic mortality and fertile hatchability.

Materials and Methods

A total of 626 hatching eggs were collected over a nine day period from a nine months old flock of Baladi chickens. The birds were housed conventionally, received water and standard laying type ration (Table 1) ad libitum, and were exposed to natrual day light. Flock mating was practiced with a cock to hen ration of 1:10.

Eggs were individually weighed to the nearest .01 gm, directly after collection and on the day of setting to calculate pre-incubation moisture loss (ML1). Experimental eggs were stored at an average temperature of 8–10°C and relative humidity of 55–60%. They were also divided according to storage time (0, 3, 6 and 9 days) into four experimental groups. Each experimental group represents one day egg collection. Eggs were thereafter incubated following standard hatchery practices. At the seventh and fourteenth days of the incubation periods, the individual weight of each egg was retaken to obtain the moisture loss during the first week (ML2) and the second week (ML3) of incubation. The eggs were also candled at the end of the first and second week of incubation. Eggs which seemed infertile or with dead embryos were broken out to determine fertility (F) and embryonic mortality for the periods 1–7 (M1), 8–14 (M2) and 15–21 (M3) of the incubation. Data collected were subjected to statistical analysis using SAS general linear model procedure, KSU Computer Center, according to the following statistical models.

$$Y_{ijk} = U + S_i + W_j + SW_{ij} + e_{ijk}$$

where the Y_{ijk} is the K^{th} observation of the i^{th} storage period and the j^{th} weight class. U is the general mean and e_{ijk} is the random error associated with Y_{ijk} observation. And

$$Y_{ij} = U + ML_i + e_{ij}$$

where the Y_{ij} is the j^{th} observation of the i^{th} moisture loss level. U is the general mean and e_{ij} is the random error associated with the Y_{ij} observation [15].

Table 1. Nutrients composition of the ration used in the experiment*.

Nutrients		%
Crude protein	(max)	17.00
Crude fat	(min)	3.00
Crude fiber	(min)	5.00
Calcium	(max)	3.50
Phosphorus	(min)	0.60
Salt	(max)	0.35
M.E. kcal/kg	2695	

* Manufactured by: Grain Silos & Flour Mills Organization, Saudi Arabia.

Results and Discussion

The effect of storage time and egg weight on moisture loss, fertility and hatchability parameters are shown in Tables 2 and 3 respectively. Moisture loss influence on hatchability parameters is also shown in Tables 4, 5 and 6. The results revealed a significant storage time and egg weight effects on moisture loss during the studied periods, while fertility was only significantly affected by storage time (Table 2). As the days of storage time increase the fertility decreases and moisture loss increases. The loss in fertility might be due to undetected early embryonic mortality. Similar observations were reported by Valdimirova [2,3] and Ahmed *et al.*[12]. On the other hand, the results on the moisture loss during the first and second week of incubation period are not consistant and seems to be independent from the storage time. The results also showed that the higher the egg weight the higher the pre-and during incubation moisture loss but fertility was not affected (Table 2). These results are in agreement with that of Valdimirova [2], Sharma and Bora [6], Ahmed *et al.*[12] and Among *et al.*[13]. A significant storage time × egg weight interaction effect upon pre-and second week of incubation periods was also found (Table 2).

Storage time was found to have a significant effect upon fertile hatchability, early and late embryonic mortality (Table 3). However, the result is inconsistant in respect to embryonic mortality. Similar results were indicated by Among *et al.*[13], Ahmed *et al.*[12], Susan Kirk *et al.*[11], Sibblies *et al.*[8], Buvendran [4] and Merritt and Clarridge [5]. The study also revealed that egg weight, within the limits of egg weights tested, had no significant effect upon embryonic mortality and fertile hatchability (Table 3). This result disagrees with that of Son and Sarda [9], Sharma and

Table 2. Storage time(S) and egg weight(W) effects on pre-incubation, first week and second week of incubation moisture loss (ML1, ML2 and ML3) and Fertility (F).

Parameter		ML1	ML2	ML3	F
Factor	n	$\bar{x} \pm$ S.E. (mg/egg/d)	$\bar{x} \pm$ S.E. (mg/egg/d)	$\bar{x} \pm$ S.E. (mg/egg/d)	$\bar{x} \pm$ S.E. (%)
S (days)		**	**	*	**
0	150	00.00 ± 0.57A	199.80 ± 2.51A	194.61 ± 3.83a	93.23 ± 3.13A
3	173	14.88 ± 0.53B	182.15 ± 2.35b	200.52 ± 3.58ab	86.60 ± 2.93A
6	133	28.88 ± 0.64C	177.59 ± 2.82B	209.69 ± 4.31b	74.32 ± 3.52B
9	169	49.16 ± 0.54D	189.04 ± 2.40C	195.32 ± 3.67a	73.04 ± 3.00B
W (grams)		**	**	**	n.s.
> 46	161	26.10 ± 0.57A	198.88 ± 2.49A	219.51 ± 3.81A	83.86 ± 3.11
42–46	259	21.66 ± 0.43B	183.41 ± 1.88B	192.83 ± 2.88B	82.44 ± 2.35
< 42	205	21.58 ± 0.49B	179.14 ± 2.15B	187.77 ± 3.28B	79.09 ± 2.68
S X W		**	n.s.	**	n.s.
Overall mean	625	22.97 ± 0.27	186.03 ± 1.21	196.67 ± 1.85	81.76 ± 1.51

a,b,c Means in the same column with different superscripts small letter differ significantly ($P \leq 0.05$).
A,B,C,D Means in the same column with different superscripts capital letter differ highly significantly ($P \leq .01$).
* Significant effect ($P \leq 0.05$); ** Significant effect ($P \leq 0.01$). n.s. Nonsignificant effect.

Table 3. Storage time(S) and egg weight(W) effects on the embryonic mortality during the first (M1), second (M2) and third (M3) week of incubation period and fertile hatchability (FH).

Parameter		M1		M2		M3		FH
Factor	n	$\bar{x} \pm$ S.E. (%)	n	$\bar{x} \pm$ S.E. (%)	n	$\bar{x} \pm$ S.E. (%)	n	$\bar{x} \pm$ S.E. (%)
S (days)		*		n.s.		*		*
0	140	3.89 ± 2.43a	135	4.64 ± 2.28	129	3.27 ± 1.79ab	140	88.60 ± 3.34a
3	151	11.53 ± 2.37b	134	8.27 ± 2.32	123	0.90 ± 1.80a	151	80.41 ± 3.26ab
6	96	13.02 ± 3.05b	82	6.12 ± 2.98	76	7.27 ± 2.27b	96	75.75 ± 4.19b
9	123	7.27 ± 2.63ab	113	10.42 ± 2.52	102	7.20 ± 1.20b	122	77.01 ± 3.62b
W (grams)		n.s.		n.s.		n.s.		n.s.
> 46	137	6.92 ± 2.45	127	7.43 ± 2.45	117	6.98 ± 1.89	137	80.15 ± 3.54
42–46	214	8.92 ± 1.98	196	9.09 ± 1.91	180	3.75 ± 1.50	214	80.12 ± 2.71
< 42	159	10.93 ± 2.25	141	5.64 ± 2.21	133	3.26 ± 1.69	158	81.05 ± 3.10
S X W		n.s.		n.s.		n.s.		n.s.
Overall mean	510	8.82 ± 1.25	464	7.33 ± 1.21	430	3.95 ± 0.93	509	81.13 ± 1.72

a,b Means in the same column with different superscripts letter differ significantly ($P < 0.05$).
* significant effect ($P \leq 0.05$); **significant effect ($P \leq 0.01$). n.s. Nonsignificant effect.

Bora [6], and Ahmed *et al.*[12] who reported a significant egg weight effect on late embryonic mortality and fertile hatchability. Valdimirova [2], Nordskog and Hassan [7] and Among *et al.*[13] indicated the same result concerning fertile hatchability. Most of those investigators found that the lower the egg weight, the lower the fertile hatchability. The difference in our result might be due to the fact the large Baladi chicken eggs are approximately equal to small ones of standard breeds.

The study also showed that the pre-incubation moisture loss had a significant effect on fertility, early embryonic mortality and fertile hatchability (Table 4). As the

Table 4. Effect of pre-incubation moisture loss (ML1) on fertility (F), embryonic mortality during the first (M1), second (M2) and third (M3) week of incubation period and fertile hatchability (FH).

Parameter		F	M1	M2	M3	FH
	n	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)
ML1 (%)		**	*	n.s.	n.s.	**
< 0.1	150	93.33 ± 2.11A	3.57 ± 2.39a	4.44 ± 2.40	3.10 ± 1.71	89.29 ± 3.39A
0.1–0.75	289	80.62 ± 2.24B	12.07 ± 1.85b	7.84 ± 1.83	2.66 ± 1.42	78.08 ± 3.32B
> 0.75	186	74.19 ± 2.79B	8.70 ± 2.40ab	9.60 ± 2.33	7.08 ± 1.83	76.64 ± 3.32B
Overall mean	625	81.76 ± 1.40	8.80 ± 1.25	7.30 ± 1.22	3.90 ± 0.92	81.13 ± 1.73

a,b Means in the same column with different superscripts small letter differ significantly ($P \leq 0.05$).
A,B Means in the same column with different superscripts capital letter differ highly significantly ($P \leq 0.01$).
* Significant effect ($P \leq 0.05$); ** Significant effect ($P \leq 0.01$). n.s. Nonsignificant effect.

moisture loss percentage increases, fertility and fertile hatchability significantly decrease while embryonic mortality tended to increase. Comparable results were found by Eriksson [1], Valdimirova [2], Coleman and McDaniel [16], McDaniel *et al.*[10] and Ahmed *et al.*[12]. The moisture loss during the first week of the incubation period was found to have no consistant effect on embryonic mortality and fertile hatchability (Table 5), while that of the second week had no significant effect on the studied traits (Table 6). These results agree with that of Ahmed *et al.*[12], but disagree with that of Susan Kirk *et al.* [11] who reported better hatchability of eggs with lower than average moisture loss during the incubation period.

Table 5. Effect of moisture loss during the first week of the incubation period (ML2) on the embryonic mortality during the first (M1), second (M2) and third (M3) week of the incubation period and fertile Hatchability (FH).

Parameter		M1	M2	M3	FH
	n	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)
ML2 (%)		n.s.	n.s.	*	n.s.
< 4	183	12.02 ± 2.10	6.83 ± 2.06	6.00 ± 1.58a	72.05 ± 2.89
4–5	260	7.31 ± 1.76	7.50 ± 1.69	1.35 ± 1.30b	84.56 ± 2.43
> 5	67	5.97 ± 3.46	7.94 ± 3.29	8.62 ± 2.54a	79.10 ± 4.77

a,b Means in the same column with different superscripts letter differ significantly ($P \leq 0.05$).
* Significant effect ($P \leq 0.05$). n.s. Nonsignificant effect.

Table 6. Effect of Moisture loss during the second week of incubation (ML3) on the embryonic mortality during the second (M2) and third (M3) week of the incubation period and fertile hatchability (FH).

Parameter		M2	M3	FH
	n	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)	$\bar{x} \pm$ S.E. (%)
ML3 (%)		n.s.	n.s.	n.s.
< 4	94	9.23 ± 2.28	5.06 ± 1.69	81.75 ± 3.34
4–5	229	5.08 ± 1.79	2.22 ± 1.30	83.02 ± 2.40
> 5	141	10.31 ± 2.64	6.90 ± 2.09	75.70 ± 3.78

n.s. Nonsignificant effect.

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تأثير مدة التخزين، وزن البيضة وفقد الماء على معايير فقس بيض الدجاج البلدي

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ملخص البحث. استخدم في هذه الدراسة عدد ٦٢٥ بيضة من الدجاج البلدي لدراسة تأثير مدة التخزين ووزن البيضة على فقد الماء، الخصوبة، الهالك من الأجنة والفقس. وقد بحث أيضًا تأثير فقد الماء قبل وأثناء الأسبوع الأول والثاني من بدء عملية التفريخ.

دلت النتائج على أنه كلما زادت مدة التخزين (٠، ٣، ٦، ٩ أيام) كلما قلت نسبة الخصوبة (٩٣ر٢٣، ٨٦ر٦٠، ٧٤ر٣٢، ٧٣ر٠٤٪) ونسبة الفقس العلمي (٨٨ر٦٠، ٨٠ر٤١، ٧٥ر٧٥ و ٧٧ر٠١٪) وازداد فقد الماء (٠٠، ١٤ر٨٨، ٢٨ر٨٨، ٤٩ر١٦ مجم/ بيضة/ يوم)، وقد اتضح أن مدة التخزين ليس لها تأثير ثابت على كل من فقد الماء خلال الأسبوعين الأول والثاني من بدء عملية التفريخ وكذلك هلاك الأجنة، أما فيما يخص تأثير وزن البيضة فإنه معنوي بالنسبة لفقد الماء، كلما زاد وزن البيضة (< ٤٦ جم) زادت كمية الماء المفقودة قبل وخلال الأسبوعين الأول والثاني من بدء عملية التفريخ (١٠ر٢٦، ١٩٨ر٨٨، ٢١٩ر٥١ مجم/ بيضة/ يوم)، كذلك أوضحت النتائج أنه كلما زادت نسبة فقد الماء أثناء فترة التخزين (< ١ر٠، ١ر٠ ـ ٧٥ر٠ و > ٧٥ر٠٪) قلت نسبة الفقس العلمي (٨٩ر٢٩، ٧٨ر٠٨ و ٧٦ر٦٤٪). وقد اتضح أيضًا أن نسبة الفقد خلال الأسبوع الأول من بدء عملية التفريخ ليس لها تأثير ثابت على معايير الفقس. أما فقد الماء خلال الأسبوع الثاني من بدء عملية التفريخ فليس له تأثير على الصفات المدروسة.