THE EFFECT OF AGE OF BROILER BREEDER AND LENGTH OF EGG STORAGE PERIOD ON EMBRYONIC DEVELOPMENT AND HATCHABILITY PERCENTAGE

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Abstract

The present study was carried out to investigate the influence of broiler breeder age and storage period on some embryonic parameters and chick weight at hatch. Five-hundred and forty eggs were collected from 41 and 56 – week –old Arbor Acres broiler breeder hens (270 eggs from each age). The eggs of each age were randomly distributed into three groups. The first group was set freshly in the setter of incubator, while, the other groups were stored for 7 or 14 days at 12° C and 85% relative humidity.

The current results showed that embryo weight on the 17th day of incubation and chicks weight at hatch were lower when eggs brought from younger hens than older ones. On the other hand, the reverse results were observed in relative weight of embryo. However, eggs obtained from young hens had significantly higher fertility than eggs from old hens. At hatch, plasma glucose concentration and cardiac glycogen were higher, while, hepatic glycogen concentration was lower in chicks from young hens than those from old hens. On the other hand, parent age was not influenced by the previous parameters, on the 17th day of incubation. Skeletal muscle glycogen measured on the 17th day of incubation was higher in young hens than old ones. Fresh eggs and those stored for only seven days before incubation had greater absolute and relative embryonic weight than those stored for fourteen days. Plasma glucose concentration tended to decrease, while, hepatic glycogen and skeletal muscle glycogen concentration tended to decrease on the 17th day of incubation and at hatch with the increase in the storage period. However, cardiac glycogen concentration not affected by storage period on day 17 of incubation, but at hatch it was decreased by the increase of storage period.

INTRODUCTION

Egg storage prior to incubation may affect the survival of embryos by limiting energy available to vital organs during the plateau stage in oxygen consumption (Christensen *et al.*, 2001). The effects of breeder age related changes in the egg and

egg shell on embryo body composition and nutrient utilization throughout incubation also need to be firmly established before subsequent broiler performance can be optimized (Peebles *et al.*, 2001). In small hen's farms and in large farms which produce numbers of eggs larger than incubator or hatchery capacity eggs must be stored for many days before incubation. Eggs from younger flocks should be stored at slightly higher temperature and lower humidity than those from older flocks (if they are to be stored for the same period). This difference could be attributed to albumin quality. Under optimum storage conditions, the hatching ability of eggs will begin to fall after 7 days. Hatchability begins to decrease 2 or 3 days after laying and this decrease increased as the holding time increased. Hatching chick weight is highly correlated with egg size at setting (Suarez *et al.*, 1997).

The present study was carried out to investigate the influence of broiler breeder's age and egg storage period on embryo weight and weight percentage, fertility%, hatchability%, plasma glucose and organs glycogen concentrations, and chick weight at hatch.

MATERIALS AND METHODS

The present work was carried out in Poultry Research Farm, Animal Production Department, Faculty of Agriculture, Cairo University. The chemical analysis was carried out at the laboratories of Animal Production Research Institute, Ministry of Agriculture.

A number of 540 fertile eggs were collected from Arbor Acres broiler breeder hens at 41 and 56 weeks of age. The eggs were produced from National Company of Poultry and gathered on a day of production.

A number of 180 eggs (90 eggs from each age) were set in the incubator (fresh). The other eggs of each age were distributed randomly into two groups, the first group was set in the incubator after 7 days of storage, while, the other group was set after 14 days of storage. The incubator environment, provided 37.5. C and 60-65 % relative humidity in setter, and 36.5. C and 70 % R. H. in hatcher. On 17 days of incubation, eggs were candled to remove the infertile eggs and determine the dead embryos. Infertile eggs were broken to detect the real infertile eggs from those of the early dead embryos.

Ten eggs containing viable embryos from each age were randomly chosen, weighed, and blood samples were collected from abdominal vein to analyze glucose concentration according to Donaldson and Christensen (1991). Eggs were broken to

remove the embryos which weighed and expressed as a relative weight to fresh egg weight. Samples of heart, liver, and thigh were obtained to analyze glycogen concentration according to Dreiling *et al.* (1987). The remaining fertile eggs were transferred to hatching basket and turned to the hatcher. On 21 days of incubation all chicks were removed from the hatcher.

Ten newly hatched chicks from each group were randomly chosen, weighed, and blood samples were collected following decapitation. Samples of heart, liver, and thigh were obtained. Hatchability was estimated as the number of healthy chicks hatched from fertile eggs. Hatching time was determined for each treatment.

Data were subjected to two-way analysis of variance. Age and storage period considered as main effect using the general linear models (GLM) procedure of SAS user's Guide (1996). Differences between mean values were compared using Duncan's multiple range test (Duncan, 1955) when significant differences existed. Significance level was set at $\alpha=0.05$.

RESULTS AND DISCUSSION

1-Embryo weight on the 17th day of incubation

The current results showed that parent age influenced embryo weight. Table1 shows that embryo belonged to older dams explained superior weight over that from younger dam. This phenomenon may be attributed to heavy eggs produced from older hens which, have more nutrients. Also, the heavy eggs may have higher shell porosity which provides more oxygen to embryo, and inturn, force the embryo to develop fastly (Christensen *et al.*,1996). Similar result was obtained by Peebles *et al.* (2001) who found that as a parental age increased the embryo weight increased too. On the other hand, the relative embryo weight was significantly higher in those belonging to younger hens as compared to other belonging to older ones.

The present results also showed partially influence of storage period on absolute and relative weight of embryo. Stored eggs of younger hens for fourteen days reduce significantly embryo weight than other groups.

2-Chick weight at hatch

Chicks from eggs of older hens had significant heavier weight than those from younger ones (Table 2). It may be due to the initial egg weight (Suarez *et al.* 1997). These results are in agreement with those obtained by Peebles *et al.* (2001) and Aly (2003). They recorded that increasing hen age increased hatch weight.

Pre-incubation storage periods had no significant effect on chick weight at hatch. Similar results were obtained by Aly (2003) who recorded that body weight of chicks at hatch was not affected significantly by storage period of eggs.

3-Fertility percentage

Figure 1 shows that eggs obtained from younger hens had significant higher fertility percentage than those from older hens (93.8 vs. 82.3%). These results are in agreement with those obtained by Aly (2003). He found significant decrease in fertility percentage with age of parent increase in contrast to the present results, Hocking and Bernard (2000) found that age had no significant effect on fertility percentage.

Figure 2 shows that fertility percentage was decreased as the storage periods increased (92.2 vs. 87.4 vs. 84.6 %). Similar results were obtained by Aly (2003).

4-Hatchability percentage

It can be observed from Figure 3 that hatchability percentage was not significantly affected by hen age. In accordance with the present results, Chen Deng

8. *B. jonellus* (Kirby)

Location: Lorestan – Khoram Abad, Date of collection: April 2000

9. *B. subterraneus* (L.) ***latreillelus*** (Kirby)

Location: Kerman – Jiroft, Date of collection: June 2000

Bombus subgenus ***Psithyrus***

10. *B. barbatellus* (Kirby)

Location: Azarbayjan – Maragheh, Date of collection: September 1998

11. *B. rupestrisp* (F.)

Location: Isfahan – Najaf Abad, Date of collection: August 1999

12. *B. sylvestris* (Lep.)

Location: Kermanshah – Ravansar, Date of collection: July 2003

13. *Chelostoma florisomne* (L.)

Location: Isfahan – Shahin Shahr, Time of collection: April 2003

14. *Chelostoma mitis* (Lep.)

Location: Gilan – Lahijan, Time of collection: May 2001

15. *Nomada armata* (Herrich-Schafer)

Location: Khorasa – Mashhad, Time of collection: June 2002

16. *Nomada flavoguttata* (Kirby)

Location: Sistan & Balochestan – Zabol, Time of collection: August 2003

those obtained by Christensen *et al.* (1996) who indicated that blood plasma glucose concentrations tended to be higher in embryos at all stages of development from 33 to 38 wks than from 39 to 44 wks hens.

Day-old-chicks from parent aged 56 weeks had higher plasma glucose concentration than those from parent of 41 weeks (Table 3). These results are in agreement with Daly and Peterson (1990) who found that mean serum glucose was higher in chicks from old breeder-hens than in chicks from young breeder- hens. The values were 193 and 201 mg/dl for young and old hens, respectively.

Plasma glucose concentration on the 17^{th} day of incubation tended to increase with the advance of the storage period (Table 3). Within the eggs from 41 – wk and 56 – wk – old hens, the differences were significantly different between fresh and stored eggs for 7 or 14 days. On the other hand, no differences were observed between 7 and 14 days-stored period.

Christensen *et al.* (2001) recorded that blood glucose concentrations increased across all the days of incubation (pre pipping =67 mg/dl, at hatch =193 mg/dl), but embryonic blood glucose concentrations were not affected by age, or storage at any of the stages of development. In contrast with these results, Fasenko *et al.* (1997) indicated that plasma glucose in the heart and liver was not significantly influenced by length of egg storage.

The same trend of plasma glucose concentration was observed at hatch in chick from parent of 41-wk- old, while, those from parent of 56-wk- old, the differences between the three periods of storage were not significant.

6-Organs glycogen concentration

Hepatic glycogen

Hepatic glycogen concentration during incubation tended to be higher in younger parent age (41 weeks) than in older one (56 weeks), but without significant difference (Table 4). Similar result was obtained by Christensen *et al.* (1996) who showed that liver glycogen declined with hen age at the plateau stage.

With respect to hepatic glycogen concentration at hatch, the reverse result was obtained when compared with concentration during incubation differences (Table 4) in which the younger parent age had the lower value than the older age. These results are in agreement with Christensen *et al.* (1996) who concluded that liver glycogen tended to increase with hen age.

Hepatic glycogen concentration tended to decrease with increasing days of storage during incubation (Table 4). The highest value of hepatic glycogen

concentration was observed in chicks from fresh eggs, while, the lowest value was observed in chicks from eggs stored for 14 days before incubation. Similar results were obtained by Christensen *et al.* (2001) who found that the 14-day storage group exhibited depressed hepatic glycogen compared with that of embryos stored only 1-day.

The same trend of hepatic glycogen concentration during incubation was observed at hatch (26.5 vs. 22.8 vs. 17.0 mg/100g wet tissue).

Cardiac glycogen

Cardiac glycogen concentration on day 17 of incubation was not affected by age of parent, but at hatch, it was declined with age (Table 5). The differences between younger and older hens were not significant. The opposite result was obtained by Christensen *et al.* (1996) who found that cardiac glycogen declined with hen age. Christensen *et al.* (2001) found that cardiac glycogen concentration declined as the hens aged. The reverse results were in other line, where cardiac glycogen was greater in embryo from 34 –wk- old hens than those from 53-wk-old hens.

On the 17^{th} day of incubation cardiac glycogen concentration tended to decrease insignificantly with increasing days of storage. The same results were obtained by Fasenko *et al.* (1997) who found that glycogen concentration in the heart was not significantly influenced by length of egg storage.

At hatch, cardiac glycogen concentration tended to decrease with increasing days of storage (3.2 vs. 2.9 vs. 1.6 mg/100g wet tissue). The significant differences were observed between both fresh eggs (0 days) and eggs stored for 7 days and those stored for 14 days. In contrast, Christensen *et al.* (2001) showed that no differences were noted at hatch.

Skeletal muscle glycogen

Skeletal muscle glycogen concentration was significantly higher in younger parent age (41 weeks) than in older one (56 weeks) during incubation (Table 6). The similar results were obtained by Christensen *et al.* (2001) who found that skeletal muscle glycogen concentration was decreased significantly with hen age.

Regardless the age of parent, skeletal glycogen concentration tended to decrease with increasing days of storage during incubation and at hatch (Table 6). But statistical analysis showed that the differences were not significant between non-stored and stored eggs for 7 days. When eggs stored for 14 days, skeletal muscle glycogen on day 17 of incubation and at hatch was significantly lower than the other storage period specially the eggs of younger hens.

It was concluded that holding broiler-hatching eggs in the farm egg cooler for 7 to 14 day at 12°C and 85% R. H. did not alter hatchability or embryonic development.

Preincubation storage period should be less than seven days. Hatchability in broiler hens can be improved if eggs are incubated as soon as they are laid, especially in older flocks. Age of breeder may be taken into account during incubation in order to provide optimal incubation conditions and to improve hatchability.

Table 1. The influence of parent age and storage period on embryo weight (g) and embryo weight % on the 17th day of incubation.

Storage period (Days)	Parent age (weeks)			
	41		56	
	Embryo weight	Embryo weight % (to egg weight after storage)	Embryo weight	Embryo weight % (to egg weight after storage)
Fresh	35.04±1.05^{a*}	57.38±1.30^{a}	35.22±1.05^{a}	49.66±1.43^{b}
7	34.96±1.00^{a}	57.17±1.36^{a}	36.81±0.91^{a}	51.09±1.24^{b}
14	30.56±0.95^{b}	51.60±1.30^{b}	34.17±1.00^{a}	48.61±1.36^{b}
Overall mean	33.46±0.58^{a}	55.37±0.77^{a}	35.43±0.57^{a}	49.8±0.78^{b}

* Values are Means ± S.E.

$^{a,b,c,d \text{ and } e}$ Means with different superscripts are significantly different ($p<0.05$).

Table 2. The influence of parent age and storage period on chick weight (g) at hatch.

Storage period (Days)	Parent age (Weeks)		Total
	41	56	
Fresh	44.04±0.88^{bc*}	46.51±0.92^{ba}	45.27±0.63^{a}
7	43.31±0.92^{c}	48.95±0.96^{a}	46.13±0.66^{a}
14	45.44±0.92^{bc}	48.50±0.92^{a}	46.97±0.65^{a}
Overall mean	44.26±0.52^{b}	47.99±0.54^{a}	46.12±0.64^{a}

*Values are means ±S.E.

$^{a,b,c,d \text{ and } e}$ Means with different superscripts are significantly different($p<0.05$).

Table 3. The influence of parent age and storage period on plasma glucose concentration (mg/dl) during incubation and at hatch.

Storage period (Days)	Parent age (Weeks)			
	41		56	
	During incubation	At hatch	During incubation	At hatch
Fresh	1.06±0.07^{c*}	1.84±0.05^{b}	1.44±0.07^{b}	2.03±0.06^{a}
7	1.79±0.07^{a}	2.10±0.06^{a}	1.78±0.06^{a}	2.15±0.06^{a}
14	1.85±0.07^{a}	2.15±0.06^{a}	1.79±0.07^{a}	2.22±0.06^{a}
Overall mean	1.57±0.04^{a}	2.03±0.03^{b}	1.67±0.04^{a}	2.13±0.03^{a}

*Values are means ±S.E.

$^{a,b,c,d \text{ and } e}$ means with different superscripts are significantly different($p<0.05$).

Table 4. The influence of parent age and storage periods on hepatic glycogen (mg of glycogen /100 gm of wet tissue mass) in chick embryos on 17th day of incubation.

Storage period (Days)	Parent age (Weeks)			
	41		56	
	During incubation	At hatch	During incubation	At hatch
Fresh	41.37±3.86[a*]	22.65±2.08[b]	28.07±3.64[b]	30.43±2.08[a]
7	28.29±3.86[b]	21.73±2.20[bc]	27.18±4.13[b]	23.94±1.97[b]
14	24.41±5.47[b]	18.08±1.88[bc]	23.19±4.46[b]	16.06±1.88[c]
Overall mean	31.78±2.55[a]	20.98±1.22[a]	26.30±2.4[a]	23.32±1.18[a]

*Values are means ±S.E

تضمن هذا العمل حصر وتعريف لمختلف الفصائل من رتبة غشائية الأجنحة خلال الفترة من ١٩٩٨- ٢٠٠٤ فى إيران . أثناء هذا العمل وجد ٤٤ نوع من فصائل مختلفة من رتبة غشائية الأجنحة تم تسجيلهم لأول مرة فى إيران تتضمن ١٩ نوع من فصيلة Apidae ، ٣ أنواع من فصيلة Andrenidae ، ٦ من فصيلةSphecidae ، ١٦ من فصيلةVespidae .

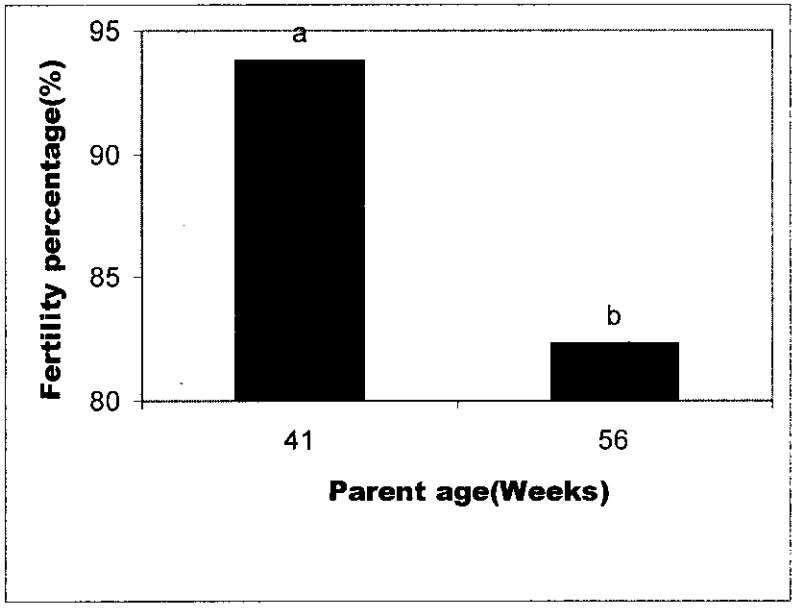

Fig. 1. The influence of parent age on fertility percentage.

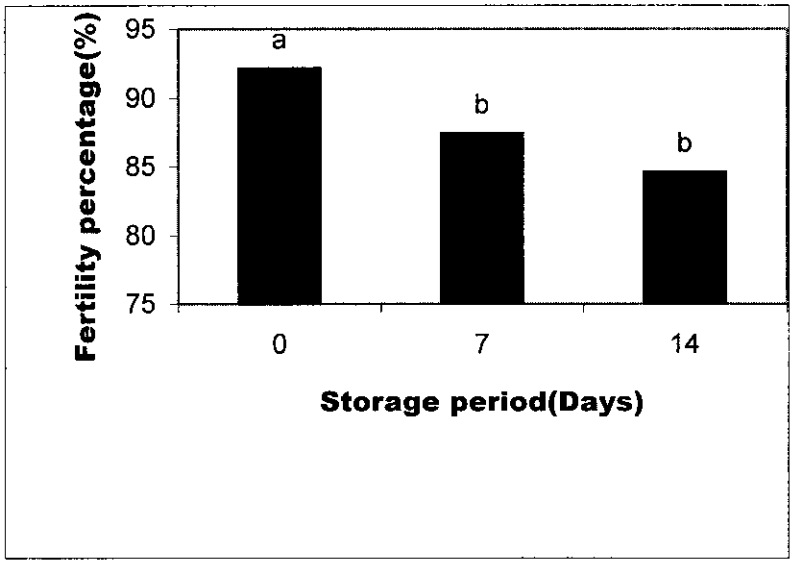

Fig. 2. The influence of storage period on fertility percentage.

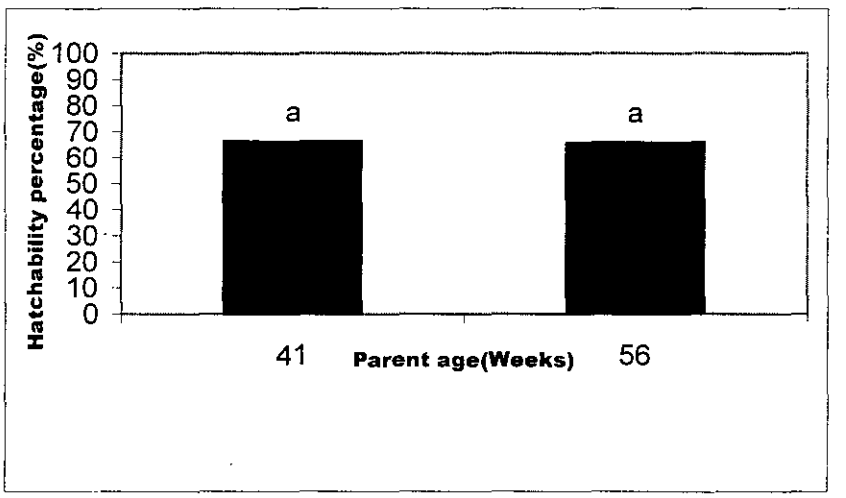

Fig. 3. The influence of parent age on hatchability percentage.

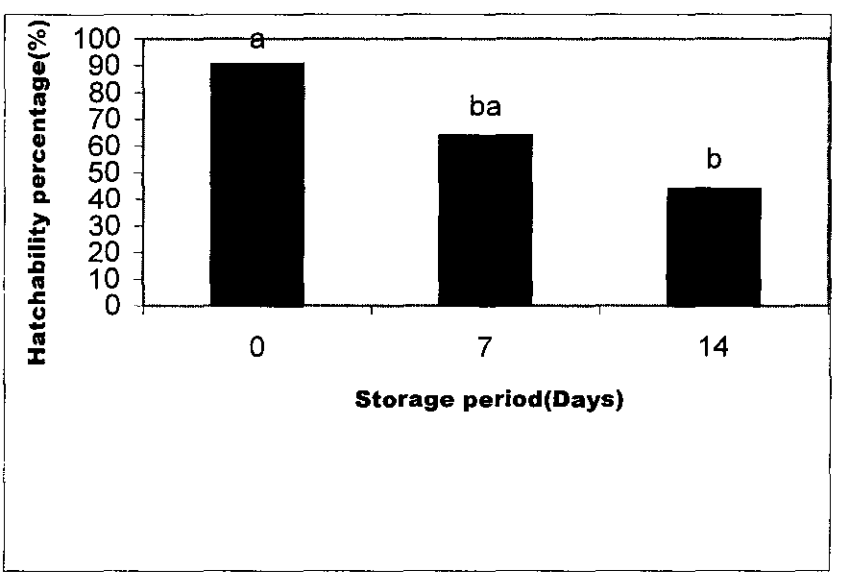

Fig. 4. The influence of storage period on hatchability percentage.

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27. *Nikolskayana miriabilis* Boucek: Host: *Xyleborus saxeseni* (Ratz.) (Scolytidae) on the cherry tree, Location: West Azarbayjan-Ourmieh, Date: Summer 1999, Collector: Unknown.

28. *Notanisus oulmesiensis* (Delucchi): Host: *Sphenoptera* sp. (Buprestidae), Location: Kermanshah-Ravansar, Date: Summer 2001, Collector: Mahmoody, F.

29. *Oodera formosa* (Girault): Host: *Capnodis* sp. (Buprestidae) on the apricot, Location: Mazandaran-Ghaemshahr, Date: Summer 2000, Collector: The second author.

30. *Ormocerus vernalis* Walker: Host: *Neuroterus tricolor* Hart. (Cinipidae), Location: Kermanshah-Kermanshah, Date: Summer 1999, Collector: Unknown.

31. *Pachycrepoideus vindemmiae* (Rondani): Host: *Drosophila melanogaster* (Meig.) (Drosophilidae) from fig fruit, Location: Mazandaran-Ghaemshahr, Date: Summer 1998, Collector: Author.

32. *Paracarotomus cephalotes* Ashmead: Host: *Syrphus pyrastri* (L.) (Syrphidae) on the sunflower field, Location: Mazandaran-Behshahr, Date: Summer 1999, Collector: The second author.

33. *Platicrizotes europeaus* Boucek: Host: *Acletoxenus formosus* Loew (Drosophilidae) on the cotton field, Location: Golestan-Gorgan, Date: Spring 2001, Collector: Karimian, Z.

34. *Rhaphitellus ladenbergi* (Ratzeburg): Host: *Ruguloscolytus multistriatus* (Marsh.) (Scolytidae) on the Faxinus, Location: Isfahan-Isfahan, Date: Summer 2000, Collector: The second author.

35. *Schizonotus seiboldi* (Ratzeburg): Host: *Chrysomela coerulans* Scrib (Chrysomelidae), Location: Mazandaran-Babol, Date: Summer 2000, Collector: The second author.

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39. *Theocalax formiciformis* Westwood: Host: *Anobium punctatum* De G. (Anobiidae), Location: Golestan-Gonbad, Date: Summer 2002, Collector: Karimian, Z.

40. *Thynodytes cyzicus* (Walker): Host: *Liriomyza conesta* Beck. (Agromyzidae) on the celery, Location: Isfahan-Isfahan, Date: Summer 1999, Collector: The second author.

41. *Toxeuma fuscicorne* Walker: Host: *Agromyza schneri* Girault (Agromyzidae), Location: Yazd-Abargho, Date: Fall 1999, Collector: Mohammadi, A.

تأثير عمر قطيع أمهات التسمين و طول فترة تخزين البيض على النمو الجنيني ونسبة الفقس

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استهدف هذا البحث دراسة تأثير عمر أمهات التسمين وفترة تخزين البيض علي التغيرات الفسيولوجية أثناء النمو الجنيني ووزن الكتكوت بعد الفقس حيث استخدمت ٥٤٠ بيضة تفريخ من سلالة أمهات التسمين (أربور ايكرز) وكانت الأمهات على عمرين مختلفين ٤١و٥٦ أسبوعاً من كل عمر ٢٧٠ بيضه و تم تقسيم كل عمر الى ثلاث مجموعات كل مجموعه تتكون من ٩٠ بيضه في المجموعه الأولى تم تفريخ ٩٠ بيضه مباشرة بدون تخزين بعد وزن البيض (مجموعة المقارنة أو الكنترول). بينما المجاميع الأخرى خزنت قبل التفريخ لمدة ٧ ، ١٤ يوماً في ثلاجة تحت درجة حرارة ١٢ ° م ورطوبة نسبيه ٨٥% و تم وزن البيض قبل و بعد التخزين ثم بعد ذلك تم تفريخها .

وبصفة عامة لوحظ انخفاض في وزن الجنين عند اليوم الـ ١٧ من التفريخ وكذلك وزن الكتاكيت التي تم فقسها من الأمهات الأصغر سناً بالمقارنة بمثيلاتها من الأمهات الأكبر سنا . أما الوزن النسبي للجنين فقد اظهر عكس ذلك . كذلك ارتفعت نسبة الخصب في بيض الأمهات الأصغر سنا بالمقارنة ببيض الأمهات الأكبر سنا . وقد لوحظ بعد الفقس ارتفاع تركيز جلوكوز بلازما الدم وجليكوجين القلب بينما انخفض تركيز جليكوجين الكبد في الكتاكيت التي تم فقسها من الأمهات الأصغر سنا بالمقارنة بمثيلاتها من الأمهات الأكبر سنا .

من ناحية أخرى وجد ارتفاع في وزن الجنين وفي الوزن النسبي للجنين في البيض الطازج والمخزن لمدة ٧ أيام عن البيض المخزن لمدة ١٤ يوماً . أما تركيز جلوكوز بلازما الدم فقد انخفض وكذلك انخفض تركيز جليكوجين الكبد وعضلات الفخذ في اليوم الـ ١٧ من التفريخ وبعد الفقس بزيادة فترة التخزين . بينما لم تؤثر فترة التخزين علي تركيز جليكوجين القلب في اليوم الـ ١٧ من التفريخ لكن انخفض التركيز بعد الفقس بزيادة عدد أيام التخزين .