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Effects Of Short-Term Thermal Manipulation During Late Embryogenesis On Hatching Traits And Post Hatched Subsequent Performance Of Mamoura Strain Chicks

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ABSTRACT

The current study was carried out to investigate the effects of short-term thermal manipulation during late embryogenesis on hatchability, chick quality, secondary sex ratio, and some blood biochemical parameters at hatch and after thermal challenge at 60 days of age . A total number of 1200 suitable hatching eggs were taken from Mamoura strain laying hens, Eggs were randomly divided into equal 4 treated groups(300 eggs each) each treatment were replicated three times (100 eggs each). All eggs were incubated at a constant temperature of 37.5ºC and 55% relative humidity (RH) throughout the incubation period until the end of 15 days, then the second, third and fourth groups were exposed to thermal manipulation (TM) treatment (39ºC and 65% RH) during the 16^{th} to 18^{th} days of incubation for 2, 3 and 4 hours per day, respectively, while the first group used as a control (without exposing to heat treatment). After hatching 225 one-day unsexed chicks from each treatment were taken(as same treatments in the hatchery). Chicks of end treatment were divided into 3 equal replicates (75 chicks each) .and separated reared for 60 days of age. After 60 days of hatch, challenge test (CT) was occurred by raising room temperature into 39 ºC and 65% humidity for 2 hours . Results indicated that thermal manipulation (TM) during late embryogenesis had no significant effect on hatchability traits and embryonic mortality percentages. Male ratio was significantly higher for chickens hatched from the group exposed to TM (39. ºC and 65% RH) for 4 h/d during the 16^{th} to 18^{th} days of incubation period. Chick length was significantly($p<0.05$) increased for the group exposed to TM for 4 h/d during late embryogenesis, while tibia length was significantly lowered for the same group compared to all treated and control groups. Body weight and body weight gain were significantly($p<0.05$) higher for chicks hatched from the group exposed to TM for 3 and 4 h/d as compared to2,3h/TM treated groups and the control group during the period from 30 to 60 days of age. There was no significant differences in body temperature in all TM treated groups and control but chick body temperature at 2 months of age was higher than post hatched chicks. Feed intake was not significantly affected by TM treatment but feed conversion was significantly improved in groups exposed to TM for 3 and 4 h compared to the control and 2h TM treated groups during the period from 30 to 60 days of age . Thermal manipulations during late embryogenesis resulted in significant ($p<0.05$) decreases in plasma total cholesterol and LDL cholesterol than the control at hatch, while , at 60 days of age , the least plasma cholesterol, and HDL values were recorded for 4 h TM /d during late embryogenesis. In addit the lowest concentration of plasma LDL was exhibited by birds 2h TM /hr 60 days age. T3 at hatch and 60 days of age (after CT) and plasma T4 at hatch were significantly decreased due to TM for 4 h/d, While, plasma Triglyceride was significantly decreased due to TM for 4 h/d at 60 days of age after CT. These results suggesting that TM for 4 h/d during the 16^{th} to 18^{th} day of incubation period improve hatching traits, chick quality and subsequent growth performance as well as plasma parameters. It can be concluded that four hours thermal manipulation during 16 to 18 days of incubation period was the best one to initiate improvement of thermo tolerance acquisition, better chick quality low embryonic mortality, and enhanced productivity of chicks at older ages without deleterious effects on blood parameters.

Keywords: short-term thermal manipulations- late embryogenesis- developed chickens

INTRODUCTION

In the Poultry industry, hatcheries are an important segment that provides the basic material for a production cycle. Improvements in commercial broiler strains resulted in shortening their life cycle with the incubation period unchanged. The most relevant factors that influence success of the incubation process are temperature, humidity, ventilation, turning and type of incubation equipment used, Consequently broiler chickens today spend about 30% of their life as embryos. This not only highlights the importance of environmental incubation factors, but also provides an avenue to manipulate embryogenesis to enhance hatchability and/or post-hatch performance.

There are many studies showed that short-term thermal manipulation during late embryogenesis had improved hatching traits, body function and chick quality parameters (Collin et al.,2005) . The effects of the duration of altering incubation temperature can be divided according to short or long term. A short-term increase of incubation temperature was found to activate the heat loss mechanism in chick embryos(Holland et al 1997) , whereas a long-term temperature increase affected the embryo morphology(Kaplan et al 1978) , increased the incidence of malpositions and decreased hatchability (French,1994) and(Romanoff ea al, 1972). Yahav et al.(2004) and Alkan,et al(2013) demonstrated that thermal anipulations during days 16 to 18 of embryogenesis may reach a significant improvement of thermotolerance acquisition,which probably related to a reduction in body temperature and plasma thyroid hormone concentrations, then assuming to reduce metabolic rate. This research focused specifically on thermal stimulation during incubation as temperature is the major determinant of success or failure in hatchery operations. Temperature directly influences hatchability and also alters chick yield, chick quality, sex ratio and post-hatch health and performance. Success or failure in hatchery operations does not end on the day of hatch but is determined by chick performance at the farm. First week mortality, first week culled chicks, first week body weight, feed intake, feed conversion and final body weight are characteristics that are influenced by incubation temperature (Lourens et al., 2005; Joseph et al., 2006; Collin et al., 2007; and Tzschentke and Halle, 2009).

The optimum temperature for the chicken embryo is 37.8 °C and it should not vary more than 0.3 °C (Wilson 1991). Because the developing embryo is

poikilothermic, any changes in incubation temperature may affect embryo size, organ growth, metabolic rate, physiological development and hatching success (Yalcin and Siegel 2003). It was previously reported that embryos, exposed to high or low temperatures during incubation, improved their capacity to adapt to hot or cold environments, respectively, in the post hatch phase. The timing of thermal manipulation (TM) has to be linked to the development of the hypothalamus-hypophysis-thyroid axis to change the heat production threshold response, and to the development of the hypothalamus-hypophysis-adrenal axis to avoid increase in stress response (Minne and Decuypere 1984, Janke et al. 2002, Yahav et al. 2004a, 2004b). In other words, Thermal manipulation is applied during the period that the thermoregulatory center in the brain develops and matures (days 6 to 16 of incubation) to alter the 'setpoint' of the systems controlling thermoregulation (Piestun et al., 2008b). Temperatures used for thermal manipulation during incubation are around 39.5°C and are applied for 6 to 12 hours per day (Piestun et al., 2008a;2009; Yahav et al., 2009; Yalçin et al., 2010).The result of thermal manipulation during incubation is that chickens are better able to cope with high temperatures during the growing period (Piestun et al., 2008b), therefore, benefits on performance. this study aimed to investigate of short-term thermal manipulations during late embryogenesis on hatching traits and chick's ability to cope with the thermal challenge (TC) at 2 months of age and hatching traits and adaptain for Mamoura developed strain of chickens.

MATERIALS AND METHODS

Incubation and hatchability traits:

The present study was carried out at El-Serw Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Egypt. A total number of 1200 suitable hatching eggs of Mamoura developed strain were taken and randomly divided into four experimental groups(300 eggs each) with 3 replicates(100 each) to investigate the effect of short-term thermal manipulations during late embryogenesis (16 to 18 day of incubation) on some hatching traits , sex ratio, body temperature, post- hatch performance and some blood biochemical parameters after hatch and after thermal challenge at 60 day of age for developed chickens. The experimental egg groups were incubated at 37.5 C and 55%RH from setting day up to the end of the 15th day of incubation, then the first group was exposed to the same temperature and humidity up to the end of the 18th day while the second, third and fourth groups were exposed to 39ºC and 65% RH for 2, 3 and 4 hours, respectively at the 16th, 17th and 18th days of incubation. All experimental egg groups were candled at the 7th day of incubation to determine fertile eggs, then candled at the 16th day to determine the embryonic mortality before thermal manipulation. Eggs all groups were transferred to the hatcher under 37.5 C and 65%RH from the 19th day until completed hatching process, hatching time was recorded and then hatched and, un-hatched chicks as well as embryonic mortality were recorded to calculate hatchability traits and pre and post embryonic mortality were recorded and their percentages were calculated .Hatched chicks were sexed to calculate male and female percentages.

Chick Quality Measurements:.

- All hatched chicks were individually numbered to and subjected to several quality measurements such as body weight, (chick, shank, tibia and toe lengths) according to (Tona et al., 2008).
- **Productive performance traits:** All hatched chicks for each experimental group were separately reared to 60 days after hatch. Body weight and feed intake were recorded and body weight gain and fed conversation were calculated at 30 and 60 days of age according to Willems et al. (2013).
- **Challenge test:** At 60 days of age after hatching, chickens of all treatments were subjected to Thermal challenge (TC) test by exposed to(39 C) for 2 hours. body temperature was measured directly after TC for three chicks from each group. T3, T4 hormones, HDL, LDL, total cholesterol and triglycerides were determine by using commercial kits
- Body temperature was measured for three hatched chick from each treatment chick quality traits were measured according to (Tona et al., 2008).
- **Blood plasma constituents :** Blood samples were taken from three chicks from each treatment by slaughtering post- hatch at 60 days directly after TC. Plasma separated by centrifugation at 2000 r.e.p for 20 minutes at room temperature and then labeled and stored in a deep freezer (-20°C) until chemical analysis

Statistical analysis

One way, analysis of variance was done using the General Liner Model procedure (SAS,2004). The main factor was the treatment (thermal manipulation). Significance level was set at $P<0.05$. Mean values were compared using Duncan's Multiple Range Test (Duncan, 1955). The model used was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where:

Yi j =any value from the overall, population, μ = the overall mean,

Ti = the effect of the ith treatment (i=1, control & 2, thermal manipulation),

e ij = the random error

RESULTS AND DISCUSSION

Results of Table 1 showed that no significant effect of thermal manipulations (TM) during late embryogenesis on Fertility and hatchability percentages (for both fertile and setting eggs) of Mamoura strain chickens. Hatchability of fertile eggs was approximately similar in all TM treatments and control group Also, embryonic mortality (%) either pre or post-TM was not significantly affected (Table 1).However, the lowest embryonic mortality (EM) was recorded for the group exposed to 2h TM , while the highest percent was recorded for those exposed to 4h TM. Generally, the group exposed to 2h TM (39ºC and 65% RH during the 16th to 18th days of incubation) with had recorded the best value for hatchability(%) and the lowest value for

EM(%) comparing to control and the other TM groups. This finding is agreement with those obtained by Tona et al, (2008); Badran et al. (2012) , Loyau et al. (2013); Piestun et al. (2013); Tzschentke and Halle (2009) and Halle and Tzshentke (2011).

Table 1: Effect of thermal manipulation during late embryogenesis on eggs hatching traits of Mamoura strain chickens

Treatments / Traits , %	Control	Thermal manipulations (TM) time		
		2 h	3 h	4 h
Fertility	93.83±0.44	93.91±0.44	94.74±0.01	93.81±2.03
Hatchability of set eggs	88.55±1.33	89.13±1.60	88.16±0.77	88.50±1.60
Hatchability of fertile eggs	94.37±1.27	94.91±1.27	93.06±0.81	94.34±2.02
EM post-TM	4.69±0.66	3.70±1.20	5.5630.66	5.19±0.33
EM Pre-TM	0.94±0.33	1.39±0.33	1.39±0.33	0.47±0.66
Total EM	5.63±1.27	5.05±1.27	6.94±0.81	5.66±2.02

EM = Embryonic mortality

Data in Table 2 showed that secondary sex ratio was significantly (p <0.05) affected by TM. Where the highest male and the lowest female chickens percentages were recorded for the group of eggs exposed to 4 h TM comparing to other TM treatments and control group, Meanwhile, the group of eggs exposed to 2h TM had the lowest male and the highest female chickens percentages. In addition, the eggs exposed to 3h TM gave approximately equal percentages of male and female chicks (51 and 49%,respectively) . this results is in agreement with Elmehdawi(2013) who found that low-intensity, short duration thermal stimulation during late incubation altered secondary sex ratio at Hatch and at 7 days in favor of males The increase of male as a result of TM (4h) may be due to male chicks were more responsive to terminal manipulation during the late stage of incubation when prolonged the exposure duration for 4 h/d (Bogdanova and Nager, 2008). Also, sex-specific may also depend on the strain of chickens, breeder age (Yalcin et al., 2005) and egg storage conditions (Khan et al., 2014).

chick length was significantly(P<0.05) increased for the groups exposed to 3 and 4 h/d TM (39. ºC and 65% RH) during late embryogenesis as compared to those of 2hTM and the control groups (Table 2) . Generally, chick length is the distance between beak and toe by stretching the chick and its better indicator for final body weight than day-old chick weight (Wolanski et al., 2004). Chick length is a useful tool to measure embryonic development as a preictior of chick growth potential (Khan et al., 2014). From table(2) it could be observed that tibia length was significantly(p< 0.05) lower for chicks of 4 h TM treatment comparing to all treated and control groups. On the other hand , as show in the same table , each of hatching time, chick weight and leg, shank and toe lengths were not significantly affected by TM treatments

Table (2): Effect of thermal manipulations during late embryogenesis on hatching time, sex ratio and chick quality measurements at hatch of Mamoura strain chickens.

Treatments / Traits	Control	Thermal manipulations (TM) time		
		2 h	3 h	4 h
Hatching time(h)	499±6.94	507±4.05	506±3.79	497±3.06
Sex ratio, %				
Male	44±1.16 ^{bc}	37±0.58 ^{c}	49±1.73 ^{b}	58±1.16 ^{a}
Female	56±1.16 ^{ab}	63±0.58 ^{a}	51±1.73 ^{b}	42±1.16 ^{c}
Chick measurements				
Chick weight (g)	35.61±0.32	35.07±0.17	35.24±0.32	35.92±0.35
Chick length (cm)	16.33^{c}±0.03	15.87^{d}±0.18	16.97^{b}±0.07	17.90^{a}±0.12
Leg length (cm)	4.18±0.04	4.29±0.02	4.21±0.12	4.13±0.09
Shank length (cm)	2.09±0.06	2.21±0.08	2.30±0.10	2.27±0.03
Toe length(cm)	2.09±0.05	2.09±0.08	1.91±0.02	1.87±0.09
Tibia length (cm)	2.25^{a}±0.08	2.32^{a}±0.04	2.23^{a}±0.03	1.99^{b}±0.07

a,b.. Means with different superscripts between treatments, within the same row are significantly different (P< 0.05).

Table 3 shows the effect of thermal manipulation (TM) during late embryogenesis on chick growth performance. It's clear that Body weight (BW) was significantly decreased for TM treated groups than the control group at 30 days of age. On the other hand ,at 60 days of chick age body weight was significantly(p<0.05) increased by TM (4h) over than the control and the rest of TM treatments.However . Exposing to 4 h/d TM during late embryogenesis increased BW over than the control group by 9.56% at 60 days of age. Body weight gain (BWG) for the chickens of TM treated groups was significantly (p<0.05) decreased than the control group during the period of 0-30 day of age, but it was significantly increased during the second period (30-60 day of age) for TM treatments . However, the highest BWG was recorded for 4h/d TM treatment followed by those of 3

h/d TM and then those of 2 hr/dTM treated chicks during the period from 30 to 60 days of age.

Table (3) illustrates that there were no significant differences in feed intake (FI) between TM treated groups each others and the control group, either during the period from 0 to 30 days or the period from 30 to 60 days of age . On the other hand, feed conversion ratio (FCR) was significantly($p<0.05$) attenuated for the groups exposed to TM than the control group at the period of 0-30 day of age, however, it was significantly($p<0.05$) improved for the groups exposed to TM (3 and 4 h/d) comparing to the control group. Body temperature was not significantly affected by TM treatments, where there were no appreciable difference between TM treatments each others and control group during both studied periods 0-30 and 30-60 days of age (Table3). The results of chick performance are partcally agreement with those of Tzschentke and Halle, (2009) and Halle and Tzshentke, (2011) who found that using thermal stimulation for 2 h/d at days 18,19,20 and 21 of incubation improved body weight and feed conversion

Table (3): Effect of thermal manipulation during late embryogenesis on chick growth traits performance at 30 and 60 days after hatch and body temperature at hatch and 60 days of age of Mamoura strain chickens

Treatments / Age (days)	Control	Thermal manipulations (TM) time		
		2 h	3 h	4 h
		Body weight (g)		
30 days	260.7^{a} ±1.2	253.3^{b} ±1.6	252.2^{b} ±1.0	255.4^{b} ±1.1
60 days	851.1^{b} ±23.1	857.0^{b} ±32.0	909.5^{ab}±11.2	932.5^{a}±13.4
		Daily body weight gain (g)		
0-30 days	7.5^{a} ±0.1	7.3^{b} ±0.1	7.2^{b} ±0.1	7.3^{b} ±0.1
30-60 dysa	19.7^{b} ±0.7	20.1^{b} ±1.0	21.9^{ab}±0.4	22.6^{a} ±0.5
		Daily feed intake (g/bird/day)		
0-30 days	25.6±0.1	25.9 ±0.2	25.1 ±0.1	25.4±0.2
30-60 days	83.1±1.1	85.6±0.3	82.9±1.0	85.1±1.4
		Feed conversion ratio (g feed/ g body gain)		
0-30 days	3.41^{c} ±0.01	3.56^{a} ±0.01	3.48^{b} ±0.01	3.47^{b} ±0.01
30-60 dysa	4.24^{a}±0.21	4.28^{a}±23	3.78^{b}±0.02	3.78^{b}±0.14
		Body temperature		
At hatch	39.13±0.06	39.4±0.17	39±0.06	39.13±0.18
At 60 day	42.13±0.09	41.97±0.08	41.91±0.09	41.97±0.13

a,b,c.. Means with different superscripts between treatments, within the same row are significantly different (P< 0.05).

Data in Table 4 showed that plasma T3 concentration was significantly($p<0.05$) decreased for all groups exposed to TM during late embryogenesis (16-18 days of incubation) than the control group either at hatch or at 60 days of age. Similar result was obtained for plasma T4 concentration at hatch, while there were no significantly differences in plasma T4 levels between TM treatments each others and control group at 60 days of age. Similar the finding were obtained by Tona et al. (2008) and Loyau et al. (2013) in broiler chicks. Also, Uni and Yahav (2003) decided that body temperature coupled with lower plasma concentration of thyroid hormones reflects the positive effect of thermal manipulation on thermoregulation which resulted in reduced metabolic rate. On the other hand, plasma triglyceride concentration was significantly($p<0.05$) decreased after thermal challenge test at 60 day of age, for incubation TM treatments comparing to control group ,while it was not significantly affected at hatch by incubation TM treatment during late embryogenesis period.

Table (4): Effect of thermal manipulations during late embryogenesis on plasma T3, T4 and triglyceride at hatch and after thermal challenge (TC) at 60 day of age for Mamoura strain chickens.

Treatments / Age (days)	Control	Thermal manipulations (TM) time		
		2 hr	3 hr	4 hr
		Triiodothyronine T3(ng/ml)		
At hatch	2.20^{a} ±0.12	1.58^{b} ±0.01	1.47^{b} ±0.03	1.47^{b} ±0.11
At 60 day	2.13^{a} ±0.09	1.64^{bc} ±0.05	1.76^{b} ±0.09	1.42^{c} ±0.06
		Tetraiodothyronine-Thyroxine T4(ng/ml)		
At hatch	9.77^{a} ±0.12	8.57^{b} ±0.20	8.54^{b} ±0.15	7.94^{c} ±0.08
At 60 day	9.53±0.35	9.11±0.17	8.73±0.38	8.27±0.23
		Triglyceride (mg/dl)		
At hatch	105.13±1.27	105.37±1.42	104.57±2.25	105.37±0.58
At 60 day	120.03^{a} ±0.55	115.70^{b} ±0.80	112.50^{b} ±1.30	105.70^{c} ±1.59

a,b,c.. Means with different superscripts between treatments, within the same row are significantly different (P< 0.05).

Results of Table(5) indicates that plasma total cholesterol and LDL cholesterol values were significantly ($p<0.05$) decreased at hatch for all TM treated groups than the control group, while HDL cholesterol values was not significantly affected during that period. On the other hand, at 60 days plasma total cholesterol was

significantly($p<0.05$) decreased for the groups exposed to TM for 2 and 4 h/d than the control and 3h/d treatments group. while both groups exposed to TC (3 and 4 h/d)had a significant lower HDL cholesterol than that of 2hr/d treatment and control group at 60 days of age. However, the group exposed to TM for 2 h/d had recorded the lowest LDL cholesterol value. These results are in agreement with those obtained by Yahav et al. (2004) who noted that TM at 39.5°C for 3 h during E16 to E18 of incubation improved chick's thermotolerance acquisition.

Table (5): Means of plasma cholesterol, HDL and LDL of Mamoura chickens as affected by the thermal manipulations during late embryogenesis and thermal challenge(TC) at 60 days of age .

Treatments Age(days)	Control	Thermal manipulations (TM) time 2 h	3 h	4 h
		Total cholesterol (mg/dl)		
At hatch	190.33^{a} ±0.88	178.33^{b} ±1.76	179.30^{b} ±0.55	175.3^{b} ±1.98
At 60 day	190.33^{a} ±0.55	183.80^{b} ±1.25	189.60^{a} ±1.08	180.80^{b} ±0.81
		HDL cholesterol (mg/dl)		
At hatch	86.67±1.20	84.34±0.88	82.33±2.40	82.32±1.45
At 60 day	89.90^{a} ±1.19	91.03^{a} ±1.20	85.10^{b} ±1.12	83.40^{b} ±1.55
		LDL cholesterol (mg/dl)		
At hatch	82.63^{a} ±0.89	72.93^{b} ±2.18	76.07^{b} ±1.85	71.87^{b} ±1.02
At 60 day	76.43^{b} ±1.02	69.63^{c} ±1.18	82^{a} ±1.82	76.26^{b} ±1.62

a,b,c.. Means with different superscripts between treatments, within the same row are significantly different (P< 0.05).

CONCLUSION

Thus, it could be concluded that, four hours thermal manipulation during 16 to 18 days of incubation was the best one to initiate improvement of thermo tolerance acquisition, better chick quality low embryonic mortality, and enhanced productivity of chicks at older ages without deleterious effects on blood parameters.

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تأثير المعالجة الحرارية قصيرة الاجل خلال فترة النمو الجنينى المتأخر على صفات الفقس وآداء الكتاكيت الفاقسة لسلالة المعمورة

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أجريت هذه التجربة لدراسة تأثير المعالجة الحرارية قصيرة الاجل خلال فترة النمو الجنينى المتأخر على صفات الفقس وآداء الكتاكيت و النسبه الجنسيه و بعض قياسات بلازما الدم لكتاكيت سلالة دجاج المعموره . حيث تم اختيار ١٢٠٠ بيضه صالحة للتفريخ من اناث سلاله المعموره تم تقسيمها عشوائيا الى أربع مجاميع متساوية (٣٠٠ بيضه لكل معاملة) وتم تقسيم كل مجموعة الى ٣ مكررات (١٠٠ بيضة / مكررة) تم وضعهم فى المحضن و تحضينهم على درجه حراره ٣٧.٥ ºم و ٥٥% رطوبه نسبيه لمدة ١٥ يوم وفى بداية اليوم ١٦ من التحضين تم اجراء المعالجة الحرارية على النحو التالى:١- المجموعه الاولى (كنترول) تم تحضين البيض على درجة الحرارة والرطوبة المثلى (٣٧.٥ ºم +٥٥% رطوبة نسبية) حتى اليوم ١٨ للتفريخ .٢- المجموعه الثانية تم نقل البيض فى اليوم ال ١٦ من العمر الجنينى الى ماكينة تفريخ اخرى حيث تم تعريض البيض لمده ساعتين يوميا لدرجة حراره ٣٩ºم و رطوبة نسبية ٦٥% على ان يعود البيض فورا لوحده التحضين الاصلية (setter) بعد التعريض.٣- المجموعه الثالثة تم نقل البيض فى اليوم ال ١٦ من العمر الجنينى الى ماكينة تفريخ اخرى حيث تم تعريض البيض لمده ٣ ساعات يوميا لدرجة حراره ٣٩ºم و رطوبة نسبية ٦٥% على ان يعود البيض فورا لوحده التحضين الاصلية (setter) بعد التعريض.٤- المجموعه الرابعه تم نقل البيض فى اليوم ال ١٦ من العمر الجنينى الى ماكينة تفريخ اخرى حيث تم تعريض البيض لمده ٣ ساعات يوميا لدرجة حراره ٣٩ºم و رطوبة نسبية ٦٥% على ان يعود البيض فورا لوحده التحضين الاصلية (setter) بعد التعريض.٥- بعد نهاية اليوم ١٨ تم نقل جميع البيض الى المفقس على درجة حرارة م° ورطوبة نسبية % حتى نهاية فترة التفريخ و بعد فقس الكتاكيت تم اخذ عدد ٢٢٥ كتكوت من كل معاملة وتربيتهم منفصلين مع تقسيم كل معاملة الى ٣ مكررات متساوية بكل مكررة ٧٥ كتكوت وقد استمرت تربية الكتاكيت لمدة شهرين لاخذ قياسات الاداء الانتاجى والفسيولوجى. وعند عمر ٦٠ يوم تم تعريض الكتاكيت الناتجة الى لدرجة حرارة عالية كما يلى :- كتاكيت المجموعه الاولى (كنترول) لم تتعرض لمعاملة حرارية - كتاكيت المجموعه الثانية والثالثه والرابعه تم تعريضهم لدرجة حرارة ٣٩ ºم لمدة ساعتين . حتى تم اجراء القياسات بعد الفقس مباشرة وبعد اجراء التعرض الحرارى للكتاكيت عند عمر ٦٠ يوم كانت اهم النتائج كما يلى:- لم تؤثر المعاملات الحراريه معنويا على كل من نسبه الفقس و الخصوبه و موت الاجنه بعد التعريض الحرارى.للبيض فى المفرخ.- تاثرت النسبه الجنسيه حيث زادت نسبة الذكور عن الاناث معنويا بزياده مدة التعرض الحرارى فى العمر الجنينى المتاخر لمدة اربع ساعات على درجه حراره ٣٩ºم و رطوبة نسبية ٦٥%.- ارتفعت جوده الكتاكيت معنويا حيث ازداد طول الكتكوت للمعامله المعرضه ل درجة حرارة ٣٩و رطوبة نسبية ٦٥% لمده اربع ساعات بينما طول عظمه التيبا كانت الاطول فى المعامله المعرضه لمده ٣,٢ ساعات مقارنة بتلك المعرضة ل ٤ ساعات فى حين لم تتاثر بقية صفات جودة الكتاكيت معنويا - ازداد معنويا كلا من وزن الجسم و معدل الزياده فى وزن الجسم للمعامله المعرضه لدرجة حراره ٣٩و رطوبة نسبية ٦٥% لمدة ٤ ساعات عند عمر ٦٠ يوم مقارنة بالكنترول وبقية المعاملات بينما لم يتاثر معنويا كمية الغذاء االمستهلك بالمعاملة الحرارية ولكن حدث تحسن معنوى فى كفاءة تحويل الغذاء للكتاكيت المعرضة ل ٤,٣ ساعات وذلك خلال الفترات من الفقس – ٣٠ ومن ٣٠-٦٠ يوم من العمر .- لم تتاثر معنويا درجة حرارة الجسم سواء بعد الفقس او بعد اجراء التعريض الحرارى عند عمر ٦٠ يوم - انخفض معنويا كلا من هرمونى ال T3,T4وكذلك الكوليسترول الكلى و LDL كوليسترول للمعاملات النعريض الحرارى وذلك بعد الفقس . بينما لم يتاثر معنويا كلا من الجليسريدات الثلاثية وتركيز HDLكوليسترول خلال نفس الفترة .- اما عند عمر ٦٠ يوم وبعد اجراء التعريض الحرارى للكتاكيت فقد حدث انخفاض معنوى لتركيز كل من هرمون T3 والجلسريدات الثلاثية والكوليسترول الكلى لكتاكيت البيض المعاملة حراريا فى المفرخ لمدة ٤ ساعات حيث سجلت الكتاكيت المعاملة حراريا لمدة ساعتين فى المفرخ اقل تركيز LDLفى البلازما فى حين لم يتاثر تركيز هرمون T4معنويا عند هذا العمر . تخلص الدراسه الى أن تعريض البيض المخصب لمدة اربع ساعات لدرجة حراره ٣٩ ºم و رطوبة نسبية ٦٥% فى ماكينة التفريخ يوميا خلال الفترة من اليوم السادس عشر حتى الثامن عشر من التفريخ يحقق افضل قدره للكتاكيت على الاقلمه الحراريه و جوده الكتاكيت و تقلل من نفوق الاجنه و تحسن من معدلات الاداء بدون التاثير على صفات بلازما الدم .