

Influence of Embryonic Thermal Manipulation During Incubation on Growth Performance and some Blood Traits of Broiler

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ABSTRACT

This study hypothesized that rising embryonic temperature during hatching process could influencing post growth performance and some plasma blood traits of broiler, this technique called Embryonic thermal manipulation (ETM), so, four hundred and forty Ross 308 broiler hatching eggs (63.54 ± 2.07 g) from 34-week old broiler breeders were used for this trail via rising incubation temperature by 1.7 C to reach 39.5 C and 55% RH, for 12 h in 7th, 10th, 13th and 16th to represent first, second, third, fourth treatment respectively and the fifth treatment was the control that had the standard incubation condition. After hatching the same of previous treatments were keep on, and only two hundred and forty unsexed one-day chick's old that get it from the hatching process were distributed, fives treatments as mentioned earlier, 48 chicks per treatment with four replicates and 12 chicks per replicate. Using ETM lead to significant increase in final body weight and feed intake in comparison with the control group but no significant differences were happened in the rest growth parameters except inconstant significant differences in the mortality rate, in addition, there were no significant differences in plasma protein and lipid profile except for total cholesterol and AST enzyme activity which increases significantly in ETM treatments in comparison with the control group, and there was no significant effects of ETM treatments on some biochemical traits of plasma.

Key words: body parameter, lipid profile, liver enzyme activity, protein profile.



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INTRODUCTION

Modern broiler was different from broiler raised in last two decades, they develop faster and faster, the pre-hatched period was constant while post hatched period were shortened due to improving genetic selection of broiler strains (Genchev et al., 2024), hence, the embryonic phase represents 50 to 60% of broiler life (21 d incubation period / 35 to 42 d market age) (Aylward et al., 2024), so, relatively the most growth occurred in embryogenesis phase for precocial species, therefore, the change in temperature and humidity throughout incubation period could become a significant tool to enhance embryonic development, finally, improving chick's quality and post-performance of broiler

(Rocha, et al., 2021). Chicken embryo behave as a poikilothermic at an early stage of embryogenesis, then they will have had ability to regulate their body temperature completely after days of hatching and became homoeothermic (Mueller et al., 2022), so, the environmental incubation condition will be constant throughout incubation period and any change of these conditions making harmful effect on embryogenesis development (Goel, et al., 2023), but some research revealed that a little elevate in environmental temperature during incubation period could influence on embryo metabolism and effect on hatching traits, chick's quality and post hatch performance, this change in temperature called Embryonic Thermal Manipulation (ETM),

ETM can be defined as a technique involved rising environmental temperature during embryogenesis period (Rogers et al., 2023). Previous studies on ETM revealed that the mode of action of ETM was its effect on some neurotransmitters, Rocha et al. (2021) revealed that subjecting hatching eggs to ETM will increase dopamine and noradrenaline levels in the brain, hence, these neurotransmitters had a key factor on maturation of the central nervous system in first 5 days of embryogenesis, additively, these neurotransmitters had an important impact on controlling breathing under resting conditions, so, ETM may improve the growth of embryo treated with ETM in comparison with untreated eggs via improving ventilation process of embryo. Another mode of action of ETM was to combat heat stress in adult broiler via subjecting hatching eggs to elevate temperature in two ways; continuously or intermittently at different time of incubation period, the hypothesis beyond this concept was ETM influence on hypothalamus-hypophysis-thyroid or adrenal axis, or both, development, and this hypothesis was verified when broiler challenged with heat stress in last phase of raising and approved this concept (Abdel-Fattah et al., 2024; Al Amaz et al., 2024). Tarkhan et al. (2020) elucidate that one of the mode of action of ETM was its effect on alteration heat shock genes expression, they referred to Hsp70 gene expression was induced during cellular heat stress, so, subjecting hatching eggs to ETM could significantly improve enhancing growth of post hatch broiler during rearing in out of the comfortable zone of broiler raising. Therefore, the main purpose of the present study was to highlights the effects of exposure hatching eggs to elevating temperature during hatching process on post growth performance of broiler and some blood traits.

MATERIALS AND METHODS

A total of four hundred and forty ROSS 308 broiler hatching eggs (63.54 ± 2.07 g) from 34-week old broiler breeders provided by Pluriton Netherland company, Netherland (www.puriton.com) were used for this trail. The embryonic thermal manipulating process were conducted according to Dalab et al.

(2023) After hatching the same of previous treatments were keep on, the first, second, third and fourth group were subjected to embryonic thermal manipulation (39.5°C , 55% RH) at 7th, 10th, 13th and 16th day of incubation respectively for 12 hours; via transferring the treated eggs from first incubator to the second, after that the thermal treated eggs were returned to the first incubator with the fifth group (control treatment) under optimal incubation conditions (37.8°C and 55% RH) throughout the incubation period (1-18 d), 240 unsexed one-day chick's old that get it from the hatching process were distributed, fives treatments as mentioned earlier, 48 chicks per treatment with four replicates and 12 chicks per replicate. Feed and water were free access (ad libitum), illumination and other directions of broiler rearing were used according to Ross 308 guide (Aviagen Group, 2022), Started diet used from the beginning to end of 11 days of age, the grower diet were used after that to the end of 24 days of age, from that age to the end of trial the finisher diet were used, all the diets had an optimum requirement as nutrition specification of breeding company (Aviagen Group, 2022), as illustrate in Table (1). Broiler performance parameters were assessed weekly; body weight, weight gain, feed consumption, feed conversion ratio, mortality percentage, realtive growth rate (RGR) (Gondwe & Wollny, 2005). Plasma biochemical traits were assesed via collecting whole blood samples from bronchial vein at 42 days of broiler (one bird of each replicate, 4 bird/treatment), the colocted whole blood samples were distiputed into anticoagulant coated tubes, after centrifugation for 10 minutes at 2000 rpm, the plasma was separated, they kept in freezing condition (-20°C) till the time of assessing plasma traits, viz : Total Protien (TP) , blood sugar , cholesterol , triglycerides, HDL , VLDL and LDL and the activities of transaminases (AST and ALT). All the plasma parameters were calorimetrically determined using Spin200 machine produced by Spinreact company following the same steps as described by manufacturers.

Table 1. The calculated percentages and chemical composition of diets used in this experiment

Feed materials (%)	Starter (0-10d)	Grower (11-24d)	Finisher (25-42d)
Maize	48	48	48
Wheat	9.7	12.8	15.6
Soybean meal	33	29.1	25.3
¹ Protein concn.	5	5	5
Oil	2	3.1	4.3
Lime stone	1.2	1.1	1
Dicalcium phosphate	0.7	0.5	0.4
Salt	0.2	0.2	0.2
Vitam. and min.	0.2	0.2	0.2
² Calculated chemical composition			
Crude protein (%)	23	21.5	20
ME (Kcal/kg feed)	3000	3100	3204
Methionine (%)	0.50	0.48	0.46
Lysine (%)	1.3	1.22	1.1
Calcium (%)	0.96	0.87	0.80
Phosphor (%)	0.47	0.43	0.40

¹ al-wafi concentrate. (www.arasco.com)

² The chemical composition of the diet components was calculated depend on (10)

To assess the significant effects of embryonic thermal manipulation on selected parameters, firstly, every percentage data were transfer to arc sine, then all transformed data were analyzed using One-Way ANOVA analysis. The analysis were applied by using General Linear Model (GLM) procedure of statistical software package SAS version 9.1 (29) *P-values* less than 0.05, 0.01 and 0.001 were considered to be significant for the main effect, results were presented as *mean/ SEM (pooled)*.

RESULTS AND DISCUSSION

Growth Performance: The ETM at 7th, 10th, 13th, and 16th day of incubation for 12 h/d via raising 1.7 °C to reach 39.5 °C with 55% RH, lead to significant increase in final body weight of broiler and feed intake (Table 2) in comparison with the control group, especially

in changing temperature at 7th day of incubation, hence the remaining ETM were not significantly different, this finding was in line with Meteyake et al. (2023) when they exposed hatching eggs to changing temperature from 7th to 16th day of incubation for 12 h/d via rising 1.7 °C to reach 39.5 °C with 65% RH, they illustrated that ETM lead to significant increase in broiler final body weight, the significant increase in final body weight may be resulted from stimulation muscle development and growth via myoblast proliferation (Al-Zghoul et al., 2019), in contrast Brannan et al. (2021) noticed that using ETM will decreased final body weight significantly at amount of 83 g. Mortality percentage was significantly increase in ETM group in comparison with the control group (Table 2).

Table 2. Impact of embryonic thermal manipulation during hatching process on accumulative broiler performance (1 – 42 day

Embryonic Thermal manipulat on on day ¹	Body Weight g at 42 day	Weight gain (g/bird/42 day)	Feed intake (g/bird/42 day)	FCR (g feed intake / g weight gain /42 day)	Relative Growth Rate (%)	Mortality (%)	Production Index (%)
7 th	3217.9 a	3172.08	3919.72 a	1.236	194.38	1.80 a	608.87
10 th	3057.1 ab	3012.077	3772.70ab	1.253	194.19	0.78 d	576.60
13 th	3071.3 ab	3025.48	3760.35ab	1.243	194.12	1.48 b	579.65
16 th	3164.9 ab	3118.43	3727.02ab	1.195	194.21	0.88 c	624.95
control	2955.8 b	2908.97	3609.01 b	1.241	193.76	0.71 e	563.23
Prob.	0.05	0.3983	0.0275	1.233	0.7699	0.0001	0.5313
Mean	3093.38	3047.41	3757.76	1.217	194.13	1.13	590.66
SEM (pooled)	37.6584	59.9497	30.7874	0.0194	2.2079	0.0562	18.3539

¹ changing temperature via rising 1.7 C to reach 39.5 C and 55% RH, for 12 h in 7th, 10th, 13th and 16th

² Different letters in columns indicate significant differences between treatments

Plasma Blood Traits

1. Protein Profile: Data in Table (3) shows that ETM during hatching process was not significantly different in all treatments, and that was in contrast with finding of Zaboli and Kameli (2022) when they notice significant decrease in total protein when they use ETM

Table 3. Influence of embryonic thermal manipulation during hatching process on plasma protein profile of broiler at 42 days of age

Embryonic manipulation on day ¹	Thermal	Total	Protein (g/dL)	Albumen (g/dL)	Globulin (g/dL)
7 th			2.68	1.469	1.21
10 th			2.82	1.538	1.27
13 th			2.93	1.535	1.40
16 th			2.78	1.416	1.36
control			2.99	1.618	1.38
Prob.			0.7458	0.6043	0.6909
Mean			2.84	1.515	1.328
SEM (pooled)			0.0747	0.3961	0.0444

changing temperature via rising 1.7 C to reach 39.5 C and 55% RH, for 12 h in 7th, 10th, 13th and 16th

2. Lipid Profile: The results in Table (4) illustrate that the control group exhibited significantly higher plasma cholesterol levels without any significant difference between changing temperature at 10th, 13th and the control, this finding was consistent with Li et al. (2024) when exposed hatching eggs to 39.5 °C with RH=65% for 8 h/d from 8th to 15th day of incubation, they observed an increase in total cholesterol in the ETM group, they referred that may be attributed to the

for 6, 12 and 18 h/d at 7th to 16th day of incubation via rising temperature to reach 39.5 °C with RH=65%, the inconsistent result of plasma protein profile may be due to disappear of EMB effect with getting older and the mode of action of ETM will lose their effects.

upregulation of the lipogenesis process. There were no significant differences between treatments in TG, HDL, VLDL, and LDL levels when contrasted with the control group, the same trend was noticed by Li et al. (2024) and Abdel-Fattah et al. (2024) which may have referred that ETM were not long lasting and may be attributed to many effects that related to physiological management conditions during rearing period.

Table 4. Influence of embryonic thermal manipulation during hatching process on plasma lipid profile of broiler at 42 days of age

Embryonic manipulation on day ¹	Thermal	Cholesterol (mg/dL)	Triglyceride (mg/dL)	HDL (mg/dL)	VLDL (mg/dL)	LDL (mg/dL)
7 th		94.75 bc	76.25	37.75	15.25	41.75
10 th		abc 105.50	59.50	52.50	12.00	41.00
13 th		115.75 ab	47.25	58.25	9.25	48.25
16 th		91.00 c	57.25	38.50	11.50	41.25
control		120.25 a	79.00	48.50	15.50	56.25
Prob.		0.05	0.3214	0.1951	0.3370	0.1698
Mean		105.45	63.85	47.1	12.7	45.7
SEM (pooled)		3.9486	5.4619	3.2484	1.0932	2.3587

¹ changing temperature via rising 1.7 C to reach 39.5 C and 55% RH, for 12 h in 7th, 10th, 13th and 16th

² Different letters in columns indicate significant differences between treatments

3. Liver Enzyme Activity: Data in Table (5) shows inconstant results of AST liver enzyme activity, hence, there was significant decrease in forth treatment in comparison with the other treatments, it may be due to the second phase of incubation process and the embryo had complete hypothalamus-hypophysis-thyroid or adrenal axis and the ETM had no effect of this

axis (Mueller et al., 2022). In addition, the activity of ALT did not show significant differences due to ETM treatments, and that was an expected result, hence the effect of EMB was no long lasting to the end, as previous research referred that both liver enzyme activity was noticed during first stage of broiler life after hatching process, the

present finding was in line with Abdel-Fattah et al. (2024) when they exposed hatching eggs to rising incubation temperature to reach 39.5 °C for 6 h/d from 14th to 18th day of

incubation leading to significant differences in liver enzyme activity of plasma at 35 day of age.

Table 5. Influence of embryonic thermal manipulation during hatching process on plasma of broiler at 42 days of age

Embryonic Thermal manipulation on day ¹	AST (U/I)	ALT (U/I)
7 th	411.50 ab	10.25
10 th	514.25 a	11.00
13 th	402.00 ab	8.25
16 th	331.25 b	9.25
control	493.00 a	9.75
Prob.	0.0190	0.6589
Mean	430.40	9.70
SEM (pooled)	21.009	0.5670

¹ changing temperature via rising 1.7 C to reach 39.5 C and 55% RH, for 12 h in 7th, 10th, 13th and 16th

² Different letters in columns indicate significant differences between treatments

CONFLICT OF INTEREST

The authors declare no conflict of interest

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تأثير المعالجة الحرارية خلال مرحلة النمو الجنيني في الاداء الانتاجي وبعض صفات الدم لفروج اللحم

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المستخلص

افترضت الدراسة الحالية ان رفع درجة حرارة الحضان اثناء عملية التفقيس يمكن ان تؤثر في اداء النمو وبعض صفات الدم لفروج اللحم باستعمال تقنية المعالجة الحرارية ، لذلك عرض 440 بيضة تفقيس من امهات روز 308 بعمر 34 اسبوع وبمعدل وزن 63.34 ± 2.07 غرام الى رفع درجة الحرارة الحضان بواقع 1.7 درجة مئوية لتصل الى 39.5 درجة مئوية لمدة 12 ساعة في اليوم وفي اليوم السابع والعاشر والثالث والسادس عشر اثناء عملية الحضان لتمثل المعاملة الاولى والثانية والثالثة والرابعة على التوالي ، بينما كانت معاملة السيطرة هي التي عرض فيها بيض التفقيس الى الظروف القياسية لعملية الحضان لتمثل المعاملة الخامسة ، وبعد انتهاء عملية الفقس وخروج الافراخ اختير 240 فرخا غير مجنسة بعمر يوم ناتجة من المعاملات الخمسة السابقة وبواقع 48 فرخ لكل معاملة واربع مكررات لكل معاملة (12 فرخ/مكرر). ادى استعمال المعالجة الحرارية اثناء عملية التفقيس الى زيادة معنوية في معدل وزن الجسم النهائي ومعدل استهلاك العلف مقارنة بمعاملة السيطرة ، ولم يلاحظ حدوث فروق معنوية في بقية معايير النمو ما عدا في نسبة الهلاكات ، بالاضافة لذلك ، فانه لم تكن هناك فروق معنوية في صفات البروتين والدهون لبلالزما الدم ما عدا زيادة معنوية في نسبة الكولسترول ونشاط انزيم AST في مجموعة المعالجة الحرارية مقارنة بمجموعة السيطرة ، من نتائج الدراسة الحالية يمكن الاستنتاج بان المعالجة الحرارية خلال مرحلة الحضان لبيض التفقيس يمكن ان تؤدي الى حدوث زيادة معنوية في معدل وزن الجسم النهائي عن طريق زيادة استهلاك العلف مع عدم وجود التأثير المعنوي في بعض معايير الكيمائية لبلالزما الدم.

الكلمات المفتاحية: معايير الجسم، معيار دهن الدم، فعالية انزيمات الكبد، معيار بروتين الدم.