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Effect of egg incubation temperature on hatching chicks' characteristics

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Abstract:

The experiment was conducted in the hatchery of the Animal Production Department of the Directorate of Agricultural Research in Slemani during the period from 1/10/2022 to 1/12/2022. 300 fertilized eggs of local Kurdish chicken (12, 13) were used in the experiment and were divided into three groups so that their weight and dimensions were not significantly different between the experimental treatments. The experiment was divided into three treatments, where the eggs of the first treatment were incubated at a temperature of 37.7 °C, while the eggs of the second treatment were incubated at a temperature of 38 °C, and the eggs of the last treatment were incubated at a temperature of 36 °C. After hatching the eggs, the chicks were sexed, and the mortality rate and quality of the chicks were calculated. There were no significant differences between the treatments used in the percentage of live and dead chicks. , as it was found that there were no significant differences in the percentage of chicks with dry and wet between the treatments used. It was found that there were significant differences between the treatments in the sex ratio of chicks. The percentage of male and female chicks in the first treatment was 23.1% and 14.8%, respectively. As for the second treatment, the percentage of males and females was 24.7% and 7.7%, respectively. In the third treatment, the percentage of males and females was 15.9% and 13.7%, respectively. It does conclude that increasing or decreasing the incubation temperature affected the chick sex, and did not affect the hatchability percentage and the chick quality. More studies are needed to find the effect of incubation temperature on chick sex to use it as a method for sexing chicks.

Keywords: Egg, chicks, temperature, sex, mortality.

Introduction:

Incubation temperature is one of the environmental factors that plays an important role in chick hatching (1). It is important to remember that the development of the chicken embryo starts in the oviduct during egg production (2). Cell division halts, the egg cools down, and the embryo enters a latent stage at oviposition (3). By adjusting the typical incubation temperature, early pre- or postnatal ontogeny can enhance broiler chickens' ability to regulate their body temperature and increase post-hatch performance (4). The performance, such as chick weight and hatchability, all depend on the first week of embryo development (5). Through early age thermal conditioning, studies have taken advantage of the immaturity of the temperature-regulating mechanism in newborn chicks during their first week of life, modifying the quick heat stress response (6). Owing to the difficulty of modifying the post-hatch environment, temperature adjustments made during the incubation phase may improve the thermal response of the embryo and enable more accurate thermal response monitoring of the developing chicken (7). To understand the mechanism of temperature's effect on embryonic development inside the egg, other factors affecting embryonic development of birds must be removed, including genetic (8, 9), pathological (10), and nutritional factors (11). To reduce the dispersion of the effect of temperature. The aim of this study is to determine the effect of high and low hatching egg temperature on the dead embryos and the health status of the chicks, in addition to the sex of the chick.

Materials and methods:

The experiment was conducted in the hatchery of the Animal Production Department of the Directorate of Agricultural Research in Slemani, during the period from (1/10/2022 – 1/12/2022). 300 fertilized eggs of local Kurdish chicken (12, 13) were used in the experiment, and were divided into three groups so that their weight and dimensions were not significantly different between the experimental treatments. The experiment was divided into three treatments, where the eggs of the first treatment were incubated at a temperature of 37.7 Cº, while the eggs of the second treatment were incubated at a temperature of 38 Cº, and the eggs of the last treatment were incubated at a temperature of 36 Cº. After hatching the eggs, the chicks were sexed, and the mortality rate and quality of the chicks were calculated. SPSS/PASW for Windows version 20 was used to analyze the data (14). To determine how the incubation temperature affected the hatchability, chick quality, and sex ratio, one-way analysis of variance was utilized. To determine whether there were any statistically significant variations between the group means, Duncan's multiple range test (15) was used.

Result and discussion:

Table 1 shows the external characteristics of the specific eggs used in the experiment. It was taken into account that the eggs were homogeneous in terms of weight, elongation, and length so as not to affect the workflow of the experiment and to obtain more accurate results. There were no significant differences in egg weight, egg elongation, egg length, and egg shape index.

Table 1: The egg external traits that used for incubation.

Treatments	Egg Weight	Egg Length	Egg Breadth	Egg Shape Index
Overall mean	50.54±0.19 a	53.82±0.13 a	40.43±0.08 a	75.67±0.22 a
1	50.46±0.36 a	53.97±0.24 a	40.40±0.13 a	75.79±0.46 a
2	51.04±0.26 a	54.04±0.18 a	40.55±0.08 a	75.64±0.30 a
3	50.14±0.33 a	53.48±0.25 a	40.37±0.16 a	75.59±0.35 a
Sig.	NS	NS	NS	NS

Table 2 shows the effect of different incubation temperatures on the percentage of live and dead chicks. There were no significant differences between the treatments used in the percentage of live and dead chicks. According to (16) they found that incubating hatching eggs at higher and lower temperatures than the average led to significant differences in the hatchability of eggs, where the control coefficient was superior to the other coefficients. In addition, there was no significant difference in chick mortality for the period following hatching from 1 to 10 days of chick age. As for (17), the increase in incubation temperature above the ideal average did not significantly affect the hatchability, while its decrease from the ideal average led to a decrease in the hatchability. While (18) found that incubating hatching eggs under temperatures higher or lower than the ideal rate led to no significant differences in the mortality rate of chicks upon hatching.

Table 2: The effect of different incubation temperatures on the percentage of live and dead chicks

			Period			Total
			1	2	3	
Mortality	Live	Count	75	67	73	215
		% of Total	30.4%	27.1%	29.6%	87.0%
	Dead	Count	11	10	11	32
		% of Total	4.5%	4.0%	4.5%	13.0%
Total		Count	86	77	84	247
		% of Total	34.8%	31.2%	34.0%	100.0%
Chi-square						0.004
Sig.						0.998

Table 3 shows the effect of different incubation temperatures on the quality, as it was found that there were no significant differences in the percentage of chicks with dry and wet between the treatments used. Our result agrees with (19), who found in his study that increase or decreasing the incubation temperature from the control temperature did not significantly affect the chick quality. Egg and chick quality are influenced by breeder farm characteristics, including breed or genetic strains, flock age, and egg management techniques, including egg storage. The incubation temperature, relative humidity, ventilation, gas exchange, egg turning, and staff technical proficiency are among the hatchery parameters. Good-quality chicks should have a high number of uniform chicks, a well-healed navel, good weight and length that correlate well with the final broiler body weight, and vivacious, alert, and active chicks. These parameters should be effectively maintained (20).

Table 3: the effect of different incubation temperatures on the chick's quality

			Period			Total
			1	2	3	
Chick quality	Dry chicks	Count	69	63	72	204
		% of Total	31.9%	29.2%	33.3%	94.4%
	Wet chicks	Count	6	3	3	12
		% of Total	2.8%	1.4%	1.4%	5.6%
Total		Count	75	66	75	216
		% of Total	34.7%	30.6%	34.7%	100.0%
Chi-square						1.328
Sig.						0.515

Table 4 presents the effect of varying incubation temperatures on the sex ratio of hatched chicks, revealing statistically significant differences among the three treatment groups. In the first group (37.7°C, the standard control), male and female chick proportions were 23.1% and 14.8%, respectively. At a slightly elevated temperature of 38°C, males accounted for 24.7% while females dropped to 7.7%. In contrast, the lower temperature group (36°C) resulted in 15.9% males and 13.7% females. These findings suggest that even within a narrow thermal range, incubation temperature can significantly influence sex ratio distributions. Although chickens rely on genetic sex determination, and not temperature-dependent sex determination like reptiles, temperature may impact embryonic development, mortality, or physiological regulation in a sex-specific manner. Several studies support this interpretation. (18) reported that both elevated and reduced incubation temperatures significantly altered the sex ratio in Japanese quail, with lower temperatures favoring males and higher temperatures increasing female ratios. Similarly, (21) showed that sex-specific differences in embryonic metabolism and heat production may lead to differential survival rates under thermal stress.

Temperature-induced mortality or developmental delays in one sex can skew the observed hatchling sex ratio without altering chromosomal sex. Studies by (16) on chickens demonstrated that embryonic development and viability are affected by even minor temperature shifts, which can have indirect effects on traits like body mass, organ development, and survivability Additionally, (22) suggested that thermal conditions might influence endocrine function during critical periods, altering sex-related gene expression or metabolic dynamics Furthermore, research by (23, 24) demonstrated that incubation temperatures outside the optimal window negatively affect chick uniformity and post-hatch performance, potentially contributing to differential hatchability by sex.

Table 4: The effect of different incubation temperatures on the sex of hatched chicks

			Period			
			1	2	3	Total
Gender	Male	Count	42	45	29	116
		% of Total	23.1%	24.7%	15.9%	63.7%
	Female	Count	27	14	25	66
		% of Total	14.8%	7.7%	13.7%	36.3%
Total		Count	69	59	54	182
		% of Total	37.9%	32.4%	29.7%	100.0%
Chi-square						6.608
Sig.						0.037

Conclusion:

It does conclude that increasing or decreasing the incubation temperature affected the chick sex, and did not affect the hatchability percentage and the chick quality. More studies are needed to find the effect of incubation temperature on chick sex to use it as a method for sexing chicks.

References:

1) Tona, K., Voemesse, K., N'nanlé, O., Oke, O. E., Kouame, Y. A. E., Bilalissi, A., Meteyake, H., & Oso, O. M. (2022). Chicken Incubation Conditions: Role in Embryo Development, Physiology and Adaptation to the Post-Hatch Environment. Frontiers in physiology, 13, 895854.
2) Vieira, S. (2007). Chicken embryo utilization of egg micronutrients. Brazilian Journal of Poultry Science, 9(1), 1–8.
3) Clift, D., & Schuh, M. (2013). Restarting life: fertilization and the transition from meiosis to mitosis. Nature reviews. Molecular cell biology, 14(9), 549–562.
4) Al Amaz, S., Mishra, B. (2024). Embryonic thermal manipulation: a potential strategy to mitigate heat stress in broiler chickens for sustainable poultry production. J Animal Sci Biotechnol 15, 75.
5) Givisiez, P. E. N., Moreira Filho, A. L. B., Santos, M. R. B., Oliveira, H. B., Ferket, P. R., Oliveira, C. J. B., & Malheiros, R. D. (2020). Chicken embryo development: metabolic and morphological basis for in ovo feeding technology. Poultry science, 99(12), 6774–6782.

6) Ouchi, Y., Chowdhury, V. S., Cockrem, J. F., & Bungo, T. (2021). Effects of Thermal Conditioning on Changes in Hepatic and Muscular Tissue Associated with Reduced Heat Production and Body Temperature in Young Chickens. Frontiers in veterinary science, 7, 610319.
7) Iraqi, E., Hady, A. A., Elsayed, N., Khalil, H., El-Saadany, A., & El-Sabrout, K. (2024). Effect of thermal manipulation on embryonic development, hatching process, and chick quality under heat-stress conditions. Poultry science, 103(1), 103257.
8) Shaker, A. S., Kirkuki, S. M., Aziz, S. R., & Jalal, B. J. (2017). Influence of genotype and hen age on the egg shape index. International journal of biochemistry, biophysics and molecular biology, 2(6), 68-70.
9) Alsalihi, L. W., Shaker, A. S., Ameen, Q. A., & Ortega Torres, M. J. (2022). The effect of line and age on the egg external characteristics of Japanese quail. Basrah journal of veterinary research, 21(S1), 27-34.
10) Onasanya, Gbolabo. (2013). Egg physical traits, performance, fertility and hatchability in exotic and Nigerian indigenous chickens. Standard Research Journal of Agricultural Sciences. Vol1 (1). 1-8.
11) AL-Jabari, Q. H., Mohammed, M. A., Baker, A. G., & Shaker, A. S. (2024). Effect of Supplementation of Different Levels of Azolla Plant Powder on The Productive Performance and Some Qualitative Characteristics of Eggs of Japanese Quail. Egyptian Journal of Veterinary Sciences, 55(7), 1869-1874.
12) Shaker, A. S., & Abdulla, S. M. (2018). Principal component analysis of internal egg traits for four genetic groups of local chicken. Egyptian poultry science journal, 38(2), 699-706.
13) Shaker, A. S., & Aziz, S. R. (2017). Internal Traits of Eggs and Their Relationship to Shank Feathering in Chicken Using Principal Component Analysis. Poultry Science Journal, 5(1), 1-5.
14) SPSS, (2011). Statistics for windows, version 20.0. Amonk. NY: IBM corp
15) Duncan, D. B. 1955. Multiple Range and Multiple Test. Biometrics. 11: 1-42
16) Ipek, A., Sahan, U., Baycan, SC., and Sozcu, A. (2014). The effects of different eggshell temperatures on embryonic development, hatchability, chick quality, and first-week broiler performance. Poultry Science, 93(2): 464-472.
17) Yildirim, I., & Yetişir, R. (2004). Effects of different hatcher temperatures on hatching traits of broiler embryos during the last five days of incubation. South African Journal of Animal Sciences. 34.
18) Yılmaz, A., Tepeli, C., Garip, M., and Çağlayan, T. (2011). The effects of incubation temperature on the sex of Japanese quail chicks. Poultry Science, 90(10): 2402-2406
19) Agyekum, G., Okai, M.A., Tona, J.K., Donkoh, A., and Hamidu, J.A. (2022). Impact of incubation temperature profile on chick quality, bone, and immune system during the late period of incubation of Cobb 500 broiler strain, Poultry Science. 101(9):101999.
20) Yeboah, P. P., Konadu, L.A., Hamidu, J.A., Poku, E.A., Wakpal, D., Kudaya, P.Y., Dey, A., and Saddiq, S.M. (2019). Hatcheries hatching chicks contribute to poor development of day-old chick's base

on biological and immunological assessment. Vet. World 12:1849–1857.
21) Tzschentke, B. (2007). Attainment of thermoregulation as related to early development – Experimental approaches to thermoregulation. World's Poultry Science Journal, 63(3), 437–457.
22) Decuypere, E., & Michels, H. (1992). Incubation temperature as a management tool: A review. World's Poultry Science Journal, 48(1), 28–38.
23) Willemsen, H., Everaert, N., Witters, A., De Smit, L., Debonne, M., Verschuere, F., & Decuypere, E. (2010). Critical assessment of chick quality measurements as an indicator of post-hatch performance. World's Poultry Science Journal, 66(4), 633–644.
24) Molenaar, R., Reijrink, I. A. M., Meijerhof, R., & Van den Brand, H. (2011). Effect of eggshell temperature during incubation on embryo development, hatchability, and posthatch development. Poultry Science, 90(3), 484–492. https://doi.org/10.3382/ps.2010-00829

تأثير درجة حرارة تفريخ البيض على خصائص الكتاكيت الفاقسة

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الملخص:

أجريت التجربة في مفقس قسم الإنتاج الحيواني التابع لمديرية البحوث الزراعية في السليمانية خلال الفترة من 2022/10/1 إلى 2022/12/1. استُخدم في التجربة 300 بيضة مخصبة من دجاج الكرد المحلي (12، 13)، وقُسِّمت إلى ثلاث مجموعات بحيث لم يكن هناك اختلاف معنوي في وزنها وأبعادها بين المعاملات التجريبية. قُسمت التجربة إلى ثلاث معاملات: الأولى حيث حضنت البيوض عند درجة حرارة 37.7°م، والثانية عند 38°م، والثالثة عند 36°م. بعد الفقس، تم تحديد جنس الكتاكيت، وحُسبت نسبة النفوق وجودة الكتاكيت. لم تُسجل فروق معنوية بين المعاملات في نسبة الكتاكيت الحية والميتة، كما لم تُلاحظ فروق معنوية في نسبة الكتاكيت الجافة والرطبة بين المعاملات. ومع ذلك، وُجدت فروق معنوية في نسبة الجنس بين الكتاكيت. بلغت نسبة الذكور والإناث في المعاملة الأولى 23.1% و14.8% على التوالي. أما في المعاملة الثانية فكانت النسبة 24.7% و7.7% على التوالي. وفي المعاملة الثالثة بلغت نسبة الذكور والإناث 15.9% و13.7% على التوالي. يُستنتج أن رفع أو خفض درجة حرارة الحضانة أثّر في جنس الكتكوت، لكنه لم يؤثر في نسبة الفقس أو جودة الكتاكيت. وهناك حاجة إلى مزيد من الدراسات لمعرفة تأثير درجة حرارة الحضانة على جنس الكتكوت بهدف استخدامها كوسيلة لتحديد جنس الكتاكيت.

الكلمات المفتاحية: البيض، الكتاكيت، درجة الحرارة، الجنس، النفوق.