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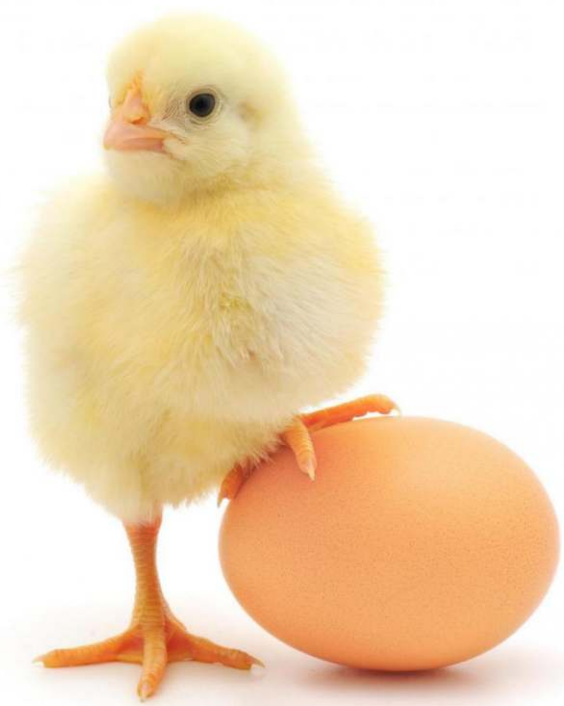

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The Effects of High Temperature on Blood Serum Parameters and the Egg Productivity Characteristics of Japanese Quails (*Coturnix coturnix japonica*)

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Abstract: In this study, it was aimed to determine the effects of higher temperatures on the blood serum values, egg productivity, egg weight and the thickness of eggshell of the Japanese quails. By this purpose, two temperature groups were arranged by consisting of control (18-24°C) and trial (35°C) groups. In the end of the research, it was observed that the higher temperature increased some of the blood serum values such as glucose, Na, triglyceride ($P<0.05$), cholesterol ($P<0.01$) and uric acid ($P<0.001$) levels but reduced the blood serum protein ($P<0.01$), albumin ($P<0.001$), P ($P<0.05$), K ($P<0.01$) and ALP ($P<0.05$) levels. Even if the higher temperature has led a decrease in the egg productivity in all ages during the trial period, the difference that was observed in all ages except the seventh week was found important ($P<0.05$). The values of the egg weight in both control and trial groups were found as 10.53 and 9.93g ($P<0.01$); the values of eggshell thickness as 0.23 and 0.20 mm ($P<0.001$).

Key words: Quail, temperature, blood serum parameters, egg characteristics

Introduction

There is a critical balance among the Na, K and Cl in poultry and such balance, which becomes at optimum level, ensures the recovery of the egg productivity, feed efficiency and the egg quality (Hugles, 1988; Phelps, 1987). In metabolism of poultry, particular in layers, the Na and H_2CO_3 have a distinguished importance in egg productivity and shell formation. The formation of the eggshell in poultry is affected by the acid-base balance in blood because the acid-base rate of the blood is a restrictive factor for the accumulation of $CaCO_3$ in eggshell (Mehner and Hartfiel, 1983). Mongin (1968) has noted that the first restrictive factor of the shell formation was the Ca and the second factor was the carbonate ions so the breakage, which was observed in eggshell in hot weathers, had been caused by a certain decrease in blood CO_2 level depending on the increase in respiration speed. Odom (1989) expressed that the independent Ca amount increased due to increase of blood pH because of the high temperature stress so this affected the shell quality negatively. Soliman and Huston (1974) have also indicated that the plasma cholesterol level have decreased at a significant level in high temperatures. Ueno *et al.* (1978) identified that the plasma total protein and total cholesterol changed depending on the increase of the environmental temperatures. In a research, which was carried out in layers, some differences indicating a few decrease generally below the starting value but not having a statistical importance under the effect of the high temperatures (35°C) in respect of the plasma total protein and total cholesterol were observed (Poyraz *et al.*, 1991b) and also it was noted that the blood glucose concentration increased and total plasma protein concentrations decreased subject to the increase of the environmental temperature in male broilers (Donkoh, 1989). Poyraz, 1988 identified the glucose rate in female and male quails as 380.4 and 281.7 respectively; cholesterol as 144.3 and 146.2; protein as 3.5 and 2.5. During the stress, glico corticoid corticosteron (Freeman, 1985) was secreted in winged animals and the typical response to be given through the adrenal gland against a stress factor includes the increase of the glycogen depots, higher blood glucose level and the increased glucolise (Donaldson *et al.*, 1991). Some researchers have noted that the high environmental temperatures cause the significant economical loss by affecting such egg productivity features negatively (Cowan and Michie, 1979; De Andrade *et al.*, 1976; Deaton *et al.*, 1981; Deaton, 1983; Salman *et al.*, 1985, Emery *et al.*, 1984) indicated that the differences among the temperature groups in respect of the feed, which was consumed each gram of egg and the egg productivity per animal included in coop were not important; but there was a significant decrease in daily feed consumption, egg weight and the shell thickness at the high temperatures, furthermore the reductions, which were observed in egg weight and shell thickness at the variable temperatures, were not the result of only a simple decrease in feed consumption at the high temperatures, but also it showed the direct effect of the high temperature stress on chickens. While the laying performance in layers with different weights was not found different among the weight groups under the control conditions (20°C), it was noted that a significant regression observed in the most of the productivity features under the high temperature stress (34°C) and the harmful effect of the high temperature stress in respect of the egg productivity and egg weight was at least significant in light animals but such harmful effect increased depending on the increase in body weight (Horst and Petersen, 1975). Peguri and Coon (1987) have noted that the egg productivity in chickens decreased to 63.7% at 33.2°C from 81.7% at 14°C and such decrease in egg weight became 13.9% at high temperature. Timmons and Gates (1988) pointed out that in 33.2°C than 21°C the egg productivity decreased by 66% due to the environmental temperature; Altan and Oguz (1996) pointed out that the high temperature stress caused a significant decrease in eggshell thickness of the quails ($P<0.01$), however it didn't have any important effect on egg productivity and the egg weight.

In many trials, it was pointed out that when the temperature increased from 21°C to 35°C , the egg weight and the thickness of the eggshell of the hatching hens decreased (Okan, 1999; Poyraz *et al.*,1991b). On the other hand, it was also indicated that the temperature stress increased some of the blood serum values such as glucose, urea, triglyceride, cholesterol values and decreased total protein and albumin values but represented no change in SGOT and SGPT values due to a research (Sahin *et al.*, 2001). Depending on other research, it was determined that the higher temperature decreased the hematocrit level of the winged animals as not important statistically (Senkoylu and Altinsoy, 1999) but increased serum glucose and total Ca level (Samara *et al.*, 1996). However, it was also indicated that the temperature stress decreased the blood plasma glucose, total protein, uric acid, albumin and the cholesterol level due to the values obtained in any other research that was carried out towards the temperature stress (Arad *et al.*,1983).

This research was carried out to determine the effects of the higher environmental temperature (35°C) on the blood parameters and the egg productivity as well as some quality features of the quails.

Materials and Methods

The animal material of the research is constituted by total 600 quails, which put into from the incubation at the same day.

The chicks that were taken from the hatching machine were put into the main machine to keep them for 1 week after the releasing weight of the broilers was noted. In this period, the broilers were provided with the temperature of 35°C. Following the first week, 282 quails (94 males + 188 females) of the rest total 564 were put in the room under the variable temperature (18-24°C) with the control purpose and the other rest of 282 quails (94 males + 188 females) was placed into the breeding cages at the room under full controlled stable temperature (35°C).

The heating process was achieved through the electrical thermostat adjusted radians in experimental group (35°C). All divisions were illuminated with the light intensity of 20 lux for 24 hours during the first week. Then such illumination period and the light intensity was decreased gradually as being for 1 hour and 2 lux for 3 days and finally during 6 weeks, the illumination for 8 hours per day with an intensity of 10 lux was fixed. The quails were placed equally (1male + 2 females) into the cages consisting of four floors and each floor was considered as the repetition.

The chicks of the quails were fed with the beginning feed for the chickens at the first two weeks (24% crude protein and 2800 ME kcal/kg) and growth feed until the end of the 6th week (22% crude protein and 3000 ME kcal/kg) through the way of *ad-libitum* and the quails were subject to group feeding during such term. In order to identify the blood parameters, 40 quails from each group (20 males + 20 females) were taken and slaughtered by taking their bloods at the end of 6th week.

By the purpose of identifying the egg productivity, total 246 female quails consisting of 123 from each temperature group including between 7th and 14th weeks were used. During such term, the quails were fed with the chicken bait (18% crude protein and 2750 ME kcal/kg) and the illumination including the intensity of 10 lux was applied for 16 hours daily. The egg weight and the shell thickness of total 320 eggs consisting of 160 eggs taken from each weight groups including at the last week of the experiment (14th week) were investigated. In such examination, the sensitive scale of 0,01 g was used for the egg weighing and micrometer for the measurements of the shell thickness. The average of the values measured from the sharp, stubby and medium sides of the egg was considered as the shell thickness.

During the slaughter, blood samples were taken into two tubes, one contained ETDA and the other had no anticoagulant. Blood glucose levels were first determined; the plasma and serum were separated and kept in the deep-freeze until further analyses. Cholesterol, ALP and uric acid levels were determined spectrophotometrically in plasma. Total protein, albumin, sodium, phosphor, calcium, potassium, AST, ALT and triglyceride activities were determined by using a (Technicon RA-XT, New York, USA) auto analyzer and its accompanying kits.

In this study, t test was used to suggest the effect of different temperature application on the blood serum characteristics of the groups; Chi-square method was also used to determine the rational differences related to the egg productivity in laying period and the survivality in breeding period depending on the different environmental temperature (Ozdamar, 1997). The statistical analyses were achieved with SPSS 10 statistical program.

Table 1: The results of statistical analysis relating to blood parameters depending on control and experiment groups (n: 40)

Parameters	Control (18-24°C)		Experiment (35°C)		P
	$\bar{x}$	$S_{\bar{x}}$	$\bar{x}$	$S_{\bar{x}}$	
Glucose (mg/dl)	223.13	23.80	233.32	22.81	*
T. Protein (g/dl)	5.06	1.92	4.39	1.26	**
Albumin (g/dl)	2.44	0.62	1.90	0.87	***
Urea (mg/dl)	1.51	0.37	1.88	0.69	***
AST (U/L)	138.61	9.41	139.51	8.65	-
ALT (U/L)	15.17	3.03	15.63	3.25	-
Phosphorus (meq/l)	4.17	1.21	4.02	1.12	*
Sodium (meq/l)	140.99	6.34	146.15	7.21	*
Calcium (mmol/l)	5.86	2.51	5.64	3.03	-
Potassium (meq/l)	7.00	1.27	5.82	2.28	**
ALP (mg/dl)	353.36	23.76	338.28	24.32	*
Trigliserid (mg/dl)	120.64	6.87	124.11	4.87	*
T. Chol. (mg/dl	212.04	5.67	219.08	5.11	**

AST : Aspartate amino transferase ALT : Alanine amino transferase
ALP: Alkaline phosphatase T. Chol. : Total cholesterol

Table 2: The results of statistical analysis relating to egg yield, egg weight and egg shell thickness depending on control and experiment groups

	Control (18-24°C)			Experiment (35°C)			P
Features	n	$\bar{x}$	$S_{\bar{x}}$	n	$\bar{x}$	$S_{\bar{x}}$	
Egg yield (%) (7-14th week)	123	65.24	10.78	123	55.38	8.93	*
Egg weight (g)	160	10.53	1.11	160	9.93	1.13	*
Egg shell thickness (mm)	160	0.23	0.18	160	0.21	0.15	*

P<0.05

Results

Blood parameters: The blood serum parameters of the control and trial group were given in Table 1. The blood serum parameters values except AST, ALT and Ca level changed significantly depending on the high temperature. Even if the high temperature increased the blood serum glucose, Na, triglyceride (P<0.05), cholesterol (P<0.01) and urea (P<0.001) level; it reduced the blood serum protein (P<0.01), albumin (P<0.001), P (P<0.05), K (P<0.01) and ALP (P<0.05) levels.

Egg characteristics: The values of egg productivity, egg weight and the eggshell thickness of the control and trial group during the trial period (7-14 weeks) were given in Table 2. The higher temperature led a decrease in egg productivity in all ages. The said difference between the groups was found important statistically (P<0.05). It was determined the egg weight and eggshell as 10.53 g and 0.23 mm respectively in control group; 9.93 g and 0.20 mm respectively in trial group. The difference noted between both groups in respect of the values of the egg weight and the eggshell thickness was found important statistically (P<0.05).

Discussion

The blood serum parameter values except AST, ALT and Ca level changed significantly depending on the higher temperatures. Due to the higher temperature, even if the blood serum glucose, urea, Na, triglyceride and cholesterol levels increased, the blood serum protein, albumin, P, K, ALP levels decreased as the result of higher temperature. The increase that was observed in blood glucose and total Ca level (Donaldson *et al.*, 1991; Samara *et al.*, 1996) as a typical response by means of adrenal gland against the stress factor occurred as the result of high environmental temperature has supported the increase obtained in glucose and calcium levels in scope of this research. In addition, the negative effect of high temperature on the blood parameters is similar with the results suggested in various researches (Arad *et al.*, 1983; Samara *et al.*, 1996; Sahin *et al.*, 2001; Senkoylu and Altinsoy, 1999).

During the said research, it was determined that the high temperature had an important effect on the egg productivity and it led an important decrease in productivity in addition to reductions in the egg weight and the eggshell thickness of the quails. The differences observed from the said reductions were found important statistically (P<0.05). The decrease of the egg productivity due to high temperature conforms to some research findings (Altan and Oguz, 1996; Deaton *et al.*,1981; Deaton, 1983; Horst and Becker, 1991; Peguri and Coon, 1987; Phelps, 1987; Salman *et al.*, 1985; Timmons and Gates, 1988). The finding, which was obtained in this research in respect of the negative effect of high temperature on the egg weight (Alarslan and Karadas, 1999; Altan and Oguz, 1996; Peguri and Coon, 1987; Phelps, 1987; Deaton, 1983; Horst and Becker, 1991; Salman *et al.*, 1985) and the eggshell thickness (Altan and Oguz, 1996; Emery *et al.*, 1984; Mongin, 1968; Odom, 1989; Peguri and Coon, 1987; Phelps, 1987; Poyraz *et al.*, 1991a; Salman *et al.*, 1985), has also been supported by many researchers.

It was suggested that the decrease occurred in egg productivity due to high temperature was not sourced from directly high temperature, it was also caused by the decrease seen in food consumption depending on the increase in environmental temperature (Emery *et al.*, 1984; Makled and Charles, 1987; Moares *et al.*, 1991). In this research, it was determined that the egg productivity decreased by 5% due to increase in temperature up to 25°C from 20°C (Moares *et al.*, 1991). The blood potassium concentration in temperature stress decreased significantly in temperature stress. It was observed that phosphor intake of the eggs increased causing some reductions in the eggshell thickness when the temperature increased. The severe and often repeated hot periods have increased the sensitivity of hens against the hot temperatures by breaking the balance of Na/Ca (Senkoylu and Altinsoy, 1999). When the temperature increased, it caused the increase in respiration frequency so the body temperature was tried to keep in balance by the evaporation of the water in respiratory system. However, the blood acid-base balance was destroyed due to increased respiration and since the loss of CO_2 thus H_2CO_3 became excessive, pH increased and respiratory alkalosis occurred (Darre *et al.*, 1980; Koelkebeck and Odom, 1994).

On the other hand, a critical balance is mentioned among the Na, K and Cl of the winged animals and to keep the said balance in optimum level shall improve the egg productivity, capability of taking benefit from the food and the quality of egg. (Hugles, 1988; Phelps, 1987). The substances such as Na and H_2CO_3 have a different importance in the metabolism of winged animals in respect of the egg productivity and the shell structure. The formation of the eggshell in winged animals is under the effect of the balance of acid-base because the acid-base rate of the blood is a restrictor factor for the $CaCO_3$ to be accumulated in the egg shell (Mehner and Hartfiel, 1983). It is observed that the excessive respiration to keep the body temperature in balance depending on the high temperature causes the alkalosis formation and the formation of the acidosis occurs during the formation of the eggshell. In such a case, it is suggested that the positive results could be obtained in respect of both egg quality and egg productivity with the addition of $NaHCO_3$ to the mixed foods of the quails in order to protect the buffer characteristic of the blood (Okan, 1999; Ozturk, 1999). Therefore, it becomes possible to indicate that broken balance of acid-base due to the variations in blood electrolyte levels may have the effect on the said decrease that occurred depending on the high temperature in the egg productivity, egg weight and the shell thickness as defined in this research. Likewise in this research, it was also seen that sodium increased due to the high temperature in contrary to the decrease in Ca, K and P.

As a conclusion, the temperature stress that occurred in breeding period of the quails depending on the higher temperatures causes the blood serum parameters changed by affecting the metabolism and accordingly the live weight increase negatively. In addition, it also had the negative effect on the egg productivity, egg weight and the eggs hell thickness characteristics of the quails. The broken critical balance, which was at optimum level among Na, K and Ca of the quails, may also be considered as one of the significant reasons of the negative effects arising under the higher temperature.

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