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STUDY THE RELATIONSHIP BETWEEN SELENIUM AND HEAT SHOCK PROTEINS UNDER HEAT STRESS FOR LOCAL SINAI CHICKENS STRAIN

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ABSTRACT: The main objective of this study was aimed to investigate the effects of different ambient temperature {normal temperature (NT) and heat stress (HS) conditions} and dietary supplementation of different selenium (Se) source (inorganic , organic and Nano Se) on some productive performance and physiological parameters for Sinai chickens during growth period and A total of 198, 8-wks-old of Sinai chickens were used and randomly distributed into two experimental groups (NT& HS), and then each group was divided into three sub-groups (inorganic , organic and Nano Se) in a factorial design (2x3). Chickens fed diet naturally contaminated with Aflatoxin (AFB_1),7.50 µg/kg DM.

The results indicated that heat stress resulted in a significant decrease in body weight and gain, feed intake and feed conversion. Lymphocytes (L) cells (%), plasma total protein and albumin were significantly decreased for chickens reared under heat stress, however, hemoglobin (Hb) concentration, white blood cells count, eosinophils cells (%), monocytes cells (%),globulin, calcium and phosphorus were not significantly affected. Moreover, a significant increases were recorded for red blood cells (RBC) count, heterophils (H) cells (%) , H / L ratio, plasma total antioxidant capacity (TAOC) and heat shock protein 70 for Sinai chickens reared under heat stress than those reared in thermo neutral during all the experimental periods.

Supplementing different selenium sources to the diet had no significant effect on body weight and gain, rectal temperature and respiratory rate, albumin, calcium, phosphor and heat shock protein 70 for Sinai chickens than those fed the control diet. Moreover, feed intake, plasma H (%), and H / L were significantly decreased as a result of supplementing Nano selenium to the diet during the periods of 12-16 and 8-16 wks of age than the control. While, feed conversion was significantly improved by supplementing different sources of Se to Sinai chickens diet than the control. Significant increases were recorded in RBC count, Hb concentration and L cells (%), total protein, globulin and total antioxidant capacity for Sinai chickens fed diet supplemented with Se as compared with those fed the control diet. These results indicated that heat stress severely reduced productive and physiological performance for Sinai chickens, whereas the productive and physiological performance was improved by dietary Se sources supplementation under heat stress.

Keywords: Heat Stress, Organic Selenium, Nano Selenium,, Productive and Physiological

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INTRODUCTION

Heat stress is associated with compromised performance and productivity in poultry due to declines in feed intake, nutrient utilization, growth rate, egg production and quality, and feed efficiency (**Habibian *et al.,* 2015**). By increasing temperature, birds will experience heat stress and physiological changes will be occurred in acidity and blood metabolites. Reduced food consumption and lack of proper returns, weight reduction, low quality of carcass, and reduction in defense power and immune system are the most important features of heat stress (**Tanighuchi *et al.,* 1997).** Heat stress is one major source of oxidative stress. Heat shock could promote an increase in oxidative stress, thus creating a redox imbalance in favor of pro-oxidants. This could arise by increasing generation and reactivity of oxidants and by inactivating cellular antioxidant defenses. As a consequence, heat is likely to induce oxidative changes in cells (**Altan *et al.,* 2000**). As living organisms, chickens have protective measures against environmental challenges. The heat shock proteins (HSP) are a set of proteins synthesized in response to physical, chemical, or biological stresses, including heat exposure (**Ming *et al.,* 2010**). Heat shock proteins are a group of evolutionarily conserved proteins that are, conventionally, classified according to molecular size, ranging from 10 to 150 kDa (**Benjamin and McMillan, 1998**). They play an important role in the protection and repair of cells and tissues. One of the most conserved and important protein families and has been studied extensively is HSP70 (**Ming *et al.,* 2010**).The stress condition there are causes free radicals and active oxygen specimens.

The organic selenium (OSe) in selenium yeast is readily available and is actively absorbed from the intestine via the Na^+ dependent neutral amino acid pathway (**Schrauzer, 2000**). Furthermore, it has been reported that selenium yeast is superior to selenium selenite in conditions of induction of feathering, causing sex-linked slow feathering broiler males and normal feathering females to increase feather development, in tissue accumulation and retention in broilers and in reducing drip loss from breast meat (**Edens *et al.,* 2000).** The above-mentioned positive responses to selenium yeast supplementation have fueled interest in the use of selenium yeast in all sectors of the poultry industry. **Upton et *al.,* (2008)** suggest that Selenium from selenium yeast was used more efficiently for performance in fast growing, high yielding broiler chickens.

With the recent development of nanotechnology, Nano-selenium (Nano-Se) has attracted widespread attention because nanometer particulates exhibit novel characteristics such as a large surface area, high surface activity, high catalytic efficiency, strong adsorbing ability, and low toxicity (**Zhang *et al.,* 2008).** The different physiological effects of Nano-Se and sodium selenite were probably related to the different absorption process and metabolic pathways (**Mohapatra *et al.,* 2014**). Furthermore, dietary supplementation of Nano- Se was effective in enhancing the serum and hepatic GSH-Px activities of chicken. Also, **Cai *et al.,* (2012)** suggested that dietary Nano-Se enhanced the antioxidant ability and oxidative stability and the optimum level of Nano-Se supplementation was ranged from 0.3 to 0.5 ppm and the maximum supplementation could not be more than 1.0 ppm in broilers. Therefore, the main objective of this study was to investigate the effect of dietary supplementation of different selenium sources on productive and physiological performance for Sinai chickens under heat stress.

MATERIALS AND METHODS

The present study was carried out at El-Serw Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Egypt. It was started at March 2015. A factorial design (2x3) was used, it performed including two temperatures (normal ambient temperature and heat stress) and three sources of selenium {inorganic (control group), organic (Selenium Yeast) and Nano selenium (Nano- Se)}. A total number of 198 of Sinai chickens, 8-wks-old were randomly distributed into two experimental groups to study temperature effect, and then each group divided into three sub-groups to study the effect of Se source. Each sub-group was divided into three replicates, each of 11 chicks. Feed and water were available *ad-libitum* throughout the study. Chicks were fed a grower diet (15% CP and 2750 Kcal) up to 16 weeks (Table 1).). Chickens fed diet naturally contaminated with Aflatoxin (AFB_1), 7.50 µg/kg DM.

A heat exposure treatment was applied at 8 and 12 wks of age, where birds were exposed to 39 ± 1 ºC for 4 hours/day for 4 consecutive days from 10.00 A.M. to 14.00 P.M. using gas heaters. The temperature of the control treatment was the normal ambient temperature (from 23 to 24ºC). Electric fans were used to maintain the indoor temperature within this range and the relative humidity was 55-60 %, with the use of selenium as an anti-stress to the heat stress in the two forms "organic and Nano selenium".

Nano selenium preparation: The prepared SeNPs, sodium selenite pent hydrate $Na_2SeO_3 \cdot 5H_2O$ was dissolved in bi-distled water, and 3-mercaptopropionic acid was then slowly added to the solution under stirring. Afterwards, pH was adjusted to eight using 1 M NaOH. The reaction mixture was stirred for 2 h. SeNPs were stored in darkness at 4 °C. One millilitre of the solution contains 158 µg of Se nanoparticles (50–100 nm in diameter). Chemicals used in this study were purchased from Sigma-Aldrich in ACS purity unless noted otherwise **Chudobova, *et al* (2014).**

Measurements:

- live body weight and feed consumption were recorded, then body weight gain and feed conversion (g feed / g gain) were calculated during 8-12, 12-16 and 8-16 wks of age. Rectal temperature (RT) of birds was taken with a digital thermometer by rectal probe (0.1% accuracy) as previously described and respiration rate (RR) of the birds was taken as the number of breaths per minute. The rectal temperature and respiratory rate were measured at 12 and 16 weeks of age.
- **Hematological parameters:** Blood samples were obtained from the brachial vein by simple venopuncture of three birds per sub-group immediately prior to loading into the crate and upon removal. Total erythrocytic count (RBC) was performed and Hemoglobin (Hb) concentration was measured calorimetrically, using a diagnostic kit according to the manufacturer instructions. Blood smears were made for subsequent differential leukocyte analysis and haemoglobin concentration (g/dl) following May-Grunwald staining (**Robertson and Maxwell, 1990**) and H/L ratios were calculated (**Mitchell *et al.* 1992**).
- **Blood plasma constituents** : Blood samples were taken from the brachial vein, plasma separated by centrifugation at 2000 g, for 20 minutes at room temperature and then labeled and stored in a deep freezer (-20°C) until analysis. Blood plasma albumin, total protein, cholesterol, TAOC, calcium, phosphorus, total lipids, triglycerides and LDL were calorimetrically determined using available commercial kits.

- Concentrations of Heat shock protein 70 level (HSP 70) determined after exposure to heat challenge by ELISA method using kits of Uscn Life Science Inc. Wuhan, Chain. Specificity of this assay has high sensitivity and excellent specificity for detection of gallinaceous HSP70. No significant cross-reactivity or interference was observed.
- The data were analyzed by General Linear Model procedures (GLM) described in SAS User's Guide (**SAS, Institute, 2003**). The mathematical model used in this study: $Y_{ijk} = M + A_i + B_j + A_i*B_j + e_{ijk}$ where:

Y_{ijk} = data observation
M = general mean
A_i = effect of temperature
B_j = effect of source of selenium
A_i*B_j = interaction between the temperature and source of selenium
e_{ijk} = experimental error

Differences among treatment means were separated by Duncan's new Multiple-Range test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Results in Table 2 showed that the heat stress resulted in a significant (P<0.01) decrease in body weight and gain for Sinai chicks than those reared in thermo neutral during all the experimental periods. Body weight was significantly decreased by 7.02 % for chickens exposed to high temperature than those reared in thermo neutral during the overall experimental period (8-16 wks of age). This result may be due to heat stress decreased feed consumption nutrient absorption, assimilation and utilization (**Withers, 1992).** Also, it may be decrease growth speed and heated shock proteins description, keeps the other proteins against destruction. These proteins were replaced by other cell synthesis proteins and cause structural proteins production decrease **(Edens *et al.*, 2000).** Moreover, body weight gain was impaired as a result of the change of respiratory alkalize pattern (**Line *et al.*, 2006**). Similar results were reported by **Chen *et al.*, (2015)** who showed that heat stress resulted in a significant decline in body weight, weight gain and feed intake, but it was not significant effect on feed conversion ratio. Also, **Mello *et al.* (2015)** observed that the body weight of broilers submitted to heat stress was approximately 18 % lower (P≤0.05) than the control group at 35 day of old.

On the other hand, different sources of selenium had no significant effect on body weight and gain of broiler chicks during the experimental periods (Table 2). These results agreement with **Haug *et al.* (2008)** who found no significant of selenium deficiency for male broilers fed different levels of Se (0.037 to 0.130 mg/kg) at 21- d of age. This indicated that the number of days chickens were supplemented was one of the most important factors in evaluating whether they were Se deficient. In contrast, **Upton *et al.* (2008)** reported that significant increases in the body weight for broilers at 42-d of age by dietary organic Se supplementation with 0.2 mg/kg as compared with diet supplemented with inorganic selenium and a control diet (no supplemented Se). **Dlouhá *et al.* (2008**) observed that feeding a diet containing 0.30 mg/kg of Nano-Se produced the greatest improvement in chicken's weight. Also, **Zhou and Wang (2011)** found that final body weight was significantly (P < 0.05) improved by feeding diet supplemented with 0.10, 0.30, and 0.50 mg Nano-Se /kg as compared to the control after 90 days of feeding. Interaction between ambient temperatures and different dietary selenium sources had no significant effect on body weight gain (Table2).

Results in Table 3 showed that heat stress resulted in a significant (P≤0.05) decrease of feed intake during all experimental periods except of 12-16 weeks of age, while the value of feed conversion ratio was significantly (P≤0.05) increased for Sinai chicks reared under heat stress than hose reared in thermo neutral during the periods of 8-16 and 12-16 weeks of age. These results may be due to heat stress decreased feed intake in order to reduce metabolic heat production (**Pelicano *et al.*, 2005).** These results are in agreement with those obtained by **Faria Filho *et al.* (2006)** who found that feed intake was decreased by 36 % in broilers reared at 32°C when compared to birds reared at 22 °C. **Ribeiro *et al.* (2008)** observed that feed intake was lowered by 5.5 % for Ross broilers reared under heat stress than birds housed under thermo neutral environment. **Laganá *et al.* (2007)** confirmed the effect of the high temperature on feed intake (14 % lower than control group) and not on feed conversion in broilers reared under different thermal environments. Feed intake was significantly (P≤0.05) decreased as a result of supplementing Nano selenium to the diet during the periods of 12-16 and 8-16 wks of age (Table 3). While, feed conversion was improved significantly by different sources of Se in Sinai chick's diets as compared with control diet. These results are agreement with the findings of **Zhou and Wang (2011)** who found that feed conversion ratios was (P < 0.05) improved for the groups fed diet supplemented with 0.10, 0.30, and 0.50 mg/kg Nano-Se as compared with those fed the control diet after 90 days of treatment. Interaction between ambient temperatures and dietary selenium source had no significant effect on feed intake and conversion (Table 3).

Results in Table 4 showed that rectal temperature and respiratory rate were significantly (P<0.05 and 0.01) increased for Sinai chicks reared under heat stress than for those reared in thermo neutral at 8 and 16 weeks of age. Similar results were reported by **Altan *et al.* (2000)** who found that broilers respond to high temperature had higher respiratory rate and body temperature. **Silva *et al.* (2001)** demonstrated that the physiologic responses include respiratory frequency and body temperature were increased when the chickens are exposed to hot environmental conditions. Also, **Borges *et al.* (2004)** reported that the duration of the high temperature stress significantly increased the body temperature and respiratory frequency. Moreover, dietary supplementation of different Se sources a had no significant effect on rectal temperature and respiratory rate (Table 4). Interaction between ambient temperatures and dietary selenium source had no significant effect on rectal temperature and respiratory rate at different ages except for respiratory rate at 16 wks which significantly affected (Table 4).

Results in Table 5 showed that heat stress resulted in a significant (P≤ 0.01) increase in RBC count, heterophils (H) cells (%) and H / L ratio and decrease in lymphocytes (L) cells (%) for Sinai chicks as compared with those reared in thermo neutral at the end of experimental period, however, Hb concentration, WBC count, eosinophils cells (%) and monocytes cells (%) did not significantly affected. The increase in H/L ratio has been used as a reliable indicator of heat stress in birds because the increase in H/L ratio may be a response to mild or moderate stress but a basophilia may result from extreme stress, such as life-threatening situations. It has been reported that during conditions of extreme stress, when a heteropenia and basophilia may develop, the H/L ratio cannot be used as a reliable measurement of stress (**Maxwell, 1993**). **Maxwell and Robertson, (1998)** reported that eosinophils disappear from circulation and basophils increase in circulation during stress, particulary acute stress . This finding is in agreement with those obtained by **Altan *et al.* (2000**), **Huff *et al*. (2005)** and

Minka and Ayo (2008) who showed that H/L ratio was increased as a result of exposed to heat stress. However, **Ajakaiye *et al.* (2010)** showed a decrease ($P \leq 0.05$) in total white blood cell, ($P \leq 0.01$) lymphocyte and monocyte values, and a significant ($P \leq 0.05$ and 0.01) increase in the values of eosinophils and heterophils post-transportation, respectively. On the other hand, supplementing different sources of Se (Organic or Nano selenium**)** to the diet resulted in a significant increase in RBC count, Hb concentration and L (%) and a significant decrease in H (%), and H / L ratio for Sinai chicks than for those with control diet (no supplemented selenium) at the end of experimental period. These results may be due to selenium leads to improve the immunity in broiler by decreasing of heterophils to lymphocytes ratio , or it may improve the activity of hemopoietic organs to increase RBC count, hemoglobin content and packed cell volume **(Ihsan and Qader , 2012).** Also, it may be due to organic and nano-Se improve the immunomodulating properties and increased cellular immunity (**Surai, 2006; Mohapatra *et al.*, 2014**). These results agreement with those obtained by **Selim *et al.* (2015)** who found that hematological examination showed significantly higher RBC count, PCV and hemoglobin values by adding organic or Nano forms of Se compared to inorganic selenium. **Hanafy *et al* (2009)** and **EI-Sheikh *et al.* (2010**) reported that organic selenium supplementation at 0.2 and 0.3 ppm significantly increased the concentrations of hemoglobin concentration. **Mohapatra *et al.* (2014)** reported that Nano-Se appeared to be more effective ($P<0.05$) in increasing different hematological parameters than that of inorganic sodium selenite at level of 0.3 ppm. Selenium has antioxidant effect on the red blood cell membrane; it prevents the degradation of the mature erythrocytes. Because of the intensification of the erythropoiesis, the red blood cell count and the hemoglobin value increase (**Raduta *et al.* 2011**). On the anther hand, **Selim *et al.* (2015)** who showed that Lymphocytes significantly increased, while heterophilous and H/L ratio significantly decreased by organic selenium treatments. **Ihsan and Qader, (2012)** and **Shlig, (2009**) stated that there were significant differences ($P<0.05$) on lymphocytes, heterophilus percentages and H/L ratio between selenium treatment groups. Nano selenium supplementation significantly increased lymphocytes while heterophilus and H/L ratio significantly decreased (**Fu-xiang *et al.*, 2008)**.

Results in Table 6 showed that the heat stress resulted in a significant ($P< 0.05$) decrease in the levels of plasma total protein and albumin, however, plasma constituents of total antioxidant capacity (TAOC) and heat shock protein 70 were significantly higher for heat stressed chickens compared with those reared in thermo neutral temperature . On the anther hand, globulin, calcium and phosphor were not significantly affected by heat stress. These results are in agreement with those obtained by **Seliem (2011)** who found that a significant decrease in plasma total protein, albumin in the heat stressed group {(exposed to daily heat stress period (38°C for 6 hs and 70 ± 5 % Rh}. Also, **Khan *et al*. (2002)** reported a noticeable decrease in the amount of protein in broilers exposed to heat stress. These results may be related to elevation of corticosterone which has elicited gluconeogenesis **(Malheiros *et al*. 2003).** Expression of heat shock protein 70, heat shock protein 60, and heat shock protein 40 were increased significantly after heat stress (**Zhao *et al.* 2013; Yu *et al.* 2007; Zeng *et al.* 2014**). Our findings that heat shock protein 70 density may be used as a biological index of stress attributed to crating is consistent with the report in which road transportation increased heat shock protein 70 expression in heart and kidney tissues of pigs (**Yu *et***

***al.,* 2007**). The overexpression of heat shock protein may be the reason for the increased requirement of ATP after heat stress (**Koelkebeck and Odom 1995**). The reported significant increase of total antioxidant capacity concentration by heat stress in agreement with results of **Zeng *et al.* (2014)** who reported that, with an increase in environmental temperatures, total antioxidant capacity activities significantly increased in Muscovy and Pekin ducks. **Spurlock and Savage (1993)** stated that high ambient temperature increased the free radicals and other reactive oxygen species (ROS) in the body fluids and tissues and added that the accumulation of ROS due to over-production or a decreased antioxidant defense, leads to damage of biological macromolecules and disruption of normal cell metabolism and physiology. On the other hand, dietary supplementation of varying selenium sources (Organic or Nano selenium**)** resulted in a significant (P≤ 0.05 or 0.01) increase in plasma total protein, globulin and total antioxidant capacity (Table 6). Moreover, albumin, calcium, phosphor and heat shock protein 70 were not significantly affected by selenium source. These results are in agreement with those obtained by **Wang and Xu (2008)** who detected that increase of total antioxidant capacity in blood plasma of broilers fed on diet supplemented with Nano-Se at levels between 0.15 and 1.2 mg/kg diet. **Huang *et al.* (2003)** explained this trend when reported that Nano-Se has a size dependent effect in scavenging various free radicals; small-size Nano-Se has greater ability to transfer electrons to radicals. Recently, **Wang and Fu (2012)** studied the transport and uptake of Na-Se, selinomethionine and Nano-Se by broiler intestine cells and found that the transportation of selenomethionine and Nano-Se from intestine cells were higher than that of sodium selenite and the highest uptake efficiency (P<0.05) was observed in cells treated with Nano-Se. On the anther hand, **Fan *et al.* (2009)** indicated that selenium could enhance enzymatic antioxidants to improve antioxidant capacity in body and meanwhile protect the muscle cell membrane to inhibit protein catabolism, bringing about decrease in uric Acid together, which benefited the recovery of growth of stressed broilers. Organic Selenium had more pronounced effect on total protein, **Sunde (1997)** reported that organic selenium could be incorporated into protein at a rate similar to methionine, because selenium and sulphur have very similar atomic properties. The ability of selenium to be treated like sulphur and the ability of SM to replace methionine so that it can be incorporated into protein when metabolized. **Kim and Mahan (2003)** indicated that selenium is biochemically similar to sulphur, selenium replaces the sulphur molecule in the normal biosynthetic pathways of the yeast cell and is absorbed actively across the intestine by the same amino acid carrier. **Combs and Combs (1986)** reported that supplemented organic Se to broiler breeders and layers was actively absorbed and can be directly incorporated into protein. Plasma albumin, total antioxidant capacity and heat shock protein 70 of Sinai chicks were significantly (P≤0.05 or P≤0.01) influenced by interaction between ambient temperatures and dietary selenium source. Whereas, total protein, globulin, calcium and phosphor were not significantly affected by the interaction at the end of experimental period.

CONCLUSION

The obtained results indicated that heat stress severely reduced productive and physiological performance for Sinai chickens, whereas the productive and physiological performance was improved by dietary selenium sources supplementation during growth period under heat stress

Table (1): Composition and calculated nutritional value of experimental diets

Ingredients	Basal diet (%)
Yellow corn	71.5
Soybean meal (44%)	18.5
Wheat bran	6.0
Limestone	2.0
Dicalcium phosphate	1.35
Salt	0.3
Premix[1]	0.3
Dl-methionine	0.05
Total	100
Crude protein%	14.57
ME (Kcal / Kg)	2750
Crude fat%	3.00
Crude fiber%	3.65
Calcium %	1.14
Av. phosphorus%	0.398
T. phosphorus%	0.595
Methionine%	0.328
Methionine+cystin%	0.584
Lysine %	0.819

Each 3 kg of the Vit and Min. premix manufactured by Agri-Vit Company, Egypt contains: Vitamin A 10 MIU, Vit. D 2 MIU, Vit E 10 g, Vit. K 2 g, Thiamin 1 g, Riboflavin 5 g, Pyridoxine 1.5 g, Niacin 30 g, Vit. B_{12} 10 mg, Pantothenic acid 10 g, Folic acid 1.5 g, Biotin 50 mg, Choline chloride 250 g, Manganese 60 g, Zinc 50 g, Iron 30 g, Copper 10 g, Iodine 1g, Selenium 0. 10 g, Cobalt 0.10 g. and carrier $CaCO_3$ to 3000 g..

Table (2): Means ± SE of body weight and body weight gain of Sinai chickens as affected by ambient temperatures and dietary selenium source during the experimental periods from 8 to 16 weeks of age.

Traits Main effect		**Body weight (g)**			**Body weight gain (g)**		
		8 wks	**12 wks**	**16 wks**	**8-12 wks**	**12-16 wks**	**8-16 wks**
Ambient temperatures							
Thermo neutral (TN)		517.89±0.73	923.33±9.86^{a}	1189.44±8.23^{a}	405.44±9.43^{a}	266.11±6.11^{a}	671.56±7.70^{a}
Heat stress (HS)		516.89±0.84	878.67±7.22^{b}	1106.11±11.02^{b}	361.78±7.16^{b}	227.44±10.07^{b}	589.22±10.95^{b}
Sig.		**NS**	**	**	**	**	**
Selenium sources							
Without Se		517.83±0.75	895.50±10.18	1126.67±21.24	377.67±9.93	231.17±13.72	608.83±21.14
Organic Se		517.50±1.06	914.17±19.60	1162.50±21.82	396.67±19.25	248.33±10.54	645.00±21.42
Nano Se		516.83±1.17	893.33±10.85	1154.17±20.67	376.50±10.10	260.83±13.00	637.33±19.90
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Interaction							
AM	Se source						
TN	without Se	517.33±1.45	908.33± 9.28	1168.33±14.53	391.00±8.33	260.00±10.41	651.00±13.08
	Organic Se	518.67±0.88	951.67±17.40	1206.67±13.33	433.00±16.52	255.00±7.64	688.00±12.50
	Nano- Se	517.67±1.76	910.00±13.23	1193.33±6.67	392.33±12.44	283.33±7.26	675.67±5.46
HS	without Se	518.33±0.67	882.67±16.34	1085.00±17.56	364.33±15.68	202.33±1.45	566.67±16.90
	Organic Se	516.33±1.86	876.67±14.53	1118.33±15.90	360.33±16.13	241.67±21.28	602.00±17.00
	Nano- Se	516.00±1.73	876.67±11.67	1115.00±23.63	360.67±10.20	238.33±16.91	599.00±21.94
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Means having different letters at the same row are differ significantly. * = (P<0.05); ** = (P<0.01); NS= Not significant.

Table (3): Means ± SE of feed intake and feed conversion of Sinai chickens as affected by ambient temperatures and dietary selenium source during the experimental periods from 8 to 16 weeks of age

Traits Main effect		**Feed intake (g)**			**Feed conversion**		
		8-12 wks	**12-16 wks**	**8-16 wks**	**8-12 wks**	**12-16 wks**	**8-16 wks**
Ambient temperatures							
Thermo neutral (TN)		2038.08±59.97[a]	2199.96±57.49	4452.77±102.59 [a]	5.05±0.20	8.33±0.37 [b]	6.32±0.18 [b]
Heat stress (HS)		1904.38±37.16[b]	2079.47±43.21	4327.67±74.74 [b]	5.28±0.15	9.25±0.35 [a]	6.78±0.17 [a]
Sig.		*	NS	*	NS	*	*
Selenium sources							
Without Se		2090.75±77.20 [a]	2144.07±62.95[ab]	4234.82±126.71	5.55±0.25 [a]	9.41±0.51 [a]	6.98±0.26 [a]
Organic Se		1911.20±48.50 [b]	2245.13±62.47 [a]	4156.33±87.81	4.85±0.15 [b]	9.09±0.28 [a]	6.46±0.10 [ab]
Nano Se		1911.73±45.03 [b]	2029.93±45.69 [b]	3941.67±88.39	5.09±0.16 [ab]	7.87±0.38 [b]	6.21±0.20 [b]
Sig.		*	*	NS	*	*	*
Interaction							
AM	Se source						
TN	without Se	2233.83±70.09	2218.93±84.73	4238.03±95.53	5.72±0.29	8.58±0.62	6.85±0.27
	Organic Se	1975.67±46.07	2352.00±44.01	3983.84±61.90	4.57±0.14	9.23±0.12	6.29±0.11
	Nano- Se	1904.73±78.22	2028.93±64.69	4238.03±95.53	4.86±0.14	7.18±0.38	5.82±0.19
HS	without Se	1947.67±66.44	2069.20±83.85	3983.84±61.90	5.38±0.43	10.23±0.47	7.12±0.49
	Organic Se	1846.73±74.03	2138.27±78.47	4238.03±95.53	5.13±0.12	8.95±0.59	6.62±0.10
	Nano- Se	1918.73±63.02	2030.93±79.08	3983.84±61.90	5.33±0.22	8.57±0.33	6.60±0.07
Sig.		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Means having different letters at the same row are differ significantly. * = (P<0.05); ** = (P<0.01); NS= Not significant.

Table(4): Means ± SE of rectal temperature and respiratory rate of Sinai chickens as affected by ambient temperatures and dietary selenium source at 8 and 16 weeks of age.

Parameters Main effect		Rectal temperature (°C)		Respiratory rate (min[-1])	
		8 wks	**16 wks**	**8 wks**	**16 wks**
Ambient temperatures					
Thermo neutral (TN)		41.76±0.04 [b]	41.79±0.07 [b]	48.78±2.99 [b]	43.89±1.48 [b]
Heat stress (HS)		42.17±0.07 [a]	42.17±0.06 [a]	58.22±2.09 [a]	52.00±0.88 [a]
Sig.		**	**	*	**
Selenium sources					
Without Se		41.95±0.07	41.88±0.14	57.33±3.77	46.67±3.50
Organic Se		42.03±0.14	42.07±0.07	51.33±3.70	49.67±1.15
Nano Se		41.90±0.13	41.98±0.11	51.83±3.61	47.50±1.57
Sig.		**NS**	**NS**	**NS**	**NS**
Interaction					
AM	**Se source**				
	without Se	41.87±0.03	41.57±0.03	52.67±5.90	39.00±1.00 [d]
TN	**Organic Se**	41.77±0.03	42.00±0.06	46.33±5.78	48.00±1.53 [bc]
	Nano- Se	41.63±0.09	41.80±0.06	47.33±5.24	44.67±1.45 [c]
	without Se	42.03±0.12	42.20±0.06	62.00±3.79	54.33±1.20 [a]
HS	**Organic Se**	42.30±0.15	42.13±0.12	56.33±3.18	51.33±1.20 [ab]
	Nano- Se	42.17±0.03	42.17±0.17	56.33±4.18	50.33±1.45 [ab]
Sig.		**NS**	**NS**	**NS**	**

Means having different letters at the same row are differ significantly. * = (P<0.05); ** = (P<0.01); NS= Not significant.

[1] Not determined

Table(5): Means ± SE of Some blood hematological of Sinai chickens as affected by ambient temperatures and dietary selenium source at the end of experimental period

Parameters Main effect		**RBC ($x\ 10^6/\mu L$)**	**Hb (g/dL)**	**WBC ($\times 10^3 \times /mm^3$)**	**Heterophils %**	**Lymphocytes %**	**H / L ratio**	**Eosinophils %**	**Monocytes %**
Ambient temperatures									
Thermo neutral (TN)		5.73±0.17^{b}	9.77±0.41	23.33±0.33	52.00±0.76^{b}	42.39±1.12^{a}	1.04±0.04^{b}	2.75±0.13	7.78±0.36
Heat stress (HS)		6.42±0.14^{a}	9.86±0.38	24.11±0.63	56.11±1.98^{a}	33.44±1.78^{b}	1.74±0.15^{a}	2.67±0.24	6.89±0.59
Sig.		**	NS	NS	**	**	**	NS	NS
Selenium sources									
Without Se		6.07±0.30^{ab}	8.75±0.34^{b}	24.17±0.54	57.67±1.93^{a}	33.33±2.60^{b}	1.81±0.19^{a}	2.58±0.20	6.83±0.65
Organic Se		6.38±0.15^{a}	10.32±0.51^{a}	23.83±0.70	54.33±1.73^{b}	39.75±3.04^{a}	1.42±0.15^{b}	2.96±0.28	8.00±0.52
Nano Se		5.78±0.19^{b}	10.37±0.20^{a}	23.17±0.65	50.17±1.01^{c}	40.67±0.49^{a}	1.23±0.02^{c}	2.58±0.20	7.17±0.65
Sig.		*	*	NS	**	**	**	NS	NS
Interaction									
AM	Se source								
TN	without Se	5.43±0.15	8.53±0.71	23.33±0.67	54.00±1.53^{bc}	39.00±0.58^{c}	1.39±0.04	2.83±0.17	8.00±0.58^{ab}
	Organic Se	6.27±0.24	10.63±0.54	24.00±0.58	51.00±0.58^{c}	46.50±0.50^{a}	1.10±0.02	2.92±0.22	7.00±0.58^{bc}
	Nano- Se	5.50±0.23	10.13±0.24	22.67±0.33	51.00±1.15^{c}	41.67±0.33^{b}	1.22±0.02	2.50±0.29	8.33±0.67^{ab}
HS	without Se	6.70±0.20	8.97±0.19	25.00±0.58	61.33±1.67^{a}	27.67±1.20^{e}	2.23±0.15	2.33±0.33	5.67±0.67^{c}
	Organic Se	6.50±0.21	10.00±0.95	23.67±1.45	57.67±1.86^{ab}	33.00±0.58^{d}	1.75±0.08	3.00±0.58	9.00±0.00^{a}
	Nano- Se	6.07±0.23	10.60±0.29	23.67±1.33	49.33±1.76^{c}	39.67±0.33^{bv}	1.24±0.05	2.67±0.33	6.00±0.58^{c}
Sig.		**NS**	**NS**	**NS**	*	**	**	**NS**	**

Means having different letters at the same row are differ significantly. * = (P<0.05); ** = (P<0.01); NS= Not significant.

Table(6): Means ± SE of blood plasma constituents of Sinai chickens as affected by ambient temperatures and dietary selenium source at the end of experimental period.

Parameters Main effect		Total protein (g/dl)	Albumin (Al) (g/dl)	Globulin (Gl) (g/dl)	TAOC (mM/L)	Calcium (mg/dl)	Phosphor (mg/dl)	HSP
Ambient temperatures								
Thermo neutral (TN)		6.46±0.43[a]	2.66±0.14[a]	3.81±0.43	0.487±0.03[b]	6.94±0.46	5.65±0.20	6.46±0.14[b]
Heat stress (HS)		5.50±0.40[b]	2.18±0.14[b]	3.32±0.40	0.556±0.02[a]	7.18±0.22	6.13±0.08	6.93±0.22[a]
Sig.		*	*	NS	*	NS	NS	*
Selenium sources								
Without Se		4.68±0.19[b]	2.21±0.19	2.47±0.18[b]	0.455±0.24[b]	6.98±0.54	5.27±0.20	6.96±0.30
Organic Se		6.58±0.65[a]	2.52±0.25	4.06±0.53[a]	0.544±0.02[a]	7.59±0.29	6.02±0.08	6.58±0.23
Nano Se		6.68±0.41[a]	2.52±0.14	4.16±0.43[a]	0.564±0.03[a]	6.61±0.50	6.08±0.21	6.54±0.19
Sig.		**	NS	*	*	NS	NS	NS
Interaction								
AM	Se source							
	without Se	4.74±0.24	2.14±0.14 [bc]	2.60±0.33	0.415±±0.02[c]	7.17±0.90	5.14±0.30	6.41±0.28[bc]
TN	Organic Se	7.80±0.69	3.05±0.10[a]	4.75±0.79	0.518±0.04[ab]	7.50±0.56	5.90±0.06	6.13±0.12[c]
	Nano- Se	6.85±0.61	2.79±0.06[ab]	4.06±0.55	0.526±0.05[ab]	6.14±0.94	5.91±0.43	6.83±0.19[abc]
	without Se	4.61±0.35	2.28±0.38[bc]	2.34±0.17	0.494±0.03[bc]	6.41±0.05	5.66±0.05	7.52±0.24[b]
HS	Organic Se	5.36±0.37	2.00±0.19[c]	3.36±0.56	0.571±0.02[ab]	7.72±0.04	6.20±0.09	7.02±0.23[ab]
	Nano- Se	6.51±0.65	2.26±0.18[bc]	4.26±0.79	0.603±0.01[a]	7.08±0.38	6.25±0.04	6.25±0.25[c]
Sig.		**NS**	*****	**NS**	*	**NS**	**NS**	**

Means having different letters at the same row are differ significantly. * = (P<0.05); ** = (P<0.01); NS= Not significant.

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الملخص العربى

دراسة العلاقة بين السلينيوم و بروتينات الصدمة الحرارية تحت ظروف الإجهاد الحراري لكتاكيت سلالة السينا المحلية

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صممت هذه التجربة لدراسة تأثيراضافة مصادر مختلفة من السلينيوم للعليقة تحت ظروف الحرارة العادية والاجهاد الحرارى على بعض الصفات الإنتاجية والفسيولوجية لكتاكيت السينا المحلية خلال فترة النمو. استخدم عدد **١٩٨** كتكوت سينا عمر ٤ أسابيع وزعت عشوائياً إلى مجموعتين تجريبيتين لدراسة تأثير درجات الحرارة (درجة الحرارة المحيطة الطبيعية والإجهاد الحراري) ثم قسمت كل مجموعة منهما إلى ثلاث مجموعات فرعية لدراسة تأثير مصادرالسيلينيوم (غير العضوي ٠,١ ملج/كجم عليقة، السيلنيوم العضوي (خميرة السيلينيوم) والنانو السيلينيوم }و كان تركيز الافلاتوكسين فى عليقة الكتاكيت و الملوثةبشكل طبيعي (AFB1، 7.50 ميكروجرام / كجم مادة جافة وذلك خلال فترة النمو. تم تسجيل وزن الجسم والعليقة المأكولة وأخذت عينات الدم لتقدير صفات الهيماتولوجى له وكذلك محتويات البلازما.، كذلك تم قياس معدل التنفس ودرجة حرارة الجسم وتم حساب معدل الزيادة فى الوزن والكفاءة الغذائية عند فترات مختلفة من التجربة.

و أظهرت النتائج المتحصل عليهما يلى:

لوحظ أن الإجهاد الحراري أدى الى انخفاض وزن الجسم والزيادة الوزنيه والغذاء المأكول والكفاءة الغذائية معنويا خلال الفترة الكلية للتجربة (٨-١٦ أسبوع من العمر) بينما اضافة المصادر المختلفة من السيلينيوم للعليقة لم تؤثر معنويا على هذه الصفات فيما عدا كفاءة التحويل الغذائى التى تحسنت باضافة النانو سيلينيوم، كما لوحظ أن التداخل بين درجات الحرارة ومصادر السلينيوم لم يؤثر معنويا على هذه الصفات.

لوحظ أن الإجهاد الحراري أدى الى ارتفاع درجة حرارة الجسم وزيادة معدل التنفس عند عمر ٨ و ١٦ أسبوع بينما اضافة المصادر المختلفة من السيلينيوم للعليقة لم تؤثر معنويا على هذه الصفات كما لوحظ أن التداخل بين درجات الحرارة ومصادر السلينيوم لم يؤثر معنويا على هذه الصفات فيما عدا معدل التنفس عند ١٦ أسبوع والذى ازاد باضافة المصادر المختلفة من السيلينيوم للعليقة مقارنة بالكنترول.

لوحظ أن الإجهاد الحراري أدى الى انخفاض نسبة الخلايا الليمفاوية وارتفاع نسبة الخلايا المتعادلة وكرات الدم الحمراء معنويا بينما اضافة المصادر المختلفة من السيلينيوم للعليقة أدت الى ارتفاع نسبة الخلايا الليمفاوية وانخفاضنسبة الخلايا المتعادلة ومن ثم انخفاض نسبة الخلايا المتعادلة الى الليمفاوية معنويا مقارنة بالكنترول ، كما لوحظ أن التداخل بين درجات الحرارة ومصادر السلينيوم أثر معنويا على هذه الصفات. ل

لوحظ أن الإجهاد الحراري أدى الى انخفاض نسبة البروتين والألبيومين فى بلازما الدم معنويا بينما ارتفع مجموع مضادات الأكسدة وبروتين الصدمة الحرارة ٧٠ معنويا . بينما اضافة المصادر المختلفة من السيلينيوم للعليقة أدت الى ارتفاع نسبة البروتين والجلوبيولين مجموع مضادات الأكسدة مقارنة بالكنترول ..

التوصية: تشير هذه النتائج أن الإجهاد الحراري يخفض بشدة الأداء الإنتاجي والفسيولوجي لكتاكيت السلالات المحلية سينا ، في حين أنه يمكن تحسين هذا الأداء بإضافة السيلينيوم العضوى أو النانو سيلينيوم لعليقه هذه الكتاكيت تحت ظروف الإجهاد الحراري