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SOME PHYSIOLOGICAL PRODUCTIVE AND REPRODUCTIVE TRAITS OF INSHAS LOCAL STRAIN AS AFFECTED BY DIETARY ZINC SUPPLEMENTATION UNDER HOT SUMMER CONDITIONS IN EGYPT

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ABSTRACT:

A 2X4 factorial design experiment was performed including two sources of zinc (inorganic or organic). The inorganic Zn was provided as zinc oxide 72% and organic Zn was provided as Bioplex Zn, a chelated Zn proteinate that contained 10% Zn (Bioplex, Alltech Inc). The inorganic or organic zinc were added to the basal diet containing 22.21 mg zinc /Kg diet completed to 35(NRC, 1994), 70, 105 and 140 mg Zn / Kg diet. A total number of 240 laying hens and 24 cocks of Inshas strain (local strain) of 24 weeks old was used to study the effect of sources and levels of Zn addition to birds rations on their productive performance, reproductive traits, immune response to SRBC and economic efficiency. Birds were randomly distributed into eight equal groups (30 hens and 3 cocks each). Each group was subdivided into three replicates (10 hens and 1 cocks each) laying hens of each group nearly equal in average body weight (1430.55± 19.95) and average daily egg production. The experiment period extended from 24 to 36 weeks of age, during hot summer season (from June to September, 2008). The average minimum and maximum ambient temperatures ranged between 23.6 and 34.7 ^{0}C, relative humidity from 31.8 to 80.7% and temperature-humidity index (THI) from 21.64 to 33.52% under Inshas, Sharkia Province, Egypt.

Results obtained showed that feed conversion, egg production% , egg mass (24 - 28 weeks of age), semen ejaculate volume (ml), percentages of sperm motility and sperm-cell concentration and antibody titer against SRBC'S were improved significantly ($P<0.05$) ,while dead spermatozoa(%) were decreased significantly ($P<0.05$) for birds fed diets *contained organic zinc as compared to those fed zinc oxide. Laying hens fed diets contained 105 mg Zn/Kg diet recorded best values of feed conversion, egg production(%), egg mass, fertile eggs (%), hatchability/total eggs (%) and hatchability/ fertile eggs (%)* values *while the lowest values were recorded with layers fed diets containing 35 mg Zn oxide /Kg diet. Inshas cocks fed 105 mg Bioplex Zn / Kg diet showed the highest sperm cell concentration and lowest in dead sperm percentages as compared with other treatment groups which, improved the positive and direct effect on the viability of sperm and consequently affect the rate of cock fertility. Heamoglobin, serum zinc and yolk zinc were higher (al most significantly) for layers fed diets contained at levels 105 or 140 Zn mg/ Kg as compared with those fed other levels of Zn at the end of experimental period. Generally, zinc from Bioplex Zn improved titer against SRBC'S better than zinc from Zn oxide.*

In conclusion, diets supplemented with organic zinc at the level of 105 mg Zn/ Kg diet improved most physiological productive and reproductive traits of Inshas strain under hot summer condition in Egypt.

Key words: Zn oxide, Bioplex Zn, productive & reproductive traits, immune response to SRBC, economic efficiency.

INTRODUCTION

High ambient temperatures compromise performance and productivity through reducing feed intake and decreasing nutrient utilization, growth rate, egg production, egg quality, and feed efficiency, which lead to economic losses in poultry production (Donkoh, 1989). Environmental stress, also leads to oxidative stress associated with a reduced antioxidant status in the bird, as reflected by increased oxidative damage and lowered plasma concentrations of antioxidant vitamins (e.g., vitamins E, A, and C) and minerals (e.g., Zn), Franco and Beck (2007) and Sahin *et al.* (2009). Supplemental zinc used in poultry diets is beneficial to layer hens during environmental stress (Sahin and Kucuk, 2003). Zinc has an important role in numerous biological processes in avian and mammalian species. For instance, Zn is an essential component of many enzymes, and it has both structural and catalytic functions in metalloenzymes (Innocenti *et al.,* 2004). Furthermore, dietary Zn is required for normal immune function, as well as proper skeletal development and maintenance, Kidd *et al.* (1992 and 2000). Sahin *et al.*, (2009) reported that one of the most important functions of Zn is related to its antioxidant role and its participation in the antioxidant defense system . Published research relative to the interactions between heat stress and Bioplex (organic) Zn in poultry is sparse. Adverse effects of heat stress on Zn metabolism caused to increase Zn excreted in poultry manure. Dietary modifications are among the most preferable and practical methods to alleviate the effect of high environmental temperature on poultry performance and such methods have previously been used. Organic Zn sources such as Bioplex Zn , Zn-methionine or Zn-propionate were more bioavailable than inorganic Zn sources such as zinc oxide (ZnO) or zinc Sulfate (ZnSO4-H2O) (Wedekind *et al.*, 1992; Hahn and Baker, 1993). Luecke *et al.*, (1978) revealed that Zn has been reported to be involved in boosting the immune system to disease outbreaks. Subsequent research provided evidence for Nutrient Requirements for Poultry (NRC, 1994) to set the requirements of layer hens at 35 ppm. Another mode of action proposed for Zn as an antioxidant is its interaction with vitamin E, because vitamin E status is impaired in zinc-deficient animals (Salgueri, *et al.*, 2000). Rashidi *et al.*(2010) found that heat stress decreased humoral and cell-mediate immune response and diet supplementation with vitamin E and Zn decreased the impact of heat stress on performance and immune system of broilers.

On the other hand, organic mineral sources such as proteinate and amino acid chelate have been used increasingly in the last years due to their higher bioavailability (Cao *et al.*, 2000) and lower manure loading (Manon *et al.*, 2005). In general, inconsistency exists among research results regarding bioavailability of organic Zn sources. Moreover, some studies indicated small or no differences in bioavailability of Zn sources either inorganic or organic (Ammerman *et al.*, 1995). This work compiles past and present information about the role of Zn in heat-stressed poultry health. This study was carried out to establish the value of Zn (source and level) on productive and reproductive performance in heat stressed laying hens. Also, some blood hematological and biochemical parameters, semen characteristics, immune response to sheep red blood cells (SRBC'S) and economical efficiency with different sources and levels of zinc were studied.

MATERIALS AND METHODS

The experimental work of this study was carried out at Inshas Poultry Research Station, Animal Production Research Institute, Agriculture Research Center, Giza, Egypt, during hot summer season (from June to September, 2008). The average minimum and maximum ambient temperatures ranged between 23.6 and 34.7 0C, relative humidity from 31.8 to 80.7% and temperature-humidity index (THI) from 21.64 to 33.52%, under Inshas, Sharkia Province, Egypt (Table 1). THI was estimated according to the formula by Marai *et al.* (2000) as follows:

Table (1). Microclimatic data during the whole experimental period, under environmental condition.

Summer months	Averages temperature (^{0}C)		Averages RH (%)		Averages (THI)	
	Min*	**Max****	**Min***	**Max****	**Min***	**Max****
June	22.5±0.37	35.0±0.40	25.7±1.11	75.5±1.66	٢٠.٦٣	٣٣.٤٤
July	23.7±0.21	34.1±0.29	34.7±1.08	83.1±1.16	٢١.٨٢	٣٣.٠٧
August	٠.٢١±٢٤.٥	٠.٢٢±٣٥.١	١.١٤±٣٤.٩	٠.٩٣±٨٣.٦	٢٢.٤٦	٣٤.٠٥
Averages	23.6±0.17	34.7±0.18	31.8±0.78	80.7±0.82	٢١.٦٤	٣٣.٥٢

*=Minimum, **Maximum, RH=Relative humidity, THI=Temperature-humidity index

THI=db^{0}C-{(0.31-0.31 RH) (db^{0}C -14.4)}, where db^{0}C = bulb temperature in Celsius and RH= RH%/100. A 2X4 factorial design experiment was performed including two sources of Zn (inorganic or organic) and four levels (35, 70, 105 and 140 mg Zn /Kg diet). The inorganic Zn was provided as Zn oxide 72% and organic Zn was provided as Bioplex Zn, a chelated Zn proteinate, that contained 10% Zn (Bioplex, Alltech Inc). The inorganic and organic zinc were added to the basal diet containing 22.21 mg Zn / Kg diet and completed to 35(NRC, 1994), 70, 105 and 140 mg Zn / Kg diet. The composition and chemical analysis of the experimental laying diet are presented in Table (2). A total number of 240 laying hens and 24 cocks of Inshas local strain at 24 weeks of age were randomly distributed into 8 treatment groups (30 hens and 3 cocks / each treatment). Each group was sub-divided into three replicates (10 hens and 1 cock each). The experimental groups were, nearly equal in average body weight (1430.55± 19.95 and average daily egg production.

The experimental period extended from 24 to 36 weeks of age. The experimental birds were leg-banded and housed in 24 pens and fed a basal diet containing 17.33% crude protein and 2722Kcal ME/ Kg diet (Table 2). Birds were fed *ad-libitum* and fresh water was available all the time during the experimental period. The photoperiod during the experimental period was fixed at 16h. Individual body weight of laying hens was recorded at 24, 28, 32 and 36 weeks of age. While egg number and egg weight were recorded daily and feed intake was calculated weekly. Egg mass was calculated by multiplying egg number by average egg weight. Feed conversion (g feed/g egg mass) was also calculated. At 36 weeks of age, 60 eggs from each treatment were collected and incubated. After

Table 2. Composition and chemical analysis of the experimental diet fed during the laying period.

Ingredients	%
Yellow corn (8.5 %)	63.14
Soybean meal (44 %)	27.10
Limestone ($CaCo_3$)	7.60
Di-calcium phosphate	1.50
Dl-Methionine 99%	0.06
Salt (NaCl)	0.30
Vit + Min. premix*	0.30
Total	**100.00**
Chemical analysis:-	
a-Calculated analysis **:-	
Crude protein, %.	17.33
ME, Kcal/Kg.	2722
Calcium, %	3.35
Available phosphorus, %.	0.40
Lysine, %.	0.88
Methionine,%	0.34
Methionine + cystine %.	0.64
Zinc (mg/Kg)	22.21
b-Determined analysis *:-**	
Crude protein,%.	16.76
Crude fiber,%.	4.15
Ash %.	6.38

* **Vitamin and mineral premix**: each 3 Kg of vitamin and mineral premix (Special component from commercial source AGRIVET Co.) contains: Vit. A. 12000000 IU, Vit. D_3 2000000 IU, Vit. K_3 2000 mg, Vit. E10,000 mg, Vit. B_1 100 mg, Vit. B_2 5000 mg, Vit. B_6 1500 mg, Vit. B_{12} 10 mg, Biotin 50 mg, Choline chloride 250000 mg, Pantothenic acid 10000 mg, Nicotenic acid 3000 mg, Folic acid 1000 mg, Manganese 60000 mg, Iron 30000 mg, Selenium 100 mg, Copper 10000 mg, Iodine 1000 mg, Cobalt 100 mg, Carrier(Ca Co_3) add to 3kg.

** Calculated according to NRC (1994).

*** Determined according to the methods of AOAC (1990).

hatching, chicks were counted and non-hatched eggs were broken to determine the percentages of fertility and hatchability. Fertility% was calculated as the percentage of fertile eggs from the total number of set eggs, while the hatchability% was expressed as chicks hatched from fertile eggs and from total set eggs. Semen samples were individually collected (24 cocks) at the end of experiment using the abdominal massage method from all cocks. Semen ejaculate volume was measured in graduated tubes and hydrogen-ion concentration (pH) was measured by Universal Indicator Paper and Standard Commercial Stain (Karras, 1952). Sperm-cell concentration was determined using the spectrophotometer density meter technique with diluted semen samples (1:250) as described by Lake and Stewart (1978). Eosin-Nigrosine stain was used to determine the percent of morphologically sperm abnormalities and dead spermatozoa (Lake and Stewart, 1978). A small droplet from cock semen was placed on a warm slide, covered with a cover slide and examined for sperm motility microscopically at 40x magnification.

Blood samples were collected, at the end of the experiment, from 3 hens per treatment (5 ml/ hen) from the brachial vein and transferred into tube. Serum samples were obtained by centrifugation of samples at -20˚C until they were analyzed. No coagulated blood was used for hemoglobin determination. Stored serum samples were analyzed for total protein, albumin and zinc and yolk zinc using the suitable commercial chemical kits. Globulins were estimated by subtraction of albumin value from total protein value of each sample. At 34 weeks of age, nine birds from each treatment were immunized by intravenously injection with 1.0 ml of suspension of sheep red blood cells (SRBC'S) 7% in sterile saline (Yamamoto and Glick, 1982). Seven days following antigen challenge, blood samples were collected. Approximately 2.0 ml of blood was drawn from the brachial vein of each bird. It was allowed to clot to provide serum for antibody titer. Humoral immune response to SRBC'S was measured using micro haemagglutination technique.

The economical efficiency (EEf) of the experimental treatments was estimated depending on feeding cost and price of egg produced.

The data pooled through the experiment were proceed by General Linear Model procedures (GLM) described in SAS User's Guide (SAS, Institute, 2003). Differences among treatment means were separated by Duncan's new multiple-range test (Duncan, 1955).

RESULTS AND DISCUSSION

Productive performance:

Results in Table (3) showed that body weight, feed intake and egg weight of laying hens were not significantly affected by dietary Zn during all the experimental periods. These results are in agreement with those obtained by Kout El-Kloub Moustafa *et al.* (2004) who reported that, the addition of Zn in laying hen diets either as ZnO or Zn-methionine resulted in no significant differences in

average body weight. Namra *et al.* (2008) found that quails fed dietary Zn (either Zn SO4, imported zinc-methionine or local zinc-methionine) had an insignificantly improvement on body weight, as compared to those of the control group at 6 weeks of age. However, feed conversion during 24 – 28 and 24-36 weeks of age, egg production and egg mass during 24 - 28 weeks of age were significantly ($P<0.05$) improved when laying hens were fed organic zinc (Bioplex Zn) compared with those fed inorganic zinc (zinc oxide) under heat summer stress . These results are in full agreement with results of Ferket *et al.* (1992) who found that, dietry Zn-Met improved feed conversion ratio turkey toms than inorganic zinc. Also, Abou El-Wafa *et al.,* (2003) concluded that properly, supplemental Zn-methionine to the control diet significantly ($P<0.05$) increased body weight gain and improved feed conversion broiler chicks.

Zinc level had no significant effect on body weight, feed intake and egg weight of layers during all the experimental period (Table 3). Similar results were the obtained by El-Husseiny *et al.* (2008) who found that, the different levels of Zn (70, 105, 140 and 175 mg/Kg diet) had no significant effect on egg weight of laying hens. Kim and Patterson (2005) found that diet supplemented with zinc (1000, 2000 or 3000 ppm) had no significant effect on body weight, egg weight and feed consumption of hens. However, feed conversion, egg production and egg mass were improved with increasing zinc level from 35 to 70, 105 or 140 mg Zn /Kg diet in laying hen diets during all experimental periods (except at 32-36 weeks of age). However, the improvement was more pronounced and significant ($P<0.05$) with the 105 mg Zn /Kg diet. These means that total dietary concentrations of 105 mg Zn /Kg diet was necessary to achieve normal productive performance in laying hens and further supplementation will be more expensive. The significant increases in egg production may be due to the important role of zinc in the synthesis and secretion of luteinizing hormone (LH) and follicle stimulating hormone (FSH) as reported by Bedwal and Bahuguna (1994). Improving feed conversion for groups fed diets supplemented with zinc may be due to better efficiency of feed utilization resulted in higher egg production than those fed the un-supplemented control diet (Kout El-Kloub Moustafa *et al.,* 2004).

Results in Table (4) showed that feed conversion during 28 -32 and 24 - 36 weeks of age, egg production during 24 -28 and 28 - 32 weeks of age, and egg mass during 24 - 28, 28 - 32 and 24 - 36 weeks of age were significantly ($P<0.05$ or $P<0.01$) improved by interaction between dietary zinc source and their levels . Within each zinc source productive performance increased with increasing zinc level in the diet. It could be noticed that Bioplex Zn at a level of 105 mg/Kg diet recorded the best values of feed conversion, egg production and egg mass, while

the lowest values were recorded with hens fed diets containing ZnO at the level of 35 mg/Kg diet. Kout El-Kloub Moustafa *et al.* (2004) found that, diet supplemented with ZnO at levels of 50 and 100mg/Kg diet showed significantly ($P<0.05$) greater values of egg production than the control group.

Reproductive performance:

1-* Fertility and hatchability percentages*:

Results in Table (5) showed that fertile eggs %, hatchability/total eggs % and hatchability/ fertile eggs % values were not significantly affected by zinc source in layers diets under heat stress. These results are impartial agreements with those of Kout El-Kloub Moustafa *et al.* (2004) who found that hatchability percentage of local laying hens was insignificantly improved by using all zinc sources (ZnO or Zn-methionine).

Layers fed diets contained 105 mg Zn/Kg diet recorded the highest fertile eggs and hatchability/total eggs percentages among all treatments. Moreover these percentages were significantly ($P<0.05$) higher than those of layers fed 35 mg Zn /Kg diet during the whole experimental period (Table 5). These results may be due to the improvement in egg and semen quality and higher sexual efficiency traits of the cocks treated with increasing level of zinc under heat stress. Similarly, Namra *et al.* (2008) suggested that, zinc supplementation as zinc-methionine at higher levels than that of NRC (1994) recommendations improved fertility of Japanese layer quails.

Fertile eggs (%) and hatchability/total eggs (%) values of Inshas laying hens were significantly ($P<0.05$) influenced by interaction between dietary Zn source and Zn level at 36 weeks of age as shown in Table 5. Inshas layer fed 105 mg Bioplex Zn /Kg diet had higher fertile eggs (%), hatchability/total eggs % and hatchability/fertility eggs % values as compared with other treatments. However, Zn source, levels and their interactions had no significant effect on hatchability/ fertile eggs (%) (Table 5).

2- Semen characteristics:

Semen ejaculate volume (ml), percentages of sperm motility and sperm-cell concentration of cocks fed diets contained Bioplex Zn were significantly ($P<0.05$) higher than those of cocks fed Zn oxide under heat stress as shown in Table 6. However, dead spermatozoa showed a reverse trend. Kout El-Kloub Moustafa *et al.* (2004) reported similar results. They found that addition of 100 and 150 mg Zn-Met / Kg or 100 mg ZnO /Kg diet significantly ($P<0.05$) improved some semen quality measurements (ejaculate volume, mass motility, advanced motility and sperm concentration) of cocks.

Table 5. Fertility and hatchability percentages $(\bar{X} \pm SE)$ of Inshas layers as affected by different sources and levels of dietary zinc and their interactions at 36 weeks of age.

Items		Fertile eggs (%)	Hatchability/total Eggs (%)	Hatchability/ fertile eggs (%)
Zinc sources		**NS**	**NS**	**NS**
Zinc oxide		81.67 ± 1.78	67.50 ±1.99	82.61 ±1.48
Bioplex Zn		85.42 ± 1.99	72.08 ± 2.50	84.28 ±1.81
Zinc level (mg/kg):		**	**	**NS**
35		76.67 ± 2.11 ^{b}	62.50 ±2.81 ^{c}	81.54 ±3.08
70		83.33 ± 2.47 ^{a}	67.50 ±2.50 ^{bc}	81.01 ±1.82
105		89.17 ± 2.01 ^{a}	77.50 ±2.14 ^{a}	86.95 ±1.84
140		85.00 ± 1.83 ^{a}	71.67 ±2.47 ^{ab}	84.28 ±1.99
Interaction effects:		*	*	**NS**
Zinc sources	**Zinc levels (mg/kg)**			
Zinc oxide	**35**	75.00 ± 2.89 ^{c}	60.00 ± 2.89 ^{c}	80.08 ± 3.45
	70	81.67 ± 4.41 ^{abc}	66.67 ± 4.41 ^{bc}	81.67 ± 3.47
	105	86.67 ± 1.67 ^{ab}	73.33 ± 1.67 ^{ab}	84.64 ± 1.82
	140	83.33 ± 1.67 ^{abc}	70.00 ± 2.89^{bc}	84.07 ± 3.80
Bioplex Zn	**35**	78.33 ± 3.33 ^{bc}	65.00 ± 5.00 ^{bc}	83.01 ± 5.78
	70	85.00 ± 2.89 ^{abc}	68.33 ± 3.33 ^{bc}	80.35 ± 2.03
	105	91.67 ± 3.33 ^{a}	81.67 ± 1.67 ^{a}	89.27 ± 2.86
	140	86.67 ± 3.33 ^{ab}	73.33 ± 4.41 ^{ab}	84.49 ± 2.28

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

Results in (Table 6) showed that semen ejaculate volume (ml), percentages of sperm motility and sperm cell concentration were significantly (P<0.05) higher cocks fed 105 mg Zn /Kg diet compared with those of cocks fed other Zn levels. While, dead spermatozoa and sperm abnormalities were significantly (P<0.05) decreased with increasing dietary Zn levels from 35 to 105 mg/Kg diet. However, hydrogen-ion concentration (pH) was not significantly affected by different levels of Zn under heat stress. Similar trends were reported by Fathi *et al.* (2000) who

found that dietary Zn supplementation caused an increase in semen volume of cocks. El-Masry *et al.* (1994) and Tharwat (1998) reported that dietary Zn supplementation showed greater proportion of progressively motile spermatozoa than those of control group. In this concern, Gunn et al., 1961 claimed that the normal levels of Zn are needed for the maturation of spermatozoa. Moreover, Underwood (1977) reported that, zinc deficiency resulted in a failure in normal sperm development, as well as, prostaticatrophy. It could be suggested that zinc may play an active role in the development of the flagellar system of the sperm which is reflected on sperm motility either via its passage and stay in the epididymis for complete maturation, or zinc may activate enzyme controlling flagellar system. Furthermore, the increasing of sperm motility may be due to increase in sperm cell concentration as a result of zinc supplementation.

The interaction between source and levels were significantly ($P<0.05$ and $P<0.01$) as shown in Table (6). Semen ejaculate volume (ml), percentages of sperm motility and sperm cell concentration of Inshas cocks fed 105 mg Zn /Kg diet were significantly ($P<0.05$) higher than those of cocks fed either 35 or 70 mg Zn /Kg diet. However, dead spermatozoa and sperm abnormalities showed a reverse trend as it decreased ($P<0.05$) with increasing Zn level from 35 to 70 and 105 mg Zn /Kg diet. Inshas cocks fed 105 mg Bioplex Zn /kg diet showed an increase in sperm cell concentration and decrease in dead sperm percentage as compared with other treatment groups which led to improve the positive and direct effect on the viability of sperm and consequently affect the rate of cock fertility.

Blood hematological, biochemical parameters and zinc yolk in egg:

Blood hematological, biochemical parameters and zinc yolk of Inshas layers as affected by different sources and levels of dietary Zn and their interactions are presented in Table 7. Heamoglobin, total protein, albumin, globulin, serum zinc and yolk zinc of layers were not affected by Zn source under heat stress. These results are in partial agreement with those reported by Kout El-Kloub Moustafa *et al.* (2004) who found that total protein, albumin and globulin concentrations were insignificantly higher in laying hens fed Zn-Met than in those fed ZnO.

Heamoglobin, serum zinc and yolk zinc were higher and almost significant ($P<0.05$) for layers fed diets contained 105 or 140 Zn mg/kg as compared with those of layers fed other levels of Zn at the end of experimental period Table 7. Whereas, total protein, albumin and globulin, were not significantly affected by different levels of Zn. These results are in good agreement with those reported by El-Husseiny *et al.* (2008) they found that hemoglobin increased with increasing either levels of Zn (70,105,140 and 175 mg /Kg diet) or niacin (30,150,300,450

mg /Kg diet). Abou EL-Wafa *et al.* (2003) demonstrated that blood plasma zinc was increased by increasing dietary zinc level of broiler chicks. Mohanna *et al.* (1999) found that plasma Zn concentration increased linearly with zinc dietary content and reached a plateau at 75 mg/Kg diet whereas the whole body zinc was saturated when the dietary zinc content was 90 mg/Kg. Verheyen *et al.* (1990) recorded that zinc concentration in egg yolk was 90 ppm at the 4th days for hens fed with a high-zinc diet (10,000 ppm zinc for 2 days followed by 5,000 ppm zinc-supplement diet for 4 days). Also, Decuypere *et al.* (1988) observed an increase in zinc content of egg yolk from the 3rd day after the start of feeding hens with zinc oxide (10,000, 20,000, or 30,000 mg Zn/Kg). Results in Table (7) showed that heamoglobin, serum zinc and yolk zinc of laying hens were significantly ($P < 0.05$) influenced by interaction between dietary source and level of Zn, whereas, total protein, albumin and globulin value were not significantly effected by that interaction at the end of experimental period.

Immune response to sheep red blood cells (SRBC'S):

Results of immune response to sheep red blood cells (SRBC'S) are presented in Table 7. Antibody titer against SRBC'S was significantly ($P<0.05$) higher for layers fed diets contained Bioplex Zn as compared with those fed Zinc oxide. These results are in full agreement with those reported by Ferket and Qureshi (1992) who found that zinc from Zn-Met has been shown to heighten cellular immunity in poultry over that of Zn from Zn SO4 and ZnO.

Layers fed the diet contained 105 and 140 mg Zn/Kg diet showed significantly ($P<0.05$) higher immune response compared to the other levels Table 7. In this concern, Kidd *et al.* (1992) found that adding zinc in hen diet increased significantly the humeral immune response of progeny chicks. EL-Kaiaty *et al.* (2001) reported that 50 or 100 mg Zn/Kg diet was more efficient in immune response than other levels (150 and 200 mg Zn/Kg diet).

Interaction between dietary zinc source and levels showed significant effect for antibody titer against SRBC'S as shown in Table 7. Supplementation of Bioplex Zn to the diet at levels of 105 and 140 mg/Kg diet recorded the best immune response to SRBC titres values (without significant differences between the two levels), while ZnO at the level of 35 mg/Kg diet recorded the lowest one. Generally, Zinc from Bioplex Zn improved titer against SRBC'S better than Zinc from ZnO. Bartlett and Smith (2003) reported that birds fed the high zinc level (181 mg/Kg diet) engulfed more SRBC'S than the other diets (34 and 68 mg/Kg diet) for opsonized and unopsonized SRBC with opsonized SRBC having greater phagocytic activity.

Economic efficiency (EEf):

Data presented in Table (8) indicated that Inshas layers fed the feeding diet containing Bioplex Zn recorded the best economic efficiency (EEf) value and the lowest feed cost required to produce number of eggs compared to those of layers fed zinc. These trends may be attributed to the reduction in feed intake and improving feed conversion. The best EEf value and lowest feed cost required to produce number of eggs were obtained with layers fed 105 mg Zn/ Kg as compared with other levels of Zn. Regarding the interaction effect, results in Table (8) demonstrated that the best EEf value during the whole experimental period was obtained with birds fed diets containing Bioplex Zn and 105 mg Zn/ Kg diet and may be due to the better performance of this treatment. These results are generally in partial agreement with those reported by Abou zeid *et al.* (1999) and Abou EL Wafa *et al.* (2003) who mentioned that Zinc supplementation to broiler's diet may be beneficial to broiler's performance and EEf. El-Husseiny et al. (2008) found that the average relative EEf increased with increasing levels of Zn (70,105,140 and 175 mg/kg diet) and decreased with increasing levels of niacin (30,150,300,450 mg/kg diet).

***In conclusion*,** from the nutritional and physiological points of view it could be concluded that the use of organic zinc at the level of 105 mg Zn/ Kg diet improved the productive, reproductive performance and economic efficiency of Inshas strain from 24-36 weeks of age strain under hot summer condition in Egypt.

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بعض الصفات الفسيولوجية والتناسلية لسلالة انشاص المحلية والمتأثرة بإضافة الزنك إلي الغذاء تحت ظروف الصيف الحار في مصر.

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اشتملت هذه الدراسة علي تجربة عامليه ٢ X 4 تضمنت مصدرين للزنك (غير عضوي وعضوي) وكان الزنك الغير عضوي عبارة عن اكسيد زنك ٧٢% والزنك العضوي عبارة عن بيو بلكس ١٠% زنك وتم إضافة كل من الزنك الغير عضوي والعضوي للعليقة حتى يكمل مستوي ٣٥ ، ٧٠ ، ١٤٠،١٠٥ مجم زنك /كجم علف. وقد استخدام في هذه الدراسة ٢٤٠ دجاجة بياضه ، ٢٤ ديك من سلالة انشاص (سلالة محلية) عند عمر ٢٤ أسبوع من العمر قسمت عشوائيا إلي ثماني مجموعات بكل مجموعه ٣٠ دجاجات بياضه وثلاثة ديوك، كما قسمت كل مجموعه إلي ٣ مكررات بكل منها ١٠ دجاجات وديك وكانت الدجاجات البياضه بكل مجموعه متساوية تقريبا في متوسط وزن الجسم وكذلك متوسط الإنتاج اليومي للبيض. وقد استمرت هذه التجربة من عمر ٢٤ أسبوع حتى ٣٦ أسبوع من العمر خلال موسم الصيف الحار من شهر يونيو حتي شهر سبتمبر ٢٠٠٨. وكان الحد الأدنى والحد الأقصى لمتوسط درجة حرارة الغرفة أثناء التجربة يتراوح بين ٣٤.٧،٢٣.٦ م° والرطوبة النسبية بين ٨٠.٧،٣١.٨%. وقد تم دراسة تأثير كل من مصادر الزنك المختلفة والمستويات المضافة منه إلي علائق الطيور وذلك علي الأداء الإنتاجي والتناسلي والاستجابة المناعية وكذلك الكفاءة الاقتصادية.

وقد أظهرت النتائج المتحصل عليها تحسن معنوي($P<0.05$) لكل من معدل التحويل الغذائي، والنسبة المئوية لإنتاج البيض، كتلة البيض (٢٤-٢٨ أسبوع من العمر)، حجم القذفه والنسبة المئوية لحركة الأسبرمات، للحيوانات المنوية الطبيعية والاستجابة المناعية بينما انخفضت معنويا ($P<0.05$) النسبة المئوية للاسبرمات الميتة وذلك للطيور المغذاة علي الزنك العضوي بالمقارنة مع تلك المغذاة علي أكسيد الزنك. سجل الدجاج البياض المغذي عند مستوي 105 مليجرام زنك/كجم عليقه أفضل قيم لكل من معدل التحويل الغذائي، النسبة المئوية لإنتاج البيض، كتلة البيض، النسبة المئوية للبيض المخصب، النسبة المئوية

للفقس بالنسبة للبيض الكلي والبيض المخصب في حين سجلت أدني القيم مع الدجاج المغذي علي ٣٥ مليجرام عليقه أكسيد الزنك /كجم. زاد تركيز الحيوانات المنوية الطبيعية لديوك انشاص بينما انخفضت نسبة الحيوانات المنوية الميتة لهم عند التغذية مستوي 105 مليجرام زنك /كجم عليقه مقارنة مع المجموعات الأخرى وهذا يؤدي إلي التحسن الإيجابي والمباشر علي سلامة الحيوانات المنوية الذي يؤثر بالتالي علي معدل خصوبة الديوك. كما زاد معنويا في معظم الحالات كل من الهيموجلوبين ، زنك السيرم ، زنك صفار البيضة وذلك للدجاج البياض المغذي علي مستوي ١٠٥، ١٤٠ مليجرام زنك /كجم عليقه مقارنة مع المستويات الأخرى في الفترة الفترات التجريبية. وبشكل عام تحسنت الاستجابة المناعية للطيور المغذاه علي الزنك من البيوبلكس الزنك عن تلك المغذاه علي الزنك من أكسيد الزنك.

توضح نتائج هذه الدراسة أن تغذية طيور سلالة انشاص المحلية علي علائق محتوية علي زنك عضوي عند 105 مليجرام زنك /كجم عليقه أدي إلي تحسين معظم الصفات الفسيولوجية والتناسلية لهذه السلالة وذلك تحت ظروف الصيف الحارة في مصر.