Egypt. Poult. Sci. Vol (34) (IV): (1055-10) (2014) (1536)

Egyptian Poultry Science Journal

http://www.epsaegypt.com

ISSN: 1110-5623 (Print) – 2090-0570 (On line)

EFFECT OF SUPPLEMENTING ORGANIC MINERALS (ZINC, MANGANESE, IRON, COPPER AND SELENIUM) ON PRODUCTIVE, REPRODUCTIVE AND IMMUNE PERFORMANCE OF GIMMIZAH CHICKENS

A.G. Abdallah, Hanaa M. Khalil, Amany A. El-Sahn, Amina S.El-Saadany,
Effat Y. Shreif, Nehad A., Nagda S., AmalAbd El-Salam
Anim. Prod. Res. Inst., Agric. Res. Center, Egypt

Received: 05/11/2014 Accepted: 25/11/2014

ABSTRACT: A trial was set up to evaluate the influence of some dietary organic trace minerals supplementations on productive and reproductive performance and immune response of Gimmizah chickens. A total of 160 hens and 40 cocks aged 24 wks of age were distributed randomly among eight experimental groups (20 hens and 5 cocks/ group) and the experiment ended at 40 wks of age.

Birds were fed different experimental eight diets. Two control diets were formulated to meet nutrient requirements of chickens as recommended by NRC (1994). The first diet was considered as negative control and supplemented with 100% inorganic trace minerals (Inorg-TM) and the second one was considered as positive control and supplemented with 100% organic trace minerals (Org-TM). The third group was supplemented with 50% of organic trace minerals. The rest five diets were supplemented with 50% of the organic form of zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), or selenium (Se), respectively. The premix was formulated to contain the requirements of trace elements in inorganic form (sulphate), organic form (peptide chelate) or in combination.

Results indicated that:

1- Supplementing the hen's diet with organic trace minerals had no significant effect on egg production %, egg weight, egg mass, feed intake and feed conversion compared with those supplemented with Inorg-TM. However, hens fed with organic mineral diets at different levels produced a heaviest egg weights compared with those fed inorganic diet.

Key Words: Organic trace minerals, chickens, egg quality, semen quality, hatchability%.

Corresponding author: abdou103@hotmail.com

2- Hens fed diets containing either 100% or 50% organic minerals (Zn, Mn, Fe, Cu and Se) had significantly higher egg shell thickness and yolk solids weight % compared with those for Inorg-TM diet.
3- White and red blood cell counts, and hemoglobin were higher in hens fed at 100 % and 50% levels of organically total complexed minerals ($p \leq 0.05$) compared with Inorg-TM group.
4- Significant increase was observed in plasma Zn, Mn, Cu and Se concentrations for hens fed 100% and 50% Org-TM and in each organic minerals were fed as a single element compared with those for 100% Inorg-TM.
5- Dietary experimental organic minerals represented the highest significant record of sperm concentration, live sperm (%), sperm output, number of motile sperm, and number of live sperm compared with inorganic one.
6- There was significant increase in fertility % for eggs of groups fed 100% and 50% Org-TM, 50%Org-Cu and 50% Org-Se compared with control Inorg-TM. The use of organic minerals in diets significantly improved hatchability % compared with control Inorg-TM .

INTRODUCTION

Trace minerals, such as Zn, Mn, Fe, Cu, and Se are essential for birds growth and involved in many digestive, physiological, and biosynthetic processes within the body. These minerals are constituents of hundreds of proteins involved in intermediary metabolism, hormone secretion pathways and immune defense systems (Dieck et al., 2003). Traditionally, these trace minerals are supplemented in the form of inorganic salts, such as sulfates, oxides and carbonates, to provide levels of minerals that prevent clinical deficiencies and allow the bird to reach its genetic growth potential (Bao et al., 2007 and Saripinar Aksu et al., 2010).

Nowadays, livestock is generally fed highly concentrated diets that are formulated to provide an excess of nutrients to maximize performance (Leeson, 2003). Organic complexed mineral is a type of mineral linked to protein/peptide/amino acids that has a higher bioavailability than those inorganic salts (Swiatkiewicz et al., 2014). These types of minerals are more easily absorbed compared to inorganic forms. Therefore, organic complexed minerals are supposed to be more effective than the inorganic minerals in broilers (Abdallah et al., 2009 and Richards et al., 2010).

The role of improvement of physical egg quality traits due to using organic trace minerals had been investigated by different researchers (Siske et al., 2000 and Maciel et al. 2010). Moreover regarding to the hematological parameters, El-Sheikh et al.(2010) observed that white and red blood cells, and blood hemoglobin were increased significantly by using organic selenium.

Barber et al. (2005) suggested that Zn, Mn, and Se enhance spermatogenesis and improve semen quality. Also, Sara et al. (2008) found that selenium supplementation is known to affect antioxidant defense of chicken semen. Several publications were reported regarding the improvement of hatch due to supplementation the diet with organic trace minerals (Hassan et al., 2003 and Dobrzanski et al., 2008).

The present study was investigated to determine the effect of organic trace minerals levels supplementation (Zn, Mn, Fe, Cu, and Se) on egg production, egg quality, hematological parameters, blood minerals concentration, semen evaluation, and fertility and hatchability (%) in Gimmizah chickens.

MATERIALS AND METHODS

The present experiment was carried out at EL-Sabahia Poultry Research Station (Alexandria), Animal production Research Institute (A.P.R.I), Agricultural Research Center. A total of one hundred and sixty laying hens and forty cocks of Gimmizah strain at 24 weeks of age were housed individually in single cages and distributed randomly in eight treatment groups (20 females and 5 males in each one).

Birds were fed different experimental eight diets. Two control diets were formulated to meet nutrient requirements of chickens as recommended by NRC (1994). The first diet was considered as negative control and supplemented with 100% inorganic trace minerals (Inorg-TM) and the second one was considered as positive control and supplemented with 100% organic trace minerals (Org-TM). The third group was supplemented with 50% of organic trace minerals. The rest five diets were supplemented with 50% of the organic form of zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), or selenium (Se), respectively. The premix was formulated to contain the requirements of trace elements in inorganic form (sulphate), organic form (peptide chelate) or in combination. Table 1 demonstrates the experimental design and Table 2 represents the compositions of the basal diets. Feed and fresh water were offered ad-libitum through treatments. Artificial lighting was used to provide birds 17 hrs lighting daily.

Egg Production:

Egg weight (g) and egg number were recorded daily. Egg mass (Kg) was calculated by multiplying egg number by average egg weight. Feed intake (g) was recorded daily per bird. Feed conversion values (g feed/g eggs) were calculated as the amount of feed consumed divided by egg mass.

Physical Egg Parameters:

At 32 wks of age, 10 eggs/group were used to record the weights of yolk, albumen, and eggshell (as percentage to egg weight), and eggshell thickness without egg shell membranes (mm).

For evaluation of yolk and albumen solids, ten egg yolks and albumens were individually weighed and dried at 55 °C in a forced-air convection oven for at least 72hrs. After 2 hrs in the environmental temperature, samples were weighed, and their yields were calculated relative to respective initial weights.

Washed shells were left for 72 hrs at environmental temperature, dried, individually weighed, and their relative weights were calculated as percentage of egg weight. Egg shell thickness was measured for three equatorial regions of ten eggs using a manual micrometer.

Hematological and Blood Minerals Parameters:

At 36 wks of age, blood samples were randomly taken after oviposition from 10 hens from each treated group in heparinized tube from the brachial wing vein. Blood samples divided into two parts ,the first part was used to measure the white blood cells (WBC`s), red blood cells (RBC`s), hemoglobin (Hb)and packed cell volume (PCV) and the second one was centrifuged at 3000 rpm for 15 minutes to separate plasma and stored at -20 ^{o}C until the time of minerals determination. Ca, P, Zn, Mn, Fe, Cu, and Se were measured spectrophotometrically using available commercial kits.

Semen Evaluation:

At 28 weeks of age, semen samples were collected from cocks of each treatment once weekly by abdominal massage technique. Some semen physical properties such as ejaculate volume (ml), forward motility (%) and live sperm (%) were determined. Sperm concentration was measured by using spectrophotometer at wave length 535 nm according to El-Sahn and Khalil (2005).

Number of motile sperm=percentage of forward motility x sperm output.

Number of live sperm=percentage of live x sperm output.

Fertility and Hatchability Percent:

At 30 wks of age, hens were inseminated twice a week with diluted semen (1:1) from cocks that received the same treated diets. Hatched eggs were collected daily from each group at 32, 34 and 36wks of age. A total of 1680 hatched eggs representing the eight experimental dietary groups were incubated in Egyptian-made incubator at 37.8°C and 55%RH during incubation and transferred to hatcher operated at 37.2°C and 65% RH. Macroscopic fertility was determined as percentage of fertile eggs from total egg set.

$$\text{Hatchability of fertile eggs \%} = \frac{\text{Number of hatched chicks}}{\text{Number of fertile eggs}} \times 100$$

Statistical Analysis:

Data were statistically analyzed according to SAS program (SAS, 2004) using GLM Procedure. Mean differences were tested by Duncan's New Multiple range (Duncan, 1955).

RESULTS AND DISCUSSION

Egg Production, Feed Intake and Feed Conversion:

Table 3 shows that no significant differences were observed in the results of egg production %, egg weight, egg mass, feed intake, and feed conversion due to supplementation the feed with all of Org-TM among the experimental groups. Also, results indicated that hens fed diet containing 50% combined organic minerals had the higher numerical egg weight compared with control Inorg-TM group.

Results herein are in agreement with those reported by Maciel et al. (2010) who did not observe any improvement in egg production, feed intake, feed conversion from laying hens supplemented with Zn, Mn and Cu in organic form. Also, Sechinato et al. (2006) did not detect any effects of Zn, Mn, Cu, Fe, or Se supplementation, alone or combined, either in organic or inorganic form, on egg production. Payane et al. (2005) reported that responses to mineral supplementation depend on the mineral concentration in basal diet. There is a broad consensus in formulation of mineral or vitamin premixes that is necessary to supplement microelements with a wide safety margin, superior to the required levels (Dale and Strong, 1998). Therefore, the control diet alone may supply all trace-mineral requirements, becoming impossible to detect any additional benefits, independent of the presentation of minerals, either inorganic or inorganic.

Data presented in the current study regarding the increase of egg weights for all of organic treatments may be due to the combined actions of the three micro minerals (Zn+Cu+Mn) used, since they are directly associated to egg formation as supported by Underwood (1999). Several explanations of the role of these minerals had been reported that Zn is one of the constituents of carbonic anhydrase, an enzyme involved in egg shell formation (Leeson and Summers, 2001), Mn is the metal activator of enzymes that are involved in the synthesis of mucopolysaccharides and glycol proteins that contribute to the formation of the organic matrix of the shell (Georgievski,1982), and according to Scott et al.(1982), Cu plays the role of co-factor of the lysyl –oxylase enzyme that is important in the formation of collagen cross- links present in the egg shell membranes. Also, Maciel et al. (2010) observed an enhancement in egg weight when hens fed diet containing 50% organic (Cu+Zn+Mn) compared with those fed inorganic diets. Moreover, Sara et al. (2008) and Hanafy et al. (2009) reported that egg weight of birds fed on diet containing organic Se was significantly greater than the inorganic form.

Physical Egg Parameters:

Table 4 shows that birds received feed supplemented with organic minerals except that for 50% Org-Zn and 50% Org-Fe produced the highest significant egg shell thickness compared with eggs of control Inorg-TM group. Feed supplemented with organic trace minerals did not represented any significant differences for egg shell weight (%) among treatment groups. All hens given 100% Org-TM, 50% Org-Zn, 50% Org-Cu, and 50% Org-Se had lower significant egg albumen weight (%) compared with inorganic group. Dietary organic minerals had no significant influence on egg albumen solid (%). Yolk weight (%) for eggs produced from hens given 100% Org-TM and 50% Zn- organic in diet were significantly($p \leq 0.05$) increased compared with those for control Inorg-TM, 50% Org-TM and 50% Org -Fe and this increase is numerical compared with the other rest groups. All analyzed egg yolk solid percentages were higher in eggs produced from hens fed organic minerals compared with inorganic minerals group. Data of shell thickness and solid yolk percentage reveal that supplementation the diet with 50% Org-TM is quite enough for improving these parameters and increasing the supplementation to 100% Org-TM did not create more positive influence.

The current results support the finding of those Maciel et al. (2010) who observed enhancement in shell thickness as an effect of 50% organic (Zn+Mn+Cu) compared with those fed inorganic diets. Also, Siske et al. (2000) reported that 50% supplementation of organic Zn, Mn and Se improved egg shell thickness compared with inorganic supplementation of these trace minerals. In addition, Hanafy et al. (2009) reported that hens fed diets supplemented with organic Se was significantly increased the egg shell thickness than the inorganic group. Mabel et al. (2003) did not find any changes in eggshell yield with the use of organic Zn or organic Mn.

Rutz et al. (2004) reported that yolk and albumen weight were improved by adding organic minerals (Cu+Zn+Mn) to the diet. Also, Fernandes et al. (2008) fed layer diets supplemented with organic trace minerals (Zn+Mn+Se) presented ($p \leq 0.05$) higher yolk yield relative to the control treatment. Also, the same authors reported that the commercial organic trace mineral added to diet at 250 ppm increased the level of yolk solids as compared to the diets supplemented with inorganic trace minerals.

Hematological Parameters:

White and red blood cell counts, HB, and PCV are presented in Table 5. WBC`s were significantly increased in 100% Org-TM , 50% Org-TM and 50% Org-Se treated groups compared with those in the other treated groups. Hens fed diet supplemented with 100% Org-TM, 50% Org-TM or50% Org-Fe had significant increase of RBC`s and Hb compared with Inorg-TM group. There was a numerical increase in PCV% for hens fed diet containing trace organic minerals compared with those for inorganic group.

Some trace elements (Zn, Cu and Se) markedly influence humoral and cellular immunity (Allgöwer et al., 1995). In addition, Ozturk-Urek et al. (2001) reported that the trace elements (Cu, Zn. Fe, Mn and Se) are involved in the metabolic activities via metalloenzymes which are essential for the antioxidant protection of chickens cells. Fekete and Kellems (2007) found that a lack of Zn, Fe, Cu and Se in the animal organism is associated with signs of immune deficiency.

Several research works regarding the effect of organic trace minerals on RBC`s, Hb and PCV. Saripinar Aksu et al. (2010) observed that when they used approximately 30% of organically complexed minerals (Cu, Zn, Mn) in broiler diets instead of inorganic forms of these minerals has not created a negative impact on hematological parameters. Also, the same authors reported that blood Hb of this group was increased due to the increasing iron in blood and explained that because a high level of zinc stimulates the synthesis of metallothionein which is synthesized from enterocytes and binding the metal ions in the blood. Shinde et al. (2011) reported that the RBC`s, Hb and PCV were higher in birds fed on Fe supplemented diets than birds fed on the control diet. In addition, Ma et al. (2014) indicated that Hb concentration was indices in reflecting differences in bioavailability among different Fe sources , and Fe organic was significantly more available to broiler than inorganic Fe sulfate for Hb enhancing.

Plasma Minerals:

Table 6 shows that feeding Gimmizah hens with diets containing organic trace minerals did not influence plasma Ca and P concentration compared to those fed Inorg-TM diet. Significant increase was observed in Zn, Mn, Cu and Se concentration for hens fed 100% Org-TM, 50% Org-TM and for each trace organic mineral supplemented separately compared with Inorg-TM. Moreover, supplementation the diet with 100% or 50% Org-TM and 50% Org-Fe numerically increased blood Fe concentration compared with Inorg-TM.

The current results are keeping with those reported by Das et al. (2014) who observed that supplementation of organic minerals of Cu, Zn and Mn either alone or combination at 50% or 100 %level in layers diet had no significant differences effect on serum calcium or phosphorus. The same results were reported by Parak and Strakova (2011) who observed that the levels of serum calcium or phosphorus did not change by using Cu, Zn, Mn minerals. With respect to plasma iron concentration, Shinde et al. (2011) reported that birds fed diets supplemented with Fe increased plasma Fe than birds fed control diet. Hanafy et al. (2009) mentioned that organic Se supplementation increased plasma Se concentration in Bandarah chickens.

Physical Semen Traits:

Physical semen traits as affected by feeding different levels of organic trace minerals (Zn, Mn, Cu, Fe and Se) to Gimmizah cocks are presented in Table 7. Semen volume did not represent any significant differences between all the organic experimental groups and the control Inorg-TM. Also, data of this table reveal that semen of cocks fed trace organic minerals represented significant ($P \leq 0.05$) increase of sperm concentration ($\times 10^9$/ml), live sperm (%), sperm output (×10^9/ejaculate), number of motile sperm (×10^9/ejaculate) and number of live sperm (×10^9/ejaculate) compared with those for control Inorg-TM. Moreover, the results showed that semen of dietary organic trace minerals groups except that for Mn and Cu groups had significant increase of sperm forward motility (%) compared with those for control Inorg-TM.

Generally, no significant differences have been shown in the previous mentioned parameters for semen quality between birds fed 50% and 100% Org-TM.

These results are keeping with those reported by Hurley and Doane (1989) who reported that Zn may act indirectly through the pituitary to influence gonadotropic hormones. Amen and Al-Daraji (2011) reported that dietary zinc supplementation can be used as active tool for enhancing reproductive performance for roosters. Moreover, Aghaei et al. (2010) found a positive correlation between Zn and Cu concentrations of seminal plasma and progressive motility percent of spermatozoa. Barber et al. (2005) suggested that Zn, Mn, and Se enhance spermatogenesis and improve semen quality. Massanyi et al .(2004) found high negative correlation between iron semen concentration and tail taros .Selenium supplementation is known to affect antioxidant defense of chicken semen (Sara et al.,2008). Edens (2002) found that dietary cocks with organic Se can improve semen quality by decreasing the abnormalities of spermatozoa mid-pice damage. Also, Hanafy et al. (2009) reported that Org-Se can improve sperm motility and in turn fertility percentage.

Fertility and Hatchability:

Fertility% and hatchability of fertile eggs % as affected by feeding different organic trace minerals to Gimmizah chickens are presented in Table 8. There were a significant ($p \leq 0.05$) increases in fertility % for in groups fed 100% Org-TM,50% Org-TM, 50%Org- Cu and 50% Org-Se compared with control Inorg-TM. Also, the supplementation of organic minerals in diets significantly ($p \leq 0.05$) improved hatchability of fertile eggs% compared with control Inorg-TM. Supplementing 50% or 100% Org-TM to the diet represented the same results of improving fertility and hatchability %.

Hassan et al.(2003) reported that feed additives of Zn methionine improved fertility and hatchability %compared to inorganic diet. Moreover, Virden et al. (2003) demonstrated that breeders fed supplemental Zn and Mn amino acid complexes have progeny with improved early survival. Hanafy et al. (2009) reported that Selenium is required for proper function of the glutathione peroxidase enzymes, which play as a antioxidant enzyme. Therefore, increased fertility and hatchability percentages in organic Se group may be due to improved antioxidant status.

CONCLUSION

Supplementing the chicken's diet with organic trace minerals especially with both concentrations of complexed organic minerals (50% and 100%) realized the concept of improving fertility and hatchability percentages. These improvements as appears on the aforementioned results could be due different factors such as physical egg quality for hens and semen characteristics for cocks. Therefore, the lower concentration of total inorganic minerals (50%) is preferable due its lower cost.

Table (1): The experimental treatments

No	Abbreviation	Treatment	Description	Chemical Structure
1	100% Inorg-TM	100% inorganic trace minerals (negative control)	Inorganic trace minerals	Inorganic trace mineral in form of sulphate
2	100% Org-TM	100% organic trace minerals (positive control)	100% organic Zn, Mn, Fe, Cu, Se	Proteinate- Zn, Mn, Fe, Cu and Se
3	50%Org-TM	Organic trace minerals	50% organic Zn, Mn, Fe, Cu, Se	Proteinate- Zn, Mn, Fe, Cu, Se
4	50%Org-Zn	Organic Zn	50% organic Zn, the other minerals in inorganic forms.	Proteinate- Zn
5	50%Org-Mn	Organic Mn	50% organic Mn, the other minerals in inorganic forms.	Proteinate- Mn
6	50%Org-Fe	Organic Fe	50% organic Fe, the other minerals in inorganic forms.	Proteinate- Fe
7	50%Org-Cu	Organic Cu	50% organic Cu, the other minerals in inorganic forms.	Proteinate-Cu
8	50%Org-Se	Organic Se	50% organic Se, the other minerals in inorganic forms.	Proteinate- Se

Table (2): Composition and calculated analysis of chicken's diet.

Ingredients (%)	**Chicken's diet**
Yellow corn	63.55
Soybean meal (44%)	25.10
Wheat bran	---
Di-Ca-P	1.45
Limestone	8.10
Vit. &Min.Mix[1]	0.30
DL-Met 98%	0.10
NaCl	0.40
Mineral supplementations	1.00
Total	100
Calculated Analyses:	
Crude Protein, %	16.50
ME, Kcal/kg	2700
Ca, %	3.50
Available P, %	0.40
Met + Cys, %	0.66
Lys, %	0.89

[1] Supplied per kg of the diet: Vit A, 12000 IU; Vit D, 2000 IU; Vit. E, 40mg; Vit K_3 , 4mg; Vit B_1 , 3mg; Vit B_2, 6mg; Vit B_6 , 4mg; Vit B_{12}, 0.3mg; niacin, 30mg; pantothenic acid, 12mg; folic acid, 1.5mg; biotin, 0.08mg; choline, 300mg; Mn, 100mg; Cu, 10mg; Fe, 40mg; Zn, 70mg; Se, 0.3 mg,; I,1.5mg; Co, 0.25mg.

Table (3): Effect of dietary organic trace minerals supplementation on productive performance of Gimmizah hens

Mineral supplementations	Parameters				
	Egg production (%)	**Egg weight (g)**	**Egg mass (Kg)**	**Feed intake (g/bird /day)**	**Feed Conversion (g:g)**
100% Inorg- TM[1]	58.6±1.2	48.56±0.7	2.86±0.08	112.1±0.8	3.97±0.06
100%Org-TM[2]	59.1±1.4	49.16±0.6	2.89±0.06	113.5±0.9	3.94±0.07
50%Org-TM	58.1±1.3	50.51±0.5	2.94±0.08	113.1±1.0	3.88±0.08
50%Org-Zn	59.3±1.1	49.72±0.7	2.95±0.06	112.3±0.9	3.83±0.06
50%Org-Mn	58.2±1.1	49.29±0.6	2.86±0.05	111.6±0.7	3.91±0.05
50%Org-Fe	60.0±1.4	49.57±0.5	2.97±0.07	114.1± 0.9	3.87±0.06
50% Org-Cu	57.8±1.2	50.47±0.7	2.91±0.06	112.2±0.8	3.87±0.06
50% Org-Se	57.4±1.4	50.16±0.6	2.88±0.08	114.2±1.0	4.01±0.09

Inorg- TM[1]: negative control inorganic trace minerals; Org-TM[2]: positive control organic trace minerals; Zn:zinc; Mn:manganese ;Fe:iron; Cu:copper; Se:selenium.

Table (4): Effect of dietary organic trace minerals supplementation on physical egg quality of Gimmizah hens

Mineral supplementations	**Parameters**					
	Shell thickness without membranes (mm)	**Shell weight (%)**	**Albumen weight (%)**	**Albumen solids (%)**	**Yolk weight (%)**	**Yolk solids (%)**
100% Inorg- TM[1]	0.37 ± 0.03b	12.7±0.3	56.4± 0.6a	14.0 ±0.5	30.8 ±0.7b	51.8±0.7c
100%Org-TM[2]	0.41±0.03a	13.2±0.5	52.2±0.7d	15.1±0.2	34.5±0.1a	57.5±0.6a
50%Org-TM	0.42±0.03a	13.1±0.1	55.5±0.4abc	14.3±0.6	31.3±0.2b	57.3±0.9a
50%Org-Zn	0.39±0.02ab	14.1±0.6	51.7±0.7d	15.1±0.5	34.1±0.9a	56.2±0.5ab
50%Org-Mn	0.42±0.02a	13.0±0.5	54.2±0.5abcd	14.3±0.6	32.7±0.8ab	56.7±0.6ab
50%Org-Fe	0.38±0.02ab	13.1±0.4	55.9±0.6ab	14.7±0.1	30.9±0.4b	56.5±0.5ab
50% Org-Cu	0.41±0.03a	13.5±0.3	53.2±0.9cd	14.8±0.3	33.2±0.7ab	54.3±0.9b
50% Org-Se	0.41±0.02a	13.5±0.5	53.6±0.9bcd	14.9±0.5	32.8±0.9ab	55.3±0.6ab

[a, b,c,d] Means with no common superscripts within each column are significantly different (P < 0.05).

Inorg- TM[1]: negative control inorganic trace minerals; Org-TM[2]: positive control organic trace minerals; Zn:zinc; Mn:manganese ;Fe:iron; Cu:copper; Se:selenium.

Table (5): Effect of dietary organic trace minerals supplementation on hematological parameters of Gimmizah hens

Mineral supplementations	**Parameters**			
	W.B.C ($10^3/mm^3$)	**R.B.C ($10^6/mm^3$)**	**Hb (g/dl)**	**P.C.V (%)**
100% Inorg- TM[1]	8.5±0.1 b	2.1±0.1c	9.5±0.1c	30.3±0.4
100%Org-TM[2]	9.2±0. 2 a	2.5±0.0a	10.3±0.1a	32.3±0.9
50%Org-TM	9.1±0.1 a	2.4±0.0ab	10.1±0.1ab	32.8±0.6
50%Org-Zn	8.6±0.1 b	2.3±0.0bc	9.5±0.0c	31.8±0.9
50%Org-Mn	8.5± 0.1 b	2.3±0.0bc	9.9±0.1abc	31.7±0.3
50%Org-Fe	8.5± 0.1 b	2.6±0.1a	10.3±0.1a	32.7±0.9
50% Org-Cu	8.6±0.1 b	2.4±0.1abc	9.9±0.1abc	31.8±0.7
50% Org-Se	9.2±0.1 a	2.3±0.0bc	9.7±0.1bc	31.1±0. 2

$^{a, b,c}$ Means with no common superscripts within each column are significantly different ($P < 0.05$).

Inorg- TM[1]: negative control inorganic trace minerals; Org-TM[2]: positive control organic trace minerals; Zn:zinc; Mn:manganese ;Fe:iron; Cu:copper; Se:selenium.

Table (6): Effect of dietary organic trace minerals supplementation on blood minerals concentration of Gimmizah hens

Mineral supplementations	**blood minerals concentration**						
	Ca (mg/dl)	**P (mg/dl)**	**Zn (mg/dl)**	**Mn (mg/dl)**	**Fe (mg/dl)**	**Cu (mg/dl)**	**Se (mg/L)**
100% Inorg- TM[1]	10.6±0.2	5.70±0.2	4.24±0.3d	0.181±0.0c	304.2±2.2	0.332±0.0d	0.060±0.0b
100%Org-TM[2]	10.7±0.2	6.00±0.2	4.83±0.1a	0.192±0.0a	314.0±2.9	0.348±0.0a	0.077±0.0a
50%Org-TM	10.8±0.2	6.10±0.2	4.61±0.1b	0.190±0.0ab	314.0±4.3	0.341±0.0bc	0.075±0.0a
50%Org-Zn	10.9±0.2	5.80±0.1	4.56±0.1b	0.181±0.0c	304.6±4.2	0.335±0.0d	0.060±0.0b
50%Org-Mn	11.1±0.2	5.90±0.2	4.53±0.1bc	0.188±0.0ab	304.1±4.8	0.336±0.0cd	0.058±0.0b
50%Org-Fe	10.9±0.2	6.10±0.1	4.38±0.1d	0.186±0.0b	312.2±3.9	0.336±0.0cd	0.060±0.0b
50% Org-Cu	10.1 ±0.2	5.80±0.1	4.36±0.1d	0.186±0.0b	308.7±2.9	0.345±0.0ab	0.058±0.0b
50% Org-Se	10.9±0.2	5.90±0.2	4.49±0.1cd	0.186±0.0b	305.9± 2.9	0.331±0.0d	0.079±0.0a

[a, b,c,d] Means with no common superscripts within each column are significantly different ($P < 0.05$).

Inorg- TM[1]: negative control inorganic trace minerals; Org-TM[2]: positive control organic trace minerals; Zn:zinc; Mn:manganese ;Fe:iron; Cu:copper; Se:selenium.

Table (7): Effect of dietary organic trace minerals supplementation on physical semen parameters of Gimmizah cocks

Mineral supplementations	**Semen parameters**						
	Ejaculate volume(ml)	**Sperm concentration (× 10^9/ml)**	**Sperm forward motility(%)**	**Live sperm (%)**	**Sperm output (× 10^9/ejaculate)**	**Number of motile sperm(× 10^9/ejaculate)**	**Number of live sperm (× 10^9/ejaculate)**
100% Inorg- TM^1	0.25±0.01	0.21±0.01c	90.0± 1.3c	98.4± 0.1c	0.051± 0.001c	4.1±0.3c	5.7±0.2 c
100%Org-TM^2	0.25±0.06	0.31±0.01a	93.5±0.7ab	99.2±0.0b	0.077±0.003a	7.2±0.2a	7.7±0.1a
50%Org-TM	0.24±0.07	0.32±0.01a	93.3± 0.7ab	99.7±0.1a	0.073±0.001ab	6.8 ±0.2ab	7.3±0.2ab
50%Org-Zn	0.23±0.07	0.32±0.04a	94.3±1.0ab	99.7±0.1a	0.073±0.004ab	6.8±0.2ab	7.2±0.0a
50%Org-Mn	0.26±0.01	0.31±0.01a	91.2±1.3bc	99.7±0.1a	0.080±0.002a	7.2±0.2a	8.1±0.2a
50%Org-Fe	0.28±0.07	0.25±0.01b	94.3±1.0ab	99.0±0.1b	0.068±0.003b	6.3±0.2b	6.8±0.3b
50% Org-Cu	0.27±0.02	0.29±0.02a	91.6±1.1bc	99.9±0.1a	0.076±0.001a	6.9±0.3ab	7.6±0.2 a
50% Org-Se	0.25±0.07	0.30±0.01a	96.0±0.3a	99.9±0.1a	0.074±0.001ab	7.1±0.2a	7.4±0.2ab

$^{a, b,c,d}$ Means with no common superscripts within each column are significantly different ($P < 0.05$).

Inorg- TM^1: negative control inorganic trace minerals; Org-TM^2: positive control organic trace minerals; Zn:zinc; Mn:manganese ;Fe:iron; Cu:copper; Se:selenium.

Table (8): Effect of dietary organic trace minerals supplementation on fertility and hatchability of Gimmizah chickens

Mineral supplementations	Parameters	
	Macroscopic fertility (%)	**Hatchability of fertile eggs (%)**
100% Inorg- TM[1]	90.47± 0.80c	87.20± 0.40c
100%Org-TM[2]	93.20 ± 0.34a	92.58± 0.44a
50%Org-TM	93.60 ± 0.33a	92.53± 0.90a
50%Org-Zn	91.37 ± 0.54bc	89.90± 0.23b
50%Org-Mn	91.60 ± 0.49bc	90.50± 0.44b
50%Org-Fe	91.20 ± 0.21bc	91.10± 0.31b
50% Org-Cu	92.10 ± 0.43ab	89.70± 0.50b
50% Org-Se	92.40 ± 0.60ab	90.30± 0.34b

a, b,c,d Means with no common superscripts within each column are significantly different ($P < 0.05$).

Inorg- TM1: negative control inorganic trace minerals; Org-TM2: positive control organic trace minerals; Zn: zinc; Mn: manganese ;Fe: iron; Cu: copper; Se: selenium.

REFERENCES

Abdallah, A. G., O. M. El-Husseiny, and K. O. Abdel –Latif.2009. Influence of some dietary organic mineral supplementations on broiler performance. International Journal of Poultry Science. 8:291-298.

Aghaei, A., S. Tabatabaei , and M. Nazari. 2010. The correlation between mineral concentration of seminal plasma and spermatozoa motility in rooster. Journal of Animal and Veterinary Advances. 9:1476-1478.

Allgöwer, M., G. A.Schoenenberger and B. G. Sparkes. 1995. Burning the largest immune organs. Burns. 21: 7-47.

Amen, M. H. M., and H .J. Al-Daraji. 2011. Effect of dietary Zinc supplementation on some seminal plasma characteristics of broiler breeders 'males. International Journal of Poultry Science .10: 814-818.

Bao, Y.M, M. Choct, I. J. I. Pa, and K.Bruerton. 2007. Effect of organically complexes copper, iron, manganese, and zinc on broiler performance, mineral excretion, and accumulation in tissues. J Applied Poultry Research. 16: 448-455.

Barber, S. J., H. M. Parker, and C. D. Mcdaniel. 2005. Broiler breeder semen quality as affected by trace minerals in vitro. Poultry Science .84:100–105.

Dale. N.,and C. F. Strong. 1998. Inability to demonstrate an effect of egg shell on shell quality in older laying hens. Journal of Applied Poultry Research. 7:219-224.

Das, A., S. K. Mishara, R. K. Swain, G. Sahoo, N. C. Behura, K. sethi, B. Chichilichi, S. R. Mishra, T. Behera, K. Dhama and P. Swain.2014. Effect of organic minerals supplementation on growth, bioavailability and immunity in layers chicks. International Journal of Pharmacology. 10:237-247

Dieck, H. T., F. Doring, H. P. Roth, and H. Daniel. 2003. Changes in rat hepatic gene expression in response to zinc deficiency as assessed by DNA arrays. J. Nutr. 133: 1004-1010.

Dobrzanski, Z., M. Korczynski, K. Chonjnacka, H. Gorecki, and S. Optalinski. 2008. Influence of organic forms of copper, manganese and iron on bioaccumulation of these metals and zinc in laying hens. J Elemental. 13:309–319.

Duncan, D. B. 1955. Multiple Rang and Multiple F Tests. Biometrics. 11:1-42.

Edens, F. W. 2002. Practical applications for selenomethionine: broiler breeder reproduction. In: Biotechnology in the Feed Industry. Proceedings of Alltech's the 18th Annual Symposium, Edited by Lyons, T. P. and K. A. Jacques, Nottingham University Press, Nottingham, UK. 29 -42.

El-Sahn, A. Amany, and Hanaa. M. Khalil. 2005. The accuracy efficiency of various methods to estimate spermatozoa concentration in local chicken strains. Proc 2nd Conf. Anim. Prod. Res. Inst., Sakha 27-29 Sep. pp: 271-276.

El-Sheikh, A. M. H., E. A. Abdalla, and M . M. Hanafy.2010. The effect of organic selenium supplementation on productive and physiological performance in a local strain of chicken. 2- immune system and some physiological aspects in Bandarah chicks affected by organic selenium. Egypt. Poultry Science. 30: 517-533.

Fekete, S. G., and R. O. Kellems. 2007. Interrelationship of feeding with immunity and parasitic infection: a review. Vet Med–Czech.52: 131-143.

Fernandes, J. I. M, Murakami, A. E. Sakamoto, I. M. G. Souza, A. Malaguido and E. N. Martins .2008. Effects of organic mineral dietary supplementation on production performance and egg quality of white layers. Brazilian Journal of Poultry Science .10: 59 – 65.

Georgievski, V. I. 1982. Mineral nutrition of animals. London: Butterworts. 475p.

Hanafy, M. Maysa, A. M. H. El-Sheikh and E. A. Abdalla. 2009. The effect of organic selenium supplementation on productive and physiological performance in a local strain of chicken. 1- The effect of organic selenium (Sel–Plex TM) on productive, reproductive and physiological traits of Bandarah local strain. Egypt. Poultry Science. 29:1061-1084.

Hassan, R. A, E. H. ELGanzoury, F. A, AbdELGhany, and M. A. Shehata. 2003. Influence of dietary zinc supplementation with methionine or microbial phytase enzyme on productive and reproductive performance for Mandarah strain. Egypt. Poultry Science. 23: 761-785

Hurley, W. L, and R. M. Doane. 1989. Recent developments in the roles of vitamins and minerals in reproduction. J Dairy Science. 72:784-804.

Hudson, B. P., B. D. Fairchild, 1 J. L. Wilson, W. A. Dozierand R. J. Buhr. 2004. Breeder age and zinc source in broiler breeder hen diets on progeny characteristics at hatching .J. Applied. Poultry Research. 13:55–64.

Hussain, M. I., S. A Khan, Z. I. Chaudhary, A. Aslam, K. Ashraf and M. F. Rai. 2004. Effect of organic and inorganic selenium with and without vitamin E on immune system of broilers. Pakistan Veterinary Journal .24:1-4.

Leeson, S. A. 2003. New look at trace mineral nutrition of poultry: Can we reduce the environmental burden of poultry manure? In, Lyons TP, Jacques KA (Eds): Nutritional Biotechnology in the Feed and Food Industries. pp. 125-129, Nottingham.

Leeson, S., J. D. Summers .2001. Nutrition of the chickens.4.ed. Guelph: University Booksp:591

Ma, X .Y., S. B. Liu, L. Lu , Li .SF, J. J. Xie, L. Y. Zhang , J. H. Zhang, and X. G. Luo.2014. Relative bioavailability of iron proteinate for broilers fed a casein-dextrose diet. Poultry Science . 93:556-63.

Maciel, M. P., A. P. Saraiva, E. F. Aguiar, P. A. P. Ribeirom D. P. Passos, and G. B. Silva. 2010. Effect of using organic micro minerals on performance and external quality of eggs of commercial laying hens at the end of laying. RevistaBrasileira de Zootecnia.39: 344-34

Mabel, I., C. Rapp, M. M. Bain, and Y. Nys. 2003. Supplementation of a corn and soybean meal diet with manganese, copper, and zinc from organic or inorganic sources improves eggshell quality in aged laying hens. Poultry Science. 82:1903-1913.

Massányi, P., J. Trandzik, P. Nad, B. Koreneková, M. Skalická, R. Toman, N. Lukac, M. Halo, and P. Strapak. 2004. Concentration of copper, iron, zinc, cadmium, lead, and nickel in bull and ram semen and relation to the occurrence of pathological spermatozoa. Journal of Environmental Science and Health.39:3005-14.

National Research Council (NRC). 1994. National Academy Press. Washington, USA.

Nollet, L., J. D, van der Klis, M. Lensing, and P. Spring. 2007. The effect of replacing inorganic with organic trace minerals in broiler diets on productive performance and mineral excretion. J Applied Poultry Research. 16: 592-597.

Ozturk-Urek, R., L. A.Bozkaya, and L. Tarhan. 2001. The effects of some antioxidant vitamin- and trace element supplemented-diets on activities of SOD, CAT, GSH- Px and LPO levels in chicken tissues. Cell Biochem. 19: 125 – 132.

Parak, T. ,and E. Strakova. 2011. Zinc as a feed supplement and its impact on plasma cholesterol concentrations in breeding cocks. Act Veterinaria Brno 80: 281-285.

Payane, R. L., T. K. Lavergne, and L. L . Southern .2005. Effect of inorganic versus organic selenium on hen production and egg selenium concentration.Poultry Science. 84:232-237.

Richards, D. J., J. Zhao, R. J. Harrell, C. A. Atwell, and J. J.Dibner .2010. Trace mineral nutrition in poultry and swine. Asian.Aust. J. Anim. Science.23:1527 – 1534.

Rutz, F., M. A. Anciuti and J. L. Rech.2004. The impact of organic minerals on performance of poultry. In: Annual Australian Poultry Science Symposium, Sydney/Austrália. 1:71-74.

Sara, A., M. Bennea, A. Odagiu, L., and L.Pantă, 2008. Effects of the organic selenium (Sel-Plex) administered in laying hens' feed in second laying phase on production performances and the eggs quality. Bulletin UASVM Animal Science and Biotechnologies. 65:1-2.

Saripinar Aksu D., T. Aksu, B. Ozsoy, and B. Devrim. 2010. The Effects of Lower Supplementation Levels of Organically Complexes Minerals (Zinc, Copper and Manganese) Versus Inorganic forms on Hematological and Biochemical Parameters in Broilers.KafkasUniv Vet FakDerg .16: 553-559.

SAS, (2004). SAS/STAT User's Guide.Version9.1.SAS Inst. Inc., Cary. NC.

Scott, M. L., M. C. Nesheim, and R. G. Young 1982. Nutrition of the chicken. 3ed. Ithaca: ML Scott and Associates, 562.

Sechinato,A.S., R. Albuquerque, S. Nakada. 2006. Efeito da suplementaçdietética com micro mineraisorgânicosnaproduçlo de galinhaspoedeiras. Brazilian Journal Veterinary Research Animal Science 43:159-166.

Shinde, P. L., S. L. Ingale, J. Y. Choi , J. S. Kim, S. I. Pak, and B. J. Chae. 2011. Efficiency of inorganic and organic iron sources under iron depleted conditions in broilers. British Poultry Science . 52:578-83.

Siske, V., L. Zeman, and D. Klecker.2000. The egg shell: A case study in improving quality by altering mineral metabolism-naturally. In: Lyons TP, Jacques KA, editor. Biotechnology in the feed industry. Proceedings of All tech's 16th Annual Symposium. T. P. Nottingham, UK: Nottingham University Press. P:327.

Swiatkiewicz, A. Arczewska-Wlosek and D.Jozefiak .2014. The efficacy of organic minerals in poultry nutrition: review and implications of recent studies. World's Poultry Science Journal.70:457-486

Underwood, E. J. 1999. The mineral nutrition of livestock.3.ed. Wallingford: CABI,. 614p.

Virden; W. S, J. B. Yeatman, S. J. Barber, C. D. Zumwalt, T. L. Ward, A. B. Johnson, and M. T. Kidd. 2003. Hen mineral nutrition impacts progeny livability. Journal of Applied Poultry Research. 12:411-416.

الملخص العربى

تأثير أضافة المعادن العضوية (الزنك والمنجنيز والحديد والنحاس والسيلنيوم) على الاداء الانتاجى والتناسلى والمناعى لدجاج الجميزة

**عبـــده جاد عبدالله ، هنـــاء محمد خليل، أمانــــى عــادل الصحن، امينه شعبان السعدنى، عفت يحيى الشريف،
نـهاد عبد الجليل، نجدة السيد عمر، امل عبد السلام**

تم عمل هذه الدراسة لتقييم تأثير بعض الاضافات المعدنية العضوية النادرة فى العلف على الاداء الانتاجى والتناسلى و كذلك الاستجابة المناعيه لدجاج الجميزة. تم توزيع ١٦٠ دجاجة و٤٠ ديك عند عمر ٢٤ اسبوع عشوائيا على ٨ مجاميع (٢٠ دجاجة و٥ ديك/مجموعة) وتم انهاء التجربة عند ٤٠ اسبوع من العمر.تم تغذية الطيور على ٨ مجاميع. تم عمل مجموعتين مقارنة وذلك للحصول على كافة الاحتياجات الغذائية كما هو موصى به فى NRC ١٩٩٤ .الاولى مجموعة مقارنة سالبة تم امدادها بكل العناصر المعدنية النادرة فى صورة غير عضوية والثانية مجموعة مقارنة موجبة تم امدادها بكل العناصرالمعدنية فى صورةعضوية .المجموعة الثالثة تم امدادها ٥٠% من كل المعادن العضوية النادرة. باقى الخمس مجاميع تم امدادها ٥٠ % فى الصورة العضوية لكل من زنك او منجنيزاوحديد اونحاس اوسيلينيوم ،على التوالى. تم عمل البيرميكس ليحتوى على الاحتياجات من المعادن النادرة اما فى صورة غير عضوية (سلفات) او صورة عضوية (ببتيدات) او كلاهما.

تدل.نتائج البحث على :

١- اضافة المعادن العضوية النادرة لعليقة الدجاج لم يؤثر على انتاج البيض % ووزن وكتلة البيض والعلف المأكول وكذلك على الكفاءة التحويلية مقارنة بمجموعة المعادن الغير عضوية النادرة. ومع ذلك الدجاج المغذى على المعادن العضوية بمستويات مختلفة حقق اعلى وزن بيض مقارنة بتلك الخاصة بمجموعة المعادن الغير عضوية.

٢- الدجاج المغذى على خليط من المعادن العضوية النادرة (زنك- منجنيز- حديد- نحاس- سلينيوم) بنسبة ١٠٠% او٥٠% انتج بيضا ذو قشرة اسمك واعلى فى النسبة المئوية لوزن المادة الجافة للصفار مقارنة بالعناصر الغير عضوية النادرة.

٣- زادت كرات الدم البيضاء والحمراء والهيموجلوبين فى الدجاج المغذى على مستويات ١٠٠% و٥٠% من المعادن العضوية($P\leq0.05$) مقارنة بتلك المغذاة على المعادن الغير عضوية المضافة.

٤- هناك زيادة معنوية فى تركيز كلا من الزنك و المنجنيز والنحاس والسيلنيوم فى بلازما الدجاج المغذى على ٥٠% و١٠٠% معادن عضوية نادرة مضافة وعلى كل عنصر تم تغذيته بصورة منفردة مقارنة بالمجموعة الكنترول (معادن غير عضوية نادرة).

٥- اظهر السائل المنوى للديوك المغذاة على المعادن العضوية النادرة اعلى زيادة معنوية فى كل من تركيز الحيوانات المنوية والنسبة المئوية للحيوانات المنوية الحية وانتاج الحيوانات المنوية وعدد الحيوانات المنوية المتحركة وعدد الحيوانات المنوية المتحركة مقارنة بتلك الناتجة فى ديوك مغذاة على معادن غير عضوية نادرة .

٦- كان هناك زيادة فى نسبة الخصوبة للمجاميع المغذاة على ١٠٠% و٥٠ % معادن عضوبة نادرة و٥٠% نحاس عضوى و٥٠% سيلنيوم عضوى مقارنة بمجموعة المعادن غير عضوية نادرة. استخدام المعادن العضوية فى العلف حسن معنويا نسبة الفقس مقارنة بمجموعة المعادن الغير عضوية النادرة.