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IMPACT OF FEED RESTRICTED SYSTEM AND ZINC FORMS ON SOME PRODUCTIVE PERFORMANCE TRAITS, EGG QUALITY PARAMETERS AND ECONOMIC EFFICIENCY OF MANDARAH LAYING HENS.

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ABSTRACT:

This study was conducted to determine the effect of feeding different level of restricted feed with different forms of zinc(Zn) on productive performance, egg quality traits and economic efficiency of Mandarah (*Egyptian local developed strain*) *laying hens. A total number of 270 laying hens + 27 cocks, 24 weeks old were randomly taken* to be *similar in* ***(1228.0 ±44.0 g)*** *in the study. Birds were randomly divided into nine experimental groups,(30 hens + 3 cocks in each group) and each group was contained three replicates (10 hens+ 1 cock / replicate). The experimental groups involved a3x3factorial arrangement, 3 zinc forms (control, organic zinc and Nano-Zn) and 3 levels of restricted system groups (ad libitum, 90 % and 80 % / hen / day) were fed a balanced basal diet without supplemented zinc as a control or supplemented with 50 mg Nano - zinc /Kg diet or 50 mg zinc from zinc methionine /Kg diet, respectively),during the experimental period lasted six month.*

The obtained results showed t*hat laying hens fed ad libitum / hen /day and 50mg Nano-Zn/Kg diet recorded the highest (P<.01) for egg production(%), egg weight, egg mass, feed conversion / eggs and body weight compared with the control and other groups.*

Dietary Nano-Zn increased significantly total body weight change, egg production (%); egg mass and improve feed conversion / eggs, most of egg quality.

*Receiving 90% feed/ hen/day recorded the best of economic efficiency. The best value of net revenue and economic efficiency of laying feeding 90% hen / day and supplemented organic zinc****.***

Conclusively, *feeding restricted system at level of 90% and dietary* *recommended to improve productive performance traits, egg quality parameters and economic efficiency of Mandarah laying hens.*

Key words: Feed restriction, zinc forms, productive traits, egg quality, economic efficiency, laying hens

INTRODUCTION

Feed management practices aiming to improve poultry industry without increasing production cost (Mateos *et al.,* 2012). Feed restriction is one of the possible ways to control body weight of hens during laying period and maximize the metabolic rate to some extent as well as improving feed conversion and reducing feed cost. Therefore, poultry egg producers use feed restriction programs to prevent birds from getting over weighed, to delay sexual maturity, to avoid reproductive dysfunction, and to increase the egg production (Renema and Robinson, 2004).

Recently, published results have reported that the ¾ feed restriction program employed during the rearing stage provides the best performance and reproductive traits response of broiler breeder hens reared on floor pens (Carneiro *et al*., 2019). Moreover, Moreira *et al.* (2012) observed that laying hens fed 5%restricted feed with supply of hay *ad* -libitum had no significant effects on the production performance of the hens and egg quality.

In previous study, a significant effect of feed restriction on egg production in Bovan Near layer strain was documented without significant effect on egg quality trait (Fasuyi and Ojo, 2012). In contrast, other investigators reported that feed restriction has no significant effect on egg number, hen-day egg production, egg weight and egg quality (Osman *et al.,* 2010). The researchers however, found significant effect of feed restriction on yolk index and Haugh units between Hisex Brown and Bovan White strains of layers.

Zinc has significant roles in the organism because it is a cofactor of more than 200 enzymes. One of the most significant functions of zinc is related to its antioxidant role and its participation in the antioxidant defense system (Powell, 2000). Zinc deficiency provokes oxidative damage through the effect of free radical action and alters the status antioxidant enzymes and substances (Salgueiro *et al.,* 2000). Zn-methionine or Zn-propionate had more bioavailability than inorganic zinc sources such as ZnO or $ZnSO_4H_2O$ (Rahman *et al.,* 2002). Khajaren *et al.* (2006) observed improvements in egg production of layers fed organic zinc.

In general, the smaller particles, are more effective in absorption, especially if the particle size is below 100 nm, therefore, it was hypothesized that nanoparticles were easier to absorb compared to their inorganic or organic counterparts (Hett, 2004). Nano trace element may enter the animal's body through direct penetration; therefore, its utilization rate will be much higher than that of the inorganic trace elements (Huang *et al*., 2015). Sahoo *et al.* (2014) and Mohammadi *et al.* (2015) reported that the tibia Zn concentration in Nano Zn group was higher compared to that in the Zn-sulphate group in broiler chickens.

The use of Nano minerals, such as Nano-selenium, Nano-chromium, or nano-zinc, may improve the animal production parameters, their health status and quality of products obtained from them, the conducted researches proved that Nano element form can be used better than the inorganic form, however minerals in the chelates form is used on a large scale in the feed industry (Rajendran, 2013).

Therefore, the aim of the present study was to evaluate the effect of restricted feed and different forms of dietary Zn supplementation on some productive performance traits and egg quality of laying hens.

MATERIALS AND METHODS

Birds, management and experimental design:

Thepresent study was carried out at Inshas Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Egypt.

A total number of 270 Mandarah (Egyptian local developed strain) laying hens+ 27 cocks, 24 weeks old was randomly taken from the farm flock, to be similar in body weight (1228.0±44.0 g) . Birds were randomly divided into nine treatment groups (30 hens + 3 cocks in each group) and then each treatment group was divided into three replicates (10 hens+ 1 cock /replicate). The experimental groups involved a 3 x 3 factorial arrangement, 3 zinc forms (control, organic zinc and Nano-Zn) and 3 levels of restricted system groups (ad libitum, 90 % and 80 % / hen / day) were fed a balanced basal diet without supplemented zinc (control) or supplemented with 50 mg Nano - zinc /Kg diet or50 mg zinc from zinc methionine /Kg diet, respectively),during the experimental period lasted six month.

All birds were housed individually in layer's rooms and maintaining in similar managerial and conditions environment with a photoperiod length of 17 h daily.Feed and water were provided ad libitum throughout, the experimental period (24-48 weeks of age). Experimental diets were formulated to be *is nitrogenous* and *iso- caloric* to cover the nutrients requirements as recommended by Agriculture Ministry Decree (1996) as shown in Table 1.

Table 1: Chemical Composition and calculated analysis of the experimental basal diet

Ingredients	%
Yellow corn	63.15
Soybean meal (44%)	23.29
Corn gluten meal (60%)	3.02
Mono calcium phosphate	1.39
Lime stone	8.40
Salt (Nacl)	0.40
Vitamins and minerals mixture*(Without zinc)	0.30
DL-methionine	0.05
Total	**100.00**
Determined analysis**	
Crude protein (%)	17.00
Available phosphorus (%)	0.72
Calcium (%)	3.41
Lysine (%)	0.868
Methionine (%)	0.377
Methionine+ Cystine (%)	0.666
Zinc mg./kg***	35
Metabolizable energy (Kcal ME/kg diet) ****	2748

Each 3 kg of Vitamins and Minerals mixture * contains: Vit. A 10000,000 IU; Vit.D3 2000,000 IU; Vit. E 10,000 mg; Vit.K_3 1000 mg; Vit.B_1 1000 mg; Vit.B_2 5000 mg; Vit.B6 1500 mg; Vit. B_{12} 10 mg; Pantothenic acid 10,000 mg; Niacin 30,000 mg; Folic acid 1000 mg; Biotin 50 mg; Choline 250,000 mg; Manganese 60,000 mg; Copper 4,000 mg; Iron 30,000mg; Iodine 300 mg; Cobalt 100 mg; CaCO3 to 3,000gm.

**A According To Egyptian feed composition Tables (2001)

***According To AOAC(1998)

****According To NRC (1994)

Measurements:

Body weight (BW) of bird at 24 and 48 weeks of age and change body weight (%) was recorded. Daily and total egg number and egg weight (g) were recorded for each hen/in eavh group, while daily and total feed intake was recorded, during the experimental periods.

Egg production rate (%) was calculated for four weeks intervals, during the production periods as egg number/hen/period for each replicate and calculated the average of the whole experimental period.

Egg mass was calculated by multiplying egg number X average egg weight. Feed conversion (g feed /g mass and Kg feed/ eggs) was calculated as

Kg feed consumption produced number of eggs for four weeks intervals and the whole experimental period.

Egg quality parameters were measured at the end of the experimental period, in which 5 eggs were randomly chosen from each treatment group.

External egg quality parameters such as egg weight, egg shape index (%) were measured. However, internal egg quality parameters such as yolk index (%), albumin index (%), Haugh units and shell thickness were calculated and percentages of egg components (yolk, albumin and shell weight / egg weight x100) were determined.

Eggs were individually weighed and broken and egg shell, yolk and albumen were weighed. Egg shell thickness, including shell membranes, was measured using a micrometer at the equator. Egg shape index and yolk index values were measured according to Sauter *et al.* (1951). Haugh unit scores were applied from a special chart using egg weight and albumin height, which was measured by using a triple micrometer according to Haugh (1937), Kotaiah and Mohapatra (1974) and Eisen *et al.* (1962).

Economic efficiency (EEF):

Economic efficiency (%) of egg production was calculated from the input-output analysis, which was calculated according to the price of the experimental diets and eggs produced. These values were calculated as the net revenue per unit of total cost.

Statistical analysis:

The data were statistically analyzed using SAS (2004) from all the response variables, which were subjected to factorial analysis (3×3) of variance according to Snedecor and Cochran (1982). To test the effect of feeding restricted system and zinc forms of bird was as following Model:

$$Y_{ijk} = \mu + F_i + Z_{j+} (FZ)_{ij} + e_{ijk}$$

Where: Y_{ijk}= Any observation, μ = Overall mean, F_i= Feed systems (i= 1,2 and 3), Z_j= Zinc forms (l= 1,2 and 3), $(FZ)_{ij}$= Interaction between feed restriction and zinc forms(ij= 1, 2 ….9), e_{ijk} = Random error.

The variations among averages of the different experimental groups were calculated according to Duncan (1955).

RESULTS AND DISCUSSION

Productive performance traits:

The effect of feed restriction or zinc forms and their interaction on productive performance for the whole experimental period are shown in Table 2.

Table (2): Effect of feed restriction and different supplemental zinc forms on productive performance traits of laying hens from 24 to 48 weeks of age.

Items		BW change(g)	Egg weight(g)	Egg number	Egg mass (g/d)	DFI (g/d)	TFI (kg)	FC(g feed /g egg mass)	FC(kg feed / eggs)	EPR %
Feeding system										
ad libitum		335.00± 14.75^{a}	49.34± 0.12^{a}	104.1± 0.9^{a}	30.57± 0.85^{a}	118.93± 0.37^{a}	19.98± 0.06^{a}	3.92± 0.11^{a}	5.21± 0.14^{b}	61.96± 1.64^{a}
90%		283.89± 15.89^{b}	48.94± 0.20^{ab}	99.6± 0.72	29.17± 0.78^{b}	107.56± 0.19^{b}	18.07± 0.03^{b}	3.71± 0.10^{b}	5.54± 0.13^{a}	59.62± 1.48^{b}
80%		230.00± 19.54^{c}	48.21± 0.12^{b}	88.83± 0.46^{c}	24.47± 0.54^{c}	95.78± 0.18^{c}	16.09± 0.18^{c}	3.93± 0.08^{a}	5.30± 0.11^{ab}	50.79± 1.07^{c}
Sig. test		**	**	**	**	***	***	**	*	**
*Zinc forms*01±										
Un-supplemented		246.94± 17.07^{b}	48.59± 0.25	90.15± 0.67^{c}	25.65± 0.84^{c}	107.15± 3.38	18.00± 0.57	4.18± 0.07^{a}	4.93± 0.08^{c}	52.77± 1.54^{c}
50mg Nano-zinc		321.11± 18.89^{a}	49.08± 0.19	103.05± 1.01^{a}	30.34± 1.05^{a}	107.78± 3.37	18.11± 0.57	3.56± 0.04^{c}	5.74± 0.07^{a}	61.81± 1.94^{a}
50 mg organic zinc		280.83± 23.42^{ab}	48.81± 0.19	98.79± 0.77^{b}	28.22± 0.99^{b}	107.33± 3.30	18.03± 0.55	3.81± 0.05^{b}	5.39± 0.06^{b}	57.80± 1.86^{b}
Sig. test		**	NS	**	**	NS	NS	**	**	**
Interaction effect										
ad libitum	0	294.17± 2043^{bcd}	49.14± 0.35^{abc}	95.01± 1.27^{c}	27.80± 1.25^{c}	118.78± 0.62^{a}	19.95± 0.10^{a}	4.29± 0.19^{a}	4.76± 0.19^{d}	56.55± 2.27^{c}
	Nano-Zn	376.67± 18.33^{a}	49.55± 0.12^{a}	112.02± 0.49^{a}	33.03± 0.35^{a}	119.44± 0.29^{a}	20.07± 0.05^{a}	3.93± 0.08^{b}	5.58± 0.09^{b}	66.69± 0.88^{a}
	Or-Zn	334.17± 12.44^{ab}	49.32± 0.05^{ab}	105.27± 0.28^{b}	30.89± 0.21^{b}	118.56± 0.99^{a}	19.92± 0.17^{a}	4.18± 0.07^{a}	5.29± 0.06^{b}	62.66± 0.51^{b}
90%	0	250.00± 7.64^{cde}	48.63± 0.48	91.29± 0.15^{d}	26.43± 0.14^{cd}	107.22± 0.40^{b}	18.01± 0.07^{b}	3.56± 0.04^{c}	5.07± 0.01^{c}	54.35± 0.27^{c}
	Nano-Zn	308.33± 29.49^{abc}	49.32± 0.10^{ab}	104.88± 0.83^{b}	31.73± 0.32^{b}	107.78± 0.40^{b}	18.11± 0.07^{b}	3.81± 0.05^{b}	5.98± 0.08^{a}	64.40± 0.79^{b}
	Or-Zn	293.33± 34.44^{bcd}	48.87± 0.31^{abcd}	101.01± 0.03^{bc}	29.35± 0.22^{b}	107.67± 0.19^{b}	18.09± 0.03^{b}	4.29± 0.19^{a}	5.58± 0.02^{b}	60.12± 0.06^{b}
80%	0	196.67± 25.22^{e}	48.01± 0.31$_{e}$	84.12± 0.58e	22.74± 0.28^{e}	95.44± 0.29^{c}	16.03± 0.05^{c}	3.62± 0.05^{cd}	4.97± 0.09	47.42± 0.80^{d}
	Nano-Zn	278.33± 22.15bcd	48.37± 0.09^{bcd}	92.28± 0.25^{d}	26.27± 0.23^{cd}	96.11± 0.29^{c}	16.15± 0.05^{c}	3.84± 0.04^{bc}	5.65± 0.04^{b}	54.33± 0.56^{c}
	Or-Zn	215.00± 39.69^{de}	48.13± 0.25^{de}	90.06± 0.40^{de}	24.41± 0.43^{d}	95.78± 0.29^{c}	16.09± 0.05^{c}	4.06± 0.04^{b}	5.29± 0.12^{b}	50.63± 0.9
Sig. test		**	**	**	**	***	***	**	**	**

a, b, c: Means in each classification in the same column with different superscripts, differ significantly (P<0.05), N.S: Not Significant, * P < 0.05, **P< 0.01, ***P < 0.001, BW: Body weight, DFI: Daily feed intake, TFI: Total feed intake, FC: Feed conversion, EPR Egg production rate

Feeding *ad libitum* of the diet significantly ($P \leq 0.01$) improved egg production percentage, egg mass and body weight change of layer compared with 90%or 80% hens. The best feed conversion ratio for laying was recorded with birds fed 90% hens as compared with those fed 80%or ad libitum / hens.

Nano-Zn supplementation in layer diets significantly ($P \leq 0.01$) increased egg production percentage, egg mass and body weight change and improved feed conversion ratio compared with organic Zn and un- Zn supplementation.

Table (2) show that egg production percentage, egg mass, body weight change and feed conversion were significantly ($P \leq 0.01$) influenced by interaction between feed restriction and zinc forms. On the other hand, the egg weight was not significantly affected by the interaction between feed restriction and zinc forms.

These results agreed with Souza *et al.* (2005) who found that the poultry production in the free-range system to be feasible should be directed to the use of alternative feeding and pastures, in the free-range system. The same author added that feeding of birds with free commercial diet may cause losses, even selling the eggs with price higher than the recommended for eggs produced industrially. These findings are in line with Abedini *et al.*, (2018) who observed the positive effect of dietary supplementation with Nano Zn on egg production in laying hens. Higher bioavailability of Zn in the form ZnO-NPs could explain the improved egg production. El-Katcha *et al.* (2018) reported that Zn-NPs significantly ($P < 0.05$) increased the average egg production% throughout the whole experimental periods compared to the control. Guo *et al.* (2002) reported no effect on egg production in laying hens fed diets supplemented with (60mg/kg) inorganic zinc (zinc sulfate). The significant increase in egg production of the Nano zinc (60mg/kg) group might be due to the important role of Zn in the synthesis and secretion of LH and FSH hormones (Bedwal and Bahugana, 1994).

Dietary zinc may influence egg production by interacting with the endocrine system since the hen is changing the production and secretion of reproductive hormones during sexual maturation (Renema *et al.*, 1999). Olgun and Yildiz (2017) reported a contrast result that supplementation 75mg/kg Nano-Zn did not affect egg production rate of laying hens. On the other hand, 75mg/kg organic zinc supplementation increased egg production % compared with laying hens fed on the same level of supplemental zinc from nano source. These results of the present study are supported by Bahakaim *et al.*, (2014) who indicated that the EM increased with the addition of organic Zn (Zn-methionine) compared to Zn-sulfate in laying hens. Also, Abd El-Hack *et al.* (2017) who reported that replacement of inorganic zinc by zinc-methionine significantly increased egg mass of laying hens. Moreover, organic zinc increased average EM as compared with birds fed supplemental zinc from Nano source.

Egg quality parameters:

The effect of Feed restriction supplemental or zinc forms and their interaction on external and internal egg quality is shown in Table (3) All parameters were significantly ($P <.01$)affected by Zn supplementation egg quality except, of Egg shape index shell weight and yolk index which was insignificantly affected by feed restriction system.

All egg quality parameters were significantly ($P \leq 0.05$) affected by the interaction among feed restriction system and Zn forms, except of egg shape index. Zinc plays an important role in the isthmus, where egg shell membranes are produced. Dietary zinc improved egg shell quality because Zn is a component of the carbonic anhydrase enzyme, which is necessary for the formation of egg shell (Carneiro *et al*., 2019 and Innocenti *et al.*, 2004). Konkol and Wojnarowski (2018) showed that thickness of the egg shell was significantly ($P < 0.05$) higher in groups birds receiving Nano-zinc and zinc methionine 60 mg/kg diet than the control group. Abd El-Hack *et al.*,(2017) observed that the highest values of Haugh unit scores and yolk to albumin ratio were recorded by the control group, which fed diet free of ZnO or Zn-Met. Supplementation with Nano or organic- Zn sources showed were improvement in shell thickness. These results were in agreement with the findings of Yang *et al.* (2012) who reported that Zn supplementation (65 mg/kg) organic increased egg shell thickness.

Another reason might be attributed as Zinc plays a role in the magnum during the deposition of albumen and in the isthmus where eggs hell membranes are produced. The increase in weight of albumen in the treated group as compared to the control group were also reported by Tabatabaie *et al.*, (2007) showed that supplementation the diet with organic zinc at a different level. Among different Zn sources used in the study, nano zinc particles are the better source in which bioavailability is highest, due to their extremely small size and unique physical properties (Sahoo *et al.,* 2014). The increase of shell thickness might be attributed to the importance of zinc function in the formation of the egg. Zinc supplementation also has been reported to improve egg shell quality because it is a component of the carbonic anhydrase enzyme, which supplies with the carbonate ions during eggshell formation (Innocenti *et al.,* 2004). Supplementation of nano zinc gave the preferable value in the Haugh unit. The reason might be attributed to an increase in albumen weight.

Table (3): Egg quality parametwers $(\overline{X} \pm SE)$ of Mandarah hens as affected by different forms of zinc and feed restriction and their interactions at 48 weeks of age.

Items		**External egg quality**		**Internal egg quality indices**				**Component of egg weight (%)**		
		Egg Weight (g)	**Egg shape index (%)**	**Sell thickens (mm)**	**Yolk index (%)**	**Albumen index (%)**	**Haugh unit (score)**	**Yolk weight (%)**	**Albumen weight (%)**	**Shell weight (%)**
Feeding restricted system										
ad libitum		51.87±0.217	78.18±0.46	0.42±0.003^{a}	46.03±0.22^{a}	9.82±0.087^{a}	81.22±0.59^{a}	33.67±0.06^{c}	56.16±0.05^{a}	10.16±0.05^{a}
90%		51.75±0.221	77.30±0.79	0.41±0.004^{b}	45.59±0.33^{a}	9.63±0.122^{a}	80.26±0.56^{b}	33.94±0.06^{b}	56.02±0.04^{b}	10.03±0.05^{a}
80%		51.46±0.279	76.66±0.63	0.38±0.002^{c}	44.56±0.26^{b}	8.10±0.85^{b}	77.56±0.47^{c}	34.13±0.07^{a}	56.00±0.05^{b}	9.87±0.05^{b}
Sig.		NS	**NS**	**	**	**	**	**	*	*
Zinc forms										
Un-suppl. (1)		51.77±0.20	77.81±0.46	0.39±0.004^{b}	45.11±0.31	8.90±0.225^{b}	77.31±0.44^{c}	34.08±0.06^{a}	55.96±0.04^{b}	9.96±0.06
50 mg Nano zinc(2)		51.73±0.30	77.10±0.87	0.41±0.005^{a}	45.83±0.28	9.44±0.221^{a}	81.46±0.58^{a}	33.76±0.07^{b}	56.16±0.05^{a}	10.09±0.06
50 mg org. zinc(3)		51.58±0.23	77.23±0.59	0.40±0.005^{a}	45.25±0.33	9.22±0.218^{a}	80.26±0.46^{b}	33.90±0.08^{b}	56.06±0.05^{ab}	10.02±0.05
Sig. test		**NS**	**NS**	**	**NS**	*	**	**	*	**NS**
Interaction effect										
ad lib.	**(1)**	51.94±0.38	77.89±0.55	0.40±0.004^{bc}	45.74±0.56^{abc}	9.52±0.099^{bc}	78.36±0.48^{c}	33.91±0.04^{bc}	55.98±0.09^{c}	10.10±0.08^{ab}
	(2)	51.82±0.52	78.73±0.78	0.43±0.004^{a}	46.41±0.36^{a}	10.11±0.039^{a}	83.35±0.36^{a}	33.50±0.09^{e}	56.26±0.06^{a}	10.23±0.10^{a}
	(3)	51.85±0.27	77.91±1.11	0.42±0.003^{a}	45.94±0.06^{ab}	9.84±0.156^{abc}	81.95±0.25^{a}	33.59±0.06^{de}	56.24±0.07^{ab}	10.16±0.06^{a}
90 %	**(1)**	51.91±0.21	78.60±0.63	0.39±0.005^{de}	45.16±0.47^{abc}	9.41±0.193^{c}	78.05±0.42^{c}	34.09±0.08^{abc}	55.95±0.01^{c}	9.97±0.11
	(2)	51.71±0.47	76.00±1.90	0.42±0.006^{a}	46.10±0.48^{a}	9.89±0.142^{ab}	82.28±0.54^{a}	33.81±0.09^{cd}	56.12±0.12^{abc}	10.09±0.05^{abc}
	(3)	51.63±0.49	77.29±1.33	0.41±0.005^{ab}	45.52±0.76^{abc}	9.60±0.260^{bc}	80.45±0.74^{b}	33.92±0.13^{bc}	56.00±0.07^{bc}	10.04±0.11^{abc}
80 %	**(1)**	51.46±0.50	76.94±0.98	0.37±0.005^{e}	44.43±0.41^{bc}	7.78±0.131^{e}	75.52±1.09^{d}	34.24±0.17^{a}	55.95±0.12^{c}	9.81±0.07^{c}
	(2)	51.65±0.66	76.56±1.63	0.39±0.003^{de}	44.97±0.43^{abc}	8.31±0.080^{d}	78.75±0.48^{c}	33.97±0.11^{abc}	56.10±0.07^{abc}	9.95±0.11^{abc}
	(3)	51.25±0.42	76.49±0.63	0.38±0.004^{de}	44.29±0.44^{c}	8.21±0.136^{d}	78.39±0.24^{c}	34.18±0.06^{ab}	55.95±0.06^{c}	9.85±0.06^{bc}
Sig. test		NS	**NS**	**	*	NS	**	**	**	*

a,b,c: Means in the same column with different superscripts, differ significantly (P<0.05)

N.S: Not Significant, * P < 0.05, ** P< 0.01.

ad lib :ad libitum

Economic efficiency:

Results of economic efficiency (%) are summarized in Table (4). Regardless feeding of (90% from *ad libitum* / hen / day) increased the net revenue over than feeding 80% from *ad libitum* / hen / day. Whereas, feeding of organic zinc increased the net revenue per hen over than the Nano zinc and un supplemented group.

Concerning the effect of interaction between feed restriction and zinc forms showed that the best value of net revenue and economic efficiency of laying feeding 90% hen / day supplemented organic zinc. Olawumi (2014) found that 90% ad libitum was better and feed efficient than ad libitum and 80% *ad libitum* recorded higher net returns and economic efficiency. These results of the present study suggested that the quantitative feed restriction (90%/hen /day) contain 50 mg. Organic zinc is employed to control growth by feeding a predetermined amount of balanced diet in order to achieve a good production during laying period as well enhanced the economic efficiency.

Conclusively, feeding restricted system at level of 90% and dietary Organic-Zn supplementation at level of 50mg/kg can be recommended to improve productive performance traits , egg quality parameters and economic efficiency of Mandarah laying hens.

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Table (4): Economic Efficiency as affected by feed restricted system and zinc forms interaction

Items		Egg number	Price/ egg (LE)	Total revenue eggs (LE)	Total feed intake (kg)	Price/ Kg feed (LE)	Total feed cost (LE)	Fixed (LE)	Total cost (LE)	Net revenue (LE)	EEf (%)
Interaction effect:											
Ad Lib.	**0**	95.00	1.5	142.50	19.95	6.00	119.73	3	122.73	22.77	18.55
	N-Z	112.03	1.5	168.05	20.07	15.00	301.00	3	304.00	-132.96	-43.74
	O-Z	105.27	1.5	157.90	19.92	6.15	122.49	3	125.49	35.41	28.22
90%	**0**	91.30	1.5	136.95	18.01	6.00	108.08	3	111.08	28.87	25.99
	N-Z	108.20	1.5	162.30	18.11	15.00	271.60	3	274.60	-109.30	-39.80
	O-Z	101.00	1.5	151.50	18.09	6.15	111.24	3	114.24	40.26	**35.24**
80%	**0**	79.67	1.5	119.51	16.03	6.00	96.21	3	99.21	23.30	23.48
	N-Z	91.27	1.5	136.91	16.15	15.00	242.20	3	245.20	-105.30	-42.94
	O-Z	85.07	1.5	127.61	16.09	6.15	98.95	3	101.95	28.66	28.11

Total revenue eggs (LE)= egg number x Price/ egg (LE), Net revenue (LE) = Total revenue eggs (LE) – total cost, EEf) : Economic efficiency (EEF) = Net revenue (LE) / Total cost (LE) x 100, Price of Nano Zn .supplement = 9.0(LE), Price Of Org-Zn= 0.15 (LE).

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تاثير نظام التحديد الغذائي وصور الزنك علي بعض الصفات الانتاجية وصفات جودة البيض والكفاءة الاقتصادية لدجاج المندرة البياض.

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اجريت هذه الدراسة بغرض تقدير تاثير تغذيه الدجاج البياض علي عليقه يوميه بكميات مختلفه مضافا اليهاعنصر زنك من مصادر مختلفه . غذيت مجموعات الدجاج البياض علي عليقه اساسيه يوميه (احتوت علي 34مللیجرام زنك/كيلو جرام) عند مستوى حد الشبع و90%و80% يوميا .وقد اضيفت للعليقة ثلاثه مصادر للزنك بدون إضافة زنك (كنترول) 50مللیجرام /كيلو جرام زنك عضوي .50 مللیجرام نانو زنك / كيلو جرام علي التوالي وقد استمرت التجربه 6 شهور .

وقد اظهرت نتائج الدراسه الاتي:

- تفوق معنوي(علي مستوي1%)في النسبه المئويه لإنتاج البيض ووزن البيض وكتله البيض في مجموعه الدجاج البياض المغذي يوميا علي كميه عليقه 120 جرام مقارنه بالمجموعات الأخري .
- ارتفاع معنوي(علي مستوي1%)في النسبه المئويه لإنتاج البيض ووزن البيض وكتله البيض ووزن الجسم مع افضل معدل تحويل غذائي وتحسن في جوده البيض في مجموعه الدجاج المغذي علي كميه عليقه اساسيه مضاف إليها 50 مللیجرام زنك عضوى /كيلو جرام .

- التوصيه:

تغذيه دجاج المندره البياض يوميا علي 90% عليقه اساسيه مضافا إليها 50 مللي جرام زنك عضوى لكل كيلو جرام يمكن ان نوصي بها بزياده انتاج البيض وجودته من الناحيه الاقتصاديه.