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IMPACT OF SOME OF NATURAL FEED ADDITIVES ON SOME PRODUCTIVE PERFORMANCE, EGG QUALITY, FERTILITY, HATCHABILITY PARAMETERS AND ECONOMICAL EFFICIENCY OF LAYING HENS

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ABSTRACT:

This study was conducted to investigate the effects of dietary zeolite and synbiotic supplementation on some egg production, egg quality traits, fertility and hatchability per total or fertile eggs of Mandarah hens (Egyptian local developed strain) during laying period. A total number of 270 laying hens + 27 cock, 24 weeks old were randomly taken to be similar in body weights (1381.30±1.27), which were randomly divided into nine experimental groups, (30 hens + 3 cocks in each). Each group was contained three replicates (10 hens+1 cock in each).The experimental groups designed as a factorial arrangement (3x3), 3 zeolite level groups (0, 1, 2 %); 3 levels symbiotic (0.0, 0.1, 0.2 %), respectively, during the experimental periods lasted six months from 24 to 48 weeks of age.

***The obtained results showed that** supplementing laying hens with 2 % zeolite improved significantly* ($P \leq 0.01$) *in final body weight (FBW); body weight change (BWC, %); total egg number (TEN); and feed conversion ratio (FCR) as kg feed /eggs when compared to hens in receiving 1% zeolite and control group, during period 24 at 48 weeks of age. Addition of zeolite to laying hens' diets at levels 2% improved significantly* ($P \leq 0.01$) *of yolk index, Haugh units, albumen index, fertility and hatchability per total or fertile eggs values as compared to the other groups. However, the effect of differences between zeolite levels show increase of net revenue (NR) and economic efficiency (EEF) percentage than the control group. Zeolite levels shows increase of net revenue (NR) and economic efficiency (EEF) percentage than the control group. The highest values 172.00 and 110.06 of (NR) and (EEF), respectively, in group 2 % zeolite supplementation.*

Concerning effect of 0.2% synbiotic supplementation in layer diets caused to increase significantly ($P \leq 0.01$) *in FBW, BWC, TEN, FFCR (kg feed/ eggs) as compared to 0.1% supplementation with synbiotic and control group. Hens received synbiotic at level 2% could be improved* ($P \leq 0.01$) *significantly of yolk* *index, Haugh units, albumen index, fertility and hatchability per total or fertile eggs values when compared to other treatments groups. However, the effect of synbiotic levels supplementation showed the best of (NR) and (EEF) was recorded 168.93 and 107.94, respectively, when treated with 0.2% symbiotic.*

The interaction effects between zeolite and synbiotic supplementation were significant ($P \leq 0.01$) *in FFCR (kg feed/ eggs), while the other traits at productive performance were not significant. Supplementation of 2 % zeolite and 2 % synbiotic caused to improve significantly* ($P \leq 0.01$) *in fertility and hatchability per total or fertile eggs values when compared to other treatments groups. The highest of (NR) recorded 174.76 in treatment supplementation of 2% zeolite and 0.2% symbiotic. The highest of (EEF) recorded 111.21 in group treated with 2% zeolite and 0.2 % symbiotic,*

***Conclusively,** it can be concluded that, supplemental layer diets with zeolite2 % or synbiotic at level 0.2% were more effective for improving significantly* ($P \leq 0.01$) *in yolk index, Haugh units, albumen index, shell weight (%), fertility and hatchability per total or fertile eggs values and recorded the highest (NR) and (EEF) when compared to other treatment groups of Mandarah laying hens.*

Keywords: zeolite, synbiotic, productive performance, egg quality, fertility, hatchability parameters, economical efficiency, laying hens.

INTRODUCTION:

In recent years, there are evidences in the literature that using of zeolite (Clinoptilolite) has encouraging effects on the poultry performance traits such as BW, BWC, EW, EM, TFI and FC (Basha *et al.*, 2016; Wawrzyniak *et al.*, 2017 and Morsy, 2018). Pavelic *et al*., (2001) reported that zeolite-natural and modified, because of their specific structure, are excellent absorbed and thus can diminish the harmful effect of heavy metals. The same authors found that clinoptilolites, due to its structural stability under high temperatures and acidity, are the most widely used zeolite in animal studies. The important research data indicated the positive influence of the feed inclusion of clinoptilolite on poultry health. Zeolite is an excellent “trapper” of waste products and heavy metals because of its chemical composition and specific lattice structure. Beltcheva *et al.,* (2015) reported that, these minerals are crystalline, hydrated aluminosilicates of alkali and alkaline earth cautions (Na, K and / or Ca caution). Emam *et al*., (2019) reported that, zeolite (0.5% or 1%) did not affect the eggshell quality parameters (eggs hell ratio and eggshell density).

Synbiotics (prebiotic and probiotic) are defined as beneficially affects the host by activating the metabolism and survival of one or a limited number of health promoting bacteria and/or by selectively stimulating their growth in ways that can improve the host’s welfare (Hinton *et al.,* 1990; Bailey *et al.,* 1991; Abdel-Raheem *et al.,* 2011; Dizaji *et al.,* 2012 and Shirley *et al.*, 2017).

The same authors added that dietary supplementation with synbiotic had a significant ($P \leq 0.05$) increase on live body weight, weight gain and improve feed conversion ratio, egg production rate of laying hens as compared to those of control group. Rizk *et al* (2019) found that Fertility % was significantly increased in eggs produced from birds fed diet supplemented with 0.4 and 0.5 g probiotic/kg diet, while, hatchability (%) was improved by feeding on diet with 0.3g probiotic/kg diet during rearing period as compared to the control diet.

Recently, Obianwuna *et a*l (2023) demonstrated that probiotics (PRO), prebiotics (PRE) and synbiotics (SYN) ($P \leq 0.05$)), respectively, showed significant increases in egg production rate, egg mass, daily feed intake and reduced number of damaged eggs. Moreover, Adriani *et al* (2021) found that addition of probiotic powder (0%, 2%, 3%, 4%) increased egg production rate by 64.1%, 41.5% and 118% respectively compared to control.

Therefore, the aim of this study to evaluate supplementation of zeolite and synbiotic in the diet on some productivity, egg production, egg quality traits, fertility and hatchability per total or fertile eggs and economic parameters of Mandarah (Egyptian local developed strain) laying hens..

MATERIALS AND METHODS

Birds, management and experimental design:

The present study was carried out at Inshas Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Giza, Egypt. A total number of 270 Mandarah laying hens and 27 cocks at 24 weeks old was randomly distributed to be similar in body weights (1381.30±1.27). Birds were randomly divided into nine treatment groups (30 hens + 3 cocks in each) and then each treatment group was divided into three replicates (10 hens+ 1 cock / replicate). The experimental groups designed as a factorial arrangement(3 x 3), 3 zeolite levels (0.0, 1.0 and 2.0 %) and 3 levels synbiotic 0.0, 1.0, 2.0 %). respectively, during the experimental period from 24 to 48 weeks of age. Birds were fed a balanced basal diet, during the experimental periods lasted six month from 24 to 48 weeks of age. All birds were housed individually in layer's pens 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 *iso-nitrogenous* and *iso- caloric* to cover the nutrients requirements as recommended by NRC (1994) and Agriculture Ministry Decrees, AMD (1996) as shown in Table 1. Chemical analyses of basal diet and zeolite (Tables 1 and 2), respectively were determined in the Central Laboratory For Soil, Foods and Feedstuffs (International Accredited Lab, has ISO 17025 Since 2012), Faculty of Technology and Development, Zagazig University, Zagazig, Egypt.

Table (1): Composition and chemical analysis of the 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
NaCl	0.40
Vitamins and minerals mixture*	0.30
DL-methionine	0.05
Total	**100.00**
Chemical analysis calculated **	
Crude protein (%)	**17.00**
Crude fiber (CF)	**3.09**
Available phosphorus (%)	**0.42**
Calcium (%)	**3.41**
Lysine (%)	**0.87**
Methionine (%)	**0.38**
Methionine + Cystine (%)	**0.67**
Metabolizable energy (Kcal ME/kg diet)	**2748**
Chemical analysis determined***	
Dry matter, %	**90.73**
Crude protein, %	**16.97**
Ether extract, %	**2.45**
Crude fiber, %	**3.96**
Ash, %	**6.37**
Nitrogen free extract, %	**60.98**

***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.K3 1000 mg; Vit.B1 1000 mg; Vit.B2 5000 mg; Vit.B6 1500 mg; Vit. B12 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.
According to NRC (1994), * AMD. (1996).
******* A. O.A.C. (1998).

Zeolite and Synbiotic products:

Zeolite was product (Manufactured by Mec Enerji, Turkey) imported from Al –Zahraa Vetmedical for Veterinary products and feed additives.

Synbiotic was used in this experiment (Poultry Star® me) is an International Product of Biomin Singapore Pte, Ltd, Biomin GmbH, Austria. It was purchased from an Egyptian Veterinary Medicinal dealer Company. According to the Biomin Company, each one gram of the used synbiotic contains 0.9 g Fructo- oligosaccharides (pure soluble inulin, chicory) and 0.1 g blend of probiotic bacteria (*Enterococcus faecium* (3 x 10^{9} CFU/g), *Bifidobacterium animalis* (5 x 10^{8} *colonies forming unit* per gram, CFU/g), *Pediococcus acidilactici* (1.3 x 10^{9} CFU/g), *Lactobacillus reuteri* (1 x 10^{8} CFU/g) and *Lactobacillus salivarius* (1 x 10^{8} CFU/g)].

Table (2): Composition and chemical analysis of zeolite product .

Chemical analyses of zeolite*		**Composition: Each 1 kg zeolite contains (%) ****	
P	0.002 %	**Sio2**	69.60
K	0.29 %	**Al2o3**	12.70
Na	0.44 %	**Fe2o3**	1.40
Ca	1.71 %	**Cao**	2.40
Fe	1523.48 mg/kg	**Mgo**	1.00
Mn	81.82 mg/kg	**Na2o**	0.30
-	-	**K2o**	4.00
-	-	**Tio2**	0.10
-	-	**P2o5**	0.10
-	-	**Mno**	0.10

* Chemical composition of zeolite according to central lab for soil, food and feedstuff (CLSFF), Faculty of Technology and Development, Zagazig University,. Zagazig, Egypt.
** Country of Origin, Turkey.

Measurements studied:

Body weight (BW), change body weight (BWC) (%) , total egg number (TEN), egg weight (EW)g were recorded individually of each group, while total feed intake (TFE) Kg were recorded weekly in each replicate, during the experimental periods (24 - 48 weeks of age). Feed conversion (FC) (Kg feed/ eggs) was calculated as Kg feed consumption produced number of eggs at four weeks intervals and the whole experimental period.

Egg quality parameters were determined at 32, 40 and 48 wks of age. Six eggs in each experimental group (2 in each replicate) were randomly taken to measure egg quality traits. Egg dimensions (width and length) were measured using digital dernier caliper for shape index (%). Eggs were broken on a flat glass plat for measuring yolk, albumen indices according to Amer (1972). Albumen and yolk heights were measured to the nearest millimeter by triple micrometer for Haugh units and albumen and yolk indices according to Ismail (2009). Shell membrane thickness was obtained after measured shell thickness and then after washed and cleaned carefully from membranes. Shell membrane is the difference between shell thickness with membrane and shell thickness without membrane.

Relative weights of each egg component to whole egg weight (shell, yolk and albumin weight) were then calculated according to Amer (1972).

Fertility (%) was calculated as the percentage of the number of fertile eggs relative to the number of total eggs. Hatchability (%) per total set eggs and fertile eggs was estimated, while chick weight produced at hatching was measured at 32, 40 and 48 wks of age.

Statistical analysis

The experiment data were statistically examined by one way classification of analysis of variance according to Snedecor and Cochran (1982) using

ANOVA procedures of SAS (SAS, 2011). The statistical model was used as follows:

$$Y_{ijk} = \mu + Z_i + S_j + (ZS)i_j + e_{ijk}$$

Where , Y_{ij}: An Observation; µ: Overall mean, Zi : Effect of the feed additives Zeolites groups (i=1,2,and 3); S_j: Synbiotic supplementation (j=1,2and 3); (ZS)ij: Interaction effect (ij=1,2….+9), e_{ijk}: Random error.

The differences among means were tested by using Duncan's multiple range test procedures (Duncan, 1955). The percentage values were subjected to be arcsine transformation before performing the analysis of variance. Means were presented after recalculated from the transformed value to percentages.

RESULTS AND DISCUSSION

Productive performance traits:

The effect of dietary zeolite or synbiotic supplementation and their interaction on productive performance traits of laying hens for the whole experimental period (24-48 weeks of age) are shown in Table 3.

Supplementing with 2% zeolite was significantly (P≤0.01) caused to improve in final body weight (FBW); body weight change (BWC, %); total egg number (TEN) and feed conversion ratio (FCR) kg feed /egg number as compared to hens in receiving 1% zeolite and control groups. Similar results were obtained by Fethiere *et al*. (1990); Roland *et al*. (1991) who found that positive significant effects of dietary zeolite were noticed on the number of eggs laid per hen, egg weight, and efficiency of feed utilization. Addition of natural zeolite to broiler diet led to promote of chicken performance (Nikolakakis *et al.,* 2013) and improve body weight gain and feed conversion ratio (Debeic M, 1994). At present, using of natural zeolite develops by utilizing features of ion-exchange, water and gas absorption (Bintas *et al.,* 2014). The exploitation of these properties underlies the use of zeolite in a wide range of industrial and agricultural applications and particularly in animal nutrition (Beltcheva *et al.*, 2015).

Concerning effect of 2% synbiotic supplementation in layer diets improved significantly (P≤0.01) in FBW, BWC, TEN, EP and FC (kg feed/egg number) as compared to 1% Synbiotic supplementation and control group during period 24-48 weeks of age (Table 3). The same results were obtained by Awad *et al.* (2009) showed that synbiotic of the starter diets and 0.5 kg/ton of the grower diets increased significantly (P≤0.05) the FBW, DWC and FCR of broiler chicks as compared with the control group.

Regarding the interaction, it could be shown that total feed intake was significantly (P≤0.01) influenced by supplementation with zeolite and synbiotic, while the other traits of egg production were not significant, during 24-48 weeks of age as shown in Table 3.

Table 3: Effect of zeolite and Synbiotic *levels* as feed additives on some productive performance parameters of Mandarah layers from 24 to 48 weeks of age.

Items		Some productive performance traits				
		FBW, g	**BWC, %**	**TEN**	**TFI, kg**	**FC (kg feed / egg numbers)**
Effect of Zeolite(ZY), %						
0.0		1704.4^{c}	23.16^{c}	104.51^{c}	18.97^{a}	5.51^{c}
1.0		1737.8^{b}	25.98^{b}	107.90^{b}	18.96^{a}	5.69^{b}
2.0		1766.7^{a}	27.97^{a}	109.38^{a}	18.87^{b}	5.80^{a}
SEM		6.38	0.46	0.51	0.07	0.07
Sig.		**	**	**	*	**
Effect of Synbiotic (SB), %						
0.0		1718.89^{b}	24.26^{b}	106.01^{b}	18.96	5.59^{b}
0.1		1743.89^{a}	26.27^{a}	107.41^{ab}	18.90	5.68^{a}
0.2		1746.11^{a}	26.58^{a}	108.24^{a}	18.95	5.71^{a}
SEM		**10.17**	**0.75**	**0.82**	0.17	**0.07**
Sig. test		**	**	**	**NS**	**
Effect of interaction (ZY x SB), %						
0.0	**0.0**	1680.0	21.30	103.43	19.22^{a}	5.38^{c}
	0.1	1710.0	23.76	105.00	18.79^{c}	5.59^{b}
	0.2	1723.3	24.43	105.10	18.91^{bc}	5.56^{b}
1.0	**0.0**	1730.0	25.06	106.20	18.83^{bc}	5.64^{b}
	0.1	1746.7	26.42	107.80	19.11^{ab}	5.64^{b}
	0.2	1736.7	26.46	109.70	18.93^{bc}	5.79^{ab}
2.0	**0.0**	1746.7	26.42	108.40	18.83^{bc}	5.76^{b}
	0.1	1775.0	28.62	109.43	18.85^{bc}	5.81^{a}
	0.2	1778.3	28.87	110.63	18.89^{bc}	5.86^{a}
SEM		**7.47**	**0.46**	**0.67**	0.04	**0.08**
Sig. test		**NS**	**NS**	**NS**	*	*

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. SEM=Mean at standard error.

FBW, g =Final body weight , BWC,% = Body weight change ,TEN =Total egg number , TFI, kg=Total feed intake , FC(kg feed / egg numbers) = Feed conversion (Kg feed/eggs),

Egg quality parameters:

The effect of dietary zeolite or synbiotic supplementation and their interaction on egg quality parameters of laying hens for the whole experimental period (24-48 weeks of age) are shown in Table 4.

1. Egg weight:

Table 4 shows the effect of zeolite, synbiotic supplementation and their interaction in egg weight quality at different of the experiment periods.

The results indicated that the differences of zeolite supplementation and in showed no significant differences in egg weight (Table 4). The presented

Table (4): Effect of zeolite and Synbiotic levels as feed additives on egg quality parameters of Mandarah layers

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 (%)
Effect of Zeolite(ZY), %										
0.0		49.04	76.96	0.39^{c}	42.29^{b}	81.13^{b}	83.66^{b}	31.98	56.45	**11.15^{c}**
1.0		48.37	76.17	0.40^{ab}	42.45^{b}	83.36^{a}	85.83^{a}	32.26	56.51	**11.45^{b}**
2.0		49.07	76.69	0.41^{a}	44.58^{a}	84.11^{a}	86.93^{a}	32.13	56.63	**11.67^{a}**
SEM±		0.38	0.46	0.00	0.43	0.41	0.47	0.19	0.23	0.08
Sig. test.		NS	NS	**	**	**	**	NS	NS	**
Effect of Synbiotic (SB), %										
0.0		48.54	76.94	0.39^{b}	42.17^{b}	81.28^{b}	83.99^{b}	32.22	56.17	11.20^{b}
0.1		48.91	76.32	0.40^{ab}	43.26^{ab}	83.23^{a}	85.70^{a}	32.05	56.75	11.38^{ab}
0.2		49.04	76.56	0.41^{a}	43.89^{a}	84.08^{a}	86.72^{a}	32.11	56.67	11.69^{a}
SEM±		0.37	0.46	0.00	0.47	0.43	0.50	0.19	0.22	0..08
Sig. test		NS	NS	**	**	**	**	NS	NS	**
Effect of interaction (ZY x SB), %										
0.0	**0.0**	48.44	77.64	0.38^{c}	42.19	78.79	81.38	32.24	55.94	10.94^{d}
	0.1	49.17	76.42	0.39^{c}	41.60	81.81	84.23	31.61	56.91	11.15^{c}
	0.2	49.50	76.82	0.39^{c}	43.08	82.77	85.37	32.10	56.51	11.37^{bc}
1.0	**0.0**	48.39	76.41	0.38^{c}	41.58	81.99	85.17	32.18	56.25	11.19^{c}
	0.1	48.22	75.92	0.41^{b}	43.12	83.69	85.58	32.51	56.30	11.42^{b}
	0.2	48.13	76.15	0.41^{ab}	42.17	84.56	86.74	32.23	56.99	11.74^{ab}
2.0	**0.0**	48.78	76.77	0.41^{b}	42.75	83.08	85.44	32.25	56.32	11.46^{b}
	0.1	49.33	76.61	0.41^{b}	45.04	84.20	87.30	32.04	57.03	11.58^{ab}
	0.2	49.11	76.69	0.42^{a}	45.94	85.06	88.05	32.11	56.53	11.95^{a}
SEM±		0.66	0.83	0.00	0.62	0.52	0.67	0.32	0.37	0.16
Sig. test		NS	NS	**	NS	NS	NS	NS	NS	**

a,b,c: Means in each classification in the same column with different superscripts, differ significantly (P≤0.01). N.S: Not Significant, ** P< 0.01

results were agree with those reported by (Kermanshahi *et al.*, 2011, Berto *et al.,* (2013) and Kralik *et al.,* 2015) who found that no significant differences (P≤0.05) were determined in average egg weight of laying hens due to feeding diets supplemented with zeolite compared to the control.

The results indicated that the effects of synbiotic supplementation on egg weight were not significantly (Table 4). However, the results indicated that the differences of interaction between zeolite, synbiotic supplementation in egg weight were not significant (Table 4).

2. Egg shape index:

The results indicated that the differences of zeolite supplementation in egg shape index were not significant (Table 4). In addition, the egg shape index in directly affected by egg width, egg length and age hens (Kul and Seker, 2004). Moreover, the egg shape index is highly significant affected mainly by the egg length and egg width rather than egg weight or the age of layer hens (Abanikannda *et al*. 2007). It is clearly observed that significant increase of egg length was found due to dietary supplementation of zeolite (Fendri *et al.,* 2012).

The results indicated that the effects of synbiotic supplementation on egg shape index were not significant (Table 4). Thus, it can be concluded that feeding of different levels of probiotics and prebiotics in the diet of laying hens did not affect egg shape index. In confirmation to our findings several researchers also observed no significant difference in shape index and yolk index due to supplementation of either probiotics or prebiotics in diet of layers (Zarei *et al.,* 2011 and Yosefi and Karkoodi (2007)). In contrast to our results, Swain *et al.,* (2011) reported that shape index was increased ($P \leq 0.05$) due to probiotic and yeast supplementation 0.5 or 1.5 or 2.0g/Kg diet.

The results indicated that the differences of interaction in egg shape index were not significant (Table 4).

3. Yolk index:

Data displayed in Table 4 revealed the effect of zeolite, synbiotic supplementation and their interaction on yolk index (YI) during the different interval periods. The results indicated that the difference between zeolite levels were significantly ($P \leq 0.01$) improved (YI) by increasing level of zeolite than control group during the experimental periods. These results agree with those reported by Tserveni-Gousi *et al*., (1997), Yannakopoulos *et al.,* (1998), Fendri *et al.,* (2012), Berto *et al.,* (2013) and Emam *et al.,* (2019b) who found that a positive effect on egg yolk index traits of laying hens due to dietary supplementation of zeolite compared to untreated one (control).

yolk index (YI) values were positively ($P \leq 0.01$) affected when the basal diet was supplemented by the different levels of synbiotic (1 and 2 gm /kg diet) during the experimental period, (Table 4). This considers the height and length of the yolk, so the greater height and smaller length found in the probiotic treatment is an indication of an egg in which the effects of storage were minimized. Therefore, an increase in yolk index may be related to the ability and functionality of hepatocytes to synthesize vitellogenin (Kasiyati *et al* 2016). Vitellogenin is a protein that transports lipids from the liver to the growing oocytes that give rise to the yolk. However, the exact mechanism of the probiotic is not known. It may be linked to the synthesis of estradiol and, as a result, to an increase in hepatic estrogen receptors, which are responsible for the synthesis of this protein.

Concerning the effect of interaction between zeolite and syniotic in YI at different periods was not significant (Table 4). The highest value of YI recorded in laying fed 2% zeolite and 0.2% synobiotic when compared to the other treatment groups (Table 4).

4. Albumen index:

The effect of zeolite, synbiotic supplementation and their interaction in albumen index (AI) at different of the experimental periods (Table 4). The results revealed that the difference between zeolite levels were significantly ($P\leq0.01$) improved during the experimental periods (Table 4).

The results indicated that the difference synbiotic supplementation in (AI) were significantly ($P\leq0.01$) improved by increasing levels as compared with control group during the experimental period (Table 4).

An interaction shows insignificantly effect in (AI) during all the experimental periods (Table 4), the highest value of (AI) recorded in layer feeding 2% zeolite and 0.2% synobiotic when compared to the other treatment groups (Table 4).

5. Haugh units:

Data displayed in Table 4 showed the effect of zeolite, synbiotic supplementation and their interaction on Haugh unit (HU) during the different periods. The results indicated that the difference between zeolite levels were t significantly ($P\leq0.01$) improved (HU) by supplementation levels of zeolite than control during all the experimental periods (Table 4). The highest value recorded 86.93 and 85.83 in laying fed zeolite supplementation 2% and 1% respectively, than control group 83.66 (Table 4). These results agree with those reported by Tserveni-Gousi *et al.*, (1997), Yannakopoulos *et al.*, (1998), Fendri *et al.*, (2012), Berto *et al.*, (2013) and Emam *et al.*, (2019b) who found that a positive effect on and Haugh unit traits of laying hens due to dietary supplementation of zeolite compared to untreated one (control).

Haugh unit values were significantly ($P\leq0.01$) improved by increasing synobiotic supplemented levels at the experimental periods studied when the basal diet was supplemented by the different levels (Table 4). These results agree with those reported by Sjofjan1 *et al*. (2020) who found that the average of the haugh unit is significantly different ($P\leq0.01$) by increasing levels of synbiotic. The increased of the haugh unit due to the absorbing nutrient in the intestinal while the level symbiotic optimizing the substrate to process Lactobacillus sp. and FOS to producing the higher lactic acid.

Concerning the effect of interaction between zeolite and syniotic on HU at was not significant. The highest values of HU recorded in layer fed 2% zeolite plus 0.2% synobiotic than the other treatment groups (Table 4).

6. Shell thickness:

The effect of zeolite, synbiotic supplementation and their interaction in shell thickness at different of the experimental periods (Table 4). The results revealed that the difference between zeolite levels were significantly ($P\leq0.01$) improved during all the experimental periods (Table 4). The beneficial effect of using zeolite on egg shell thickness may be related to its high affinity for calcium and its high ion exchange capacity. Furthermore, these beneficial effects may also be related to the Al, Si or Na of zeolites content, these elements have influence on Ca metabolism (Roland *et al.,* 1993). The increase in serum aluminum and zinc concentration in laying hens due to zeolite supplementation that can be lead to improving in quality of the eggshell and bone development (Rabon *et al.*, 1995).

The results indicated that the difference synbiotic supplementation in shell thickness were significantly (P≤0.01) improved during all the experimental periods, except at 48 weeks of age was not significantly (Table 4). Mahdavi *et al*., (2005), and Mohebbifar *et al*., (2013), found no considerable effects from inclusion of probiotic in the layers' diet on egg quality whereas Sheoran *et al*., (2017), reported increase in eggshell thickness from 0.348 to 0.374 mm when feed was supplemented with probiotics and prebiotics. It was assumed that the beneficial effect on eggshell quality was associated with the stimulating effect of pro- and prebiotics on metabolic events and utilization of calcium (Abdelqader *et al*., 2013 and Li *et al*., 2017). External eggs quality revealed improved traits in the eggs produced in hens group fed with 1‰ synbiotic, compared to control. Shell thickness increased with 3.35%, while shell breaking strength (mg/cm2) improved with 3.36 % (Cristina and Simeanu 2010).

An interaction shows significantly (P≤0.01) in shell thickness at different experimental periods (Table 4).

7. Yolk weight percentage:

Data displayed in Table 4 showed the effect of zeolite, synbiotic supplementation and their interaction on Yolk weight percentage (YW %) during the different interval periods.

The results indicated that the difference between zeolite levels were not significant during the experimental period (Table 4). The increasing of the absolute yolk weight of eggs produced from hens fed diets supplemented with zeolite levels may attributed to the increasing the hepatic biosynthesis rate of yolk precursors in the mode of their transport from the liver into the ovarian follicle and the oocyte. In this connection, it has been reported that 95% of yolk total lipids is derive from triaglycerol – rich lipoprotein which is synthesized in the liver and transferred into rapidly – developing yolks from the plasma over a period as several days before ovulation. The remaining yolk lipid is derived from the lipovitellin component of plasma vitellogenin Griffin *et al.* (1984). The improvement both of absolute and relative egg components may attributed to the increase in absolute and relative egg weight in the present study, which occurs due to different treatments applied. These results agree with those obtained by Tserveni-Gousi *et al.,* (1997); Yannakopoulos *et al.,* (1998) and Berto *et al.,* (2013) who found that there was a significant (P≤0.05) increase in egg yolk weight when layers fed diets supplemented with different levels of zeolite compared with the control group. . On other hand, our results disagreed with those reported by Fendri *et al.,* (2012) and Romero *et al.*, (2012) who showed that there are no significant differences in egg yolk weight of eggs produced from hens fed diet supplemented with zeolite levels compared to control.

Yolk weight percentage values were insignificantly effected when the basal diet was synbiotic supplemented by the different levels at experimental periods studied (Table 4). These results agree with those reported by Nour et *al* (2021) who illustrated that the yolk % significantly ($P \leq 0.01$) increased only at 8–20 weeks due to probiotic supplementation in all groups compared to the control.

Concerning the effect of interaction between zeolite and syniotic in YW % at different periods was not significant (Table 4).

8. *Albumen weight percentage:*

Effect of either of zeolite, synbiotic supplementation and their interaction in albumen weight percentage (AW %) during experimental period (Table 4). The results revealed that the difference between zeolite levels, synobiotic and interaction were not significantly, during the experimental periods (Table 4).

The improvement of the average egg albumen weight of laying hens due to zeolite supplementation probably attributed to the changes in dietary composition that eventually imbalance the energy, protein, and amino acid contents of the diets. Moreover, the addition of zeolites also changes the calcium, aluminum, sodium, and other mineral contents which could affect mineral imbalance (Wu *et al*., 2013). The quality of egg albumen is mainly dependent on the amount of ovomucin , especially β-ovomucin, secreted by the magnum. It is well known that β-ovomucin is largely responsible for the gelatinous traits of the thick albumen gel.These results agree with those reported by Rizzi et *al.,* (2004); Romero *et al.,* (2012); Kralik *et al.*,(2015) and Ergün *et al.,* (2017) who are found that no significant ($P \leq 0.05$) differences in absolute and relative egg albumen heights of laying hens due to feeding on diets supplemented with different levels of zeolite compared to control (untreated one).

The results revealed that the differences of (AW %) between synobiotic levels of were not significantly during the experimental periods (Table 4). Albumen is characterized as a clear colloidal solution that contains protein and is produced by epithelial cells in the magnum (Lee *et al* 2020). Hence, albumen quality is a parameter that reflects egg freshness (Sobczak *et al*.. 2015) and protein quality. Thus, the increase in albumen weight observed in the probiotic treatment is probably due to higher protein deposition in these eggs. This may have occurred due to beneficial modulation of the intestinal microbiota, which provided better health and, consequently, better digestion and absorption of nutrients. However, it is important to highlight that most of the knowledge available on poultry science has been generated in broilers, which have different gut microbiota to those of layers. Thus, more gut microbiota-related studies are needed to better understand the role of different microbial communities in the performance of laying hens and in egg quality.

The results revealed that the difference of interaction between zeolite, and synobiotic levels of (AW %) were not significant, during experimental periods (Table 4).

9. Shell weight percentage:

Table 4 shows the effect of zeolite, synbiotic supplementation and their interaction in shell weight percentage, during the experiment period.

The results indicated that the differences by increasing levels of zeolite were significant (P≤0.01), during experimental period (Table 4). Furthermore, these beneficial effects may also be related to the Al, Si or Na of zeolites content, these elements have influence on Ca metabolism (Roland *et al.,* 1993). The increase in serum aluminum and zinc concentration in laying hens due to zeolite supplementation that can be lead to improving in quality of the eggshell and bone development (Rabon *et al.,* 1995).

Shell weight percentage were significantly (P≤0.01) by synbiotic levels supplementation, (Table 4). The improvement in egg shell percentage and egg shell thickness may be attributed to the enhancement of calcium absorption and retention associated with adding yeast into the diet Yosefi and Karkoodi (2007). Several reports are in agreement with the research findings of our present study with laying hens which have also shown that prebiotic fructans such as inulin or oligofructose may positively affect mineral utilization and in this way, improve eggshell and bone quality (Świątkiewicz *et al*., (2010) and Świątkiewicz and Arczewska – Włosek (2012).]. The mechanism of the positive effect of prebiotics on mineral utilization can be attributed to the high solubility of minerals because of the increased production of short chain fatty acids which resulted from colonic fermentation of non-digestible carbohydrates (Scholz-ahrens *et al*., 2007). Lack of treatment effect on eggshell weight could be attributed to sufficient amount of minerals such as calcium and phosphorus in the commercial diet which was efficiently utilized for improved eggshell quality.

Concerning the effect of interaction between zeolite and symbiotic showed significantly affect (P≤0.01) during period on shell weight percentage (Table 4). The highest values of shell weight percentage recorded in layer fed 2% zeolite plus 0.2% synobiotic than the other treatment groups (Table 4).

Fertility and hatchability percentages:

Fertility percentage:

Data in Table 5 showed the effect of zeolite, synbiotic supplementation and their interaction in fertility percentage during the different periods. The results indicated that the difference between zeolite levels were significantly (P≤0.01) improved fertility percentage by supplementation levels of zeolite

Table (5): Effect of zeolite and Synbiotic levels as feed additives on fertility, hatchability and chick weight at hatching of Mandarah layers.

Items		Fertility, (%)	Hatchability/ Total eggs (%)	Hatchability/ fertile eggs (%)	Chick weight at hatching, g
Effect of Zeolite (ZY), %:					
0.0		90.99^{b}	78.89^{b}	86.66^{b}	32.67
1.0		92.59^{a}	82.35^{a}	88.99^{ab}	32.85
2.0		93.33^{a}	84.20^{a}	90.21^{a}	32.96
SME		0.56	0.86	0.81	0.18
Sig.		**	**	**	**NS**
Effect of Synbiotic (SB), %					
0.0		90.99^{b}	79.51^{b}	87.38^{a}	32.44^{a}
0.1		92.59^{a}	82.10^{a}	88.67^{a}	32.89^{ab}
0.2		93.33^{a}	83.83^{a}	89.81^{a}	33.15^{a}
SME		0.55	0.98	0.91	0.1
Sig. test		**	**	**	**
Effect of interaction (ZY x SB), %					
0.0	**0.0**	88.89^{b}	75.56^{d}	85.04^{b}	32.33
	0.1	91.85^{a}	79.63^{c}	86.65^{b}	32.67
	0.2	92.22^{a}	81.48^{bc}	88.29^{ab}	33.00
1.0	**0.0**	91.85^{a}	80.74^{bc}	87.96^{ab}	32.44
	0.1	92.59^{a}	82.96^{bc}	89.65^{ab}	33.00
	0.2	93.33^{a}	83.33^{ab}	89.38^{ab}	33.11
2.0	**0.0**	92.22^{a}	82.22^{bc}	89.15^{ab}	32.56
	0.1	93.33^{a}	83.70^{ab}	89.70^{ab}	33.00
	0.2	94.44^{a}	86.67^{a}	91.78^{a}	33.33
SME		**0.74**	**1.03**	**1.27**	**0.26**
Sig. test		**	**	**	**NS**

a,b,c: Means in each classification in the same column with different superscripts, differ significantly($P \leq 0.01$). N.S: Not Significant,(** $P < 0.01$).

than control during the experimental periods (Table 5). The highest value recorded 93.33 and 92.59% in laying fed zeolite supplementation 2% and 1% respectively, than control group 90.99% (Table 5).

Fertility percentage were significantly ($P \leq 0.01$) improved by increasing Synbiotic supplemented levels at the experimental period (Table 5). These results is agreement with Rizk *et al.,* (2019) reported that the fertility percentage was significantly improved by 21.0 , 25.0 and 25.0% for eggs produced from hens fed diet supplemented with 0.3,0.4 and 0.5 g probiotic /kg, respectively as compared with the control group.

Concerning the interaction between zeolite and syniotic in fertility percentage at different periods was significantly ($P \leq 0.01$) effected (Table 5). The highest value of fertility percentage recorded in layer fed 2% zeolite plus 0.2% synobiotic than the other treatment groups (Table 5).

2. Hatchability of total eggs:

Effect of zeolite, synbiotic supplementation and their interaction in hatchability of total egg set at different of the experimental periods (Table 5).

The results revealed that the difference between zeolite levels were significantly ($P \leq 0.01$) improved, during the experimental period. The best values 84.20 and 82.35% in groups treated with 2 and 1% zeolite supplementation than the 78.89% untreated groups (Table 5).

The results indicated that the difference synbiotic supplementation in hatchability of total egg set were significantly ($P \leq 0.01$) improved by increasing levels as compared with control group at the experimental periods (Table 5). The best values 83.83 and 82.10% in groups treated with 0.2 and 0.1% synobiotic supplementation than the 79.51% in group untreated (Table 5). These results is agreement with Rizk *et al.,* (2019) reported that the hatchability of set eggs was significantly increased by all dietary probiotic treatments as compared to the control.

An interaction shows significantly ($P \leq 0.01$) effect in hatchability of total egg set, during the experimental period. The highest values recorded in layer feeding 2% zeolite and 0.2% synobiotic (86.67%) when compared to the other treatment groups, while the lowest value (75.56%) in without supplementation (Table 5).

3. Hatchability of fertile eggs:

Effects of both zeolite, synbiotic supplementation and their interaction in hatchability of fertile egg at different of the experimental periods (Table 5). The results revealed that the differences in hatchability of fertile egg between zeolite levels were improved significantly ($P \leq 0.01$), during the experimental periods, (Table 5). The best values 90.21 and 89.99% in groups treated with 2 and 1% zeolite supplementation than the 86.66% untreated groups (Table 5).

The results indicated that the difference synbiotic supplementation in hatchability of fertile egg percentage were insignificantly improved by increasing levels as compared with control group at the all the experimental periods (appendix 23). The best values 89.81 and 88.67% in groups treated with 0.2 and 0.1% synobiotic supplementation than the 87.67% in group untreated (Table 5). These results is agreement with Rizk *et al.,* (2019) who reported that the hatchability of fertile eggs (%) was significantly increased for eggs produced from hens fed 0.3 g probiotic/kg during rearing period than the control, but this elevation was not significant in eggs produced from hens fed 0.4 or 0.5 g probiotic/kg diet

An interaction shows significantly effect in hatchability of fertile egg percentage, during all the experimental period (Table 5), the highest values recorded in layer feeding 2% zeolite and 0.2% synobiotic (91.78%) when compared to the other treatment groups, while the lowest value (85.04%) in without supplementation (Table 5).

4. Chick weight at hatching:

Table 5 showed the chick weight at hatching (ChW) g. affected by either zeolite, synobiotic and their interaction. The results revealed that the difference between zeolite levels were improved, but not significant, during experimental period. The results indicated that the difference of synbiotic supplementation in (ChW) were significantly improved by increasing levels as compared with control group at the all the experimental periods as shown in Table 5.

An interaction effect between zeolite and synbiotic in (ChW) showed insignificantly improved. The highest weight of chicks at hatching recorded that (33.33gm) by treatment of 2% zeolite and 0.2% symbiotic, but the lowest value (32.33gm) in without supplementation group (Table 5).

Economic efficiency:

Data in Table (6) showed the economic efficiency affected by treated of both zeolite, symbiotic and their interaction.

Table (6). Effect of zeolite and synbiotic levels as feed additives on Economic efficiency of Mandarah during period 24- 48 weeks of age.

Items		Total egg number	Price/ egg (LE)	Total revenue eggs (LE)[1]	Total feed intake (kg)	Price/ Kg feed (LE)	Total feed cost (LE)	Fixed (LE)	Total cost (LE)	Net revenue (LE)[1]	Economic efficiency (EEf)[2]
Effect of Zeolite (ZY), %											
0.0		105	3	313.53	18.97	8.02	152.14	3.00	155.14	158.39	**102.44**
1.0		108	3	323.70	18.96	8.08	153.20	3.00	155.20	168.50	**108.57**
2.0		109	3	328.47	18.87	8.13	153.41	3.00	156.41	172.06	**110.06**
Effect of Synbiotic (SB), %											
0.0		106	3	318.03	18.96	8.06	152.82	3.00	155.82	162.21	**104.10**
0.1		107	3	322.23	18.90	8.08	152.71	3.00	155.71	166.52	**106.94**
0.2		108	3	325.43	18.95	8.10	153.50	3.00	156.50	168.93	**107.94**
Effect of interaction (ZY x SB), %											
Zeolite	**Syn.**										
0.0	**0.0**	103	3	310.30	19.22	8.00	153.76	3.00	156.76	153.54	**97.88**
	0.1	105	3	315.00	18.79	8.02	150.70	3.00	153.70	164.30	**106.90**
	0.2	105	3	315.30	18.91	8.04	152.03	3.00	155.03	160.27	**103.38**
1.0	**0.0**	106	3	318.60	18.83	8.06	151.77	3.00	154.77	163.83	**105.85**
	0.1	108	3	323.40	19.11	8.08	154.41	3.00	157.41	165.99	**105.45**
	0.2	110	3	329.10	18.93	8.10	153.33	3.00	156.33	172.77	**110.52**
2.0	**0.0**	108	3	325.20	18.83	8.12	152.90	3.00	155.90	169.30	**108.60**
	0.1	109	3	328.30	18.85	8.14	153.44	3.00	156.44	171.86	**109.86**
	0.2	111	3	331.90	18.89	8.16	154.14	3.00	157.14	174.76	**111.21**

Price of one egg =3.00, Cost of basal kg diet = 8.00 LE, Price of one kg zoilet= 20 Pounds , Price of one kg synbiotic =200 Pounds

Total revenue eggs (LE) = Number of eggs x price of one egg, LE = Egyptian pound

* Net return (LE) = Total revenue eggs (LE) – total cost (LE).

** Economic efficiency (EEf %) = Total revenue bird (LE) / total cost (LE).

The effect of differences between zeolite levels shows increase of net revenue (NR) and economic efficiency (EEF) percentage than the control group. The highest values 172.00 and 110.06 of (NR) and (EEF), respectively, in group 2 % zeolite supplementation, but the lowest value recorded 158.30 and 102.44 in control group.

The effect of synbiotic levels supplementation showed the best of (NR) and (EEF) recorded 168.93 and 107.94, respectively, when treated with 0.2% symbiotic, but the lowest value recorded 162.21 and 104.10 in control group .

An interaction between zeolite and symbiotic supplementation revealed that the highest of (NR) recorded 174.76 in treatment supplementation of 2% zeolite and 0.2% synbiotic, the lowest of (NR) recorded 153.54 in group without supplementation. The highest of (EEF) recorded 111.21 in group treated with 2% zeolite and 0.2 % symbiotic, while the lowest EEF recorded 97.88 in group without any supplementation (Table 6).

Conclusively, *it can be concluded that, supplemental layer diets with zeolite2 % or synbiotic at level 0.2% were more effective for improving significantly* (P≤0.01) *in yolk index, Haugh units, albumen index, shell weight (%), fertility and hatchability per total or fertile eggs values and recorded the highest (NR) and (EEF) when compared to other treatments groups of Mandarah laying hens.*

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تاثير بعض الاضافات الطبيعية للعليقة علي بعض الصفات الانتاجية وجودة البيض والخصوبة والفقس الكفاءة الاقتصادية للدجاج المحلى المستنبط البياض

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اجريت هذه الدراسة لمعرفة تاثير التتغذيه علي عليقه تحتوي علي الزيوليت والسينبيوتك لسلالة المندره)سلالة مصريه مستنبطة (خلال فترة البيض علي انتاج البيض ,صفات جودة البيض ,الخصوبه والفقس .تم استخدام عدد 270دجاجة و 27ديك عمر 24اسبوع وزعت عشوائيا بنفس الوزن) 1381.30 (,وتم توزيعها الي 9معاملات 30)دجاجه و 3ديوك .(كل معامله وزعت علي ثلاث مكررات 10)دجاجات و ديك في كل مكرره .(وصممت المعاملات بنظام التداخل ,(3*3)ثلاث مستويات من الزيوليت 2% ,1 ,0وثلاث مستويات من السينبيوتك 0.2% ,0.1 ,0.0بالترتيب استمرت التجربة 6شهور من 24حتي 48اسبوع من العمر.

وخلصت النتائج التحصل عليها :اضافة الزيوليت بنسبة % 2حسنت معنويا كلا من وزن الجسم في نهاية التجربة,التحسن في وزن الجسم ,اجمالي عدد البيض ,عدد البيض لكل كيلوجرام عليقة مستهلكة مقارنة بالدجاج المغذي علي عليقة مضاف لها % 1زيوليت و الكونترول.اضافة الزيوليت بمستوي % 2للعليقة حسنت معنويا كلا من دليل الصفار ووحدات هاف ودليل البياض ونسبة الاخصاب ونسبة الفقس للبيض المخصب مقارنة بالمعاملات الاخري .بينما ,اضافة مستويات من الزيوليت حسنت العائد والجدوي الاقتصادية النسبية اكثر من الكونترول.

: اضافة السينبيوتك بنسبة 0.1%حسنت معنويا كلا من وزن الجسم في نهاية التجربة,الى زيادة في وزن الجسم ,اجمالي عدد البيض ,عدد البيض لكل كيلوجرام عليقة مستهلكة مقارنة بالدجاج المغذي علي عليقة مضاف لها 0.2%سينبيوتك و الكونترول.اضافة السينبيوتك بمستوي % 2للعليقة حسنت معنويا كلا من دليل الصفار ووحدات هاف ودليل البياض ونسبة الاخصاب ونسبة الفقس للبيض المخصب مقارنة بالمعاملات الاخري.

التداخل بين اضافة كلا من الزيوليت والسينبوتك للعليقة اظهر معنوية في عدد البيض الناتج من كل كيلو جرام عليقة بينما باقي الصفات الانتاجية لم تتاثر معنويا.اضافة الزيوليت بنسبة 2 % + السينبيونك بنسبة 0.2%للعليقة حسنت معنويا كلا من نسبة الاخصاب ونسبة الفقس للبيض الكلي مقارنة بالمعاملات الاخري.

التوصية :استنتجت هذه الدراسة ,أن اضافة الزيوليت 2%والسينبيونك 0.2%لعلائق الدجاج المندره البياض أظهر افضل تاثير معنوي لتحسن الكفاءة الانتاجية وصفات جودة البيض)دليل الصفار ووحدات هاف ودليل البياض والتسبة المئويه لوزن القشره وكذلك نسبة الخصوبه والفقس للبيض المخصب او الكلي مقارنة بالمعاملات الاخري .