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EFFECT OF ECHINACEA PLANT SUPPLEMENTATION AS A SOURCE OF ANTIOXIDANTS ON PRODUCTIVE PERFORMANCE OF SINAI LAYING HENS AND COCKS

Nahla A. ElRazik; Azza R. Fawzy; Soheir A. shazly and A.M.Alazab
Anim. Prod. Res. Instit., Agric. Res. Center, Minis. of Agric. Dokki, Giza.

Corresponding author: Azza R. Fawzy Email :AzzaRefat83@yahoo.com

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ABSTRACT: Two experiments were desigen to evaluate the effect of Echinacea powder (EP) as a feed additive in layers diet on the egg production and reproductive properties of both Sinai laying hens and cocks. In Experiment 1, one hundred and thirty two laying Sinai birds (120 ♀+ 12 ♂) at 34-wks-old were weighed and randomly distributed into four experimental groups, as follow, the 1st was the basal diet without supplementation, while 2nd , 3rd and 4th groups were supplemented with 1,2 and 3 g EP/kg diet respectively. In Experiment 2, ninety six of Sinai birds (36 ♂ + 60 ♀) were weighed and randomly distributed into same four experimental groups to feeding the cocks (9 cocks / treatment distributed in 3 three replicates) on experimental diets, while the all hens were fed on the control diet. In experiment 1, no significant alternations were reported in egg number /hen, egg weight and egg mass due to use any of the dietary treatments. But, the results confirmed the superiority of diet supplemented with 3g EP/ kg diet to hatchability of set and fertile eggs as it was significantly greater ($P \leq 0.05$) than control group. Results in experiment 2 cleared that the diets supplemented with different levels of EP recorded significantly ($P \leq 0.05$) higher values of fertility percent than control diet. Also, hatchability of set eggs% was significantly ($P \leq 0.05$) improved by feeding on diets supplemented with 1 and 2 g EP/kg diet compared to the control diet. Thus, the Sinai cocks fed diets supplemented with 1 and 2g EP/ kg diet as an antioxidant can be used to enhance cock's welfare, fertility, and hatchability percent and to improve the economic efficiency.

Key Words: Echinacea, Laying, reproductive properties, Economic

INTODUCTION

The formation of reactive oxygen species (ROS) overpasses the cellular antioxidant capacity called oxidative stress where, imbalance status was happened. Mass production from the studies illustrated that a number don't little of medicinal plants such as Echinacea plant (EP), fruits as well as leaves of some berry plants biosynthesize phytochemicals possessing antioxidant activity and may be used as a natural source to scaveng the compounds of free radicals (Sacchetti et al., 2005; Yu et al., 2005). Many diseases occur due to insufficient amounts of antioxidants deficiency in the feed (Young and Woodside, 2001). Beshara et al., (2008) suggested that the effect of commercial synthetic antioxidant on productive performance of laying hens seemed to be instant meanwhile the natural antioxidants seemed to act gradually and persisting for longer period.

It is clear that, the antioxidant function is to act as a coordinated and balanced system to protect tissues and body fluids from damage by free radicals whether produced physiologically or as a response to inflammation infection or disease (Turrens *et al.*, 1984). Moreover, Halliwell , (1996 b) reported that in health, the balance between free radicals and the antioxidant defenses lies slightly in favor of the reactive species so that they are able fulfill their biological roles. Repair system take care of damage which occurs at a low level even in healthy individuals.

In fact, there is a high demand for antioxidants from natural source because the synthetic antioxidants, such as butylated hydroxytoluene (BHT), are not always beneficial for human health (Lobo et al., 2010) and they can cause adverse effects (Sabouri *et al.,* 2012). Thus numerous plant medications well branded in conventional medicine possess as anti-infective character by stimulating nature and adaptive shield mechanism of the host also,by directly affecting on pathogen (El-Murr et al., 2019; Ortuño-Sahagún et al., 2017). One of these plants is *Echinacea purpurea* (EP), which has an immunomodulation (Seckin et al., 2018) and antibacterial (Chiellini et al. 2017). Erenler et al. (2015) reported that *Echinacea purpurea* contains a variety of active substances like alkamides, glycoproteins, phenolic complexes, and flavonoids.

In addition, Echinacea purpurea, is an herbal medicine with positive effects on various immune parameters and known as the purple coneflower (Duke 2002). There are two different elemental distribution patterns within the plant of Echinacea purpurea where the first is flowers which contain the highest concentration of Cu, Zn and Ni, then the sccond, the leaves which contain concentration of Mg, Ca, Fe, Mn, Li and Sr is higher in leaves than flowers (Razˇic et al., 2003). Also, it is interesting to note that the studies on rates, humans by administration Echinacea purpurea proved to be very slightly toxic or nontoxic when examined even administered intravenously at high doses (Stanisavljević et al., 2009). Many components included volatile compounds, polysaccharides, alkylamides, polyphenols, caffeic acid derivatives, alkaloids, and many other different structures were isolated from roots or aerial parts of the plant (Yu et al., 2013).

Therefore, the objective of the current study was to invistigate the influence of dietary supplementation of Echinacea purpurea by diffenr levels as a source of nature antioxidants on the productive and reproductive performance of hens fed a common commercial diet (corn-soybean). Also, the reproductive traits of Sinai cocks were estimated by designed an in another experiment.

MATERIALS AND METHODS

Experimental bird's procedure and management:

The current experiment was performed at El–Serw Poultry Production Research Station, Animal Production Research Institute (APRI), Ministry of Agriculture, Egypt. The trial was lasted for 12 weeks; from 34 to 46 weeks of age. Two experiments were conducted to evaluate the effect of Echinacea powder supplementation of a layer diet on the laying performance and reproductive properties of both Sinai laying hens and cocks, in a completely randomized scheme.

An experiment 1, one hundred and thirty two laying Sinai birds (120 ♀+ 12 ♂) at 34-wks-old were weighed and randomly distributed into four experimental groups, three replicates for each (10 ♀+ 1♂). The experimental design consisted of four experimental groups as follow, the first diet (diet) was the basal diet without any supplementation, the second diet was supplemented with 1g Echinacea powder/ kg diet, the third diet was supplemented with 2g Echinacea powder/ kg diet, the fourth diet was supplemented with 3g Echinacea powder/ kg diet.

An experiment 2, the effect of the same four levels of EP (0, 1, 2 and 3g EP/kg diet) on the reproductive performance of cocks was studied where, ninety six of Sinai birds (36 ♂ +60 ♀) were weighed and randomly distributed into four experimental groups to feeding the cocks only while the all hens were fed on the basal diet without any supplementation of EP, 9 cocks for each treatment distributed in 3 three replicates. At the onset of the experiment, birds were weighed and assigned to treatments based on body weight so that mean body weight were nearly similar for birds on all treatments and the birds were kept on cages with one bird /cage (60 cm long x 50cm wide x 60cm high) Also, sixty local Sinai laying hens at 34 weeks old of age were randomly assigned to fed the same layer diet to evaluate the effect of cocks dietary treatments on reproductive and economic performance till 46 weeks of age. A daily photoperiod was 16 hr during the laying period. Throughout the experimental period, feed and fresh water were available all the time. The composition and calculated analysis of diet treatments are shown in Table 1.

Experiment 1

Laying performance traits

Body weights of hens were recorded at the beginning of study at 34 of age which ranged from 1615 to 1640 g/ hen. Egg number and egg mass were recorded then were averaged and expressed per hen/28 days through the three periods and the overall experimental period (34– 46 -wk. -old). Feed intake of each replicate was recorded every 28 days in g/hen Laying rate and feed conversion ratio was calculated through the same periods.

Reproductive performance:

The reproduction traits which included fertility, hatchability and chick weight at hatch were measured at the end of study.

Biochemical analysis of blood serum:

At the end of the experimental period, 4 birds from each treatment (2 ♀+ 2♂) were chosen randomly, blood samples were collected and divided into two halves. The blood sample was centrifuged at 3500 rpm for 15 minutes , to separate the serum for biochemical analysis, which include metabolic indicators as triglycerides, cholesterol, high density lipoprotein (HDL) and low density lipoprotein (LDL). Also, total antioxidant capacity was determined in serum by commercial kit as indicator of oxidation stress in living system according to Koracevic et al., (2001).

Experiment 2:

Natural insemination was used in this study, where at 46 wks. of the experimental period the males were transported to the hens then eggs from each replicate were collected for nearly 5 days. The eggs were set in incubator. Fertility and hatchability were calculated and hatched chicks were weighed.

Economic efficiency and net return:

Data were calculated based on the prices of Echinacea (290 LE/ one kg), Economical efficiency for egg production was expressed as hen-production and calculated using the following equation:

Economic efficiency (%) = (Net return LE/Total feed cost LE) × 100.

Statistical analysis:

Data were analyzed by the analysis of variance according to SPSS (2008) and significant differences among means were detected by the Duncan's Multiple Range Test (Duncan, 1955).The following model was used : $Y_{ij} = \mu + T_i + e_{iJ}$ where, Y_{ij} = an observation, μ = overall mean, T_i = Effect of treatment (1, 2 , 3 , 4) and e_{iJ} = Random error

RESULTS AND DISCUSSION

Experiment 1

The productive performance:

As shown in Table (2), the results of egg number / hen indicated that all dietary treatments which included three levels of Echinacea powder (EP) (1, 2 and 3g /kg diet) did not actually differ from control diet in the period from 34- 46 weeks of age. The same manner, in comparison with the control diet no significant alternations were reported in egg weight and egg mass due to using any of the dietary treatments during the overall period, however hens fed the diet supplemented with 2g EP/ kg diet produced significantly higher ($P \leq 0.05$) egg weight than those fed the control diet.

In addition, the dietary treatments did not significantly ($P \geq 0.05$) differ from control diet in respect of feed intake and feed conversion ratio during the different periods of the current study.

In consistent with the current results, two researchers (Roth-Maier et al., 2005; Bóhmer et al., 2009) have invistigate the efficiency of Echinacea purpurea on performance of broilers and layers who reported that performance estimates were not affected in diets supplemented with Echinacea extract. On the other hand, other studies illustrated that feed conversion ratio values of Echinacea purpurea diets were significantly lower compared with that of control birds (Lee et al., 2009). Similarly, a study was conducted on laying hens, it showed that egg production percentage was affected by supplementation Echinacea purpurea in the diet throughout the trial period where, supplemented of Echinacea purpurea powder in the layers diet at two levels (5 and 7.5 g/kg) improved ($P \leq 0.05$) feed conversion ratio values compared with control diet (Jahanian et al., 2017).

The different between findings in current study and others may be due to many factors have an effect on these plant chemicals: 1- the part of the plant (leaves, flowers, stems, or roots). 2- the genetic traits of Echinacea species. 3- the growing drying and storage conditions, (Gray et al., 2003). In this sense, the roots contain more volatile components and pyrrolizidine alkaloids, such as tussilagine and isotussilagine, aerial parts contain mainly alkylamides and polyacetylenes, caffeic and ferulic acid derivatives, polysaccharides, and glycoproteins, (Stanisavljević et al., 2009). Furthermore, these chemical constituents fluctuate during the Echinacea purpurea growth cycle, both quantitatively and qualitatively indeed, these compounds decline slowly in the aerial parts and increase in the roots as the plant matures (Mistrikova and Vaverkova, 2006).

Reproductive performance of hens:

As shown in Table 4, the results of reproductive performance of Sinai chickens strain during the first experiment clearly observed that no significant alternation in fertility % due to supplementation EP to the layer diet was detected. However, the results confirmed the superiority of diet supplemented with 3g EP/ kg diet at hatchability of set and fertile eggs as it was significantly greater ($P \leq 0.05$) than control group. Also, the other treatments resulted in insignificant improve ($P \geq 0.05$) in hatchability of set and fertile eggs as compared to the control diet.

Regarding chick weight at hatch, results obtained clearly indicated that no significant influence on chick weight compared to the control.

These effects on hatchability % may be due to antioxidant properties of Echinacea from some compounds which including phenolic compounds in Echinacea powder (Jukić et al., 2015). Georgieva et al., (2014) reported that the antioxidant power in ascorbic acid (vitamin C) was lower than that showed by Echinacea purpurea extract, and it the total phenol content in Echinacea purpurea was 353.6 mg gallic acid equivalents/ 100 ml. These components can act in several ways as follow:

1-Reducing agents,
2-Hydrogen donors,
3-Singlet oxygen quenchers
4-Metal chelating agents.

Serum biochemical

AS shown in Table (5), the results showed that significantly ($P \leq 0.05$) the highest values of triglycerides were showed in serum of birds fed diets contained different levels of EP especially those fed high level of EP as compared to the control group. Comparison with the control diet, cholesterol was not significantly ($P \geq 0.05$) affected by the dietary supplements applied. It is remarkable is that the best values of HDL in blood serum was achieved as a result of feeding on diets supplemented with 1g EP/ kg diet as compared to the control and other diets. In addition, statistical analysis revealed that diet supplemented with 1g EP/kg diet had no significant ($P \geq 0.05$) effect on LDL compared to the control diet, however, the diets supplemented with 2 and 3 g EP/ kg diet resulted in a significantly ($P \leq 0.05$) decrease in LDL comparing with the T2 and control group. In respect of the total antioxidant capacity, it is clear that the low level of EP did not any significant alternations compared to the control group, but the other dietary treatments led to significantly ($P \leq 0.05$) lower values than the T2 and control diet.

Indeed, the most remarkable result is that the diet supplemented with 2g EP/ kg diet significantly improved HDL level in blood. Also, LDL in serum was significantly decreased due to feeding on diets contained 2 and 3g EP/ kg diet. These results seems to agreement with those obtained by Jahanian et al., (2017) who reported that the diet inclusion of Echinacea purpurea resulted in an increase of serum HDL up to 7.5 g/kg in laying hen̕s diets during 35-d periods. In addition, consistent with these findings, it has been shown that adding soy genistein to laying hens diet led to increase of HDL concentration (Saiafzadeh and Jahanian 2013). However, results in current study have some contradict with Lee et al., (2009) who found that supplemental EP caused reductions in blood triglycerides in broilers and laying hens, respectively. According to Jahanian et al., (2017), the raised in serum high desity lipoprotein and redsuction serum low desity lipoprotein cholesterol concentration due to Echinacea purpurea supplementation might be companied to the restrained impact of bioactive constituents of Echinacea purpurea on the main enzyme in cholesterol biosynthesis which cahhed β-hydroxy-β-methylglutaryl coenzyme A reductase.

Experiment 2:

Reproductive performance of cocks:

Effect of dietary Echinacea plant powder supplementation for Sinai cocks on reproductive performance was showed in Table 6. It showed that the diets supplemented with different levels of EP recorded significantly ($P \leq 0.05$) higher values of fertility percent than control diet. Also, hatchability of set eggs% was significantly ($P \leq 0.05$) increased due to feeding on diets supplemented with 1 and 2 g EP/kg diet while using 3 g EP/ kg diet had no significant influence on this trait compared to the control diet. In respect of hatchability of fertile eggs, the diet supplemented with 3g EP/ kg diet resulted in a significantly ($P \leq 0.05$) decrease in the scientific hatchability compared to the control diet, but the other dietary treatments led to insignificant ($P \geq 0.05$) improve compared to the control diet. Chick weight was significant ($P \leq 0.05$) decreased as a result of feeding on diet contained 1g EP/ kg diet.

Results in the current study have support from a study by Abdulkarim and Al-Sardary (2009) who clarified that supplemental chicken male diets by black cumin enhanced fertility and hatchability. In addition, Awad el al., (2021) showed that under summer conditions, supplementation of Echinacea plant powder at 2.5 g/kg had possitive effects on reproductive performance as well as economically valued to breeder ducks.

Many antioxidants constitunts were isolated from aerial or roots parts of Echinacea such as caffeic acid derivatives, volatile compounds, alkylamides, polyphenols, polysaccharides, alkaloids, and many other different components (Yu et al., 2013). In fact, phenolic compounds has high interest due to the antioxidant and free radical scavenging activities (Dorman et al., 2003). In addition, from nutritional value of the phenolic compounds. Several experimental studies have suggested that the consumption of bioactive polyphenolic contents with potent antioxidant activities, may provide several health benefits including improvement in cognitive function (Joseph et al., 1999), antioxidant effects (Youdim et al., 2000), and modulation of obesity and adiposity.

These results are largely due to the high antioxidant activity of Echinacea components. It has been reported that

Echinacea contains bioactive components such as echinacoside, cichoric acid, and caffeic acid derivatives, which have antioxidant activity (Pellati et al., 2005; Thygesen et al., 2007). This antioxidant property could integrity of the cell membrane against oxidative stresses probably through reducing different free radical species such as superoxide anion radical ($O2^{-\cdot}$),peroxyl radical ($HOO^{\cdot}$), hydrogen peroxide (H_2O_2), hydroxyl radical ($OH^{\cdot}$),lipid peroxide radical ($ROO^{\cdot}$), single Oxygen(O2), nitric oxide ($NO^{\cdot}$) and peroxy nitrite ($ONOO^{-\cdot}$). Caldwell, (2003) found that polyphenols are antioxidants with redox properties which allow them to act as reducing agents, H_2 donators, and O2 quenchers.

According to Ravie and Lake., (1985) in birds the phospholipids of spermatozoa are characterized by extremely high proportions of long chain, highly n-6 polyunsaturated fatty acids (mainly 20:4n-6 and 22:4n-6).There is considerable evidence that such fatty acids play an important, although as yet unspecified, role in sperm function since cases of impaired fertility in birds (Kelso et al., 1996) have been associated with reduced amounts of these 115 polyunsaturated fatty acids in spermatozoa. However, the high degree of polyunsaturation typical of sperm lipids renders these gametes highly susceptible to lipid peroxidation, with the consequent risk of damage to cellular structures (Niki et al., 1993). In fact, peroxidative damage to spermatozoa is believed to be a major cause of male subfertility (Aitken, 1994) . Thus , enhancement of the antioxidant capacity of semen by supplementation of natural antioxidants such as EP could present a major opportunity for improving male fertility.

In accordance with Surai et al., (1997), who postulated that the beneficial consequences of an effective protection against lipid peroxidation of birds semen are likely to result from two related mechanisms: (a) Defense against peroxidative damage is essential to maintain the structural integrity of the spermatozoa; (b) Minimization of lipid peroxidation will prevent any reduction in the concentrations of the functionally important n-6 polyunsaturated fatty acids of the semen phospholipids.

It is clear that, the antioxidant role is to act as a coordinated and balanced system to protect tissues and body fluids from damage by free radicals whether produced physiologically or as a response to inflammation infection or disease (Turrens et al., 1984). Moreover, Halliwell, (1996 b) reported that in health, the balance between free radicals and the antioxidant defenses lies slightly in favor of the reactive species so that they are able to fulfill their biological roles. Repair system takes care of damage which occurs at a low level even in healthy individuals. For these reasons, it was not strange to find that EP supplementation showed better fertility and hatchability percentage than control diet.

The economic efficiency (EE):

The data obtained in Tables (7 and 8) represents the economic efficiency (EE) of chicks hatched in response to feeding Sinai hens and cocks on dietary treatments.

The results in the present study illustrated that no significant in EE of chicks hatched could be detected among the experimental groups and the control diet as shown in

Table 7. On the other hand, the results clearly observed that the cocks fed diets contained 1 and 2g EP/ kg diet produced significantly ($P \leq 0.05$) the highest values of EE of hatched chicks as compared to the control diet.

CONCLUSION

According to the current results obtained the Sinai cocks fed diets supplemented with 1 and 2g EP/ kg diet as an antioxidant can be used to enhance cock's welfare, fertility, and hatchability percent and to improve the economic efficiency. Regarding egg production, further investigations are required to identify a optimize level of Echinacea powder supplementation that are most responsible for the positive effects on hens health.

Table (1): Ingredients and calculated analysis of the layer diet

Ingredients	**%**
Yellow corn	64.00
Soy bean meal (44 %)	22.50
Corn gluten (60%)	1.58
Wheat bran	1.68
Di-calcium phosphate	1.40
Limestone	8.14
premix [1]	0.30
Sodium chloride	0.30
DL- Methionine (99%)	0.10
Total	100
Calculated Analysis [2]	
Crude protein %	16.10
ME (Kcal / kg)	2730
Crude fiber %	3.30
Ether extract %	2.87
Calcium (%)	3.43
Av. Phosphorus (%)	0.39
Methionine %	0.40
Lysine	0.84
Methionine + Cystine %	0.68
Price (LE/kg diet) [3]	5.02

1-Each 3 kg of vitamins and Minerals premix contains 100 million IU vitamin A; 2 million IU Vit.D_3;10 g vitamin E; 1 g Vit.K_3 ; 1 g vitaminB_1; 5 g vitamin B_2 ;10 mg vitamin B_{12} ; 1.5 g vitamin B_6; 30 g Niacin ;10 g Pantothenic acid ;1g Folic acid;50 mg Biotin ; 300 g Choline chloride; 50 g Zinc; 4 g Copper; 0.3 g Iodine ; 30 g Iron; 0.1 g Selenium; 60g Manganese ;0.1 g Cobalt; and carrier $CaCO_3$ to 3000 g . 2- According to Feed Composition Tables for animal and poultry feedstuffs used in Egypt (2001). 3- Price of one kg (Egyptian pound / kg diet) for different ingredients: Yellow corn, 3.95 ; Soybean meal 8.0 ; Wheat bran, 2.42 ; Corn gluten, 13.8 ; Di-calcium phosphate, 10.8 ; Limestone, 0.2; Premix, 60.0; Salt, 0.50; Dl-methionine, 70.0.

Table (2): Effect of dietary Echinacea plant powder supplementation on egg production performance of Sinai laying hens at different laying periods

Age \ Treatment	Echinacea powder (g/Kg diet)				SEM	Sig.
	T1	**T_2**	**T_3**	**T_4**		
Egg number/ hen						
34-38	19.60	16.63	18.2	17.86	0.50	NS
38-42	17.87	16.0	15.03	15	0.51	NS
42-46	15.23	14.0	13.37	12.9	0.47	NS
34-46 (overall)	52.7	46.63	46.6	45.73	1.39	NS
Laying rate %						
34-38	70.00	59.4	65.00	63.7	1.81	NS
38-42	63.81	57.14	53.69	53.57	1.81	NS
42-46	54.40	50	47.74	46.07	1.69	NS
34-46 (overall)	62.74	55.51	55.48	54.44	1.65	NS
Egg weight (g)						
34-38	48.35	48.58	49.55	48.66	0.26	NS
38-42	49.72	50.22	50.92	50.79	0.27	NS
42-46	50.37^{c}	51.22^{bc}	52.62^{a}	51.64^{ab}	0.28	0.05
34-46 (overall)	49.49^{b}	50.01^{ab}	51.03^{a}	50.36^{ab}	0.23	0.05
Egg mass						
34-38	947.82	807.6	902.22	868.25	25.34	NS
38-42	889.5	803.4	765.86	762.03	25.60	NS
42-46	767.55	717.15	703.5	667.01	23.77	NS
34-46 (overall)	2604.9	2328.18	2300.58	2297.3	69.5	NS

a,b..c :means in the same column and effect bearing different superscripts are significantly different ($P \leq 0.05$).

SEM= standard error mean; NS = non-significant; * = $P \leq 0.05$

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (3): Effect of dietary Echinacea plant powder supplementation on feed intake and feed conversion ratio of Sinai laying hens at different laying periods

Treatment / Age	Echinacea powder (g/Kg diet)				SEM	Sig.
	T1	T_2	T_3	T_4		
Feed intake (g/ hen/day)						
35-38	109.26	108.79	107.71	108.31	0.39	NS
39-42	112.12	111.67	110.35	110.20	0.53	NS
43-46	109.32	109.77	110.45	110.30	0.28	NS
35-46 (overall)	110.23	110.07	109.50	109.60	0.27	NS
Feed conversion ratio (Feed g / egg mass g)						
35-38	3.24	3.81	3.35	3.51	0.10	NS
39-42	3.58	3.92	4.04	4.05	0.10	NS
43-46	3.05	4.31	4.41	4.07	0.15	NS
35-46 (overall)	3.62	4.01	3.93	4.1	0.11	NS

SEM= standard error mean; NS = non-significant; * = $P \leq 0.05$

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (4): Effect of dietary Echinacea plant powder supplementation on reproductive performance of Sinai laying hens

Treatment / Traits	Echinacea powder (g/Kg diet)				SEM	Sig.
	T1	T_2	T_3	T_4		
Reproductive parameters						
Fertility %	96.67	100	100	100	0.598	NS
Hatchability of total eggs %	86.67^{b}	89.11^{ab}	91.78^{ab}	98.89^{a}	1.878	0.05
Hatchability of fertile eggs %	89.53^{b}	89.11^{b}	91.78^{ab}	98.89^{a}	1.57	0.05
Chick weight (g)	34.23	34.98	34.8	35.1	0.319	NS

a,b..c :means in the same row and effect bearing different superscripts are significantly different ($P \leq 0.05$).

SEM= standard error mean; NS = non-significant; * = $P \leq 0.05$

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (5): Effect of dietary Echinacea plant powder supplementation on serum biochemical of Sinai laying hens

Treatment / Traits	Echinacea powder (g/Kg diet)				SEM	Sig.
	T1	**T_2**	**T_3**	**T_4**		
Serum biochemical						
Triglycerides	61.93^{b}	73.15^{b}	169.87^{a}	177.1^{a}	14.04	0.05
Cholesterol	183.17	168.72	169.7	204.32	8.15	NS
HDL	62.78^{b}	70.67^{a}	50.60^{c}	43.63^{c}	2.92	0.05
LDL	122.96^{a}	135.53^{a}	68.75^{b}	73.07^{b}	8.22	0.05
TAC	2.26^{a}	2.19^{a}	1.52^{b}	1.52^{b}	0.099	0.05

a,b..c :means in the same row and effect bearing different superscripts are significantly different (P≤0.05).

SEM= standard error mean ; NS = non-significant ; * = P≤0.05

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (6): Effect of dietary Echinacea plant powder supplementation for Sinai cocks on reproductive performance

Treatment / Traits	Echinacea powder (g/Kg diet)				SEM	Sig.*
	T1	**T2**	**T3**	**T4**		
Reproductive traits						
Fertility %	83.26b	94.68a	91.18a	92.66a	1.45	0.05
Hatchability of total eggs %	75.74b	89.37a	88.0a	78.82b	1.94	0.05
Hatchability of fertile eggs %	90.94a	94.36a	96.64a	85.14b	1.50	0.05
Chick weight (g)	37.17a	34.21b	36.00a	36.25a	0.39	0.05

a,b :means in the same row and effect bearing different superscripts are significantly different (P≤0.05).

SEM= standard error mean * = P≤0.05

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (7): Effect of dietary Echinacea powder supplementation for Sinai hens on economic efficiency of hatchability

Characteristic	Treatments				SEM	Sig.
	T1	T_2	T_3	T_4		
Total feed intake (Kg/hen)[1]	9.26	9.25	9.20	9.21	0.06	NS
Total egg number /hen	52.7	46.63	46.6	45.73	1.39	NS
Echinacea addition cost (L.E)	0.0	0.12	0.23	0.23	0.04	-
Price/Kg feed (L.E)	5.02	5.14	5.25	5.37	0.04	-
Total feed cost (L.E)2	46.48^{c}	47.49^{b}	84.31^{b}	49.42^{a}	0.34	0.05
Hatchability of set eggs	86.67^{b}	89.11^{ab}	91.78^{ab}	98.89^{a}	1.878	0.05
Number of hatched chicks	45.48	41.49	42.74	45.26	1.09	NS
Price/chick (L.E)	3.0	3.0	3.0	3.0	-	-
Total return (L.E)[3]	136.4	124.5	128.2	135.8	3.28	NS
Net return (L.E)[4]	89.9	77.0	80.0	86.4	3.25	NS
Economic efficiency (EE)[5]	1.94	1.62	1.65	1.75	0.07	NS

1. Total feed intake (Kg/hen) = Daily feed intake x 84 days. 2. Total feed cost (LE) = Total feed intake (Kg) x price of kg feed. 3. Total return/ hen (LE) = Total chicks hatch / hens x price of chick (LE). 4. Net return / hen (LE) = Total return / hen (LE) – Total feed cost / hen (LE). 5. Economic Efficiency (E.E) = Net return per hen (LE) / Total feed cost per hen (LE).

a, b : Means in the same row with different superscripts are significantly different ($p \leq 0.05$);

NS= Non-significant;

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

Table (8): Effect of dietary Echinacea powder supplementation for Sinai cocks on economic efficiency of hatchability

Characteristic	Treatments				SEM	Sig.
	T1	T_2	T_3	T_4		
Number of set eggs	60	60	60	60	-	-
Price of fertile egg (L.E)	2	2	2	2	-	-
Total cost (L.E)2	120	120	120	120	-	-
Hatchability of set eggs	75.74^b	89.37^a	88.0^a	78.82^b	1.94	0.05
Number of hatched chicks	45.44b	53.62a	52.8a	47.29b	1.09	0.05
Price/chick (L.E)	3.0	3.0	3.0	3.0	-	-
Total return (L.E)[3]	136.3b	160.9a	158.4a	141.9b	3.40	0.05
Net return (L.E)[4]	16.3b	40.9a	38.4a	21.9b	3.50	0.05
Economic efficiency (EE)[5]	13.6^b	34.1^a	32.0^a	18.2^b	2.91	0.05

1. Total feed intake (Kg/hen) = Daily feed intake x 84 days. 2. Total feed cost (LE) = Total set eggs x price fertile egg. 3. Total return/ hen (LE) = Total chicks hatch / treatment x price of chick (LE). 4. Net return / hen (LE) = Total return / hen (LE) – Total feed cost / hen (LE). 5. Economic Efficiency (E.E) = Net return per hen (LE) / Total cost (LE).

a, b : Means in the same row with different superscripts are significantly different ($p \leq 0.05$); NS= Non-significant;

T1: control diet, T2: Echinacea supplemented with 1g/kg diet, T3: Echinacea supplemented with 2g/kg diet, T4: Echinacea supplemented with 3g/kg diet.

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الملخص العربي

تأثير اضافة نبات الإشنासيا كمضادت أكسدة علي الأداء الإنتاجي لدجاج السينا البياض

نهله عبد الرازق محمد ،عزه رفعت فوزي ، سهير عبد النبي شازلي، أحمد منير العزب
معهد بحوث الإنتاج الحيواني ـ مركز البحوث الزراعية ـ وزارة الزراعة ـ الدقي ـ جيزة

تم اجراء تجربتين بهدف دراسة تاثير اضافة مسحوق نبات الإشناسيا للعليقة البياض علي الأداء الانتاجي والتناسلي لكل من دجاجات وديوك سلالة السينا. التجربة الأولي ، تم استخدام ما جملته 132 طائر بياض من السينا (120♀ + 12♂)عمر 34 أسبوع حيث تم وزنها وتوزيعها علي 4 معاملات تجريبية كما يلي: العليقة الأساسية (المقارنة) ، العليقة الثانية مضاف اليها 1 جم اشناسيا / كجم عليقة ، العليقة الثالثة مضاف اليها 2 جم اشناسيا / كجم عليقة ، العليقة الرابعة مضاف اليها 3 جم اشناسيا / كجم عليقة. التجربة الثانية ، تم استخدام ما جملتة 96 طائر سينا (36♂ + 60♀) تم وزنها وتوزيعها (الذكور فقط) علي نفس المعاملات التجريبية الاربعة السابقة (9 ديوك/ معاملة موزعة علي 3 مكررات) في حين تم تغذية الإناث علي العليقة الأساسية فقط. أوضحت نتائج التجربة الأولي أنه لا يوجد فروق معنوية في كل من عدد البيض الناتج /دجاجة ووزن البيض وكذلك كتلة البيض الناتج كنتيجة لاستخدام اي من المعاملات التجريبية. لكن اوضحت النتائج أنه قد تحقق تفوقا معنويا في نسبة الفقس من البيض الكلي ومن البيض المخصب نتيجة لأضافة 3 جم من الأشناسيا/ كجم علف مقارنة بالعليقة المقارنة. التجربة الثانية، سجلت المستويات المختلفة من الإضافة القيم الأعلي معنويا في الخصوبة مقارنة بالعليقة المقارنة. أيضا ارتفعت معنويا نسبة الفقس من البيض الكلي الموضوع بالتغذية علي العلائق المضاف اليها 1و 2 جم اشناسيا /كجم علف وذلك مقارنة بالعليقة الأساسية. لذلك، يمكن التوصية بتغذية ديوك السينا علي علائق مضاف اليها 1 و 2 جم اشناسيا /كجم علف وذلك لتعزيز صحة الديوك ونسبة الخصوبة والفقس وكذلك الأداء الإقتصادي.