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The Effect of Using Fennel on Plasma Estrogen and Performance of Laying Hens

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Abstract

An experiment was conducted for investigating the effect of a medicinal herb, fennel, on the production performance, qualitative properties of egg and morphology of the laying hens' ovary in Qazvin Province, Takestan County, Kahak Village. The subjects of this experiment were 55-week-old white shaver hens. The experiment was carried out within a completely random block design with four different treatments. The experimental treatments included an evidence group (with no use of hormone and extract), a group treated with 2.5mg estrogen hormone, a group injected with 10mg fennel extract and a group treated orally with 10mg fennel extract. The experiment results indicated that the experimental treatments significantly influence the egg production, egg weight, yolk weight, estrogen, calcium, liver weight, abdominal fat and the large white follicles but no significant effect was documented on such traits as triglycerides, cholesterol, large yellow follicles, small white follicles and small yellow follicles.

Keywords: Estrogen, Fennel, Laying Hen, Performance.

Introduction

Statement of the Problem:

During the past several decades, the performance of producing commercial egg-laying birds has been considerably improved and this includes the increase in the egg production, reduction in the feed output and increase in the viability. Various factors like genetic, coop, vaccination, lighting, nutrition, molting, ambient temperature and processing might influence the production of the egg. Amongst these factors, devising strategies for optimal nourishment in line with satisfying the vast needs of the commercial layers is necessary. Surely, these birds should be maximally supplied with energy, nutrients, micronutrients and vitamins so as to be able to entice high performance in them. Poultry and ranching industries and their associated feed industry is constantly in search of effective and healthy, safe and cost-effective products with a defined performance and justified interests.

The increase in the age of the layers would cause their production undergo decrease in a faster pace. The production reduction usually comes about following the decrease in the concentration of estrogen, as a sex hormone, in hens. Preventing the decline in the level of estrogen via stimulating the synthesis of yolk precursors would lead to the preservation and continuation of production in the hens. The present study aims at investigating the solutions for preserving the blood estrogen levels in layers for improving their reproductive performance as well as enhancing the qualitative traits of the eggs. Fennel is one of the plants that can be used for preserving estrogen in the body of layers. In this experiment, estrogen and fennel extract were added in various treatments to the layers' feed. Fennel contains a large amount of antol (50-70%) the polymers of which act as phytoestrogen (Albert Pleiu, 1980). Due to being in possession of a structure like that of estradiol, phytoestrogens can act as estrogen or antiestrogen (Naz, 2004). Steroid hormones, especially estrogen, play a large role in reproductive activities and making and formation of egg in layers and they also play an important part in calcium metabolism regulation via various mechanisms (Niz et al, 1989).

Materials and Methods

The experiment was conducted in a chicken shed with a capacity of 28000 laying hens situated in Qazvin province, Takestan County, Kahak Village, Setayesh Henhouse. The birds used in the experiment were 55-week-old white shaver hens. Before the commencement of the experiment, a total of 80 layers were selected from the flock in such a way that their average weights did not differ significantly from one another in every experiment. In doing this experiment, use was made of 20 experimental units (cage) each accommodating four hens. The dimensions of the cages used in this experiment were 40×40×30cm. each cage was equipped with a nipple waterer and trough feeder. To separate the feed specified for each cage, a barrier made of plastic was placed inside the feeder between the two adjacent cages. The experiment was started at 11/15/2018 and lasted two weeks and, in this

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experiment, 80 55-week-old shaver layers were subjected to the aforementioned treatments.

The experiment was conducted with the format of a completely random block design with four different treatments. Each treatment was replicated five times and each replication included four egg-laying hens. The studied treatments were as follows: treatment one (A): a control group that received a ration without fennel or injection without fennel or estrogen hormone. To make the conditions identical for the control group and all the three treatment groups, 3ml canola oil was injected subcutaneously on the backside of these birds' neck on a daily basis. Treatment two (B): this group received a daily dose of 2.5mg estrogen per every kilogram of the body weight subcutaneously on the backside of the neck. Treatment three (C): this group orally received 10mg fennel essential oil per every kilogram of body weight. Fennel essential oil was procured from Gol Qatreh Tus Company. The traits studied in this experiment were: the egg production percentage, egg weight, yolk weight, shell thickness, body weight change, carcass-related traits, blood parameters (triglyceride, total cholesterol and calcium). In the end, the data analysis was carried out using SASS software and data mean comparison by Tukey test. Moreover, the diagrams were drawn using Excel Software.

Results and Discussions

Body Weight in 55 Weeks of Age:

Fifty five weeks of age is the first weight of pre-experiment period and a variance analysis table was prepared for this item to assure that the average weights of the subjects are equal hence not different from one another in the beginning of the period before the experiment and also to ensure that the experiment is done with uniform weights of all the treated subjects during the beginning of the period. Variance analysis table obtained from the extracted data indicated that the experimental treatments that had received estrogen hormone and 10mg fennel extract orally and by injection do not significantly differ from one another hence equal in terms of average weight (table 1-4).

Body Weight Changes:

The results of variance analysis resulting from the data indicated that the experimental treatments could not significantly change the hens' body weights (table 1).

Table 1: The results of variance analysis resulting from the data indicated that the experimental treatments could not significantly change the hens' body weights

Variation source	Degree of freedom	Performance indices						
		Body weight in week 55	Body weight change	Egg production	Yolk weight	Relative weight of yolk	Egg weight	Eggshell thickness
Experimental error	16	0.00094	0.0009	2.1002	0.181	2711378.9	1.97	2.42
Experimental treatment	3	0.00029^{ns}	0.0012 ^{ns}	13.658**	3.755**	24631500.3 ^{ns}	13.78**	15.38**
Variations' coefficient		1.84	1.82	1.82	2.4	12.7	1.2	4.33
Signs *, ** and ns respectively indicate significance in 5% and 1% levels and insignificance.								

Table 2: comparison of the various experimental treatments' means of body weight traits and egg traits

Treatment	Body weight in week 55	Body weight variations	Egg production	Egg weight	Yolk weight	Relative weight of yolk	Eggshell thickness
A	1.674a	1.67^{a}	78.76^{a}	64.06^{a}	15.98^{a}	24.96^{a}	33.40^{a}
B	1.676a	1.71^{a}	79.14^{a}	67.26^{b}	17.84^{b}	26.54^{a}	37.00^{b}
C	1.676a	1.70^{a}	78.00^{a}	67.18^{b}	17.64^{b}	26.27^{a}	37.20^{b}
D	1.666a	1.70^{a}	81.80^{b}	64.70^{a}	16.68^{a}	25.79^{a}	36.20^{ab}
P-value	0.31	0.29	0.004	0.003	0.0009	0.052	0.004
In each column, the mean values shown with dissimilar letters have significant differences. Letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract).							

Egg Production:

The results of the data variance analysis indicated that the experimental treatments (2.5mg of estrogen, injection with 10mg of fennel extract and oral feeding on fennel extract) have a significant effect on egg production in 1% significance level ($P<0.01$) (table 1). Mean comparison of the data indicated that the highest rate of egg production with a statistical mean of 81.1 eggs was obtained for the group that had been orally treated with 10mg of fennel extract and the lowest number of eggs with a mean value of 78 eggs was evidenced for the group that was injected by 10mg of fennel extract in its ration; however, no significant difference was found between the aforesaid treatments and the control group and the group that had been treated with 2.5mg of estrogen hormone (table 4). The results obtained in the present study are consistent with the findings by Nasimi et al who had used 40mg/kg fennel extract as well as Takii et al who had used various 200mg/kg, 400mg/kg and 600mg/kg levels of fennel extract. Furthermore, Vakili (2012) used 40mg/kg fennel extract as well as this same amount of extract along with flaxseed and reported similar results. Nasir Al-Eslami and Torki used 350mg/kg fennel essence in the ration of the layers and reported

similar results. Abdullah et al (2011) added 1g/kg of the powder of such plants as fennel anise, fenugreek and cinnamon in the form of separate and mixed treatments and observed a significant effect in the percentage of egg production. On the other hand, Whitehead (2004) showed that the birds with higher concentration of blood estrogen also had a higher rate of egg production and more regular egg-laying.

Egg Weight:

Comparison of this trait's mean values indicated that the experimental treatments have had a significant effect on the egg weights in $P<0.01$, i.e. in a 99% confidence level (table 1). The results obtained in the present study are in compliance with what has been found by Vakili (2012) who used 40mg fennel and thyme extracts per every kilogram of ration in the form of separate treatments of egg-laying hens. It can be seen in the table for the mean comparison of this trait that the highest rates of egg weight with mean values equal to 67.26g and 67.18g belong to the groups treated with 2.5mg of estrogen hormone and 10mg of fennel extract injected in the ration and that the lowest egg weight was found belonging to the control group with a mean of 64.06g (table 2). Yazarlou et al (2012) reported similar results using 0.4%, 0.8% and 1.2% of fennel seeds in the ration of Japanese egg-laying quail. Abdullah et al (2011) added one gram per kilogram of the powders of such plants as fennel anise (roman fennel), fenugreek and cinnamon in separate treatments as well in mixtures and observed a significant increase in the egg weight. Fennel causes an increase in the blood estrogen and large amounts of estrogen in plasma stimulates bone growth, increases the amount of the materials adding to the thickness of eggshell, accumulation of yolk protein and fat in liver (enlargement of the liver) and increase in the size of oviducts. Enlargement of oviducts causes more activity in them for the supply of albumin proteins, shell membranes and the required calcium carbonate for the formation of the shell and coticule. The high level of estrogen in plasma boosts the synthesis of 1,25-hydroxycholecalciferol (Yazarlou et al, 2012). This compound causes an increase in the uptake and storage of calcium for the formation of the eggshell. In addition, the improvement in the specific weight of the eggshells in the use of medicinal herbs in respect to the evidence group signifies the useful effects of these plants including the increase in the secretion of various digestive enzymes as well as the improvement of the intestines' anatomical situation for absorbing various nutrients, including calcium with the uptake of a larger volume of which a larger amount of them is deposited in the shell that will generally have a direct effect on egg weight and causes an increase in the egg weight (Nowbakht et al, 2011).

Yolk Weight:

The results obtained from the data variance analysis indicated that the experimental treatments (control group that received 2.5mg of estrogen hormone, the treatment group that orally received 10mg of fennel extract and another treatment group that received 10mg of fennel extract injected in its ration) have had a significant effect on yolk weight in a 99% significance level (table 1). The mean comparison of these treatments indicated that the highest yolk weights with mean values of 17.84mg and 17.64mg belong to the treatment groups that received 2.5mg of estrogen hormone and 10mg of fennel extract injected in its ration, respectively, but no significant difference was found between these two treatments. On the other hand, the lowest weight mean (with a value of 15mg) was found belonging to the control group (that received no hormone and fennel extract) (table 2). Kazemifard et al (2015) reported in their study that fennel extract causes a linear increase in yolk weight in week 92. Consistent with these findings, the results reported by York and Mitchell showed that increase in estrogen causes an increase in fat accumulation.

Relative Yolk Weight:

The results obtained from the data variance analysis indicated that the experimental treatments (control group that received 2.5mg of estrogen hormone, the treatment group that orally received 10mg of fennel extract and another treatment group that received 10mg of fennel extract injected in its ration) have had no significant effect on the relative weight of yolk (table 1).

Eggshell Thickness:

The results obtained from the data variance analysis indicated that the experimental treatments have had a significant effect on the eggshell thickness in 1% significance level (table 1). The comparison of the mean values obtained from the extracted data showed that the highest eggshell thickness belongs to treatment C (10mg of fennel extract injected in the ration) with a mean value of 37.2mm but no significant difference was found between the foresaid treatment and the treatment using 10mg of oral fennel extract (D) and the treatment using 2.5mg of estrogen hormone (B). On the other hand, the lowest thickness was obtained for the control treatment (A) with a mean value of 33.4mm (table 2). Due to the increase in the secretion of various digestive enzymes as well as the improvement in the intestines' anatomical status for the uptake of various nutrients, including calcium, following the application of medicinal plants in feeding poultry, a larger amount of calcium is deposited on the eggshell (Nowbakht et al, 2011) and this can per se enhance the eggshell's qualitative properties, including weight, thickness and resistance. Steroid hormones are engaged in regulating calcium mechanism in layers through several active mechanisms. A short while before sexual maturity, estrogen causes the formation of medullary bones and elevating the calcium retention (Muntzouris et al, 2008). For its possession of estrogen, fennel can bring about an increase in the size of oviducts hence more activation of them for supplying albumin proteins, shell membrane and the required calcium carbonate for shell and coticule formation. The high level of plasma estrogen boosts the synthesis of 1, 25-dihydroxycholecalciferol that stimulates the absorption and storage of calcium for eggshell formation.

Blood Parameters:

Triglycerides:

Data variance analysis table indicated that the experimental treatments could not exhibit a significant effect on triglycerides (table 3).

Table 3: blood parameters' variance analysis

Variations source	Degree of freedom	Blood parameters			
		Triglycerides	Estrogen	Cholesterol	Calcium
Experimental error	16	9706.1	8773	625.72	4.65
Experimental treatment	3	9621.65^{ns}	2652255.6*	976.98^{ns}	18.85**
Variations coefficient		7.37	6.95	18.17	8.43
Signs *, ** and ns respectively indicate significance in 5% and 1% levels and insignificance.					

Estrogen:

The results indicated that the experimental treatments (control group that received 2.5mg of estrogen hormone, the treatment group that orally received 10mg of fennel extract and another treatment group that received 10mg of fennel extract injected in its ration) have had a significant effect on the estrogen levels of the treated hens (table 3). Mean comparison based on the extracted data showed that the highest estrogen level with a mean value of 1954.6 belongs to the group that was treated using 10mg of fennel extract injected in its ration (C) and the lowest estrogen level with a mean value of 392.8 belongs to the control group (A). It is worth mentioning that no significant difference was found between the group treated by 2.5mg of estrogen hormone (B) and the group treated by 10mg of injected fennel extract (C) (table 4).

Cholesterol:

The results obtained from variance analysis table indicated that the experimental treatments (control group that received 2.5mg of estrogen hormone, the treatment group that orally received 10mg of fennel extract and another treatment group that received 10mg of fennel extract injected in its ration) could not have a significant effect on the blood cholesterol of the treated hens. But, according to the mean comparison results in terms of this trait, it was made clear that the highest cholesterol level with a mean value of 150 belongs to the group treated by 2.5mg of estrogen hormone (B) and the lowest cholesterol level with a mean value of 119 belongs to control treatment (A) but no significant difference was documented between these treatments (table 4).

It is imagined that the main reason for the increase in the serum triglyceride following the increase in estrogen level is the direct stimulation of triglyceride synthesis and secretion by liver that takes place at the same time with the entry of VLDL as a hepatic product into plasma. Therefore, one method for compensating the increase in the entry of LDL cholesterol into liver following the application of estrogen is the exit of an amount of VLDL from the liver into plasma. Many of the studies on animals indicated that estrogen has hypolipidemic effects. Ramperatp et al (1990) showed that the use of estrogen causes a reduction in blood lipids via reducing VLDL and LDL. The increase in estrogen causes VLDL extraction through separation or isolation of that by increasing Apo lipoprotein. Lisson et al (1995) reported that the increase in serum lipids occurs by estrogen induction for increasing the yolk size.

The protective effect of estrogen is exerted by the direct effect on the blood vessels' walls through regulation of antiatherogenic agents of nitic zeroxide and the indirect effect on liver and the final result of estrogen action in liver is the change in the plasma cholesterol level. Part of plasma cholesterol is transferred by LDL that supplies the cholesterol needs of extrahepatic tissues and its residuals are carried by the assistance of HDL. LDL deposits cholesterol on the vein wall whereas HDL uptakes cholesterol from the smooth muscle of the veins' wall and transfers it to liver through reverse path of cholesterol transport for metabolism and excretion.

Table 4: mean comparison of the effect of various experimental treatments on blood parameters

Treatment	Estrogen	Triglyceride	Cholesterol	Calcium
A	392.80^{a}	1286.60^{a}	119.40^{a}	23.20^{a}
B	1875.40^{b}	1334.60^{a}	150.20^{a}	27.80^{b}
C	1954.60^{b}	1393.40^{a}	134.20^{a}	26.20^{ab}
D	1166.80^{c}	1330.00^{a}	146.80^{a}	25.00^{ab}
P-value	0.0002	0.42	0.23	0.02
In each column, the mean values shown with dissimilar letters have significant differences. Letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract).				

Calcium:

The results obtained from variance analysis table indicated that the experimental treatments (control group that received 2.5mg of estrogen hormone, the treatment group that orally received 10mg of fennel extract and another treatment group that received 10mg of fennel extract injected in its ration) could exert a significant effect on the amount of blood calcium in the treated hens (table 3). Mean comparison of the experimental treatments showed that the highest calcium amount with a mean value of 27.8 belongs to the group that was treated by 2.5mg of estrogen hormone and the lowest amount of calcium with a mean value of 23.2 belongs to the control group (table 4). Gardner and Pefiffer (1943) expressed that estrogen increases the amount of calcium in the blood by

elevating the calcium uptake in the digestive tracts Cuman et al (1948) stated that the increase in synthetic estrogen causes an increase in plasma calcium and phosphorus and ovary weight. Yurist (1959) reported that estrogen is responsible for increasing serum calcium and phosphorus and accelerating the intramedullary formation in the 10-month-old laying hens.

Steroid hormones are involved in calcium metabolism regulation in layers through several mechanisms. The high plasma estrogen level increases the synthesis of 1,25-dihydroxycholecalciferol (Yazarlou et al, 2012). This way, an increase is brought about in the uptake and storage of calcium for the formation of eggshell. Estrogen stimulates oviduct growth, blood calcium elevation and accumulation of proteins, fats, vitamins and the other materials required for the egg formation (Nakada et al, 1994). On the other hand, fennel extract causes the creation of active D3 vitamin form through activating hydroxylase that increases calcium uptake in the digestive tracts thereby to elevate the serum calcium level.

Carcass:

Peripheral Hepatic Fat Weight:

The results of the variance analysis based on the extracted data indicated that the experimental treatments have a significant effect on the fat weight of the hepatic periphery (table 5). The mean comparison of this trait also showed that the highest weight of the peripheral hepatic fat with a mean value of 4.94g belongs to the group that was treated using 2.5mg of estrogen hormone and the lowest weight with a mean value of 4.32g belongs to the group that orally received 10mg of fennel extract but no significant difference was documented between these two treatments in terms of peripheral hepatic weight (figure 1). The abdominal cavity fat is highly associated with the total carcass fat hence it can be used as a scale for estimating the fat status of the bird's carcass. Abdominal cavity fat is amongst the unfavorable traits by the intramuscular fat, is considered as a desirable trait for it can bring about physical change in tissue structure and lead to the formation of a tender meat. The ingredients of carcass are also effective on the feather growth rate of birds. Improvement in the quality of carcass is genetically feasible through selection of the inheritable traits, body weight and body ingredients. The amount of fat accumulation in abdominal cavity in the chickens selected based on their growth speed is associated with the change in the hormones' concentrations and neural mechanisms as well as the other processes involved in controlling nutrient uptake. The large differences between the genotype and phenotype in terms of carcass might stem from the effect of environmental factors. But, the results of the studies in regard of the inheritability of the fat accumulation in abdominal cavity signify the idea that the trait is inheritable by a value in a range from 50% to 80%. Thus, the genetic selection in regard of carcass can bring about an increase in breast meat and reduction in the abdominal cavity fat without causing any reduction in the cellular fat (Zerehdaran, 2004).

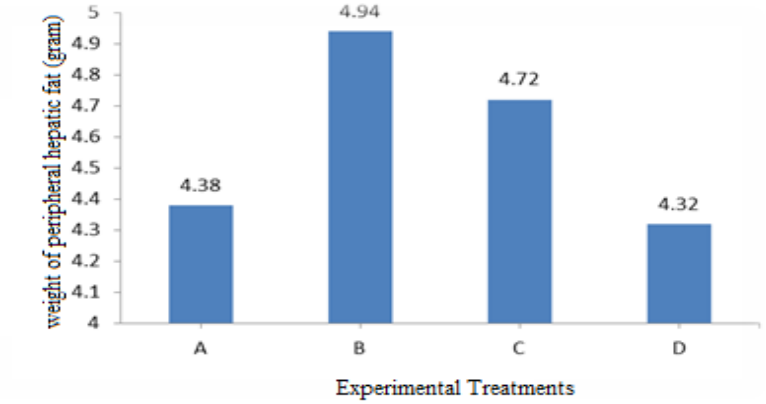

Fig. 1: the effect of various treatments on the weight of peripheral hepatic fat; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

Table 5: variance analysis of carcass

Variations source	Degree of freedom	Carcass indices					
		Peripheral hepatic fat	Liver weight	Number of large yellow follicles	Number of small yellow follicles	Number of small white follicles	Number of large white follicles
Experimental error	16	0.052	0.039	1.05	2.7	8.17	2.85
Experimental treatments	3	0.427**	**	0.066^{ns}	3.6^{ns}	4.58^{ns}	24^{ns}
Variations coefficient		4.9	8.85	18.63	13.69	13.2	5.8
Signs *, ** and ns respectively indicate significance in 5% and 1% levels and insignificance.							

Liver Weight:

The results of the variance analysis obtained from the extracted data indicated that the experimental treatments have a significant

effect on the liver weight in a 99% significance level (table 5). Mean comparison of this trait is expressive of the idea that the highest liver weight with a mean value of 2.44g was obtained for the group treated with 2.5mg of estrogen hormone (B). It is worth mentioning that no significant difference was evidenced between this treatment group and the group that received injective and oral fennel extracts each for 10mg (C&D). The lowest amount of liver weight, as well, with a mean weight of 1.84g was observed in evidence treatment (A) (figure 2). Fennel contains diantol that is similar to the estrogenic medication acetyl bestrol in terms of structure and activity. According to the findings by El-Ghalid (2009), prescription of estrogen causes increase in blood estrogen and, thus, the high amounts of estrogen in plasma causes an increase in bone growth, stimulation of protein and fat materials of yolk in liver (increase in the size of liver) that can generally bring about an increase in production (Tukey et al, 2015).

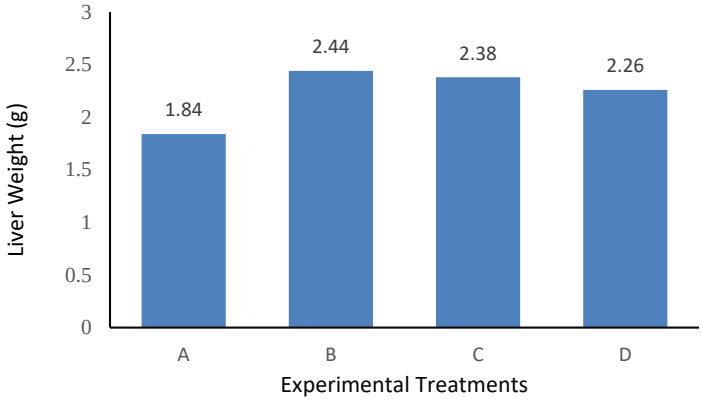

Fig. 2: the effect of various treatments on liver weight; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

Number of Large Yellow Follicles:

The results of the variance analysis obtained from the data indicated that there is a significant difference between the treatments in terms of such traits as the number of large yellow follicles (table 3). Mean comparison of the data, as well, indicated that there is no significant difference between the treatments (figure 3). Nasimi et al (2011) reported that addition of 40ml fennel extract per every kilogram of the layers' ration causes an insignificant increase in the yolk color. Chiristaki et al (2011) showed that addition of anise to the ration of Japanese egg-laying quail causes an improvement in the yolk color. The reason for the color accentuation in yolk following the use of medicinal plants can be ascribed to carotenoids existent in them (Farkhoy et al, 1994).

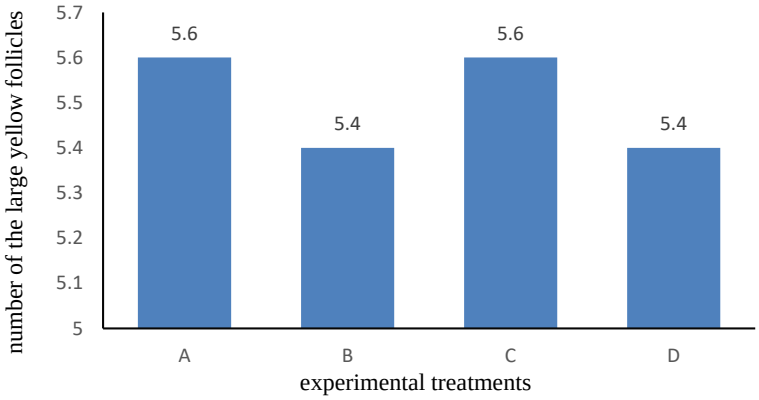

Fig. 3: the effect of the various treatments on the large yellow follicles; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

Number of Small Yellow Follicles:

The results of the mean comparison table of the extracted data indicated that there is no significant difference between the exerted treatments in terms of the number of small yellow

follicles. This insignificance has also been shown in the mean comparisons (table 6, figure 4).

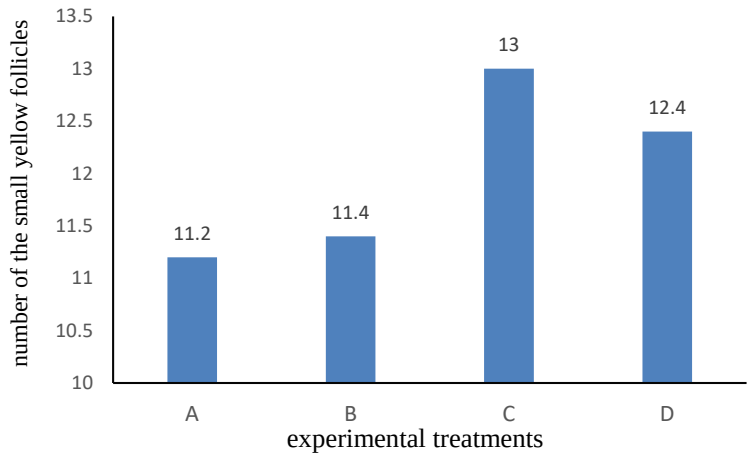

Fig. 4: the effect of various treatments on the small yellow follicles; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

Number of the Small and Large White Follicles:

The results of the variance analysis obtained from the data indicated that the exerted treatment could not again cause a significant difference between the treatment groups in terms of the number of the small and large white follicles. The mean comparison of these treatments in figures (5) and (6) are expressive of this idea. Melaki et al (2012) reported that the relative weight of the ovary, egg duct and oviduct are significantly influenced by the fennel seeds' levels and a significant increase was evidenced for the treatment containing 1.2% of fennel seeds that is not consistent with what was found herein. Khaza'ei et al (2011) reported that the addition of 100mg and 200mg of fennel extract to the rats' feed causes a significant increase in the total counts of the follicles in respect to the evidence treatment. The abovementioned researchers showed that alcoholic fennel seed extract brings about a significant increase in the number of graph, antral and preliminary follicles and improves the follicle production in female rats' ovaries. Abdullah et al (2011) added a mixture of several plants (fennel, roman fennel, fenugreek and cinnamon) to the ration of the egg-laying hens and observed the total hatch percentage of the eggs in contrast to the evidence group.

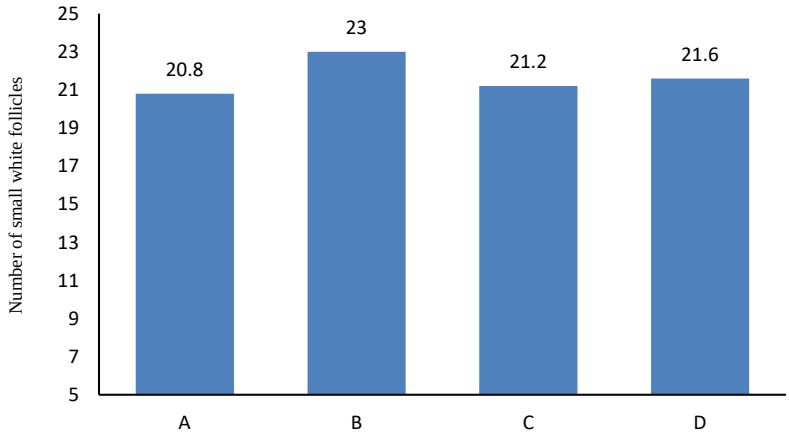

Fig. 5: the effect of various treatments on the small white follicles; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

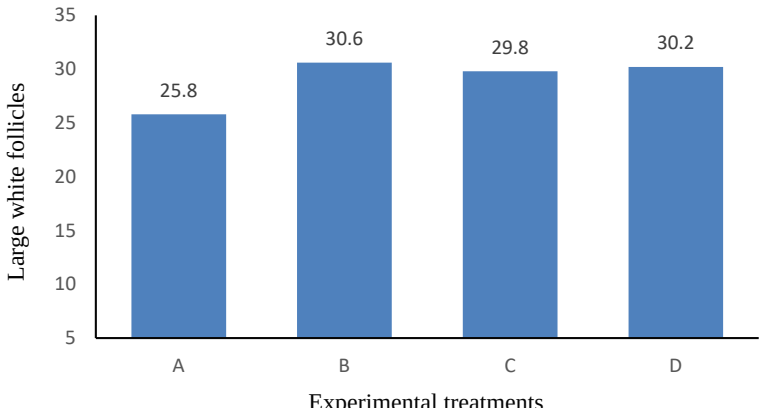

Fig. 6: the effect of various treatments on the large white follicles; letters A, B, C and D respectively indicate the evidence treatment (with no use of hormone and extract), treatment group that received 2.5mg of estrogen, the treatment group that was injected with 10mg of fennel extract and the treatment group that was orally fed on fennel extract)

Conclusion

The use of nutritional additives in the feed given to the poultry is considered as a solution for more productivity of the feed. Antibiotics are amongst the nutritional additives that are applied for preventing the growth of intestinal pathogens, stimulation of growth and improvement of performance in poultry nourishment. Creation of resistance in pathogens and the possibility of antibiotics' retention in the products are amongst the disadvantages limiting their application as growth stimulator in feeding the domestic animals and poultry. The limitation in the use of antibiotics increases the tendency for using secondary plant metabolites qualified for bioactivity as a solution for improving the performance of domestic animals and poultry. In this regard, many plants have been identified with antimicrobial properties. Besides antimicrobial effects, medicinal plants also possess other merits like assisting the digestion and uptake of nutrients, stimulation of appetite as well as reduction of serum lipids.

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