

## **Including Essential Oils of Fennel (*Foeniculum Vulgare*) and Ginger (*Zingiber Officinale*) to Diet and Evaluating Performance of Laying Hens, White Blood Cell Count and Egg Quality Characteristics**

**Nasiroleslami, M. and M. Torki**

*Animal Science Department, Agriculture Faculty, Razi University, Imam Avenue, Kermanshah, Iran, Postal Code: 6715685418,*

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### **ABSTRACT**

The effects of adding essential oils (EO) of fennel (*Foeniculum vulgare*) and ginger (*Zingiber officinale*) to a basal diet on laying hens' performance, egg quality traits, blood biochemical parameters and differential count of white blood cells were evaluated in this study. A total number of 90 Lohmann LSL-Lite hens after production peak were randomly divided in 15 cages (n=6). Three iso-caloric and iso-nitrogenous (ME = 2720 Kcal/ Kg and CP = 145.0 g/Kg) experimental diets including basal diet with no additive as control or with 300 milligrams essential oils of fennel or ginger per kg diet were fed to hens with 5 replicates during 6-week trial period. To determine blood biochemical parameters and differential count of white blood cells, one hen per replicate was bled via wing vein on day 40 of trial. Collected data of feed intake (FI), egg production (EP), egg mass (EM), calculated feed conversion ratio (FCR), egg traits as well as blood biochemical parameters and differential count of white blood cells were analyzed based on completely randomized design using GLM procedure of SAS. Productive performance of laying hens including FI, EP, EM and FCR were not affected by dietary essential oil inclusion ( $P>0.05$ ). Adding essential oils to diets did not affect on egg index and yolk index ( $P>0.05$ ); While, Caloric unit and egg shell traits were affected by treatment ( $P\leq 0.05$ ). Haugh unit was decreased in fennel-included compared to ginger-included and control dietary group ( $P=0.003$ ). Dietary fortification with herbal essential oils improved egg shell weight and thickness compared to control ( $P\leq 0.05$ ). Neither blood biochemical parameters nor differential count of white blood cells was affected by dietary inclusion of EO, except for monocyte count which was higher in fennel-included compared to ginger-included and control dietary group. From the results of this investigation, it can be concluded that diet inclusion of laying hens with essential oils of fennel or ginger can be beneficial in improving egg quality characteristics in terms of egg shell weight and thickness.

**Key words:** ginger, *Zingiber officinale*, fennel, *Foeniculum vulgare*, performance, egg quality, laying hens

### **Introduction**

Antibiotic feed additives have been used for more than 50 years to enhance growth performance and to prevent disease in livestock feeding environments. While, recently, it has been reported that the usage of antibiotics as a growth promoter in

chicken diets has caused some unwanted factors [5,13,15]. Therefore, the searches for alternative feed supplements have been increased extensively and considerable attention has been given to the essential herbs as replacements for antibiotics growth promotants[7]. The chemical components of most essential oils from plants are generally recognized as

### **Corresponding Author**

Nasiroleslami, M., Animal Science Department, Agriculture Faculty, Razi University, Imam Avenue, Kermanshah, Iran, Postal Code: 6715685418,  
Email: of corresponding author: torki@razi.ac.ir

safe, and are used commonly in the food industry [22]. Essential oils derived from herbs have been shown to have antimicrobial effects [9]. Langhout [11], Varel [22], Williams and Losa [23] and Dorman and Deans [9] discovered that essential oils have a stimulating effect on animal digestive systems. They postulated that these effects could be due to the increased production of digestive enzymes and the improved utilization of digestive products through enhanced liver functions. The herbal essential oil may be considered a potential growth promoter. Several studies have been conducted on the effect of dietary essential oils or combinations on the performance of poultry but with varying and often conflicting results. While some reports suggested that dietary herbal essential oils improved growth performance [2,3], others showed no such effect [4,12,18]. Dietary essential oils have also been studied for their antioxidative properties in poultry meat. Supplementation of poultry diets with essential oils has been found to be a simple and convenient strategy to introduce natural antioxidants into meat [4]. *Zinziber officinale* (*Z. officinale*) has been shown to have antimicrobial activity [10,19]. The essential oils of *Z. officinale* showed antimicrobial activity against gram-positive and gram negative bacteria using the agar diffusion method [14].

*Foeniculum vulgare* is claimed to have an effect in relieving inflammation. In an in vivo study with mice, oral administration of *F. vulgare* fruit methanolic extract exhibited inhibitory effects against acute and subacute inflammatory diseases and type IV allergic reactions and showed a central analgesic effect [6]. An effect of oil of *F. vulgare* on hemostasis has been evidenced, with a significant correlation with its phenylpropanoid content [20]. The objectives of the present study were to determine the effects of including essential oils of fennel and ginger to a laying hens' diet on performance, egg quality traits, blood biochemical parameters and differential count of white blood cells.

## Materials and methods

A total number of ninety Lohman-LSL hybrid laying hens were used in this experiment. Birds were randomly assigned to 3 groups. The isocaloric and isonitrogenous experimental diets were as follows: 1) control or basal diet, 2) basal diet included 300 mg essential oil of ginger/kg of diet and 3) basal diet included 300 mg essential oil of fennel/kg of diet. The composition of the basal diet is presented in table 1. Experiment lasted for 6 weeks. During the experiment, hens were fed approximately 120 (gr/day) and water was offered *ad libitum*. Egg production and feed consumption amounts were recorded weekly from each cage. Feed conversion was calculated as the ratio of gram of feed consumed

per gram of egg weight produced. Egg quality characteristics including Haugh unit, egg index, and yolk index were measured on week 3. To determine blood biochemical parameters and differential count of white blood cells, one hen per replicate was bled via wing vein on day 40 of trial.

## Results and discussion

The effects of dietary inclusion of plant essential oils on feed intake (FI) and feed conversion ratio (FCR) of laying hens in the experiment are presented in table 2 and 3. Essential oils of ginger and fennel in this experiment did not affect on FI and FCR ( $P > 0.05$ ); While, treatments groups achieved numerically higher performance values. Dietary inclusion of essential oils did not affect on egg production ( $P > 0.05$ , table 4), egg weight and egg mass in laying hens ( $P > 0.05$ , table 5). The effect of adding essential oils on egg quality traits were not statistically significant ( $P > 0.05$ ), except for Haugh unit as well as egg shell quality. Hens receiving the diets containing 300 mg fennel had significantly lower Haugh unit compared to those fed the control and the diet containing 300 mg ginger ( $P = 0.005$ ). In addition, egg thickness in this group was shown higher compared to control and ginger groups ( $P = 0.053$ ). Tollba [21] reported that adding fennel as natural feed additives to broiler diets under normal or high temperature conditions increased FCR. Moorthy *et al.* [16] showed that the FCR in broiler was significantly superior in ginger-curry leaf fed groups compared to control. Based on the findings of Ademola *et al.* [1]; Doley *et al.* [8] no difference in FI in broilers fed with ginger and pepper extract was observed for a period of six weeks. Onimisi *et al.* [17] stated that FCR was significantly improved when broilers were with graded levels of ginger waste meal from 10-40%. Dietary addition with essential oils did not affect on egg index and yolk index ( $P > 0.05$ ); While, Haugh unit and egg shell traits were affected from treatment ( $P \leq 0.05$ ). Haugh unit was decreased in fennel-included compared to ginger-included and control dietary group ( $P = 0.003$ ). Dietary fortification with herbal essential oils improved egg shell weight and thickness compared to control ( $P \leq 0.05$ ). Neither blood biochemical parameters nor differential count of white blood cells was affected by dietary inclusion of EO, except for monocyte count which was higher in fennel-included compared to ginger-included and control dietary group.

From the results of this study, it can be concluded that adding essential oils of fennel or ginger to laying hen diet can be beneficial in improving egg characteristics especially in terms of egg shell quality traits.

**Table 1:** The ingredient of experimental diets

Ingredients	Control	Ginger-included diet	Fennel-included diet
Corn	67.97	67.97	67.97
Soybean meal	19.63	19.63	19.63
Limestone	8.78	8.78	8.78
Dicalcium phosphate	1.19	1.19	1.19
Salt	0.29	0.29	0.29
sand	1.49	1.46	1.46
<i>Zingiber officinal</i>	-	0.03	-
<i>Foeniculum vulgare</i>	-	-	0.03
Vitamin premix	0.25	0.25	0.25
Mineral premix	0.25	0.25	0.25
Methionine	0.15	0.15	0.15
ME (kcal/kg)	2720	2720	2720
CP %	14.50	14.50	14.50

**Table 2:** Feed intake (g/hen/day) of laying hens fed experimental diets

Weeks	Feed intake (g/hen/day)				
	1	2-3	4-5	6-7	1-7
Treatments					
Control	118.93±0.87	118.56±1.62	118.67±1.63	114.91±6.77	117.28±2.39
Fennel essential oil	119.10±0.59	119.24±0.56	119.22±1.11	118.78±0.56	119.09±0.56
Ginger essential oil	119.26±0.30	118.79±0.66	118.92±1.03	117.10±1.67	118.41±0.62
SEM	0.608	0.265	0.314	1.055	0.402
P values	0.714	0.652	0.627	0.357	0.327
CV	0.51	0.86	1.02	3.49	1.32

**Table 3:** Feed conversion ratio (g:g) of laying hens fed experimental diets

Weeks	FCR				
	1	2-3	4-5	6-7	1-7
Treatments					
Control	2.12±0.25	2.35±0.21	2.40±0.30	2.47±0.43	2.36±0.29
Fennel essential oil	2.01±0.13	2.14±0.17	2.23±0.19	2.26±0.14	2.18±0.11
Ginger essential oil	2.12±0.16	2.21±0.28	2.26±0.24	2.16±0.18	2.20±0.18
SEM	0.048	0.059	0.063	0.076	0.055
P values	0.569	0.136	0.479	0.31	0.314
CV	8.96	10.24	10.75	12.8	9.45

**Table 4:** Egg production (%) of laying hens fed experimental diets

Weeks	Egg production (%)				
	1	2-3	4-5	6-7	1-7
Treatments					
Control	87.14±10.04	78.33±6.59	78.09±8.05	75.00±11.60	78.57±8.58
Fennel essential oil	90.95±6.39	85.47±6.54	82.61±5.98	81.90±4.07	84.42±4.03
Ginger essential oil	88.57±6.60	85.95±8.56	85.00±9.24	86.85±6.31	86.31±6.71
SEM	1.925	1.976	2.032	2.308	1.829
P values	0.697	0.055	0.285	0.122	0.13
CV	8.39	9.19	9.61	11	8.52

**Table 5:** Egg mass (g/hen/day) of laying hens fed experimental diets

Weeks	Egg mass (g/hen/day)				
	1	2-3	4-5	6-7	1-7
Treatments					
Control	56.78±7.18	50.79±5.05	50.15±5.57	52.89±12.00	52.06±5.87
Fennel essential oil	59.28±4.23	55.95±4.49	53.84±4.42	52.84±3.38	54.93±2.91
Ginger essential oil	56.35±4.10	54.23±6.00	53.42±5.64	54.43±3.71	54.37±3.97
SEM	1.328	1.373	1.329	1.807	1.108
P values	0.599	0.112	0.413	0.172	0.2
CV	8.95	9.91	9.81	10.75	8.56

**Table 6:** Egg quality characteristics of laying hens fed experimental diets

Treatments	Egg quality characteristics				
	Egg index	Shell weight	Shell thickness	Yolk index	Haugh unit
Control	74.30±1.59	6.09±0.18b	37.55±1.73b	43.18±1.34	71.90±1.48a
Fennel essential oil	75.80±1.61	6.74±0.26a	41.00±1.17a	43.63±1.18	67.83±1.87b
Ginger essential oil	75.86±2.38	6.72±0.32a	39.60±2.63a	44.14±2.34	70.64±1.56a
SEM	0.493	0.102	0.599	0.42	1.566
P values	0.204	0.001	0.599	0.66	0.005
CV	2.53	6.12	5.89	3.73	8.13

Means ± SD. Means within a column with different superscripts are significantly different.

**Table 7:** Differential count of white blood cells of laying hens fed experimental diets

Treatments	differential count of white blood cells				
	Heterophil	Lymphocyte	Monocyte	Eosinophil	Basophil
Control	27.60±4.33	67.80±5.16	0.8±0.44b	2.00±0.70	1.80±0.83
Fennel essential oil	31.60±11.45	60.40±12.87	2.00±0.95a	3.40±1.51	2.80±0.44
Ginger essential oil	30.20±10.49	64±11.93	1.00±0.70b	3.00±1.87	2.20±1.30
SEM	2.27	2.65	0.181	0.38	0.248
P values	0.792	0.558	0.004	0.324	0.27
CV	29.5	16.03	55.55	52.62	42.4

Means ± SD. Means within a column with different superscripts are significantly different.

**Table 8:** Blood biochemical parameters of laying hens fed on experimental diets

Weeks	Blood biochemical parameters			
	Cholesterol	Triglyceride	HDL	LDL
Control	177.40±25.34	177±194.55	47±6.51	52.60±4.82
Fennel essential oil	188.40±53.64	173.80±338.92	53.40±11.78	56.40±5.41
Ginger essential oil	149±26.41	151±294.36	44.20±5.54	53.20±6.94
SEM	10	74.27	2.25	1.45
P values	0.269	0.319	0.247	0.554
CV	22.57	17.19	18.14	10.42

**Table 9:** Blood biochemical parameters of laying hens fed on experimental diets-continue

Treatments	Blood biochemical parameters		
	Glucose	Total protein	Albumin
Control	247.80±24.74	9.38±0.48	1.9±0.15
Fennel essential oil	253.40±33.24	9.82±0.99	1.94±0.23
Ginger essential oil	264±12.1	10.08±0.311	2.00±0.10
SEM	6.22	0.17	0.04
P values	0.594	0.28	0.659
CV	9.45	7.01	8.43

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