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IMPACT OF USING GINGER (*ZINGIBER OFFICINALE*) IN LAYING QUAIL DIETS ON EGG PRODUCTION, EGG QUALITY AND BLOOD PARAMETERS

M.M.A. El-kashef and A.R. Roshdy

Dep. of Anim. and Poult.Prod., Fac. of Enviro. Agric. Sci., Arish Uni., Egypt.

Corresponding author: M.M.A. El-kashef E-Mail: melkashef89@yahoo.com

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ABSTRACT: This study was carried out to evaluate the effect of using ginger (*Zingiber officinale*) in laying quail diets on egg production, egg quality and blood parameters. A total of 120 female quails at 10-weeks old were used with four treatment groups, in three replicates for each treatment, and 10 birds per replicate. The first group (control) was fed a basal diet. Second, third, and fourth treatments were fed on diets containing ginger roots powder at levels of 0.25, 0.5, and 0.75% of the diet. Egg production and exterior and interior quality of eggs were measured over eight-week period. At the end of the experiment period three birds were taken randomly from each treatment and slaughtered to evaluate blood parameters. The results showed that the groups fed diets containing ginger recorded a highly significant difference in egg production, egg number, egg mass, and average egg weight compared to the control group. On contrary, egg quality did not show any statistically significant differences except eggshell percentage, egg shape index, the weight of albumin, and yolk which was for the benefit of the groups fed diets that contain ginger. In addition, using ginger in quail diets decreased total cholesterol, LDL-cholesterol, glucose, ALT and AST and increase total protein, globulin, albumin and HDL-cholesterol. Also, results showed a highly significant difference in LH, FSH, and Estradiol hormones in groups fed diets containing ginger compared to the control group.

In conclusion, the results of this study showed that the using ginger up to 0.75% seems to have a positive influence on egg production, egg quality and blood biochemical parameters in laying quail birds.

Key words: Ginger, laying quail, egg production, egg quality, blood parameters

INTRODUCTION

In developing countries and specifically Egypt animal protein intake has dropped due to the high expense. So, the consumption of plant protein sources increased because of their low cost. These legumes lack essential amino acids and vitamin B_{12} **(FAO, 2012).** For this reason it turns out that there is no substitute for animal protein sources as a protein source to provide these essential nutrients. Furthermore, the increase in demand for animal protein due to the continuous increase in the population poses a significant threat to global food security (Mengesha, 2012; Seleiman et al., 2020). Where, the world will need to double its current output in order to accommodate the anticipated population growth rate (FAO, 2012). So, the poultry industry aims to provide animal protein at an affordable cost. Nowadays, eggs are one of the sources of animal protein and can contribute to decreasing the deficit resulting from the consumption of protein from meat. Quail is of great economic importance due to their short maturity period, less space needed for breeding, and short incubation period (Rahmani et al., 2014).

Nowadays, producers do not prefer to use antibiotics in the production process due to the miss-using of antibiotics in poultry production and the remnants of these substances in meat tissues in addition to the development of antibiotic-resistant bacteria (Burgat, 1991 and Shahin et al., 2002). These factors negatively affect carcass characteristics, blood constituents and lead to immune system imbalance which reflects on the rate and quality of production. For this reason, there has been an interest in using environmentally-friendly products such as herbs and medicinal plants due to the effect of their active substances, where medical plants are characterized as available, easily digestible, cheap and with no side effects on animal and human health.

So, medicinal plants are considered a good alternative for antibiotics due to their effect on the different physiological systems, activities on immune and digestive systems, in addition, these plants possess many active components, antioxidants, anti-inflammatory and anti-microbial activities (Nasir and Grashorn, 2010 and Khan et al., 2012).

One of these plants is Zingiber offcinale known as ginger, (Han et al., 2013). Not only that ginger important is nutrient-rich like fatty acids, amino acids, minerals, and vitamins such as iron, calcium, magnesium, selenium, Zinc, Vitamin E and vitamin C (Shirin and Jamuna 2010). But ginger also contains many biologically active compounds such as terpene and phenolic compounds. The phenolic compounds are mainly gingerol, gingerdiol, shogaols, gingerdione, and paradols (Zhao et al., 2011; Stoner 2013; Liu et al., 2019) that are potent intestinal mucous membrane and digestion stimulators (Dieumou et al., 2009). Ginger exhibited many bioactivities such as antioxidant (Chakraborty et al., 2012; Nile and park 2015), and health-benefiting effects by reducing free radicals damage and improving cardiovascular status (Bosisio, 1992 and Verma et al., 2004), anti-anxiety (Vishwakarma et al., 2002), anti-inflammation (Grzanna et al., 2005 and Zhang et al., 2016), anti-diabetic (Al-Amin et al., 2006), anticancer (Citronberg et al., 2013), antimicrobial, anti-parasitic antibacterial effects (Boyraz and Ozcan, 2006; Ghazalah and Ali, 2008; Kumar et al., 2014), and antiseptic materials (Ali et al., 2008). Furthermore, ginger is used for the alleviation of upper respiratory tract infections (Wang and Wang, 2005).

Therefore, the present search amid to study the effect of using different levels of ginger roots in laying quail diets on the production and quality of eggs, and blood biochemical parameters.

MATERIALS AND METHODS

Study area:

This study was carried out at the Animal Production Farm of the Department of Animal and Poultry Production, Faculty of Environmental Agricultural Sciences, Arish University, North Sinai Governorate, Egypt.

Experimental birds and design:

One hundred and twenty laying quail birds at 10 week-old were used in this study after being randomly assigned to four treatments groups, at nearly equal body weight. Each treatment was sub-divided into three replicates with 10 birds per replicate. The birds were kept in multi-stage wire cages in a well-ventilated room and light regime (14 hr Light : 10 hr darkness) throughout the experiment. The birds were subjected to similar conditions of management and sanitary conditions throughout the period of the experiment.

Experimental diets:

Ginger was obtained from a local herb store in North Sinai and was used in the diets at levels of 0, 0.25, 0.50 and 0.75%. During the experimental period, birds received diets containing 20% CP and 2900 Kcal ME/ Kg. Feed and clean water were provided daily and ad-libitum. The diets were formulated according to NRC (1994) to meet the nutrient requirements of quail birds as recommended during this period. The composition of the experimental diets was showed in Table (1).

Nutrient composition of ginger:

Ginger is composed of 93.52% Dry matter, crude protein (8.42%), crude fiber (3.11%), total ash (5.95%), Either Extract (5.54%) and nitrogen-free extract (70.84%).

Measurements

Egg production and quality:

Feed consumption, egg production rate, and egg weight were recorded weekly whereas at the end of the experimental period, egg mass was determined. Two eggs were randomly gathered from each replicate at the end of every week for an evaluation of the fresh egg quality traits, measurements were made by using a digital caliper, and the egg height and width and subsequently shape index was determined. Eggs from each treatment were individually weighed then broken opened onto a flat plate. Albumin and yolk weight were recorded to calculate albumen percentage, yolk percentage, and yolk: Albumin ratio. Eggshells were dried after washing with warm water at 100 ◦C for 4 h and weighed to determine the eggshell weight and percentage. By using a micrometer eggshell thickness was measured at three different points, and the average of these points was considered for the mean eggshell final thickness.

Blood biochemical changes:

At the end of the experimental period (12 weeks), blood samples (5ml) were collected from three birds selected randomly from each replicate in the morning before feeding. Samples were collected in test tubes without heparin to obtain serum. Blood samples were centrifuged at 3500 rpm for 20 minutes and were stored until analysis. Collected serum samples were subjected to biochemical analysis of each parameter according to the manufacturers' exact steps of its kit. Total protein, albumin and total cholesterol were measured according to the methods described by Sonnenwirth and Jarett (1980), Doumas (1971) and Stein (1986), respectively.

By using Radioimmunoassay (RIA) the serum concentrations of luteinizing hormone and follicle-stimulating hormone were determined. From Biocode Company-Belgium the LH/FSH kits were obtained, and analysis was carry according to the protocol provided with each kit. The sensitivities of hormone detected per assay tube were 0.2 ng/ml and 0.14 ng/ml for FSH and LH, respectively.

Economic Evaluation

The economic efficiency (EE, in percent) of the experimental diets were calculated according to the local market price of feed components and price of quail birds and quail eggs, as shown below.

Nr = Tr – Tc

EE **(%) =** (Nr / Tc) × 100.

Where, Nr, Tr and Tc represent net and total revenue and total cost, respectively.

The relative economic efficiency (REE) is the result of dividing the EE by the EE of the control diet, assuming that the REE of the control diet is 100%.

Statistical analysis

Analysis of Variance (ANOVA) was used to statistically evaluate the collected data by following the General Linear Model (GLM) Procedure outlined in the SAS User's Guide **(SAS, 2004).** Duncan's multiple range test was used to examine significance levels for mean differences at ($P<0.05$) **(**Duncan, 1955).

The statistical model was:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where, Y_{ij} = an observation, μ = the overall mean, T_i = effect of treatment and e_{ij} = random error.

RESULTS AND DISSCUSION:

Egg production and quality:

The results in Table (2) indicated the influence of using ginger roots levels on egg number, egg production, egg weight, and egg mass for laying quail birds. The results demonstrated an improvement in egg production parameters when ginger was included in the diets of laying quail birds.

The egg number and egg production were significantly ($P\leq0.05$) high in groups fed diets containing different levels of ginger compared to those of the control group. In the same trend, egg weight and egg mass were significantly ($P\leq0.05$) higher in the same groups, during the three age stages in addition to the total breeding period. These results agree with Abd El-Galil and Mahmoud (2015) who found significant improvement in egg weight, egg mass, and egg number when used ginger in quail diets by rates of 0.25, 0.5 and 0.75%, also, Kumar et al. (2019) found same results when they study the effect of supplementation of ginger root powder on leghorn layers by rate 0.5 and 1%. Also, Herve et al. (2019) found that ginger essential oil improved the egg weight of quail birds, a similar pattern by Núñez-Torres et al. (2021) who found improvement in egg weight when used ginger flour of 0.2%, 0.4%, and 0.6% on laying quail birds, Also, Zomrawi et al. (2014) and Malekizadeh et al. (2012) showed decrease in egg weight due to supplementation of ginger root powder at different levels. While, Wen et al. (2019) found a significant increase in the weight and mass of eggs in birds fed ginger extract. Akbarian et al. (2011) found that the quail birds fed diets containing 0.25, 0.5, and 0.75% 0f ginger had better egg production percentages. In contrary, Malekizadeh et al. (2012) observed a decrease in egg production due to supplementation of ginger rhizome powder in White Leghorn layer diets. Zomrawi et al. (2014) found similar results with supplementation of ginger root powder in diet of laying hens. Sittiya et al. (2017) reported a non-significant decrease in egg production due to the supplementation of dry fermented ginger at a rate of 500 ppm.

The data in Table (3) showed the influence of using ginger roots levels on egg quality for laying quail birds. The results demonstrated an improvement in the weight of albumin and yolk, eggshell percentage, and egg shape index when ginger was included in the diets of laying quail birds, while using ginger in quail diets lead to there are no significant differences in albumin and yolk percentage, yolk/albumen ratio, and eggshell thickness. These results agree with Abd El-Galil and Mahmoud (2015) who found a non-significant effect in yolk and albumin percentage and shell thickness, while they found a significant effect in eggshell percentage, yolk index, and egg shape when used ginger in quail diets by rates of 0.25, 0.5, and 0.75%. Also, Nemati et al. (2021) found insignificant effects on egg quality like yolk and albumin percentage, albumin to yolk, and shell thickness with using ginger powder by rates of 0.5, 1, 1.5 g/kg of quail diet, a similar pattern by Wen et al. (2019) when they used ginger extract in fed diets of laying quail birds. On the contrary, Núñez-Torres et al. (2021) found improvement in egg quality when they used ginger flour at levels of 0.2, 0.4, and 0.6% of laying quail diets.

The reason for this improvement is ginger contains important nutrient-rich like amino acids, fatty acids, vitamins, and minerals such as iron, calcium, magnesium, selenium, Zinc, Vitamin E and vitamin C (Shirin and Jamuna, 2010). In addition, ginger also contains many biologically active compounds such as phenolic and terpene compounds. phenolic compounds in general possess various physiological properties such as antioxidant (Nile and Park, 2015), anti-anxiety (Vishwakarma et al., 2002), anti-inflammation (Zhang et al., 2016), anti-diabetic (Al-Amin et al., 2006), and health-benefiting effects by reducing free radicals damage and improving cardiovascular status (Verma et al., 2004), anticancer (Citronberg et al., 2013), and antibacterial effects (Ghazalah and Ali, 2008), anti-parasitic, antimicrobial (Kumar et al., 2014), and antiseptic materials (Ali et al., 2008). Furthermore, ginger is used for the alleviation of upper respiratory tract infections (Wang and Wang, 2005). More importantly, it has a role in enhancing the fertility rate (Grzanna et al., 2005; Manallah, 2012). The alkaloids have the ability to dilate the blood vessels of the sexual organs (Sanda et al., 2012; Abedi et al., 2013). Terpenes have antifungal, antiviral, antibacterial, and anti-inflammatory drugs (Temple-Smith et al., 1985), enabling them to tackle all infections responsible for low fertility. Furthermore, some studies showed that ginger has some properties of sex hormones which help to improve sexual performance (Kamtchouing et al., 2002; Herve et al., 2018; Banihani, 2019; Ogbuewu and Mbajiorgu, 2020).

Blood parameters:

Results in Table (4) showed that the diets containing different levels of ginger led to improvement in blood traits compared to control group. In the present study, results showed that total protein, albumin, and globulin levels were significantly

($P \leq 0.05$) increased in groups fed diets containing ginger compared to other group. The same results were recorded by Swain et al. (2017) and Zhang et al. (2009) in broiler chickens treated with ginger rhizomes powder at levels of 5 g/kg of diet, Also, Herve et al. (2017) found a significant increase in total protein, albumin and globulin when they used ginger essential oil at levels of 50, 100 and 150 ml/kg body weight in Laying Japanese quail, the same trend was showed by El-Kashef (2022) who recorded that using ginger in male quail diets by 0.25, 0.50, and 0.75%. The increase in total proteins may be due to the phenol components of ginger like gingerdiol, gingerol, gingerdione, and, shogaols which elevate immune responses because possess potent antioxidant properties. Also, the increased level of globulin in the blood indicates serves as an indicator of the immune response and the source of antibodies (Abdel Fattah et al., 2008) and the production of immunoglobulin. So, the observed effect may be due to an increase in immunoglobulin concentration and improved immunity of birds (Abu Taleb et al., 2008; Meysam et al., 2017; Rehman et al., 2017 and Habibi and Ghahtan, 2019)

In addition, using ginger led to decrease serum total cholesterol and LDL-cholesterol, while HDL-cholesterol was increased in all groups compared to the control group. The results agree with Salmanzadeh (2015); Zeweil et al. (2016); Swain et al. (2017); Herve et al. (2018); Asghar et al. (2021) and El-Kashef (2022) who recorded that ginger significantly decreased total cholesterol, HDL-cholesterol, and LDL-cholesterol. The decrease in plasma cholesterol levels may be attributed to the high content of ginger from unsaturated fatty acids which may stimulate the cholesterol excretions into the intestine. In addition, ginger showed a strong anti-lipidemic effect on triglyceride levels and cholesterol (Jang et al., 2007); hence, its mode of action may be related to the inhibition of cholesterol synthesis such as hydroxy-methylglutaryl coenzyme A (Saeid et al., 2010), to cause liver-specific inhibition of cholesterol synthesis (Manju et al., 2006).

On the other side, using ginger in laying quail diets led to a significant ($P \leq 0.05$) decrease level of glucose in the blood as compared to the control group, these results agree with Salmanzadeh (2015); Swain et al. (2017) and El-Kahef (2022). This may be due to the anti-diabetic activity in ginger that works to reduce the level of sugar in the blood. It is thought that the anti-diabetic properties of ginger are induced by the activation of adenosine monophosphate kinase, affecting cellular uptake of proteins with hypolipidemic and anti-diabetic properties (Haddad et al., 2003 and Sanz, 2008). Also, Plasma ALT and AST decreased with using all levels of ginger compared to the control group. The liver releases these enzymes into the blood when injured (Kaplan et al., 2003). Hence, the significant ($P \leq 0.05$) differences between groups in ALT and AST enzymes may reflect the normal liver function of the laying quail birds fed diets containing ginger, and this suggests that ginger has properties that can promote liver health.

On other side, results in Table (4) showed a significant increase in estradiol with the increase in ginger levels used in quail diets. Estradiol is the main reproductive hormone, it's playing an important role in determining egg quality. It stimulates the liver to produce yolk precursors vitellogenin, the primary source of yolk protein (Wallace, 1985). Also, estrogen hormones partially controlled in egg albumen (Yu et al., 1971). The ginger may stimulate the synthesis of estradiol hormone by acting on the hypothalamic-pituitary-gonad axis. In addition, the Estradiol hormone is the most physiologically active in response to LH and under the control of the hypothalamic-pituitary axis (Hüseyin, 2013). Also, estradiol serves to facilitate the actions of the follicle stimulating hormone and luteinizing hormone (Richards, 1980). Where results show significant and higher means values of FSH and LH in laying quails birds that had fed diets containing different levels of ginger compared to the control group. These results agree with Saeid et al. (2011) who reported that using ginger of laying broilers chickens by 0 and 100 mg/kg diet for 44 consecutive weeks led to significantly increased LH and FSH in these groups compared to other groups. On the same trend, Herve et al. (2017) found a significant increase in LH, FSH and estradiol hormone when used ginger essential oil at 50, 100 and 150 ml/kg body weight in Laying Japanese quail. Additionally, El-Kashef (2021) recorded an increase in LH and FSH hormones when using ginger roots with quail male diets.

In confirmation of the role of ginger in generally as a sexual promoter, Sekiwa et al. (2000); Kamtchouing et al. (2002) and El-Kashef (2021) they found that using ginger in fed quail males diets has improved sexual characteristics and levels of LH, FSH, and testosterone hormones.

Economic efficiency:

Results in Table (5) show the economic evaluation of using ginger in feed diets of laying quails birds. The best economic efficiency was recorded at 14.89, 15.79, and 15.99 for birds fed a diet containing 0.25, 0.50, and 0.75% of ginger, respectively while the control group archived the lowest value (10.16). The relative economic efficiency calculated relative was 100%, 146.53%, 155.41% and 157.39% for groups fed diets containing 0, 0.25, 0.50 and 0.75% of ginger, respectively.

CONCOLUSION

It is concluded that supplementation of ginger up to 0.75% in laying quail diets, could be recommended for improving egg production of laying quail and may be considered a safe alternative to antibiotics.

Table (1): Composition and calculated analysis of the experimental diets during the egg production period.

Ingredients %	***Zingiber officinale* levels, %**			
	0	**0.25**	**0.50**	**0.75**
Yellow corn	62.69	62.69	62.67	62.68
Soybean meal (44%)	25.05	24.68	24.33	23.95
Corn gluten meal (60%)	6.05	6.21	6.37	6.53
Di-calcium phosphate	2.65	2.63	2.61	2.59
Salt	0.30	0.30	0.30	0.30
Limestone	2.84	2.82	2.8	2.78
L. Lysine	0.11	0.11	0.11	0.11
DL. Methionine	0.11	0.11	0.11	0.11
(V&M.)Premix*	0.20	0.20	0.20	0.20
Zingiber officinale	0.00	0.25	0.50	0.75
Total	100	100	100	100
	Calculated analysis (%)			
Crude protein	20	20	20	20
ME Kcal/Kg	2900	2900	2900	2900
Calcium	2.5	2.5	2.5	2.5
AV. Phosphorus	0.57	0.57	0.57	0.57
L. Lysine	1.10	1.09	1.09	1.10
DL. Methionine	0.45	0.45	0.45	0.45

* Each kg of vitamin mineral premix: contains: vitamin A, 1200000; vitamin E, 700 mg; vitamin D_3, 300000IU; vitamin K3, 500 mg; vitamin B2, 200 mg; vitamin B1, 500 mg; vitamin B6, 600 mg; vitamin B12, 3 mg; choline chloride, 1000 mg; folic acid, 300mg; Niacin, 3000 mg; panathonic acid, 670 mg; Biotin, 6 mg; manganese sulphate, 3000 mg; zinc sulphate, 1800 mg; iron sulphate, 10000 mg; copper sulphate, 3000 mg; cobalt sulphate, 300 mg; iodine, 1.868 mg; selenium, 108 mg.

Table (2): Effect of using different levels of ginger on egg production parameters of laying quail birds.

		Control	*Zingiber offcinale* levels, %			Sig.
			0.25	0.50	0.75	
Average egg number/bird/day						
	8 - 11 week	$0.78^{c}\pm0.14$	$0.85^{b}\pm0.09$	$0.89^{ab}\pm0.10$	$0.90^{a}\pm0.12$	*
	12-15 week	$0.88^{b}\pm0.19$	$0.99^{a}\pm0.11$	$0.99^{a}\pm0.13$	$0.99^{a}\pm0.12$	*
	16-20 week	$0.52^{b}\pm0.05$	$0.59^{ab}\pm0.04$	$0.67^{a}\pm0.07$	$0.70^{a}\pm0.10$	*
	Over all	$0.73^{c}\pm0.11$	$0.81^{b}\pm0.08$	$0.85^{ab}\pm0.09$	$0.87^{a}\pm0.06$	*
Egg production (%)						
	8 - 11 week	$77.82^{c}\pm2.95$	$85.11^{b}\pm2.45$	$88.64^{ab}\pm2.12$	$90.43^{a}\pm2.14$	*
	12-15 week	$88.39^{b}\pm2.55$	$98.71^{a}\pm2.75$	$98.86^{a}\pm2.17$	$99.11^{a}\pm2.74$	*
	16-20 week	$51.83^{b}\pm3.41$	$59.40^{ab}\pm2.80$	$67.03^{a}\pm4.03$	$70.00^{a}\pm3.04$	*
	8 - 20 week	$72.68^{c}\pm2.81$	$81.07^{b}\pm2.83$	$84.84^{ab}\pm2.09$	$86.51^{a}\pm2.66$	*
Average egg weight (g)						
	8 - 11 week	$11.95^{c}\pm1.17$	$12.96^{b}\pm1.09$	$13.18^{ab}\pm1.13$	$13.284^{a}\pm1.17$	*
	12-15 week	$12.35^{b}\pm1.32$	$13.75^{a}\pm1.20$	$13.88^{a}\pm1.18$	$13.92^{a}\pm1.29$	*
	16-20 week	$12.15^{b}\pm1.14$	$12.95^{ab}\pm1.35$	$13.47^{a}\pm1.45$	$13.51^{a}\pm1.34$	*
	8 - 20 week	$12.15^{c}\pm1.19$	$13.22^{b}\pm1.17$	$13.51^{ab}\pm1.12$	$13.57^{a}\pm1.21$	*
Egg mass (g)						
	8 - 11 week	$9.30^{c}\pm0.62$	$11.03^{b}\pm0.70$	$11.68^{a}\pm0.61$	$12.01^{a}\pm0.69$	*
	12-15 week	$10.92^{c}\pm1.31$	$13.57^{b}\pm1.10$	$13.72^{a}\pm1.30$	$13.80^{a}\pm1.27$	*
	16-20 week	$6.30^{c}\pm1.63$	$7.69^{bc}\pm1.28$	$9.03^{ab}\pm1.64$	$9.46^{a}\pm1.31$	*
	8 - 20 week	$8.84^{c}\pm1.32$	$10.77^{b}\pm1.19$	$11.48^{ab}\pm1.13$	$11.75^{a}\pm1.16$	*

^{a,b,c} Means in the same row with different superscripts are significantly different ($P\leq0.05$).
NS= Not significant, * (P<0.5), ** ((P<0.1).

- Egg production = (average eggs number / live layers number) × 100
- Average egg weight = collected total weight / collected total number
- Egg mass = (egg production (%) × average egg weight (g)) / 100 or egg number × egg weight

Table (3): Effect of using different levels of ginger on egg quality parameters of laying quail birds.

		Control	*Zingiber offcinale* levels, %			Sig.
			0.25	0.50	0.75	
Albumen	Weight(g)	7.02^{b}±1.06	7.66^{a}±1.17	7.69^{a}±1.15	7.70^{a}±0.98	*
	%	57.78±1.37	57.94±1.44	56.92±1.43	56.74±1.32	NS
Yolk	Weight(g)	3.61^{b}±0.78	3.95^{a}±0.89	3.98^{a}±0.67	4.05^{a}±0.72	*
	%	29.71±1.15	29.88±1.28	29.46±1.05	29.85±1.22	NS
Yolk /Albumen ratio		0.51±0.00	0.52±0.00	0.52±0.01	0.53±0.01	NS
Eggshell percentage		12.50^{b}±1.11	12.18^{b}±0.93	13.62^{a}±1.08	13.40^{a}±1.17	*
Eggshell thickness		0.20±0.02	0.19±0.01	0.20±0.02	0.21±0.01	NS
Egg shape index		75.23^{b}±1.21	77.61^{a}±1.66	77.16^{ab}±1.87	78.92^{a}±1.30	*

^{a,b,c} Means in the same row with different superscripts are significantly different (P≤0.05).
NS= Not significant, * (P<0.5), ** ((P<0.1).

- Egg shape index = egg (width/ length) × 100.
- Albumen percentage = (weight of albumen / weight of egg) ×100
- Yolk percentage = (weight of yolk / weight of egg) × 100
- Yolk Albumen ratio = weight of yolk / weight of albumen
- Eggshell percentage = (shell weight dried / weight of egg) × 100

Table (4): Effect of using different levels of ginger on blood biochemical parameters of laying quail birds.

Items	Control	*Zingiber offcinale* levels, %			Sig.
		0.25	0.50	0.75	
T. protein(g/dl)	4.08^{d}±1.05	4.77^{c}±1.15	5.11^{b}±1.21	5.35^{a}±1.28	*
Albumin (A) (g/dl)	1.51^{c}±0.43	1.85^{b}±0.62	2.07^{a}±0.96	2.19^{a}±0.41	*
Globulin (G) (g/dl)	2.57^{d}±0.75	2.92^{c}±0.38	3.04^{b}±0.47	3.16^{a}±0.42	*
A/G ratio	0.59^{b}±0.02	0.63^{ab}±0.03	0.68^{a}±0.03	0.69^{a}±0.04	*
Glucose (mg/dl)	171.52^{a}±1.40	147.84^{b}±1.79	134.66^{c}±1.81	123.17^{d}±1.74	*
Cholesterol (mg/dl)	153.52^{a}±1.06	144.68^{b}±1.05	135.55^{c}±1.32	130.83^{d}±1.13	*
HDL- (mg/dl)	70.47^{c}±1.15	78.61^{b}±1.63	82.34^{a}±1.05	85.14^{a}±1.73	*
LDL- (mg/dl)	83.05^{a}±1.13	66.07^{b}±1.62	53.21^{c}±1.76	45.69^{d}±1.91	*
ALT (U/L)	55.74^{a}±1.77	51.84^{b}±1.93	50.21^{bc}±1.26	48.62^{c}±1.30	*
AST (U/L)	20.77^{a}±0.37	19.01^{ab}±0.70	18.47^{b}±0.64	18.06^{b}±0.42	*
FSH (ng/ml)	6.25^{c}±0.15	8.47^{b}±0.23	9.23^{a}±0.62	9.75^{a}±0.13	*
LH (ng/ml)	11.62^{c}±0.56	14.73^{b}±0.70	15.24^{ab}±0.63	16.18^{a}±0.53	*
Estradiol (ng/ml)	63.25^{b}±1.53	72.41^{a}±1.75	73.72^{a}±1.31	75.18^{a}±1.13	*

^{a,b,c} Means in the same row with different superscripts are significantly different (P≤0.05).
NS= Not significant, * (P<0.5), ** ((P<0.1).

Table (5): Economic efficiency of using ginger on laying quail birds' diets.

Items	**Control**	***Moringa oleifera* leaves, %**		
		2.5	**5.0**	**7.5**
Feed intake (kg)	6.84	6.57	6.64	6.68
Costing of one kg feed (LE)	8.9	9.76	9.98	10.08
Total feed cost (LE)	60.88	64.12	66.27	67.33
Managerial cost (LE)	7.5	7.5	7.5	7.5
Total cost (LE)	68.38	71.62	73.77	74.83
Price of bird (L.E)	15	15	15	15
Egg production	72.62	79.44	82.74	84.4
price of egg	0.83	0.83	0.83	0.83
Egg selling revenue	60.27	65.94	68.67	70.05
Total revenue (LE)	75.27	80.94	83.67	85.05
Net revenue	6.95	10.66	11.65	11.97
Economic efficiency	10.16	14.89	15.79	15.99
Relative economic efficiency	100	146.53	155.41	157.39

Total feed cost = feed intake × costing of one Kg feed
Managerial cost = labor, veterinary care, and cost of a growth period
Total cost = Total Feed cost + Managerial cost
Egg selling revenue = Egg production × price of egg
Total revenue = egg selling revenue x Price of bird

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الملخص العربي

تأثير استخدام الزنجبيل في علائق طيور السمان البياض على إنتاج وجوده البيض ومعايير الدم

محمد مصطفى عبدالهادي الكاشف ، عبدالفتاح رشاد رشدي
قسم الانتاج الحيواني والداجني - كلية اعلوم الزراعية البيئية – جامعة العريش – مصر

صممت هذه الدراسة لتقييم استخدام جذور الزنجبيل في علائق طيور السمان البياضة على إنتاج البيض وجودته وبعض معايير الدم. تم استخدام 120 طائر سمان بعمر 10 أسابيع تم تقسيمهم الى أربع مجموعات بواقع 3 مكررات لكل معاملة وتم استخدام 10 طيور لكل مكرر. تم تغذية المجموعة الأولى على نظام غذائي أساسي بدون أي اضافات. وتم تغذية المعاملات الثانية والثالثة والرابعة على علائق تحتوي على 0.25 و 0.5 و 0.75٪ من مسحوق جذور الزنجبيل. تم قياس إنتاج البيض والجودة الخارجية والداخلية للبيض خلال فترة ثمانية أسابيع. في نهاية التجربة تم أخذ ثلاثة طيور بشكل عشوائي بعد تصويمها وذبحها لتقييم معايير الدم. أظهرت النتائج أن المجموعات التي تغذت على العلائق المحتوية على الزنجبيل سجلت فرق معنوياً عالياً في إنتاج البيض وعدد البيض ومتوسط وزن البيض وكتلة البيض مقارنة مع مجموعة الكنترول. على العكس من ذلك لم تظهر جودة البيض أي فروق ذات دلالة إحصائية باستثناء نسبة قشر البيض ودليل شكل البيضة ووزن الألبومين وصفار البيض والتي كانت لصالح المجموعات التي تتغذى على العلائق المحتوية على الزنجبيل. ايضاً أدى استخدام الزنجبيل في علائق السمان إلى خفض الكوليسترول الكلي والكوليستيرول منخفض الكثافة والجلوكوز وانزيمات الكبد بينما ادي استخدام الجنزبيل الى زيادة البروتين الكلي والألبومين والجلوبيولين ووالكوليستيرول عالي الكثافة. كما أظهرت النتائج وجود فروق معنويه في نسبة هرمونات LH و FSH و Estradiol في الدم للمجموعات التي تغذت على علائق تحتوي على الزنجبيل مقارنة بالكنترول.

في الختام: أوضحت نتائج هذه الدراسة أن إضافة الزنجبيل بنسبة تصل إلى 0.75٪ لها تأثير إيجابي على إنتاج البيض وجودته ، وبعض معايير الدم.

الكلمات المرشده:
الزنجبيل ، السمان البياض ، انتاج البيض ، جوده البيضة ، مكونات الدم