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The effects of diets supplemented with crushed and extracted grape seed on performance, egg quality parameters, yolk peroxidation and serum traits in laying hens

Einfluss von Futterrationen mit zerkleinerten und extrahierten Traubenkernen auf die Leistung, Eiqualitätsparameter, Lipidoxidation im Dotter und Blutserum-Kennwerte von Legehennen

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Introduction

Grape (*Vitis vinifera*) is one of the worlds largest fruit crops and grape seeds are usually by-products of processed grape products such as grape juice, grape molasses and wine production. Grape seed is a complex matrix containing approximately 40% fiber, 16% oil, 11% proteins, and 7% complex phenols including tannins, in addition to sugars, mineral salts, etc. (KIM et al., 2006). Monomeric phenolic compounds, such as (+)-catechin, (-)- epicatechin and (-)-epicatechin-3-O-gallate and dimeric, trimeric and tetrameric procyanidins are dominant phenolic substances in grape seeds, and these compounds have antimutagenic and antiviral activities (SAITO et al., 1998). Grape seeds contain very high quantities of proanthocyanidins (condensed tannins). Especially dimeric, trimeric, oligomeric, or polymeric proanthocyanidins account for most of the superior antioxidant capacity of grape seeds (LACHMAN et al., 2009). Excessive tannin consumption is known to result in depressed growth rate, poor feed efficiency, and decreased nutrient digestibility, with the maximum tannin tolerance reportedly is 1% for chickens (KAYA et al., 2014). In addition phenolic compounds from grape seeds have pharmacological and nutraceutical benefits that are closely related to their antioxidant and singlet oxygen quenching ability (JAYAPRAKASHA et al., 2003). Lipid oxidation in food is promoted by the presence of various reactive species, resulting in the formation of free radicals, hydroperoxides and other deterioration products (LIN and LIANG, 2002). Antioxidant agents and some natural substances (e.g., resveratrol) that possess antioxidant potentials are commonly used to control oxidation of polyunsaturated fats in foods and dietary supplementation of antioxidant nutrients (e.g., vitamin E, vitamin A, lycopene) is one of the effective ways to minimize lipid peroxidation in eggs at farm level because some of these compounds are transferred into egg yolk (ŞAHIN et al., 2010). SHI et al. (2003) reported that the antioxidant power of proanthocyanidins is twenty times and fifty times greater than that of vitamins E and C, respectively, arising from increased levels of polyphenols proanthocyanidins and oligomers of flavan-3-ol units, especially catechin and epicatechin present in GSE. Besides its antioxidant activity, the grape seed extract proved to act also as antibacterial agent (CHEDEA et al., 2011). YILMAZ and TOLEDO (2004) indicated that dimeric, trimeric, oligomeric, or polymeric procyanidins account for most of the superior antioxidant capacity of seeds from grapes of *Vitis vinifera* varieties Merlot, Chardonnay and Muscadine. Recognition of such health benefits of catechins and procyanidins has facilitated the use of grape seed extract as a dietary supplement (KIM et al., 2006). Grape seeds from grape juice and wine processing can be separated, extracted, dried and purified into grape seed extract (GSE) which contain polyphenolic compounds. Waste products of the winery and grape juice industry derived from grape seeds represent a rich source of polyphenols. But it is well known that the concentration of polyphenolic compounds in grapes depends on the grape cultivar and other factors, such as ripening time, climate, soil and location of growth (GOĐEVAC et al., 2010).

By-products of wine/grape juice processing provide an abundant and inexpensive source of flavonoid compounds. Little or no published information is available on the use of GS or GSE provided by grape (*Vitis vinifera*) or on how it could be evaulated as feed ingredient in diets for laying hens. Therefore, the objectives of this study were to investigate the possibility of GS and GSE use in maize-soybean meal based diets for laying hens on performance, egg quality traits, yolk oxidation degree and some blood parameters of laying hens.

Material and Methods

Preparation of grape seed extract

Merlot seed from Merlot grapes, harvested at optimum maturity from Tekirdağ, Turkey, used in this stuy were obtained from Doluca Winery. Seeds were dried in the shade for 3–4 days. The dried samples were ground to a fine powder in a hammer mill. About 100 g milled seeds were taken up into 1000 ml flask and extracted with 500 ml of 100% ethanol for 48 hours at room temperature. Supernatants were separated from the suspension by filter and ethanol was removed by using rotary evaporator under vacuum at 50–60°C. The obtained extract was maintained at 4°C in the refrigerator for use in the study.

Animals, diet, and management

In total, one hundred and sixty eight Lohmann white layers, at age 44 wks, were randomly assigned to seven treatment groups, with 6 replicate cages each (50 × 46 × 46 cm) as subgroups, comprising four hens. Experimental groups were fed standart commercial layer diet (Control), basal diet plus 0.5% GS (GS 1), 1.0% GS (GS 2), 1.5% GS (GS 3), 675 mg kg^{-1} GSE (GSE 1), 1350 mg kg^{-1} GSE (GSE 2) and 2025 mg kg^{-1} GSE (GSE 3) for 12 weeks. Levels of GSE were determined as 675, 1350 and 2025 mg kg^{-1} as the grape seeds contained 13.5% etanol extract. Ingredient and chemical composition of basal diet and GS are given in Table 1. The experimental diets are formulated to meet NRC (1994) recommendations and analyzed using AOAC (1990) methods. Hens were fed *ad libitum* once daily at 08:30 hours and water was available all the times during the experimental period (12 weeks). Lighting was 17 h light/7 h dark.

Table 1. Ingredients and analyzed nutrient composition of experimental diets

Zusammensetzung und analysierte Nährstoffgehalte der Versuchsrationen

		Chemical Composition (DM basis)		
Ingredients	**(%)**		**Basal Diet**	**Grape Seed**
Maize	53.73	Dry Matter (%)	88.2	89.1
Soybean (46% CP)	18.72	Crude protein (%)	16.6	12.4
Bonkalite	7.50	Crude Fiber (%)	4.18	21.4
Fish meal	2.16	Ether Extract (%)	2.74	13.9
Sunflowerseed meal (36% CP)	5.35	Ash (%)	13.6	6.62
Vegetable fat	0.50	ME (MJ ME/kg)*	11.1	11.5
Dicalcium phosphate[1]	2.04			
Marble	9.80			
Vitamin-mineral premix[2]	0.30			
Salt	0.23			
Methionine[3]	0.40			
Lysine[4]	0.25			

[1] Each kilogram contained 24% Ca and 17.5% P.

[2] The premix provided per 1 kg of diet: vitamin A, 15.000 IU; cholecalciferol, 1500 ICU; DL-α-tocopheryl acetate, 30 IU; menadione, 5.0 mg; thiamine, 3.0 mg; riboflavin, 6.0 mg; niacin, 20.0 mg; panthotenic acid, 8.0 mg; pyridoxine, 5.0 mg; folic acid, 1.0 mg; vitamin B12, 15 µg; Mn, 80.0 mg; Zn, 60.0 mg; Fe, 30.0 mg; Cu, 5.0 mg; I, 2.0 mg; and Se, 0.15 mg.

[3] DL-methionine.

[4] L-lysine hydrochloride.

* This value was found to with calculation from tabular values of feedstuffs reported for chickens, NRC (1994)

Sample collection and analytical procedure

Feed intake and egg production were recorded daily, egg weight was measured bi-weekly. Feed conversion ratio (FCR) was recorded as kilogram of feed consumed per kilogram of eggs produced. Before determination of egg weight, 12 eggs from each experimental group were stored for 24 h at room temperature. Twelve eggs were randomly selected from each experimental group every month to evaluate egg quality parameters, including shape index, shell strength (determined by using machine with spiral pressure system), shell thickness (determined in 3 different parts by using micrometer), albumen index, yolk index, yolk color (Yolk Colour Fan, the CIE standard colorimetric system, F. Hoffman-La Roche Ltd., Basel, Switzerland), and Haugh unit. Eggs were assessed according to the method of KAYA and MACIT (2012).

At the end of the experiment, blood samples taken from the subcutaneous vena ulnaris were collected from two hens from each cage and stored in additive-free vacutainers. Serum was obtained following centrifugation at 3,000 g for 10 min at 20°C, and kept at −20°C until laboratory analyses. Serum parameters – albumin, cholesterol, total protein, glucose, ALP, AST, ALT, Ca and P were measured using commercial kits (DDS® Spectrophotometric Kits, Diasis Diagnostic Systems Co., İstanbul, Turkey) with autoanalyzer Mindray perfect Plus 400.

The malondialdehyde (MDA) formed during refrigerated storage was evaluated as an index of lipid peroxidation (BOTSOGLOU et al., 2005). To determine the MDA in yolk, 24 shelled eggs were taken from each group at the end of the experiment, and were stored for 0, 7, 14 and 28 days at + 4°C. Yolk samples were then analyzed following the method of PLACER et al. (1966) using a Biotek ELISA Reader (Bio Tek μQuant MQX200 Elisa reader/USA).

Statistical analysis

Data were subjected to an ANOVA using GLM procedure of SPSS software (1999). Polynomial contrast was constructed to determine the effect of the feeding level of GS and GSE in the diets. The effects of the dietary treatments on response variables were declared to be significant at $P < 0.05$. The simple GLM used was as follows:

$Y_{ij} = \mu + a_i + e_{ij}$;

where μ is Overall mean, a_i effect of the diet i and eij the residual error.

Result and Discussion

Laying performance

Table 2 summarizes the effects of GS and GSE supplementation on laying performance. There were no effects of GS and GSE supplementation on feed consumption, damage egg ratio and feed conversion ratio (FCR) except for egg weight and egg production. Egg weight decreased in GS 3 and GSE 1 groups. The presence of polyphenolic compounds in the diet may have some adverse metabolic effects which are mainly associated with lower efficiency of nutrients particularly protein, inhibition of digestive enzymes and increased excretion of endogenous protein (BRENES et al., 2010). Supplementation of GS and GSE in the layer diets increased egg production linearly ($P < 0.01$) compared to the control group. Damage egg ratio and egg weight tended to decrease in GS and GSE groups compared with those birds fed control diet (Table 2). GS and GSE prapered equivalent levels to GS levels supplementation did not change the FCR. ŞAHIN et al. (2010) stated that the addition of resveratrol (200 and 400 ppm) to quail diet did not significantly affect performance parameters.

Table 2. Effects of grape seed and grape seed extract supplementation to diets on laying performance parameters in hens

Einfluss der Zulage von Traubenkernen und extrahierten Traubenkernen zum Futter auf die Leistung der Legehennen

Groups		Feed consumption (g/d)	Egg production (%)	Damage Egg Ratio (%)	Egg weight (g)	FCR[1]
Control		136	77.1[b]	3.26	66.6[ab]	2.76
GS 1		148	87.8[a]	0.424	68.7[a]	2.49
GS 2		138	87.0[a]	1.112	63.7[cb]	2.51
GS 3		145	91.0[a]	0.011	62.1[c]	2.55
GSE 1		152	96.5[a]	0.732	61.5[c]	2.60
GSE 2		153	93.3[a]	0.009	64.5[cb]	2.54
GSE 3		142	91.1[a]	0.641	64.5[cb]	2.42
SEM		6.64	2.73	1.32	1.05	0.124
P		0.443	0.001	0.643	0.001	0.563
Polynomial Analyze						
Grape Seed	Linear	0.582	0.023	0.246	0.074	0.346
	Quadratic	0.734	0.341	0.619	0.022	0.252
	Cubic	0.211	0.313	0.498	0.076	0.653
Grape Seed Extract	Linear	0.452	0.008	0.262	0.581	0.396
	Quadratic	0.024	0.005	0.353	0.038	0.988
	Cubic	0.899	0.197	0.941	0.062	0.781

[1] FCR = Feed conversion ratio (kg feed consumed per kg egg produced).
a,b,c: Means with different superscripts each column differs significantly $P < 0.05$.

Similar results have been obtained in a study conducted by KARA et al. (2011), where the addition of grape pomace into layer diet did not change feed conversion ratio, feed consumption and egg production compared with birds fed on control diet. ÖZGAN et al. (2009) reported that the addition of grape seed oil to layer diet did not effect feed intake, egg mass, feed conversion efficiency and body weight. HUGHES et al. (2005) found that addition of condensed tannins extracted from grape seed at the level of 30 g/kg depressed feed intake and growth of broiler chickens but not levels of 2, 5 and 10 g/kg condensed tannins. In contrast to this study VIVEROS et al. (2011) stated that weight gain and feed conversion ratio of broiler chicks fed diet containing 7.2 g/kg GSE were decreased by diet, whereas, feed consumption was not affected.

Egg quality

The effects of the experimental diets on egg quality parameters are given in Table 3. In all treatment groups, egg quaility parameters were not affected by dietary GS and GSE except for Haugh unit. The addition of GS and GSE at different levels to layer diets increased linearly ($P < 0.01$) albumen index and Haugh unit compared to control group. Albumen quality is dependent on the quantity of β-ovomucin secreted by magnum, and β-ovomucin is essentially responsible for the gelatinous height of egg white (ÖZGAN et al., 2009). High egg albumen of treatments groups could be caused by the protective effect of grape seed and grape seed extract due to the antioxidant effect on β-ovomucin quantity secreted by magnum. Unfortunately, very limited scientific data were found in the literature relating to the effects of GS or GSE on egg quality in poultry. SILICI et al. (2011) reported that the addition of GS (0.5, 1, and 1.5%) to quail diet did not significantly affect Haugh unit, egg shell thickness, egg yolk color compared to control group. ŞAHIN et al. (2010) stated that there were no effects of resveratrol, a phenolic compound known to be in grape seed, supplementation on egg weight, eggshell weight, shell thickness, shape index, albumen index, yolk color, yolk index and Haugh unit in quail. Similar results have been obtained in study a conducted by KARA et al. (2011), where the addition of grape pomace to layer diet did not affect albumen index, Haugh unit, egg yolk index, yolk color, egg shell ratio, and egg shell thickness.

Table 3. Effects of grape seed and grape seed extract supplementation to diets on egg quality

Einfluss der Zulage von Traubenkernen und extrahierten Traubenkernen zum Futter auf die Eiqualität

Groups		Shape index (%)	Shell strength (kg/cm^2)	Shell thickness (mm × 10^{-2})	Shell weight (g)	Yolk color	Yolk index (%)	Albumen index (%)	Haugh unit
Control		76.8	2.39	0.353	7.96	12.4	41.9	8.21	81.1^b
GS 1		76.3	2.09	0.350	7.97	12.7	43.4	9.37	85.2^a
GS 2		76.8	2.16	0.364	7.75	12.3	41.4	9.23	86.3^a
GS 3		77.2	2.23	0.372	7.69	12.3	42.3	9.82	88.2^a
GSE 1		75.9	2.77	0.372	7.55	12.1	41.4	8.77	84.5^a
GSE 2		76.6	2.44	0.368	7.82	12.5	42.3	9.50	86.7^a
GSE 3		75.4	2.16	0.381	8.02	12.4	42.9	8.85	85.0^a
SEM		0.572	0.282	0.009	0.201	0.162	1.129	0.423	1.18
P		0.321	0.087	0.231	0.616	0.396	0.644	0.153	0.004
Polynomial Analyze									
Grape Seed	Linear	0.461	0.742	0.184	0.241	0.442	0.843	0.008	0.001
	Quadratic	0.332	0.478	0.636	0.878	0.456	0.781	0.482	0.432
	Cubic	0.615	0.764	0.620	0.661	0.238	0.207	0.275	0.536
Grape Seed Extract	Linear	0.196	0.143	0.071	0.610	0.591	0.432	0.151	0.007
	Quadratic	0.821	0.567	0.789	0.142	0.468	0.628	0.144	0.019
	Cubic	0.231	0.192	0.343	0.411	0.109	0.741	0.401	0.571

a,b: Means with different superscripts each column differs significantly $P < 0.05$.

Metabolic Profile

The changes in metabolic parameters in response to the experimental diets are presented in Table 4. There were significant effects of experimental diets on inspected metabolic parameters ($P < 0.01$), except for alanine aminotransferase (ALT). Levels of Albumin (Alb), total protein (TP), glucose (Glu), cholesterol (Chol), alkaline phosphatase (ALP), aspartate aminotransferase (AST), Calcium (Ca) and Phosphorus (P) in serum from hens fed 2025 g/mg GSE decreased compared with hens receiving the standard control diet. The 2025 g/mg GSE added group exhibited the lowest metabolic parameters compared to the other groups. Decreasing serum protein concentration may be due to an interference of tannins in GSE. Because GSE is containing 97.8% proanthoccyanidins (condese tannin) bound protein in a 6.5% wt/v solution (VISLOCY and FERNANDEZ, 2010), Tannin interferes with protein metabolism, and compromises starch digestibility and activities of pancreatic and intestinal enzymes, and consequently may adversely affect the metabolic profile (KAYA et al., 2014). To our knowledge, there is no data dealing with effects of GS or GSE supplementation to layer diet on metabolic parameters in the literature. But supplementation with grape seed proanthocyanidins appears to benefit blood glucose control (VISLOCY and FERNANDEZ, 2010). EL-ALFY et al. (2005) observed a decline in hyperglycemia and an increase in serum insulin levels in rats fed grape seed proanthocyanidins (GPS). These researchers also stated that GSP possess potent protective effect on the induction of diabetes by alloxan. This protection is mediated via prevention and restoration of pancreatic antioxidant defense systems. CAO and ITO (2003) reported that studies have shown that grape seed oil exhibit many pharmaceutical activities, such as properties against the oxidation of low-density lipoproteins, prevention of thrombosis, inhibitation of cardiovascular diseases, reduction of cholesterol in serum, dilation of blood vessel, and regulation of autonomic nerve. Findings from this study showed that addition of GS and GSE into basal diet did have an decreasing effect on plasma cholesterol. These reduction may be associated with the polyphenolic compounds in grape seed and insoluble fiber structure which increases the excretion of lipids and thus reduces the cholesterol level. CARRON et al. (1999) showed that addition of commercial dietary fiber and polyphenols rich product (DFPP), obtained from grape pomaces orginating from wine or grape juice production, to diets decreased serum cholesterol and LDL-cholesterol concentrations in rats.

In a study made TEBIB et al. (1994) to determine the effect of grape seed tannins in either monomeric or polymeric form on plasma cholesterol in rats showed an decrease in total and low-density lipoprotein plasma cholesterol and a decrease in plasma high-density lipoprotein by the addition of 2% polymeric grape tannins but not by monomeric tannins. They reported that polymeric grape seed tannins significantly increased the fecal excretion of lipids and cholesterol and exerted a hypocholesterolemic effect in high-cholesterol-fed rats.

Table 4. Effects of grape seed and its ekstract supplementation on blood serum parameters in laying hens

Einfluss der Zulage von Traubenkernen und extrahierten Traubenkernen zum Futter auf die Blutkennwerte der Legehennen

Groups		Alb[1]	TP[1]	Glu[2]	Chol[2]	ALP[3]	AST[3]	ALT[3]	Ca[2]	P[2]
Control		3.09^{a}	2.85^{a}	188^{ab}	171^{a}	87.0^{bc}	188^{a}	61.5	22.8^{a}	6.85^{a}
GS 1		1.82^{b}	3.08^{a}	178^{ab}	107^{b}	101.5^{bc}	140^{a}	30.5	18.6^{a}	4.37^{b}
GS 2		2.03^{ab}	3.72^{a}	182^{ab}	79.5^{b}	131.0^{b}	149^{a}	29.5	17.2^{a}	4.18^{b}
GS 3		2.55^{ab}	4.12^{a}	240^{a}	111^{b}	257.5^{a}	182^{a}	44.0	22.2^{a}	5.15^{b}
GSE 1		1.74^{b}	2.35^{ab}	175^{b}	89.5^{b}	113.0^{b}	138^{a}	23.0	17.4^{a}	3.53^{b}
GSE 2		2.24^{ab}	3.51^{a}	188^{ab}	95.5^{b}	96.0^{bc}	168^{a}	26.5	18.8^{a}	4.90^{b}
GSE 3		0.485^{c}	0.760^{b}	53.0^{c}	26.5^{c}	26.5^{c}	50.0^{b}	23.0	6.53^{b}	1.14^{c}
SEM		0.387	0.542	19.1	13.7	27.6	18.6	8.81	2.13	0.575
P		0.002	0.006	0.001	0.001	0.001	0.001	0.061	0.001	0.001
Polynomial Analyze										
Grape Seed	Linear	0.294	0.011	0.067	0.015	0.004	0.936	0.314	0.746	0.041
	Quadratic	0.009	0.801	0.081	0.012	0.120	0.051	0.071	0.050	0.006
	Cubic	0.380	0.682	0.610	0.779	0.593	0.696	0.781	0.729	0.628
Grape Seed Extract	Linear	0.002	0.107	0.001	0.001	0.015	0.001	0.033	0.001	0.001
	Quadratic	0.632	0.112	0.005	0.689	0.010	0.059	0.118	0.131	0.709
	Cubic	0.044	0.082	0.052	0.036	0.894	0.009	0.313	0.061	0.002

Alb: albumin, TP: total protein, Glu: glucose, Chol: cholesterol, ALP: alkaline phosphatase, AST: aspartate aminotransferase, ALT: alanine aminotransferase, Ca: Calcium, P: Phosphorus.
[1]: g/dL; [2]: mg/dL; [3]: unit/L
a,b,c: Means with different superscripts each column differs significantly $P < 0.05$.

Egg yolk oxidation status

Studies to improve oxidative stability of eggs and meat via dietary antioxidant enrichments reveal an inverse relationship between levels of dietary antioxidant and MDA contents in egg yolk, meat, and blood serum, a lipid peroxidation indicator in the poultry products (ŞAHIN et al., 2010). The levels of determined MDA in egg yolk samples, as an index of lipid peroxidation, are shown in Table 5. The MDA in yolk was altered significantly by addition of different levels of GS and GSE to the basal diet after 7 and 14 days of refrigerated storage. Yolk MDA values were not significantly influenced by treatment groups after 28 days of refrigerated storage. GS and GSE supplementation decreased linearly and cubicly egg yolk MDA levels on 7th and 14th day compared to control group. Few data are available in the literature in relation to the use of GS or GSE in chicken feed. BRENES et al. (2010) reported that this activity in the grape seed extract is related with total phenolic content and GSE rich in polyphenols could represent an efficient source of antioxidant in the chicken diet. ŞAHIN et al. (2010) stated that addition of resveratrol known to be one of the penolic compounds in grape seed enhanced antioxidant status of egg in quail. It is reported that egg yolk MDA levels were reduced by 4 and 6% grape pomace supplementation to laying hen diets (KARA et al., 2011). TURAN and ÖZTÜRK (2010) investigated the effects of GS (0.5, 1, 2%) and GSE (200, 400, 800 g kg $^{-1}$) and vitamin E in broiler chicks on meat antioxidant status. They stated that GS and GSE can be used a natural antioxidant in broiler diet. We assume that this effect of GSE as free radical scavengers is related to the total phenolic content.

Table 5. Effects of grape seed and its extract supplementation to diets on MDA Values of egg samples stored for 7, 14 and 28 days (ng/g)

Einfluss der Zulage von Traubenkernen und extrahierten Traubenkernen zum Futter auf die MDA-Werte der Eidotter nach einer Lagerung von 7, 14 und 28 Tagen (ng/g)

Groups		0 Day	7 Day	14 Day	28 Day
Control		1.84	2.07^{bc}	2.44^{a}	6.22
GS 1		1.68	2.53^{ab}	2.08^{ab}	5.59
GS 2		1.63	2.28^{abc}	1.59^{b}	6.08
GS 3		1.77	2.74^{a}	1.84^{ab}	5.30
GSE 1		1.88	2.66^{a}	2.38^{a}	5.86
GSE 2		1.58	1.75^{c}	1.65^{b}	5.76
GSE 3		1.83	2.07^{cb}	1.65^{b}	6.19
SEM		0.161	0.194	0.203	0.611
P		0.801	0.003	0.009	0.930
Polynomial Analyze					
Grape Seed	Linear	0.739	0.049	0.001	0.492
	Quadratic	0.412	0.989	0.108	0.917
	Cubic	0.916	0.098	0.304	0.474
Grape Seed Extract	Linear	0.610	0.232	0.001	0.907
	Quadratic	0.493	0.424	0.893	0.372
	Cubic	0.191	0.001	0.182	0.878

a.b.c: Means within columns with different superscripts differ at $P < 0.05$

Conclusion

The present study aimed to determine the effects of grape seed or grape seed extract inclusion into diets of laying hens on performance, egg quality parameters, yolk oxidation and serum traits and provides evidence that GS or GSE can be incorporated without impaired performance. This work has shown that the addition of GSE into layer diet caused beneficial effects on some important performance and egg quality tarits and yolk oxidation. In addition, at the end of a 7 days period, the GSE (1350 mg/kg) had the lowest MDA value and at this level the albumen index and Haugh unit increased compared with control diet. In conclusion, the inclusion of GSE (1350 mg/kg) into diets of laying hens could enhance egg production, Haugh unit and antioxidant status.

Summary

The experiment was conducted to investigate the effect of different levels of grape seed (GS) and grape seed extract (GSE) on performance, egg quality parameters, yolk oxidation, and serum traits in laying hens. A total of one hundred and sixty eight Lohman layers, 44 weeks old were divided into seven treatment groups, each of which included six cages of four hens each. Experimental groups were fed standart commercial corn-soybean layer diet which also served as a Control (C) diet. The experimental diets were as follows: C + 0.5% GS (GS1), C + 1.0% GS (GS2), C + 1.5% GS (GS3), C + 675 mg GSE/kg (GSE1), C + 1350 mg GSE/kg (GSE2), and C + 2025 mg GSE/kg (GSE3). The experiment lastet 12 weeks.

Performance traits such as feed consumption, damage egg ratio and feed conversion ratio did not differ significantly amoung the groups ($P > 0.05$), but supplementation of GS and GSE to layer diets increased linearly ($P < 0.01$) egg production and affected egg weight quadratically ($P < 0.05$) compared to the control group. Experimental diets did not affect egg quality parameters, except Haugh unit. The diet containing GS and GSE increased Haugh unit linearly ($P < 0.01$) compared with birds fed the basal diet. Levels of total protein, glucose, aspartate aminotransferase, calcium, and phosphorus in serum from GSE 3 group and serum cholesterol level in all treatments groups were reduced compared to hens fed the control diet. The malondialdehyde (MDA) in yolk was altered linearly by addition of different levels of GS and GSE to the basal diet after 7 and 14 days of refrigerated storage, but not after 28 days. In

conclusion, the inclusion of GSE at level 1350 mg/kg into diets could enhance egg production, Haugh unit and antioxidant status in laying hens.

Key words

Laying hen, nutrition, grape seed, performance, egg quality, lipid oxidation, yolk, serum traits

Zusammenfassung

Einfluss von Futterrationen mit zerkleinerten und extrahierten Traubenkernen auf die Leistung, Eiqualitätsparameter, Lipidoxidation im Dotter und Blutserum-Kennwerte von Legehennen

Das Ziel der Studie war die Untersuchung des Einflusses von Zulagen von Traubenkernen (GS) und extrahierten Traubenkernen (GSE) in unterschiedlicher Höhe zum Futter auf die Leistung, Eiqualitätsmerkmale, Oxidation im Dotter und Blutserum-Parameter bei Legehennen. Hierzu wurden 168 Legehennen im Alter von 44 Wochen auf sieben Behandlungsgruppen verteilt, die jeweils 6 Käfige a 4 Hennen umfassten. Alle Hennen erhielten eine kommerzielles Legehennenalleinfutter auf Mais-Soja-Basis zur freien Verfügung, das auch als Kontrolle (C) diente. In den Behandlungsgruppen wurden dem Legehennenalleinfutter 0,5% GS (GS1), 1,0% GS (GS2), 1,5% GS (GS3), 675 mg/kg KSE (GSE1), 1350 mg/kg GSE (GSE2) bzw. 2025 mg/kg GSE (GSE3) zugezetzt. Die Versuchsdauer betrugt 12 Wochen.

Die Behandlungen hatten sich nicht signifikant auf die Futteraufnahme, die Futterverwertung und den Anteil an Brucheiern ausgewirkt ($P > 0,05$). Allerdings führte die Zulage von GS und GSE zum Futter im Vergleich zur Kontrolle zu einer signifikanten, linearen Verbesserung der Legeleistung ($P < 0,01$) und einer signifikanten, quadratischen Verbesserung des Eigewichts ($P < 0,05$). Die Behandlungen wirkten sich außer auf die Haugh-Einheit nicht auf andere Eiqualitätsparameter aus. Im Vergleich zur Kontrollgruppe nahm bei den Behandlungen GS und GSE mit zunehmender Zulagenhöhe die Haugh-Einheit linear zu ($P < 0,01$). In der Behandlung GSE3 waren im Vergleich zur Kontrollgruppe die Gehalte an Gesamteiweiß, Aspartat-Aminontransferase, Kalzium und Phosphor im Blutserum vermindert. Der Cholesterol-Spiegel war bei allen GS- und GSE-Zulagegruppen im Vergleich zur Kontrolle geringer. Nach 7 und 14 Tagen Lagerung wurden bei den Behandlungen mit GS- und GSE-Zulagen signifikant niedrigere Malondialdehyd-Gehalte im Dotter gemessen. Bei einer Lagerdauer von 28 Tagen waren die Unterschiede nicht signifikant. Es wurde daher der Schluß gezogen, dass eine Zulage von 1350 mg GSE/kg Futter die Legeleistung und die Eiqualität, gemessen als Haugh-Einheit und Oxidationslevel, vebessern kann.

Stichworte

Legehenne, Fütterung, Traubenkerne, Legeleistung, Eiqualität, Lipidoxidation, Blutparameter

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