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Effects of Eucommia Leaf Extract on Production Performance, Egg Quality, Yolk Cholesterol Content, and Serum Antioxidant Capacity in Late-Laying Hens: Postprint

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Abstract

The present study was conducted to investigate the effects of Eucommia leaf extract on production performance, egg quality, yolk cholesterol content, and serum antioxidant capacity of laying hens during the late laying period. A single-factor experimental design was adopted, in which 1,200 healthy 420-day-old Hy-Line Brown laying hens with similar laying rate and body weight were randomly allocated into 4 groups, with 6 replicates per group and 50 hens per replicate. The control group was fed a basal diet, while the experimental groups were fed the basal diet supplemented with 100, 200, and 300 g/t of Eucommia leaf extract, respectively. The preliminary period lasted for 1 week, and the formal experimental period lasted for 8 weeks. The results showed that: 1) Compared with the control group, the experimental groups exhibited significantly lower rates of broken and soft-shelled eggs and mortality and culling rate ($P < 0.05$). 2) On day 56 of the experiment, compared with the control group, the experimental groups showed significantly increased eggshell thickness and eggshell strength ($P < 0.05$), and a highly significant reduction in yolk cholesterol content ($P < 0.01$). 3) Compared with the control group, the experimental groups demonstrated highly significant increases in serum superoxide dismutase and catalase activities ($P < 0.01$), and a highly significant decrease in serum malondialdehyde content ($P < 0.01$). In conclusion, dietary supplementation with Eucommia leaf extract can reduce mortality and culling rate and the rate of broken and soft-shelled eggs, increase eggshell thickness and eggshell strength, decrease yolk cholesterol content, and improve antioxidant capacity, with the 300 g/t Eucommia leaf extract group showing the best effects.

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Full Text

Effects of Eucommia Leaves Extract on Performance, Egg Quality, Yolk Cholesterol Content and Serum Antioxidant Capacity of Laying Hens during Late Period of Laying

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Abstract

This experiment was conducted to investigate the effects of Eucommia leaves extract on production performance, egg quality, yolk cholesterol content, and serum antioxidant capacity of laying hens during the late laying period. Using a single-factor experimental design, 1,200 healthy 420-day-old Hy-Line Brown laying hens with similar laying rates and body weights were randomly allocated into four groups, each consisting of six replicates of 50 hens. The control group was fed a basal diet, while the experimental groups received the basal diet supplemented with 100, 200, or 300 g/t of Eucommia leaves extract. The study included a 1-week pre-trial period followed by an 8-week formal experimental period. The results showed that: (1) Compared with the control group, the experimental groups exhibited significantly lower rates of unqualified eggs and mortality ($P < 0.05$). (2) On day 56, the experimental groups demonstrated significantly increased eggshell thickness and eggshell strength ($P < 0.05$), along with extremely significant reductions in yolk cholesterol content ($P < 0.01$). (3) The experimental groups also showed extremely significant elevations in serum superoxide dismutase and catalase activities ($P < 0.01$), accompanied by extremely significant decreases in serum malondialdehyde content ($P < 0.01$). In conclusion, dietary supplementation with Eucommia leaves extract can reduce mortality and unqualified egg rates, increase eggshell thickness and strength, decrease yolk cholesterol content, and improve systemic antioxidant capacity, with the 300 g/t supplementation level showing the optimal effects.

Keywords: Eucommia leaves extract; laying hens during late period of laying; performance; egg quality; antioxidant capacity

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With China' s economic development and rising living standards, consumer demand for green, safe, and antibiotic-free eggs has grown substantially. In laying hen production, suboptimal rearing environments, management practices, and nutritional levels often prevent hens from achieving their full genetic potential.

Many producers overlook the performance and egg quality of hens during the late laying period. As hens age, combined with cumulative effects of nutrition, environment, and disease factors, eggshell breakage becomes severe, with substantial visible and invisible fecal contamination on eggshell surfaces, increasing susceptibility to microbial contamination. Concurrently, the antioxidant capacity and disease resistance of the hens gradually decline.

Chinese herbal preparations can regulate organ function and maintain robust disease resistance without inducing drug resistance. Eucommia (*Eucommia ulmoides*), a natural herbal resource listed in feed additive directories, is rich in chlorogenic acid, flavonoids, and polysaccharides, exhibiting antibacterial, anti-stress, antioxidant, free radical-scavenging properties, while also increasing digestive enzyme secretion, promoting growth, and improving meat quality. Eucommia leaves extract possesses natural, multifunctional, and biologically safe characteristics. The chlorogenic acid and geniposide in Eucommia leaves extract can promote bile secretion, while flavonoids can stimulate osteoblast proliferation and accelerate osteoblast differentiation and mineralization. Saponins, alkaloids, and polysaccharides in Eucommia leaves can enhance immune cell function, activate immune organs and systems, and promote antibody production. Previous research demonstrated that 50% ethanol extract of Eucommia leaves significantly enhanced lymphocyte transformation and macrophage phagocytosis in mice, without significantly affecting spleen antibody-forming cells. However, no reports have addressed the application of Eucommia leaves extract for addressing decreased performance and poor egg quality in late-period laying hens. Therefore, this study aimed to investigate the effects of dietary Eucommia leaves extract supplementation on production performance, egg quality, yolk cholesterol content, and serum antioxidant capacity of laying hens during the late laying period, providing a theoretical basis for improving late-period hen health and formulating egg quality-enhancing diets.

1.1 Experimental Materials

Eucommia leaves extract was purchased from Shandong Longchang Animal Health Products Co., Ltd., containing 7.0% chlorogenic acid, 15% Eucommia flavonoids, 40% Eucommia polysaccharides, and 38% water-soluble impurities.

1.2 Experimental Design and Diets

A total of 1,200 healthy 420-day-old Hy-Line Brown laying hens with similar laying rates and body weights were randomly divided into four groups, with six replicates per group and 50 hens per replicate. The control group received a basal diet, while the experimental groups received the basal diet supplemented with 100, 200, or 300 g/t Eucommia leaves extract. The pre-trial period lasted one week, followed by an eight-week formal experimental period.

The basal diet was formulated according to NRC (1994), Chinese Feeding Standard of Chickens (NY/T 33-2004), and the Hy-Line Brown laying hen manage-

ment manual, without Eucommia leaves extract. The composition and nutrient levels of the basal diet are presented in Table 1 .

Table 1 Composition and Nutrient Levels of the Basal Diet (Air-Dry Basis)

Ingredients	Content (%)	Nutrient Levels[2])	Content
Corn		Metabolizable Energy (MJ/kg)	
Soybean meal		Crude Protein (%)	
Soybean oil		Total Phosphorus (%)	
Limestone		Available Phosphorus (%)	
$CaHPO_4$		Lysine (%)	
NaCl		Methionine (%)	
DL-methionine			
Choline chloride			
Premix[1])			
Total	100.00		

[1]) The premix provided the following per kilogram of diet: VA 10,000 IU, VD_3 3,000 IU, VE 20 IU, VK_3 2 mg, thiamine 1 mg, riboflavin 8 mg, calcium pantothenate 40 mg, niacin 32.5 mg, pyridoxine 8 mg, biotin 2 mg, folic acid 1.5 mg, VB_{12} 5 mg, choline 500 mg, Mn 70 mg, I 1 mg, Fe 80 mg, Cu 8 mg, Zn 80 mg, Se 0.3 mg.
[2]) Metabolizable energy was a calculated value, while others were measured values.

1.3 Management

During the experimental period, hens were fed dry mash twice daily at 06:30 and 14:30. They were housed in windowed poultry facilities with three-tiered step cages, accommodating four hens per compartment in the upper and middle tiers and three hens per compartment in the lower tier. Hens had ad libitum access to feed and water with a constant photoperiod of 16 hours daily. Management and immunization procedures followed the existing protocols of the experimental farm.

1.4.1 Production Performance

The health status of hens in each group was monitored throughout the trial. Daily feed allocation, egg number, egg weight, unqualified egg count, and mortality were recorded by replicate, with feed consumption calculated every seven days. On days 28 and 56 of the experiment, laying rate, average egg weight, average daily feed intake, feed conversion ratio, unqualified egg rate, and mortality rate were calculated for each replicate.

1.4.2 Egg Quality

On days 28 and 56, five eggs per replicate were collected to measure egg shape index using an Egg Index Reader (Fujihira Industry Co., Ltd.), eggshell thickness using an Egg Shell Thickness Gauge (Orka Technology Ltd.), and yolk color and Haugh unit using a SONOVA Egg Analyzer™ (Orka Technology Ltd.).

1.4.3 Yolk Cholesterol Content

On days 28 and 56, five eggs per replicate were collected. Yolks from the five eggs were pooled, and 0.05 g of the mixed sample was saponified with anhydrous ethanol-potassium hydroxide solution, extracted with a petroleum ether and anhydrous ether mixture, and quantified with methanol solution. Yolk cholesterol content was determined by high-performance liquid chromatography.

1.4.4 Serum Antioxidant Capacity

On the morning of day 56, one hen per replicate was randomly selected for blood collection from the wing vein after fasting. Serum was prepared by centrifugation at 3,600 r/min for 10 minutes, aliquoted, and stored at -20 °C. Serum superoxide dismutase (SOD) activity was measured by xanthine oxidase method, malondialdehyde (MDA) content by thiobarbituric acid method, and catalase (CAT) activity by colorimetry. Assays were performed using kits from Nanjing Jiancheng Bioengineering Institute according to the manufacturer's instructions.

1.5 Statistical Analysis

Raw data were initially processed using Excel 2010. One-way ANOVA was performed using SPSS 19.0, with Duncan' s multiple range test for post-hoc comparisons. Results are expressed as means ± standard error.

2.1 Effects of Eucommia Leaves Extract on Production Performance of Laying Hens during Late Period

As shown in Table 2 , on days 28 and 56, average egg weight in the Eucommia leaves extract groups was slightly higher than in the control group, but differences among groups were not significant ($P > 0.05$), with the 300 g/t group showing the highest values. Similarly, average daily feed intake was slightly higher in the experimental groups compared to the control group without significant differences ($P > 0.05$), with the 300 g/t group having the highest intake. Laying rate was also marginally higher in the supplemented groups versus the control group, though not statistically significant ($P > 0.05$), with the 300 g/t group showing the highest rate. Feed conversion ratio was slightly lower in all Eucommia leaves extract groups compared to the control group, with no significant differences among groups ($P > 0.05$), but showed a decreasing trend with increasing supplementation levels, with the 300 g/t group achieving the lowest ratio.

On both days 28 and 56, the 300 g/t group exhibited significantly lower unqualified egg rates compared to the control and 100 g/t groups ($P < 0.05$), while the 100 and 200 g/t groups had significantly lower rates than the control group ($P < 0.05$). No significant difference was observed between the 100 and 200 g/t groups ($P > 0.05$), indicating the 300 g/t group was most effective in reducing unqualified egg rates. Regarding mortality rate, the 300 g/t group showed significantly lower rates than the control, 100, and 200 g/t groups on both sampling days ($P < 0.05$). The 200 g/t group had significantly lower mortality than the control and 100 g/t groups ($P < 0.05$), while the 100 g/t group was significantly lower than the control group ($P < 0.05$), demonstrating the superior efficacy of the 300 g/t supplementation level.

Table 2 Effects of Eucommia Leaves Extract on Performance of Laying Hens during Late Period

Items	Control group	Eucommia leaves extract supplemental level/(g/t)			P-value
		100	200	300	
Average egg weight/g	62.13$±3.96	63.02±2.61	64.67±4.80	65.09±2.89	> 0.05
	$Average daily feed intake/g$	123.36±0.88	124.61±0.47	125.84±1.97	126.94±1.73	> 0.05
	$Laying rate/$	±2.14	87.50±2.23	87.26±2.09	89.10±2.71	> 0.05
	$Feed conversion ratio$	2.28±0.11	2.25±0.16	2.23±0.08	2.18±0.07	> 0.05
	$Unqualified egg rate/$	±0.01^{a}	0.59±0.01^{b}	0.48±0.01^{bc}	0.29±0.01^{c}	< 0.05
	$Mortality rate/$	±0.15^{a}	0.59±0.21^{b}	0.51±0.14^{c}	0.21±$0.07	

In the same row, values with different small letter superscripts indicate significant difference ($P < 0.05$), while values with the same or no superscripts indicate no significant difference ($P > 0.05$). This applies to all tables.

2.2 Effects of Eucommia Leaves Extract on Egg Quality of Laying Hens during Late Period

As presented in Table 3 , on days 28 and 56, no significant differences were observed in albumen height, yolk color, egg shape index, eggshell percentage, yolk percentage, or albumen percentage among the 100, 200, and 300 g/t groups compared to the control group ($P > 0.05$). On day 28, the 300 g/t group showed significantly lower Haugh units compared to the control group ($P < 0.05$), while no significant differences were detected among the 100, 200, and 300 g/t groups, nor between the 100 and 200 g/t groups and the control group ($P > 0.05$). However, on day 56, no significant differences in Haugh units were found among all groups ($P > 0.05$).

Eggshell thickness did not differ significantly among groups on day 28 ($P > 0.05$). However, on day 56, the 100, 200, and 300 g/t groups exhibited significantly greater eggshell thickness compared to the control group ($P < 0.05$), with

no significant differences among the three supplementation levels (P > 0.05), indicating the 300 g/t group achieved the best improvement in eggshell thickness. Similarly, eggshell strength showed no significant differences among groups on day 28 (P > 0.05), but on day 56, the 200 and 300 g/t groups demonstrated significantly higher eggshell strength than both the 100 g/t group and control group (P < 0.05), with no significant difference between the 200 and 300 g/t groups (P > 0.05). The 100 g/t group also showed significantly higher eggshell strength than the control group (P < 0.05).

Table 3 Effects of Eucommia Leaves Extract on Egg Quality of Laying Hens during Late Period

Items	Control group	Eucommia leaves extract supplemental level/(g/t)			P-value
		100	200	300	
Albumen height/mm	6.60$±0.56	6.88±0.90	6.93±1.41	7.00±0.88	> 0.05
Yolkcolor	8.09±1.13	8.09±0.53	8.45±0.68	8.72±0.64	> 0.05
Haughunit	78.24±3.40^{b}	81.37±5.67^{ab}	82.48±4.62^{ab}	84.50±5.48^{a}	< 0.05
Eggshellthickness/mm	0.44±0.03	0.44±0.03	0.43±0.02	0.45±0.03	> 0.05
Eggshellstrength/(N/m^{2})	37.1±5.38	37.49±4.21	37.44±5.03	39.09±5.38	> 0.05
Eggshapeindex	1.40±0.04	1.39±0.04	1.40±0.05	1.42±0.04	> 0.05
Eggshellpercentage/±1.06	11.63±0.82	11.61±0.93	11.59±1.18	> 0.05	
Yolkpercentage/±2.12	26.39±1.74	26.55±2.41	27.10±2.58	> 0.05	
Albumenpercentage/±2.56	61.96±1.72	61.82±2.45	60.53±$3.11		

2.3 Effects of Eucommia Leaves Extract on Yolk Cholesterol Content of Laying Hens during Late Period

As shown in Table 4 , on day 28, the 300 g/t group exhibited extremely significantly lower yolk cholesterol content compared to the 100 g/t group, 200 g/t group, and control group (P < 0.01). The 200 g/t group was also extremely significantly lower than the 100 g/t group and control group (P < 0.01), while the 100 g/t group was extremely significantly lower than the control group (P < 0.01). On day 56, the 300 g/t group showed extremely significantly lower yolk cholesterol content than the 100 g/t group and control group (P < 0.01), the 200 g/t group was extremely significantly lower than the control group (P < 0.01), and the 100 g/t group was extremely significantly lower than the control group (P < 0.01). These results demonstrate that dietary Eucommia leaves extract supplementation can extremely significantly reduce yolk cholesterol content, with the 300 g/t group showing the lowest cholesterol levels on day 28.

Table 4 Effects of Eucommia Leaves Extract on Yolk Cholesterol Content of Laying Hens during Late Period

Items	Control group	Eucommia leaves extract supplemental level/(g/t)			P-value
		100	200	300	
Cholesterol content on day 28	2.87$±0.02^{A}\|2.57±0.01^{B}\|2.52±0.03^{c}\|2.29±0.03^{D}\| < 0.01\|\|*Cholesterolcontentonday*56\|3.01±0.03^{Aa}\|2.71±0.01^{Bb}\|2.70±0.02^{Bcbc}|2.54±$0.01				

2.4 Effects of Eucommia Leaves Extract on Serum Antioxidant Capacity of Laying Hens during Late Period

As presented in Table 5 , dietary Eucommia leaves extract supplementation extremely significantly increased serum SOD activity compared to the control group ($P < 0.01$). The 300 g/t group showed extremely significantly higher SOD activity than the 100 g/t group, 200 g/t group, and control group ($P < 0.01$). The 200 g/t group was extremely significantly higher than the 100 g/t group and control group ($P < 0.01$), while the 100 g/t group was extremely significantly higher than the control group ($P < 0.01$), indicating the 300 g/t group was most effective in improving serum SOD activity.

Serum MDA content was extremely significantly reduced by Eucommia leaves extract supplementation ($P < 0.01$). The 300 g/t group showed extremely significantly lower MDA content than the 100 g/t group, 200 g/t group, and control group ($P < 0.01$). The 200 g/t group was extremely significantly lower than the 100 g/t group and control group ($P < 0.01$), and the 100 g/t group was extremely significantly lower than the control group ($P < 0.01$), demonstrating the superior efficacy of the 300 g/t group in reducing serum MDA content.

Similarly, serum CAT activity was extremely significantly enhanced by Eucommia leaves extract supplementation ($P < 0.01$). The 300 g/t group exhibited extremely significantly higher CAT activity than the 100 g/t group, 200 g/t group, and control group ($P < 0.01$). The 200 g/t group was extremely significantly higher than the 100 g/t group and control group ($P < 0.01$), while the 100 g/t group was extremely significantly higher than the control group ($P < 0.01$), with the 300 g/t group showing the greatest improvement in serum CAT activity.

Table 5 Effects of Eucommia Leaves Extract on Serum Antioxidant Capacity of Laying Hens during Late Period

Items	Control group	Eucommia leaves extract supplemental level/(g/t)			P-value
		100	200	300	

Items	Control group	Eucommia leaves extract supplemental level/(g/t)			P-value
SOD (U/mL)	169.84$\pm$0.24^{D}	170.21$\pm$0.40^{c}	180.81$\pm$0.64^{B}	184.24$\pm$0.35^{A}	< 0.01
$MDA(nmol/mL)$	3.38$\pm$0.01^{A}	3.34$\pm$0.02^{B}	2.59$\pm$0.02^{c}	2.38$\pm$0.02^{D}	< 0.01
$CAT(U/mL)$	1.21$\pm$0.40^{D}	1.26$\pm$0.21^{c}	2.34$\pm$0.30^{B}	2.52$\pm$\$0.15	

3.1 Effects on Production Performance

Numerous factors influence laying hen performance, including individual variation, age, environment, activity level, reproductive stage, and dietary energy level. This study found that dietary supplementation with 100, 200, or 300 g/t Eucommia leaves extract did not significantly affect average egg weight, average daily feed intake, laying rate, or feed conversion ratio during the experimental period. Similar results were reported by Ma Deying et al., who found that Chinese herbal additives did not significantly affect body weight or weight gain in young laying hens. The flavonoids in Eucommia leaves extract can promote osteoblast proliferation and mineralization, stimulate the gastrointestinal tract, increase digestive enzyme secretion, enhance blood circulation, and improve nutrient digestibility and absorption, thereby potentially improving animal performance. However, other studies have shown that Eucommia leaves extract as a feed additive can enhance animal immunity, improve livestock growth performance, and enhance product quality. During the late laying period, accelerated oxidative aging increases feed intake while decreasing laying rate. Supplementation with 300 g/t Eucommia leaves extract showed a trend toward delaying this decline in laying rate. The 8-week experimental period may have been relatively short for the slow-acting Eucommia leaves extract to exert significant effects on average egg weight, feed intake, laying rate, and feed conversion ratio. The significant improvement in unqualified egg rate and mortality rate with 300 g/t supplementation may be attributed to the antibacterial, hemostatic, and leukocyte-increasing effects of chlorogenic acid. Okada et al. reported that terpenoid compounds such as geniposide can interfere with T lymphocytes and exhibit immunosuppressive activity, potentially enhancing immunity and contributing to reduced unqualified egg rates and mortality.

3.2 Effects on Egg Quality

During the late laying period, egg size increases while eggshell quality deteriorates and shell color becomes uneven. Egg quality is influenced by multiple factors including genetics, diet, lighting, and hen health status. Egg shape index, eggshell strength, and eggshell thickness are critical quality indicators. Eggshell composition consists of 94–97% inorganic matter (primarily 93% calcium carbonate, 1% magnesium carbonate, and 2.8% mixed carbonates) and 3–6% organic matter, plus trace elements including copper, iron, manganese, zinc, and selenium. This study found that different levels of Eucommia leaves extract supplementation did not significantly affect yolk color, egg shape index,

or egg component percentages, but did improve Haugh units. Higher Haugh units indicate thicker, more viscous egg white and better egg quality. Eggs contain numerous bioactive proteins such as ovotransferrin, lysozyme, ovalbumin, lipovitellin, and biotin-binding protein that determine egg freshness. Xu Xianzhu et al. demonstrated that Eucommia polysaccharides can effectively improve immune function in mice, possibly by stimulating spleen enlargement and enhanced immune responsiveness, promoting T-cell secretion of immune factors, activating dormant immune cells, and increasing immune cell populations, thereby improving the activity of these functional proteins and increasing Haugh units. Yu Lu et al. reported that eggshell calcium deposition is closely related to calcium-binding protein (CaBP) expression in the oviduct and uterus. The significant enhancement of eggshell thickness and strength on day 56 may be attributed to changes in eggshell membrane formation induced by Eucommia leaves extract supplementation. The highly soluble minerals and organic acids in Eucommia leaves extract can significantly increase blood calcium and phosphorus concentrations, influencing CaBP expression in the oviduct and uterus during eggshell formation and thereby determining calcium deposition and shell quality.

3.3 Effects on Yolk Cholesterol Content

Poultry maintain cholesterol homeostasis through synthesis, transport, and degradation pathways. The liver and ovary are primary sites of cholesterol synthesis, which occurs via isoprenoid synthesis from acetyl-CoA through multiple enzymatic steps. 3-hydroxy-3-methylglutaryl-CoA reductase (HMGR) is the key rate-limiting enzyme in cholesterol synthesis, while cholesterol 7α-hydroxylase (CYP7$ 1)$is critical for cholesterol conversion to bile acids. HMGR is inactivated by protein kinase–catalyzed phosphorylation in the cytoplasm, and guanylate cyclase (GC) can accelerate this phosphorylation and din shelled turtle muscle and significantly reduced muscle cholesterol content. This study demonstrated that dietary s activities, thereby promoting cholesterol conversion to bile acids and reducing systemic cholesterol levels, which subsequently lowers yolk cholesterol content. These findings are consistent with the results reported by Lai Lingling et al.

3.4 Effects on Serum Antioxidant Capacity

During the late laying period, accelerated oxidative aging occurs as hens continue producing eggs. The vigorous metabolic processes generate substantial reactive oxygen species, and as hens age, endogenous antioxidant enzyme activities decline, leading to free radical accumulation, lipid peroxidation, and cellular function damage. Superoxide dismutase (SOD) and catalase (CAT) are intracellular antioxidant enzymes that scavenge free radicals. SOD, widely distributed in biological tissues, eliminates superoxide radicals ($\cdot O_2^-$), while malondialdehyde (MDA) is a lipid peroxidation product. Therefore, SOD and MDA are important indicators of oxidative status and antioxidant capacity. This study demonstrated that dietary Eucommia leaves extract supplementation extremely significantly increased serum SOD and CAT activities while ex-

tremely significantly reducing serum MDA content, thereby improving systemic antioxidant capacity. Previous research using D-galactose-induced aging models in mice showed that Eucommia leaves extract administration significantly improved SOD and glutathione peroxidase (GSH-Px) activities and reduced plasma MDA content compared to control and model groups, indicating protective effects against oxidative damage. These findings are similar to those reported by Ye Wenfeng. Xiang Canhui et al. investigated the antioxidant activity of Eucommia leaves extract using DPPH · and FRAP assays, comparing it with vitamin C, and found that Eucommia leaves extract possessed strong antioxidant capacity closely correlated with total flavonoid content, showing a linear relationship within certain concentration ranges and strong DPPH · scavenging activity. The improved serum antioxidant capacity in laying hens may be attributed to the potent antioxidant properties of flavonoids in Eucommia leaves extract, which can quench reactive oxygen species, inhibit free radical activity, and prevent damage to normal cells by active oxygen free radicals, thereby enhancing systemic antioxidant capacity.

4 Conclusion

For laying hens during the late laying period, dietary supplementation with 300 g/t Eucommia leaves extract provided optimal effects, improving Haugh units, eggshell strength, and eggshell thickness, extremely significantly reducing yolk cholesterol content, and enhancing systemic antioxidant capacity.

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