

# The Effect of Green Tea (*Camelia sinensis*) Supplementation on Internal Quality of Laying Hens Table Eggs

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## Abstract

In this experiment the effects of supplementation of the diet for laying hens with different doses of green tea (*Camelia sativa*) on egg quality were studied. Hens of laying hybrid Lohmann Brown (n=30) were randomly divided into 3 groups (n=10) and fed for 16 weeks with diets with green tea powder supplemented. In the control group hens received feed mixture without any additives. The diets in the first and second treatment group were supplemented with 0.5% or 1.0% green tea powder. The egg weight (g), specific egg weight (g/cm<sup>3</sup>), egg yolk weight (g), egg yolk index, egg yolk color (°HLR), albumen weight (g), egg albumen index and Haugh units (HU) were evaluated.

Results showed that the addition of green tea powder slightly decreased egg weight (P>0.05). Supplementation of the feed mixture with the green tea powder statistically significantly affected the albumen index in both groups compared to the control group (P<0.05) (values in the order of the groups: 84.04±16.06, 87.67±14.19\*, 89.42±16.10\* mean±SD). Addition of a feed mixture with a green tea powder increased Haugh units in both the tests groups, however, significantly affected the Haugh units only in the second treatment group compared to the control group (values in the order of the groups: 79.89±7.26, 81.19±6.49, 84.84±11.99\* mean±SD). The results suggest that the egg weight, specific egg weight, yolk weight, yolk index, yolk colour and albumen weight were not significantly influenced with green tea addition.

**Keywords:** egg albumen, egg yolk, green tea, quality, table eggs.

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## 1. Introduction

In the recent past, antibiotic feed additives have extensively been used as growth promoters in poultry diets. However, after the ban of antibiotics for this purpose in the European Union in 2006, non-antibiotic substances with growth promoting potential including organic acids, probiotics and botanical products have received more attention. Botanical products, also known as phytogetic feed additives, have inconsistent effects on poultry performance mainly due to differences in their botanical origin, processing, and composition [1], [2]. It was emphasized that selection of proper

plants, active components, and efficacious dietary doses are important for suitability of these substances to influence poultry performance [3]. Phytobiotics is a term used to describe the natural bioactive substances of plant origin, which affect the growth and health of the animal. Are often applied in the form of powder [4], essential oils and plant extracts [5]. Research findings were obtained from various recent studies, where much attention was focused on the role of green tea in the promotion of both animal and human health [6]. Tea contains lots of functional activated compositions, such as tea polyphenol, alkaloid, polysaccharide, etc. Particularly, tea polyphenol plays roles such as anti-oxidizing [7, 8], anti-bacterial [9, 10], anti-aging [11], anti-cancerous [12]. Current researches suggest that tea treatment could affect the egg quality [13, 14] and egg production performance [15], but the results were

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inconsistent and even very different from each other [16].

The aim of this work was to observe the influence of different doses of green tea addition on egg weight and qualitative parameters of yolk and albumen of Lohmann Brown laying hens eggs in pilot system.

## 2. Materials and methods

### *Animals, diets and treatments*

Hens (n=30) of the laying hybrid Lohmann Brown, 17 weeks old, were randomly divided into

3 groups, each containing 10 hens in four replicates. Hens were fed for a 16 weeks with diet containing of different amounts of green tea (*Camelia sativa*) powder.

At the beginning of the experiment, the hens were kept in the three-deck enriched cage technology system. The technology system was in accordance with requirements specified by the Directive 1999/74 EC. The layer hens were kept by the standard bioclimatic conditions. The composition of the basal diet (BD) fed to the laying hens is shown in Table 1 and Table 2.

**Table 1.** Composition of the trial diets

Component	Participation in the Diet (%)
Wheat	26.30
Rye	15.00
Barley	20.00
Soybean meal (47% crude protein)	22.00
Soybean oil	2.50
Fat	2.00
Monocalcium phosphate	1.70
Calcium carbonate	9.14
Natrium chloride (38% Na)	0.30
Sodium bicarbonate (28% Na)	0.10
Methionin (99% DL-Methionin)	0.16
Vitamin Premix	0.40
Mineral Premix	0.10
Choline chloride	0.20
Caroten premix	0.10

**Table 2.** Nutrient content in the trial diets

Nutrient	Nutrient Content in Mixture
MEN (MJ.kg <sup>-1</sup> of DM)	11.5
CP (g.kg <sup>-1</sup> of DM )	177
LYS (g.kg <sup>-1</sup> of DM )	8.81
MET (g.kg <sup>-1</sup> of DM )	4.17
M + C (g.kg <sup>-1</sup> of DM )	7.41
THR (g.kg <sup>-1</sup> of DM )	6.27
LA (g.kg <sup>-1</sup> of DM )	19.0
Ca (g.kg <sup>-1</sup> of DM )	39.1
Pavail. (g.kg <sup>-1</sup> of DM )	3.8
Na (g.kg <sup>-1</sup> of DM )	1.5

\* MEN: metabolisable energy for poultry, CP: crude protein, LYS: lysine, MET: methionine, M+C: methionine plus cysteine, THR: threonine, LA: linoleic acid, Ca: calcium, Pavail.: available phosphorus, Na: natrium.

In the control group hens received feed mixture without any additives. The diets in the first and second experimental groups were supplemented with 0.5% and 1.0% green tea (Vetservis s.r.o.,

Nitra, Slovakia). Laying hens accepted fodder *ad libitum*. All kinds of feed supplements used in the experiment were homogenously incorporated into the feed mixture in the feed mill.

*Sample Analysis*

Eggs of laying hens of Lohmann Brown strain were collected regularly one a month (n=30 per group) and were assessed immediately after collection. The egg weight (g), specific egg weight (g/cm<sup>3</sup>), egg yolk weight (g), egg yolk index, egg yolk colour (°HLR), albumen weight (g), egg albumen index and Haugh units (HU) were evaluated.

All these parameters were detected using routine methods. Weight parameters were detected using analytical weighting machine and the growth intensity and percentage contents were calculated from weight data. Indexes were calculated as the length: width ratio. Haugh units (HU) detected egg quality as relation of albumen weight and egg weight [100 log.(dense albumen height-1.7x egg

weight<sup>0.37</sup>+7.6)]. Yolk colour was evaluated using Hoffman la Roche colour scale (Hoffman-La Roche, Switzerland). Experiment lasted 16 weeks.

*Statistical analysis*

Statistical analysis was done using one-way analysis of variance (ANOVA) with the post hoc Tukey's multiple comparison test in the program SAS.

**3. Results and discussion**

Table 3 presents the changes in the whole egg quality, egg yolk and egg albumen qualitative parameters with green tea powder addition to feed.

**Table 3.** Influence of green tea (*Camelia sativa*) supplementation into laying hens feed mixture on the alterations of Lohmann Brown laying hen's egg quality

Parameter	Groups		
	Control BD	BD+green tea powder 0.5%	BD+green tea powder 1.0%
Egg weight (g)	61.19±3.94	60.43±4.09	60.18±4.29
Specific egg weight (g/cm <sup>3</sup> )	1.08±0.007	1.08±0.006	1.08±0.007
Egg yolk weight (g)	16.64±1.56	16.23±1.64	16.57±1.58
Egg yolk index	47.64±3.42	48.69±4.26	48.84±6.69
Egg yolk colour (°HLR)	6.54±0.55	6.89±0.78	6.78±0.53
Egg albumen weight (g)	38.02±4.10	38.04±4.09	38.39±3.52
Egg albumen index	84.04±16.06	87.67±14.19*	89.42±16.10*
Haugh Units (HU)	79.89±7.26	81.19±6.49	84.84±11.99*

n=120; BD-basal diet; Values are means±SD; °HLR-coloured Hoffman La Roche scale; HU-Haugh units; Distinct superscripts within row=significant difference (P<0.05).

After add of different doses of green tea, egg weight values were in the order of groups 61.19±3.94; 60.43±4.09; 60.18±4.29 (g±SD). Egg weight was in the experimental groups lower in compare with control group. In the treatment groups with both doses of green tea has been reported not significantly lower differences compared to the control group (P>0.05).

The results of study [17] showed a cubic effect on feed conversion ratio, egg production and egg weight, due to the black tea factory waste supplementation into layer diets. In accordance with our findings [18] indicated a reduction in egg weight using phytobiotics, though not to a statistically significant difference. Similarly, Florou-Paneri et al. [19] after addition of oregano

in accordance with our results recorded in relation to the weight of the eggs a non-significant impact. On the other hand, Yang et al. [20] observed after the addition of green tea significantly negative impact of phytobiotics. Uganbayar et al. [21] indicated statistically significantly lower egg weight by using of green tea powder supplement, also. The egg weight tended to decrease with green tea powder supplementation, while egg production rate tended to increase in the experiment of Biswas et al. [22].

Effect of adding of green tea into feed mixture in both doses caused a non-significant affected yolk weight. Increasing dietary level of all oil seed cakes (rapeseed, linseed, and hemp seed) lowered the yolk percentage and increased the egg white

percentage in the experiment of Halle and Schöne [23].

A significant reduction in the weight of the yolk, compared to the control group ( $P < 0.05$ ) was observed in the groups with addition of 5% and 10% (*Camelina sativa*) in the experiment of Cherian et al. [24]. In our experiment, were recorded among all treatment groups and a control group a statistically non-significant differences ( $P > 0.05$ ). Our findings are accordance with Kaya et al. [17] who reported non-significant differences. Minor differences in yolk index of eggs from hens fed a garlic meal in its attempt had also Yalcin et al. [25] or Canogullari et al. [26]. Adding essential oils of fennel (*Foeniculum vulgare*) and ginger (*Zingiber officinale*) to diets did not affect on egg index and yolk index ( $P > 0.05$ ) in the experiment of Nasiroleslami et al. [27]. In the indicator yolk colour were observed non-significant differences between the groups. Shades of yellow colours on the colour scale Hoffman La Roche were in the normal range for the add green tea. Radwan et al. [28] on the contrary with the conclusions of our experiment detected after the addition of oregano significant differences in colour shade yolk, but after adding turmeric effect was significantly pronounced. Significant increase in the intensity yolk addition of 2% concentration of green tea also noted Yang et al. [20], respectively. The results of Kaya et al. study [17] showed cubic effect on yolk colour due to the black tea factory waste supplementation into layer diets. In contrary, the egg yolk colour in all treated groups was significantly improved in comparison with control ( $P < 0.05$ ) in the experiment of Kim et al. [29] by using of water extract mixtures of *A. capillaris*, *C. sinensis*, *S. chinensis* and *V. coloratum*.

In groups with both doses of green tea powder supplement was albumen weight relatively balanced. In our experiment, supplementation of the feed mixture with the green tea powder statistically significantly affected the albumen index in both groups compared to the control group. The results of Kaya et al. study [17] showed a quadratic effect on albumen index and Haugh unit score due to the black tea factory waste supplementation into layer diets.

In the Haugh units parameters, in our experiment, we found a significantly positive effect of the supplement in the second experimental group, that is, at a higher, 1% green tea dose.

In line with our findings green tea powder treatment had some beneficial effects on egg quality, especially in the albumen height and Haugh unit in the experiment of Xia et al. [30]. The albumen height and the Haugh unit (HU) of hens fed tea polyphenols in dose 200 mg/kg were higher than those of hens fed the control diet ( $P < 0.05$ ) in the experiment of Wang et al. [31]. The egg production rate, egg mass, and feed conversion ratio were significantly improved in all treatments compared to those of control ( $P < 0.05$ ), Haugh unit in all treated groups were significantly improved in comparison with control ( $P < 0.05$ ), but no significant differences were observed for egg shell quality in the experiment of Kim et al. [29]. Haugh unit score was significantly increased with green tea powder, which accompanied with the increased albumen height in the experiment of Biswas et al. [22].

#### 4. Conclusions

The addition of green tea powder slightly decreased egg weight. Supplementation of the feed mixture with the green tea powder statistically significantly affected the albumen index in both groups compared to the control group. Addition of a feed mixture with a green tea powder increased Haugh units in both the tests groups, however, significantly affected the Haugh units only in the second treatment group compared to the control group. The results suggest that the egg weight, specific egg weight, yolk weight, yolk index, yolk colour and albumen weight were not significantly influenced with green tea addition.

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#### References

1. Brenes, A., Roura, E., Essential oils in poultry nutrition: Main effects and modes of action, Anim. Feed Sci. Technol., 158, 2010, 1–14.
2. Reisinger, N., Steiner, T., Nitsch, S., Schatzmayr, G. A., Effects of a blend of essential oils on broiler performance and intestinal morphology during coccidial vaccine exposure, J. Appl. Poult. Res., 2011, 20, 272–283.

3. Hafeez, A., Männer, K., Schieder, C., Zentek, J., Effect of supplementation of phytogetic feed additives (powdered vs. encapsulated) on performance and nutrient digestibility in broiler chicken, *Poultry Science*, 2016, 95, 622–629.
4. Ertas, O. N., Güller, T., Ciftci, M., Dalklic, B., Simswek, G., The effect of an essential oil mix derived from oregano, clove and anise on broiler performance. *International Journal of Poultry Science*, 2005, 11, 879–884.
5. Friedman, M., Overview of antibacterial, antitoxin, antiviral, and antifungal activities of tea flavonoids and teas, *Molecular Nutrition and Food Research*, 2007, 51, 116–134.
6. Khan, S. H., The use of green tea (*Camellia sinensis*) as a phytogetic substance in poultry diets. *Onderstepoort Journal of Veterinary Research*, 2014, 81, 706, DOI: 10.4102/ojvr.v81i2.706
7. Gramza-Michałowska, A., Kobus-Cisowska, J., Kmiecik, D., Korczak, J., Helak, B., Dziedzic, K., Górecka, D., Antioxidative potential, nutritional value and sensory profiles of confectionery fortified with green and yellow tea leaves (*Camellia sinensis*), *Food Chem.*, 2016, 211, 448–454.
8. Rodrigues, M. J., Neves, V., Martins, A., Rauter, A. P., Neng, N. R., Nogueira, J. M., Varela, J., Barreira, L., Custódio, L., In vitro antioxidant and anti-inflammatory properties of *Limonium algarvense* flowers' infusions and decoctions: a comparison with green tea (*Camellia sinensis*). *Food Chem.*, 2016, 200, 322–329.
9. Nakayama, M., Shigemune, N., Tsugukuni, T., Jun, H., Matsushita, T., Mekada, Y., Kurahachi, M., Miyamoto, T., Mechanism of the combined anti-bacterial effect of green tea extract and NaCl against *Staphylococcus aureus*, and *Escherichia coli*, o157:h7., *Food Control.*, 2012, 25, 225–232.
10. Kawarai, T., Narisawa, N., Yoneda, S., Tsutsumi, Y., Ishikawa, J., Hoshino, Y., Senpuku, H., Inhibition of streptococcus mutans biofilm formation using extracts from Assam tea compared to green tea, *Arch Oral Biol.*, 2016, 68, 73–82.
11. Li, F. D., He F., Ye X. J., Shen W., Wu Y. P., Zhai Y. J., Wang X. Y., Lin J. F., Tea consumption is inversely associated with depressive symptoms in the elderly: a cross-sectional study in eastern China. *J Affect Disord.*, 2016, 199, 157–162.
12. Shih, L. J., Lin, Y. R., Lin, C. K., Liu, H. S., Kao, Y. H. Green tea (-)-epigallocatechin gallate induced growth inhibition of human placental choriocarcinoma cells, *Placenta*, 2016, 41, 1–9.
13. Kojima, S., Yoshida, Y., Effects of green tea powder feed supplement on performance of hens in the late stage of laying, *Int J Poult Sci.*, 2008, 7, 491–496.
14. Wei, Y., Qu, X., Cai, C. Effects of green tea powder on performance, egg quality and yolk cholesterol of green shell laying hens. *China Feed.*, 2012, 22, 22–24.
15. Uganbayar, D., Bae, I. H., Choi, K. S., Shin, I. S., Firman, J. D., Yang, C. J., Effects of green tea powder on laying performance and egg quality in laying hens, *Asian Austral J Anim.*, 2005, 18, 1769–1774.
16. Panja, P., The effects of China tea (*Camellia sinensis*) supplementation in laying hen diets on production, quality and cholesterol content of egg, *Songklanakarin J Sci Technol.*, 2007, 29, 636–638.
17. Kaya, H., Gul, M., Celebi, S., Kaya, A., Apaydin Yildirim, B., Macit, M., The Effects of Black Tea Factory Waste Supplementation into Laying Hen Diets on Performance, Egg Quality, Yolk Peroxidation, and Blood Parameters, *Kafkas Universitesi Veteriner Fakultesi Dergisi*, 2014, 20, 3, 375–382.
18. Son, K. S., Kwon, O. S., Min, B. J., Cho, J. H., Chen, Y. J., Kim, H. S., Kim, I. H., Effect of dietary herb products (*Animumin Powder could*) on egg characteristic, blood components and nutrient digestibility in laying hens., *Animal Science Journal*, 2005, 83, 29.
19. Florou-Paneri, P., Dostas, D., Mitsopoulos, I., Dostas, V., Botsoglou, E., Nikolakakis, I., Botsoglou, N., Effect of Feeding Rosemary and  $\alpha$ -Tocopheryl Acetate on Hen Performance and Egg Quality, *The Journal of Poultry Science*, 2006, 46, 143–149.
20. Yang, C. J., Uganbayar, D., Sun, S. S., Firman, J. D., Effect of dietary green tea on productivity and egg composition in laying hens, *Animal Science Journal*, 2003, 81, 204.
21. Uganbayar, D., Shin, I. S., Yang, C. J., Comparative performance of hens fed diets containing Korean, Japanese and Chinese green tea, *Asian-Australasian Journal of Animal Sciences*, 2006, 19, 8, 1190–1196.
22. Biswas, A. H., Miyazaki, Y., Nomura, K., Wakita, M., Influences of long-term feeding of Japanese green tea powder on laying performance and egg quality in hens. *Asian-Australasian Journal of Animal Sciences*, 2000, 13, 980–985.
23. Halle, I., Schöne, F. Influence of rapeseed cake, linseed cake and hemp seed cake on laying performance of hens and fatty acid composition of egg yolk. *Journal für Verbraucherschutz und Lebensmittelsicherheit*, 8, 2013, 185–193 DOI: 10.1007/s00003-013-0822-3
24. Cherian, G., Campbell, A., Parker, T. Egg quality and lipid composition of eggs from hens fed *Camelina sativa*. *Journal of Applied Poultry Research*, 18, 2009, 143–150.
25. Yalcin, S., Onbasilar, E. E., Reisli, Z., Yalcin, S. Effect of garlic powder on the performance, egg traits and blood parameters of laying hens, *Journal of the Science of Food and Agriculture*, 2006, 86, 1336–1339.
26. Canogullari, S., Karaman, M., Erdogan, Z., Baylan, M., Kucukgul, A., Duzguner, V., Kemali Ozugur, A., Effect of garlic powder on egg yolk and serum

cholesterol and performance of laying hens, Bulletin of the Veterinary Institute in Pulawy, 2009, 53, 515-519.

27. Nasiroleslami, M., Torki, M. 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, Advances in Environmental Biology, 2010, 4, 341-34.

28. Radwan N., L., Hassan, R. A., Qota, E. M., Fayek, H. M., Effect of natural antioxidant on oxidative stability of eggs and productive and reproductive performance of laying hens, International Journal of Poultry Science, 2008, 7, 134-150.

29. Kim, D. W., Kim, J. H., Kang, G.H., Kang, H. K., Choi, J. Y., Kim, S. H. Kang, C. W., Effects of Water Extract Mixtures from *Artemisia capillaris*, *Camellia*

*sinensis*, *Schizandra chinensis*, and *Viscum album* var. *coloratum* on Laying Performance, Egg quality, Blood Characteristics, and Egg Storage Stability in Laying Hens, Korean Journal for Food Science of Animal Resources, 2010, 30, 449-457.

30. Xia, B., Liu, Y. L., Sun, D., Liu, J., Zhu, Y. J., Lu, L. Z., Effects of green tea powder supplementation on egg production and egg quality in laying hens, Journal of Applied Animal Research, 2018, 46.

31. Wang, X. C., Wang, X. H., Wang, J., Wang, H., Zhang, H. J., Wu, S. G., Qi, G. H., Dietary tea polyphenol supplementation improved egg production performance, albumen quality, and magnum morphology of Hy-Line Brown hens during the late laying period, Journal of Animal Science, 2018, 96, 225-235.