ORIGINAL PAPER 원저

남은 음식물과 녹차 부산물이 산란계의 산란성적과 계란품질에 미치는 영향

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Effects of Dried Leftover Food and Green Tea By-Product on Performance and Egg Quality in Laying Hens

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ABSTRACT

This study was designed to determinate the effects of dried leftover food and green tea by−product on laying hens performance and egg quality in hens. A total of 210 "Tetran Brown" layers 50−weeks of age were assigned to 7 treatments in a completely randomized design. Each treatment had five replicates per treatment with six layers per replication. Seven dietary treatments were a control diet (formula diet) and dried leftover food (DLF) mixed in 10, 20, 30 and 40% to the control diet substituting the corn grain and soybean meal, control diet containing 1.0% GTB without DLF supplementation and control diet containing 30% DLF plus 1.0% GTB supplementation. The trial period was for 8 weeks. The egg production rate of layers was significantly increased in 10, 20 and 40% DLF treatments compared to that of the control treatment ($P<0.05$). The egg weight was significantly decreased in 10% DLF treatment compared to that of the control ($P<0.05$). The feed intake of layers was higher in 20% DLF and 30% DLF plus 1.0% GTB treatment than that of the control ($P<0.05$). The feed conversion ratio significantly decreased in 10% DLF and control plus 1.0% GTB treatments compared to that of the control ($P<0.05$). The egg yolk cholesterol not varied among the DLF and control treatments ($P>0.05$). However, the linolenic acid content of egg yolk was significantly increased in DLF and control treatments both containing 1.0% GTB supplementation.

Keywords : Leftover Food, Egg Production, Feed Intake, Yolk Cholesterol, Egg Quality

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초 록

본 연구는 산란계에서 남은 음식물과 녹차 부산물이 산란계의 산란성적과 계란품질에 미치는 영향을 연구하였다. 공시동물은 50주령 Tetran Brown종 산란계 210수를 7처리 5반복 (반복당 6수)으로 임의 배치하였다. 시험설계는 대조구와 옥수수 곡류와 대두박을 대용한 건조된 남은음식물 10, 20, 30 및 40% 첨가구 (10% DLF, 20% DLF, 30% DLF 및 40% DLF)와 1.0%의 녹차 부산물 첨가구 (1.0% GTB)와 30% DLF와 1.0% GTB를 첨가한 혼합 첨가구를 두어 사양실험을 8주 동안 실시하였다. 산란율은 대조구에 비하여 10, 20 및 40% DLF 처리구에서 유의적으로 증가하였다 ($P<0.05$). 난중은 대조구에 비하여 10% DLF 처리구에서 유의적으로 감소하였다 ($P<0.05$). 사료 섭취량은 대조구보다 20% DLF 처리구와 30% DLF와 1.0% GTB의 혼합 첨가구에서 높게 나타났다 ($P<0.05$). 사료 요구율은 대조구에 비하여 10% DLF 처리구와 1.0% GTB 처리구에서 유의적으로 감소하였다 ($P<0.05$). 난황 콜레스테롤은 DLF 처리구와 대조구 사이에서 변화가 없었다 ($P>0.05$). 난황의 리놀렌산은 DLF 처리구와 1.0% GTB 첨가한 처리구에서 유의적으로 증가하였다.

핵심용어 : 남은 음식물, 산란 능력, 사료 섭취량, 난황 콜레스테롤, 난품질

1. Introduction

The increasing demand for new feedstuffs and the high prices of conventional feedstuffs have been stimulated to the search for new feed ingredients, which are capable to reduce a feed cost without altering productive performance of domestic animals. Currently, much effort has been paid to examine the possibilities of utilizing the wastes of food industry as feedstuff. It was recognized that fermented leftover foods had enough nutritional value to be used as feed supplement for broiler chicken and laying hens[1, 2, 3, 4]. Some researchers indicate that converting the leftover food to the animal feed may not only solve the environmental pollution caused by the wastes but also reflect on national economy[5].

Green tea production (Camellia sinensis) is one of most popular beverage consumed over the world. Beverage companies manufacturing various tea drinks produce thousand tones of green tea by−product annually, most of which burned, dumped into landfills or used as compost. Although, some studies demonstrated that green tea by−product (GTB) is good source of protein consisting 23−35% of crude protein[6, 7], could be one of possible feed supplement for broilers and hens[6, 8], for milk cattle, and goat[7, 9], they recommended a certain percentage of green tea by−product (GTB) as feed supplement for animal diets already. However, limited information available to using dried leftover food (DLF) combined with green tea by−product (GTB) for layer diet, its effects on laying performances. So, objective of this study was determinate the effects of different level of dried leftover food and 30% DLF plus 1.0% green tea by−product on laying performance and egg quality in hens.

2. Materials and methods

2.1 Experimental animals and design

A total of 210 “Tetran Brown” laying hen

50-weeks of age were assigned to 7 treatments in a completely randomized design. Two layers were housed in one cage (24 cm×38 cm×45 cm) and each treatment had 5 replicates and 6 layer per replication, of which one was consisted of 3 adherent cages. Seven dietary treatments were a control diet (formula diet) and dried leftover food (DLF) mixed in 10, 20, 30 and 40% to the control diet substituting the corn grain and soybean meal, control diet containing 1.0% GTB no DLF supplementation and control diet containing 30% DLF plus 1.0% GTB supplementation for average subsititution level of DLF for Laying hens due to limited number of hens used in this experiment. All diets were formulated to meet or exceed the nutrient requirements of laying hens, NRC (1994), the formula and chemical compositions of the experimental diets are given in [Table 1]. The commercial formula feed was used as a concentrate to be substituted with dried left over feed (DLF) with different levels. The diets and drinking water were supplied ad libitum. The bird care and the lighting program were followed by

[Table 1] Formula and Chemical Composition of Experimental Diet (%)

Ingredients	Control	DLF				Control +1.0%GTB	DLF 30% +1.0%GTB
		10%	20%	30%	40%		
Corn grain	65.59	58.00	50.40	42.45	34.06	65.59	42.52
Wheat bran	6.50	4.56	2.34	1.15	1.05	6.50	1.15
Soybean meal	16.00	17.13	18.00	17.30	15.00	6.00	17.30
Corn gluten	2.60	2.21	2.10	2.80	4.45	2.60	2.80
Salt	0.30	0.02	0.00	0.00	0.00	0.30	0.00
Vit-min. mix	0.30	0.30	0.30	0.30	0.30	0.30	0.30
L-Lysine, HCl	0.04	0.08	0.13	0.21	0.33	0.04	0.21
Methionine	0.07	0.12	0.18	0.23	0.25	0.07	0.23
Limestone	7.73	6.78	5.88	4.98	4.05	7.73	4.98
Tricalcium P	0.87	0.80	0.67	0.58	0.51	0.87	0.58
Leftover food	0.00	10.00	20.00	30.00	40.00	0.00	30.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Chemical composition[2]							
ME (kcal/kg)	2750	2750	2750	2750	2750	2750	2750
Crude Protein	15.00	16.50	18.00	19.50	21.00	15.0	19.50
Calcium	3.25	3.25	3.25	3.25	3.25	3.2	3.25
Avail. P	0.25	0.25	0.25	0.25	0.25	0.2	0.25

1Vit-min. mix provided following nutrients per kg of diet: Vitamin A, 9,000,000 IU; Vitamin D3, 2,100,000 IU; Vitamin E, 15,000 IU; Vitamin K, 2000 mg: Vitamin B1, 1,500 mg; Vitamin B2, 4,000 mg; Vitamin B6, 3,000 mg; Vitamin B12, 15 mg; Pan-acid-Ca, 8,500 mg; Niacin, 20,000 mg; Biotin, 110 mg; Folic-Acid, 600 mg; Fe, 40,000 mg; Co, 300 mg; Cu, 3,5000 mg; Mn, 55,000 mg; Zn, 40,000 mg; 1,600 mg; Se, 130, 130 mg
2.Calculated value
DLF: dried leftover food, GTB: green tea by-product

management technology of laying hens in commercial farm. All eggs produced each day were collected and counted for record and all eggs produced on a certain day of the week were weighed individually for egg weight determination. The egg production rate, egg weight, egg mass, feed conversion ratio and egg shell thickness were monitored on weekly basis. The total egg yolk cholesterol content, fatty acid composition and the sensory evaluation of eggs were determinate at the end of the experiment. The layers were given one week of adjustment period and the trial period was for 8 weeks.

2.2 Experimental feed and feeding

Dried leftover food (DLF) processed by fluidized bed-dry method and provided from local leftover food processing company (Samneung construction Inc., Gwangju, Korea). Processing of DLF was rinsing out with water → grinding (hammer cruller) → dehydration (screw press) → vacuum dehydration (steam) → mixing with rice bran → removing foreign substances (drum screen) → removing metals (magnet separator) → removing fine alien substances (shaking sorter) → storage → packing. The green tea by-product was supplied by the Green Tea Experimental Station (Boseong, Korea). Before to mixed to the formula diet the dried leftover food (DLF) and green tea by-product (GTB) were subjected to chemical composition analysis by AOAC10). The dried leftover food contained 90.02% of dry matter (DM), 20.09% of crude protein (CP), 10.55% of crude fat (EE), 16.70% of crude fiber and 14.64% of crude ash. The green tea by-product contained 93.96% of dry matter (DM), 15.17% of crude protein (CP), 3.09% of crude fat (EE), 64.19% of crude fiber and 5.15% of crude ash content respectively. The catechin contents of green tea by-product also were determined according to the methods of Ikeda et al. (2003)11) using HPLC (Model 501, Waters, Milford, USA) before to mix at formula diet. Total catechin content of green tea by-product was 17.02% of dry matter basis. Of this total catechin content, 0.62% for (+) catechin, 0.93% for epicatechin, 1.16% for epigallocatechin, 0.51% for epicatechin gallate and 13.80% of epigallocatechin gallate were found respectively.

2.3 Measurements

2.3.1 Feed intake and feed conversion ratio

Feed intake was determined every week by measuring feed residues. Feed conversion ratio was calculated by dividing feed intake by egg mass on weekly basis.

2.3.2 Egg production rate, egg weight and egg mass

Egg production rate was calculated by dividing the total number of eggs by hen-day and expressed in percentage. Egg weight was measured by electronic scale HM-200 (A&D Co., Ltd, Japan). Egg mass was calculated by multiplying the average egg weight by egg production rate.

2.3.3 Egg shell thickness

A total of 105 eggs (3 eggs × 5 replicate × 7 treatment) were selected for eggshell thickness measurement in every week. The egg yolk, albumen and eggshell membrane were removed from broken eggs and the egg thickness was measured by Peacock dial pipe gauge FHK (Model P−1, Ozaki, Meg. Co., Ltd, Japan) and represented as average thickness of large band, sharp end and middle band of the shell.

2.3.4 Shape index, Albumen index Yolk index and Haugh unit

On biweekly basis, thirty−five eggs (1 egg × 5 replicate × 7 treatments) were selected for shape index, albumen index yolk index measurement and Haugh unit determination. Each selected eggs were examined by for shape index (100 times the ratio of width to length of egg), albumen index (the ratio of average albumen height to the average of the width and length), yolk index (the ratio of yolk height to its average width) and the Haugh unit (the ratio of albumen height and egg weight).

2.3.5 Egg yolk color

A total of 35 eggs (1 egg × 5 replicate × 7 treatments) were collected to measure egg yolk color changes in every two weeks. The egg yolk color changes were measured by Chromameter, CR−200 (Minolta, Japan), after the egg albumen, egg shell and shell membranes were removed from broken eggs.

2.4 Chemical analysis

2.4.1 Egg yolk cholesterol content

Total cholesterol content was determined according to the method of Brunnekreeft et al[12]. : Approximately 0.5 g egg yolk and 100 ㎍ of −cholestane was homogenized with 0.5 N KOH solution and saponified for 30 minutes at 55℃. Total cholesterol was extracted with hexane and analyzed by gas chromatography (HP 5890 series II, USA) equipped with HP−1 (cross−linked methyl silicone, 25 m × 0.32 mm × 0.17 ㎛) capillary column.

2.4.2 Fatty acid composition of egg yolk

In last week of the experiment, 35 eggs (1 egg ×5 replicate × 7 treatments) were selected for fatty acid composition. Each egg was cracked and albumen, yolk and membranes was removed from egg shell followed 5 gram of egg yolk was taken by plastic spoon. Then sampled egg yolk was dissolved into 100 ml of Folch solution (Chloroform: methanol 2:1 v/v) and filled with nitrogen (N) gas. After 30 min extraction at room temperature with shaking, the extract was filtered through a Buchner filter. After adding 70 ml of distilled water, the extract was separated in liquid and organic layer and the organic layer put on vacuum condensation. Then the concentrated solution was transferred to a test tube and dried under N gas flow and 3 ml of 5% sulfuric acid−methanol was added. Finally the concentrate was extracted 3 times with 3 ml of petroleum ether and dried again under nitrogen gas flow and melted with petroleum ether (100 ㎍), injected to gas chromatograph (GC). For fatty acid separation, a HP−1 (cross−linked methyl silicone, 25 m × 0.32 mm × 0.17 ㎛) capillary column was used, the column temperature was maintained at 290℃.

2.4.3 Sensory evaluation for table eggs

A total of 35 boiled eggs (1 egg × 5 replicate × 7 treatments) laid on the 56th day of feeding, were boiled separately by treatments at 100℃ then and organoleptically evaluated by a panel of 12 judges on the six point hedonic scale in terms of appearance, color, juiciness, texture, flavor and overall acceptability.

2.5 Statistical Analysis

Statistical analysis was performed by SAS package program version 6[13]. All data from the trial were analyzed using analysis of variance (ANOVA). When ANOVA indicated a significant p value, means were separated using Duncan's multiple range test [14].

3. Results and discussion

3.1 Productive performance

The effects of DLF and GTB on laying performance are shown in [**Table 2**]. The egg production rate of layers was increased significantly in 10, 20 and 40% DLF and 30% DLF plus 1.0% GTB treatments compared to that of control ($P<0.05$). Similar results reported by Cho et al[15]. cited that 20 to 30% DLF supplementation to the layer diet was reduced egg production rate in hens. In contrast, Soliman et al.[16] and Yoshida and Hoshii[17] reported up 50% restaurant food waste and 20% garbage (inedible parts of fresh fish and vegetables) supplementations to the layer diet was increased egg production rate in hens. In our previous study showed that 4.0 and 6.0% GTB supplementation to the layer had increasing effects on egg production rate in hens[8]. Current study showed that 30% DLF plus 1.0% GTB supplementation to layer diet also increased the egg production rate of hens ($P<0.05$). The egg weight was significantly decreased in 10% DLF treatment compared to that of the control ($P<0.05$), however no significant differences were observed for rest treatments ($P>0.05$). Supplementation of 7.5% kitchen waste to the layer diet had no adverse effect on egg weight of laying hens[4]. The egg mass was significantly increased in 10, 20 and 40% of DLF and 30% DLF plus 1.0% GTB treatments compared to that of the control ($P<0.05$). This increase of egg mass for DLF treatments clearly caused by high egg production and egg weights obtained from DFL treatments. The feed intake of hens was significantly increased in 20 and 40% DLF and 30% DLF plus 1.0% GTB treatments

[Table 2] Effects of Dried Leftover Food and Green Tea By-Product on Performance of Hens

Items \ Treatments	Control	DLF				Control +1.0%GTB	30%DLF+ 1.0%GTB
		10%	20%	30%	40%		
Egg prod. R[1] (%)	72.88^{b}	82.65^{a}	81.55^{a}	79.94^{ab}	82.93^{a}	76.11^{b}	82.39^{a}
Egg weight (g)	62.18^{abc}	60.02^{d}	60.85^{cd}	62.82^{a}	62.59^{ab}	61.07^{bcd}	63.78^{a}
Egg mass (g)	45.32^{c}	49.61^{ab}	49.62^{ab}	50.23^{a}	51.91^{a}	46.48^{bc}	52.53^{a}
Feed intake (g/b/d)	128^{cd}	125^{cd}	143^{a}	132^{bc}	139^{ab}	118^{d}	143^{a}
FCR (feed: gain)	2.81^{a}	2.47^{b}	2.86^{a}	2.74^{ab}	2.64^{ab}	2.51^{b}	2.68^{ab}

^{abcd} Mean with different superscripts in same raw are significantly different ($P<0.05$).
Egg prod. R[1]: Egg production rate

compared to that of the control (P<0.05). Our result in accordance with Maeng et al[18]. who reported that up to 50% of fermented leftover food (FLF) supplementation to the layer diet had increasing effects on feed intake of hens. Supplementation of 20 and 40% extruded food waste combined with animal manure also increased the feed intake in laying hens[19]. The feed conversion ratio of layers was significantly decreased in 10% DLF and control plus 1.0% GTB treatments compared to that of the control (P>0.05). Cho et al[15]. reported that 10% DLF supplementation to the layer diet reduced feed conversion ratio in hens. On the other hand, Yang et al[8]. reported that 4.0 and 6.0% GTB supplementation to layer diet also reduced a feed conversion ratio in hens.

3.2 Egg shell thickness, shape, albumen, yolk indexes and Haugh unit

The egg shell thickness was significantly lower (P>0.05) in GTB treatments (control plus 1.0% and 30% DLF plus 1.0% GTB) than that of other DLF treatments [**Table 3**]. Although, this slight reduction of egg shell thickness does not exceed a market requirement (360 ㎛) of shell thickness are required to prevent egg loss during distribution. No significant differences in terms of shape and albumen index of eggs were observed among DLF and control treatments (P>0.05). However, the yolk index was significantly increased in control plus 1.0% GTB treatments compared to rest DLF treatments (P<0.05). The Haugh unit of eggs was slightly decreased in 10% DLF treatment but without significant differences (P<0.05). Supplementation of 20 to 50% kitchen waste to the layer diet had no adverse effect on shape index and Haugh unit of eggs in hens[16].

3.3 Egg yolk color

Effects of 10 to 40 % DLF and 30% DLF plus 1.0% GTB supplementation on egg yolk color changes are shown in [**Table 4**]. There were no significant differences in lightness and yellowness of egg yolk among DLF and control treatments with or without 1.0% GTB supplementation (P>0.05). However, the redness of egg yolk was significantly increased in control and 30% DLF treatments both containing 1.0% GTB supplementation (P<0.05). Soliman et al.16) reported that 10 to 50% DLF supplementation to layer diet had no effects on egg yolk color changes. Uuganbayar[20] reported that 2.0% green tea

[Table 3] Effects of Dried Leftover Food and Green Tea-by Product on Egg Quality Traits

Item \ Treat	Control	DLF 10%	DLF 20%	DLF 30%	DLF 40%	Control+ 1.0%GTB	DLF30+ 1.0%GTB
Shell thickness (㎛)	375^{ab1}	384^{a}	377^{a}	383^{a}	382^{a}	364^{b}	364^{b}
Shape index	73.55	73.75	72.00	74.80	74.10	73.00	73.05
Albumen index	0.100	0.092	0.105	0.131	0.148	0.103	0.099
Yolk index	0.441^{b}	0.448^{ab}	0.456^{ab}	0.451^{ab}	0.453^{ab}	0.463^{a}	0.444^{ab}
Haugh unit	86^{ab}	84^{b}	89^{a}	86^{ab}	89^{ab}	87^{ab}	87^{ab}

^{ab}Mean with different superscripts in same raw are significantly different (P<0.05).

powder slightly increased the yellowness of egg yolk.

3.4 Egg yolk cholesterol content

Effects of DLF and GTB on cholesterol content of egg yolk are presented in **[Table 5]**. There were no significant differences in total cholesterol contents for DLF and control treatments with or without 1.0% GTB supplementation (P>0.05). Cho et al.[15] reported that 10 to 30% DLF supplementation to the layer diet also not varied the cholesterol content of egg yolk. Yang et al.[8] reported that 1.0 to 2.0% GTB supplementation to the broiler diet 2.0 to 6.0% of GTB in layer diet reduced the meat egg yolk cholesterol contents. Yang et al.[8] reported that 4.0 and 6.0% GTB supplementation to the layer diet slightly reduced the egg yolk cholesterols. Current study showed that when laying hens fed diets containing different level of DLF with 1.0% GTB supplementation did not affect on cholesterol content of egg yolk.

3.5 Fatty acid contents of egg yolk

The fatty acids of egg yolk are listed in the order of myristic, palmitic acid, linoleic acid and oleic acids. The myristic acid of egg yolk was significantly increased (P>0.05) in 10 and 20% DLF and 30% DLF plus 1.0% GTB treatments compared to that of control treatment **[Table 6]**. There were no significant differences were in oleic, eicosatrienoic and eicosatetraenoic acids contents among different level of DLF and 30% DLF plus 1.0% GTB treatments (P>0.05). However, the linoleic acids of egg yolk was significantly increased in 20, 30 and 40% DLF and control plus 1.0% GTB% treatments compared to that of the control (P<0.05). The α-linolenic acid content of egg yolk was significantly increased in control and 30% DLF treatments both containing 1.0% GTB supplementation

[Table 4] Effects of Dried Leftover Food and Green Tea By-Product on Egg Yolk Color

Item \ Treatments	Control	DLF				Control+ 1.0% GTB	30%DLF+ 1.0%GTB
		10%	20%	30%	40%		
Lightness (L)	57.31	55.71	54.37	54.17	52.87	56.90	52.47
Redness (a)	1.16 b	1.33ab	1.90ab	2.06a	2.14ab	2.78a	2.51a
Yellowness (b)	51.95	51.95	51.36	54.11	51.16	54.85	51.70

abMean with different superscripts in same raw are significantly different (P<0.05).
L 97.10 a (-0.17) b+1.99.

[Table 5] Effects of Dried Leftover Food and Green Tea-by Product on Egg Yolk Cholesterol (㎎/g)

Item \ Treatments	Control	DLF				Control+ 1.0% GTB	30%DLF+ 1.0%GTB
		10%	20%	30%	40%		
Total cholesterol	12.62	12.44	12.39	12.84	12.00	13.92	13.20

(P>0.05). Yang et al.[8] reported that 4.0% and 6.0% GTB supplementation to the layer diet increased the α−linolenic acid content of egg yolk in laying hens.

3.6 Sensory Evaluation of eggs

〔Table 7〕 shows the results of sensory evaluation of eggs from layers fed diets containing different level of DLF and 1.0% GTB supplementation. There were no significant differences in appearance, juiciness and flavor of eggs among DLF and

〔Table 6〕 Effects of Dried Leftover Food and Green Tea By-Product on Fatty Acid Composition in Egg Yolk (%)

Fatty acids	Control	DLF				Control + 1.0%GTB	30%DLF+ 1.0%GTB
		10%	20%	30%	40%		
(C14:0)	0.36^{c}	0.42^{ab}	0.42^{ab}	0.39^{bc}	0.73^{c}	0.36^{c}	0.43^{a}
(C16:0)	25.21^{bc}	25.64^{b}	25.73^{b}	24.86^{cd}	24.08^{d}	25.80^{b}	26.91^{a}
(C16:1)	3.59^{a}	4.10^{a}	4.14^{a}	2.47^{b}	2.95^{b}	3.79^{a}	3.81^{a}
C18:0)	9.89^{a}	8.75^{b}	7.97^{b}	10.29^{a}	8.43^{b}	8.44^{b}	9.14^{ab}
(C18:1ω9)	43.30	46.59	44.56	45.06	46.12	44.66	45.51
(C18:2 ω6)	12.12^{b}	11.57^{b}	14.34^{a}	14.06^{a}	14.96^{a}	14.26^{a}	11.67^{b}
(C18:3 ω3)	0.21^{d}	0.32^{cd}	0.60^{ab}	0.32^{cd}	0.76^{a}	0.60^{ab}	0.43^{bc}
(C20:1 ω9)	0.29^{d}	0.33^{ab}	0.31^{bc}	0.28^{d}	0.34^{a}	0.30^{cd}	0.30^{cd}
(C20:2 ω 6)	0.13^{ab}	0.12^{ab}	0.12^{ab}	0.15^{ab}	0.17^{a}	0.13^{ab}	0.11^{b}
(C20:3 ω6)	0.20	0.17	0.15	0.20	0.29	0.14	0.15
C20:4ω6	1.63	1.99	1.64	2.12	1.55	1.51	1.54

abcdMean with different superscripts in same row are significantly different (P<0.05).
C 14:0 (myristic acid), C16:0 (palmitic acid), C16:1 (palmitoleic acid), C18:0 (stearic acid), C 18:1ω9 (oleic acid), C18:2ω6 (linoleic acid), C18:3ω6 (linolenic acid), C20:1ω6(eicosenoic acid), C20:2ω6 (eicosadienoic acid), C20:3(eicosatrienoc acid), C20:4ω6 (eicosatetraenoic acid), C20:5ω3 (eicosapentaenoic acid), C22:6ω3 (docosahexaenoic acid).

〔Table 7〕 Effects of Dried Left Over Food and Green Tea By-Product on Sensory Traits of Eggs

Treatments / Item	Control	DLF				Control + 1.0%GTB	DLF30+ 1.0%GTB
		10%	20%	30%	40%		
Appearance	3.21^{ab}	3.15^{ab}	3.52^{a}	2.94^{b}	3.26^{ab}	3.21^{ab}	3.36^{ab}
Color	3.00^{b}	3.00^{b}	3.63^{a}	3.21^{ab}	3.00^{b}	3.63^{a}	3.36^{ab}
Juiciness	2.84	3.10	2.94	2.89	2.63	3.31	3.57
Texture	2.94^{b}	3.31^{ab}	3.42^{ab}	3.00^{ab}	2.89^{b}	3.31^{ab}	3.57^{a}
Flavor	3.26	3.31	3.21	2.89	2.89	3.31	3.15
Acceptability	2.84^{b}	3.10^{ab}	3.15^{a}	2.94^{ab}	3.05^{b}	3.26^{ab}	3.68^{a}

abcdMean with different superscripts in same row are significantly different (P<0.05).

control treatments (P>0.05). However, the yolk color of boiled eggs was significantly increased in control plus 1.0% GTB treatment (P>0.05), while the texture and over all acceptability of boiled eggs were significantly increased in 30% DLF plus 1.0% GTB treatments (P<0.05). Uuganbayar et al.[20] reported that 1.0 and 2.0% green tea powder supplementation to the layer increased the flavor and overall acceptability of the boiled eggs.

4. Implications

Supplementation of 10 to 40% dried leftover food (DLF) and 30% dried leftover food (DLF) plus 1.0% green tea by-product (GTB) had increasing effects on egg production rate in laying hens. Supplementation of 10 to 40% DLF and 30% DLF plus 1.0% GTB had no adverse effects in egg quality in terms on albumin, yolk index and Haugh unit of eggs. The cholesterol content egg yolk and sensory traits eggs not varied when supplemented DLF up to 40% inclusion level with or without 1.0% GTB supplementation.

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