Jein Rinny Leke, et al/Animal Production. 20(3):147-154, 2018
Accredited by Kemenristek Dikti No 32a/E/KPT/2017. ISSN 1411-2027

Nutritional Characteristics and Quality of Eggs from Laying Hens Fed on Papaya Peel Meal Diet

Jein Rinny Leke[1*], Florencia Nery Sompie[1], Erwin Wantasen and Trina Ekawati Tallei[2]

Department of Animal Husbandry, Sam Ratulangi University, Manado
Department of Biology, Faculty of Mathematics and Natural Sciences, Sam Ratulangi University, Manado
Corresponding author email: rinileke@unsrat.ac.id

Abstract. The objectives of this study were to analyze the eggs' nutritional characteristics and quality from laying hens fed with dried papaya (*Carica papaya L*) peel meal diets. A total of 200 brown laying hens strain MB 402 (42 week-old) were used in this experiment. The design used in this study was a completely randomized design (CRD) consisting of 5 treatments and 4 replications (10 hens each). The treatments consisted of dried papaya peel meal (DPPM) 0%, 3%, 6%, 9% and 12%. Total feeding trial was 8 weeks. The parameters recorded included egg weight (g/bird)), egg yolk weight (g/bird), yolk index (%), albumen index (%), egg yolk color, egg cholesterol (mg/100g), egg crude protein (%), egg crude fat (%), egg white crude protein (%), egg yellow fat (%), eggshell calcium (%), eggshell phosphorus (%), blood cholesterol (mg/dl), blood LDL cholesterol (mg/dl), and blood HDL cholesterol (mg/dl) of the laying hens. The results showed that feeding birds with 12 % increased egg yolk weight, egg yolk color, egg crude fat, egg yellow fat, egg cholesterol, egg shell calcium, egg shell phosphor, blood cholesterol, blood HDL. Moreover there were no significant differences in egg weight, yolk index , albumen index, egg crude protein, egg white crude protein and blood LDL. In Conclusion, DPPM diets can be fed to the laying hens up to 12 % to produce eggs without negative effects on the egg quality.
Keywords: nutritional characteristics, egg quality and papaya peel

Abstrak. Penelitian ini bertujuan untuk mengetahui karakteristik nutrisi dan kualitas telur ayam MB 402 yang mengkonsumsi tepung kulit papaya dalam ransum. Penelitian ini dilakukakan menggunakan 200 ekor ayam petelur MB 402 yang berumur 42 minggu. Rancangan penelitian yang digunakan yaitu rancangan acak lengkap (RAL) yang terdiri atas 5 perlakuan dan 4 ulangan, dan tiap perlakuan terdiri atas 10 ekor ayam petelur MB 402. Perlakuan yang diberikan yaitu : 0 %,3 %, 6 %, 9 % dan 12 % DPPM. Pemberian pakan perlakuan dilakukan selama 8 minggu. Variable penelitian meliputi : berat telur (g/ekor)), berat kuning telur (g/ekor), index kuning telur (%), index putih telur (%), warna kuning telur, kolesterol telur (mg/ 100g), protein kasar telur (%), lemak kasar telur (%), protein kasar putih telur (%), lemak kasar kuning telur (%), kalsium kerabang telur (%), fosfor kerabang telur (%), kolesterol darah (mg/dl), kolesterol darah LDL (mg/dl), and kolesterol darah HDL (mg/dl) ayam petelur. Hasil penelitian menunjukkan bahwa pemberian ransum yang dengan suplemen DPPM sampai 12 % meningkatkan berat kuning telur, lemak kasar telur, lemak kasar kuning telur, kolesterol telur, kalsium kerabang telur, fosfor kerabang telur, kolesterol darah, kolesterol darah HDL, tetapi tidak berpengaruh nyata terhadap berat telur, index kuning telur, index putih telur, protein kasar telur, protein kasar putih telur dan kolesterol darah LDL. Kesimpulan dari penelitian ini yaitu : DPPMdapat digunakan dalam pakan ayam petelur MB 402 sampai 12 % karena tidak memberikan pengaruh negatif pada kualitas telur.
Kata Kunci: karakteristik nutrisi, kualitas telur dan kulit pepaya

Introduction

A brown laying hen with early egg weight during the early stages of egg production is being developed mainly for the purpose of satisfying markets that require bigger sizes of eggs. Egg quality has been intimately associated with their diet and age of the birds. Aneuploidy or incorrect number of chromosomes in a cell increases in the egg with advanced reproductive age of the hen (Hassold et al. 2001). White Leghorn (WLH) chickens are already well known for their ability to produce table eggs (Bell and Weaver. 2002). Moreover, egg industries egg industries are faced with consumer needs for enriched eggs, yet low in cholesterol content.

Several studies have shown that there is a positive correlation between cholesterol concentration in the blood with an increase in the incidence of atherosclerosis,coronary heart disease (CHD), stroke, and other metabolic diseases (Willet, 2012; Rafieian-Kopaei et al. 2014). However, to reduce cholesterol contents

is not easy without reducing egg production and weight. Dikman and Saham (2007). According to recommendation by Leeson and Summers (2005), the laying hens aged 18 – 32 weeks old need 20 g crude protein/hen/day and 260 Kcal ME/hen/day. A decrease in energy and protein intake can cause a decrease in egg production.The internal quality of an egg when it is laid (Roxana and Usturoi. 2012). The nutrition as well as management of the hens play a significant role in maintaining the quality internal of the eggs. Egg handling and the storage practices provide a significant impact on the quality of eggs until they arrive at the consumers. Eggs are an important and inexpensive source of nutrition for a balanced diet because they contain protein, vitamins and minerals that paly an important role in health. There are many factors affecting egg quality, for instance, molting induced by the age of the hen, climate, environment, and nutrition. In recent years, there are growing concerns about the quality of eggs produced (Veena et al. 2015). This quality will affect the consumer's acceptance of these eggs, and as a result of this, it is pertinent to pay adequate attention to the challenges of preserving and marketing of eggs in maintaining its quality. From the consumers' perspective, the weight of the egg is one of the important characteristics for quality eggs.

The papaya (carica papaya L.) fruit is always available throughout the year regardless of season. This fruit is a source of antioxidants, vitamin (B,pantothenis,folic acid), minerals (magnesium, potassium),and also fiber. The DPPM incorporation into feed may serve as an alternative to increase the yolk color and decrease yolk cholesterol. The use of 8 % papaya leaf, for example, produced the thickest egg shell 039 – 0.4 mm of Arabian chicken called brakel kriel silver (Muharlien et al. 2015). However, there are limited information on eggs nutritional characteristics and quality through the use of papaya peel on laying hens. Therefore , this research was required to evaluate the Nutriotional characteristics and quality of eggs from laying hens fed DPPM diet.

Materials and Method

Preparation of Dried Papaya Peel Meal

The papaya peels were washed with clean water to remove sap and dirt. They were subsequently sundried for 5 days on a clean concrete floor. On the 5th day, the peels had become dried and crispy at a constant weight, after which they were later grinded into meal.

Birds, Feeding and Management

A total of 200 42-weeks old laying hens strain MB 402 were used in this study. Before the initiation of the experiment, the average day production of the hen was 80%. The hens were individually placed into 200 units of battery cage sized 120 x 34 x 28 cm (length x width x height). In the rearing system, the hens were distributed in 25 cages. Each cage, which served as treatment units, consisted of 8 hens. Each cage is equipped with feeding and drinking tools, as weel as a hollow egg nest. The usual diets were given to the hens during the flushing based on need and age. Subsequently, the hens were adapted for 2 weeks before introducing new diet. It is important to point out that at this period they were already 42 weeks old. The feeding period lasted for 8 weeks, starting from the period when the chicken were 42 to 52 weeks old, with the addition of four weeks for the purpose of acclimatization. Five dietary treatments which was made up of (R1) 0 % , (R2) 3% DPPM, (R2) 3% DPPM, (R3) 6% DPPM dan (R4) 12% DPPM were formulated. These diets were formulated based on the ideal iso-protein (17% protein), iso-energy (2800 kcal/kg) and iso-nutritive (Table 1) to meet the nutritional requirements as provided by the National Research Council (1994). The chemical compositions of the DPPM diet were 25.74% crude protein, 4.52 % fat, 20.06% crude fiber, 1.12% calcium, 0.47 % phosphorus and 3722 of Gross Energy (GE). The different chemical

composition of diets is shown in Table 1.The experimental birds were maintained with diets and ad libitum drinking water on a daily basis. The birds were fed two times daily at 8.00 am and 2.00 pm. During the period of the experiment (8 weeks), 25 eggs were collected in the morning (08:00 h) per each experimental laying hen, to determine the eggs' quality and performance. This means that up to a total of 200 eggs were sampled over the period of the 8 weeks.

The quality characteristics of the eggs included egg weight, yolk weight (Stadelman and Cotteriil, 1997: Monira et al.2003;Parmer et al. 2006). To determine the shape index the length and diameter of the eggs were measured using a digital caliper with a sensitivity of 0.001 mm. After that, each of the egg was broken and placed on a flat surface. After five minutes, the yolk was separated from the albumen and weighted.The shells including the membrane were washed gently under flowing tap water, air-dried, and weighted after 2 hours. The thickness of the shell, diameter and height of the yolk were measured using digital caliper (Küçükyılmaz et al. 2012). The performance and quality of the eggs were measured using the following formulas according to Yannakopoulus and Tserweni-Gousi (1986).

$$\text{Yolk index}(\%) = \frac{\text{yolk height}}{\text{yolk diameter}} \text{ x } 100$$

$$\text{Albumen index } (\%) = \frac{\text{albumen height (mm)}}{[\text{albumen length (mm)} + \text{albumen width (mm)}]/2} \text{ x } 100$$

The DSM yolk color fan was used to determine the yolk (Hunton, 1987; Parmar et al. 2006; Monira et al. 2003). The yolk density was distinguished using 15 scales color index.The content of egg kolesterol was measured according to Lieberman-Burchard method. The Liebermann-Burchard known as acetic anhydride test is applied for the detection of cholestetrol. When the birds were 55 weeks old, 25 of them in each unit were individually weighed on a digital scale with (1g accuracy). After 6 hours of fasting, the blood samples were obtained,by puncturing the ulnar vein using sterile syringes and needles. As musch as 3 ml blood aliquot was trasnferred into a sterile tube without anticoagulant and sent to Medistar Clinical Laboratory for blood cholesterol, blood HDL, Blood LDL tests.

Table.1. Composition of Experimental Diets

Nutrient Composition	Diets (% of DPPM)				
	R0*	R1*	R2*	R3*	R4*
	0%	3 %	6%	9 %	12 %
Based Diet	100	97	94	91	88
DPPM	0 %	3	6	9	12
Crude protein (%)	16.38	16.65	16.94	17.22	17.51
Crude Fat (%)	6.77	6.83	6.9	6.96	7.02
Crude Fiber (%)	4.49	4.73	4.98	5.22	5.46
Ca (%)	1.89	1.91	1.92	1.93	1.95
P(%)	0.71	0.71	0.72	0.72	0.73
ME (Kcal/kg)	2802.7	2791.19	2779.68	2768.17	2768.17

DPPM:=Dried Papaya Peel Meal

* Analysis by Laboratory of Nutritional Biochemistry and Fodder, Gadjah Mada University (2018)

Statistical Analysis

Analysis of data was done using one-way analysis of variance (One-Way ANOVA) at a significant level of $P < 0.05$. The means of the treatments were using Duncan's Multiple Range Test (Steel and Torrie, 1980). Software used for statistical calculations was The IBM SPSS®V.2.

Results and Discussion

The effects of dietary papaya peel meal on eggs' performance and quality characteristics produced by laying hens are as presented in Table 2. The results showed that dried papaya peal meal has significant effect on the daily feed intake and also on egg yolk weight, egg yolk weight, egg yolk color, egg crude fat, egg yellow fat, egg cholesterol, eggshell calcium, eggshell phosphorous, blood total cholesterol, and blood HDL. The experiment did not show significant effect on egg quality characteristics such as egg weight, yolk index, albumen index, egg crude protein, egg white crude protein, and blood LDL. The results suggested that dried papaya peal meal didn't exert a negative impact on the performance of 52 week old laying hens.

One of the most important parameters for both consumers and egg producers is the egg weight (Genchev, 2012). The result of the experiment showed that the average egg weight was not significantly affected by DPPM (46.25±22.95 to 56.74±0.48 g/bird). The egg weight apparently will vary according to the strain of the laying hens. Breed and strain variation in the quality of eggs haves been reported to be as a result of genetic variation (Silversiders et al. 2006; Ahmad, 2013). Lalev (2013) showed that several strains of laying hens produced an average 61.15 – 61.58 g/egg.

Abiola et al. (2008) categorized eggs weight into three size categories: small (41.09–50.97 g), medium (50.98–57.39 g) and large (57.40–69.64 g). An average of 57.20 g was found in Rhone Island Red Breed according to Monira et al. (2003). Within the strain, there is a connection between the variations in egg weight and in albumen weight. Scott and Silversiders (2000). Administering DPPM on laying strain MB 402 did not affect the eight weight. This is because the available nutrient R0 is less balanced compared to other feed treatments. March and MacMillan (1990) reported that egg size was influenced by the composition of feed fat. Lionoleic fatty acids were needed as part of lipoprotein complex to synthesize egg follicles with the stimulation the estrogen.

Table 2 showed that the weight of egg yolk produced by birds fed with R0 (0%) was significanlty differ from R4 (12%). Egg yolk produced by birds fed with R4 is more yellow compared to R0 (without DPPM). According to Yangtui et al. (2013), internal egg quality

Table 2. Egg Quality from laying hens fed on a dried papaya peel meal diet

Variables	0 % DPPM	3 % DPPM	6 %DPPM	9 % DPPM	12 % DPPM	SEM	P Value
Egg Weight (g/bird)	55.38±0.30	46.25±22.95	56.19±0.10	56.74±0.48	56.72±0.47	2.04	.449
Egg Yolk Weight (g)	14.31±0.68[a]	14.76±0.10[a]	14.85±0.35[a]	15.09±0.35[b]	15.52±0.45[b]	.113	.005
Yolk Index (%)	0.46±0.0	0.46±0.17	0.45±0.16	0.45±0.00	0.45±0.00	.002	.127
Albumen Index (%)	0.44±0.07	0.45±0.10	0.44±0.03	0.43±0.17	0.44±0.13	.010	.989
Egg Yolk Color	7.40±0.23[a]	8.39±0.36 [b]	8.53±0.22 [b]	8.86±0.77[c]	9.17±0.38[d]	.132	.000

[abcd] values in the same rows followed with different letters are signicant at 1% (P< 0,01)

characteristics, such as height of albumen was not significantly affected, while egg weight and egg shell thickness was significanlty affected by dietary treatments. This argument is supported by Grobas et al. (2001), Senkoylu et al. (2004), and Bohnzack et al. (2007) when they showed that diets that have unsaturated fatty acids in them (which are more easily absorbed into the portal blood) may supply a readily available source of lipid for direct deposition in egg yolk which may help in increasing egg weight, or on the other hand, increase the energy intake through oil addition rather than the increased oil content of the diet.

The color of egg yolk in R4 increased Table 2. The higher the yolk color value shows the yolk is getting yellow to orange, and vice versa. The main factor that affects the color of the yolk is the pigment contained in its constituent feed ingredients. Some feed ingredients contain pigments that may affect the color of egg yolk are ingredients that contain high enough pro vitamin A, for example papaya peel. Murharlien and Nurgiartiningsih (2015) stated that papaya leaf waste in the form of flour and juice (0%, 4%, and 8%) did not affect significanlty the feed consumption, egg weigth, ration convertion, number of eggs laid, hen day production (HDP), and shell thickness, but improve the color of the yolk and income over feed cost (IOFC). Yunita et al. (2014) showed that administration of papaya leaf flour on laying quail rations to a level of 6% could reduce the production and the weight of quail eggs. Therefore after a long egg period, the hen skin tissue became pale or bluish white. Widjastuti (2009) stated in her research that administration of papaya leaves up to 10% did not show negative effect on eggs production, egg qualities (egg weight, Haugh unit value, yolk index, yolk color score, and shell thickness), however increased the color of yolk.

The observed values were not significant (Table 3). The average egg protein content in the control egg laying hens was 11.05 % And this level increased by 12.25 – 12.86 % In the eggs of hen supplemented with papaya peel

Table 3. Proximate composition (%) and cholesterol content (mg/100g) in egg laying hens

Variables	0% DPPM	3 % DPPM	6% DPPM	9% DPPM	12 % DPPM	SEM	P Value
Egg Crude Protein (%),	11.05±0.47	12.25±0.28	12.57±0.19	12.38±0.48	12.86±0.13	.141	.000
Egg Crude Fat (%)	19.93±0.45^{a}	19.89±0.93 ^{b}	20.31±0.43 ^{b}	19.32±0.6^{b}	17.94±0.52^{c}	.204	.000
Egg White Crude protein (%)	14.41 ±0.14	14.27 ±0.98	14.42 ±0.14	14.31±0.92	14.47 ±0.34	.037	.453
Egg Yellow Fat (%)	31.03 ±0.54^{a}	30.43 ±0.17 ^{b}	30.43 ±0.15^{b}	30.07±0.5^{b}	28.64 ±0.09^{a}	.176	.000
Egg Cholesterol (mg/100g),	212.00±2.7^{a}	209.20±3.9^{a}	203.80±5.3^{b}	198.00±4.^{c}	206.00±0.8^{b}	1.197	.000
Egg Shell Calcium (%),	28.84±0.77^{a}	28.48±1.53^{a}	30.06±0.50^{b}	30.40±1.2^{c}	31.13±0.80^{c}	.276	.003
Egg Shell Phosphor (%)	0.54±0.08^{a}	0.46±0.05^{b}	0.54±0.02^{a}	0.47±0.01^{b}	0.53±0.04^{a}	.011	0.36

DPPM = Dried Papaya Peal Meal.

^{abcd} Values in the same rows followed with different letters are significant at P<0.01

Table 4. Serum Metabolites of Eggs

Variables	0% DPPM	3% DPPM	6 % DPPM	9 % DPPM	12 % DPPM	SEM	P Value
Blood Cholesterol (mg/dl),	112.40±13.12[a]	100±10.38[b]	108.4±5.89[b]	101.03±6.13[b]	98.76 ±0.25[c]	1.89	0.08
Blood LDL (mg/dl)	120.2±0.11	118.7±4.57	115.7±4.56	116.7±4.12	112.7±5.62	1.90	0.09
Blood HDL (mg/dl)	104.5±3.79[ab]	100.6±1.35[b]	109.1±2.68[ab]	109.3±6.4[a]	102.5±4.31[ab]	1.82	0.02

DPPM = Dried Papaya Peal Meal.

[a,b,c] Values in the same rows followed with different letters are significant at P<0.01

meal (DPPM) with 12 %. Egg crude protein is a combination of protein contained in egg yolk and albumen. According to Bashir et al. (2015), hybrid chicken produced 3.43% egg yolk protein and 27.65 egg yolk crude fat. This study showed that egg yellow fat and egg cholesterol level decreased significantly from treatment 3% DPPM to 12% DPPM. Yolk has been reported to be a rich contain high level of fat (Bell and Weaver, 2002). Chicken egg yolk has a cholesterol of 213 mg/mg (USDA. 1991). According Leke at al. (2015), the effect of tomato meal on egg crude protein was found to be 10.28 – 10.64%, egg fat 7.87 – 8.41 %, egg carbohydrate 1.19 – 1.49 % and cholesterol of egg 180.44 – 189.19 mg/100g. Cholesterol levels are also related to high egg production rates. High egg production causes lower cholesterol levels per egg and vice versa. The number and size of eggs produced can also determine the cholesterol content of the egg. Table 4 shows that the DPPM has a very high significant effect on serum metabolites, in which the blood total cholesterol and blood HDL decreased, but did not have any significant effect on blood LDL. The HDL serum level decreased from 104.5 mg/dl (R0) to 102.5 ml/dl (R4), and LDL serum level from 112.7 to 120.2 mg/dl. According to Hardini (2007), administering lemuru fish oil and palm oil caused the LDL serum level of chicken varied from 21.05 to 23.81 mg/dl, HDL from 111.89 to 123.69 mg/dl, and total cholesterol varied from 157.67 to 170.37 mg/dl. According to Basmacioglu and Ergul (2005), the average LDL level of race chicken blood should be lower than 130 mg/dl.

Conclusions

The research showed that dried papaya peel meal diet can be fed to the layer hens up to 12% to produce eggs without negative effects on the egg quality.

Acknowledgement

This research was funded by Lembaga Penelitian dan Pengabdian Masyarakat Univertitas Sam Ratulangi foundation for excellent application of research under Riset Terapan Unggulan Unsrat 2018 grant.

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