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Original Article

Effect of date (*Phoenix dactylifera* L.) pit flour as alternative feed ingredients on egg quality of laying hens

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Abstrak

Tujuan: Penelitian dilakukan untuk mengevaluasi pengaruh penggunaan tepung biji kurma (*Phoenix dactylifera* L.) sebagai bahan pakan alternatif terhadap kualitas telur ayam petelur.
Metode: Penelitian terdiri dari 5 perlakuan dan 5 ulangan menggunakan Rancangan Acak Lengkap (RAL) dan apabila pengaruh nyata (P>0,05) atau sangat nyata (P>0,01) dilanjutkan Uji Jarak Berganda Duncan (UJBD). Perlakuan pemberian tepung biji kurma dengan level konsentrasi yang berbeda yaitu 0% (P0), 2,5% (P1), 5% (P2), 7,5% (P3), dan 10% (P4).
Hasil: Hasil penelitian menunjukkan bahwa penggunaan tepung biji kurma dapat meningkatkan berat telur, berat kerabang, indeks bentuk telur, dan warna kuning telur.
Kesimpulan: Penggunaan tepung biji kurma (*Phoenix dactylifera* L.) hingga 10% sebagai bahan pakan alternatif dapat meningkatkan kualitas telur ayam petelur.

Kata Kunci: Ayam petelur; Berat telur; Biji kurma; *Haugh unit*; Kualitas telur

Abstract

Objective: The aims this study of evaluate the effect of use date (*Phoenix dactylifera* L.) pits as alternative feed ingredient on egg quality of laying hens.
Methods: This study was designed to consist of 5 treatments and 5 replications using a Completely Randomized Design (CRD) and if the effect was significant (P>0.05) or very significant (P>0.01), then Duncan's Multiple Distance Test (DMRT) was continued. The treatment in this research was the use of date pit flour with different concentration levels, namely 0% (P0), 2.5% (P1), 5% (P2), 7.5% (P3), and 10% (P4).
Results: The results showed that the use of date pit flour could increase egg weight, shell weight, shape index, and yolk color.
Conclusions: The use of date pit flour (*Phoenix dactylifera* L.) up to 10% level was used to improve the egg quality of laying hens.

Keywords: Laying hens; Egg weight; Date pit; Haugh unit; Egg quality

INTRODUCTION

Feed is one of the essential factors in the production of livestock to achieve optimal productivity of laying hens. Providing quality feed is one of the efforts to improve the quality and quantity of laying hens. Currently, the problem faced in the development of the livestock industry is the lack of quality conventional feed ingredients due to the high cost of production [1]. Farmers are trying to reduce feed costs by using cheap and conventional feed ingredients. Therefore, there is a need for alternative feed ingredients that are more affordable and able to improve the quality of laying hens to increase productivity and reduce feed costs [2].

Dates (*Phoenix dactylifera* L.) is a type of palm plant that grows in extreme climates and is cultivated in tropical and sub-tropical countries. Several countries such as Saudi Arabia, Egypt, United Emirates, and Iran produce around 70-90% of world production [1]. Dates have several inedible parts for human food consumption, including by-products of dates, namely date pit, date leaves, and by-products from industry such as date fiber and syrup [3]. Date pits are the inedible, about 10% of whole date fruit weight. In recent years, date pits can be used as alternative feed ingredients to overcome the shortage of local feed ingredients, reduce feed costs, and pollution [4].

Date pits are a great source of nutrients. Date pits are rich source of minerals, vitamin, and fiber with higher percentage compared to corn, which can be used as alternative feed ingredients in poultry diets. Sources of minerals in date pits such as magnesium, calcium, phosphorus, sodium, potassium, aluminum, cadmium, and sulfur. Date pits contain several vitamins such as A (β-carotene), C, and B complex. In addition, date is an excellent source of energy and high in sugar content [5]. Date pits also contain phenolic compounds that can increase egg weight, hen day production, egg mass, Haugh Unit, and shell thickness [6]. Based on the content in date pit so that it can improve quality of feed and egg in laying hens They are based on the content in date pit so that it can improve quality of feed and egg in laying hens.

However, date pit had a high crude fiber content and anti-nutritional such as Non-Starch Polysaccharides (NSP) of 9.8-22.3% are considered as limiting factors for using dates in poultry diets. Dates pit can be used alternative feed ingredients because the anti-nutritional composition is lower and will not interfered with other nutrients such as mineral and protein in the body [1]. In a previous study, the use of 20% date pit with olive oil can increase feed intake and egg mass of laying hens [7]. Then, the results study of Najib and Al-Yousif [8] the use of 10% date palm flour with 660 g β-mannanase/kg feed can significantly increase egg shell weight. In this study, the use of 10% date pit flour can increase egg weight and shell weight of laying hens. This study aims to evaluate the effect of use date (*Phoenix dactylifera* L.) pit flour as an alternative feed ingredient on egg quality of laying hens.

MATERIALS AND METHODS

Ethnical approval

Ethical approval for the study was given by the Animal Care and Use Committee, University of Brawijaya, No. 44-KEP-UB-2022.

Hen and housing condition

The experiment used 125 (26 weeks-old) ISA Brown laying hens raised in a single battery cage (47 cm x 36 cm x 30 cm).

Date pit flour and diets

This study used date (*Phoenix dactylifera* L.) pit flour. The process of making date pit at PT. Rumah Desa Sejahtera, Surabaya. Self-mixed feed production (Table 1) and date pit nutrition content (Table 2) were analyzed at the Laboratory of Nutrition and Animal Feed, Faculty of Animal Science, Universitas Brawijaya.

Experimental design

The method used was *in vivo* experiment with Completely Randomized Design. The treatments used date pit powder with different levels, control (P0); 2.5% (P1); 5% (P2); 7.5% (P3); and 10% (P4). The feed was presented by restricted feeding (120 g/hen/day) and drinking water was given *ad libitum*.

Table 1. Formulated feed and nutrients content based on calculations

Ingredients	Composition (%)				
	P0	P1	P2	P3	P4
Corn	51.61	48.89	46.17	43.45	40.74
Concentrate	32.26	32.48	32.70	32.92	33.13
Barn	16.13	16.13	16.13	16.13	16.13
Date pits	0	2.5	5	7.5	10
Total	100	100	100	100	100
Nutritions chemical					
Metabolism energy (kkal/kg)	2856.43	2848.89	2841.36	2833.82	2826.39
Crude protein (%)	17.18	17.18	17.18	17.18	17.18
Crude fat (%)	4.59	4.77	4.94	5.11	5.28
Crude fiber (%)	4.42	4.66	4.89	5.13	5.37

Table 2. Nutrition content of date pits

Nutritional content	(%)
Dry matter	96.35
Ash	1.52
Crude protein	6.29
Crude fiber	11.13
Crude fat	10.89
NFE*	70.17

*NFE: Nitrogen-free extract.

Data and sampling collection

Variables of egg quality were egg weight, shell weight, shape index (SI), Haugh unit (HU), and yolk color. Egg weight counted by digital scaled precision 0.01 g. The egg weight was calculated on daily egg recording. Shell weight was counted by scale with precision 0.001 g. Digital caliper with precision 0.1 mm was used for counting egg width and egg length. Shell thickness used micrometer screw with precision 0.01 mm. Albumen height was calculated by tripod micrometer with precision 0.01 mm. All of the above methods use the library sources of Marwi *et al*. [9]. Yolk color was known by using yolk color fan with eight color level. The formula of Shape Index (SI) and Haugh Unit (HU) were presented below [9,10].

$$SI = \frac{\text{Egg Width (mm)}}{\text{Egg Length (mm)}} \text{x } 100\%$$

HU = 100 log (albumen height (mm) + 7.57 – 1.7 x weight egg (g) 0.37)

Statistical analysis

The data obtained were processed using Microsoft Excel software and continued with statistical analysis using analysis of variance (ANOVA), if the results obtained were significantly different (P<0.05) or very significantly different (P<0.01) followed by Duncan's Multiple Range Test [11].

RESULTS

Egg weight (g)

The results of research related to egg weight are presented in Table 3. The average egg weight in this study from the highest to the lowest was P4 (63.26±0.44 g), P3 (62.34±1.84 g), P2 (61.06±0.1.68 g), P1 (60.74±2.05 g), and P0 (60.29±0.56 g). The addition of date pit flour by 10% (P4) and 7.5% (P3) to the diet increased egg weight. Treatment P4 has the highest egg weight. Egg from laying hens fed by P3 has higher weight than P2, P1, and P0. Based on the result of statistical analysis the use of date pit flour has significant effect (P<0.05) on egg weight of laying hens. No significant differences between treatment P2, P1, and P0.

Shell weight (g)

The results of research related to egg weight are presented in Table 3. The average shell weight in this study from the highest to the lowest was P4 (8.086±0.26 g),

Table 3. The effect of date pit flours as alternative feed ingredient on egg quality of laying hens.

Variable	Treatment					p value
	P0	P1	P2	P3	P4	
Egg weight (g)	60.29±0.56[a]	60.74±2.05[a]	61.06±1.68[a]	62.34±1.84[b]	63.26±0.44[c]	0.03
Shell weight (g)	7.457±0.42[a]	7.943±0.13[bc]	7.914±0.36[bc]	7.830±0.19[b]	8.086±0.26[c]	0.03
Shape index (%)	78.48±1.04	79.31±1.85	79.97±1.39	78.86±1.47	79.87±1.43	0.45
Haugh unit (%)	106.09±4.51	109.08±1.67	107.51±1.51	106.19±2.27	104.32±3.6	0.17
Yolk color (roche)	7.74±0.75	7.97±0.34	7.860.40	7.86±0.32	8.14±0.66	0.80

a-c means that different superscripts in the same line showed significant differences (P<0.05).

P1 (7.943±0.13 g), P2 (7.914±0.36 g), P3 (7.830±0.19 g), and P0 (7.457±0.42 g). The addition of date pit flour by 10% (P4) to the diet increased shell weight. Treatment P4 has the highest shell weight. Egg from laying hens fed by P3 has higher weight than P2, P1, and P0. Based on the results of statistical analysis the use of date pit flour has significant effect (P<0.05) on shell weight of laying hens. No significant differences between treatment P1 and P2.

Shape index (%)

The results of research related to shape index are presented in Table 3. The average shape index in this study from the highest to the lowest was P2 (79.97±1.39%), P4 (79.87±1.43%), P1 (79.31±1.85%), P3 (78.86±1.47%), and P0 (78.48±1.04%). The addition of date pit flour by 5% (P2) and 10% (P4) to the diet increased shape index. Treatment P2 has the highest shape index. Egg from laying hens fed by P4 has higher shape index than P1, P3, and P0. Based on the results of statistical analysis the use of date pit had no significant effect (P>0.05) on shape index of laying hens. No significant differences between P0, P1, P2, P3, and P4.

Haugh unit (%)

The results of research related to Haugh unit (HU) are presented in Table 3. The average Haugh unit (HU) in this study from the highest to the lowest was P1 (109.08±1.67%), P2 (107.51±1.51%), P3 (106.19±2.27%), P0 (106.09±4.51%), and P4 (104.32±3.60%). The addition of date pit flour by 2.5% (P1) and 5% (P2) to the diet can increased Haugh unit. Treatment P1 has the highest Haugh unit. Egg from laying hens fed by P2 has higher Haugh unit than P3, P0, and P4. The results of statistical analysis the use of date pit had no significant effect (P>0.05) on Haugh unit (HU) of laying hens. No significant differences between P0, P1, P2, P3, and P4.

Yolk color (*Roche*)

The average yolk color in this study from the highest to the lowest was P4 (8.14±0.66 roche), P1 (7.97±0.34 roche), P2 (7.86±0.40 roche), P3 (7.86±0.32 roche), and P0 (7.74±0.75 roche). The addition of date pit flour by 10% (P4) and 2.5% (P1) to the diet can increased yolk color. Treatment P4 has the highest yolk color. Egg from laying hens fed by P1 has higher color than P2, P3, and P0. Based on the results of statistical analysis the use of date pit had no significant effect (P>0.05) on yolk color of laying hens (Table 3). No significant differences between P0, P1, P2, P3, and P4.

DISCUSSION

Date pits are rich in carbohydrates, mineral sources, and vitamins that can help the process of egg formation. In addition, date pit also contains antioxidants and phenolics compounds. A previous study showed that phenolic compounds increase egg weight, hen day production, egg mass, Haugh unit, and shell thickness [12]. The value of egg weight in this study was 60.29-63.26 g. According to Sakroni *et al.* [13] that egg weights more than 60 g are categorized as extra-large eggs. In this research, the use of 10% (P4) date pit can increase egg weight. The results showed that treatment P4 showed the highest egg weight value of 63.26 g. Similarly, Najib and Al-Yousif [8] that used 10% and 15% date pit flour can increase hen day production, egg weight, egg mass, and feed conversion ratio. Meanwhile, Al-Saffar *et al.* [4] showed that using date pit flour with or without phytase enzyme supplementation can increase egg weight by 3.8% and 2.1%, respectively. Date pits are good energy source, while 100 g can provide

1.31 MJ of energy [14]. Egg weight correlates with the energy and protein content in the feed. The energy and protein also needed for the growth and production of laying hens [15]. In this study, treatment P0 with addition 0% date pit flour had the lowest egg weight value of 60.29 g. According to Kusumasari *et al.* [16] that egg weight is influenced by many factors, one of which is the nutrients including fat and protein in poultry diets.

The addition of date pit flour to the diet can increased shell weight. Treatment P4 had the highest shell weight value compared to treatments P0, which was 8.086 g and 7.045 g. It can be understood that shell weight has a positive correlation with egg weight where the average value of egg weight is highest in treatment P4 (63.26 g) and the lowest in treatment P0 (60.29 g). The formation of egg shells is influenced by feed nutrients, especially calcium, phosphorus, and vitamin D. Date pit contains mineral sources such as calcium, potassium, phosphorus, and magnesium by 0.046%, 0.471%, 0.085%, and 0.145%, respectively. These mineral sources can help the formation of eggshells [14]. In the formation of eggshells, the most critical element needed is calcium. Calcium is also a food reserve in the digestive tract and cartilage which affects the formation of egg shells. Shell weight is only 10% of total egg weight, and the feed factor greatly affects the shell weight [17].

Shape index is one of the optimize of egg character selection. The results of this study have a higher shape index value ranging from 78-79% compared to research conducted by Salajegheh *et al.* [18] that the use of enzymes and date palm flour with different levels has an average shape index ranging from 70.91 - 71.39%. The addition of date pit flour by 5% (P2) and 10% (P4) to the diet increased shape index. It can be seen that date pit contains nutrients such as protein, amino acids, carbohydrates, and several other mineral sources [5]. Date pit contain high enough amino acids such as arginine, glutamic, and aspartic acid, so they can help the egg formation [19]. The shape index is also influenced by protein and amino acids in diets, the width of the isthmus, age of the parent, feed quality, strain, and season. Meanwhile, the food substances present in the feed will also affect the egg quality [17,20].

Haugh unit is a parameter of egg quality seen from albumen and yolk thickness [21]. Based on the results with the use of 10% (P4) date pit has the lowest value compared to other treatments, which is 104.32%. Date pits had highest crude fiber content of 13%. The inclusion of date pits can decrease metabolism energy and amino acid avaibility due to increased feed passage rate through the gastrointestinal tract [4]. Because date pits contain anti-nutrients of Non-Starch Polysaccharides (NSP) which can increase intestinal viscosity. With increased feed passage rate in the gastrointestinal tract, it can affect production performance and egg quality. Other factors that affect the value of Haugh unit are nutrition in feed, storage time and temperature. A low Haugh unit value indicated that the albumen is very fluffy and expand, this is due to high temperatures, low humidity, and a lack of carbon dioxide (CO_2) [20].

Yolk color is the main criteria for the quality of egg contents. The addition of date pit flour by 10% (P4) and 2.5% (P1) to the diet can increased yolk color. The results of this study have an average yolk color score of 7.74 to 8.14 roche. The results of this study are different from the research by Mohebbifar *et al.* [22] the use of 24% date pit flour and enzyme supplementation can decrease yolk color with a value of 6.58 to 5.92 roche, which is most likely due to the high carotenoid content of corn in the research conducted. Date pits are a source of important vitamins such as A (β carotenoids), C (ascorbic acid), and B complex (thiamine, niacin, and riboflavin) [5,14]. According to Sjofjan *et al.* [23], the increase in yolk color is due to carotene content in eggs, while carotene consists of xanthophyll pigments. The yolk pigment will be absorbed by the digestive organs of the small intestine and circulated to the target organs that need it. Yolk pigments are carotene and riboflavin, classified as lipochromes, namely xanthophylls, so the yolk color is increasingly reddish orange [24]. Yolk color comes from xanthophylls, carotenoids, cryptoxanthin, and vitamin A in feed [25]. In addition, date pit also contains phenolic compound that increases yolk color, albumen

weight, and decreases yolk cholesterol [12]. The presence of antioxidants, mineral sources, and important vitamins contained in date pit can increase yolk color in treatment (P4) compared to treatment (P0).

CONCLUSION

This study suggests that the inclusion of use date pit as alternative feed ingredient showed can improve egg weight and shell weight. The best treatments in this study by P4 had the highest results on egg weight, shell weight, and yolk color.

CONFLICT OF INTEREST

The authors declare no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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