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Effects of Date Seed Flour on Broiler Chickens' Growth Performance, Apparent Digestibility of Protein, and Apparent Metabolizable Energy

Ilmiatus Sholichatunnisa[1], Osfar Sjofjan[2], Tri Eko Susilorini[2], Danung Nur Adli[2], and Muhammad Halim Natsir[2]*

[1]*Postgraduate Student of Faculty of Animal Science, University of Brawijaya, Malang, East Java, Indonesia*
[2]*Faculty of Animal Science, University of Brawijaya, Malang, East Java, Indonesia*

Corresponding author's E-mail: emhanatsir@ub.ac.id

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ABSTRACT

The use of agricultural by-products as alternative feed ingredients is recommended to reduce production costs and maximize income. This study aimed to determine the effects of added date seed flour on broiler chickens' growth performance, protein digestibility, and metabolic energy. A total of 200 Lohmann MB-202 day-old chicks were randomly allocated to 5 treatments and 4 replication with 10 broiler chickens per cage. The treatments used in the current research included control without the addition of date seed flour (T0), basal feed + 2.5% date seed flour (T1), basal feed + 5.0% date seed flour (T2), basal feed + 7.5% date seed flour (T3), basal feed + 10% date seed flour (T4). The investigated parameters were growth performance, apparent digestibility of protein, and apparent metabolizable energy-nitrogen (AMEn). The result showed that adding date seed flour significantly affected final body weight, apparent digestibility of protein, and AMEn. In contrast, the date seed flour was no significant effect on the feed intake feed conversion ratio and income over feed cost. In conclusion, the addition of 10% date seed flour successfully increases final body weight, apparent digestibility of protein, and AMEn without any adverse effect on the broiler chickens.

Keywords: Broiler chicken, Date seed flour, Metabolizable energy, Performance, Protein digestibility

INTRODUCTION

Intensive poultry production systems are increasingly demanding a supply of protein. Generally, the success of poultry rearing depends on breed, feed, and management. Feed costs contributed to approximately 65-75% of poultry industry production (Sjofjan et al., 2021a). As farmers face the problem of the rising price of feed, it is crucial to use potentially available feed sources (Adli, 2021a). This case would be reducing the cost of poultry feeds as well as simultaneously contributing to reducing foot carbon print (Adli, 2021b). One potentially raw feed that can be used for broiler chickens is date palm (*Phoenix dactylifera* L.).

Dates are quite famous in Muslim countries, including Indonesia, as well as middle-east countries (Risa et al., 2018). In the Middle East, dates are the main staple food. In addition, the date palm is relatively adaptable to tropical areas, compared to subtropical areas. Thus, this condition would be advantageous for tropical countries like Indonesia. Dates consisted of minerals, such as iron, potassium, selenium, calcium, and vitamins (C, B_1, and B_2) (Primurdia and Kusnadi, 2014). The glucose content, crude protein, and crude fiber of date palms are around 50-57%, 1.8-2%, and 2-4%, respectively (Kresnadipayana and Lestari, 2017). Tareen et al. (2017) reported 7.5% fat and 5.8% protein content for date seeds. The amino acids consisted of 0.17% methionine, 0.31% lysine, and 0.36% threonine, which is higher than maize (Tareen et al., 2017).

The nutritional content of dates depends on their strain and level of maturity (Giovanny et al., 2019). Although dates are rich in nutritional content, the seeds should be processed to increase shelf-life, palatability, and digestibility. Accordingly, this study aimed to determine the effects of added date seed flour on growth performance, protein digestibility, and metabolic energy of broiler chickens

MATERIALS AND METHODS

Ethical approval

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

Experimental design

A total of 200 MB-202 Lohmann chicks aged one day old (JAPFA Comfeed Ltd. Commercially) were randomly allocated to 5 treatments and 4 replicates of 10 broilers per cage. Each cage was adjusted with installed nipple drinks, free access water (*ad libitum*), rice hulls (130 × 100 cm, × 60 cm), and a controlled environment. The feed was given twice a day at the morning (07.00 a.m.) and afternoon (4 p.m.).

The treatments used in the research were the control without the addition of date seed flour (T0), basal feed + 2.5% date seed flour (T1), basal feed + 5.0% date seed flour (T2), basal feed + 7.5% date seed flour (T3), and basal feed + 10% date seed flour (T4). The investigated parameters included growth performance, apparent digestibility of protein, apparent metabolic energy (AME), and apparent metabolizable energy-nitrogen corrected (AMEn). The formulated feed (starter periods) consisted of maize, soybean meal, meat bone meal, corn gluten meal, crude palm oil, custom mineral mix, custom premix, and date seed (BSN, 2015a; Table 1). The finisher diet consisted of maize, soybean meal, meat bone meal, rice bran, crude palm oil, custom mineral mix, custom premix, and date seed (BSN, 2015b; Table 2).

Preparation of the date seed flour

The current study was conducted on dates (*Phoenix dactylifera* L.). The preparation step of making date seed flour was the following (Bouaziz et al., 2021). The mean weight of the dates was 25 g. First, the dates were subjected to reverse osmosis (RO) water. Afterward, dates were dried using the oven at 60°C and ground into a powder, followed by 3-day storage at room temperatures. Before beginning the trial, dates were taken for analyses of proximate (Sjofjan et al., 2021b).

Growth performance

The broiler chickens' weights were recorded at the beginning and the end of the weeks. In line, feed intake was measured as the differences between the amount of feed given and the remaining feed. Income over feed cost (IOFC) was calculated by considering final body weight multiples with broiler price at the site and differences between feed intake and feed price (Setyawan et al., 2019). In the end, the feed conversion ratio (FCR) was expressed by dividing the amount of feed given by the total weight gained (Adli, 2021b)

Apparent digestibility of protein and apparent metabolizable energy-nitrogen corrected

At the end of the experiments (35 days old), a total of 20 broiler chickens were removed into metabolic-artificial cages. The feed intake of the broiler chickens was recorded for apparent digestibility of protein on day 37 and AMEn on day 38.

Both AME and AMEn were measured according to the following formulae:

AME = AME-(ANR/FI)

AMEn = AME-(8.22×ANR/FI)

Where, ANR is apparent Nitrogen retention, FI denotes feed intake. The correction factor is 8.22 (Sjofjan et al., 2021a).

The apparent digestibility of protein is calculated using the following formulae.

Protein digestibility = (A X B) – (C X D)

(A X B)

Where, A is feed consumption, B signifies protein in feed, C accounts for the amount of excreta, and D denotes protein (%) in excreta (Regar and Kowel, (2021).

Statistical analysis

For the statistical analysis, analysis of variance (ANOVA) using a general linear model (GLM) was carried out using SAS OnDemand for Academics (ODA, Cary, NC, USA). The results were presented as standard error mean (SEM). Moreover, probability values were calculated using the least significant different testing. The following model was used:

$Y_{ij} = \mu + T_i + e_{ij}$

Where, Yij signifies the parameters observed, μ is the overall mean, Ti denotes the effect level of date seed flour, and eij is the amount of error number. The treatments included control without the addition of date seed flour (T0), basal feed + 2.5% date seed flour (T1), basal feed + 5.0% date seed flour (T2), basal feed + 7.5% date seed flour (T3), basal feed + 10% date seed flour (T4). P value less than 0.05 was considered statistically significant. Moreover, probability values were calculated using the least significant different testing if there differ significantly ($p < 0.05$).

Table 1. Composition of broiler chicken diet at starter period

Ingredients (% as is basis)	T_0	T_1	T_2	T_3	T_4
Yellow maize	43.55	41.50	38.55	36.05	33.55
Maize gluten meal	22.45	22.45	22.45	22.45	22.45
Soya bean meal	25.00	25.00	25.00	25.00	25.00
Meat and bone meal 50	2.50	2.50	2.50	2.50	2.50
Poultry meat meal	2.50	2.50	2.50	2.50	2.50
Palm olein	1.00	1.00	1.00	1.00	1.00
Salt	0.15	0.15	0.15	0.15	0.15
Custom Mineral mix*	1.00	1.00	1.00	1.00	1.00
Custom Vitamin mix**	1.00	1.00	1.00	1.00	1.00
Date seed flour	-	2.50	5.00	7.50	10.00
Total	100	100	100	100	100
Calculated composition					
ME (Kcal/kg)	2982.00	2969.88	2957,77	2945,65	2933,54
Crude Protein (CP)	21.56	21.56	21.56	21.56	21.56
Crude fibre (CF)	3.60	3.78	3,97	4,15	4,34
Calcium (Ca)	3.0	3.0	3.05	3.11	3.05
Phosphorus (P)	1.5	1.5	1.5	1.5	1.5
Lysine	1.21	1.21	1.21	1.21	1.21
Methionine	0.70	0.70	0.70	0.70	0.70
Proximate composition					
(Wet Chemical analyses)					
ME (Kcal/kg)	2833	2873	2832	2811	2833
Crude Protein (CP)	21.01	21.00	21.00	21.00	21.00
Crude fibre (CF)	4.00	4.00	4.00	4.00	4.00
Calcium (Ca)	1.2	1.2	1.2	1.2	1.2
Phosphorus (P)	1.75	1.75	1.75	1.75	1.75

*: 12.5 mg Iron, 3 mg Copper, 37.5 mg Manganese, 31.32 mg Zinc, 5 mg Iodine, and 0.0625 mg Selenium; **: 6000 IU Vitamin A, 1000 IU Vitamin D3, 10 mg Vitamin E, 1.5 mg Vitamin K3, 5 mg Vitamin B1, 2.5 mg Vitamin B2, 0.5 mg Vitamin B6, 2 mg Vitamin B12, 5.5 mg Niacin, 0.2 mg Pantothenic acid, 30 mg Betaine; * T0: Control without the addition of date seed flour, T1: Basal feed + 2.5% date seed flour, T2: Basal feed + 5.0% date seed flour, T3: Basal feed + 7.5% date seed flour, T4: Basal feed + 10% date seed flour

Table 2. Composition of broiler chicken diet at finisher period

Ingredients (% as is basis)	T_0	T_1	T_2	T_3	T_4
Yellow maize	43.40	41.50	38.55	36.05	33.55
Maize gluten meal	19.45	19.45	19.45	19.45	19.45
Soya bean meal	25.00	25.00	25.00	25.00	25.00
Rice bran	9.00	9.09	9.09	9.09	9.09
Palm olein	1.00	1.00	1.00	1.00	1.00
Salt	0.15	0.15	0.15	0.15	0.15
Custom Mineral mix*	1.00	1.00	1.00	1.00	1.00
Custom Vitamin mix**	1.00	1.00	1.00	1.00	1.00
Date seed flour	-	2.50	5.00	7.50	10.00
Total	100	100	100	100	100
Calculated composition					
ME (Kcal/kg)	2983,70	2971,10	2971,10	2971,10	2971,10
Crude Protein (CP)	19.89	19.89	19,89	19,89	19,89
Crude fibre (CF)	4.30	4.49	4,49	4,49	4,49
Calcium (Ca)	2.0	2.0	2.0	2.0	2.0
Phosphorus (P)	0.5	0.5	0.5	0.5	0.5
Lysine	0.8	0.8	0.8	0.8	0.8
Methionine	0.3	0.3	0.3	0.3	0.3
Proximate composition					
(Wet Chemical analyses)					
ME (Kcal/kg)	2900	2900	2900	2900	2900
Crude Protein (CP)	19.00	19.00	19.00	19.00	19.00
Crude fibre (CF)	4.00	4.00	4.00	4.00	4.00
Calcium (Ca)	1.5	1.5	1.5	1.5	1.5
Phosphorus (P)	0.5	0.5	0.5	0.5	0.5

*: 12.5 mg Iron, 3 mg Copper, 37.5 mg Manganese, 31.32 mg Zinc, 5 mg Iodine, and 0.0625 mg Selenium; **: 6000 IU Vitamin A, 1000 IU Vitamin D3, 10 mg Vitamin E, 1.5 mg Vitamin K3, 5 mg Vitamin B1, 2.5 mg Vitamin B2, 0.5 mg Vitamin B6, 2 mg Vitamin B12, 5.5 mg Niacin, 0.2 mg Pantothenic acid, 30 mg Betaine; * T0: Control without the addition of date seed flour, T1: Basal feed + 2.5% date seed flour, T2: Basal feed + 5.0% date seed flour, T3: Basal feed + 7.5% date seed flour, T4: Basal feed + 10% date seed flour

RESULTS AND DISCUSSION

The results of adding date palm flour on growth performance can be seen in Table 3. The result showed that adding date seed flour had significant effects ($p < 0.05$) on final body weight, apparent digestibility of protein, and AMEn (Tables 3 and 4). In contrast, the date seed flour had no significant effect ($p > 0.05$) on the FCR and IOFC.

The feed intake results were lowest in T4, including 10% date seed flour. This result may be due to higher fiber in the date seed causing this condition. There is a difference between T_0 and T_4, the energy and protein, where one factor caused the result of this condition.

Table 3. The addition of date seed flour on the growth performance of broiler chickens

Parameters	T_0	T_1	T_2	T_3	T_4	SEM
FI (g)	2701.88	2675.81	2719.30	2705.47	2615.67	110.06
FBW (g)	1515.96^{b}	1500.00 ^{b}	1530.95^{b}	1531.72^{b}	1383.29^{a}	28.00
FCR	1.79	1.78	1.78	1.77	1.89	0.05
IOFC (IDR/head/day)	13127.22	13037.38	13445.98	13613.48	11271.36	1073.45

FI: Feed intake, FCR: Feed conversion ratio, FBW: Final body weight, IOFC: Income over feed cost. ^{a,b,c,d} Means with different superscripts in the row differ significant ($p < 0.05$). T_0: Basal diet, T_1: Basal diet + 2.5% date palm flour, T_2: Basal diet + 5% date palm flour, T_3: Basal diet + 7.5% date palm flour, T_4: Basal feed + 10% date palm flour

Table 4. The effects of date seed flour on protein digestibility and metabolic energy of broiler chickens

Parameters	T_0	T_1	T_2	T_3	T_4	SEM
Apparent digestibility of protein (%)	70.20	75.06	74.48	78.29	73.31	1.82
AME (Kcal/kg)	3659.32^{d}	3546.80^{c}	3294.25^{b}	3490.43^{c}	3161.67^{a}	61.25
AMEn (Kcal/kg)	3046.50^{d}	2891.52^{c}	2644.06^{b}	2806.96^{c}	2521.67^{a}	0.02

AMEn: Apparent metabolizable energy Nitrogen corrected, AME: Apparent metabolizable energy. ^{a,b,c,d} Means with different superscripts in the row different significant ($p < 0.05$). T_0: Basal diet, T_1: Basal diet + 2.5% date palm flour, T_2: Basal diet + 5% date palm flour, T_3: Basal diet + 7.5% date palm flour, T_4: Basal feed + 10% date palm flour

According to Allama et al. (2012), if the energy and protein do not meet standard criteria, the cell tissue would convert protein into energy. Moreover, the final body weight was optimum when date seed flour was given at 7.5%, while the body weight was at its lowest in T4 (10% date seed flour). Corollary, Masoudi et al. (2011) reported that date flour at a 10-30% level caused a reduction in final body weight. In addition, El-Faham et al. (2017) found that giving 10% date palm waste in feed reduced the final body weight. Accordingly, the use of date flour for more than 10% could have a significant effect on body weight. The reason can be the high crude fiber content of date seed flour. The capability of absorption is one factor on the growth performance instead feed intake and body weight (Astuti et al., 2015). Furthermore, FCR is the ratio of given feed weight over animal weight gain. An increase in FCR was indicative of inefficient feed used during the experiment. In addition, the replacement of corn with 15% date pits resulted in the FCR range of 1.72-1.84 (Hammod et al., 2018).

Income over feed cost can be reflected in the successful rearing management in the poultry industry. The IOFC in T3 was higher than in control and other treatments. According to Muchlis et al. (2021), IOFC is influenced by several factors, including feed intake, final body weight, and the selling price of broiler chickens. The FCR is key to the IOFC of broiler chickens (Prayitno et al., 2019).

The apparent digestibility of protein is one of the essential indicators related to the growth performance of broiler chickens (Azizah et al., 2020). The T_3 presented the best value for the apparent digestibility of protein. The appropriate value of the apparent digestibility indicated the high protein utilization in the broiler chickens. Furthermore, the higher result of apparent digestibility of protein can be reflected in the content of micro minerals. As El-Faki (2002) mentioned, date seeds consist of micro minerals, including iron (Fe) 7.4 mg/100 g, manganese (Mn) 2.8 mg/100 g, zinc (Zn) 1.9 mg/100 g, and copper (Cu) 1.2 mg/100 g. The Cu minerals had a main role in inhibiting microorganisms' activity in the digestive tract. Meanwhile, Zn minerals act as cofactors for protease enzymes that break down protein molecules into amino acids (Azizah et al., 2020). Natsir et al. (2018) reported that a reduction in protein digestibility causes low body weight in broiler chickens.

Metabolic energy measured in this study is AME and AMEn. The results indicated that the higher the use of date

seed flour in the feed, the lower the AME value (Table 4). This result may be due to the high crude fiber content in date seed flour which causes broiler chickens to require more energy to digest crude fiber. Feed ingredients with high crude fiber content can reduce the digestibility value of other feed ingredients because digesting the crude fiber content requires more energy (Noviadi et al., 2012). Therefore, the nutrient contents in date seed flour affected the nutrient content in experiments.

The AMEn result (T_4: Basal feed + 10% date palm flour) was lower than that of the AME (T_0: Basal diet + 0% control) caused by nitrogen retention in AMEn. Biologically, metabolic energy is determined by nitrogen retention (Sukaryana, 2010; Table 4). In addition, Dady et al. (2015) stated that high crude fiber will cause the availability of energy in the feed to decrease. The undigested crude fiber as well as other undigested nutrients, will excrete (Siabandi et al., 2018).

CONCLUSION

In conclusion, adding 10% date seed flour helps increase final body weight, apparent protein digestibility, and apparent metabolizable energy, without any adverse effect on the broiler chickens.

DECLARATION

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Author's contribution

Ilmiatus Sholichatunnisa contributed to collecting data, analysis of proximate, data analysis, and preparing the manuscript. Osfar Sjofjan contributed to the research design and supervision; Tri Eko Susilorini provided a sample and site for *in vivo* and supervision. Muhammad Halim Natsir was the supervisor. Danung Nur Adli supervised and revised the manuscript grammatically. All authors read and approved the final version of the manuscript in the present journal.

Competing interest

No potential conflict of interest relevant to this article was reported.

Ethical consideration

All authors have been checked the ethical issues, plagiarism, fabrication and/or falsification, double publication, and redundancy.

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