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Research Paper

Concentrate Substitution With Maggot Black Soldier Fly (*Hermentia Illucens*) Flour On Layer Quality Performance (*Coturnix Coturnix Japonica*)

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ABSTRACT
This study aims to determine the effect of substitution of concentrate with maggot black soldier fly (Hermetia illucens) flour on the performance of laying quails (Coturnix coturnix japonica). This research used the experimental method Completely Randomized Design (CRD) with 5x4. Treatment A was using 14% concentrate + 0% maggot flour, treatment B was using 10.5% concentrate + 3.5% maggot flour, treatment C was using 7% concentrate + 7% maggot flour, treatment D was using 3.5% concentrate + 10.5% maggot flour, and treatment E was using 0% concentrate + 14% maggot flour. The variables observed were feed consumption (g/head/day), daily egg production (%), egg weight (g/egg), egg mass production (g/head/day) and feed conversion. The results showed that the substitution of concentrates with maggot black soldier fly (Hermentia illucens) flour was not significantly different (P>0.05) on feed consumption, daily egg production, egg weight, egg mass production and feed conversion. This study concludes that maggot flour can be used as a concentrate substitute for up to 14% (treatment E) without disturbing the performance of laying quail (Coturnix coturnix japonica), the feed results were 22.35 g/head/day, daily egg production 71.13 %, egg weight 10.36 g/egg, egg mass 7.37 g/head/day and feed conversion 3.03.

KEYWORDS: *Concentrate, Performance, Laying quail, Maggot flour.*

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I. INTRODUCTION

Animal science has long been occupied by the people of Indonesia. The development of animal science in Indonesia is followed by an increase in human resources, which has led to increased demands for the fulfillment of livestock products as a source of human nutrition, one of which is quail. The type of quail that is often kept and cultivated for its eggs is *Coturniix coturnix japonica*. According to Animal Science and Animal Health Statistics data (2019), in the last five years (2015-2020), quail population and quail egg production has increased. The population of quails increased from 13.78 million to 14.12 million. Meanwhile, quail egg production increased from 22,131 tons to 29,090 tons.

The development of animal science in Indonesia has led to competition between food and feed. There are several sources of feed ingredients that are currently starting to compete with the needsin humans such as corn, soybeans and several other ingredients, while switching to manufactured feed ingredients such as concentrate will harm small farmers due to the high price. Concentrate is one of the good quality quail feed which has nutritional content such as crude protein 38.00%, crude fiber 3.00%, crude fat 4.00%, calsium 5.50%, phospor 1.00% and metabolic energy 2910.00 Kcal./kg (PT.Charoen Pokphan product packaging label). In feed formulations for poultry such as quail, alternative feed ingredients are always sought which are relatively cheaper and have the same quality as fish meal, so that the feed formulations are obtained at the lowest price, but the nutrient needs are still met. One of the alternative feed ingredients as a source of protein is maggot.

Maggot or black soldier fly (BSF) larvae are an alternative feed source of animal protein that can help breeders reduce feed prices. The nutritional content of BSF larvae is high crude protein, namely 44.26% (Fahmi *et al.*, 2007). Maggots from black soldier fly (BSF) flies are a source of animal protein with carbohydrate levels less than 0.05%, maggot protein content ranges from 25.22-41.22%, fat levels between 0.73-1.02%, levels water

between 64.86-74.44%, and ash content between 2.88-4.65% (Waluyo and Nugraha, 2020).Judging from its content, maggot is suitable for use as an alternative source of feed for poultry.
Concentrate substitution with maggot flour was carried out to see the effect of treatment on the performance of laying quails. The performance to be seen includes feed consumption, daily egg production, egg weight, egg mass and feed conversion. Based on the description above, the authors are interested in researching the substitution of concentrates with maggot black soldier fly (*Hermetia illucens*) flour on the performance of laying quail (*Coturnix coturnix japonica*).

II. METHOD

The raw materials used in this research are 200 quail (*Coturnix coturnix japonica*) in layer phase with a production of 70-75%. Quail was reared for 4 weeks to observe the performance of laying quails.The feed ingredients used to compile the experimental feed consisted of milled corn, soybean meal, rice bran, coconut oil, bone meal, top mix, CaCO3, concentrate and maggot flour.
The composition of feeds, nutrient content and metabolic energy of each treatment can be seen in Table 1.

Table 1. Feed ingredients, nutrient content (%) and metabolic energy (kcal/kg) of ingredients (as feed)[a]

Feed Ingredients	Crude protein (%)	Crude Fat (%)	Crude Fiber (%)	Ca (%)	P (%)	ME (Kcal)[c]	Met (%)	Lys (%)
Concentrate [b]	38.00	4.00	3.00	5.50	1.00	2,910.00	1.00	1.76
Milled corn	8.58	2.66	2.90	0.38	0.19	3,300.00	0.00	0.20
Maggot flour[d]	47.71	24.40	6.98[e]	0.19[f]	1.62[f]	3,714.02[f]	0.63[g]	2.33[g]
Soybean meal	43.35	2.49	4.50	0.63	0.36	2,240.00	0.50	2.60
Bran	9.50	5.09	14.50	0.69	0.26	1,640.00	0.29	0.77
Coconut oil	0.00	0.00	0.00	0.00	0.00	8,600.00	0.00	0.00
Bone Flour	0.00	0.00	0.00	24.00	12.00	0.00	0.00	0.00
CaCO3	0.00	0.00	0.00	40.00	0.00	0.00	0.00	0.00
Top mix	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00

Information :
[a]Nuraini *et al.* (2019)
[b]PT. Chareon Pokphan
[c]Scoot *et al.* (1982)
[d]Results of analysis of the UNAND Feed Industry Laboratory (2020)
[e]Mawaddah et al. (2018)
[f]Results of UNAND Non-Ruminant Laboratory Analysis (2020)
[g]Results of laboratory analysis of the Bogor Agricultural University (2021)

Table 2. Composition of feeds (%)

Feed Ingredients	A	B	C	D	E
Concentrate	14.00	10.50	7.00	3.50	0.00
Milled corn	53.25	53.25	53.25	53.25	53.00
Maggot flour	0.00	3.50	7.00	10.50	14.00
Soybean meal	23.00	22.00	21.25	20.00	19.50
Bran	2.00	2.75	3.25	4.45	4.75
Coconut oil	1.25	1.00	0.75	0.50	0.50
Bone Flour	3.00	3.00	3.00	3.00	3.00
CaCO3	3.00	3.50	4.00	4.30	4.75
Top mix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00

Table 3. Nutrient content (%) and metabolic energy (kcal/kg) of feeds

Feed substances	A	B	C	D	E
Crude Protein (%)	20.05	20.03	20.09	20.00	20.13
Crude Fat(%)	2.65	3.38	4.10	4.84	5.55

Crude Fiber(%)	3.29	3.49	3.67	3.93	4.08
Calsium (%)	3.05	3.06	3.08	3.01	3.00
Phospor (%)	0.69	0.71	0.73	0.75	0.77
ME (Kcal/kg)	2,820.15	2,816.69	2,814.73	2,813.05	2,826.66
Met (%)	0.26	0.25	0.23	0.21	0.20
Lys (%)	0.97	0.97	0.97	0.97	0.98

Note: Calculated based on Tables 1 and 2

Research Implementation

The equipment used in this study is the cage used in this study, namely the battery cage made of wire as many as 20 units where each unit is occupied by 10 quails. Each unit of the cage measuring 45x20x30cm is equipped with a place to eat and drink in each unit. As a means of lighting at night, 1 incandescent lamp 20 Watt is used. Weighing the feed used a weston scale with a capacity of 10 kg and a digital scale.

Experimental design

This research was conducted using an experimental method designed with a Completely Randomized Design (CRD) with 5 treatments and 4 replications, each of which consisted of 10 quail as an experimental unit.

Observed Variables

1. Feed consumption (g/head/day)
2. Daily Egg Production (%)
3. Egg Weight (g/egg)
4. Egg Mass production (g/head/day)
5. Feed conversion

Data analysis

The data obtained were processed statistically with analysis of variance according to a 5 x 4 completely randomized design based on Steel and Torrie (1995).

III. RESULTS AND DISCUSSION

Effect of Treatment on Quail Performance

Based on the results obtained, it was known that the use of maggot flour as a concentrate substitute in laying quail feeds had an no significant difference (P>0.05) on the performa of laying quails.

Table 4. Average performance of quail

Performance[ns]	A	B	C	D	E	SE
Feed consumption (g/head/day)	22.32	22.32	22.33	22.34	22.35	0.01
Daily Egg production (%)	71.96	71.52	71.43	71.34	71.13	0.32
Egg weight (g/egg)	10.38	10.37	10.36	10.36	10.36	0.004
Egg mass production (g/head/day)	7.47	7.42	7.40	7.39	7.37	0.03
Feed conversion	2.99	3.01	3.02	3.02	3.03	0.01

Information :ns = non significantly different (P> 0.05)
SE= Standard Error

In table 4, it can be seen that the feed consumption from the application of maggot flour as a source of protein in quail feeds ranges from 22.32% - 22.35%. The results of the analysis of variety showed that the used of maggot flour had no significant effect (P> 0.05) on feed consumption. This showed that the used of maggot flour (*Hermentia illucens*) on quail feeds that have been mixed with other feed ingredients does not affect feed consumption. The consumption of the same laying quail feeds in the treatment using maggot flour (treatment B, C, D and E) with the treatment without maggot flour (treatment A) showed the same feed palatability. The use of maggot flour (*Hermentia illucens*) as a concentrate substitute up to 14% was still the same as the control so that the laying quail still preferred feeds.

The palatability of the feed greatly affects the level of consumption. Adha *et al.* (2016) stated that the higher the level of palatability of the feeds given, the higher the feed consumption and vice versa. Apart from palatability, many factors influence feed consumption such as age and physiological condition of livestock (Akbarillah *et al.*, 2011) as well as color, smell and taste of a given feed (McDonald *et al.*, 2010). Replacing the

concentrate with maggot flour (*Hermentia illucens*) in each treatment did not have a different effect on color so that the resulting palatability was the same. The content contained in maggot flour is rich in amino acids needed by laying quails. Amino acids in maggot flour aspartic acid 3,61%, threonin 1,52%, serine 1,47%, glutamate 4,31%, glycine 2,09%, alanine 2.60%, valine 2.32%, methionine 0.63%, ileucine 2.11%, leucine 6.74%, tyrosine 2.97%, phenilalanin 1.85%, histidine 1.05%, lysine 2.33% and arginine 1,48% (Results of laboratory analysis of the Bogor Agricultural University, 2021). The amino acids found in maggot flour provide the same palatability to concentrate. Ansyari *et al.* (2012) stated that giving maggot flour to the feed can increase feed consumption. The feed consumption in this study was lower than the research conducted by Mawaddah *et al.* (2018) which used maggot flour in laying quail feeds between 22.66-23.32 g/head/day, besides that the feed consumption obtained in this study was adequate. with Marsudi and Cahyo (2012) who stated that the consumption of quail feeds aged 7-60 weeks ranges from 20-22 g/head/day.

It did not affect (P> 0.05) the treatment on daily egg production was due to almost the same consumption in each treatment (Table 4), the same consumption indicated that the amount of food substance consumed by the quails was the same so that the daily egg production produced was relatively the same. The used of maggot flour as a source of protein in quail feeds on daily egg production ranges from 71.13% - 71.96%. Egg production is influenced by feed consumption, increased egg production occurs due to high feed consumption so that the amount of feed substances contained in the feed is needed in the formation of eggs. Egg formation is closely related to protein consumption. According to Mousavi *et al.* (2013) a sufficiently balanced protein and amino acid content in the feed will provide optimal productivity.The consumption of protein in this study was almost the same, namely treatment A was 4.48%, treatment B was 4.47%, treatment C was 4.49%, treatment D was 4.47% and it was the same for treatment E 4.50%. Protein is the main element in the formation of eggs, if the consumption of protein is high, the resulting egg production will be high.

The production of eggs is the same in each treatment because the provision of maggot flour can cover the kanutritional content of concentrate, milled corn and soybean meal. Maggot flour has a high protein content and has complete amino acids so that it can cover the nutritional content of other feeds. Daily egg production in this study ranged from 71.13% - 71.96%, higher than the study conducted by Eishu *et al.* (2005) of 20-32 weeks of quail with crude protein administfeed of 20% resulted in egg production 62.50 %. The results of this study are lower than the research conducted by Wuryadi (2013) that the peak production of quail ranges from 12-20 weeks with daily egg production between 78-85%.

The used of maggot flour had no effect (P> 0.05) on egg weight, because each treatment contained almost the same protein and feed energy content. Yuwanta (2010) reports that the nutritional content in feed determines the weight of eggs including the energy content of the feed, the protein content of the feed, the amino acid methionine, unsaturated fatty acids, especially linoleic acid, and mineral phosphorus. In this study, treatment A was almost the same as the energy, protein, fat and phosphorus content in the feeds with treatment B, C, D and E. In treatment A, energy was 2,820.15%, protein 20.05%, fat 2.65%, phosphorus 0.69%, in treatment B energy was 2,816.69%, protein 20.03%, fat 3.38%, phosphorus 0.71%, in treatment C energy was 2.814.73%, protein 20.09%, fat 4.10%, phosphorus 0 , 73%, in treatment D energy 2,813.05%, 20% protein, 4.84% fat, 0.75% phosphorus, and in treatment E energy 2.826.66%, 20.13% protein, 5.55% fat, 0.77% phosphorus. Increasing the amount of balanced protein consumption will increase egg size faster (Amrullah, 2003). Added by Tugiyanti *et al.* (2017) that protein in feed affects protein synthesis in albumin and egg yolk, the two components that are the biggest component in determining egg weight. The weight of eggs produced in this study was still classified as normal and according to the standard, which ranged from 10.36 - 10.38 g/egg. Tserveni-Goussi and Fortomaris (2011) the weight of quail eggs ranges from 6-16 g/egg.

There was no effect (P> 0.05) on egg mass production treatment, because egg weight and egg production had no significant effect. According to Mawaddah *et al.* (2018), egg mass production is closely related to egg weight and production and is strongly influenced by the content and quality of feed protein. A sufficiently balanced protein and amino acid content in the feed will provide optimal productivity (Mousavi *et al.*, 2013). According to Amrullah (2003), the mass production of eggs compared to the number of eggs is a way of comparing the ability of egg production between groups or lines of poultry due to better feeding and management programs. The mass production of quail eggs produced in this study ranged from 7.37 - 7.47 g/head/day. Putra (2013) reported that the mass of quail eggs at the age of 16-20 weeks was 7,64 g/head/day.

The used of maggot flour had no effect (P> 0.05) on feed conversion because the protein and energy content in the feed were almost the same for each treatment. In fact, the feed conversion shows that the used of maggot flour level of 14% even though there is a reduction in the concentrate, milled corn and soybean meal in quail feeds are as efficient in egg production as the control feed which mostly uses concentrate, milled corn and soybean meal.

The feed conversion is calculated to determine the feed consumption against the resulting productivity. Setiawan (2006) states that low conversion rates in quails indicate that livestock are more efficient in utilizing the feed they consume for life and production. The better the quality of the feed, the smaller the feed conversion.

Whether or not the quality of the feed is determined by the balance of the nutrients in the feeds needed by the quails. Feed that lacks nutritional elements will cause the quail to eat more so that they can meet their body needs. In addition, feed palatability affected feed conversion. Increased palatability of feeds due to taste, color and aroma. High palatability results in high consumption and results in maximum productivity resulting in low conversion. In accordance with the opinion of Campbell *et al.* (2009) in addition to the nutritional content of feeds, egg production, egg weight, feed palatability can affect feed conversion. This showed that the substitution of concentrate with maggot flour can be done without having a negative impact on the conversion of quail feeds.

The feed consumption produced in this study ranged from 2.99 - 3.03. Makund (2006) reported that the good feed conversion in quails was 3.34. The feed conversion results in this study were lower than Ansyari *et al.* (2012) that the feed conversion obtained from the substitution of fish meal and maggot flour of 25.88% in laying quail feeds resulted in a feed conversion of 4.51. Mawaddah (2018) added that the feed conversion from substituting MBM with maggot flour of 6.18% in laying quail feeds resulted in a feed conversion of 4.27.

IV. CONCLUSION

Utilizationof maggot flour up to 14% in the feed of laying quails *(Coturnix coturnix japonica)* can replace the concentrate without the negative effect on performance quail.Obtained feed consumption 22.35 g/head/day, daily egg production 71.13 %, egg weight 10.36 g/egg, egg mass production 7.37 g/head/day and feed conversion 3.03.

INTERES CONFLICT

This study does not conflict with other organizations. So far this research is different from other studies. There are no conflicts related to finances.

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