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THE EFFECT OF SUBSTITUTION OF FISH MEAL BY BLACK SOLDIER FLY(*Hermetia illucens*) MAGGOT MEAL IN THE DIET ON PRODUCTION PERFORMANCE OF QUAIL *(Coturnix coturnix japonica)*

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Abstract

Black Soldier Fly (BSF) maggot is the larvae of a fly Hermitia illucens, which hatch in four days, very well used as a source of protein feed ingredients for poultry and could be used to substitute fish meal (FM) where still a lot of imported. BSF maggot meal contains 46.58% crude protein, crude fiber 4.32%, 23.56% crude fat and metabolizable energy 3457 kcal/kg and the amino acid profile has similarities with the amino acid profile of fish. This experiment was carried out to study the effect of fish meal substitution meal by black soldier fly (Hermetia illucens) maggot meal in the diet on quail (Coturnix coturnix japonica) production performance. One hundred female Japanese quails at 6 weeks of age were raised in cages until 20 weeks old. The treatments were 5 types of diets, i.e., R_0 (100% FM), R_1(75% FM + 25% BSF), R_2 (50% FM + 50% BSF), R_3 (25% FM + 75% BSF) and R_4 (100% BSF). Completely Randomized Design (CRD) was used 5 treatments, replicated four times, and if there are any significant effect then followed by orthogonal contrasts test. The results showed that treatment substitution of fish meal (FM) protein with maggot meal (BSF) protein in quail diet was significant effect on feed consumption, feed conversion and egg weight but was no significant effect on egg production. The average consumption of R_4 treatment (100 % BSF maggot level) was lower than the R_0 treatment (100% FM level) in production of quail egg. This indicated that black soldier fly (BSF) maggot meal can be used to alternative protein source of feedstuff to substitute fish meal protein in quail diet.

Keywords: *Fishmeal, black soldier fly maggot meal, egg production, Coturnix coturnix japonica.*

INTRODUCTION

Fish meal is a conventional source of animal protein in poultry feed, because it has been valued for its balanced amino acids, vitamin content, palatability and growth factors. The use of fish meal as a source of animal protein ranged from 10-15%, or one-third of the protein ration (Anggorodi, 1985; Amrullah, 2003). However, the constraint on the use of fish meal as the feed material is evaluable commodity imported in puts that are relatively expensive. Such conditions, it would be a threaten to the poultry industry facilities especially feed meal production.

Dependence on imported feed ingredients need to search for alternative sources ingredients are cheap and do not compete with humans and nutritional content worth transform and utilized. Black soldier fly (BSF) maggot is the larvae of a fly *Hermetia illucens*could be used as an excellent source of protein feed ingredients for fish meal substitute a lot recently imported. Black Soldier fly maggot (*Hermetia illucens*), which are larvae from housefly, grow easily on poultry droppings or any organic waste and the larvae matured within in a short period of 3 to 4 days and were harvested, dried and milled to form maggot meal (Olivier, 2000; ESR, 2009).

BSF maggot meal contains 46.58% crude protein, 4.32% crude fiber, 23.56% crude fat, 2.39% calcium, 1.03% phosphorus, and 3457 kcal/kg metabolizable energy (Science and Technology Laboratory, IPB, 2008), and the amino acid profile are similarities with the amino acid of fish meal profile (Newton et al, 2009; Gunawan, 2012). BSF maggot meal turns lower in protein than fish meal protein (46.58% vs. 60%). Thus, if fish meal partially substituted by maggot meal the nuse in the composition of the ration will be effectively. According Akpodiete et al. (1998) concluded that maggot meal can nutritionally and productively replace fish meal in layer diet without adverse consequences on performance

and egg quality characteristics. Awoniyi et al. (2003) reported that the performance of broilers was not affected by treatment ration substituting fish meal by maggot meal. Agunbiade et al. (2007) reported that maggot meal can substitute a 50% fish meal and did not have negative effect on egg production and shell thickness. While Okah and Onwujiariri (2012) showed that the replacement of a 4% dietary fish meal in finisher broiler chickens diet with 50% maggot meal showed superior performance characteristics to the basal diet, and also proved to be more economically option.

Therefore, to evaluate the protein quality of maggot meal must be tested against the test object, and quail are highly responsive animal experiments. This study aimed to evaluate the replacement of maggot meal value for fish meal in quail diets on quail production performance (*Coturnix coturnix japonica*).

MATERIALS AND METHODS

One hundred female Japanese quails at 6 weeks of age were raised in cages until 20 weeks old, with the average of body weight was 117 grams (Coefficient variance 7.41%). The birds kept in cage system, as much as 20 cages, and each cage consisted of 5 quails. The ration was made by corn meal, fish meal, rice bran, soybean meal, bone meal, $CaCO_3$, maggot meal and premix as additive feed in 20 percent protein and 2900 kcal/kg of metabolizable energy (NRC, 1994). The composition, nutrient and metabolizable energy contents are showed in Table 1 and Table 2. The experiment rations were:

R_0 Ration contained 100% fish meal
R_1 Ration contained 75% fish meal and 25% maggot meal
R_2 Ration contained 50% fish meal and 50% maggot meal
R_3 Ration contained 25% fish meal and 75% maggot meal
R_4 Ration contained 100% maggot meal

Completely Randomized Design (CRD) was used with 5 treatments, and each treatment was replicated 4 times. The data were analyzed by using analysis of variance and, if there are any significant effects, then followed by orthogonal contrasts test. The analyzed variable were feed consumption, egg weight, egg production (quail day) and feed conversion.

Table 1.Composition of the formula rations (%)

Ingredients	**Ration**				
	R0	**R1**	**R2**	**R3**	**R4**
Yellow corn meal	53.0	50.0	50.0	52.0	51.0
Soy-bean meal	21.0	22.0	23.0	22.0	23.0
Rice bran meal	10.0	12.0	11.0	10.0	10.0
Fish meal	10.0	7.5	5.0	2.5	0
Maggot meal	0	2.5	5.0	7.5	10.0
Bone meal	2.0	2.0	2.0	2.0	2.0
$CaCO_3$	3.5	3.5	3.5	3.5	3.5
Premix	0.5	0.5	0.5	0.5	0.5
Total	100.00	100.00	100.00	100.00	100.00

Table 2. The nutrient and metabolism energy content in the rations

Nutrients	**R0**	**R1**	**R2**	**R3**	**R4**
Crude Protein (%)	20.26	20.51	20.67	20.09	20.27
Crude Fat (%)	6.10	6.39	6.70	7.13	7.51
Crude Fiber (%)	4.90	5.11	5.10	5.30	5.20
Calcium (%)	2.26	2.77	2.24	2.30	2.31
Phosphorus (%)	0.69	0.69	0.69	0.68	0.68
Metabolizable Energy (Kcal/kg)	2.900	2.900	2.900	2.900	2.900

RESULTS AND DISCUSSIONS

The effect of dietary treatment on feed consumption, egg weight, quail day and feed conversion of quail (*Coturnix coturnix japonica*) is shown in Table 3.

Table 3. The average of feed consumption, egg weight, quail day and feed conversion

Variable	R0	R1	R2	R3	R4
Feed consumption (g/day)	17.90[a]	19.08[b]	19.23[b]	17.85[a]	17.18[a]
Egg weight (g)	9.25[a]	10.12[b]	10.12[b]	9.41[a]	9.41[a]
Quail day (%)	74.80[a]	75.26[a]	75.19[a]	75.09[a]	74.21[a]
Feed conversion	2.44[a]	2.27[b]	2.33[b]	2.42[a]	2.54[a]

Note: The Similar superscript in the same row no significant difference (P>0.05)

Feed Consumption

Feed consumption were variations, from the lowest R_4 = 17.18 gram to the highest R_3 = 19.23 gram (Figure 1).

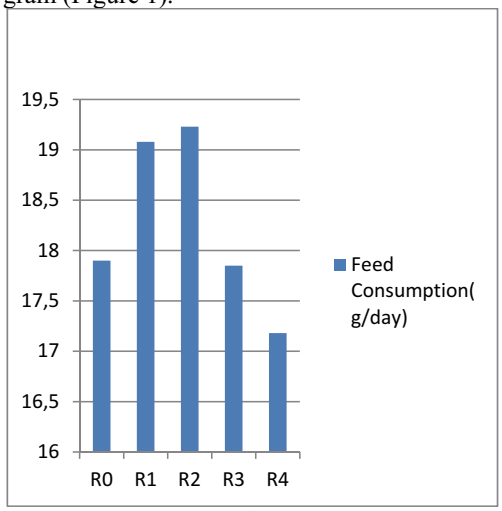

Figure1. Feed Consumption

In Table 3 shows that feed consumption reduced with increase the level of BSF maggot meal in the diets. The analysis of variance showed that substitution of fish meal by maggot meal has significant effect ($P<0.05$) on quail feed consumption. The difference is due to the consumption of palatability diet containing fish meal better than a diet containing BSF maggot meal. The decrease of feed consumption in the diet containing 100% BSF maggot meal (R_4) is caused by high levels of fat contained in the maggot meal, so the ration R_4 which has the highest fat content is equal to 7.51%. High fat content in the diet determined a decreased feed consumption, it is because of fat can produce high energy, so that quail will stop eating when energy needs has been reached. In line with the opinion of Zouand Wu (2005) which states that fat supplementation or increased energy ration will reduce feed intake and improve feed conversion of laying hens. At R_1 treatment (25%) and R_2 (50%) of substitution between fish meal with BSF maggot meal has reached the proper composition, thereby affecting the palatability of feed, quail consequently will consume more feed. Awoniyi et al. (2000) reported that BSF maggot meal was not nutritionally inferior to fish meal.

Egg Weight

The egg weight of each treatment is showed in Table 3. The average of egg weight was 9.25 – 10.12 g (Figure 2).The results of the analysis that the substitution treatment of fish meal by BSF maggot meal significantly affect on egg weight. This suggests that the substitution of fish meal by maggot meal gave a positive response on the weight of quail eggs. Orthogonal contrasts test results indicate that the substitution of fish meal by BSF maggot meal until 50% in the diet resulted in weight of eggs was significantly higher compared with control diet (without BSF maggot meal). According Agunbiade et al. (2007) that the maggot meal can replace 50% of fish meal with no negative effect on egg production, egg weight and egg shell strength. In the research substitution of fish meal by BSF maggot meal as much as 75% produce the same weight of eggs with control diet (R_0).

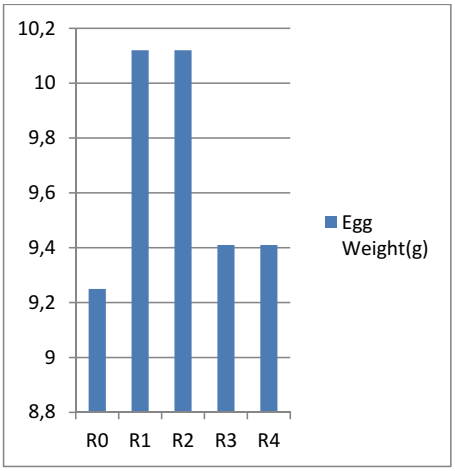

Figure 2. Egg Weight

The treatment of R_1 and R_2 produce egg weights were significantly higher than R_0, because of the relationship with feed intake were significantly higher, so the protein consumed will be higher resulting in an increase on weight of eggs produced. BSF maggot meal can replace fish meal, because maggot meal has a protein with characteristics of the amino acid profile relatively similar to fish meal (Newton et al., 2009).

Quail Egg Production

Substituting fish meal with maggot BSF meal produces a range egg production 74.21 – 78.19 percent, this suggest that utilize maggot meal as good as fish meal (Fig. 3).

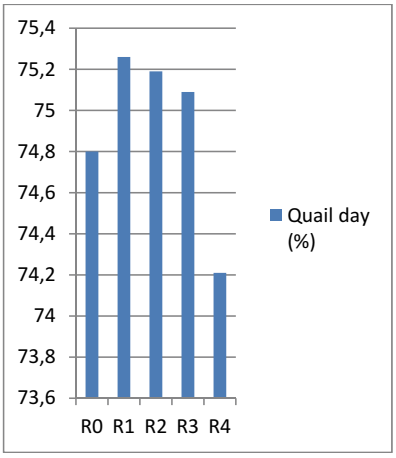

Figure 3. Quail Day (%)

The results of analysis of variance showed that fish meal substitution by BSF maggot meal into the ration was significantly ($P<0.05$) effect on quail egg production (Table 3). Increased levels of maggot meal in the ration had no effect on egg production. This proves that the similarity in the quality of fish meal protein with BSF maggot meal. Despite the reduction in feed intake with increasing levels of fish meal substitution by maggot meal which resulted on low protein intake, but egg production can still be maintained. This result is consistent with research Akpodiete et al. (1998) reported that the replacement of fish meal by maggot meal had no effect on egg production.

Feed Conversion

The feed conversion ratio of quails fed BSF maggot meal diets were better ($P<0.05$) than for those control diet fed (without maggot meal). Therefore the use of maggot meal in the quails diets enhanced nutrient utilization than fish meal based diet. By treatment of substitution fish meal by BSF maggot meal until 50% in the ration gave the best result of feed conversion ratio and significantly different ($P<0.05$) from other treatments

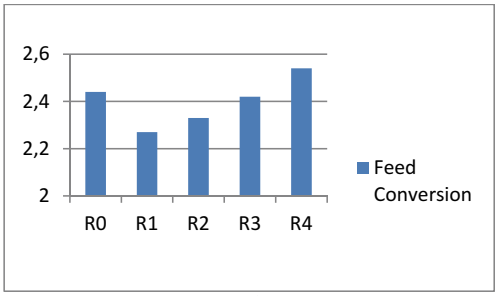

Figure 4. Feed Conversion

The result was parallel on feed consumption those was no significant different among the treatment R_1 (25% BSF maggot meal) and R_2 (50% BSF maggot meal) and significant different to R_0, R_3 (75%) and R_4 (100%). Its mean that BSF maggot meal from 25% until 50% in the ration did not influence palatability of ration and quail appetite. The similarity in amino acid profile maggot meal with fish meal showed that quail can utilize BSF maggot meal as well as fish meal. According to Agunbiade et al. (2007) that maggot meal can replace 50% of fish meal with no negative effect on the layer performance.

CONCLUSIONS

It can be concluded that the substitution of fish meal by black soldier fly (*Hermetia illucens*) maggot meal until 50% levels in the ration were still able to support a good result on quail production performance *(Coturnix coturnix japonica)*.

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