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# Evaluation of Black Soldier Fly Larvae as Feed Addtive on Performance Production of Broiler

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## Abstract:

The current study aimed to evaluate utilization of BSFL powder as feed additive on performance production of broiler. The study was conducted in Sumbersekar Field Laboratory, Faculty of Animal Science, Brawijaya University, Dau, Malang. Materials used was 160 Day old Cick (DOC) of Lohmann MB platinum strain unsexed. Each unit of experiment consisted of 8 birds. Average BW of DOC was 44.9 ± 2.9 g with variance coefficient of 6%. The study implemented Completely Randomized Design (CRD) with 5 treatments and 4 replications. The treatment groups consisted of P0 = Basal ; P1 = Basal + BSFL powder 0.25%; P2 Basal + BSFL powder 0.50%; P3 = basal + BSFL powder 0.75%; and P4 = basal + BSFL powder 0.50% ; P3 = basal + BSFL powder 0.75%; and P4 = basal + BSFL powder 1%. Analysis was done by using Analysis of variance (ANOVA). Should there had been significant differences, the analysis would have been continued with Duncan's Multiple Range Test (DMRT). The result showed that BSFL as feed additive gave highly significant impact ($P<0.01$) on final BW and FCR. Treatments also gave significant impact ($P<0.05$) on Performance Index (IP), nonetheless insignificant on feed intake ($P>0.05$), mortality, and IOFC. In conclusion, additional BSFL 1% as feed additive exhibited best result based on the production appearance.

*Keywords* **—Black Soldier Fly (BSF), Broiler, Feed Additive.**

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## I. INTRODUCTION

The inclination in population number has been a challenge faced by food sustainability. Whereas the problem impacts the also inclining demands for feed and society's awareness of the importance of nutrition fulfillment of protein and animal fat source. The demand of animal protein of Indonesian citizen is as high as 61.23% being chicken meat. Chicken meat is chosen by many due to lower price, readily accessible for many economic levels of society. The high rate of poultry farm development, especially broiler, demands for availability of feed in terms of quality and quantity. Broiler feed should not exceed demands for food, not containing toxin, good palatability, cheap, and environment friendly.Accordingly, innovation is needed to ensure sustainability of food and suppress the impact of production of both food and feed on the environment.

BSFL is larvae phase of the fly species Black Soldier Fly (BSF). BSFL is known as decomposer or bio-converter due to its food being organic matters. Composition of nutrition in BSFL varies accordingly to the feed provided, protein content ranges from 37 to 36%, and fat content also varies from 7 to 39%. Average BSFL contain high levels of protein and fat [9]. Study [3] on nutrition content of BSFL namely crude protein (CP) 32- 44.52%, crude fat 31.95 – 38.21%, Ash 5.25 – 10.25% and crude fiber (CF) 13.48 – 17.85%. Few of the studies revealed that fat and CF of BSFL appeared high and limiting in the usage of BSFL as feed for animals, especially poultry. Fat content in BSFL is

  

considered high, especially its saturated fatty acid [10]. Utilization of BSFL fat currently is developing due to the high fatty acid level of BSFL, in addition the active substance lauric acid as high as 60.89%. The mentioned substance functions as antiinflammation, supporting the immune system, antiviral, antibacterial, and antiprotozoal. The other essential fatty acids, such as linoleic acid, linolenate, Eicosapentanoic Acid (EPA), and Docosahexaenoic (DHA) also is present within BSFL fatty acid despite the amount being highly influenced by the growth media implemented.

Utilization o BSFL in animal feed, especially poultry, is limited by the number of animals and its high fiber content. Fiber content is considered nutrition component that is commonly avoided in higher amount, nonetheless fiber has function for the animals' digestive system such as controlling the intestinal activity and pushing the growth of digestive organs [4]. Fiber of BSFL represents chitin. This substance could hinder absorbability of protein. Study regarding BSFL powder as feed additive in poultry has yet to be conducted. Utilization of BSFL in form of powder aims to make easier the application when it's in the hand of farmers, in addition to minimizing processing cost. Active substance in BSFL applied as feed additive of broiler is hoped to be able to exert improvement in performance production. Finalpaper submission is available from the conference website.

## II. MATERIALS AND METHODS

### *A. Material*

The birds used in phase II were 160 Lohmann Platinum MB 202 unsexed broiler DOC produced by Japfa Comfeed Indonesia with average BW of 44 ± 2.9 g, coefficient of variance 6.44% and vaccinated with ND Live, ND kill, and IBD MHV.

The housing used was an open house with rice hulls litter. The litter is covered with newspaper sheets for two days during chick in. The housing was arranged into 20 squares with plastics walling for segmentation. Each square was measured around 100 x 100 x 50 cm, with each equipped with feeder, water station, and lighting. During brooding, the housing was equipped with gasolec(s) for heater and tarp surrounding for isolating the temperature inside of brooding area. Thermometer was installed outside and inside of the housing. Placement of each treatment and replication are randomized in each square.

Feed that was to be used for phase II was Green Feed commercial divided into starter (1 – 21 day) and finisher (22 - 28 day). Incorporation of additive BSFL into feed was done in every formulation accordingly to decided percentage. Water that was provided during rearing was clean, unpolluted, and nontoxic. The water originated from tank available in the Sumber Sekar Field Laboratory. Feed and water was given ad-libitum.

Tabel 1. Content of feed substance

| Feed Content | Standard | *Starter* | *Finisher* |
|---|---|---|---|
| Water (%) | Maks | 12 | 12 |
| Crude Protein(%) | Min | 20 | 19 |
| Crude Fat (%) | Min | 5.0 | 5.0 |
| Crude Fiber(%) | Max | 5.0 | 5.0 |
| Ash (%) | Min | 8.0 | 8.0 |
| Calsium (%) | | 0.9-1.1 | 0.8-1.1 |
| Phospor (%) | Min | 0.60 | 0.60 |
| Amino Acid: | | | |
| Lysin (%) | Min | 1.20 | 1.05 |
| Methionine (%) | Min | 0.45 | 0.40 |
| Mehionin + Cyistin (%) | Min | 0.80 | 0.75 |
| Tryptophan (%) | Min | 0.19 | 0.18 |
| Threonine (%) | Min | 0.75 | 0.65 |
| Urea | | - | - |
| Aflatoxin Total (ppb) | Max | 50 | 50 |
| Metabolic Energy (Kkal/Kg) | Min | 3000 | 3100 |

Table 2. Content of feed of maggot

| Nutrient Contentof *BSFL* | % |
|---|---|
| BK | 95.86 |
| Ash | 12.70 |
| CP | 37.82 |
| CF | 8.42 |
| Fat | 30.17 |

### ***B.*** *Method of Study*

Study method of phase II was a field experiment with CRD consisted of 5 treatments and four replications, where each square of replication

  

contained eight birds. The birds were reared for 28days. Treatments were done since arrival of DOC. Treatments given in phase II included as follows:

T0 : Control (basal)
T1 : basal + 0.25% powder BSFL
T2 : basal + 0.50% powder BSFL
T3 : basal + 0.75% powder BSFL
T4 : basal + 1% powder BSFL

## III. RESULTS AND DISCUSSION

Result of study on production appearance of broiler including feed intake, final BW, FCR, IP, and IOFC could be seen in Table 3.

Tabel 3. Effect of Treatments on Production Appearance of Broiler

| Treatment Group | Feed Intake (g/bird) | Final BW (g/bird) | FCR | Index of Performance (IP) | IOFC (Rp) |
|---|---|---|---|---|---|
| T0 | 1.944±31,92 | 1.394±13$^{A}$ | 1.44±0.04$^{A}$ | 324±28.3$^{a}$ | 10.945±487 |
| T1 | 1.949±10,99 | 1.406±20$^{A}$ | 1.43±0.02$^{A}$ | 339±12.7$^{ab}$ | 10.912±409 |
| T2 | 1.953±38,70 | 1.410±18$^{B}$ | 1.43±0.04$^{A}$ | 331±54.3$^{ab}$ | 10.744±550 |
| T3 | 1.955±23,06 | 1.424±3$^{B}$ | 1.42±0.02$^{B}$ | 360±4.8$^{b}$ | 10.793±207 |
| T4 | 1.958±18,85 | 1.431±7$^{B}$ | 1.41±0.01$^{B}$ | 362±2.4$^{b}$ | 10.690±90 |

- Superscript notation (A-B) within same column gave highly significant influence (P<0,01).
- Superscript notation (a-b) within same column gave significant influence (P<0,05).

### *A. Effect of Treatment on Feed Consumption of Broiler*

Feed consumption is the amount feed consumed by the birds during rearing phase. Consumption is an important aspect for evaluating feed quality. Result of variance analysis showed that treatment given did not exert significant difference (P>0.05) on feed consumption. From economics standpoint, the absence of difference in feed consumption shows similar efficiency among treatments. However, in Table 3 it is isible that additional powder BSFL as feed additive of broiler could raise feed consumption in T4 –(1.958±18.85), which exhibited the highest feed consumption. Powder BSFL contains high fat and fiber content. Implementation of the two substances needs to be limited due to its ability to lower food consumption. Feed containing high fiber has bulky nature that would cause feed consumption to decline. Feed consumption of broiler is influenced by energy contained within the feed. If the energy need is fulfilled, the bird will stop eating. Therefore, it is crucial to balance between energy and nutrient content to fit the need. In the current study, the occurance of the incline in fiber and fat content along with the increasing amount of powder BSFL usage. However no decline in feed consumption was observed. This is suspected to have taken place due to incorporation of powder BSFL in amount of $\leqslant$ 1% did not influence composition of feed substance in the provided feed.

### *B. Effect of Treatment on Broiler Final Body Weight*

The result of variance analysis showed difference and effect of treatment to be very significant (P<0.01) among treatment groups. This study showed that level of powder BSFL concentration incorporated as feed additive influences final BW of broiler along the increasing concentration of powder BSFL provided. Highest BW in the treatment was exhibited by P4 (1.431±7B g/bird) and the lowest by P0 (1.394±13A g/ekor). Feed consumption data on Table 3 showed an incline despite being non-significant (P>0.05). The mentioned evidences imply that usage of feed during the study was efficient for usage for growth of broiler. The matter aligns with that of [11], that increase of BW shows that feed consumed by the birds is sufficiently efficient and frequently applied for growth.

The factors that could influence final BW are namely Feed consumption, feed quality, temperature, humidity, sex, and age of bird. Significant increase in final BW was expected to have taken place due to the presence of active substance in maggot such as essential fatty acid (omega 3 and omega 6), as well as other fatty acid that could give advantage of increasing production and health of bird. Maggot fatty acid is rich in SFA which is dominated by lauric acid. In the current study, implemented level of lauric acid in maggot was 37.56%. Lauric acid could play role as antibacterial, antifungal, as well as antivirus. According to [1], fatty acid of maggot could exert inhibiting effect on a few groups of gram-negative bacteria such as E. coli and Salmonella sp. This is

  

supported by [5] and [12] that maggot does not have antimicrobial activity in gram-positive bacteria and shows inhibition zone in gram-negative group such as *E. coli* and *Salmonella* sp. Growth of pathogen bacteria in digestive tract would improve nutrient absorption. This would make more efficient the consumed feed for growth. Aside from being a strong antimicrobial, fatty acid of maggot could also stimulate growth without presence of toxicity [7]. The study showed that the high level of fatty acid, especially of the SFA group in maggot fat appears to be natural antimicrobial that could promote growth performance of broiler.

### *C. Effect of Treatments on Feed Conversion of Broiler*

Analysis of variance result exhibited that the providence of powder BSFL as feed additive gave highly significant difference and influence (P<0.01) among groups of treatments. This study showed that level of concentration of powder BSFL incorporated as feed additive could influence FCR in broiler. Treatment P0 had highest FCR, at 1,44±0,04A and P4 had the lowest showing 1,41±0,01B. FCR value is a comparison between feed consumption and BW gain of certain period as a parameter for measuring Productivity of the animals. This study had FCR ranging from 1.51 to 1.60, which is considered high by farmers. Hoowever, according to [13], FCR in broiler for 5 weeks in litter housing is as large as 1.6. Thus, FCR is representinf parameter for efficiency level of feed and suitability of formulation.

Low value of FCR is correlates with good efficiency of feed. [8] stated that there are many factors that could influence feed conversion, namely feed consumption and BW gain. Good conversion value of feed indicates good quality of DOC, health, environment sanitation, temperature, feed quality, housing quality, and rearing management that support the production performance of the flock. [14] stated that with addition of maggot in feed up to level of 20% gave good effect where FCR value declined from 1.55 to 1.39. Aside from lauric acid, there is possibility that chitin from maggot, in low level could take role as prebiotic in the intestine of broiler as explained, resulting in improved FCR [2].

### *D. Effect of Treatments on IP of Broiler*

Result of analysis of variance showed that providence of powder BSFL as feed additive exerted highly significant influence (P<0.05) on IP of broiler. The current study exhibited that the level of concentration of power BSFL that is incorporated as additive could influence IP where P0 had lowest value IP (324) and P4 had highest value (362), and all treatments had increase as compared to control. According do [15] poultry business with IP <300 is considered underperformed. IP value of 301-325 is considered enough, 326-350 is good, 351-400 is very good, and >400 is excellent. The IP value in the current study was within the good and enough category.

Effect of Treatments on IOFC of Broiler

IOFC is a term for income from livestock business on feed cost. IOFC is a barometer for how high is the feed cost that is the highest in a livestock business. The result of analysis of variance showed that addition of powder BSFL as feed additive gave non significant influence (P>0.05) on IOFC. IOFC measurement in the current study was Rp10.945±487 (T0), Rp10.912±409 (T1), Rp 10.744±550 (T2), Rp 10.793±207 (T3), dan Rp 10.690±90 (T4). Lowest value showed in control group, due to the amount of feed consumed not being comparable to the resulting value of BW gain. In other words, control group had low feed conversion resulting in low IOFC. This imply that addition of powder BSFL in feed contributes well on IOFC.

IOFC value of broiler is influenced by two main factors, average of final BW and total feed cost. The value of IOFC is a parameter of success of broiler business, calculating how high the feed cost which is the largest cost in the business and its effect on income [6]. Higher concentration of powder BSFL added could increase feed cost. However, the increase would not influence significantly the IOFC. This is due to the addition of powder BSFL exerting increase in optimum BW and lower FCR, raising the selling price of the bird.

  

The differences in feed costs between each treatment is caused by the increasing levels of additional powder BSFL. Average differences of feed between each treatment is ±Rp.200,-/kg. The price of powder BSFL that is considerably high (±Rp43.000/kg) given as feed additive in low concentrations of 0.25-1% of the total feed do not increase feed cost in significant extent despite giving optimum production.

## CONCLUSIONS

In conclusion, prowder BSFL meal provided at 1% of feed as feed additive exhibited the best result according to performance production.

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