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Protein and Energy Utilization of Black Soldier Fly Maggot at Different age on Chicken

N. G. T. Marbun, M. Tafsin*, and Y. L. Henuk

Animal Production Program Study, Faculty of Agriculture, UniversitasSumatera Utara, Padang Bulan, Medan 20155, Indonesia
**Correspondent author: martafsin@yahoo.com*

Abstract. This study aims to determine the efficient use of protein and energy of Black Soldier fly larvae at different age levels on chicken. This research was conducted at Jl. RK, Desa Namo Bitang, Kecamatan Pancur Batu Kabupaten Deli Serdang, North Sumatra. Animal Husbandary Study Program, Faculty of Agriculture, Universitas Sumatra Utara, Medan. The design of this study was a completely randomized design (CRD) with 4 treatments and 5 replications. The treatment consisted of P0, P1, P2, and P3 (larvae 14, 21, 28, and 35 days old). Observed variables were protein digestibility, nitrogen retention and apparent metabolizable energy.The results showedthat the treatment had a significant effect (P<0,01) on protein digestibility, nitrogen retention and apparent metabolizable energy. Based on research result it can be concluded that maggot of black soldier fly more efficient at the age between 24-25 days.

Keywords: black soldier fly maggot, protein digestibility, nitrogen retention, apparent metabolizable energy.

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1. Introduction

Protein-based feed is feed that has the biggest share in the nutritional needs of livestock. Protein-based feed are feed ingredients that have a protein content of at least 20%. Protein-based feed can come from plants and animals. Protein-based feed derived from animals have advantages compared to those from plants, where the essential amino acid content is more complete.

To meet the needs of protein for livestock, the source of protein feedfrom animal commonly used is fish meal, because of its high protein content and easy to digest. The price of fish meal is high because Indonesia is still dependent on imported fish meal. Due to the high cost of fish meal, the price of feed increases, so that production costs increase, which in turn increases the selling price of livestock products [1].

Based on the above problems it is necessary to look for other alternative feed ingredients as a source of protein. One of them is protein-based feed from insects. The potential of insect as a protein-based feed is very promising, this makes the use of insect as a protein source has been widely discussed by researchers in the world such as [2] [3] and [4]. Insects are reported to have high feed conversion efficiency and can be maintained, and mass produced.

As feed raw material, insect-based products must be safe from chemical contaminants [5] [6]. Maggot of Black soldier fly can be an option for supplying protein feed sources because this fly is easy to find, breed, and is one type of natural feed material that has high protein. Maggot is a black soldier fly (BSF) larvae or flower insect, has a texture that is chewy and has the ability to secrete natural enzymes. Maggot is one of the sources of high animal protein because it contains a range of 30-45% protein and has been used as fish food and poultry. Maggot also has anti-microbial and antifungal properties, which can increase the body's resistance from bacterial and fungal diseases. This shows that BSF maggot is potentially used as an alternative feed.

BSF maggot life cycle starts from eggs, larvae, pre-pupae, pupae and then BSF flies. In the larval phase, pre-pupae and pupae can be used as feed ingredients [7] [8]. However, each phase has a different nutritional content and quality, so digestibility testing of maggot is needed [9]. Based on this the authors are interested in conducting research related to the efficient use of protein and energy of maggot black soldier fly at different age levels in chickens.

2. Materials and Method

This research was conducted at Jl. RK, Namo Bintang Village, Kec. Pancur BatuKab. Deli Serdang, North Sumatra. This research was conducted in August until October 2019. The equipment used was 20 units of modified metabolic cages with a size of 25cm x 25cm x 30cm, stool plastic storage, digital scales, 20 units of tumbler, lamps as lights, stationery and books. The materials used are adult male native chickens with a weight of ± 1 - 1.5 kg as many as 20, rodalons, water, boric acid with a concentration of 5%, fresh maggot flour at different ages: 14 days, 21 days, 28 days and 35 days.

2.1. Method

The study design used was a completely randomized design (CRD) consisting of 4 treatments and 5 replications. Each treatment consisted of 4 chickens asfollows:

P0: Maggot flour (larval phase / 14 days age)
P1: Maggot flour (larval phase / 21 days age)
P2: Maggot flour (pre-pupa phase / 28 days age)
P3: Maggot flour (pupa phase / 35 days age)

The changes observed in this study were as follows:

Protein digestion, nitrogen retention, apparent metabolic energy.

The data obtained were analyzed using analysis of variance. If the results of the variance analysis show differences, further tests will be conducted with theDuncan method.

3. Result and Discussion

Table 1. Average digestibility values of BSF maggot protein

Treatment	Replications					Average ± SD
	1	2	3	4	5	
P0	72,56	73,42	70,97	73,86	72,55	$72,67 \pm 1,11^{a}$
P1	69,30	67,79	69,66	67,98	67,56	$68,46 \pm 0,96^{b}$
P2	64,51	62,01	64,31	64,52	63,35	$63,74 \pm 1,08^{c}$
P3	58,16	56,94	60,23	60,60	58,86	$58,96 \pm 1,50^{d}$

Note: Different superscripts in the same row and column show very significant differences (P <0.01).

Statistical test results showed that the use of BSF maggot flour had avery significant effect (P <0.01). The highest average value was P0 treatment at 72.67%, then followed by P1 treatment at 68.46%, then followed by P2 treatmentat 63, 74% and the lowest in P3 treatment was 58.96%. This study obtained the digestibility value of BSF maggot protein in the range of 58.96% - 72.67%. The range values indicate that the BSF maggot used in this study is low, medium and high quality. According to [9] statement that there are 3 categories of feed qualitybased on their digestibility, namely: digestibility values in the range of 50% - 60% are low quality, between 60% - 70% of medium quality and above 70% of high quality.

The results of this study indicate that the digestibility value of BSF maggot crude protein in P0 treatment has a higher value compared to P1, P2, and P3 treatments. The higher the age of BSF maggot, the higher the chitin content so that it can reduce digestibility. The high protein digestibility in the P0 treatment was due to the BSF maggot used in the P0 treatment was the younger BSF maggot among the other treatments.

The low digestibility of protein in the P3 treatment due to BSF maggot used in the P3 treatment is an older BSF maggot among other treatments. Based on the results of proximate analysis shows the crude protein content of BSF maggot in P0 treatment has a higher value among other treatments and P3 has a lower value among other treatments. This is in accordance with the statement.

[10] which states that in terms of age, larvae have a different percentage of nutritional components. Dry matter content of BSF larvae tends to be positively correlated with increasing age. The same thing also occurs in the components of crude fat, but in contrast to the crude protein component which tends to decrease in older age.

Decreased protein digestibility is also influenced by the presence ofchitin content in BSF maggot. Chitin is a polysaccharide compound found in the exoskeleton of an arthropod [11] which cannot be digested by most monogastricanimals including quail, due to the absence of the enzyme chitinase [12].

3.1. Calculation of Nitrogen Retention

Table 2. Mean BSF maggot nitrogen retention values

Treatment	Replications					Average ± SD
	1	2	3	4	5	
P0	71,88	73,12	69,62	73,73	71,86	72,04 ± 1,58[a]
P1	67,43	65,28	67,96	65,55	64,94	66,23 ± 0,37[b]
P2	60,52	56,93	60,23	60,52	58,85	59,41 ± 1,55[c]
P3	51,26	49,53	54,22	54,74	52,25	52,40 ± 2,14[d]

Note: different superscripts in the same column show very significant differences(P <0.01).

Based on the results of diversity analysis (ANOVA) BSF maggot has a very significant effect (P <0.01) on nitrogen retention. The average retention value of BSF maggot nitrogen is around 52.40% - 72.04%. The nitrogen retention values from the highest to the lowest were obtained at P0 treatment at 72.04%, P1 treatment at 66.23%, P2 treatment at 59.41% and P3 at 52.40%.

The results of this study indicate the nitrogen retention value of BSF maggot in the P0 treatment has a higher value compared to the treatments P1, P2,and P3. High and low nitrogen retention is influenced by differences in the level of protein content in the BSF maggot. [13] stated that nitrogen retention depends on the level of protein in the feed, the nitrogen content retained in line with the protein content of the feed. Nitrogen retention is influenced by several factors, namely: ration consumption, protein consumption and protein quality. The higherthe consumption of rations, the higher nitrogen retention will be.

3.2. Pseudo Metabolic Energy Calculation

Table 3. Average pseudo metabolic energy values of BSF maggot

Treatment	Replications					Average ± SD
	1	2	3	4	5	
P0	3072,66	3011,09	2923,23	30,82,59	2994,97	3016,91 ± 64,64[a]
P1	3402,32	3524,13	3384,19	3325,34	3374,52	3402,10 ± 73,93[c]
P2	3569,41	3471,47	3421,09	3542,79	3505,72	3502,10 ± 58,52[b]
P3	3569,41	3471,47	3421,09	3542,79	3505,72	3597,69 ± 35,85[d]

Note: different superscripts in the same column show very significant differences(P <0.01).

Statistical test results showed that the use of BSF maggot flour had avery significant effect (P <0.01). The average pseudo metabolic energy value of BSF maggot is around 3016.91 - 3597.69 kcal / kg. Pseudo metabolic energy values from highest to lowest were obtained in the treatment P3 of 3597.69 kcal /kg P2 treatment of 3502.10 kcal / kg, P1 treatment of 3402.10 kcal / kg and P0 of3016.91 kcal / kg.

The results of this study indicate the pseudo metabolic energy value of BSF maggot in P3 treatment has a higher value compared to P0, P1, and P2 treatments. The high apparent pseudo metabolic energy value in P3 treatment is due to the high gross energy content in BSF maggot P3 treatment. The high energy consumption gives an illustration that high energy metabolic rate. This

is in accordance with the opinion of [14], which states that the higher the energy consumption, the higher the metabolic energy.

The low pseudo metabolic energy value in the P0 treatment is due to the low gross energy content in the P0 treatment. Factors affecting metabolic energy according to [15] digestibility of metabolic energy is influenced by the gross energy of feed and the amount of energy used by livestock.

4. Conclusion

The increasing age of maggot in line with the increase of chitin contentin maggot and vice versa if the age of maggot gets younger then the chitin content in maggot will be lower. Chitin content in maggot can reduce digestibility. Based on a review of energy and protein utilization among the 4 treatments, it shows that the age of BSF maggot is more efficient at the age between 24-25 days.

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