The Extent to Which Larvae (BSF) Are Used as a Substitute in KUB Chicken Feed Based on Live and Carcass Weight, Carcass Percentage, and Commercial Cut

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Abstract. Finding the ideal limit for the use of maggot larvae on live weight, carcass weight, and commercial cuts in KUB chickens (Kampung Unggul Balitnak) is the goal of this study. In this investigation, 60 DOC KUB hens were employed. A Randomized Block Design (RBD) trial with four groups and five treatments based on starting body weight was the methodology employed. RA treatment (0% larvae BSF), RB treatment (3.75% larvae BSF), RC treatment (7.50% larvae BSF), RD treatment (11.25% larvae BSF), and RE treatment (15% larvae BSF) were the treatments employed in this investigation.The treatment ration was prepared with 2800 kcal/kg of energy and 17.5% protein. Live weight, carcass weight, carcass percentage, and commercial cuts in KUB chickens were the variables that were measured. The percentage of carcasses and commercial cuts was not significantly affected ($P>0.05$) by the addition of BSF maggot flour to KUB chicken feed, however living weight and carcass weight were significantly affected ($P<0.05$). The best conclusion is that KUB chickens' live and carcass weights can be increased by substituting BSF maggot flour at a supply level of 3.75% in their meal

1 Introduction

The native Indonesian chicken, known as Balitnak Superior Kampung Chicken (KUB), is the result of six generations of female line selection. One of the local chicken brands from the breeding batch produced by the Department of Agriculture and Development, situated in Ciawi, Bogor, is KUB chicken. Using indigenous farmers from different parts of West Java, including Cipanas District/Cianjur Regency, Jatiwangi District/Majalengka Regency, Pondok Rangon District/Depok City, Ciawi District/Bogor Regency, and Jasinga District/Bogor Regency, Balitnak conducted extensive research on kampung chicken farming practices during the 1997–1998 establishment of the KUB chicken farm.

These characteristics of KUB chicken include a body weight of 1,200-1,600 grams at 20 weeks of age, an egg weight of 35-45 grams, an earlier first laying age (20-22 weeks), higher

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egg production (160-180 eggs/head/year), 50% hen-day egg production, peak egg production of 65-70%, and greater disease resistance. One of the primary determinants of a livestock business's success is feed. The competition between food and feed, particularly in terms of protein source feed, remains present, making it impossible to overcome the use of feed ingredients. Feed accounts for 60–70% of a livestock business's success, and due to its high cost, farmers are paying closer attention to it, particularly to the relatively expensive animal protein source feed ingredients.

In order to replace alternative animal protein source feed ingredients that are more reasonably priced, easily accessible, and have adequate nutritional value, a breakthrough is therefore required. Maggot BSF (Hermetia illucens), which has a high protein content and is simple to produce because maggots use organic waste as their body nutrients, is one alternative animal protein source feed ingredient that can be used in place of the expensive protein source feed. Due to their ease of production and speed, Black Soldier Fly (BSF) maggots have the potential to be a good and affordable source of protein. One gram of BSF maggot eggs can yield two kilograms of fresh maggots, and maggot egg seeds are available for IDR 3,000 per gram.

Due to their high protein content and long shelf life, BSF maggots are often used as an alternative feed ingredient to replace expensive concentrate feed. They can also be administered effectively. Typically, BSF maggots are turned into flour. BSF maggot flour contains enough nutrients, including water (12.38%), crude protein (38.83%), crude fiber (2.00%), crude fat (15.32%), ash (13.12%), calcium (1.84%), and phosphorus (1.0%) [1]. It also contains all of the essential amino acids, including methionine (0.83-0.90%) and lysine (2.21-3.40%) [2].

Methionine is one of several essential amino acids that are vital to the livestock body. Essential amino acids are also necessary for the body to assemble proteins and support the metabolic processes of the cells in the livestock body. Methionine is a sulfur-containing amino acid that is necessary for monogastric animals. It also acts as a donor of methyl groups (CH3), which are subsequently utilised in the process of protein metabolism through the transmethylation reaction [3. Providing poultry with methionine also helps promote growth.

Growth hormone, which regulates muscle growth, is closely related to amino acids; maintaining a balance between growth hormone secretion and testosterone is crucial for maximising muscle growth. Growth hormone (GH) promotes muscle fiber hypertrophy by raising protein synthesis linked to the proliferation of Muscle Satellite Cells (MSC). At the same time, testosterone regulates the size and quantity of muscle fibers by promoting the longitudinal growth of muscle fibers. According to extensive research on the use of BSF maggot flour, it is recommended to use maggot flour with a crude protein content of 40%, which is comparable to the crude protein content of meat and bone flour in broiler rations, at a rate of 6% of the ration. Maggots contain nearly the same amount of animal protein as imported fishmeal.

Because their nutritional value is similar to that of local fishmeal, maggots themselves have good potential as an animal protein feed source for Indonesian livestock. Maggot flour (Hermetia illucens) can replace fishmeal in the ration by 75% or 11.25% without compromising the effectiveness of broiler feed use, according to Ref. [4].. This study fills a knowledge gap in the literature by examining the ambiguous impact of maggot powder on chicken growth.

The purpose of this study is to ascertain how the use of BSF (Hermetia illucens) maggot flour in rations affects the commercial cuts, live weight, carcass weight, and carcass percentage of KUB chickens. The findings of this study should be helpful in educating readers about the potential of Black Soldier Fly (Hermetia illucens) maggots to increase the live weight and carcass weight of KUB chickens, as well as the use of BSF (Hermetia illucens) maggot flour as an alternative source of animal protein feed for livestock, which can replace the protein requirements of fish meal.

2 Materials and Method

2.1 Location and duration of research

This research was conducted at the Animal Husbandry Technical Implementation Unit, Andalas University, West Sumatra. This research was conducted for 12 weeks.

2.2 Research tools and materials

A total of 60 DOC KUB (Kampung Unggul Balitnak) chickens were used as study animals. The chickens received treatment from the time they were 6 weeks old until they were 12 weeks old.

The primary ingredient utilized in this study was BSF maggot flour, which was made by cultivating BSF maggots using growth media materials, specifically chicken manure and coconut dregs in a 75%:25% ratio. The KUB chickens were fed a ration that included BSF maggot flour at provision rates of 0%, 3.75%, 7.50%, 11.25%, and 15%. The maggot flour was then combined with additional feed ingredients, including mineral B12, fish meal, soybean meal, fine bran, and ground corn. According to the Livestock Research Institute's (2011) guidelines, the ration formulation was prepared by reaching an energy of 2800 Kcal/kg and a protein content of 17.5%. composition, metabolic energy (kcal/kg), and nutrient content (%).

2.3 Research methods

With four groups and five treatments—each with three KUB chickens in each experimental unit—this study was carried out experimentally using a Randomized Block Design (RBD).

BSF maggot flour, which was produced by cultivating BSF maggots with coconut pulp as a growth medium, served as the treatment ration in this investigation. Furthermore, the KUB chicken ration is made up of fish meal, soybean meal, fine bran, ground corn, and vitamin B12.

The variable observed were initial weight, final weight:

1. Live Weight (grams/head) Live weight is the live weight of chickens that have been fasted for 12 hours calculated in grams / head.
2. Carcass Weight (grams/head) Carcass weight is the weight of chickens that have been separated from feathers legs, head, internal organs, neck.
3. Carcass Percentage (%) Carcass percentage
4. Commercial Cut Percentage (%):
   - Wing percentage,
   - Chest percentage,
   - Percentage of upper thigh
   - Percentage of lower thigh

2.4 Data analysis

To determine whether there are differences between the treatments tried, the data obtained in this study were analyzed using analysis of variance. If there are significant differences ($P<0.05$), then it will be continued with Duncan's Least Significant Difference test [13].

3 Results and Discussion

3.1 The effect of treatment on live weight, carcass weight, carcass percentage

The average live weight, carcass weight and carcass percentage of KUB (Kampung Unggul Balitnak) chickens in each treatment during the study can be seen in Table 1

Table 1. The average live weight, carcass weight and carcass percentage of KUB chicken.

Treatment	Weight of body (g/head)	Weight of carcass (g/head)	PTC Carcass (%) NS
FA (0% maggot flour BSF)	852,25 ab	502,50 abc	58,76
FB (3,75% maggot flourBSF)	946,00 a	562,50 a	59,48
FC (7,50% maggot flourBSF)	923,00 ab	548,25 ab	59,37
FD (11,25% maggot flour BSF)	792,25 bc	465,00 bc	58,56
FE (15% maggot flour BSF)	698,00 c	413,25 c	59,28
SE	42,29	29,18	1,05

Explained: Different superscripts in the same column indicate significantly different effects ($P<0.05$).
NS Non Significant
SE: Standard Error

The average live weight of KUB chickens fed maggot flour in this study varied between 698.00 and 946.00 grams/head, as shown in Table 1. Live weight decreased when the amount of maggot flour in KUB chicken feed was increased by 15%. This supports the claim made in [6] that using more than 3.75% maggot flour improves body weight, reduces feed consumption, and increases the ration conversion rate. According to the study's findings, the 15% reduction in live weight resulting from the FE treatment, as a result of maggot flour, was attributed to its lower lysine and methionine amino acid content compared to the other treatments.

The Livestock Research Institute (2019) states that KUB chickens require 0.40 and 0.90 per cent of the ration to contain the amino acids methionine and lysine, respectively, to meet their basic nutritional needs. Live weight is impacted because the 15% BSF (Hermetia illucens) maggot flour used in the FE treatment ration has an amino acid content that is 0.36% and 0.10% lower than other treatments.

This view is corroborated by Ref. [7], who claimed that the amino acid content of lysine and methionine is beneficial for the development of poultry body tissue, including the production of meat. Methionine is the primary component in the process of feather growth and plays a role in the metabolism of epinephrine, carnitine, and creatine in poultry. Lysine is an amino acid that is involved in the growth and repair of body tissue, cytokine synthesis, and the release of growth hormone, Insulin-like growth factor 1 (IGF-1) [8]. According to a further statement [9], a lysine deficiency in chickens will result in slow growth and weight loss.

Table 1 shows that the average weight of KUB chicken carcasses administered maggot flour varied between 413.25 and 562.0 grams per head. The analysis of variance results indicated that the weight of KUB chicken carcasses varied significantly ($P <0.05$) depending on the level of maggot flour administered to the KUB chickens (Kampung Unggul Balitnak). According to Table 1, the FB treatment produced the highest KUB chicken carcass weight (502.50 grams), while the FE treatment produced the lowest carcass weight (413.25 grams).

The carcass weight of KUB chickens may increase if 3.75% maggot flour is used. When using 11.25% maggot flour, the carcass weight of KUB chickens can still be tolerated; however, when using 15% maggot flour, the carcass weight of KUB chickens decreases.

This is consistent with the final live weight; KUB chickens' live weight decreases when maggot flour is added at a 15% level, whereas their live weight increases when maggot flour is used at a 3.75% level. The high crude fibre content in the 15% BSF (Hermetia illucens) maggot flour treatment may have contributed to the reduction in carcass weight observed in this treatment. This is because the high crude fibre content hinders the livestock's ability to digest the ration, which in turn prevents the body from absorbing the necessary nutrients.

The high crude fibre content of the FE treatment (5.50%) interferes with the body's ability to absorb nutrients and form tissue, resulting in low carcass weights for the animals.

The percentage of KUB chicken carcasses that used BSF maggot flour up to 15% averaged 59.09%, as shown in Table 1 above. The percentage of KUB chicken carcasses did not change or show any significant difference ($P > 0.05$) between treatments, as indicated by the analysis of the carcass percentage results. Compared to the study by Ref. [10], which yielded an average percentage of 12-week-old KUB chicken carcasses of 67.58%, the average results of the KUB chicken carcass percentage (Kampung Unggul Balitnak) in this study were lower.

Due to antinutrients in the form of chitin found in the outer skin of maggots, the low percentage of carcasses brought on by the provision of high percentage maggot flour may have an impact on the chickens' ability to absorb nutrients. Chitin is a readily available alkaline biopolymer compound that is hard to dissolve after sulfate. According to Ref. [11], maggots have high protein digestibility due to two factors: first, they contain a non-protein nitrogen component; second, they contain chitin compounds, which allow them to form complex bonds with proteins and prevent chickens from digesting protein in their digestive tracts.

Anti-nutrients in feed can alter the feed ingredients prior to consumption and inhibit the absorption of essential nutrients, including vitamins, minerals, and protein.Ref. [12] The process of meat formation is less than ideal when nutrients are prevented from being absorbed by the digestive system. This claim is corroborated by Ref. [13], which states that the chitin content of BSF maggots (Hermetia illucens) is 17.93%, and [14], which states that chitin levels in chicken rations that are higher than the limit of 2.32% can interfere with the chickens' ability to grow.

3.2 Effect of treatment on commercial cuts

The results of the percentage of commercial cuts of KUB (Kampung Unggul Balitnak) chickens can be seen in Table 2.

Table 2. Average percentge cut comercial KUB chickens.

Treatment	Wings (%) ^{NS}	chest (%) ^{NS}	Uper thigh (%)^{NS}	Lower thigh (%)^{NS}
FA (0% maggot flour BSF)	15,04	24,25	30,02	15,82
FB (3,75% maggot flour BSF)	16,58	26,88	30,63	15,87
FC (7,50% maggot flourBSF)	14,88	24,85	28,87	16,32
FD (11,25% maggot flour BSF)	15,37	24,94	27,46	16,21
FE (15% maggot flour BSF)	15,11	24,22	31,70	15,81
SE	0,99	1,14	0,55	1,72

When maggot flour was administered to KUB chickens in this study, the average percentage of wings varied between 14.88% and 16.58%. Although it was able to sustain it, the application of maggot flour had an impact on the KUB chicken wing percentage results. The majority of the protein that the animal's body absorbs during the growth period is utilised to produce the animal's feathers.

Bone growth also affects the percentage of wings, with a higher percentage of wings being associated with a higher weight of wing bones and a lower percentage of wings being associated with a lower weight of wing bones. The fact that the wing has less potential to produce meat and is primarily composed of bone components also influences the percentage of wing weight. According to research by Ref. [15], the wings, back, neck, and legs are the body parts with the most bones.

There was no discernible difference in the percentage of upper thighs in KUB chickens fed maggot flour (P>0.05). In this study, the average proportion of upper thighs ranged from 27.46% to 31.71%. KUB chickens can still withstand up to 11.25% of the offered maggot flour, but the proportion of commercial cuts of KUB chicken breast decreases when up to 15% of the flour is given. Statistically speaking, there is no significant difference in the percentage of commercial breast cuts (P > 0.05).

There was no discernible difference in the average percentage of lower thighs in KUB chickens fed maggot flour (P > 0.05). In this study, the average proportion of lower thighs ranged from 15.81% to 16.32%.The study's findings demonstrated that the upper thigh's percentage was higher than the lower thigh's. Tthe thigh is the carcass part that produces the second most meat after the chest, and the ration's protein content influences its development. This is because the lower thigh is a part of the limb, meaning that its meat component is lower than the upper thigh. These findings also demonstrate that to support the mid-sized chicken industry in the community, the government should subsidise the production of maggot powder. Both the poultry economy and the social actors involved will benefit from this policy.

4 Conclusion

According to the research findings, the best way to increase the live weight and carcass weight of KUB chickens raised between 5 and 12 weeks of age is to use BSF maggot flour (Hermetia illucens) as a substitute in KUB chicken rations at a provision level of 3.75%. This is the recommended amount of BSF maggot flour in KUB chicken rations. This outcome ought to serve as the foundation for government policy that supports the midsize poultry industry in the community by subsidizing the production of maggot flour or powder.

Acknowledgments

The author would like to thank the Dean Faculty Animal Science Universitas Andalas Padang, and the Directorate of Research and Community Service for the research funds provided.

References

1. Ahlul, K. A. 2022. Pengaruh Penggunaan Tepung Maggot BSF (Black Soldier Fly) Dalam Ransum Terhadap Peforma Produksi Ayam KUB Periode Layer. Skripsi. Fakultas Peternakan. Universitas Andalas. Padang.
2. Popa, R. dan Green, T. 2012. Dipterra LCC e-Book Biologi dan Ekologi Black Soldier Fly Dipterra LCC.
3. Hidayat, N. Z. 2022. Pengaruh Pemberian Bawang Putih (Allium sativum L) Sebagai Feed Additive Terhadap Laju Pertumbuhan, Intake Protein, Dan Efesiensi Penggunaan Protein Pada Itik Hibrida. Fakultas Peternakan. Universitas Andalas. Padang.
4. Dengah, S. P., J.F. Umboh., C. A. Rahasia., dan Y. H. Kowel. 2016. Pengaruh penggantian tepung ikan dengan tepung maggot (Hermetia illucens) dalam ransum

terhadap performans broiler. ZOOTEC, 36(1), 51– 60. https://doi.org/10.35792/zot.36.1.2016.9444.

5. Steel, R., G D & J. H. Torrie. 1995. Prinsip dan Prosedur Statistik Terjemahan : B. Sumantri. PT. Gramedia Pustaka Utama. Jakarta.
6. Tribudi Y. A., T. Ahmad., N. Haryuni., and V. Lesmana. 2022. Black soldier fly (Hermetia illucens) larva meal as a substitute for fish meal in feed on Joper chicken performance during the starter period. Jurnal Nutrisi Ternak Tropis. Vol. 5:1. 2022.
7. Wahyu, J. 2004. Ilmu Nutrisi Unggas. Cetakan ke-5. Gadja Mada University Press. Yogyakarta.
8. Anggorodi, R. 1995. Nutrisi Aneka Ternak Unggas. PT. Gramedia Pustaka Utama.
9. Anggraini, A. D., W. Widodo, I. D. Rahayu, dan A. Susanto. 2019. Efektifitas penambahan tepung temulawak dalam ransum sebagai upaya peningkatan produktivitas ayam kampung super. Jurnal Sain Peternakan Indonesia,14 (2) : 222—227. Badan Litbang Pertanian. Kementerian Pertanian RI.
10. Haikal. 2022. Pengaruh Penggunaan Tepung Maggot BSF (Black Soldier Fly) Dalam Ransum Terhadap Performa Karkas Ayam KUB. Skripsi. Fakultas Peternakan, Universitas Andalas. Padang.
11. Hidayat, C. 2018. Pemanfaatan insekta sebagai bahan pakan dalam ransum ayam pedaging. Jurnal WARTAZOA. Vol. 28 No. 4 Hal. 161-174.
12. Kumar, R. 2003. Anti-nutritive factors, the potential riks of toxicity and methods to alleviate them. Artikel Ilmiah. 145 – 156.
13. Kanto, D. A. R., A. D. Permana., dan R. Hertadi. 2018. Ekstrasi dan karakterisasi kitin dan kitosan dari lalat serdadu hitam (Hermetia illucens). Skripsi. Program Studi Kimia, Universitas Bandung. https://journal.uniga.ac.id/index.php/ JFB.
14. Reddy, V. R., V. R Reddy and Quddratullah, S.1996. Squilla: A novel animal protein, can it be used as a complete substitute for fish in poultry ration. Feed International, 17:18 – 20.
15. Frangki, S., J.S. Ellen., dan S. Zainuddin. 2019. Evaluasi Persentase Karkas Ayam Kampung Super Dengan Pemberian Jerami Jagung Fermentasi . Jurusan Peternakan. Fakultas Pertanian. Universitas Gorontalo.