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Research Article

Influence on the Carcass Yield of Native Chicken using Maggot as A Nutrient

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ABSTRACT

This study aims to determine the effect of BSF (Black Soldier Fly) maggot in rations on native chicken carcass yield, including body weight, carcass weight, carcass percentage, and abdominal fat. The native chicken that was used in this study was KUB chicken. This study used 100 native chickens aged six weeks, and the study duration was six weeks. Chickens were placed in cages measuring 100×100×100 cm. The experimental method in this study included a completely randomized design (CRD) with five treatments and four replications. The treatment used treatment T1 (0% maggot flour), T2 (7% maggot flour), T3 (14% maggot flour), T4 (21% maggot flour), and T5 (28% maggot flour). The ration was prepared with 17.5% iso-protein and 2800 kcal/kg iso-energy. Body weight, carcass weight, carcass percentage, and abdominal fat percentage were observed in this study. The results and analysis of variance showed that the inclusion of BSF maggot flour in rations had a significant effect ($P<0.05$) on body weight and carcass weight, had no significant effect ($P>0.05$) on carcass percentage, and highly significant ($P<0.01$) to abdominal fat percentage. In conclusion, using up to 14% of BSF maggot flour produced the best carcass yield on the native chicken of KUB.

Keywords: carcass, diet, KUB, maggot, native chicken

INTRODUCTION

Native chickens or non-purebred chickens are native local chicken livestock in Indonesia. Native chickens are very famous among the people of Indonesia because they are widely distributed in various rural areas and are easy to maintain. Native chickens are kept as a hobby or raised to be used as a food source. Native chickens also have an important role in improving the economy of Indonesian society, especially in rural areas. Native chickens have the advantage of being able to adapt to situations such as climate change, weather, and environmental conditions. In addition, native chickens can produce better quality meat and eggs than purebred chickens even though the price of native chickens is more expensive than the price of purebred chickens. Consumer demand for native chicken is relatively high, as seen from the growth of the native chicken population, which is increasing yearly, and the improvement in breeding, feeding, and management is regularly processed (Hidayat & Asmarasari, 2015; Bakrie *et al*., 2021).

At this time, several types of native chickens have undergone breeding, one of which is the Kampung Unggul Balitnak (KUB) chicken. KUB chicken, or superior native chicken Balitbangtan,

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is one type of native chicken innovated by the Livestock Research Institute, Ciawi-Bogor, Indonesia (Bakrie *et al*., 2021; Hidayat *et al*., 2017; Iskandar & Sartika, 2014). KUB chickens have advantages over other native chickens, namely having egg production of 45-50% hen day and incubation properties that have been reduced by 90%. In addition, KUB chickens have good meat potential, namely rapid weight growth. According to (Munawaroh *et al*., 2021), KUB chickens can reach an average body weight of 1 kg at 12 weeks, while ordinary native chickens need up to 20 weeks of age to reach a weight of 1 kg.

One of the most important factors in the KUB chicken farming business is feed because feed supports the growth process and energy supply so chickens can grow and develop properly. Feed costs are the most significant component that must be incurred by farmers, which is around 60-70% of production costs (Ahiwe *et al*., 2018). According to (Ravindran, 2013), feed hight cost is a result of its main raw materials, including corn, soybean meal, fish meal, meat meal, and bone meal. Finding alternative, it is necessary to find alternative feed sources at relatively low prices with sufficient nutritional content and not compete with humans, one of which is Black Soldier Fly (BSF) maggot flour. Giving BSF maggot flour as much as 14% in the ration can provide good performance in KUB chickens (Amizar *et al*., 2023).

Maggot flour comes from BSF larvae, which are dried and processed into flour. BSF is one of the insects that could be developed as a source of protein for animal feed. BSF maggots can be cultivated and made into commodities that can be traded. BSF maggot cultivation only takes 21 days, and the growing media comes from organic materials (Mertenat *et al*., 2019). BSF maggot cultivation can reduce organic waste that has the potential to pollute the environment (Rehman *et al*., 2023). BSF maggot protein is more affordable, environmentally beneficial, and plays a significant part in nature (Heines *et al*., 2022). BSF is comparable to common fed protein sources such as fish meal. Maggots' high and low protein depends on the growing medium used (El-Hack *et al*., 2020).

The protein content of BSF maggots is easily digested so that it can accelerate growth in poultry. According to Dengah *et al*. (2015), using maggot flour *(Hermetia illucens*) can replace fish meal by 75% or 11.25% in the ration without adversely affecting the efficiency of broiler rations. According to (Wahid *et al*., 2021), using maggot flour in rations can increase feed consumption, body weight gain, feed conversion ratio, and protein consumption.

Based on the description above, BSF maggot flour's high content and nutritional quality are expected to be a source of protein feed in the KUB chicken ration. This study aims to determine the effect of using BSF maggot in rations on native chicken carcass yield, including body weight, carcass weight, carcass percentage, and abdominal fat. BSF maggot can replace the protein source such as fish meal on the chicken ration.

MATERIAL AND METHODS

Research Material

Amount of 100 native chickens (KUB) aged six weeks was used in this study. Experimental cage was used in this study was a plot box cage of 20 units. Each cage box measures 100cm x 100cm x 100cm, containing five chickens per cage unit.

The constituent materials of the ration used in this study were prepared with feed ingredients such as ground corn, bran, commercial feed CP512, maggot flour, and mineral B12. The nutritional composition, content of food substances, metabolic energy, and the constituent materials of the ration can be seen in Table 1.

Research Methods

In this study, an experimental method with a Complete Randomized Design (RAL) was adopted. The experimental unit consisted of five treatments and four repeats, each with five chickens. Treatment rations are rations with different levels of use of maggot flour. The treatment consisted of T1 (0% maggot flour), T2 (7% maggot flour), T3 (14% maggot flour), T4 (21% maggot flour), and T5 (28% maggot flour).

Table 1. Content of food substances (%) and metabolic energy (Kcal/kg)

Feed ingredients	Crude protein (%)	Crude fat (%)	Crude fibre (%)	Ca (%)	P (%)	Methionine (%)	Lysine (%)	EM (Kcal)
Ground corn[a]	8.25	3.90	3.23	0.03	0.11	0.18[e]	0.20[e]	3290
Fine bran[a]	10.55	11.35	13.82	0.11	0.47	0.29[f]	0.77[f]	1620
Feed CP512[b]	21.00	5.00	5.00	0.90	0.60	0.40	1.05	3100
Maggot flour[c]	38.82	15.32	7.05	1.84	1.00	0.83[g]	2.21[g]	3281.25
Mineral B12[d]	-	-	-	49.00	14.00	-	-	-

Remarks:
[a]Non-Ruminant Nutrition Laboratory, Faculty of Animal Husbandry, Andalas University (2020)
[b]Product Packaging Label PT. Charoen Pokphand
[c]Non-Ruminant Nutrition Laboratory, Faculty of Animal Husbandry, Andalas University (2021)
[d]Product Packaging Label PT. Eka Farma
[e]Widodo (2010)
[f]Mathius & Sinurat (2001)
[g]Newton *et al*. (2005)

Preparation of Research Rations

The research ration was prepared with a balanced crude protein of 17.5% and metabolic energy of 2800 Kcal/kg (Iskandar *et al.,* 2014). The composition of the research ration can be seen in Table 2. The content of food substances (%) and energy metabolism (kcal/kg) of the research ration can be seen in Table 3.

Measured Parameters

The following parameters were measured to evaluate the growth performance and body composition of chickens in this study. These measurements were taken at the end of the study to ensure comprehensive and accurate data collection. Each parameter was calculated based on standard procedures to provide reliable insights into the chickens' growth and body composition.

1. Body weight (g/head)
   Body weight was obtained by weighing chickens (fasted for 12 hours) at the end of the study.
2. Carcass weight (g/head)
   Carcass weight is obtained from the total weight (g/head) after being slaughtered minus the weight of feathers, legs, head, neck, and internal organs.
3. Carcass percentage (%)
   Carcass percentage is obtained from carcass weight (g/head) divided by body weight (g/head) multiplied by 100%.

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4. Abdominal fat percentage (%)
   Abdominal fat percentage is obtained from the weight of abdominal fat (g/head) divided by body weight (g/head) multiplied by 100%.

Table 2. The composition of the treatment ration (%)

Feed ingredients	Treatment ration				
	T1	T2	T3	T4	T5
Milled corn	11.00	19.50	28.50	37.50	46.00
Fine bran	19.00	20.50	22.00	23.50	25.00
Feed CP512	69.00	52.00	34.50	17.00	0.00
Maggot Flour	0.00	7.00	14.00	21.00	28.00
Mineral B12	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

Table 3. Food substances (%) and metabolic energy (kcal/kg) of research rations

Food content (%) and metabolic energy (kcal/kg)	Treatment ration				
	T1	T2	T3	T4	T5
Crude protein	17.40	17.41	17.35	17.30	17.30
Crude fat	6.04	6.76	7.48	8.20	8.92
Crude fiber	6.43	6.56	6.67	6.79	6.91
Calcium (Ca)	1.14	1.11	1.09	1.07	1.05
P available	0.66	0.64	0.62	0.60	0.59
Methionine	0.35	0.36	0.37	0.38	0.39
Lysine	0.89	0.90	0.90	0.90	0.90
EM (kcal/kg)	2808.70	2815.34	2822.93	2830.51	2837.15

Remarks: Calculated based on Table 1 and 2

Research Implementation

Procurement and maintenance of BSF maggots

BSF maggots were first cultivated by buying BSF baby maggots at one of the maggot breeders in the city of Padang. Baby maggot BSF is placed in a growing tofu pulp and bran media container. Baby maggots placed in the growing medium are raised until they become larvae of the pre-pupa phase with enlargement duration of 21 days. During the enlargement process, the BSF maggot growing medium is taken care not to be too dry or wet.

Maggot flour making

After maintenance for 21 days until pre-pupa, the BSF maggot is removed from the growing media container and washed with clean water to clean the remaining feed from its body. Maggot is turned off by dousing it with hot water, drying it under the sun's heat, and then grinding it to maggot flour.

Data analysis

All data obtained were processed statistically by diversity analysis according to the Complete Random Design (CRD) pattern. Differences between treatments were further tested

with Duncan's Multiple Range Test (DMRT) according to the procedure according to Stell and Torrie (1995). The data were analyzed using analysis of variance, and when there were significant differences, Duncan's tests were performed using the SPSS Statistics for Windows Version 21.0 (IBM SPSS Statistics for Windows, Version 21.0).

RESULTS AND DISCUSSION

The results of this study present the effects of maggot flour inclusion in the diet on the growth performance and body composition of KUB chickens. Parameters such as body weight, carcass weight, carcass percentage, and abdominal fat percentage were analyzed to determine the impact of the treatments. The findings are summarized in Table 4, including statistical differences among treatments.

Table 4. Results of average body weight, carcass weight, carcass percentage, and abdominal fat percentage of KUB chickens during the study

Treatment	Body Weight (g/head)	Carcass Weight (g/head)	Carcass Percentege (%)^{ns}	Abdominal Fat Percentage (%)
T1 (0% maggot flour)	1044.43^{a}	714.36^{ab}	68.40	0.73^{A}
T2 (7% maggot flour)	1048.20^{a}	710.20^{ab}	67.76	0.75^{A}
T3 (14% maggot flour)	1049.60^{a}	715.49^{ab}	68.16	0.77^{A}
T4 (21% maggot flour)	1041.35^{ab}	703.37^{bc}	67.54	0.84^{AB}
T5 (28% maggot flour)	1024.58^{b}	683.87^{c}	66.75	0.91^{B}
SE	5.63	7.24	0.47	0.03

Remarks:
Superscript lowercase letters on the same line show a significant difference (P<0.05), Uppercase superscript on the same line shows a very significant difference (P<0.01), SE: Standard error, ns: non-significant (P>0.05).

The effect of treatment on body weight

The study results of the effect of BSF maggot flour in the ration on the body weight of KUB chickens can be seen in Table 4. Body weight is a picture of growth for chickens that can be used to assess the success of a farm business. The analysis of the body weight of KUB chickens from each treatment showed a significant difference (P<0.05). The body weight of treatment T1, T2, and T3 was significantly greater than T5, while the body weight of T4 was not significantly different from T1, T2, T3, and T5. The body weight with the highest average value was treatment T3, 1049.60 g/head, and the body weight with the smallest treatment T5, 1024.58 g/head. Giving maggot flour by 14% can increase the body weight of KUB chickens. Increased use of maggot flour by 28% resulted in decreased body weight in KUB chickens. This is in line with the statement of Tribudi *et al*. (2022) that the use of more than 25% maggot flour has an impact on reducing feed consumption, weight gain, and increasing ration conversion rates.

Maggot flour has an amino acid profile similar to soybean flour, namely cystine, and methionine so it will optimize chicken growth. In addition, BSF maggot flour has a higher content of essential amino acids for poultry, namely the amino acid lysine, amino acid lysine, and methionine, the two main limiting amino acids in chicken rations. The amino acid lysine is

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needed by chickens for growth, namely in the process of fat metabolism in the formation of good meat-forming body tissues, and has a role in forming carnitine, which functions as a growth driver. Even though it has several advantages, using maggot flour in the ration must still be considered. Based on the research results, the use of maggot flour above 25% has an impact on reducing the digestibility rate of dry matter (DM), energy, and protein due to high crude fiber content, rations with high crude fiber content can reduce poultry productivity (Leeson, 2012).

Feed type, environment, strain, and feed consumption influence body weight. In this study, feed consumption in treatment E decreased compared to other treatments. According to Horhoruw & Rajab (2019), ration consumption reflects the entry of several nutrients into the chicken's body. The level of ration consumption affects the growth rate and final body weight because the formation of body weight results from feed consumed by livestock to produce good body weight.

The effect of treatment on carcass weight

The results of the analysis of KUB chicken carcass weights from each treatment showed significantly different values ($P<0.05$) (Table 4). The weight carcass of the T3 treatment differed significantly from the E treatment but not significantly from the T1, T2, and T4 treatments. The carcass weight with the highest average value is treatment T3 of 715.49 g/head, and the weight of the carcass with the smallest average is treatment T5 of 683.87 g/head. Giving maggot flour as much as 14% can increase the weight of KUB chicken carcasses. An increase in the use of maggot flour by 28% decreased carcass weight in KUB chickens. This is in line with the resulting body weight. The addition of BSF maggot flour to the level of 14% resulted in a higher body weight, while the addition to the level of 28% decreased KUB chickens' body weight.

Several factors influence the weight of the carcass. One of the factors that affect carcass weight is the weight of life. Increased weight is positively correlated with carcass weight. Carcass weight achievement depends on body weight and body weight gain. Body weight gain is caused by the balance of amino acids in tissues whose feed protein consumption is directly related to growth (Winedar, 2006). Maggot flour itself is rich in protein; therefore, the growth of carcass weight produces good quality depending on the level of feeding, where if it gives more than the limit, then it will result in carcass quality that is not optimal (Hidayat & Asmarasari, 2015; Hidayat *et al*., 2017).

The effect of treatment on the carcass percentage

The results of the study's effect of adding BSF maggot flour in the ration on the percentage of KUB chicken carcasses can be seen in Table 4. The results of the percentage analysis of KUB chicken carcasses from each treatment showed different values non-significant ($P>0.05$). The average percentage of KUB chicken carcasses with the addition of BSF maggot flour ranged from 66.75-68.40%. The treatment does not affect the percentage of carcass but can be maintained. The average percentage of KUB chicken carcasses aged 12 weeks in this study was higher than the research by (Komarudin *et al*., 2021), resulting in an average percentage of KUB chicken carcasses of 61.12-64.10%. Adding BSF maggot flour containing lysine and methionine amino acids can increase muscle growth in KUB chickens. The amino acids lysine and methionine can contribute to muscle growth during maintenance. They further explained to (Bunchasak, 2009) that methionine is superior to other amino acids. Methionine plays a role in helping other metabolism in the body, such as the metabolism of choline, protein, and carbohydrates. The amino acid methionine is necessary for rapid growth and all staple life of livestock, improving

protein synthesis, absorption, transport, and bioavailability of essential minerals (Bunchasak, 2009).

The effect of treatment on abdominal fat percentage

The percentage of abdominal fat with the highest ration value is treatment T5 of 0.91%, and the percentage of abdominal fat with the smallest average of treatment A is 0.73% (Table 4). Based on the diversity analysis results, adding BSF maggot flour significantly affects (P<0.01) KUB chickens' abdominal fat percentage.

The results of the DMRT test showed that the abdominal fat percentage of treatment T5 was very different (P<0.01) from treatment T1 and T2, significantly different (P<0.05) from treatment T3. Treatment T4 was significantly different (P<0.0 5) from treatment T1 and T2. This showed that adding as much as 28% maggot flour caused an increase in abdominal fat percentage in KUB chickens. This is because the fat content of this maggot is quite large, which is 15.32%, so that it can cause an increase in the percentage of abdominal fat.

Abdominal fat is influenced by several factors, one of which is the fat content of the ration. When the fat in the ration increases, the abdominal fat percentage will increase. Excess energy from fat will be stored precisely under the skin and abdominal cavity. About 60% of total abdominal fat is in the form of fat solids. High fat is due to poor ration conversion because it takes more food to produce fat than meat (Amrullah, 2002).

CONCLUSION

Based on the results of this study, it can be concluded that the use of BSF maggot flour in the KUB chicken ration for the Finisher period can still be used up to the level of 14%. The use of maggot flour up to the level of 14% can increase body weight 1049.60g/head, carcas weight 715.49g/head, carcas percentage 68.16%, and abdominal fat percentage 0.77%. Adding maggot BSF flour to ration until 14% can replace using protein sources such as fish meal without adversely affecting broiler rations' efficiency.

CONFLICT OF INTERESTS

The authors declare that they do not have any competing interests.

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