EFFECT OF DEFATTED BLACK SOLDIER FLY LARVAE ON GROWTH PERFORMANCE AND COST ANALYSIS OF CROSSBREED VILLAGE CHICKEN

By

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(D20A0096)

A RESEARCH PAPER SUBMITTED IN PARTIAL

FULFILLMENT OF THE REQUIREMENT FOR THE

DEGREE OF DOCTOR OF VETERINARY MEDICINE

FACULTY OF VETERINARY MEDICINE

UNIVERSITI MALAYSIA KELANTAN

2024

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ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, in partial requirement on the course DVT 55204 – Research Project.

This study investigates the use of Defatted Black Soldier Fly Larvae (Def-BSFL) as a sustainable protein source for village crossbreed chicken or Ayam Kampung Kacuk (AKK) chickens to obtain growth performance & address rising feed costs. Thirty chickens categorized into treatment groups, (T1) 100% fed commercial feed, second were fed commercial feed supplemented with 5% (T2) and finally commercial feed and 10% (T3) Def-BSFL over nine weeks. Results showed significant differences in feed intake and feed conversion ratio (FCR), with 5% Def-BSFL achieving the highest intake but control diets demonstrating better FCR. However, body weight and daily gain showed no significant differences across diets. While Def-BSFL enhanced feed consumption, its impact on growth performance and efficiency was limited. Economic analysis suggests potential cost reductions and sustainable benefits for small-scale poultry farmers from cost analysis that was analyzed. This research aims to guide farmers in improving chicken performance together with adopting cost-effective, environmentally sustainable feeding practices.

Keywords*: Defatted Black Soldier Fly Larvae, intensive farming, growth performance, nutritional analysis*

ABSTRAK

Abstrak kertas penyelidikan yang dibentangkan kepada Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan, sebahagian daripada keperluan kursus DVT 55204 – Projek Penyelidikan.

Kajian ini menyiasat penggunaan Larva Lalat Tentera Hitam Tanpa Lemak (Def-BSFL) sebagai sumber protein mampan untuk ayam kampung kacuk (AKK) bagi meningkatkan prestasi pertumbuhan dan menangani peningkatan kos makanan. Tiga puluh ekor ayam dikategorikan ke dalam kumpulan rawatan, (T1) diberi makan 100% makanan komersial, kedua diberi makanan komersial yang ditambah dengan 5% (T2) dan akhirnya makanan komersial dan 10% (T3) Def-BSFL selama sembilan minggu. Keputusan menunjukkan perbezaan ketara dalam pengambilan makanan dan nisbah penukaran makanan (FCR), dengan 5% Def-BSFL mencapai pengambilan tertinggi tetapi diet kawalan menunjukkan FCR yang lebih baik. Namun, berat badan dan pertambahan harian tidak menunjukkan perbezaan ketara antara diet. Walaupun Def-BSFL meningkatkan pengambilan makanan, kesannya terhadap prestasi dan kecekapan pertumbuhan adalah terhad. Analisis ekonomi mencadangkan potensi pengurangan kos dan faedah mampan untuk penternak ayam berskala kecil daripada analisis kos yang dianalisis. Penyelidikan ini bertujuan membimbing penternak dalam meningkatkan prestasi ayam bersama-sama dengan mengamalkan amalan pemakanan yang menjimatkan kos dan mesra alam.

Kata Kunci: *Larva Lalat Tentera Hitam Tanpa Lemak, pertanian intensif, prestasi pertumbuhan, analisis pemakanan*

CERTIFICATION

This is to certify that we have read this research paper entitled **'Effect Of Defatted Black Soldier Fly Larvae On Growth Performance And Cost Analysis Of Crossbreed Village Chicken'** by Muhammad Fatih Bin Misebah, and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the course DVT 55204 – Research Project.

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ACKNOWLEDGEMENT

Special thanks to those who have given their support, guidance, advice, and aid for the completion of this project paper:

Dr. Amirul Faiz Bin Mohd Azmi

Dr Luqman bin Abu Bakar

Dr. Muhammad Ali Imran Bin Mohamed Kamil

Muhammad Fikri bin Kamaruzzaman

Ameer Rustam bin Alias

Lokman bin Jasni

Nur Aimi binti Ahmad Zaini

Family

DVM 5 class of 2025/2026

Thank You

DEDICATIONS

I write my dissertation as a tribute to my numerous friends and family. My loving parents, Misebah bin Sanjan and Lilnajipa binti Asngari, whose words of support and encouragement continuously keep ringing in my ears, deserve to be thanked.

I also thank my supervisors and seniors who have helped me by dedicating this dissertation to them. They helped me improve my abilities as a veterinary student, and I will always be grateful for everything they did, especially Dr. Amirul Faiz Bin Mohd Azmi, Dr Luqman bin Abu Bakar, Dr. Muhammad Ali Imran Bin Mohamed Kamil and Dr Murshidah Binti Mohd Asri.

I also want to thank my good friends Muhammad Fikri Bin Kamaruzzaman, Muhammad Ameer Rustam Bin Alias, Lokman Bin Jasni, Ahmad Jafni Bin Mohamad Hizad and Muhammad Amirul Shauqat & Nur Aimi binti Ahmad Zaini for their help with this research project. They have all been my most incredible supporters. I express my sincere gratitude to them.

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ABBREVIATION

Def-BSFL	-	Defatted Black Soldier Fly Larvae
BSFLM	-	Black Soldier Fly Larvae Meal
AKK	-	Ayam Kampung Kacuk
FCR	-	Feed Conversion Ratio
CP	-	Crude protein
kg	-	Kilogram
g	-	Gram
SEM	-	Standard Error of Mean
p-value	-	Sig.
ADG	-	Average Daily Gain

CHAPTER 1

1.0 INTRODUCTION

A greater demand for animal proteins as a result of rising global population and rising living standards in developing nations has driven up the price of materials used in animal feed, including fish meal, fish oil, soybean meal, and cereals. Fulfilling the increased demand, food production also increased, eventually lead to loss of other resources such as land, water and forests, as well as a notable burden on the global environment (Van Huis *et al*., 2013).

Animal production nowadays must search for innovative methods which can upgrade the future social, environmental and economic needs soon. With high protein and lipid contents and a strong source of vitamins and minerals similar to soybean and fish meal, black soldier fly larvae (BSFL) have become a promising alternative source of nutrients. Through partial replacement of soybean and/or fish meals, black soldier fly larvae (BSFL) have the potential to lower the cost of chicken feed compositions which have a favourable feed conversion efficiency (Premalatha *et al*., 2011).

Defatted Black Soldier Fly (DBSF) larvae meal has high protein than normal BSFL is gaining recognition as a high-quality ingredient in poultry feed formulations, particularly for broilers. As a natural component of a chicken's diet, insects offer great promise as supplemental and alternative chicken food. By considering this, defatted BSF larvae meal can be an alternative protein sources and effectively utilized in broiler feed, contributing to sustainable and cost-effective poultry production.

1.1 RESEARCH PROBLEM

The village chicken which is primarily Ayam Kampung Kacuk (AKK) is one of the popular choices among local rearing or small farms as alternative to common industry broilers chicken breeds such as Ross and Cobb in Malaysia. The Ayam Kampung Kacuk breed also is sturdy and high disease resistant and well suited to Malaysian climate and many small farmers choose this breed as they broiler meat chicken replacement. The arising cost of commercial poultry feed & other raw materials especially throughout the country implicates the rearing costs. Black soldier fly larvae can provide an alternative source of protein and energy when fed defatted black soldier fly larvae as supplements to the AKK chicken. The potential increase growth performance, which can aid small farmers and poultry industries other than relying solely on commercial feed and eventually be cost effective primarily.

1.2 RESEARCH QUESTIONS

i. What is the effect of feeding Defatted Black Soldier Fly Larvae (Def-BSFL) as additional supplement on feeding with commercial feed towards growth performance of Ayam Kampung Kacuk.

ii. What is the final rearing cost of conducting Defatted Black Soldier Fly larvae (Def-BSFL) in small scale farming.

1.3 RESEARCH HYPOTHESIS

H0: Defatted Black Soldier Fly larvae did not improve the growth performance of local village chicken and did not give financial gain to farmer.

H1: Defatted Black Soldier Fly larvae has significant boost on growth performance of local village chicken and give financial gain to farmer.

1.4 RESEARCH OBJECTIVE

i. To compare growth performances of Ayam Kampung Kacuk fed with Defatted Black Soldier Flies Larvae

ii. To evaluate the overall cost of Ayam Kampung Kacuk fed with Defatted Black Soldier Fly Larvae and commercial feed.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 NUTRITIONAL PROFILE OF DEFATTED BLACK SOLDIER FLY LARVAE

Black Soldier Fly larvae *(Hermetia illucens)* are usually high in amino acids (AA) composition of BSFL is rich in methionine and lysine and is reported to be similar or even superior to soybean as animal feeding sources (Schiavone et al., 2017). Both defatted and full-fat BSFL have a rich amino acid profile and are thus considered a more sustainable protein source than conventional soybean meal (CSBM) or fish meal (Crosbie et al,. 2020).

When comparing the concentrations of arginine, alanine, methionine, histidine, and tryptophan in BSF larvae and soybean meal (based on g/16 g N), the larvae have a lower concentration of arginine and a larger concentration of these nutrients. On the other hand, the dried BSFL and defatted BSFL have some differences. The full-fat and defatted flours had high protein content (45.82% and 56.11% respectively). Defatting significantly ($p < 0.05$) increases the protein content by approximately 10%, while the fat content decreased from 25.78% in full-fat larvae to 4.8% in defatted larvae (Zozo et al., 2022). It was discovered that the whole larvae and defatted larvae both have high nutritional value, with 45.82% and 56.11% protein content, respectively. The author's research from the differences above also can be influenced by several factors such as larvae stage, chitin contain on larvae and other factors.

2.2 AYAM KAMPUNG KACUK (AKK) BREED AS ANIMAL MODEL

Ayam Kampung (village) chickens or *Gallus gallus domesticus*, brown broiler, silkie, and original kampung chickens complete the list (Azlina & Engku, 2021). These crossbreds mimic many of the phenotypic traits of the original kampung chickens, even though they grow larger than the originals. This breed is suitable to be rearing under intensive, semi-intensive and much more adaptable environments. Malaysians buy crossbred kampung chickens mainly for their body

weight, not fully feathered live birds like commercial white broilers, which are sold to customers as eviscerated dressed carcasses and cut-up parts. Crossbred animal especially chicken that combine traits from genetically unrelated breeds achieve many performances gain in efficiency. A study conducted in Indonesia, local crossbred chicken was produced after crossbreed making the breed a good candidate for productivity of village chicken (Takdir et al., 2014). In this study, chicken selected will be under observation in which their behaviour on feeding correlated with performance at the end of the project.

2.3 GROWTH PERFORMANCE

The study which will be conducted demonstrate supplying commercial feed of poultry using starter and growers together mixing them with defatted BSFL can increase broiler growth performance. Schiavone et al.,2017) demonstrated that defatted BSFL (*Hermetia illucens L.*) meals can be considered as an excellent source of apparent metabolizable energy (AMEn) and digestible AA for broilers, thus potentially resulting into a better efficient nutrient digestion. In fact, the chicks' weight quadruples, thus influencing the subsequent growth rate (Aviagen, 2016). It appears that the inclusion of 10% larva meal in partial substitution of soybean meal is suitable, as a feed ingredient, for broiler chicken diets during the starter period (Gajana et al., 2016). The primary causes of the nutritional differences are the defatting process and the insect-rearing medium, both of which can affect the concentrations of ether extract. (Elangovan *et al.,* 2021; Wang & Shelomi, 2017).

2.4 DIGESTIBILITY OF DEFATTED BLACK SOLDIER FLY LARVAE

Scientists have discovered that insects with softer bodies like silkworm larvae contain less chitin. The impaired feed efficiency observed in the broiler chickens fed 15% HI diet of the current trial may be attributed to the chitin contained in (*Hermetia illucen*) HI larvae, which is not digestible by monogastric animals. Thus, in defatted BSFL should be far more digestible for the monogastric chicken to be utilize by the body. Insect protein is more easily digested than plant-based protein when compared to other animal proteins. The gastrointestinal health benefits of this structural polysaccharide's prebiotic potential, for example, are well-established (Selenius *et al.,* 2018).

2.5 COST AND PROFIT ANALYSIS OF REARING CROSSBRED VILLAGECHICKEN FED WITH DEFATTED BSFL

The analysis of costs and profits is integral when evaluating the economic sustainability of using defatted Black Soldier Fly Larvae (BSFL) as feed for Crossbred Village Chickens. Research has shown that BSFL can significantly reduce feed costs compared to conventional ingredients such as soy and maize, making it an attractive option for poultry farmers in Asia (Chia & Goh, 2021; Tan et al., 2023). For example, a study by Nguyen et al. (2022) highlighted that BSFL not only lowered the overall cost of poultry feed but also enhanced feed efficiency, leading to higher profitability in Vietnamese farms. In addition to feed expenses, the analysis must consider other costs such as infrastructure, labor, and veterinary care, alongside income generated from selling the chickens, in order to assess overall profitability (Lee & Khoo, 2020).

Given the increasing demand for sustainable agricultural practices in Asia, where poultry farming faces challenges like rising feed prices and environmental concerns, understanding the financial implications of adopting BSFL is critical (Hassan et al., 2021). Therefore, conducting a thorough cost-profit analysis will provide poultry farmers and policymakers with valuable insights into whether BSFL can serve as a viable, cost-effective, and eco-friendly alternative feed source.

CHAPTER 3

3.0 MATERIALS AND METHOD

3.1 STUDY DESIGN OF INTENSIVE FARMING ON EFFECT OF DEFATTED BLACK SOLDIER FLY LARVAE ON GROWTH PERFORMANCE AND COST ANALYSIS OF CROSSBREED VILLAGE CHICKEN.

An experiment of intensive farming on effect of defatted black soldier fly larvae as feed towards the growth performance and cost of rearing village chicken was carried out at Teaching Farm, Faculty of Veterinary Medicine, Universiti Malaysia Kelantan, 16310 Bachok Kelantan. 16310 Bachok Kelantan.

The chickens were divided into three groups which is Control A, 5% Defatted BSFL and 10% Defatted BSFL. Intensive cage system consists of three steel cages that accommodate total of 10 chicken for each treatment which will be used throughout 42 days of rearing and additional 21 days. They were given defatted black soldier fly larvae meal and commercial poultry diet calculated according to their increasing need of feed intake every week.

The data collection consists of weight gain, leftover feed, feed conversion ratio (FCR), average size of growing chicken were taken as image to evaluate the performance and later the cost analysis of feed given to the experimental animal.

3.2 ETHICAL CONSIDERATIONS

In this study, research ethic was approved by the institution to carry out experiments for Effect of Defatted BSFL on growth performance on crossbred village chicken under the approval code UMK/FPV/ACUE/FYP/017/2024.

3.3 EXPERIMENTAL ANIMAL

The chickens were divided into 3 groups consisting of 2 replicates and with 5 chickens per group n=30. The first group is the control group fed with standard commercial poultry diet starter & grower only which is control (C) group. Next group will be, 5% of black soldier fly larvae mix with commercial poultry diet (T1) and final group will be 10% black soldier fly larvae mix with commercial poultry diet (T2). During the experimentation, the body weight of chickens were recorded weekly. Amount of feed given (g) was recorded daily to monitor feed intake by the chickens. After 63 days, the final weight of chickens were taken and at the end of the conducted experiment, all the chickens were euthanised by exsanguination. Finally, each body part of the carcass were measured and weight for data collection. *Table 3* shows each treatment of Def-BSFL throughout 9 weeks of rearing.

3.4 PREPARATION OF DEFATTED BLACK SOLDIER FLY LARVAE MEAL & COMMERCIAL DIET

Defatted black soldier fly larvae meal were ordered and prepared by company which was selected to obtain the product. Different from original black soldier fly larvae, the meal was extracted their lipids under high pressure mechanical machine and become powder form. Same with commercial diet, starter and grower formulation diet obtained and these feeds weighed and calculated to equally distributed to the experimental animal.

3.5 PROXIMATE ANALYSIS OF DEFATTED BSFL AND BROILER FEED FORMULATION

The village chicken broiler feed formulation were first conducted proximate analysis to measure the composition of feed according to their gross composition and the treatments. Procedure was conducted in feed laboratory based on UMK Kampus Jeli, Kelantan.

3.6 FEED COST ANALYSIS (FCA)

Feed Cost Analysis (FCA) initially calculated in which according to the requirement of feeding cost/kg on live weight gain of model animal, the crossbred village chicken (AKK). Required cost consists of basic diet on commercial concentrate diet starter feed, commercial concentrate diet grower feed and defatted BSFL as supplementation. Indicated prices are varies (RM/kg) in which focuses on:

1) Live crossbred village chicken (AKK)
2) Commercial Concentrate Diet (Starter)
3) Commercial Concentrate Diet (Grower)
4) Defatted Black Soldier Fly Larvae (DBSFL)
5) Commercial Concentrate Diet (Starter) mix with 5% defatted BSFL
6) Commercial Concentrate Diet (Grower) mix with 5% defatted BSFL
7) Commercial Concentrate Diet (Starter) mix with 10% defatted BSFL
8) Commercial Concentrate Diet (Grower) mix with 10% defatted BSFL

3.7 PRE- AND POST- POULTRY MANAGEMENT

There are several important takes that must be take into consideration when conducting or rearing poultry management. It is crucial as it ensures productive efficiency and sustainability when rearing such animals.

3.7.1 PRE-POULTRY MANAGEMENT

Maximum profitability of broiler raisings is related with the broiler performance however maximum performance of broiler is not necessary to be the cheapest cost of production (Tangendjaja ,2013). Selection of poultry breed is the initial procedure as hybrid such as the Cobb and Ross broiler commonly used for best growth and feed conversion ratios. In this case, village chicken crossbreed or AKK was selected. Next, housing and facility design focusing on modern poultry houses. In Teaching Farm, UMK Kampus Bachok it has several small poultry houses indicated for small rearing of chickens with standardized biosecurity, ventilation, temperature control and humidity, and efficient space usage to observe best bird growth performance. Noted that the farm has biosecurity measures such as fencing and foot dip before entering certain area.

Feeding management are key components on a successful growth strategy of the chickens. Selection of feed such as Defatted BSFL and commercial poultry diets when mixed are expected to enhance the growth of the experimental animal. Furthermore, all the chickens especially during Day of Chicken (DOC) were vaccinated to be free from disease such as Newcastle Disease, Infectious Bursal Disease, and Avian Influenza.

3.7.2 POST-POULTRY MANAGEMENT

The production of halal meat according to halal system requires good animal husbandry practices particularly on the animal welfare aspect starting at the farm level (Fazly et. al, 2019). At the final day of experimenting, all the animals were slaughtered in humanely procedures according to Halal Standards and went to be processed to perform defeathering, evisceration, and separating them into body parts to be assessed in which related to the growth performance to be included in data collection. Next, proper disposal of manure and poultry wastes generated throughout the rearing and slaughtering are important for environmental sustainability and were taken care of according to the farm standards.

CHAPTER 4

4.0 RESULTS AND DISCUSSION

Table 2 compares the nutritional composition of experimental diets formulated for the study. The inclusion of defatted Black Soldier Fly Larvae (BSFL) in the diets resulted in slight variations in energy, crude protein, crude fat, fiber, ash, moisture and dry matter content across the different treatment groups (T2 and T3) and feeding phases (Starter and Grower).

4.1 NUTRITIONAL COMPOSITION OF FEEDS BASED ON DRY MATTER BASIS

Table 1: Nutritional composition of feeds based on dry matter basis

TYPE		**T1**		**T2**		**T3**	
NO.	**PARAMETER**	**STARTER**	**GROWER**	**5% + S DEF BSFL**	**10% + S DEF BSFL**	**5% +G DEF BSFL**	**10% +G DEF BSFL**
1	Energy (kcal/100g)	346.00	370.00	350.00	356.00	373.00	367.00
2	Dry matter (DM%)	87.60	90.00	88.50	88.70	90.10	89.60
3	Crude Protein (%)	23.90	19.30	24.00	24.40	21.50	20.10
4	Crude Fat (%)	3.50	5.50	3.70	4.50	6.20	5.30
5	Crude Fiber (%)	1.30	1.50	1.80	1.60	1.90	1.70
6	Ash (%)	5.60	4.40	5.60	5.30	4.60	4.40
7	Moisture (%)	12.40	10.00	11.50	11.30	9.90	10.40

Note: **T1** = Control, **T2** = (5% Defatted BSFL, 95% Commercial Concentrate Diet), **T3** = (10% Defatted BSFL, 90% Commercial Concentrate Diet)

4.2 GROWTH PERFORMANCE.

Table 3 resulted the growth performance of crossbreed village chickens (AKK) fed with three dietary treatments (T1, T2, and T3) was evaluated over 63 days. The diets consisted of 100% commercial diet for T1 (Control), 95% commercial diet with 5% Defatted Black Soldier Fly Larvae (BSFL) for T2, and 90% commercial diet with 10% Defatted BSFL for T3. The results indicated significant differences in some parameters across the treatments which refers to **significance level of <0.05**.

The **average total feed intake** differed significantly ($p = 0.009$), with T2 (4.47 kg) having the highest feed intake, followed by T3 (4.06 kg) and T1 (3.35 kg). However, there were no significant differences in **initial body weight ($p > 0.05$)**, **final body weight ($p > 0.05$)**, or **body weight gain ($p > 0.05$)** across treatments, indicating similar growth performance in terms of weight.

The **feed conversion ratio (FCR)** was significantly different ($p = 0.001$), with T1 achieving the most efficient feed utilization (2.15), followed by T3 (2.61) and T2 (2.94). Parameters such as **average daily gain (ADG) ($p > 0.05$)** and **average body weight gain ($p > 0.05$)** showed no significant differences, highlighting uniform growth trends across groups. Significant differences were observed in **total feed intake per day ($p < 0.05$))** and **average body weight initial and final ($p < 0.05$)**, which may reflect the dietary variations.

Overall, while BSFL inclusion increased feed intake, its impact on growth performance and feed efficiency did not show consistent advantages compared to the control diet.

Table 2: Total feed intake, Initial body weight, final body weight, body weight gain, average daily gain, feed intake (DM kg/day), total feed intake per day (kg/day), and feed conversion ratio.

			T1	T2	T3		
		BSFL	-	5%	10%		
	TYPE	**COMMERCIAL DIET**	100%	95%	90%		
NO.	**PARAMETER**		**FINAL**	**FINAL**	**FINAL**	**SEM**	**p-Value**
1.	Total Feed Intake (TFI) (kg)		3.35^{c}	4.47^{a}	4.06^{b}	0.08	0.009
2.	Average Initial Body Weight (IBW) (kg)		0.044	0.041	0.043	0.07	0.163
3.	Average Final Body Weight (AVFBW) (kg)		1.61	1.59	1.64	0.41	0.912
4.	Average Body Weight Gain (ABWG) (kg)		1.57	1.55	1.59	0.42	0.921
5.	Average Daily Gain (ADG) (kg/day)		0.026	0.024	0.025	0.0007	0.676
6.	Total Feed Intake Per day (TFIPD) (kg/day)		0.05^{c}	0.07^{a}	0.06^{b}	0.02	0.000
7.	Feed Conversion Ratio (FCR)		2.15^{c}	2.94^{a}	2.61^{b}	0.09	0.001

Note: **T1** = Control, **T2** = (5% Defatted BSFL, 95% Commercial Concentrate Diet), **T3** = (10% Defatted BSFL, 90% Commercial Concentrate Diet), SEM (Standard Error of Means)

4.3 FIXED COST AND VARIABLE COST

Table 4 cost analysis highlights the impact of incorporating Defatted Black Soldier Fly Larvae (Def-BSFL) into poultry diets. Fixed costs (e.g., chick price) remained constant across treatments, while variable costs, particularly feed costs, increased with higher BSFL inclusion levels. T3 (10% BSFL) exhibited the highest total cost (RM 312.20), reflecting the additional expense of BSFL compared to the control (T1, RM 245.90). Despite the increased costs, the potential benefits of enhanced nutrition and growth performance justify further evaluation.

Table 3: Fixed cost and variable cost

			Price		
No	**Cost item**	**Unit**	**T1**	**T2**	**T3**
	A. Fixed cost				
1	Chicken	Chick	35.00	35.00	35.00
	B. Variable cost				
1	201p Starter	kg	10.50	10.20	9.90
2	202p Grower	kg	235.40	212.00	194.30
3	Def-BSFL	kg	-	36.50	73.00
	Total (RM)		**245.90**	**258.70**	**312.20**

Note: **T1** = (Control), **T2** = (5% Defatted BSFL, 95% Concentrated Diet), **T3** = (10% Defatted BSFL, 90% Commercial Concentrate Diet)

4.4 COST ANALYSIS (RM) OF ONE CROSSBREED VILLAGE CHICKEN IN DIFFERENT DIETS

Table 5 shows cost analysis for different diets, including the inclusion of defatted black soldier fly larvae (DBSFL), reveals significant economic insights into poultry feeding strategies. The total feed cost for 63 days per chicken varied across the diets, with T1 (Control) at RM 15.70, T2 (5% DBSFL) at RM 14.50, and T3 (10% DBSFL) at RM 17.53. The inclusion of 5% DBSFL in T2 reduced the total feed cost compared to the control diet (T1), suggesting that partial replacement of commercial feed with DBSFL can be cost-effective. However, at a 10% inclusion rate in T3, the feed cost increased, likely due to the higher cost of DBSFL (RM 9.03/kg). This demonstrates that while DBSFL has potential as an alternative protein source, its cost must be carefully balanced against its inclusion rate.

Gross return over feed cost, calculated as the difference between income from live weight gain (A) and total feed cost (B), was highest for T2 at RM 18.61, followed by T3 at RM 18.18 and T1 at RM 15.38. This indicates that T2 achieves the most efficient balance between feed cost and weight gain performance. Net profit, which accounts for both feed costs and fixed costs, further highlights the advantage of T2, showing the highest value at RM 6.64 compared to RM 5.92 for T1 and RM 4.41 for T3. Although T3 achieved the highest income from live weight gain (RM 25.44), its higher feed cost limited profitability. These results emphasize that a 5% inclusion rate of DBSFL is economically optimal among the tested diets.

The analysis underscores the potential of DBSFL as a sustainable and cost-effective protein source in poultry diets. However, the economic feasibility of its inclusion depends on the inclusion rate, feed cost management, and market price for chicken. While a 5% inclusion rate proved optimal, higher rates like 10% may not be viable unless DBSFL costs decrease. Moreover, fluctuations in chicken market prices can influence net profit margins and should be considered when evaluating feeding strategies.

In conclusion, incorporating 5% DBSFL (T2) in the diet of crossbreed village chickens offers the best balance between cost and profit, outperforming both the control diet and the 10% DBSFL diet. Future research should focus on

Table 4 : Cost analysis (RM) of 1 crossbreed village chicken in different diets.

	Diet		
	T1	**T2**	**T3**
A. Income from mean live weight gain 63 days (RM/63 day/ chicken)	RM 25.12	RM 24.64	RM 25.44
B. Cost of feeding in 63 days (RM/63 day/ chicken)			
Starter Feed (3 Weeks)	RM 1.47	RM 1.45	RM 1.50
Grower Feed (4 Weeks)	RM 14.23	RM 13.05	RM 12.33
Def-BSFL	-	RM 1.99	RM 3.70
Total feed cost in 63 days(RM/chicken)	RM 15.70	RM 14.50	RM 17.53
C. Fixed cost in 63 days			
Chicks (1)	RM 3.50	RM 3.50	RM 3.50
D. Gross return over feed cost (RM/63 day/ chicken)	RM 15.38	RM 18.61	RM 18.18
E. Net profit from mean live weight gain for 63 days (RM/63 day/chicken)	RM 5.92	RM 6.64	RM 4.41

Note: **T1** = (Control), **T2** = (5% DBSFL, 95% Commercial Concentrate Diet), **T3** = (10% DBSFL, 90% Commercial Concentrate Diet), Price Retrieved from: *Harga Ex-Farm Ayam Hidup Tahun (Julai), 2024.* Chicken price: RM16/kg; Starter feed RM 2.90/kg, Grower feed RM 2.90/kg, Def-BSFL RM 9.03/kg

A = Mean Average Body Weight Gain x Current AKK Market price (RM/kg)

B = [(Total Feed Intake starter or grower/ 10 chicken)] x Price of feed RM/kg

D = A – B

E = [Mean live weight gain (kg) x Current AKK market price (RM/kg)] – B – C

CHAPTER 5

5.0 DISCUSSION

The crossbred village chicken's experimental meals nutritional makeup shows minor variations between treatments, particularly when defatted Black Soldier Fly Larvae (BSFL) are added. There were minor changes in calories, crude protein, fat, fiber, and moisture content because of adding Def-BSFL. Since protein is necessary for muscle growth and fat provides energy, treatment T2 (5% Def-BSFL) and treatment T3 (10% Def-BSFL) had higher crude protein and fat concentrations than the control (T1). (Wicht et al., 2022) defatting treatments resulted in higher crude protein values than the full-fat treatment which beneficial to AKK chickens that were reared.

This could potentially lead to enhanced growth rates. Nonetheless, there were minor variations in the amount of ash and crude fiber, which could affect how well nutrients are absorbed and digested. Defatted Black Soldier Fly Larvae (BSFL) meal significantly enhances the protein content of poultry diets while reducing fat. Studies have shown that defatting increases protein levels by approximately 10%, with protein content reaching up to 56% in defatted samples (Wicht et al., 2022).

The growth performance study reveals that although feed intake rose with the addition of Def- BSFL, there were no appreciable improvements in body weight gain, final body weight, or average daily gain (ADG) across the treatments, despite these variations in nutritional content. (Van Loon et al., 2021) explained that inclusion of BSFL meal inclusion increase weight gain of birds fed with the meal.

This suggest that whereas Def- BSFL may increase feed intake, improved growth results and others. The control group (T1) demonstrated the most efficient feed use, which is consistent with the feed conversion ratio (FCR) data. The higher feed intake in T2 and T3 did not result in proportionately greater growth but potentially beneficial in some other way in other parameters although (Van Loon et al., 2021) stated ADG and FCR were not significantly affected by increasing inclusion levels of BSFLM.

The financial effects of adding BSFL to chicken diets are further shown by the cost analysis. Firstly, the prices of selling AKK chickens were noted depend on current market where this study referred to the price stated by Department of Veterinary Services Malaysia. (2024). *Harga ex-farm ayam hidup tahun 2024*. Treatments (T1, T2, and T3) for crossbred village chickens over 63 days reveals notable variations in feed costs, gross returns, and net profits. While T1 (control) had the highest total feed cost at RM 15.70 per chicken, T2 (5% Def-BSFL) recorded the lowest at RM 14.50, and T3 (10% Def-BSFL) had the highest at RM 17.53 due to the increased cost of BSFL supplementation. Despite slightly lower income from live weight gain in T2 (RM 24.64) compared to T1 (RM 25.12) and T3 (RM 25.44), the gross return over feed cost was highest in T2 (RM 18.61), followed by T3 (RM 18.18) and T1 (RM 15.38). The net profit was also highest in T2 at RM 6.64 per chicken, showing that moderate BSFL inclusion (5%) offers better cost efficiency, reducing feed expenses while maintaining profitability. In contrast, T3 (10% BSFL) incurred higher feed costs, resulting in the lowest net profit (RM 4.41), indicating that excessive BSFL inclusion may not be economically viable. These findings suggest that while BSFL can be a cost-effective feed ingredient, optimizing its inclusion level is crucial for maximizing financial returns.

In this study, we investigated how Def-BSFL potentially affect the local village chicken's ability throughout rearing. In comparison to a control group, the study observes to evaluate the idea that adding defatted BSF larvae to the food of chickens could considerably enhance their growth performance. The study's null hypothesis was that the local village chickens' growth performance would not be enhanced by feeding them defatted Def-BSFL. The underlying presumption that there is no direct effect is this hypothesis. In this study, we examined whether any observed variations in growth performance were caused by the presence of defatted BSF larvae or were just the result of chance. On the other hand, the alternative hypothesis suggested that local village chickens' growth performance would be considerably improved by Def-BSFL.

According to this statement, the chickens' growth metrics would be measurably improved by the larvae's use as an efficient meal supplement. To ascertain whether the data supported rejecting the null hypothesis, we employed a p-value threshold of <0.05 in our statistical analysis using One-Way ANOVA in IBM SPSS 26. One statistical metric that represent in evaluating the evidence against the null hypothesis is the p-value. A statistically

significant effect is indicated if the p-value is less than 0.05, which implies that the observed differences between the groups are unlikely to have happened by coincidence. The p-value that was obtained after running the pertinent statistical tests was higher than 0.05. This finding suggests that there is insufficient evidence in the data to rule out the null hypothesis. To put it another way, random variation rather than any treatment was probably the cause of the observed disparities in growth performance between the groups (those fed with defatted BSF larvae and the control group).

We maintain the null hypothesis (H_0) considering the statistical analysis. This indicates that there is insufficient statistical support to draw the conclusion that Def-BSF larvae enhance the growth performance of nearby village hens within the parameters of this investigation. Even though the study did not uncover a significant effect, it is crucial to remember that future research may yet produce more conclusive findings regarding the possible advantages of BSF larvae in chicken feed, possibly with larger sample sizes or various experimental designs. This experiment supports the arising scientific research where the utilization of insect meal as high-quality ingredients in chicken, pig and fish diets has grown rapidly (Sumbule et al., 2021) to support any new findings in the future.

The results highlight how crucial thorough statistical analysis is when assessing experimental treatments. Future research could examine different feeding techniques or the addition of additional factors that might affect how well chickens grow when fed Def-BSF larvae.

5.1 ENVIRONMENTAL AND OTHER FACTORS

The growth and general health of chickens are greatly influenced by environmental factors, such as temperature and humidity. Jiang et al. (2019) found that optimal temperature and humidity levels were crucial for improving growth performance in both broilers and local breeds of chicken, with deviations leading to significant health problems such as dehydration and reduced weight gain. Environmental influences can have a significant impact on the growth, feed conversion efficiency, and immunological response of broiler chickens in particular. High humidity levels have been linked to increased heat stress in chicken, which has been linked to lower feed intake, subpar growth, and increased fatality rates, according to

studies. Similarly, by raising metabolic expenditures, cold temperatures can hinder growth and immunological function, which is particularly detrimental for undeveloped chicks. Niemi et al. (2018) observed that chickens raised under high ambient humidity had lower feed conversion ratios, suggesting that moisture stress may lead to reduced feed intake and growth.

5.2 UNDERDEVELOPED CHICK

Often called "weak chicks" or "stunted growth" chicken, underdeveloped chicks are frequently the consequence of poor care in their early life phases. Smith et al. (2020) found that undernutrition during the early life stages, particularly in broilers, leads to permanent stunting, which impacts long-term growth and performance. Poor nourishment, insufficient temperature, and inappropriate handling during hatching are all examples of this. Furthermore, because some strains of poultry are more likely to have delayed growth or developmental problems, genetic factors may also play a role in the development of underdeveloped chicks. Rahman et al. (2019) showed that chicks with inadequate access to feed or water during critical periods of development exhibit reduced weight gain and growth stunting.

5.3 VISUALIZATION OF FEED PREFERENCES

Optimizing feed formulations and increasing growth rates in poultry requires an understanding of their feed preferences. Graham et al. (2019) observed that chickens exhibit a preference for grain-based feed over compound feed, which could influence their feed intake and growth performance.

Depending on the type of feed (grains, mash, or pellets) and how palatable it is, chickens will feed in different ways. Research has indicated that broilers and crossbred chickens exhibit unique dietary preferences that can affect feed conversion ratios, growth, and health. Dissanayake et al. (2020) used video observation and tracking technologies to study the feeding behaviors of chickens, showing that broilers tend to prefer certain feed types, affecting their overall performance.

In this study, observations have been conducted while rearing the chickens for 63 days. In the control group, feed intake is higher than 5% Def-BSFL & 10% Def-BSFL fed chickens this supports the statement that the chickens preferred more on grain visualisation since the

other two treatments mixed visualized grain and mesh in mixed proportions.

CHAPTER 6

6.0 CONCLUSION AND RECOMMENDATION

6.1 CONCLUSION

This study investigated the effect of defatted Black Soldier Fly Larvae (BSFL) inclusion in the diets of crossbreed village chickens, focusing on growth performance and cost analysis. The results revealed that the inclusion of 5% and 10% defatted BSFL in poultry diets led to slight changes in the nutritional composition, particularly in terms of crude protein and fat content. These modifications did not, however, significantly impact the growth performance of the chickens, as reflected in parameters such as body weight gain, average daily gain, and feed conversion ratio. While feed intake increased with BSFL supplementation, the growth outcomes did not show a proportional improvement.

From a cost perspective, incorporating BSFL resulted in higher feed costs, which in turn impacted the overall profitability of the farming operation. Although T1 (the control group) achieved the highest net profit due to lower feed costs, the increased feed expenses in T2 and T3 did not translate into significantly higher returns. Nevertheless, the positive nutritional aspects of BSFL, such as its high protein and fat content, suggest that its inclusion could be beneficial under specific conditions or in combination with other strategies aimed at enhancing poultry growth.

Addition of Def-BSFL to poultry diets did not result in directly substantial improvements in growth performance or feed efficiency although feed composition are varied, it offers potential as a supplementary poultry feed ingredient which slightly improve performances while cost perspectively, T2 resulted in better net profit (36.89%) although not as high different from T1 (30.83%) and T3 (20.97%) which also must take considerations of current market prices and expenses which could varies years to years and thus, determination of feed formulation is important with management strategies to enhance optimum yield and overall cost at the end

6.2 RECOMMENDATIONS

To improve nutrient retention and growth performance, future research should concentrate on optimizing poultry feed formulations by investigating dried BSFL as an alternative to defatted BSFL meal. Feed efficiency could be further increased by combining BSFL with other protein sources and assessing various inclusion levels. Furthermore, more statistically sound data from experimental trials with a larger number of hens would provide a better understanding of the overall efficacy of BSFL as a feed supplement. Determining long-term impacts on growth, feed efficiency, and chicken health may also be aided by extending the study period beyond nine weeks.

The digestibility and bioavailability of nutrients in meals based on BSFL, including their effects on gut flora, fatty acid composition, and amino acid profiles, should be evaluated in future research. To assess the long-term cost-effectiveness of BSFL supplementation, taking market conditions and ingredient price fluctuations into account, a more thorough economic feasibility study is required. Finally, studying how large-scale BSFL farming affects the environment may shed light on how it relates to circular economy principles, waste minimization, and sustainable poultry production. Future studies can improve the use of BSFL in chicken feed by addressing these factors, supporting economical and environmentally friendly agricultural practices.

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8.0 APPENDICES

Figure 1: Worktable for feed preparations.

Figure 2: Setting up cage with the help of supervisor.

Figure 3 : Day of Chicken (DOC)

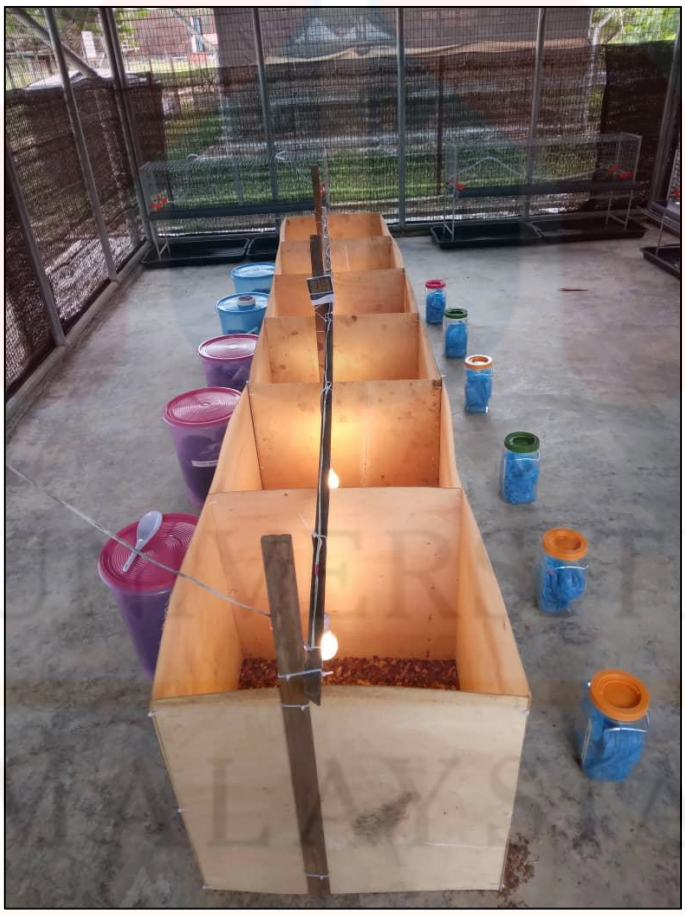

Figure 4: Brooder for chicks.

Figure 5: Broiler starter feed

Figure 6: Broiler grower feed.

Table 5: Control treatment, 5% Defat-BSFL and 10% Defat-BSFL for 1st week.

1st week		
Control	5% Defat-BSFL	10% Defat-BSFL
		

Table 6: Control treatment, 5% Defat-BSFL and 10% Defat-BSFL for 3rd week.

3rd week		
Control	5% Defat-BSFL	10% Defat-BSFL
		

Table 7: Control treatment, 5% Defat-BSFL and 10% Defat-BSFL for 9 week

9 week		
Control	5% Defat-BSFL	10% Defat-BSFL
		

Figure 7: Caging system for brooder & adult broiler

Figure 8 : Final day and exsanguination of AKK Broilers

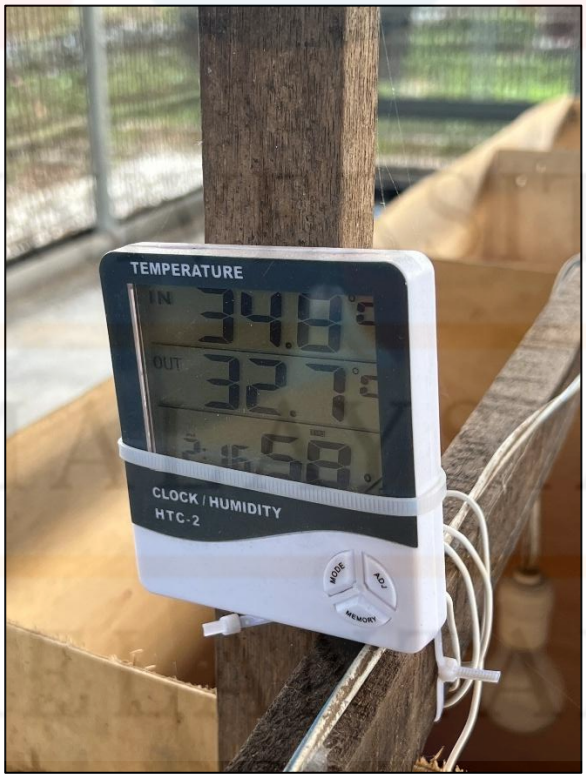

Figure 9: Temperature & humidity clock

Figure 10: Post rearing cleaning & disinfection

Figure 11: Tagging of each chicken with adjustable strap.

Figure 12: Anti-stress vitamin for the chickens.

Figure 13: Rearing of the AKK chickens.

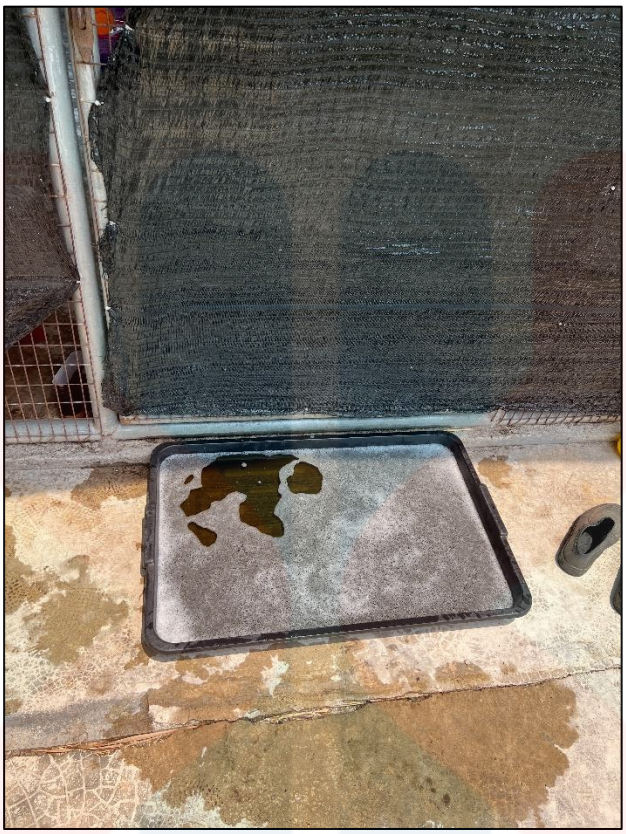

Figure 14: Foot dip before entering pen.

Figure 15: A chick undeveloped wing from control group.