

# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH

2026, Vol. 7, No. 6, 2683 – 2695

<http://dx.doi.org/10.11594/ijmaber.07.06.24>

## Research Article

### Growth, Laying Performance, and Egg Quality of White Leghorn Chickens Supplemented with Live Black Soldier Fly (*Hermetia illucens*) Larvae Under Litter Floor Rearing System

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#### Article history:

Submission 19 February 2026

Revised 15 June 2026

Accepted 23 June 2026

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#### ABSTRACT

This study was conducted in Mati, San Miguel, Zamboanga del Sur to evaluate the growth performance, laying performance, and egg quality of White Leghorn chickens supplemented with Black Soldier Fly Larvae (BSFL) under a litter floor rearing system using a Completely Randomized Design (CRD). Sixty (60) ready-to-lay chickens were randomly assigned to four treatments with three replications of five birds each. Treatment 1 received 100% commercial feed, while Treatments 2, 3, and 4 were supplemented with 15%, 20%, and 25% BSFL, respectively. Data collected included average daily gain, feed intake, feed conversion ratio (FCR), egg production, hen-day egg production, egg weight, egg size (length and width), shape index, yolk diameter and height, yolk index, and yolk color. All data were analyzed using Analysis of Variance (ANOVA) through the Statistical Tool for Agricultural Research (STAR). Results revealed that growth performance (average daily gain, feed intake, and FCR) exhibited only numerical differences and was not statistically significant ( $p > 0.05$ ) among treatments. However, laying performance and egg quality showed high statistical significance ( $p < 0.01$ ). Chickens supplemented with 20% BSFL (T3) recorded the highest egg production, hen-day egg production, egg weight, egg size, and improved FCR for egg production. Economic analysis indicated that 20% BSFL supplementation provided the most cost-effective return.

**Keywords:** *Black soldier fly larvae, Egg quality, Growth, Hen-day egg production, Laying performance, Supplementation, Yolk*

#### How to cite:

Tormes, E. D. & Dayama, J. M. C. (2026). Growth, Laying Performance, and Egg Quality of White Leghorn Chickens Supplemented with Live Black Soldier Fly (*Hermetia illucens*) Larvae Under Litter Floor Rearing System. *International Journal of Multidisciplinary: Applied Business and Education Research*. 7(6), 2683 – 2695. doi: 10.11594/ijmaber.07.06.24

## Background

The demand for sustainable protein sources in poultry production has led to a surge in interest in alternative feed ingredients. Among these alternatives, the Black Soldier Fly (*Hermetia illucens*) larvae have gained attention due to their high nutritional value and potential to substitute conventional protein sources in poultry diets (Spranghers et al., 2017). White Leghorn chickens are renowned for their high egg-laying capacity and economic importance in egg production (FAO, 2020). White Leghorn chickens, being prolific layers, represent a significant portion of the poultry industry, making them an ideal subject for research on alternative feed supplementation. The rearing environment plays a pivotal role in influencing their growth and laying performance. One such environment is the litter floor rearing system, where birds are raised on a bedding material spread over the floor. Studies have shown that the rearing system significantly affects the growth metrics of White Leghorn chickens. For instance, research indicates that pullets reared on deep litter floors exhibit higher body weights at various growth stages compared to those reared in cages. At 20 weeks of age, birds in deep litter systems had an average body weight of 1,472.66g, whereas those in cage systems averaged 1,402.94g (Sonkamble et al., 2020). This difference may be attributed to increased locomotor activity in litter-reared birds, leading to higher feed intake and subsequent weight gain. This system allows for natural behaviors such as scratching and dust bathing, potentially impacting both their productivity and welfare.

Chitin is one of the limiting factors in insect-based diets because high chitin consumption may negatively affect laying performance in chickens because chitin is a poorly digestible structural polysaccharide that interferes with nutrient digestion and absorption, particularly crude protein and amino acids needed for egg production. Studies reported that diets rich in chitin, such as shrimp meal-based feeds, resulted in deteriorated laying performance and reduced nitrogen utilization due to the low digestibility of chitin in poultry (Sangkaew et al., 2021). Furthermore, excessive chitin also acts

as an anti-nutritional factor by limiting the activity of digestive enzymes and reducing nutrient availability, which consequently decreases feed efficiency and egg production performance (Razdan & Pettersson, 2007).

Conventional poultry diets often rely heavily on soybean meal and fishmeal as primary protein sources. However, concerns over environmental sustainability, fluctuating prices, and dependency on imported ingredients have prompted researchers to explore alternative protein sources. While Black Soldier Fly larvae have shown promise as a sustainable protein alternative, limited research exists on their precise effects on the growth, laying performance, and egg quality of White Leghorn chickens (Cutrignelli et al., 2018). Understanding the optimal inclusion levels of Black Soldier Fly larvae in chicken diets is crucial for maximizing performance while ensuring economic feasibility and sustainability.

This research holds significant importance for both the poultry industry and sustainable agriculture. By evaluating the effects of Black Soldier Fly larvae supplementation on White Leghorn chickens, this study can contribute to the development of more sustainable and cost-effective poultry production practices. Furthermore, reducing reliance on traditional protein sources like soybean meal and fishmeal can alleviate pressure on global protein supply chains and mitigate environmental impacts associated with their production.

This study aims to investigate the effects of supplementing White Leghorn chicken diets with varying levels of live Black Soldier Fly larvae on growth, laying performance, and egg quality under litter floor rearing system. The primary objectives of this research are as follows: to compare the growth rates of White Leghorn chickens supplemented with different levels of Live Black Soldier Fly Larvae; to assess the laying performance including egg production as well as egg quality, in White Leghorn chickens provided with various levels of Live Black Soldier Fly Larvae; and to determine the potential economic benefits of utilizing Live Black Soldier Fly Larvae as dietary supplements in poultry production.

## Materials and Methods

### Time and Place of the Study

This study was conducted from December 24, 2024 to February 24, 2025 at Mati, San Miguel, Zamboanga del Sur as an investigation of the potential effects on Growth, Laying performance, and Egg quality of White Leghorn Chicken supplemented with different variations of Live Black Soldier Fly Larvae (LBSFL) under litter floor rearing system.

### Layout of Experimental Area

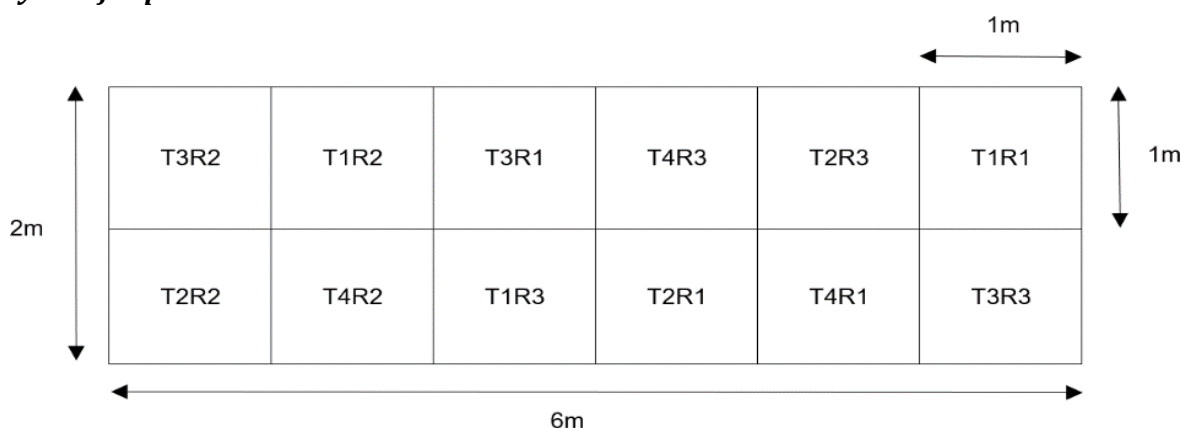


Figure I. The experimental layout of the study.

### Construction of Cages

A litter floor rearing system was employed in this study (Figure II). The poultry house was made up of poultry net, straw lace, lumber, bamboo, sacks, nails, and rice hull as litter material. There were 12 cages and each of which was about 1 meter in length, 1 meter in width

### Experimental Design and Treatments

The study was laid out in a Completely Randomized Design (CRD) with four (4) treatments, each treatment was replicated three (3) times.

The varying treatments were the following:

T1 – Pure Commercial Feeds

T2 – 15% of LBSFL

T3 – 20% of LBSFL

T4 – 25% of LBSFL

and 0.8m in height was used. Feeders and waterers were also prepared in each area at all times. Rice hull as litter material was evenly distributed to each cage.

Cages were thoroughly cleaned and disinfected before the introduction of chickens to the respective area to prevent illness and diseases.



Figure II. Construction of experimental cages.

### **Procurement of Experimental Birds**

Sixty heads of seventeen (17) – week – old or Ready-to-Lay (RTL) chickens were purchased in trustworthy layer raiser in Z-Layer Farm, Agunod, Calamba, Misamis Occidental. The chickens were transferred randomly to the respective treatment. Ring band was worn on to each individual bird for easy identification during data gathering.

### **Distribution of Experimental Birds**

Sixty Heads (60) heads of White Leghorn chickens were randomly distributed to each cage with five (5) chickens per replication.

### **Care and Feeding Management**

Prior to feeding, waterers and feeders were examined for pollutants and any foreign organisms that can cause illness and diseases to chickens. Upon the arrival, the chickens were allowed to drink electrolytes diluted in water to recover from any transportation stress. The area was secured by fence to prevent the entry of stray animals that can transmit any diseases and other predators that would attack the chickens. Clean drinking water was always available at all times and cleaning of waterers and feeders was also implemented. A restricted feeding system was employed on this study and feeding was done every morning and afternoon. The birds were given commercially prepared feeds in accordance to the age and need of the chickens. Vitamins was also given to ensure the health of the experimental birds three (3) times

a week. Replacement of litter material (rice hull) was strictly implemented and was done every week – also the way of removing dung to get rid of flies and a foul odor. Proper sanitation and management were observed during the entire duration of the study.

### **Production of Black Soldier Fly Larvae**

To culture Black Soldier fly larvae as feed supplements for chickens, it was started by procuring one-hundred (100) grams of Black Soldier Fly eggs in Nueva Ecija. Setting up a large container or bin with proper drainage to prevent waterlogging was done as preparation. The containers were filled with a substrate mixture of organic waste materials such as kitchen scraps, agricultural by-products, and livestock manure in 1:1:1 ratio. Ensure the substrate is moist but not soggy, maintaining a moisture content around 50-70%. The young Black Soldier fly larvae was introduced into the substrate as permanent food. Containers were kept in a shaded area with good airflow to promote optimal conditions for larval development. After 3 – 4 weeks the larvae matured and emerged into adult. The adult flies laid eggs in the provided organic matter in the bottom container.

After a few days, the eggs hatched into tiny larvae. Fresh batch of organic waste was provided for the growing larvae. Mature larvae were harvested when they reach the desired size, typically within 10-15 days.



*Figure III. Breeding cage and production set up.*

The harvested larvae were sieved thoroughly to remove any substrate residues before feeding to chickens. Substrates were regularly replenished and managed to sustain con-

tinuous larval production. Hygiene and sanitation were maintained throughout the process to prevent contamination and ensure the quality of the larvae as chicken feed.



Figure IV. Harvested black soldier fly larvae.

### Administration of Treatments

Treatment 1 was given 100% pure commercial feeds. Treatment 2, Treatment 3, and Treatment 4 were provided with 15%, 20%, and 25% of Live Black Soldier Fly Larvae per

kilogram of commercial feeds, respectively. Feeding live larvae directly was employed in this study and provided from the start until the termination of the study with daily replacement of unconsumed feeds (Figure V).



Figure V. Administration of live black soldier fly larvae (treatment).

### Data Collection

Data collection was conducted on a weekly basis starting from the initiation of treatment administration. Growth performance parameters were measured during the 1<sup>st</sup> and 2<sup>nd</sup> weeks of the study, as the birds were expected to start egg laying by the fourth week. This limited early monitoring was implemented to minimize stress and disturbance, which could potentially interfere with the chickens' physiological transition to laying and overall performance. Therefore, two weeks were given as resting period that allowed them to be physiologically prepared for laying. Furthermore,

laying performance parameters were recorded continuously from the onset of egg production until the end of the experimental period.

### Data Gathered

#### A. Growth Performance

##### 1. Average Daily Gain (ADG)

Weight was taken weekly. Weekly weight was subtracted by its initial weight divided by the number of supplementation days.

$$ADG = \frac{\text{Final weight gain} - \text{initial weight}}{\text{Number of days}}$$

2. Average Voluntary feed Intake (AVFI)

Weekly data was taken about the difference of given feed in a week by left-over feed divided by the total number of birds in a group/treatment.

$$AVFI, g = \frac{\text{Total Feed Given} - \text{Feed Refused}}{\text{Number of Birds}}$$

3. Feed Conversion Ratio (FCR)

This data was determined by dividing the total feed consumed by the live body weight of the chicken in the present week period.

$$FCR = \frac{\text{Feed Intake}}{\text{Average Daily Gain}}$$

produced during the experimental period by the total number of birds, and multiplied by 100.

$$\%HDEP = \frac{\text{average no. of eggs produced}}{\text{Total no. of live birds}} \times 100$$

3. Feed Conversion Ratio (FCR)

This data was determined by dividing the total feed consumed by the total egg produced of the chicken in the present week period.

$$FCR = \frac{\text{Feed Intake (kg)}}{\text{Total egg produced (dozen)}}$$

Feed Intake (kg) Total egg produced (dozen)

**B. Laying Performance**

1. Weekly Egg Production

*(Weekly egg production was the total no. of eggs produced in a week in each treatment).*

2. Hen-Day Egg Production (%)

The hen-day egg production was determined by dividing the total number of eggs

**C. Egg Quality**

1. Weight (g) of Eggs

Egg weights was measured in grams. In every group, all of the eggs that measured were calculated to get the egg weight average.

2. Egg length (mm)

3. Egg Width (mm)

*(Egg length and width were measured using vernier caliper.)*



Figure VI. Measuring egg using caliper.

4. Egg shape index (%)

For determination of shape index of eggs, the average width and length of the eggs was calculated and expressed using following formula:

$$\text{Egg Shape Index} = \frac{\text{Egg width}}{\text{Egg length}} \times 100$$

5. Egg yolk height (mm)

6. Egg yolk diameter (mm)

(Egg length and width were measured using vernier caliper.)



Figure VII. Measuring yolk height and diameter.

#### 7. Egg Yolk Index (%)

Egg yolk height and diameter were measured using vernier caliper. The yolk index was calculated by dividing the yolk height by the yolk diameter of the egg broken on flat surface.

$$\text{Egg Yolk Index} = \frac{\text{Yolk Height}}{\text{Yolk Diameter}} \times 100$$

#### 8. Yolk Color

The yolk color intensity was evaluated and scored according to the yolk color fan/chart.



Figure VIII. Identifying yolk color using color fan.

#### D. Net Profit

The Net profit was also determined using a formula:

$$\text{Profit} = \text{Income} - \text{Expenses}$$

#### Statistical Analysis

To make the findings and conclusions of the study valid, the raw data gathered was treated statistically using the following process:

The Analysis of Variance (ANOVA) in Completely Randomized Design (CRD) using software Statistical Tool for Agricultural Research (STAR) was used to test the validity of the

hypothesis that spelled out the significant differences among the four treatments. The Level of Significance among treatments was measured using Least Significant Difference (LSD).

#### Result and Discussion

##### A. Growth Performance

Table I presents the Average Daily Gain (gram), average voluntary feed intake (AVFI), and feed conversion ratio (FCR) of White Leghorn Chicken supplemented with varying levels of Black Soldier Fly Larvae. The results showed that supplementation of Black Soldier

Fly Larvae (BSFL) at different levels caused numerical differences but no significant effects on the growth performance of White Leghorn chickens in terms of average daily gain (ADG), voluntary feed intake (VFI), and feed conversion ratio (FCR) over the two-week period. The 20% BSFL group consistently showed favorable performance, recording the highest ADG, lower feed intake, and the most efficient FCR, indicating better nutrient utilization. Feed intake generally increased as birds grew, and all treatments demonstrated good acceptability of BSFL-based diets. The absence of significant differences suggests that BSFL can be used as an alternative protein source without negatively affecting growth or feed efficiency when diets are properly balanced. These findings are consistent with previous studies reporting

comparable growth performance, good digestibility, and efficient energy utilization in poultry fed BSFL (Schiavone et al., 2017; Cullere et al., 2016; Dabbou et al., 2018; Onsongo et al., 2018). However, slightly reduced performance at higher inclusion levels (25%) may be attributed to the chitin content of insect meals, which can limit nutrient digestibility when present in excess (Bovera et al., 2016). In addition, the presence of beneficial compounds such as antimicrobial peptides and lauric acid may contribute to improved gut health and feed utilization (Spranghers et al., 2018). The moderate variability observed among birds may be due to individual differences in metabolism, feed intake behavior, and adaptation to insect-based diets.

Table 1. Average Daily Gain (gram), average voluntary feed intake (AVFI), and feed conversion ratio (FCR) of White Leghorn Chicken supplemented with varying levels of Black Soldier Fly Larvae

TREATMENTS	INITIAL WEIGHTS (g)	ADG		AVFI		FCR	
		Week 1	Week 2	Week 1	Week 2	Week 1	Week 2
T1 - 100% CF	1,219	21	12	427	519	3.02	6.07
T2 - 15% BSFL	1,233	21	11	450	539	3.37	7.28
T3 - 20% BSFL	1,221	24	16	408	462	2.51	4.14
T4 - 25% BSFL	1,219	18	16	462	574	3.85	5.43
F-test	ns	ns	ns	ns	ns	ns	ns
%cv	2.46	28.87	27.28	7.02	14.09	24.47	21.65

ns = not significant

### B. Laying Performance

#### 1. Weekly Egg Production

Table II demonstrates that supplementing White Leghorn chickens with Black Soldier Fly Larvae (BSFL) significantly enhanced weekly egg production from Week 2 onwards, following a non-significant initial week. The T3 treatment (20% BSFL) consistently yielded the highest egg counts, peaking at 35 eggs in the final weeks, and significantly outperformed the control group (T1), while the T4 group (25% BSFL)

showed increased production but did not surpass T3. These findings corroborate research by Schiavone et al. (2017) and Marono et al. (2015) regarding the efficacy of insect meal replacements, though the lack of superiority in the 25% group aligns with Mwaniki et al. (2018), who caution that inclusion levels exceeding 20% may lead to diminishing returns due to amino acid imbalances or digestibility constraints.

Table II. Weekly Egg Production (no. of eggs) of White Leghorn chicken supplemented with varying levels of Black Soldier Fly larvae

TREATMENT	WEEK 1	WEEK 2	WEEK 3	WEEK 4
T1 - 100% CF	28	27 <sup>b</sup>	29 <sup>c</sup>	29 <sup>c</sup>
T2 - 15% BSFL	29	31 <sup>a</sup>	32 <sup>b</sup>	32 <sup>b</sup>
T3 - 20% BSFL	30	34 <sup>a</sup>	35 <sup>a</sup>	35 <sup>a</sup>
T4 - 25% BSFL	27	25 <sup>b</sup>	33 <sup>ab</sup>	34 <sup>a</sup>

TREATMENT	WEEK 1	WEEK 2	WEEK 3	WEEK 4
F-test	ns	**	**	**
%cv	9.48	7.19	3.77	1.97

Means with the same letter are not significantly different.

Means with different superscript are significantly different at  $p < 0.05$ . ns = not significant; \*\* = highly significant

## 2. Hen-Day Egg Production (%)

Table III presents the Hen-Day Egg Production of White Leghorn chickens supplemented with different levels of Black Soldier Fly Larvae (BSFL) and showed no significant differences in Week 1, but significant effects were observed from Weeks 2 to 4. The 20% BSFL treatment (T3) consistently recorded the highest production across all weeks, followed by the 15% (T2) and 25% (T4) treatments, while the control group (100% commercial feed) had the lowest values. Although the 25% BSFL group showed improved performance, it did not significantly outperform the 20% level. These results indicate that moderate BSFL inclusion enhances

laying performance and supports improved productivity. The findings are consistent with Schiavone et al. (2017) and Marono et al. (2015), who reported that BSFL meal can improve feed efficiency and effectively replace conventional protein sources without reducing egg production. However, the lack of additional improvement at higher inclusion levels agrees with Mwaniki et al. (2018), who noted that excessive BSFL (>20%) may lead to nutrient imbalances and reduced efficiency. Overall, the results suggest that 20% BSFL is the optimal inclusion level for maximizing Hen-Day Egg Production, while higher levels provide no significant additional benefits.

Table III. Weekly Hen-Day Egg Production (%) of White Leghorn chicken supplemented with varying levels of Black Soldier Fly larvae

TREATMENT	WEEK 1	WEEK 2	WEEK 3	WEEK 4
T1 – 100% CF	79	77 <sup>b</sup>	83 <sup>c</sup>	84 <sup>c</sup>
T2 – 15% BSFL	84	90 <sup>a</sup>	92 <sup>b</sup>	90 <sup>b</sup>
T3 – 20% BSFL	86	98 <sup>a</sup>	101 <sup>a</sup>	100 <sup>a</sup>
T4 – 25% BSFL	76	72 <sup>b</sup>	95 <sup>ab</sup>	99 <sup>a</sup>
F-test	ns	**	**	**
%cv	9.39	7.21	3.96	2.53

Means with the same letter are not significantly different.

Means with different superscript are significantly different at  $p < 0.05$ .

ns = not significant; \*\* = highly significant

## 3. Feed Conversion Ratio (FCR)

Table IV outlines the Feed Conversion Ratio (FCR) of White Leghorn chickens supplemented with varying levels of Black Soldier Fly Larvae (BSFL) over a four-week period, revealing that while initial results in Week 1 showed no significant differences, subsequent data from Weeks 2 through 4 displayed statistically significant improvements ( $p < 0.01$ ). The T3 treatment (20% BSFL) consistently exhibited the best feed efficiency, maintaining the lowest FCR

values throughout the latter weeks (reaching 2.40 by Week 4), while T4 (25% BSFL) also showed improved efficiency by the final week. These results indicate that incorporating 20–25% BSFL positively influences feed conversion, a conclusion supported by Starčević et al. (2020) and Cullere et al. (2016), who validate BSFL as a sustainable, functional protein source that enhances poultry growth and nutrient utilization.

Table IV. Feed Conversion Ratio (FCR) on Egg Production of White Leghorn chicken supplemented with varying levels of Black Soldier Fly larvae

TREATMENT	WEEK 1	WEEK 2	WEEK 3	WEEK 4
T1 – 100% CF	3.05	3.12 <sup>bc</sup>	2.90 <sup>c</sup>	2.86 <sup>c</sup>
T2 – 15% BSFL	2.87	2.69 <sup>ab</sup>	2.60 <sup>b</sup>	2.63 <sup>b</sup>
T3 – 20% BSFL	2.81	2.45 <sup>a</sup>	2.38 <sup>a</sup>	2.40 <sup>a</sup>
T4 – 25% BSFL	3.20	3.37 <sup>c</sup>	2.52 <sup>ab</sup>	2.42 <sup>a</sup>
F-test	ns	**	**	**
%cv	9.94	8.94	3.63	2.01

Means with the same letter are not significantly different.

Means with different superscript are significantly different at  $p < 0.05$ .

ns = not significant; \*\* = highly significant

### C. Egg Quality

#### 1. Weight of Eggs (g)

Table V presents a study investigating the effects of Black Soldier Fly Larvae (BSFL) supplementation on egg weight in White Leghorn chickens. The study revealed that a 20% BSFL inclusion (T3) consistently resulted in the heaviest eggs throughout the trial period. This finding aligns with previous research by Schiavone et al. (2017), Marono et al. (2015), and

Mwaniki et al. (2018) indicating that BSFL meal can enhance nutrient absorption and provide a high-quality protein source, thereby improving egg size. While higher inclusion levels of 25% BSFL (T4) also increased egg weight compared to control groups, they did not significantly outperform the 20% level, suggesting that a 20% BSFL inclusion is optimal for maximizing egg weight.

Table V. Weekly egg weights (g) of White Leghorn chicken eggs supplemented with varying levels of Black Soldier Fly larvae

TREATMENT	WEEK 1	WEEK 2	WEEK 3	WEEK 4
T1 – 100% CF	54.61	55.36 <sup>b</sup>	55.62 <sup>b</sup>	55.11 <sup>c</sup>
T2 – 15% BSFL	54.99	55.88 <sup>b</sup>	55.85 <sup>b</sup>	54.88 <sup>c</sup>
T3 – 20% BSFL	56.94	58.72 <sup>a</sup>	60.76 <sup>a</sup>	61.66 <sup>a</sup>
T4 – 25% BSFL	55.23	57.36 <sup>ab</sup>	55.99 <sup>b</sup>	57.77 <sup>b</sup>
F-test	ns	*	**	**
%cv	2.34	2.16	1.47	1.21

Means with the same letter are not significantly different.

Means with different superscript are significantly different at  $p < 0.05$ .

ns = not significant; \* = significant; \*\* = highly significant

#### 2. Egg length and width (mm)

Table VI presents the effects of Black Soldier Fly Larvae (BSFL) supplementation on egg quality in White Leghorn chickens, revealed nuanced impacts on egg characteristics. While a 20% BSFL inclusion (T3) led to the greatest egg length and width, other parameters, such as egg shape index, yolk height and diameter, and yolk index, showed no significant differences across treatments. Yolk color also remained consistent, falling within the light-yellow category across all treatments. These findings align with previous research

(Hwangbo et al., 2009; Mwaniki et al., 2018; Schiavone et al., 2019) suggesting that BSFL can serve as a viable alternative protein source without negatively impacting most egg quality traits. The study supports the potential of BSFL in sustainable poultry nutrition, as it can be incorporated into poultry diets to enhance certain egg dimensions without compromising overall egg quality, though factors like carotenoid content may influence yolk pigmentation (Maurer et al., 2016; Hammershøj & Kidmose, 2016).

Table VI. External measurements, Yolk measurements and color of White Leghorn chicken eggs supplemented with varying levels of Black Soldier Fly larvae

TREATMENT	External			Yolk			
	Length	Width	Index (%)	Height	Diameter	Index (%)	Color
T1 – 100% CF	54.88 <sup>b</sup>	42.11 <sup>b</sup>	76.73	14.27	35.97	39.65	7.67
T2 – 15% BSFL	54.99 <sup>b</sup>	42.22 <sup>b</sup>	76.78	15.47	35.90	43.10	6.33
T3 – 20% BSFL	56.22 <sup>a</sup>	43.10 <sup>a</sup>	76.67	15.00	36.97	40.57	6.33
T4 – 25% BSFL	55.51 <sup>ab</sup>	42.41 <sup>b</sup>	76.40	16.23	36.50	44.55	7.33
F-test	**	**	ns	ns	ns	ns	ns
%cv	0.6874	0.4434	0.8548	5.31	4.12	5.14	15.05

Means with the same letter are not significantly different.

Means with different superscript are significantly different at  $p < 0.05$ .

\*\* = highly significant.

#### D. Net Profit

Table VII presents the net profit of rearing White Leghorn chickens under different dietary treatments. Among the treatments, T3 (20% BSFL inclusion) generated the highest net profit (₱5,663.83), followed by T2 (15% BSFL; ₱4,989.83) and T4 (25% BSFL; ₱4,842.83). The control treatment, T1 (100% commercial feed), recorded the lowest profit (₱2,897.50) despite having the highest production cost (₱6,775.50).

The higher profitability of BSFL-based diets was primarily due to their lower feed expenses and increased egg sales compared with the control treatment. Although T4 also reduced production costs, its profit was slightly lower than T3 because of reduced egg sales. These results indicate that incorporating 20% BSFL in the diet is the most economically advantageous feeding strategy, providing the greatest return while maintaining lower production costs.

Table VII. Net profit of White Leghorn Chicken across treatments.

TREATMENTS	SALES OF EGGS (pesos)	SALES OF CHICKENS (pesos)	GROSS INCOME (pesos)	EXPENSES (pesos)	Profit
T1 – 100% CF	₱2,173.00	₱7,500.00	₱9,673.00	₱6,775.50	₱2,897.50
T2 – 15% BSFL	₱3,482.00	₱7,500.00	₱10,982.00	₱5,992.17	₱4,989.83
T3 – 20% BSFL	₱4,156.00	₱7,500.00	₱11,656.00	₱5,992.17	₱5,663.83
T4 – 25% BSFL	₱3,335.00	₱7,500.00	₱10,835.00	₱5,992.17	₱4,842.83
<b>TOTAL</b>	<b>₱13,146.00</b>	<b>₱30,000.00</b>	<b>₱43,146.00</b>	<b>₱24,752.01</b>	<b>₱18,393.99</b>

#### Conclusion

In conclusion, this study indicates that a 20% Black Soldier Fly Larvae (BSFL) supplementation (T3) in White Leghorn chicken diets offers a balanced approach to enhancing productivity and maintaining egg quality. While 20% BSFL showed potential for improving growth and significantly enhanced weekly egg production, hen-day egg production, and feed conversion ratio from the second to fourth week, its effect on average daily gain was not statistically significant. This level of BSFL inclusion also resulted in significantly heavier and larger eggs, though other egg quality parameters remained unaffected. Economically, a 20%

BSFL inclusion provides a near-optimal return on investment, making it a cost-effective alternative for enhancing poultry production.

#### Recommendation

Based on the study's findings, it is recommended that White Leghorn chicken diets include 20% Black Soldier Fly Larvae (BSFL) to optimize growth, laying performance, and egg quality while ensuring cost-effectiveness. Further research should focus on the long-term effects of BSFL supplementation beyond a 20% inclusion level, its nutrient composition, and digestibility. Small-scale farmers and poultry producers are encouraged to explore local BSFL

production to reduce feed costs, and additional studies should assess consumer preferences and market acceptance of eggs from BSFL-fed hens to determine their market value.

### Acknowledgment

Sincere gratitude is expressed to everyone who contributed to the success of this research study. Deepest appreciation goes to the adviser, Emelyn D. Tormes, Ph.D., for her invaluable guidance and unwavering support throughout this journey and for providing a conducive environment for conducting this research.

Deep gratitude is also felt for the mentors and professors, whose expertise and encouragement have significantly contributed to the learning and growth. To the friends and classmates, thank you for your moral support and motivation, which kept inspired throughout this process.

Profound appreciation is extended to the beloved families for their unwavering love, prayers, encouragement, and financial support. Their constant support has been the greatest source of strength in overcoming challenges and achieving this milestone.

Lastly, deepest gratitude is extended to the Almighty for granting wisdom, strength, and perseverance throughout this research journey. Without guidance from above, this study would not have been possible.

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