


**EFFECT OF VARYING LEVELS OF PARTIALLY DEHYDRATED BLACK SOLDIER FLY (*Hermetia illucens*) LARVAE ON THE CARCASS YIELD OF BENGUET NATIVE PIGS**

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**ABSTRACT**

This study evaluated the effects of partially dehydrated Black Soldier Fly larvae (BSFL) on the carcass yield of Benguet native pigs. Nine pigs with an average initial body weight of  $18.51 \pm 0.48$  kg were assigned to three dietary treatments containing 0%, 5%, and 10% partially dehydrated BSFL as partial replacement for soybean meal. The feeding trial lasted for 35 days, during which pigs reached an average slaughter weight of  $30.45 \pm 0.84$  kg.

Results indicated that slaughter and dressed weights were not significantly affected by the inclusion of BSFL. However, dressing percentage significantly increased ( $p < 0.05$ ) with increasing BSFL inclusion. Pigs fed 10% BSFL obtained the highest dressing percentage ( $61.09 \pm 2.37\%$ ), compared with  $59.24 \pm 2.36\%$  for 5% BSFL and  $56.47 \pm 1.25\%$  in the control group. Backfat thickness and abdominal fat showed no significant differences.

The relative percentage of internal organs, including the heart, liver, spleen, kidney, and lungs were not significantly affected by the inclusion of partially dehydrated BSFL. Other observations suggest that partially dehydrated BSFL inclusion did not impose renal or hepatic burden, as kidney and liver weight remained within stable ranges, reflecting improved metabolic efficiency. Similarly, digestive organs and abdominal fat deposition remained statistically comparable across treatments. Primal cuts showed no significant differences among treatments. These findings suggest that a 10% inclusion of partially dehydrated BSFL can effectively replace soybean meal, optimizing carcass yield and nutrient utilization in native pigs' production.

**Keywords:** Native Pigs, Black Soldier Fly Larvae (BSFL), Protein Source, Carcass Evaluation, Partial Dehydration

## 1. INTRODUCTION

The integration of insect-based feeds in livestock production systems, particularly in pig production, has gained significant attention due to its potential to provide sustainable and alternative protein sources amid rising costs of conventional feeds like fish meal and soybean meal in the Philippines (Alimorin, 2025, p. 477; Briones & Espineli, 2025; Zhu et al., 2022). Swine production is a cornerstone of the Philippine livestock sector, providing approximately 60% of the country's total meat production and serving as a critical factor in ensuring national food security. Within the sector, native pig farming holds particular significance. Indigenous strains, such as Benguet native pigs, developed through the "Conservation Improvement and Profitable Utilization of the Philippine Native Pigs" program initiated by DOST-PCAARRD in 2014, play a crucial role in meeting local pork demand (Simon & Garcia, 2024).

The use of Black Soldier Fly Larvae (BSFL) as an alternative protein source not only addresses environmental concerns associated with conventional protein meals, but also offers a viable pathway to enhance the economic viability of pig farming in this region. The utilization of BSFL meal has shown promise in improving growth performance, carcass yield, and meat quality in finisher pigs (Chia et al., 2021). Numerous studies have demonstrated that the inclusion of BSFL in swine diets can positively influence intramuscular fat content and fatty acid composition, key determinants of meat quality (Zhu et al., 2022). This is particularly relevant for native pigs, which are known for their distinct meat characteristics and could benefit from dietary interventions that enhance these qualities.

The nutritional evaluation of BSFL as a feed ingredient for pigs, particularly concerning nutrient utilization, has been explored through various processing methods like hot-air, microwave, freeze, and infrared drying, which affect its efficacy as a protein source (Oh et al., 2024). These processing methods influence not only the nutritional availability but also the palatability and digestibility of the larvae, thereby impacting growth performance and carcass characteristics (Chia et al., 2021). However, the precise effects of partial dehydration on BSFL and its subsequent impact on the carcass yield and meat quality of Philippine native pigs, such as Tiaong, Kalinga or Benguet native pigs remain less explored. The exploration of partially dehydrated BSF as a feed component presents a unique opportunity to evaluate its impact on the amino acid profile and overall nutritional value of the pork produced, offering a more comprehensive understanding beyond conventional carcass yield assessments (Srikha et al., 2025).

This study aims to investigate the effects of partially dehydrated BSFL on the carcass characteristics and meat quality of Benguet native pigs, thereby providing important information

on the practical application of this sustainable feed ingredient in local swine production. This research specifically evaluates how varying inclusion levels of 0%, 5% and 10% of partially dehydrated BSFL in the diet influence carcass parameters, building upon findings that BSFL can effectively substitute soybean meal while potentially enhancing final carcass weights (Chia et al., 2021b; Seyedalmoosavi et al., 2022). This investigation contributes to understanding sustainable feed alternatives and processing of feed ingredients for indigenous pig breeds, and potentially leads to improved production performance and carcass yields.

## **2. MATERIALS AND METHODS**

### ***2.1. Ethical Compliance***

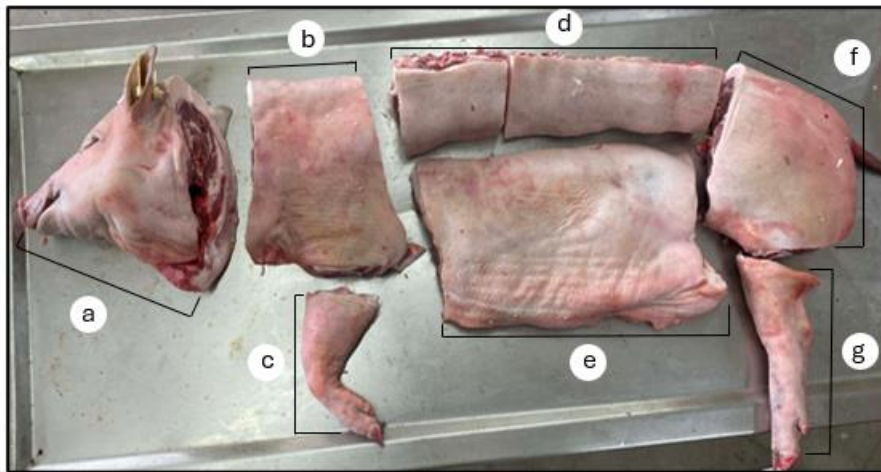
All protocols in this experiment were evaluated by the Institutional Animal Care and Use Committee (IACUC) of the Benguet State University, La Trinidad, Benguet and approved by the Bureau of Animal Industry (BAI) with reference number AR-2025-0466. The welfare of the experimental animals was strictly observed throughout the study.

### ***2.2. Experimental Animals, Design, and Treatments***

The experiment was laid out in a Randomized Complete Block Design (RCBD). The initial weight serves as the blocking factor, with each block serving as replication for each treatment combination. There was one pig housed in each cage unit. The animals were individually penned in a 0.75m x 1m metal cage. The metal cages are installed with nipple drinkers and feeding troughs. All experimental animals were subjected to the same care and management, except for the level of partially dehydrated BSFL (0%, 5%, and 10%) that were mixed on their diets. Depending on the treatment to which they were assigned.

Carcass evaluation was conducted after thirty-five days of growth trial, when the native pigs reached an average body weight of  $30.45 \pm 0.84$ kg. A total of nine pigs were randomly selected and fasted for 24 hours with *ad libitum* water. After fasting, the pigs were weighed and then slaughtered following standard procedures by Singh et al. (1998). The animals were first stunned using an electric stunner to render them unconscious and insensible to pain. Bleeding was performed immediately afterward, where the major blood vessels in the neck or chest were cut to ensure rapid and complete blood drainage. Next, scalding and dehairing were carried out, where the loosened hair was removed manually. Finally, evisceration was performed to remove the internal organs.

After slaughtering, the carcasses were then subjected to chilling for 24 hours to help firm the muscle tissues. This process also makes the carcass easier to identify and separate different cuts accurately (Nastasijević et al., 2018; Overholt et al., 2019). The chilled carcasses were thawed and measured for specific parts, then fabricated into shoulder, loin, belly, ham, and spare ribs. Their individual weights were subsequently recorded.



**Fig. 1: Sample of dressed and fabricated carcass**

*\* a) Head, b) Shoulder, c) Forelimb, d) Loin, e) Belly, f) ham, g) hindleg*

### **2.3. Data Gathered**

Carcass evaluation parameters;

2.3.1 Slaughter weight (kg). This is the weight of each pig after eight hours of fasting.

2.3.2 Dressed weight (g). This is the weight of the carcass after removal of the hair, head, viscera and feet.

2.3.3 Chilled carcass weight (kg). Dressed carcass that has been chilled in a refrigerator at 0-4°C for 24hrs after dressing.

2.3.4 Carcass length (cm). Carcass length is measured in a straight line from the forward edge of the first rib to the forward edge of the aitch bone.

2.3.5 Dressing percentage (%). This was calculated using the formula:

$$\text{Dressing Percentage} = \frac{\text{Dressed weight}}{\text{Slaughter weight}} \times 100$$

2.3.6 Backfat thickness (cm). This refers to the depth of subcutaneous fat measured over the longissimus dorsi muscle, at three standardized anatomical points: P1- first rib (just behind the shoulder), P2- last rib, and P3-last lumbar vertebra (near tail head). These measurements provide a representative profile of fat distribution along the carcass and are used to assess leanness, carcass quality, and market value. The average backfat thickness is computed using the formula:

$$\text{Average backfat thickness (cm)} = \frac{P1 + P2 + P3}{3}$$

2.3.7 Weight of major cuts (g). This is the individual weight of the shoulder, loin, belly, ham and spare ribs.

2.3.8 Major cuts yield (%). These are the yields of the shoulder, loin, belly, and ham after fabrication, expressed as a percentage of the carcass weight.

2.3.9 Weight of organs and by-products (g). These are the weights of visceral organs and non-carcass components collected during evisceration, such as liver, heart, kidney, spleen, lungs, stomach and intestines.

2.3.10 Percentage of organs and by-product (%). Refers to the relative proportion of edible organs (offal) and non-carcass components obtained after slaughter, expressed as a percentage of the live weight or dressed carcass weight.

$$\text{Percentage (\%)} = \frac{\text{Weight of organ or by-product}}{\text{Live weight or carcass weight}} \times 100$$

## **2.4. Data Analysis**

Data were analyzed using the analysis of variance (ANOVA) appropriate for randomized complete block design (RCBD). Differences between treatment means were compared using the Least Significant Differences (LSD) Test at 5% level of significance.

## **3. RESULTS AND DISCUSSIONS**

This study presents the findings, analysis and discussion of results on the carcass yield of Benguet native pigs fed ration with 0%, 5 % and 10% partially dehydrated Black Soldier Fly Larvae (BSFL).

### **3.1. Carcass Yield**

TABLE 1 presents the effects of varying levels of partially dehydrated BSFL on the slaughter weight, dressed weight, and dressing percentage of native pigs. Statistical analysis ( $p < 0.05$ ) showed that varying levels (0%, 5%, and 10%) did not significantly influence slaughter weight and dressed weight. However, significant differences ( $p > 0.05$ ) were observed in dressing percentage across treatments, 10% BSFL obtained,  $61.09 \pm 2.37$ ,  $59.24 \pm 2.36$  in 5%, and  $56.47 \pm 1.25$  from 0%, respectively.

The absence of significant differences in slaughter weight suggests that BSFL can partially replace conventional feed ingredients without compromising body weight. These findings align with the

study conducted by Makkar et al. (2014), Biasato et al. (2019), Hong and Kim (2022), where insect-based protein sources generally support comparable growth rates to soybean meal and fish meal when diets are properly balanced.

**Table 1: Slaughter, Dressed Weight and Dressing Percentage of the Native Pigs**

TREATMENT	SLAUGHTER WEIGHT	DRESSED WEIGHT	DRESSING PERCENTAGE
0% BSF	30.83 ± 2.01	22.45 ± 1.44	56.47 ± 1.25 <sup>b</sup>
5% BSF	29.63 ± 0.80	22.14 ± 0.46	59.24 ± 2.36 <sup>ab</sup>
10% BSF	30.30 ± 1.62	22.73 ± 0.44	61.09 ± 2.37 <sup>a</sup>

\*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least-square means of 3 observations for all treatments

Similarly, dressed weight values remained statistically consistent across all groups, indicating that BSFL inclusion does not negatively affect muscle deposition or overall carcass yield (Chia et al., 2021). The absence of significant differences in dressed weight further suggests that BSFL inclusion does not compromise carcass quality or dressing performance. This is consistent with the findings of (Srikha et al., 2025) in Thai native chicken, (Kirimi et al., 2023; Saidani et al., 2025b) in broiler chicken and hybrid pigs.

According to Saidani et al. (2025), inclusion of BSFL does not negatively affect, but often improves carcass traits and meat quality of livestock, including broilers, quails and pigs. (Seyedalmoosavi et al., 2022). These improvements are driven by a favorable amino acid profile, high protein digestibility and beneficial lipid composition of the insects (Cullere et al., 2016 and Biasato et al., 2019). Dressed weight is an important indicator of carcass yield and economic return (Encyclopedia of Meat Science, 2004). The comparable observation in the result suggests that BSFL inclusion does not compromise carcass quality.

Dressing percentage is a critical carcass trait as it reflects the efficiency with which live weight is converted into usable carcass, directly influencing meat yield and economic value. The group fed 10% partially dehydrated BSFL recorded the highest dressing percentage (61.09±2.37%), which was comparable to the 5% BSFL treatment (59.24±2.36%). Both treatments, however, exhibited significantly higher dressing percentage ( $p < 0.05$ ) than the 0% BSF group (56.48±1.25%).

The higher dressing percentage observed in the 10% BSFL group suggests that BSFL may improve carcass yield due to its high nutritional density. Full-fat BSFL or supplemental BSF oil provide an energy-dense lipid fraction that increases growth and feed efficiency (Boontiam et al., 2022; Van Heugten et al., 2022). Szczepanik et al. (2024) reported that piglets fed Black Soldier Fly (BSF)

larvae meal exhibited significantly enhanced nutrient absorption in the jejunum and ileum, which in turn improved their feed conversion efficiency. Zhu et al. (2022b) reported that pigs fed 8% BSFL had significantly greater backfat thickness and increased intramuscular fat content than 0% inclusion. This is supported by the study conducted by Phaengphairee et al. (2023), BSFL inclusion enhanced nutrient digestibility and feed efficiency, improved growth performance, leading to more efficient conversion of feed into carcass mass.

**Table 2: Backfat Thickness and Carcass Length of the Native Pigs (cm)**

TREATMENT	BACKFAT THICKNESS	CARCASS LENGTH
0% BSF	2.43 ± 0.30	52.66 ± 0.94
5% BSF	2.55 ± 0.13	52.53 ± 0.36
10% BSF	2.93 ± 0.23	52.43 ± 1.17

*Note.* \*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least-square means of 3 observations for all treatments

TABLE 2 presents the effects of varying dietary inclusion of partially dehydrated BSFL on backfat thickness and carcass length, which serve as indicators of fat deposition and skeletal development, respectively.

Statistical analysis indicated no significant differences ( $p > 0.05$ ) across treatments for either backfat thickness or carcass length. The stability in the backfat thickness suggests that BSFL inclusion at levels up to 10% does not significantly affect subcutaneous fat deposition compared to conventional diets. These findings contradict the findings of Zhu et al. (2022), where an 8% inclusion of BSFL significantly increased backfat thickness and intramuscular fat content in growing pigs. The difference may be attributed to the specific nutrient profile or energy density of the basal used in this trial. Diets with enhanced energy and protein content can increase lipogenesis once the requirements for lean tissue growth are met (Lawrence & Fowler, 2002). In monogastric animals, excess dietary energy is ideally stored as fat, which aligns with the observed increase in backfat thickness at higher BSFL levels. Previous studies have reported that insect-based meals can enhance carcass fat content due to improved nutrient digestibility and feed efficiency (Cullere et al., 2017; Makkar et al., 2014).

Carcass length remained relatively uniform across treatments (52.43±1.17 to 52.66±0.94 cm), indicating that BSFL inclusion did not significantly affect skeletal growth. Carcass length is largely determined by genetics and overall frame size and is less responsive to dietary manipulation once nutritional requirements for growth (National Academies Press, 1988). Similar observations have been reported in sheep performance (National Academies Press 1988b; Prache et al., 2021) and in

cattle carcasses (Fuerniss et al., 2023). This suggests that while partially dehydrated BSFL may influence tissue composition, particularly fat deposition, it does not alter linear skeletal growth.

### 3.2. Cut up Yield of Internal Organs

TABLES 3 and 4 present the effect of varying levels of partially dehydrated BSFL on the weight and relative percentages of selected internal organs. Statistical analysis revealed no significant differences ( $p > 0.05$ ) across all treatments for any organ, measured, including the heart, liver, spleen, kidney and lungs. The relative percentage of the heart remained statistically uniform across treatments. This consistency suggests that BSFL inclusion does not impose additional metabolic demand on the cardiovascular system. In support with the findings of Kierończyk et al. (2024), replacing soybean oil with Black Soldier Fly (BSF) fat did not result in any significant differences in heart weight.

**Table 3: Weight of Edible Offal in the Different Treatments (g)**

TREATMENT	Heart	Liver	Spleen	Kidney	Lungs
0% BSF	121.95±15	857.22±10	65.66±11	155.00±20	366.33±40
5% BSF	114.50±16	726.83±42	61.00±2	128.67±3	220.67±40
10% BSF	94.02±10	681.02±40	64.00±5	132.00±15	200.67±40

*Note.* \*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least square means of 3 observations for all treatments

**Table 4: Percentage of Edible Offal in the Different Treatments (%)**

TREATMENT	Heart	Liver	Spleen	Kidney	Lungs
0% BSF	0.39±0.01	2.65±0.09	2.11±0.11	0.49±0.02	1.90±0.11
5% BSF	0.38±0.01	2.53±0.09	2.10±0.11	0.44±0.02	0.74±0.11
10% BSF	0.31±0.01	2.30±0.09	2.04±0.11	0.43±0.02	0.65±0.11

*Note.* \*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least square means of 3 observations for all treatments

Richardson et al. (2025), mentioned that heart size is closely related to metabolic rate and overall body mass, thus, reductions in organ weight without compromise of slaughter weight may reflect improved metabolic efficiency rather than pathological effects. This is supported by Phaengphairee et al. (2022), who reported that BSFL diets do not negatively impact heart development in pigs.

A study reported by Ahmed et al. (2023) decrease in heart weight by 12.50% with the inclusion of 5% BSF. However, a study reported by Borgiono et al. (2022) with increase of 6.67% in the inclusion of insect meal. He added that heart tend to be heavier in groups with BSF larvae compared to controls.

Similarly, the liver percentage showed no significant differences, with values ranging from 2.39% to 2.65%. The liver is central to nutrient metabolism, and its size can fluctuate based on dietary protein and lipid quality (Li et al., 2024). The consistency observed indicated that the favorable amino acid profile and digestible lipids in BSFL do not induce hepatic stress or excessive enlargement (Biasato et al., 2019b). These findings align with previous studies suggesting that BSFL inclusion maintains normal internal organ health in livestock species (Wang & Shelomi, 2017; De Souza Vilela et al., 2021; Saidani et al., 2025; Isnaini, 2025). Ahmed et al., (2023) mentioned that liver weight may increase (+4.16%, +4.73%) and decreases (-4.14%, -4.57%) with BSFL inclusion. Another study found no significant differences in liver weight when BSF fat replaced soybean oil (Kierończyk et al., 2024). While Auza et al., (2021) reported that there were no negative effects on internal organs, including the liver, at certain BSF inclusion levels.

The relative percentage of the spleen (2.04% to 2.11%) and kidney (0.43% to 0.49%) were not significantly affected by the inclusion of BSFL. The spleen plays an important role in immune function and blood filtration, and a stable spleen weight indicates the absence of immunological stress or inflammation (Koutsos & Klasing, 2014). While some studies suggest that the chitin content in insects can act as an immunostimulant and increase spleen weight (Phaengphairee et al., 2022b), the current results indicate that the inclusion levels used did not significantly change spleen mass in native pigs.

Insect meal is known for its immunostimulatory properties, particularly due to its chitin content (Henry et al., 2017; Randazzo et al., 2021). Supporting this, Oddon et al., (2021) reported that birds fed insect larvae exhibited significantly higher spleen weights, which were linked to the immunostimulatory effects of chitin. Similarly, an increase in the weight of immune organs, including the spleen, was observed with higher supplementation of live BSF larvae (Bongiorno et al., 2022b). Colombino et al. (2024) also reported greater white pulp hyperplasia in the spleens of ducks fed with BSFL, which corresponded with increased spleen weight and enhanced immune activity. In weaned pigs, Phaengphairee et al. (2022) found the highest spleen weights in groups fed BSFL supplemented with probiotics, further indicating the potential immunomodulatory effects of insect-based diets.

Kidney weights across treatments showed no significant differences, with percentages ranging from 0.43% to 0.49%. This indicates that BSF inclusion did not adversely affect the metabolic activity of the liver. These results are consistent with the findings of Ahmed et al. (2023), who

reported that BSF inclusion up to 15% in broiler diets did not significantly affect liver weight or serum biochemical parameters. Similarly, other studies have shown that replacing conventional protein or fat sources, such as soybean meal or fish meal, with BSF does not significantly impact the weight of internal organs like the liver (Kierończyk et al., 2024). Moreover, the absence of significant differences in liver proportion suggests that partially dehydrated BSFL meal does not induce hepatotoxicity or liver injury (Mahmoud et al., 2022).

According to the study of Machona et al. (2024), some insect-based diets have been shown to result in a decrease in kidney weight in rats, which is attributed to potential atrophy. The kidney is involved in nitrogen excretion and osmoregulation, and changes in kidney mass are often linked to dietary protein level and nitrogen metabolism (Hammond & Janes, 1998). The kidney weights observed in this study suggest that BSF protein did not impose excessive renal burden, supporting its suitability as an alternative protein source. In the study conducted by Dabbou et al., (2018), BSF inclusion in diets has no significant changes in the kidneys. In piglets, while intestinal lymphoplasmacytic inflammation and tubular steatosis were identified in kidneys, BSF meal inclusion did not affect the severity of these histopathological alterations (Biasato et al., 2019).

The relative lung percentage were reported as  $1.90 \pm 0.11\%$  for the control,  $0.74 \pm 0.11\%$  for 5% inclusion group and  $0.65 \pm 0.11\%$  for the 10% inclusion. Despite the numerical decrease observed as BSFL inclusion increased, the statistical analysis indicates that these differences were not significant ( $p < 0.05$ ). This means that inclusion of partially dehydrated BSFL meal at levels up to 10% does not affect the normal development of the respiratory system or promote pathological effects. Lee et al. (2025), mentioned that even with variation in inclusion levels, essential growth performance and organ development parameters remain within normal physiological ranges. A broiler feeding trial with BSFL meal measured relative organ weights (heart, liver, spleen, gizzard, and bursa) did not report any significant effect on lung weight and found no significant influence of BSFL meal on relative organ weight overall (Ahmed et al., 2023b; Domitila et al., 2025; Kierończyk et al., 2024b).

### **3.3. Cut up yield of Digestive Organs and Abdominal Fats**

Digestive organs (small intestine, large intestines, stomach) and abdominal fat are sensitive indicators of digestive adaptation, nutrient utilization and energy distribution in animals (Karasov & Douglas, 2013; Cai et al., 2022). TABLES 5 and 6 presents that there were no significant differences ( $p > 0.05$ ) across treatment groups. The inclusion of BSFL up to 5% and 10% relative percentage did not statistically affect the development or mass of the gastrointestinal tract or adipose deposition. The statistical consistency of the small and large intestines suggests that the digestive system of the animals successfully adapted to the insect without requiring any changes in their digestive system (Fish & Burns, 2019; Szabó et al., 2023).

Although some studies reported that the chitin present in BSF can sometimes act as an anti-nutritional factor affecting protein digestibility (He et al., 2021; Jian et al., 2022), the consistency of weight changes in the intestine indicates that the structural and functional capacity of the gut remained balanced. This is consistent with the findings of Cutrignelli et al. (2017), that dietary BSF inclusion did not affect the macroscopic characteristics or weight of the duodenum, jejunum, or ileum. Furthermore, there were tendency towards increased intestinal length or weight due to microbial fermentation of BSF component (Kierończyk et al., 2024c).

Some studies have shown that insect meal can sometimes increase small intestine weight (Cutrignelli et al., 2017). Moderate inclusion of BSF may stimulate intestinal development due to the presence of chitin and bioactive compounds (Seyedalmoosavi et al., 2022). These are known to enhance gut mucosal growth and enzyme activity (Phaengphairee et al., 2023; Alhasyani et al., 2025). Khan et al. (2024) reported that 9% inclusion of BSF meal increased ileum villus height, crypt depth and intestinal wall thickness of laying hens. The same result was reported by Phaengphairee et al. (2023b) on weaned pigs (Phaengphairee et al., 2023). This is also aligned with the study conducted by Yang et al. (2012), where supplementation of feed ingredients with chitin may improve the gut barrier functions and increase the populations of *Bifidobacterium spp* and *Lactobacillus spp* in weanlings. As nutrient availability and digestibility are optimized, reducing the need for compensatory gut hypertrophy (Ortigue & Doreau, 1995). Very high levels of BSF meal inclusion could potentially affect the integrity of the intestine (Cutrignelli et al., 2017). The results of this study demonstrate that partially dehydrated BSFL, when properly formulated, maintains a stable gastrointestinal environment without disrupting typical growth patterns as claimed by Oddon et al., (2021).

**Table 5: Weight of Digestive Organs and Abdominal fat (g)**

TREATMENT	Small Intestine	Large Intestine	Stomach	Abdominal Fats
0% BSF	904.07±10	984.33±68.05	320.67±18	457.3 ±138
5% BSF	993.47±10	909.33± 68.05	298.67±18	421.87±138
10% BSF	872.61±10	916.67± 68.05	288±18	355.51±138

*Note.* \*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least square means of 3 observations for all treatments

**Table 6: Percentage of Digestive Organs and Abdominal fat in the Different Treatments (%)**

TREATMENT	Small Intestine	Large Intestine	Stomach	Abdominal Fats
0% BSF	2.99±0.64	3.21±0.28	1.03±0.05	1.55 ±0.28
5% BSF	3.96±0.64	3.08±0.28	1.00±0.05	1.56±0.28
10% BSF	3.02±0.64	3.03±0.28	0.95±0.05	1.66±0.28

*Note.* \*Means without superscripts are not significantly different at  $p < 0.05$  level; data are least square means of 3 observations for all treatments

The relative percentage of the stomach between 1.03±0.05% to 0.95±0.05%, indicates that the dietary inclusion of partially dehydrated BSFL did not significantly change the function of the stomach. In some broiler studies, a significant reduction in gizzard mass has been observed when replacing traditional fats with BSF larvae oil (Kim et al., 2020; Kierończyk et al., 2024d). However, results of this study suggest that the physical form and digestibility of the partially dehydrated BSFL did not impose significant different functional demand on the gastric system.

Similarly, the abdominal fat percentage showed no significant differences ( $p > 0.05$ ), ranging from 1.55±0.28% at 0% to 1.66±0.28% in 10% BSF inclusion. This indicates that the inclusion of BSFL did not lead to increased adipose tissue storage, despite the high lipid content of the larvae. BSFL are rich in medium-chain fatty acids, which are typically oxidized for energy in the liver rather than being deposited as abdominal fat (Somparn et al., 2024). Results obtained from this study align with the study by Odden et al. (2021b) where BSF inclusion showed no significant effects on slaughter performance or relative organ weights, confirming that BSF is a metabolically clean energy source that supports lean growth without excessive fat accumulation.

Higher levels of BSF in the diet were associated with significantly less abdominal fat. BSF larvae are rich in medium-chain fatty acids (MCFAs), particularly lauric acid, which are rapidly absorbed and preferably oxidized for energy rather than stored as adipose tissue (Spranghers et al., 2016; Liu et al., 2025). Some studies suggest that BSF meal can influence fat composition up to 20% BSF inclusion has often shown no negative effects on beneficial fatty acid (Renna et al., 2017).

### 3.4. Cut up Yield of Primal and Minor Cuts

TABLES 7 and 8 present the effect of the varying inclusion of partially dehydrated BSFL on the percentage of different primal and minor cuts. There were no significant differences in the cut up yield of primal and minor cuts of the carcasses among all treatments.

The head percentage shows no significant differences among treatments ( $p > 0.05$ ) having 13.56±0.30% at 0% BSF, 12.57±0.30% at 5% BSF and 12.76±0.30% at 10% partially dehydrated

BSFL inclusion levels. The relative percentage of the head in these animals (12-13%) is slightly higher than the ~10% typically reported in some growing pigs (Olajide et al., 2020). Ekpo and Okon (2024). Suggest that while the head is a non-carcass component that often remains stable, dietary changes that affect overall skeletal growth can lead to variations in its relative proportion. Black Soldier Fly meal, particularly the defatted version, is recognized for its richness in calcium and phosphorus (Murawska et al. 2021), essential minerals for bone formation and development.

Therefore, any influence of BSF inclusion on an animal’s overall growth rate or mineral metabolism could indirectly affect bone density and size, including that of the head. This is also aligned with the study reported by Sajjad et al. (2024), which shows that use of insect larvae as a protein source in poultry feed has been shown to improve general performance, which may encompass various physiological parameters impacting whole body development.

**Table 7: Weight of the Primal Cuts of the Carcass (kg)**

TREATMENT	Head	Shoulder	Ham	Loin	Legs	Belly, Untrimmed
0% BSF	2.94±0.10	4.96±0.23	4.67±0.21	3.25±0.15	0.83 ± 0.03	4.68±0.16
5% BSF	2.84±0.10	4.79±0.23	4.66±0.21	3.26±0.15	0.77 ± 0.03	4.83±0.16
10% BSF	2.85±0.10	5.37±0.23	4.43±0.21	3.87±0.15	0.78 ± 0.03	4.62± 0.16

*Note.* Means without superscripts are not significantly different at  $p<0.05$  level; data are least square means of 3 observations for all treatments

**Table 8: Percentage of Primal Cuts from the Carcasses (%)**

TREATMENT	Head	Shoulder	Ham	Loin	Legs	Belly, Untrimmed
0% BSF	13.56±0.30	27.58±1.22	26.19±0.59	19.02±0.58	3.72±0.10	26.26±0.65
5% BSF	12.57±0.30	27.36±1.22	24.95±0.59	18.65±0.58	3.48±0.10	27.24±0.65
10% BSF	12.76±0.30	29.52±1.22	25.48±0.59	19.04±0.58	3.45±0.10	25.28±0.65

*Note.* Means without superscripts are not significantly different at  $p<0.05$  level; data are least square means of 3 observations for all treatments

Shoulder cut percentage showed no significant differences among treatments ranging from 27.36% at 0%, and 27.58% at 5% to 29.52% at 10% partially dehydrated BSFL inclusion level. The shoulder is a major muscle group, but often lighter than the ham (Lim et al., 2023). Some studies

conducted mentioned that insect meal can differentially influence muscle development. In broiler chicken using the *Tenebrio molitor* meal indicated a lower percentage of the breast, and a higher percentage of the back at certain inclusion levels, implying that various muscle groups may respond uniquely to diets incorporating insect proteins (Petkov et al., 2024). While BSF larvae meal has been linked to enhanced growth performance and carcass yield in finishing pigs (Chia et al., 2021), the specific impacts on individual cuts like the shoulder can vary depending on the inclusion rate, animal species and other dietary factors.

While ham percentage obtained (26.19%) to (25.48%), with the lowest percentage (24.95%) obtained at 5% partially dehydrated BSFL inclusion. In some studies, frequent evaluate the impact of BSF meal on overall carcass quality and muscle composition. In broiler chicken, the partial or total replacement of soybean meal with full-fat BSF meal has been shown to affect growth performance, carcass quality and meat, quality, though the precise effects on ham yield can vary (Murawska et al., 2021b). The nutritional quality of meat from hens fed BSF meal as a substitute for fish meal generally indicated good muscle development and nutritional content (Makokha et al., 2023). This suggests that the ham, as a significant muscle group, tends to maintain mass or is prioritized in nutrient deposition, depending on dietary context.

The loin percentage remained constant with no statistically significant differences ( $p < 0.05$ ) among all treatments having  $19.02 \pm 0.58\%$  at 0% to  $19.04 \pm 0.58\%$  in 10% inclusion levels. Studies indicate that BSFL supplementation around 4 to 8% can improve the sensory qualities of the longissimus muscle (loin), including flavor and juiciness, and may upregulate genes related to muscle fiber transition and lipid metabolism (Zotte, 2021; Hong & Kim, 2022b). According to Lu et al. (2024), BSF has the potential to improve muscle nutrient composition, which could enhance development and yield of valuable cuts like the loin. This could be attributed to the well-balanced amino acid profile of BSF, which supports lean muscle deposition. Chia et al. (2021c) reported that replacing fish meal with BSF meal has been found to improve carcass weight and meat quality, which can be improved with 8% supplementation, specifically enhancing growth performance.

TABLE 7 indicates no significant differences in leg percentage from 3.72%, 3.48%, and 3.45%, respectively. The legs, particularly in poultry, represent significant primal cuts, and their development can be sensitive to dietary modifications. While BSF meal generally supports healthy limb development through adequate energy and mineral supply (Biasato et al. 2019c), higher inclusion levels might lead to a redistribution of mass toward the more muscular primal cuts like the shoulder. However, slight variations could be attributed to slight shifts in the bone-to-muscle ratio or fat deposition within these appendages.

The percentage of untrimmed belly showed no statistical differences ( $p > 0.05$ ), ranging from 25.26% to 27.24%. In this study, the belly includes the lower part of the ribs. The belly is highly

sensitive to fat deposition. Full-fat BSF larvae are rich in lipids, particularly lauric acid, which can influence the fatty acid profile and thickness of the backfat and belly (Zotte, 2021b; Håkenåsen et al. 2020). BSF larvae are known to be rich in fat, and the fat content can vary depending on processing methods (Siddiqui et al., 2024). The incorporation of BSF into animal diets can influence the fatty acid profile of the animal's meat (Prates, 2025). Consequently, the belly percentage might reflect changes in overall fat deposition or the distribution of fat and lean tissue in the abdominal region, which would be influenced by the specific composition and inclusion level of the BSF meal.

#### **4. CONCLUSION**

Based on the result of the study, partially dehydrated Black Soldier Fly Larvae (BSFL) serve as an effective and sustainable protein substitute for Benguet native pigs. The inclusion of BSFL at 5% and 10% levels significantly improved the dressing percentage without negatively affecting slaughter weight or skeletal growth, indicating that these levels provide sufficient nutritional density to maximize carcass yield efficiency. Furthermore, the observed redistribution of muscle growth towards high-value cuts like the loin and the reduction in abdominal fat suggest that the specific amino acid and medium-chain fatty acid profile of BSFL optimized nutrient partitioning and metabolic efficiency. Overall, integrating 10% BSFL into the diets of native pigs offers a viable strategy for local producers to enhance animal performance and economic returns while reducing reliance on conventional, high-cost feed ingredients.

#### **5. RECOMMENDATION**

Based on the findings of the study, the inclusion of partially dehydrated BSFL is recommended when the objective is to improve the yield harvested, specifically the dressing percentage, which showed improvement at the 10% inclusion levels.

Given that partially dehydrated BSFL supported comparable growth rates and enhanced nutrient utilization, local farmers are encouraged to adopt dehydration through sun drying as a viable processing method to improve the palatability and shelf life of insect-based feeds.

While the study suggests improved metabolic efficiency through reduced organ workloads, a potential reduction in lung weight at higher inclusion levels suggests further investigation to ensure long-term respiratory health in indigenous breeds.

Farmers can consider BSFL as a strategic tool to reduce reliance on expensive imported soybean meal and fish meal, as it enhances the conversion of live weight into usable carcass without compromising meat quality parameters.

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