

Original Article

Proximate Analysis of Nymph, Subadult, and Adult Cockroaches *Blatta lateralis* and *Blaptica dubia* as a Potential Food and Feed Source

Clark Dell O. Soria

Author Information:

College of Natural Sciences and
Mathematics, Mindanao State University –
Main Campus, Marawi City, Philippines

Correspondence:
clarkdell.soria@gmail.com

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Abstract. With a growing world population and increasingly demanding consumers, producing sufficient protein from livestock, poultry, and fish will be a serious challenge in the future. Thus, this study generally seeks to determine the nutritional value of nymphs, subadults, and adults of *Blatta lateralis* and *Blaptica dubia* as potential human food, feed, or feed ingredients. The test samples were cleaned and dried for three hours at 110°C to remove moisture, pulverized, and then stored in a non-vacuum desiccator. Proximate analysis was conducted on 6 samples representing three developmental stages (nymph, subadult, adult) of two cockroach species. Moisture content was determined using the oven-drying method; crude protein, the Kjeldahl method; crude fat, the indirect solvent extraction method; crude fiber, the Weende method; and ash content, the ignition gravimetric method. Analysis revealed that the protein content of *B. lateralis* (52.72-68.55%) and *B. dubia* (57.21 – 59.84%) is much higher compared to the Philippine Bureau of Animal Industry Standard (2008) for poultry feeds (21.5%, min.). The crude fat content of 8.97-25.99% for *B. lateralis* and 16.67-24.46% for *B. dubia* is also higher than the standard minimum of 4.00%. Both samples have high fiber content, 7.35-8.99% in *B. lateralis* and 7.95-9.49% in *B. dubia*, but failed the BAI standard of 3.50%, max. The ash content, % carbohydrates (or nitrogen-free extract), and gross energy values are 4.59-5.34%, 8.56-9.35%, and 391-482 kcal/100g for *B. lateralis*, and 4.07-5.05%, 5.39-10.95%, and 431-472 kcal/100g for *B. dubia*, respectively. This implies that the nymphs, subadults, and adults of *B. lateralis* and *B. dubia* can be formulated as appropriate feed or feed ingredients for animals, or as food and food additives for human consumption.

Keywords: *Blaptica dubia*; *Blatta lateralis*; Nutritional content; Proximate analysis.

With a growing global population and increasingly demanding consumers, ensuring sufficient protein production from conventional sources such as livestock, poultry, and fish presents a significant challenge for the future (Henchion et al., 2021). Environmental pressures, rising production costs, food and feed insecurity, and increasing protein demand among expanding middle-class populations have intensified the search for sustainable alternatives (van Huis & Oonincx, 2022). In this context, insects have emerged as a promising solution due to their efficient feed conversion, rapid growth, and relatively low environmental footprint compared to traditional animal protein sources. Insects are already utilized globally for diverse purposes, including human consumption (Baiano, 2020), animal feed (Gasco et al., 2020), and as sources of bioactive compounds with potential medicinal applications (Mohan et al., 2020). Their suitability as feed is further

supported by their natural inclusion in the diets of many livestock species and their high nutritional value, particularly in terms of protein and fat content (Ederer et al., 2023). Currently, more than two billion people worldwide consume insects as part of their regular diet, with over 1,900 species identified as edible (van Huis, 2020). While insect consumption traditionally relies on wild harvesting, commercial insect farming for food and feed is increasingly developing in countries such as Thailand, Laos, and Vietnam (Van Peer & Van Miert, 2024).

Among the insect groups of interest, cockroaches (order *Blattodea*) represent an ancient and highly successful lineage that originated during the Carboniferous period, approximately 359 million years ago, with modern forms emerging during the Cretaceous period around 100 million years ago (Li & Huang, 2023). Morphologically, cockroaches are characterized by dorsoventrally flattened bodies, chewing mouthparts, prominent antennae, and cerci, traits that have contributed to their evolutionary stability and ecological success (Wipfler et al., 2022). Although there are an estimated 4,000 cockroach species worldwide, only about 30 species have adapted to urban environments and are considered pests (Aboagye et al., 2025). Their global distribution has been shaped by both geological processes and human activities such as commerce and transportation, leading to the spread of several invasive species (Fan et al., 2022). Beyond their pest status, cockroaches have attracted scientific interest due to their biological resilience and nutritional composition. However, their association with unsanitary environments and their role as mechanical vectors of pathogens have historically overshadowed their potential utility (Agany et al., 2025).

Two cockroach species that have gained commercial importance as feed insects are *Blatta lateralis* and *Blaptica dubia*. *Blatta lateralis*, commonly known as the Turkestan or red runner cockroach, is native to the Middle East and parts of Central Asia, where it primarily inhabits gardens, animal manure piles, and structures with earthen floors (Petrovskiy, 2024). This species is oviparous, fast-moving, and incapable of climbing smooth surfaces, characteristics that make it manageable in controlled rearing environments. It is widely recognized for its rapid reproductive rate, which allows colonies to expand quickly once established (Smith et al., 2023). Adult *B. lateralis* exhibit sexual dimorphism, with males possessing fully developed wings and females having shortened wings that do not cover the abdomen.

Blaptica dubia, commonly referred to as the Dubia cockroach, is native to Central and South America and belongs to the family *Blaberidae*. It is larger in size, reaching up to 4.5 cm in length, and exhibits ovoviviparous reproduction, giving birth to live nymphs, a trait typical of blaberid cockroaches (Li et al., 2024). Both nymphs and adults cannot climb smooth surfaces due to the absence of a developed arolium, which enhances containment during rearing. *B. dubia* is widely used as feed for reptiles and amphibians because of its high protein content, low odor production, and ease of maintenance compared to other feeder insects. Ecologically, this species also plays a role in litter decomposition in tropical environments, feeding on leaf litter and functioning as an opportunistic omnivore (Enebe & Erasmus, 2024).

Assessing the Nutritional quality of insects such as *Blatta lateralis* and *Blaptica dubia* is still often done using proximate analysis. This classical analytical framework partitions food into core macronutrient and inorganic categories (moisture, protein, fat, fiber or chitin, ash, and carbohydrate by difference) to characterize their chemical composition (Zhou et al., 2022). Proximate profiling remains essential for determining the potential of insect biomass in human and animal diets because these measurements indicate energy contribution and nutrient availability. Recent studies confirm that edible insects generally contain substantial protein and fat, along with measurable ash and fiber fractions (primarily chitin), reflecting wide inter-species variation that depends on taxonomy, development, and rearing conditions (Tan et al., 2025). Moreover, lipids in insects contribute significantly to overall energy value, with compositions rich in unsaturated fatty acids that support both caloric density and dietary quality (Anyasi, 2025). Finally, ash measurements in insect proximate profiles provide a quantitative estimate of mineral content, which is useful in evaluating micronutrient supply in diets and feed formulations (Tan et al., 2025).

Previous studies have demonstrated that nutritional composition in cockroaches varies across species and developmental stages. Cerreta et al. (2022) reported that adult *B. lateralis* and *B. dubia* contain higher crude protein but lower fat compared to subadults, while amino acid and fatty acid profiles remained relatively stable within species. Similarly, Sule et al. (2020) found that cockroach meal derived from *Periplaneta americana* contained high protein levels and appreciable amounts of essential minerals and fatty acids, reinforcing the potential of cockroaches as nutrient-dense feed ingredients. Further evidence indicates that the developmental stage

significantly influences nutrient quantity and quality in insects, with adult cockroaches exhibiting higher digestible protein but lower lipid content than nymphs (Kulma et al., 2020). Despite these findings, comprehensive, stage-specific proximate data for *Blatta lateralis* and *Blaptica dubia* remain limited.

In response to these gaps, the present study aims to determine and compare the proximate composition, moisture, crude protein, crude fat, crude fiber, ash, nitrogen-free extract, and gross energy of the nymph, subadult, and adult stages of *Blatta lateralis* and *Blaptica dubia*. By generating stage-specific nutritional data for two commercially important cockroach species, this study provides essential baseline information for optimizing insect rearing, harvest timing, and feed formulation. The findings contribute to the growing body of evidence supporting insects as sustainable alternative protein sources and inform strategies addressing future food and feed security, thereby serving as a foundation for the methodological approach described in the succeeding section.

Methodology

Research Design

This study employed a quantitative, descriptive-comparative research design. This design was deemed appropriate because the primary objective of the study was to determine and compare the proximate composition, including moisture, crude protein, crude fat, crude fiber, ash, nitrogen-free extract, and gross energy, of *Blatta lateralis* and *Blaptica dubia* across three developmental stages (nymph, subadult, and adult), rather than to manipulate variables or establish cause-and-effect relationships.

A quantitative approach was selected because the study relied on numerical measurements generated through standardized laboratory analyses, allowing objective assessment of nutrient composition. The descriptive component of the design enabled systematic documentation of the nutritional characteristics of each species and developmental stage according to established analytical parameters. Meanwhile, the comparative aspect enabled statistical comparisons of nutrient values across developmental stages and between species, directly addressing the study's research questions and objectives.

The use of standard proximate analysis methods prescribed by the Association of Official Analytical Chemists (AOAC, 2003) further supports the suitability of this design, as these procedures are internationally recognized for generating valid, reliable, and replicable quantitative data on food and feed composition. In addition, the application of One-Way Analysis of Variance (ANOVA) with post hoc multiple-comparison tests aligns with the descriptive-comparative design by assessing whether observed differences in nutrient composition among developmental stages are statistically significant.

Overall, the chosen research design is methodologically sound and well-aligned with the study's problem, as it enables an evidence-based evaluation of the nutritional potential of *B. lateralis* and *B. dubia* as alternative food and feed sources without introducing experimental manipulation, thereby ensuring objectivity and scientific rigor.

The study was made in a series of analyses following the standard analytical procedures described in AOAC (2003). Figure 1 shows the study flow.

Sample Preparation

The samples were taken from Mr. Donnie Maghinay, a local reptile breeder, from Ozamis City. The samples were wiped with lint-free tissue paper to remove dust particles. Drying of the samples was done at the Chemistry Department, Mindanao State University-Marawi. The samples were placed in a clean, dry large watch glass and heated in an oven set to 110 °C. Once drying was done, the samples were stored in a non-vacuum desiccator. Statistical treatment of the data collected was done using One-Way ANOVA, and a Bonferroni-corrected multiple comparison test.

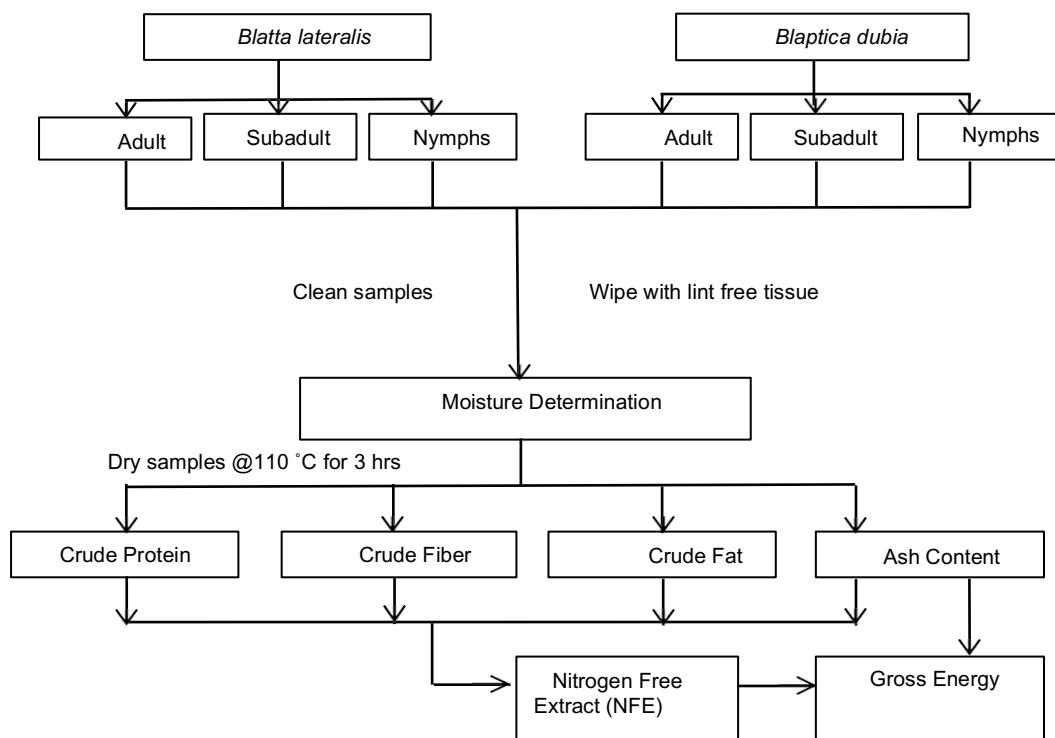


Figure 1. Overall schematic design

Proximate Composition

The samples were analyzed for moisture, crude protein, crude fat, crude fiber, ash, NFE, and gross energy content at the Feed Chemical Analysis Laboratory (FCAL), Department of Agriculture-Regional Field Office 10 (DA RFO 10) using the methods prescribed by AOAC (2003).

Determination of Moisture

The moisture content of the samples was determined by drying them in an oven set at 110°C for 3 hours until the mass became constant. The representative samples were individually weighed in clean, dry weighing bottles (W1). After drying, they were cooled in a desiccator and then weighed (W2).

The percent moisture was calculated using the formula:

$$\% \text{ Moisture} = \frac{W1 - W2}{Ws} \times 100 \quad (1)$$

where:

W1= weight before drying

W2= weight after drying

Ws = weight of sample

Determination of Crude Protein

The crude protein content of the samples was determined using the Kjeldahl method. About 1.000x grams of sample was introduced into the digestion tube and was heated at 420°C for 60 minutes in the presence of (12mL concentrated H₂SO₄ and 2 Kjeltab® capsules as catalyst). The nitrogen content was released as ammonia and collected in 4% boric acid solution, which was then made alkaline with 40% NaOH and titrated against standard HCl.

The protein content was as follows:

$$\% \text{ Crude protein} = 6.25 \times \% \text{ N} \quad (2)$$

$$\% \text{ N} = \frac{(S - B) \times N \times 0.014 \times D \times 100}{\text{Wt. of the sample}} \quad (3)$$

where:

S = Volume of HCl used for the sample

B = Volume of HCl used for the blank determination

N = Normality of HCl

D = Dilution of the sample after digestion

0.014 = milliequivalent weight of nitrogen

Determination of Crude Fat

Approximately 1.000x g of moisture-free sample (W_s) was wrapped in ashless filter paper, placed in a fat-free thimble, and then introduced into the extraction tube. A cleaned and dried extraction cup was weighed (W_1), filled with 70 mL of petroleum ether, and fitted into the apparatus. The extraction equipment was closed, and then the cooling water flow and heating were started. After the solvent started boiling, the thimble was immersed by placing the slider in the "Immersion" position. After 60 minutes, the thimble was extracted from the solvent by placing the slider into "Washing position". After 60 minutes of reflux washing, the stopcock under the water-cooled condenser was closed, and the solvent was completely evaporated from the extraction cup. The air pump was turned on to improve the displacement of the condenser. The sample was transferred, dried in an oven for 2 hours at 100°C, cooled in a desiccator, and weighed (W_2). The difference in weights was attributed to the fat extracted from the sample.

The percent fat was determined by using the following formula:

$$\% \text{ Crude fat} = \frac{(W_2 - W_1)}{W_s} \times 100 \quad (4)$$

where:

W_1 = weight before extraction

W_2 = weight after extraction

W_s = weight of sample

Determination of Crude Fiber

A crucible was preheated and weighed (W_1). Then, 1.000x g of the sample was weighed into the crucible (W_2). The crucible was placed in the cold extraction unit, which was filled with 25mL of acetone, then vacuumed after 10 minutes, and washed with distilled water three times. The cold extraction was repeated. After cold extraction, the crucible was transferred into the hot extraction unit. Approximately 150mL of hot 1.25% H_2SO_4 was carefully added, and after 30 minutes of extraction, the solution was drained and washed with distilled water three times. Approximately 150mL of hot 1.25% NaOH solution was added, and after 30 minutes of extraction, the solution was drained and washed with distilled water three times. The crucible was dried in an oven at 100°C for 2 hours, cooled in a desiccator, and weighed (W_3). The crucible was then transferred into the furnace for 3 hours at 525°C, cooled in a desiccator, and weighed (W_4).

The percent fiber was determined by using the following formula:

$$\% \text{ Crude fiber} = \frac{W_2 - W_4}{W_2 - W_1} \times 100 \quad (5)$$

where:

W_1 = weight of crucible

W_2 = weight of crucible + sample

W_3 = Weight after drying

W_4 = Weight after ashing

Determination of Ash

A clean, empty porcelain crucible was placed in a muffle furnace at 600°C for an hour, cooled in a desiccator, and

then weighed to constant weight. About 2.000x grams of the previously dried and pulverized sample were placed into the crucible (W1). The sample was then ignited in a muffle furnace at 600°C for 3 hours. The appearance of gray-white ash indicates that all organic matter in the sample has been completely oxidized. After the ignition, the crucible was cooled in a desiccator and weighed to a constant weight (W2).

Percent ash was calculated using the following formula:

$$\% \text{ Ash} = \frac{W2 - W1}{W_s} \times 100 \quad (6)$$

where:

W1 = Weight of crucible

W2 = Weight of crucible and ash

Ws = weight of sample

Determination of Nitrogen Free Extract

Nitrogen Free Extract (NFE) was calculated by difference after analysis of all other items in the proximate analysis.

$$NFE = [100 - (\% \text{ crude protein} + \% \text{ crude fat} + \% \text{ crude fiber} + \% \text{ ash})] \quad (7)$$

Gross Energy Calculation

The calorie content of the samples was calculated from the percentage of crude protein and nitrogen-free extract by a factor of 4, and from crude fat by a factor of 9, as shown in the equation below. The values were then presented as kilocalories per 100 g of the sample.

$$E = 4 (\text{Crude protein}) + 4(\text{nitrogen free extract}) + 9(\text{crude fat}) \quad (8)$$

Ethical Considerations

This study adhered to ethical research practices applicable to invertebrate organisms, specifically *Blatta lateralis* and *Blattella germanica*. Although formal animal ethics regulations do not typically cover insects, the research followed the principles of humane treatment, scientific necessity, and harm minimization. The use of cockroaches was justified by their relevance as potential food and feed sources and the lack of suitable non-living alternatives for proximate nutritional analysis. Specimen numbers were limited to the minimum required for valid statistical analysis. All samples were obtained from a local, licensed breeder to avoid disrupting wild populations. Specimens were handled carefully and processed according to standard laboratory procedures. Euthanasia occurred during thermal processing as part of sample preparation, an accepted method in insect-based food and feed research. All biological waste was disposed of in accordance with institutional biosafety and environmental guidelines. Data collection and reporting were conducted with transparency and integrity.

Results and Discussion

Moisture

Moisture content in food influences its taste, texture, weight, appearance, and shelf life. Even a slight deviation from a defined standard can adversely impact the physical properties of a food material. In addition, microbial growth increases with total water content, potentially resulting in spoiled batches that must be disposed of. Table 1 shows the moisture content of *B. lateralis* and *B. dubia* at different developmental stages.

Table 1. Moisture Content (as is) of *B. lateralis* and *B. dubia* at Different Developmental Stages

Species	Stages	% Moisture
<i>B. lateralis</i>	Adult <i>B. lateralis</i>	65.5±0.70% ^a
	Subadult <i>B. lateralis</i>	59.71±1.29% ^b
	Nymphs <i>B. lateralis</i>	47.24±1.41% ^c
<i>B. dubia</i>	Adult <i>B. dubia</i>	57.11±0.10% ^d
	Subadult <i>B. dubia</i>	47.77±1.79% ^e
	Nymphs <i>B. dubia</i>	59.04±0.53% ^d

Note: Values having the same letter are not significantly different.

As shown in Table 1, adult *B. lateralis* yielded more moisture content than other developmental stages. The one-way ANOVA for *B. lateralis* and *B. dubia* revealed statistically significant differences, with p-values of 0.01 and

0.00, respectively. Post hoc comparisons using Tukey's procedure were used to determine which pairs of moisture contents across the three developmental stages of *B. lateralis* and *B. dubia* differed. For *B. lateralis*, the moisture content of the adult *B. lateralis* is significantly higher compared to the subadult ($p = 0.03$) and nymphs of *B. lateralis* ($p = 0.00$). Moreover, the moisture content of adult *B. dubia* is significantly higher than that of the sub-adult stage.

The higher moisture content in adults may reflect greater body water reserves necessary to support reproductive activity, mobility, and metabolic processes. Subadults, which are still developing, and nymphs, which are smaller and less physiologically active, naturally contain less water. In *B. dubia*, the similarity between adult and nymphal moisture might be associated with species-specific differences in exoskeletal structure or water retention, as well as with developmental allocation of water to growth versus reproduction. These patterns highlight the interplay between developmental stage and physiological water requirements in maintaining optimal body function. ($p=0.00$). However, adult *B. dubia* show no difference in the moisture content of nymphs.

Crude Protein

Table 2 shows the protein content of *B. lateralis* and *B. dubia* at different developmental stages. The protein content for nymph *B. lateralis* is statistically higher than that of the adult and subadult stages. However, for *B. dubia*, protein content is the same for all developmental stages. Insects undergo many morphological and anatomical changes, which are often connected with changes in dietary habits during development (Kraus et al., 2020). While juvenile cockroaches eat to support growth, the dietary requirements of adults shift as they invest their energy and protein into reproduction (Carrel & Tanner, 2002). The crude protein content of edible insects is considered high compared to other protein sources, such as chicken or beef. (Kim, et al., 2019). Protein is one of the macronutrients that the body needs in relatively large quantities because proteins are considered to be an important building block of bones, muscles, cartilage, skin, and blood.

Table 2. Crude Protein (Dry) of *B. lateralis* and *B. dubia* at Different Developmental Stages

Species	Stages	% Crude Protein
<i>B. lateralis</i>	Adult <i>B. lateralis</i>	60.55±1.15% ^a
	Subadult <i>B. lateralis</i>	52.72±2.14% ^a
	Nymphs <i>B. lateralis</i>	68.55±0.21% ^b
<i>B. dubia</i>	Adult <i>B. dubia</i>	59.84±1.04% ^c
	Subadult <i>B. dubia</i>	57.21±1.10% ^c
	Nymphs <i>B. dubia</i>	59.47±0.10% ^c

Note: Values having the same letter are not significantly different.

According to the Food Research and Nutrition Institute (FNRI) of the Department of Science and Technology (DOST), the average male adult (19-29 years old) weighing 60.5 kilograms needs to consume 71 grams of protein per day. This may suggest that our average male adults are recommended to eat an average of 120g *B. lateralis* or *B. dubia* to meet the recommended daily nutrient intake.

Crude Fat

Table 3 shows the results of the analysis of crude fat in *B. lateralis* and *B. dubia*. Both One-Way ANOVA and multiple comparisons showed that the crude fat content of *B. lateralis* differs statistically across all developmental stages. In contrast, crude fat values for all developmental stages of *B. dubia* were statistically the same.

Table 3. Crude Fat (Dry) of *B. lateralis* and *B. dubia* in Different Developmental Stages

Species	Stages	% Crude Fat
<i>B. lateralis</i>	Adult <i>B. lateralis</i>	16.56±0.51% ^a
	Subadult <i>B. lateralis</i>	25.99±0.18% ^b
	Nymphs <i>B. lateralis</i>	8.97±0.38% ^c
<i>B. dubia</i>	Adult <i>B. dubia</i>	20.23±0.40% ^d
	Subadult <i>B. dubia</i>	24.46±1.05% ^d
	Nymphs <i>B. dubia</i>	16.67±1.39% ^d

Note: Values having the same letter are not significantly different.

The results for crude fat content showed a high value of crude fat content of 25.99% in subadult *B. lateralis*, 20.23% in adult *B. dubia*, and 24.46% in subadult *B. dubia*. A higher fat content means higher absorption of fat-soluble vitamins such as A, D, E, and K; hence, fat is very important in the diet. It is composed of triglycerides, which contain a glycerol molecule and three fatty acids in their molecular makeup (FAO, 2013). The values presented in Table 6 show the potential of subadult *B. lateralis*, adult *B. dubia*, and subadult *B. dubia* as sources of edible oil for the

cooking and food industries.

FNRI suggests that an intake of 15-30% of the total fat acceptable intake per day be consumed by an average male (19 years old and above). This means that adult and subadult *B. lateralis*, with crude fat of 16.46% and 25.99%, and all three stages of *B. dubia*, with crude fat of 20.23%, 24.46%, and 16.67%, can meet the fat nutrient needs.

Crude Fiber

Insects contain significant amounts of fiber as measured by crude fiber, acid detergent fiber (ADF), or neutral detergent fiber (NDF) (Finke, 2013). In this study, significant amounts of crude fiber were detected in the samples, as shown in Table 4. The adult stage in both species contained higher crude fiber compared to their other developmental stages.

Table 4. Crude Fiber (Dry) of *B. lateralis* and *B. dubia* in Different Developmental Stages

Species	Stages	% Crude Fiber
<i>B. lateralis</i>	Adult <i>B. lateralis</i>	8.99±0.45% ^a
	Subadult <i>B. lateralis</i>	7.35±0.01% ^a
	Nymphs <i>B. lateralis</i>	8.32±0.17% ^a
<i>B. dubia</i>	Adult <i>B. dubia</i>	9.49±0.47% ^b
	Subadult <i>B. dubia</i>	7.95±0.09% ^b
	Nymphs <i>B. dubia</i>	8.84±0.44% ^b

Note: Values having the same letter are not significantly different.

The crude fiber contents of the nymph, subadult, and adult stages in both *B. lateralis* and *B. dubia* are statistically the same as each other.

Ash Content

The ash refers to any inorganic material, such as minerals, present in food. Ash is the residue that remains after heating in a furnace that removes water and organic material such as fat and protein. Generally, natural foods contain 5 percent ash, while some processed foods can have ash content of more than 10 percent. *B. lateralis* and *B. dubia* can be considered natural food and categorized as good sources of human nutrition. Results for ash content are presented in Table 5. Values for all developmental stages of *B. lateralis* are statistically the same. For *B. dubia*, only the subadults and adults have statistically the same ash content.

Table 5. Ash Content of *B. lateralis* and *B. dubia* in Different Developmental Stages

Species	Stages	Reported Values
<i>B. lateralis</i>	Adult <i>B. lateralis</i>	5.34±0.26% ^a
	Subadult <i>B. lateralis</i>	4.59±0.01% ^a
	Nymphs <i>B. lateralis</i>	5.03±0.02% ^a
<i>B. dubia</i>	Adult <i>B. dubia</i>	5.05±0.18% ^b
	Subadult <i>B. dubia</i>	4.66±0.04% ^b
	Nymphs <i>B. dubia</i>	4.07±0.04% ^c

Note: Values having the same letter are not significantly different.

Nitrogen-Free Extract (NFE) and Gross Energy

Nitrogen-free extract is a vital part of animal feed assessment. The NFE estimates non-fibrous carbohydrates, such as sugars and starch. Moreover, Gross Energy is the total energy that can be consumed in food. The calculated NFE and Gross Energy are presented in Tables 6 and 7. The NFE is 8.56% in adult *B. lateralis*, 9.35% in subadult *B. lateralis*, 9.13% in nymphs *B. lateralis*, 5.39% in adult *B. dubia*, 5.72% in subadult *B. dubia*, and 10.95% in nymphs *B. dubia*. The gross energy per 100 grams is calculated to be 425.48 kcal/100g in adult *B. lateralis*, 482.19 kcal/100g in subadult *B. lateralis*, 391.45 kcal/100g in nymphs *B. lateralis*, 442.99 kcal/100g in adult *B. dubia*, 471.86 kcal/100g in subadult *B. dubia*, and 431.71 kcal/100g in nymphs *B. dubia*. This implies that we can obtain sufficient energy and non-fibrous carbohydrates for each species. In comparison to the Recommended Nutrient Intakes (RNI) by the Food Nutrition and Research Institute of the Department of Science and Technology, a male adult with an average weight of 60.5 kg, ranging from 19-29 years old, requires 2530 kcal of energy per day.

Proximate Analysis Results Versus Standards

The summary of proximate analyses is presented in Tables 6 and 7, compared with the Philippine Bureau of Animal Industry (BAI) Standard (2008) for poultry feeds (chick booster).

Table 6. Proximate Composition of *B. lateralis* in Different Developmental Stages Versus Standard

Proximate Composition	<i>B. lateralis</i> (Adult)	<i>B. lateralis</i> (Subadult)	<i>B. lateralis</i> (Nymphs)	Chick Booster*
% Moisture	65.5±0.70% ^a	59.71±1.29% ^a	47.24±1.41% ^b	≤ 12.00%
% Crude Protein	60.55±1.15% ^a	52.72±2.14% ^a	68.55±0.21% ^b	≥ 21.50%
% Crude Fat	16.56±0.51% ^a	25.99±0.18% ^b	8.97±0.38% ^c	≥ 4.00%
% Crude Fiber	8.99±0.45% ^a	7.35±0.01% ^a	8.32±0.17% ^a	≤ 3.50%
% Ash	5.34±0.26% ^a	4.59±0.01% ^a	5.03±0.02% ^a	
% Carbohydrates (NFE)	8.56%	9.35%	9.13%	
Gross Energy (kcal/100g)	425.48	482.19	391.45	

Note: Values having the same letter are not significantly different.

* - BAI Standard (2008) for Poultry Feeds

Table 7. Proximate Composition of *B. dubia* in Different Developmental Stages Versus Standard

Proximate Composition	<i>B. dubia</i> (Adult)	<i>B. dubia</i> (Subadult)	<i>B. dubia</i> (Nymphs)	Chick Booster*
% Moisture	57.11±0.10% ^a	47.77±1.79% ^a	59.04±0.53% ^a	≤ 12.00%
% Crude Protein	59.84±1.04% ^a	57.21±1.10% ^a	59.47±0.10% ^a	≥ 21.50%
% Crude Fat	20.23±0.40% ^a	24.46±1.05% ^a	16.67±1.39% ^a	≥ 4.00%
% Crude Fiber	9.49±0.47% ^a	7.95±0.09% ^a	8.84±0.44% ^a	≤ 3.50%
% Ash	5.05±0.18% ^a	4.66±0.04% ^a	4.07±0.04% ^b	
% Carbohydrates (NFE)	5.39%	5.72%	10.95%	
Gross Energy (kcal/100g)	442.99	471.86	431.71	

Note: Values having the same letter are not significantly different.

* - BAI Standard (2008) for Poultry Feeds

As shown in Tables 6 and 7, the moisture contents of all *B. lateralis* and *B. dubia* samples are much higher than the BAI standard (2008) for poultry feeds. It must be noted, however, that the moisture values for the samples in this study are obtained on an as-is or wet basis, whereas the BAI standard is on a dry basis, as feeds are dried to improve their stability for long-term storage. The fiber content of the samples, 7.35-8.99% in *B. lateralis* and 7.95-9.49% in *B. dubia*, exceeds the BAI standard of 3.50%, max. Both crude protein and crude fat content of *B. lateralis* and *B. dubia* are much higher compared to the BAI standard. This implies that adult, subadult, and nymph *B. lateralis* and *B. dubia* can be formulated as appropriate feed or feed ingredients in poultry farming. *B. lateralis* and *B. dubia* can similarly be potentially used in feed formulations for swine, cattle, and equine consumption.

Conclusion

This study demonstrates that *Blatta lateralis* and *Blaptica dubia* possess strong potential as alternative feed ingredients, given their high protein and lipid contributions and overall energy value, supporting their relevance for poultry nutrition. These characteristics indicate that cockroach-derived meals could supplement or partially replace conventional feed components, offering a nutritionally dense option amid rising feed costs and sustainability concerns in the poultry industry. At the same time, the elevated fiber content observed across developmental stages highlights the need for careful formulation and processing to ensure optimal nutrient utilization in monogastric diets. Future research should therefore focus on characterizing amino acid profiles, assessing protein bioavailability, and evaluating the digestibility of the fiber fraction, particularly chitin, alongside controlled feeding trials to determine performance outcomes. Overall, the findings provide a solid foundation for the strategic integration of *B. lateralis* and *B. dubia* into poultry feed systems and support their broader role in advancing sustainable animal nutrition.

Contributions of Authors

Not Indicated

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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