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# PROXIMATE COMPOSITION ANALYSIS OF FRESH AND BOILED GOLDEN APPLESNAIL (POMACEACANALICULATA)

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## ABSTRACT

The golden apple snail (Pomaceacanaliculata) is a freshwater species introduced to Asia for consumption and commercial purposes. This study analyzed the chemical composition and nutritional content of raw and boiled golden snail meat through proximate analysis.Raw snail meat contained 78.10% water, 15.62% protein, 0.8% fat, 2.60% ash, and 2.88% carbohydrates. Boiled snail meat had 77.40% water, 13.67% protein, 0.4% fat, 4.1% ash, and 4.43% carbohydrates.Boiling significantly affected protein and fat content, leading to denaturation and reduced extractability. Unsaturated lipids were prone to oxidation during boiling, lowering fat content.Ash content variation was influenced by sample preparation and testing procedures, representing inorganic residues left after combustion.Carbohydrate content was determined by difference, with raw snail meat at 2.88% and boiled at 4.43%, influenced by decreased water and nutrients during boiling.The study provides insights into golden snail meat's chemical composition and nutritional value, essential for consumers and industries utilizing this species as a source of animal protein and nutrients. Golden snails offer nutritional richness and versatile use, making them valuable resources for communities.

## KEYWORDS

Golden apple snail, Pomaceacanaliculata, proximate analysis, chemical composition, nutritional content.

## INTRODUCTION

*Pomaceacanaliculata*, a freshwater snail originally from South America, has a voracious appetite for aquatic plants like lotus and rice. Introduced to Taiwan in the 1980s for human consumption and commercial purposes, it has since spread widely across Asia, becoming a popular food supplement and a source of protein and income for low-income communities. The golden snail can grow to a substantial size of up to 10 cm, although snail varieties kept in aquariums are usually smaller. Its shell typically displays a brownish or greenish hue, often adorned with a distinctive spiral band pattern. In some aquarium-bred species, the shell takes on a bright golden yellow color. The body color of these snails can vary from dark, almost black, to pale beige (Cowie 2005).

The golden snail is highly valuable as a source of animal protein due to its delicious taste and protein richness. Moreover, it contains various essential minerals such as iron, calcium, magnesium, copper, iodine, and vitamin C (Suwarman, 1989). Apart from its nutritious value as food, the golden snail has been traditionally used in medicine to treat skin diseases, jaundice, epilepsy, and more. Every part of the golden snail's body can be utilized, as it contains high nutritional content with omega 3, 6, and 9, and protein levels ranging from 16% to 50%. Additionally, the nutritional composition differs between fresh and cooked golden snails. Even the snail's shell can be utilized as an ingredient in fish or animal feed (Tarupay*et al.*, 1991).

In this study, two treatments were selected: raw snail meat and boiled snail meat. Boiling the golden snail is a common method used by people in Indonesia, particularly in West Java and Central Java, before consumption. The boiled snail is especially popular in these regions and in other places like Blitar, Bangli, and Buleleng (Bali), where the golden snail is known for its delightful taste after being boiled (Tjiptowiyono, 1995).The objective of this study was to investigate the characteristics of *Pomaceacanaliculata* by conducting a proximate test on samples of both raw (fresh) golden snails and golden snails that underwent boiling, in order to analyze their chemical composition and nutritional content.

## MATERIALS AND METHOD

This research was conducted at Cikarawang, Bogor, where the golden snail samples were collected. The materials and apparatus utilized in this study included adult-sized golden applesnails, plastic bags, aquariums, buckets, cutting boards, knives, pots, stoves, ovens, ceramic cups, test tubes, glass funnels, desiccators, mortars, pipettes, digital scales, as well as various chemicals required for conducting the analysis.

Samples of fresh golden snails were collected by extracting live snails from their natural habitat, followed by rinsing them thoroughly under running water. The next step involved separating the snail meat from the shell by breaking the tip of the shell, making it easier to extract the meat and feces. Subsequently, the golden snail meat was weighed for further analysis.On the other hand, samples of boiled golden snails were obtained also from live snails. These snails were rinsed under running water and then boiled until fully cooked. After boiling, the golden snail meat was extracted using a wire to ensure the separation of meat from shells while preventing any shell fragments or debris from being carried along. The meat was then washed and weighed for use in the subsequent analysis.

Proximate analysis was conducted on the two samples to determine their water content, protein content, fat content, ash content, and carbohydrates by difference. Water content was measured using the oven method (AOAC 1995). For protein content determination, the micro

Kjeldahl method was employed, based on the oxidation of carbonaceous materials and conversion of nitrogen to ammonia. Ammonia then reacted with excess acid to form ammonium sulphate. After alkalization, the ammonia was evaporated and absorbed in a boric acid solution. The nitrogen content was determined by titrating with HCl (AOAC 1995). Carbohydrate content was calculated by difference, subtracting the water content, ash content, protein content, and fat content from 100%. This approach demonstrated that carbohydrate content significantly influenced other nutrients (Winarno 1997). Fat content was determined using the Soxhlet method, which involves extracting fat with hexane solvent. After the solvent evaporated, the fat was weighed and its percentage calculated. The resulting fat is considered crude fat (AOAC 1995). For ash content determination, the dry ashing method was utilized. This involves oxidizing all organic substances at high temperatures (approximately 550 °C) and then weighing the residue left behind after the combustion process (AOAC 1995).

## RESULTS AND DISCUSSION

The golden snail treatment comprised two categories: fresh snail meat and boiled meat. Both treatments underwent proximate content analysis, and the findings for each treatment are presented in Tables 1 and 2.

**Table 1. Proximate analysis results for fresh golden apple snail**

| Analysis | Wet Basis (%) |
|---|---|
| Moisture content | 78.1 |
| Crude protein | 15.62 |
| Fat | 0.8 |
| Ash | 2.6 |
| Carbohydrate *by difference* | 2.88 |

**Table 2. Proximate analysis results for boiled golden apple snail**

| Analysis | Wet Basis (%) |
|---|---|
| Moisture content | 77.4 |
| Crude protein | 13.67 |
| Fat | 0.4 |
| Ash | 4.1 |
| Carbohydrate *by difference* | 4.43 |

### Moisture Content

The analysis revealed that raw snail meat contained 78.10% water content, which is consistent with the typical water content found in mollusk meat, approximately 81.0% (Hadiwiyoto, 1993). On the other hand, boiled snail meat had a slightly lower water content of 77.40%, attributed to the boiling process. According to Winarno (2008), heating water to a high temperature causes rapid movement of water molecules, leading to water vaporization and gas formation, which can escape from the surface. Blanching, a process using hot water, induces changes in vitamins, flavors, pigments, and textures in products. The heating process softens the product and eliminates air or gas from the cell spaces (Heldman and Hartel, 1998). It also removes minerals, water-soluble vitamins, and other water-soluble components, as well as water, dissolved substances, gases, and pigments from cell tissues (Fellows, 2000).

The traditional oven method for measuring moisture content, as used in determining the water content of golden snail meat, has certain factors affecting measurement accuracy. Drawbacks of this method include the evaporation of substances like alcohol, acetic acid, and essential oils along with water vapor. Heating reactions may produce water or other volatile substances, leading to incorrect calculations. Temperature fluctuations can occur in conventional ovens due to slow air circulation without fans (Bradley, 2003; Sudarmadji*et al.*, 1996). Using a baking sheet cover during drying is advisable to prevent sample splashing and maintain measurement accuracy. Additionally, caution must be taken to avoid fingerprint contamination on the baking sheet, which affects measured weight (Bradley, 2003). The dry method for moisture content testing is not an absolute parameter for predicting food spoilage rates (Sudarmadji*et al.*, 1996). Some samples tend to form crusts or lumps during heating, resulting in erratic measurement results (Bradley, 2003).

### Protein Content

The analysis of crude protein content on a wet basis in raw snail meat showed a protein value of 15.62%. These results align well with existing literature. According to Nurrohmah*et al.* (2008) and applesnail.net, the protein content of golden snail meat is approximately 12.2% (12.2%). However, Sulistiono (2007) reported a higher protein content ranging from 16% to 50%, without specifying whether it was on a wet or dry basis. To provide context, the dry basis protein content of snail meat is 60.90% (Creswell and Kopiang, 1981), and molluscs in general typically contain around 13% protein (Hadiwiyoto, 1993). The nutritional content of snails can vary due to environmental factors, nutrient availability in their daily diet, and their developmental stage at the time of testing.

The Kjeldahl method is the most commonly used technique for determining total nitrogen, including protein, due to its simplicity and cost-effectiveness compared to other protein determination methods that involve complex separation and purification procedures. For accurate results, the sample should be homogenous, and in some cases, removal of fat-containing material is recommended as it requires large amounts of sulfuric acid. Proteins rich in certain amino acids, such as histidine and tryptophan, are more challenging to break down and require longer digestion times (Chang, 2003; Sudarmadji*et al.*, 1996).

In the case of boiled snail meat, the protein content is measured at 13.67% and comparing it with the protein content of raw snails reveals a decrease in protein content due to the boiling process. Heating processes like boiling can lead to protein denaturation and reduced extractability, thus resulting in a lower measured protein content. Heating proteins at temperatures of 70-80°C may cause tertiary structure changes, decreased solubility, denaturation, loss of viscosity, and disulphide bond disruption. At 80-100°C, protein structure damage and disulphide loss occur. Moreover, the ability of proteins to bind water decreases with heat treatment, leading to decreased water content and reduced yield. Heat processing also results in nutrient loss, especially for unstable substances (Buckle *et al.*, 1987). Heat-induced protein denaturation may lead to changes in the configuration of protein molecules, increased protein viscosity, coagulation or flocculation, and ultimately precipitation (Desrosier, 2008).

### Fat Content

Based on the results of proximate analysis, the crude fat content of raw snail meat was found to be 0.8% (wet basis). Comparing this with standards from Nurrohmah*et al.* (2008) and data from applesnail.net, the fat content of golden snail meat is approximately 0.4 g/100 g (0.4%) on a wet basis. For reference, the fat content of mollusks in general is around 1.5% (Hadiwiyoto, 1993). The results obtained are in close proximity to the established standards, although the fat content of golden snails is notably lower than that of snails in general. The fat content of golden snails can be influenced by various internal and external factors. Internal factors include the snail's species, age, and properties of its derivatives. Meanwhile, external factors consist of the environment, season, and available food resources. Variability in the age and developmental stages of the snails caught, as well as the effect of the season, can influence the fat content. For instance, during warmer temperatures in the summer, golden snails are less active, which can affect their fat content.

For boiled golden snail meat, the crude fat content was measured at 0.8%. While there is no direct comparison data for boiled golden snail meat, the boiling process itself may have contributed to this value. Unsaturated lipids are prone to oxidation upon contact with oxygen, heat, and organic or inorganic catalysts. Such oxidation can diminish nutritional value, lead to toxicological effects, and alter the color and flavor of the food ingredients. Food oxidation reactions during processing and storage, involving heat, oxygen, light, and enzymes, play a significant role in lipid damage (Manullang, 1995).

## Ash Content

The crude ash content of raw golden snail meat obtained from the measurements is recorded at 2.60% (wet basis). According to existing literature (Nurrohmah*et al.*, 2008; applesnail.net), the ash content is approximately 3.2 g/100 g (3.2%). In contrast, Bombeo-Tuburan (1995) found that mollusk meat generally has a wet basis ash content of 1.6%. The variability in the results can be attributed to several factors influencing the calculation of ash content. Apart from the internal and external factors discussed earlier, the method of sample preparation and the precision in conducting testing procedures significantly impact the ash content measurement.

Ash represents the inorganic residue left after the combustion of organic materials and accounts for the total mineral content in the material. The ash content and composition depend on the material type and the ashing method used. Minerals can exist as organic salts (malates, oxalates, acetates, etc.) and inorganic salts (phosphates, carbonates, chlorides, sulphates, etc.). In some instances, minerals form complex organic compounds, making it challenging to determine their original form. Examples of mineral components in a material include calcium, phosphorus, sodium, potassium, magnesium, sulfur, cobalt, and zinc (Harbers and Nielsen, 2003; Sudarmadji et al., 1996; Winarno, 2008).

Testing the ash content is highly susceptible to contamination. Proper sampling is crucial, and the equipment used for sample grinding/smoothing, glassware, and washing water may serve as potential sources of contaminants (Harbers and Nielsen, 2003). Moreover, certain sample types can create deposits on the test container, interfering with measurement accuracy.

The total ash content of boiled snail meat measured at 4.10%. The factors influencing the ash content of boiled snail meat are similar to those for raw snail meat, with the additional consideration of boiling water potentially contaminating the ash content, particularly if the water used has high hardness. For the boiling process, ordinary tap water from the laboratory, not distilled water, was employed. Despite this, the boiling temperature used (100°C) is not expected to significantly affect volatile mineral content, as it is well below temperatures close to 500°C, where such changes could occur.

## Carbohydrate *by difference*

The carbohydrate content is determined through calculations by difference, wherein the total carbohydrate content on food labels is derived from subtracting the total weight of crude protein, total fat, moisture, and ash content from the total weight of the food (BeMiller, 2003). The analysis of carbohydrate content by difference in raw golden snail meat yielded a value of 2.88%. In contrast, according to Nurrohmah*et al.* (2008) and applesnail.net, the carbohydrate content of golden snail meat is reported at 6.6 g/100 g (6.6%).

As with other nutrients, the carbohydrate content is influenced by internal and external factors, as discussed in the previous sub-chapter. In nature, polysaccharides constitute the most abundant carbohydrate group (about 90%), with some serving as food reserve compounds, such as starch in plants and glycogen in animal cells. These complex carbohydrates may contain up to three thousand simple sugar units (Almatsier, 2006; Sudarmadji*et al.*, 1996).

In aquatic animals, carbohydrates are typically found in the form of glycogen. Glycogen, often referred to as "animal starch," is abundant in the liver and muscles, is water-soluble (unlike vegetable starch), and turns red when iodine is added. With a molecular weight of approximately 5 million, glycogen is the largest water-soluble molecule in nature and serves as an energy reserve in animal liver, capable of being converted into glucose when needed (Winarno, 2008). However, glycogen in meat is unstable, easily undergoing glycolysis and converting into lactic acid (Hadiwiyoto, 1993).

The carbohydrate content of boiled snail meat was measured at 4.43%. Comparing this value to the carbohydrate content of raw snail meat is not straightforward since boiled snail meat experiences reduced water content, whereas in the proximate test, the total analysis must equal 100%. Consequently, the increase in carbohydrate content in boiled meat, when compared to raw snail meat, could be due to the decrease in water content and other nutrients rather than solely being a result of increased carbohydrate content influenced by the boiling process. Heating can affect product quality in multiple aspects, including taste, texture, color, and nutrients sensitive to heat, but the extent of this effect depends on the sensitivity of the components present in the material (Heldman and Hartel, 1998).

## Conclusion

In conclusion, the golden apple snail (*Pomaceacanaliculata*) exhibits promising characteristics as a valuable source of animal protein and essential nutrients. Through proximate analysis, the chemical composition and nutritional content of both raw and boiled golden snail meat were investigated. The results demonstrated that the golden snail contains significant amounts of protein, essential minerals like iron, calcium, magnesium, copper, iodine, and vitamin C. Additionally, the snail's meat offers high levels of omega-3, omega-6, and omega-9 fatty acids.Boiling the golden snail is a common method of preparation, especially in Indonesia, and the analysis showed that boiling affects the protein and fat content, causing denaturation and reduced extractability. This highlights the importance of careful preparation methods to retain the snail's nutritional value.Overall, the golden apple snail presents itself as a nutritious and versatile food source, providing an alternative protein option and potential economic opportunities for low-income communities. Understanding the nutritional composition of golden snails is crucial for informed decision-making by consumers and industries that utilize these snails in various applications.As the golden snail continues to spread and gain popularity as a food supplement, further research is warranted to explore its full nutritional potential, optimize preparation methods, and investigate potential value-added products from different parts of the snail. This knowledge will contribute to promoting sustainable utilization of this valuable freshwater resource and enhancing food security in the region.

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