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Research Article

Amino Acid Profile of *Pila globosa* Swainson in Active and Aestivation Periods

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Abstract

The snail *Pila globosa*'s amino acid composition was examined. To analyse the amino acids in the snail meat, samples were taken from the Chalan Beel at various times. The BCSIR, ITTI lab in Dhaka, Bangladesh is where the amino acid analysis is carried out. Following a 300-400 mg weight measurement, 12 ml of HCl was added, and the mixture was vortexed. It was then hydrolyzed for 24 hours at 102 ℃ with a pH adjustment (1.95-2.00). Leucine was shown to be the predominant essential amino acid throughout both the active and aestivation periods, whereas glutamic acid was the most prevalent non-essential amino acid. Eight essential and nine non-essential amino acid types made up the total of 17 amino acid types discovered. While the percentage of non-essential amino acids was 71.2% and 72.7%, respectively, the rate of essential amino acids was 28.8% and 27.3%. Compared to snail meat during the active period, snail meat during the aestivation period has a greater amino acid profile. The essential amino acids valine, isoleucine, lysine, and phenylalanine were below the necessary level in both seasons, whereas methionine was in the margin line. The study concluded that, based on their circumstances, eating snail meat should be advised for a variety of malnourished individuals.

Keywords

P. globosa, Amino Acid, Aestivation, Leucine

1. Introduction

A specialty food, snails have long been valued in many countries, especially in Thailand, China, Taiwan, and Western European countries. It has been noted that snail flesh is a good source of minerals, amino acids, and vital fatty acids. Snail meat has been regarded as a nutritious substitute for animal protein in various regions of the world because of its nutritional advantages [1].

Pila is an expert on giant water snails, which are molluscs that are aquatic gastropods. *P. globosa* is low in fat and high in protein. Snail meat's protein composition was 40.87% during the aestivation phase and 42.88% during the active time, per dry-weight protein analysis. [2]

An organic component with carboxyl and amine groups is called an amino acid. The human body needs amino acids. The amount and quality of amino acids in an animal determines its nutritional value [3-5]. The meat of fish and shellfish is generally regarded as being very nutrient-dense since it contains vital proteins and amino acids [6-8]. The human body needs amino acids to function. Repairing damaged tissue after injury, protecting the liver from toxins, decreasing blood pressure, controlling cholesterol metabolism, encouraging growth hormone release, and lowering blood ammonia levels are all functions of these amino acids [9]. Vitamins,

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trace minerals, and digestible protein are abundant in snail meat, which stimulates the organism [10, 11].

Previous research has examined the nutritional value of various aquatic creatures to higher order consumers based on their amino acid profiles [12-17]. In order to determine the nutritional value of snail meat, this study compared the amino acid profiles of the flesh from *Pila globosa* throughout its active and aestivation periods. The amino acid profile's content serves as the analysis in this study.

2. Material and Methods

2.1. Sample Collection

The *Pila* species of *Pila globosa* Swainson from the Chalan beel served as the study's base, along with additional materials for the examination of the amino acid profile, including distilled water (H_2O), hydrochloric acid (HCl), AccQ-Fluor Borate, Fluor Reagent A, and a standard amino acid solution.

2.2. Sample Preparation

Chalan beel snails (*Pila globosa* Swainson) served as the study's samples. They cleaned, gutted, and drained the snail. After the samples were drained, they were dried in an oven set between 68 and 72 degrees Celsius. The snail was left to dry for 56 hours. After the sample has dried, it is ground into a powder and kept in a plastic container at room temperature (20-25 ℃). All the sample preparation processes were carried out at the Ecology Lab, Institute of Environmental Science, University of Rajshahi.

2.3. Analysis of Amino Acid

2.3.1. Preparation of Sample

The Amino acid analysis is done at the ITTI lab of BCSIR, Dhaka. After weighing the sample between 300 and 400 mg, adding 12 ml of HCl, and vortexing it, it was hydrolysed for 24 hours at 102 ℃ with a pH adjustment (1.95-2.00).

2.3.2. Preparation of Standard Solutions

A Sykam Amino Acid analyser S433 (Sykam GmbH, Eresing, Germany) was used to determine the amino acid composition following the standard procedure (Association of Official Analytical Chemists, 1990). However, tryptophan cannot be fully determined with this method. The ground samples were concentrated in a rota-evaporator after being hydrolysed in 7 N HCl for 22-24 hours at 110 ℃ in a nitrogen environment. The manufacturer's sample dilution buffer (0.12N citrate buffer, pH 3.4) was used to reconstitute the concentrated samples. The amino acid composition of the hydrolysed samples was examined. Column: LCA K07/Li (PEEK e column 4.6 _ 180 mm); application: physiological; detector: Integrated Dual-Channel Photometer (570 nm, 440 nm); detection principle: ninhydrin reaction; and inert gas: N_2 were the working settings of the amino acid analyser. The FAO/WHO/UNU, 1985 was used to determine the amino acid score.

3 Results

3.1. Analysis Amino Acid

Chromatography is a popular technique for identifying and isolating a mixture's constituent parts in laboratory analysis. The chromatogram shows the outcome of a chromatography (Figure 1 and Figure 2). In addition to data that can be utilised for qualitative or even quantitative research, these chromatograms provide a wealth of information about the condition of the gas chromatography apparatus. The retention time is the amount of time the sample takes to flow through the column and out, and it is shown on the x-axis. The analyte peak's measured response in the detector is shown by the y-axis. When no analyte is eluting from the column, the baseline displays the signal from the detector. The various compounds found in snail meat can be identified by comparing the sample's various peaks in terms of retention and form to those of known compounds. Additionally, a compound's concentration can be ascertained by comparing its peak area to a sample calibration curve of the same component at various concentrations.

Figure 1 below displays the findings of the analysis of the *Pila globosa* snail's amino acid profile during the active season from the Chalan beel.

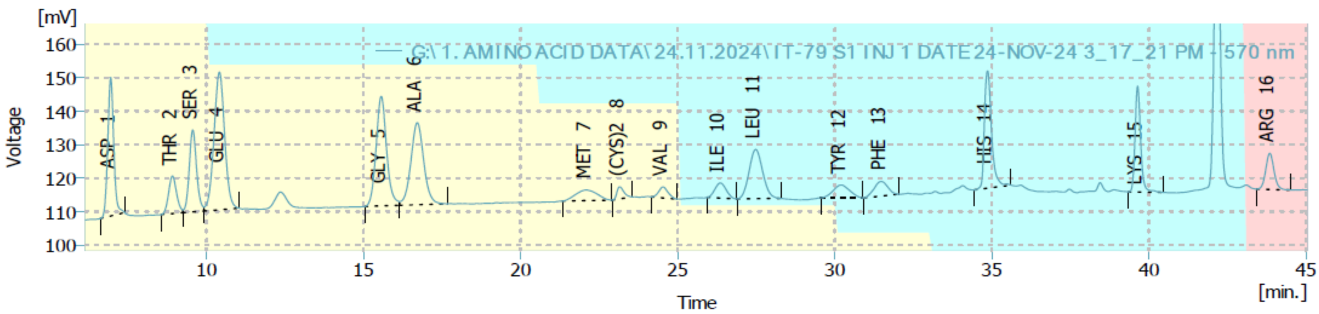

Figure 1. *Levels of Amino Acids in active period's snail.*

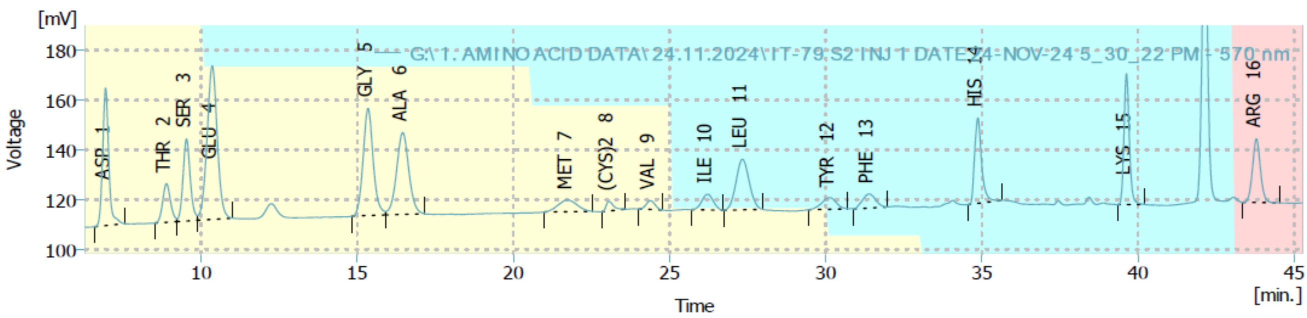

Figure 2*. Levels of Amino Acids in aestivation period's snail.*

3.2. Amino Acid Profile of *Pila globosa* Swainson and Comparison with *Pomecea canaliculata*

Figure 3 below shows the results of the comparison of the amino acid profiles of *Pila globosa* from challan beel and farmed *Pomecea canaliculata* during the active and aestivation periods:

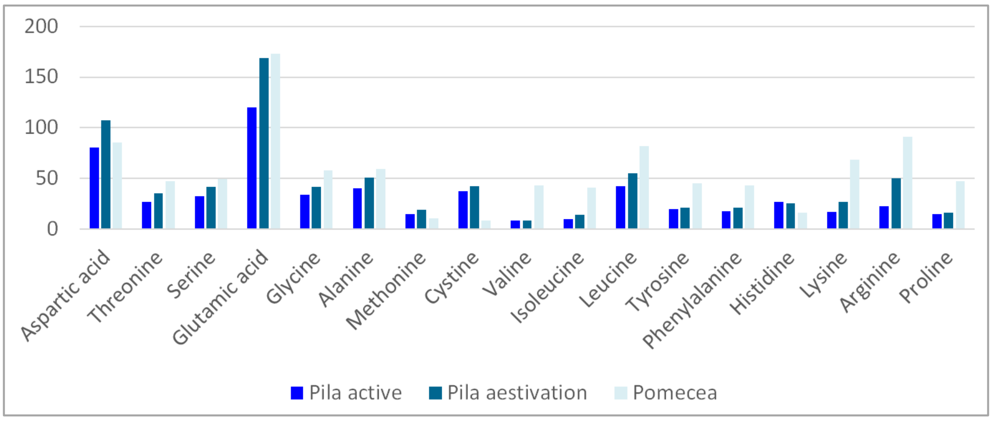

Figure 3*. The comparison of P. globosa and P. canaliculata's amino acid Content (data of P. canaliculata adopted from Ghosh et al.2017) [27].*

Figure 4 below shows the results of the comparison of the essential amino acid profile in the *Pila globosa* from the active period and the *Pila globosa* from the aestivation period from Challan Beel and the suggested protein pattern based on FAO/WHO/UNU (1985) [26]:

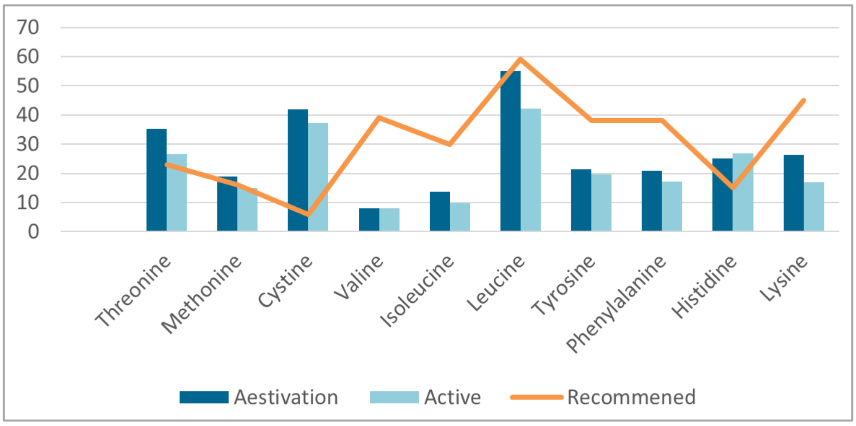

Figure 4*. Comparison of essential amino acids composition between P. globosa and recommended protein pattern based on FAO/WHO/UNU (1985).*

4. Discussion

One of the primary macromolecules that are transferred throughout aquatic food webs is amino acids [18]. They are essential for cellular metabolism and serve as energy metabolites in addition to being protein building blocks [16]. Numerous illnesses, including inflammatory and Crohn's diseases, are regulated by high amino acid levels.

In the current investigation, a total of eight essential amino acids were identified (Figure 1 and Figure 2). In both seasons of the current investigation, leucine was high and valine was low. The snail from the berried aestivation period had the highest levels of total essential amino acids (202.752 mg/g). During both study periods, leucine, threonine, and lysine were the most prevalent essential amino acids. Sixty-five percent of all necessary amino acids were these. One amino acid that produces ketones is leucine. Acetyl-CoA and acetyl-acetic acid, crucial intermediates in the metabolism of fats and carbohydrates, could be produced from it. With Methonine, Lysine, Valine, Threonine, Histidine, and Tyrosine in the diet, leucine is widely recognized as one of the necessary amino acids that may be limiting [19]. Combine leucine, isoleucine, and valine to aid in the repair of bones, muscles, and skin. For people recuperating from surgery, leucine is advised because it decreases blood sugar and promotes the generation of growth hormone [20]. Valine and histidine levels were lower during the aestivation period (25.020 and 7.876) but higher during the active time (26.690 and 8.065 mg/g). Conversely, methionine, phenylalanine, threonine, leucine, and isoleucine were lower during the active period and greater during the aestivation period. Together with aspartic acid and methionine, threonine maintains the body's normal protein balance, aids in the production of collagen, elastin, and tooth enamel, aids in liver and lipotropic function, inhibits the accumulation of fat in the liver, and promotes assimilation and metabolism. Nevertheless, the *P. globosa* sample did not contain the important amino acid tryptophan.

In the current investigation, a total of nine non-essential amino acids were identified (Figures 1 and 2). Maximum glutamic acid levels were consistent over both seasons. Proline, however, was scarce. Berried snails during the aestivation period had the highest levels of total non-essential amino acids (538.871 mg/g). Remarkably, *P. globosa* possessed a comparatively high proportion of amino acids that enhance flavour, specifically glutamic (120.059 and 168.974) and aspartic (80.399 and 107.377) acids, respectively, which add to its pleasing umami flavour [21]. While aspartic acid serves physiological purposes as a component of nucleic acids and nucleotides, glutamic acid serves as a precursor for the synthesis of glutathione and the neurotransmitter gamma-aminobutyric acid (GABA) [22]. Glutamic acid can help limit excessive alcohol intake, speed up the healing of intestinal wounds, enhance mental well-being, and lessen sadness [23].

Often referred to as the channelled apple snail or golden apple snail, *Pomacea canaliculata* is a freshwater gastropod that belongs to the Ampullariidae family. Many countries around the world, including China and much of Southeast Asia, including Korea, consider the species to be edible [24, 25]. According to the results of the comparison of the amino acid profiles during the active period and *Pila globosa* and farmed *Pomecea canaliculata* during the aestivation period (Figure 3), the essential and non-essential amino acid levels of Pomecea are higher than those of *Pila globosa* during both seasons. *Pomecea* had lower levels of the non-essential amino acid cysteine and two essential amino acids (methionine and histidine) than both of Pila's periods. The only amino acid in *Pomecea* that is higher during aestivation and lower during active times is aspartic acid, which is a non-essential amino acid. *Pila* and *Pomecea canaliculata* had 28.8% and 27.3% of necessary amino acids, respectively, and 37% of non-essential amino acids, while *Pila* had 71.2% and 72.7% of non-essential amino acids, respectively, and *Pomacea canaliculata* had 63% (Figure 3).

Animal proteins including meat, eggs, and poultry are the richest providers of necessary amino acids. Alternative protein sources are now required to supply the world's protein needs as a result of population expansion and the depletion of arable land and fresh water. Therefore, we examined the protein contents of *P. globosa* and the suggested protein pattern based on FAO/WHO/UNU (1985), as well as the essential and non-essential amino acid contents and, more specifically, the contents of leucine, lysine, and methionine. According to the results, methionine is in the margin line in both seasons, whereas the essential amino acids valine, isoleucine, lysine, and phenylalanine were below the required value in both seasons. Leucine is at the recommended amount during the estimation period, but it falls below the recommended value during the active season. In both seasons, the levels of the non-essential amino acid cysteine and the essential amino acids histidine and threonine are within the recommended range (Figure 4).

5. Conclusions

In amounts comparable to some animal proteins, the study's findings demonstrated that *P. globosa* is a good source of protein and possesses a favorable nutritional balance of essential and non-essential amino acids. The current sources of animal protein are under more strain as a result of the growing human population. In addition to being costly, traditional protein sources like lamb, cattle, fish, and poultry are also at risk from climate change and low local breed production. In countries where people have negative opinions about eating snail meat, it is hoped that this research would add information to the food composition table and spark interest in consuming these treats.

Abbreviations

BCSIR Bangladesh Council of Scientific and Industrial Research

FAO Food and Agriculture Organization
ITTI Institute of Technology Transfer and Innovation
UNU United Nations University
WHO World Health Organization

Conflicts of Interest

The authors declare no conflicts of interest.

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