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Bio-Chemistry and Nutritional health benefits of *Bellamya bengalensis* (Edible Gastropod): A Review

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Abstract:
Bellamya bengalensis, a freshwater gastropod commonly found in Asia, has been a significant part of traditional diets in many regions. This review article aims to consolidate existing knowledge regarding the bio-chemistry and nutritional health benefits of *Bellamya bengalensis*. Through an extensive review of scientific literature, this paper examines the protein, vitamin, mineral, and fatty acid content of *Bellamya bengalensis*, as well as its potential health implications.

Keywords: bio-chemistry, *Bellamya bengalensis*, *human health*, *nutritional value*, *traditional foods*

1. Introduction:

The consumption of gastropods as a food source dates back centuries, with cultural and culinary significance in various parts of the world (Voultsiadou et al., 2010). *Bellamya bengalensis*, known for its distinctive spiral shell and tender flesh, is one such gastropod species widely harvested for culinary purposes (GOSwami et al., 2020). Despite its popularity as a food item, comprehensive studies on its nutritional composition and health benefits are limited (Hasler, 2002; Khalua et al., 2014). This review seeks to address this gap by synthesizing available information on the nutritional value and potential health-promoting properties of *Bellamya bengalensis*.

1.2 Gastropods as a traditional food item

Gastropods, including various species of snails and freshwater mollusks like *Bellamya bengalensis*, have a long history as traditional food items in many cultures worldwide (Subba, 2012). Here's an overview of their significance:

Cultural Heritage:

The consumption of gastropods dates back thousands of years and has deep cultural roots in many societies (Burgos et al., 2019). In regions such as France, Italy, Greece, and parts of Africa and Asia, gastropods have been cherished as culinary delicacies, often associated with special occasions and traditional celebrations (Cattaneo-Vietti et al., 2016).

Sustainable Food Source:

Gastropods are often harvested from natural habitats such as forests, rivers, and coastal areas, providing a sustainable food source for communities living in these regions (Hasidu et al., 2020). Their abundance and rapid reproduction make them an accessible and renewable protein source, particularly in areas where other forms of livestock farming may be less feasible (Gerber et al., 2015).

Traditional Medicine:

In addition to their culinary uses, gastropods have also been employed in traditional medicine for their purported health benefits (Nongmaithem et al., 2017). In some cultures, snail mucus is believed to possess healing properties and is used in skincare products and topical treatments for wounds and skin ailments (Cilia and Fratini, 2018).

Culinary Innovation:

Despite their long history as traditional food items, gastropods continue to inspire culinary innovation (Pitcher and Lam, 2015). Chefs around the world experiment with new recipes and preparations, incorporating gastropods into contemporary dishes to showcase their unique flavors and textures (Mouritsen, 2009).

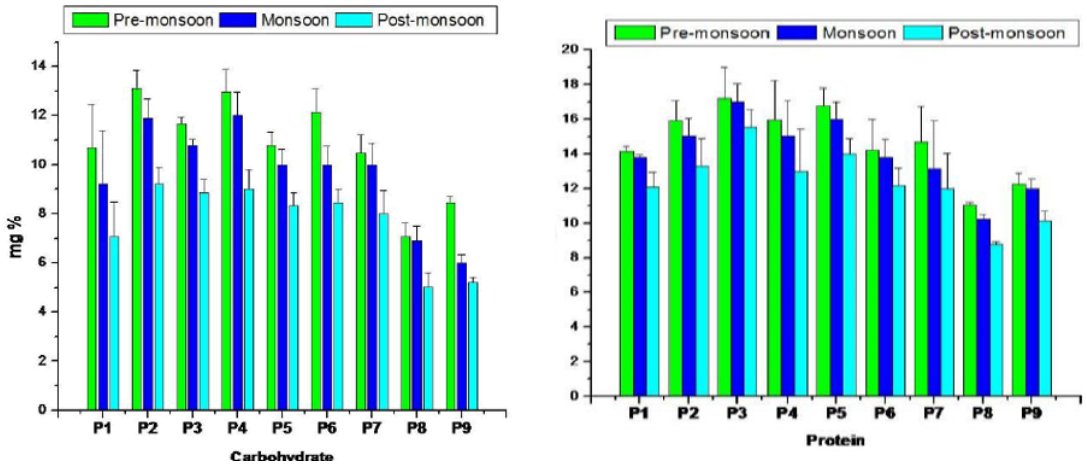
1.3 Nutritional Composition and health benefits:

Bellamya bengalensis is valued for its high protein content, with studies indicating levels comparable to or exceeding those found in other protein-rich foods such as fish and poultry (Pradhan et al., 2016). Additionally, analysis of its vitamin and mineral profile reveals significant concentrations of essential nutrients, including Vitamin A, B vitamins, iron, zinc, and calcium. Furthermore, *Bellamya bengalensis* serves as a source of omega-3 fatty acids, particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), known for their role in cardiovascular health and cognitive function (Rádis-Baptista, 2022).

The nutritional profile of *Bellamya bengalensis* suggests numerous potential health benefits (Chakraborty et al., 2015). Its protein content supports muscle development and repair, making it a valuable dietary component for athletes and individuals engaged in physical activity. The

presence of vitamins and minerals contributes to overall health and immune function, while omega-3 fatty acids offer protective effects against cardiovascular disease and inflammation. Moreover, the low-fat and low-calorie nature of *Bellamya bengalensis* makes it suitable for individuals seeking weight management solutions without compromising nutritional adequacy (Ragi and Nair, 2017).

Figure: 1 *Graphical presentation of carbohydrate and protein value of Bellamya bengalensis* (Khalua et al., 2014)



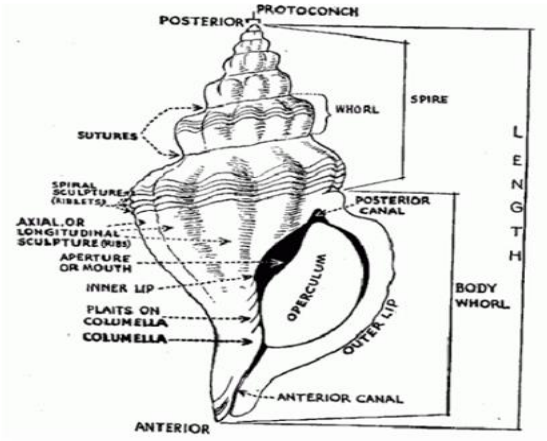
1.3 Chemistry of Gastropods

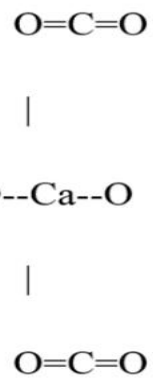
The chemistry of gastropods, including both terrestrial (land) and aquatic (freshwater and marine) species, is diverse and multifaceted (Darias Jerez et al., 2006). Here's an overview of some key chemical components and processes associated with gastropods:

Shell Composition:

Gastropods are characterized by their single, often spiraled shell, which serves as a protective exoskeleton (Geiger, 2006). The shell primarily consists of calcium carbonate (CaCO3), typically in the form of calcite or aragonite crystals (Fu et al., 2015). Organic components, such as proteins and polysaccharides, also contribute to shell structure and strength.

Figure: 2 Chemistry of Gastropods (Geiger, 2006; Darias Jerez et al., 2006)





Mucus Production:

Gastropods produce mucus for various purposes, including locomotion, moisture retention, and defense against predators. The mucus composition varies among species but often contains glycoproteins, glycosaminoglycans, and water. Mucus may also contain antimicrobial compounds to protect against infections (Davies, 1998).

Digestive System:

The digestive system of gastropods plays a crucial role in nutrient acquisition and energy metabolism. Gastropods possess a radula, a specialized feeding organ equipped with chitinous teeth, which they use to scrape and rasp food particles. Digestive enzymes, including proteases, lipases, and carbohydrases, facilitate the breakdown of ingested food into absorbable nutrients (Lobo-da-Cunha, 2019).

Metabolic Pathways:

Gastropods utilize various metabolic pathways to generate energy and maintain physiological functions. These pathways include glycolysis, the citric acid cycle (Krebs cycle), oxidative phosphorylation, and anaerobic metabolism (e.g., fermentation). Additionally, gastropods may engage in metabolic adaptations, such as aestivation (entering a dormant state) during dry or adverse conditions (Gäde, 1983).

Reproductive Chemistry:

Reproduction in gastropods involves chemical signalling and interactions between individuals. Mating behavior often includes the release of pheromones, chemical compounds that convey information about the reproductive status and suitability of potential mates. After fertilization, gastropods may produce egg capsules containing protective coatings or adhesive substances (Johansson and Jones, 2007).

Toxicology and Defense Mechanisms:

Some gastropods possess chemical defenses against predators and competitors. For example, certain species produce toxins or noxious compounds, such as alkaloids or secondary metabolites derived from dietary sources (e.g., algae). These chemical defenses deter predation and help maintain ecological balance within their habitats (Bornancin et al., 2017).

Environmental Interactions:

Gastropods can influence environmental chemistry through their feeding habits, excretion, and shell formation. For example, grazing gastropods may contribute to nutrient cycling and algal control in aquatic ecosystems. Additionally, the dissolution of gastropod shells can influence local water chemistry, particularly in areas with low pH or calcium concentrations (Harayashiki et al., 2020).

Table: 1 *Macro and Micro minerals present in Gastropods* (Salas et al., 2018)

Macrominerals	
Ca	$38.10^{c}\pm0.50$
P	$98.00^{b}\pm1.50$
Na	$95.00^{b}\pm0.60$
Mg	$75.79^{b}\pm0.20$
K	$149.60^{a}\pm0.47$
Microminerals	
Zn	$1.27^{d}\pm0.02$
Cu	$0.16^{e}\pm0.01$
Mn	$0.11^{e}\pm0.01$
Fe	$1.65^{d}\pm0.01$
Se	$30.44^{c}\pm0.05$
Mo	$0.07^{e}\pm0.05$

Table: 2 *Essential amino acids present in Gastropods* (Salas et al., 2018)

Essential amino acids	
His	69.30 ± 0.45
Arg	$551.3^{a}\pm0.50$
Thr	$186.3^{b}\pm1.10$
Val	$112.9^{c}\pm1.04$
Met	$106.2^{c}\pm0.51$
Ile	$130.0^{c}\pm0.91$
Leu	$321.6^{b}\pm1.13$
Phe	$117.3^{c}\pm1.21$
Lys	$263.0^{b}\pm1.45$
ΣEAA	1857.9 ± 2.10

2. Conclusion:

In conclusion, *Bellamya bengalensis* represents a valuable source of nutrition with potential health benefits. Its protein, vitamin, mineral, and omega-3 fatty acid content make it a desirable

dietary option for promoting overall well-being. Further research is warranted to elucidate its bioavailability and specific health effects, facilitating informed dietary recommendations and promoting the sustainable utilization of this edible gastropod species.

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