

**BELAMYA BENGALENSIS: A REVIEW ON ITS ECOLOGICAL IMPORTANCE,
NUTRITIONAL VALUES AND ETHNO MEDICINAL IMPORTANCE****Anindita Bar***

Assistant Professor, Department Of Zoology, Ramananda College, Bishnupur, Bankura-722122, West Bengal, India.

***Corresponding Author: Anindita Bar**

Assistant Professor, Department of Zoology, Ramananda College, Bishnupur, Bankura-722122, West Bengal, India.

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ABSTRACT

Bellamyia bengalensis (Lamarck, 1822) is a fresh water edible snail, distributed throughout Asia and Africa. The snail's flesh part is widely used in ethno medicine as well as food. It has a very high protein content which is even greater than some common fish and red meat group. It plays an important role in fresh water ecosystem. It has been traditionally used in the treatment of various human ailments like chronic gastric disorders, arthritis, joint pain, rheumatism, controlling blood pressure, asthma, rickets, calcium metabolism, nervousness, giddiness and has been recommended for the treatment of cardiovascular diseases, conjunctivitis, night blindness, diarrhoea. *In vivo* and *in vitro* studies have provided the support against traditional demands of the snail as anti-inflammatory, immune booster, anti-microbial, anti-oxidative, anti-hypersensitive uses. However, further studies are required to define the active chemical compositions and to validate its clinical utilisation for human uses. This review provides an overview of ecological importance, nutritional values and traditional applications, current knowledge on *Bellamyia bengalensis*.

KEYWORDS: Freshwater snail, Drug development, Ethno medicine, Bioindicator species, Nutritional values**1. INTRODUCTION**

From immemorial times *Bellamyia bengalensis* is being used as food mainly by the tribal people. The ethnic races from the North East Indian states like Manipur, Mizoram, Tripura, West Bengal, Bihar, Jharkhand etc. use it as food as well as medicine. This snail along with other fresh water molluscs play a vital role in the economy and tradition of west Bengal in India by serving as a food of more than 80% families.^[5] The lower market price and availability has made it a good source of protein for the poor villagers and ethnic people. Not only that, from the monetary point of view, it has a much cheaper market rate than fish and red meat groups. By selling this commodity a lots of people can able to earn their daily livelihood, because beside its good edible value & medicinal value, it also act as a cheap source of protein.^{[14][15]} It also has a great ecological importance. This review work aims to discuss on the ecological importance, nutritional and ethno medicinal values of *Bellamyia bengalensis*.

2. DISTRIBUTION

Distributed all over the Asia and Africa.

3. ZOOLOGICAL CLASSIFICATION

Bellamyia is a genus of freshwater snails, It is the type genus of the subfamily Bellamyinae.^[1]

Taxonomic position

Kingdom: Animalia
Class: Gastropoda
Sub-class: Prosobranchia
Order: Mesogastropoda
Family: Viviparidae
Sub-family: Bellamyinae
Genus: *Bellamyia*
Species: *B. Bengalensis* (Lamarck)

4. SALIENT FEATURES

Bellamyia bengalensis is a fresh water mollusc. Its body is covered with shell. The shell is oval as a whole. The upper part of the shell is slightly conoidal rather than conical. The aperture is sub-circular and has a narrow black margin. The colouration varies considerably, but it is never very brightly coloured. The ground colour is greenish and opaque. The operculum is moderately thin and of a deep brownish colour. The viviparid (mystery-snail) females are equipped with a uterus in which they gestate the eggs until they become juvenile snails hence called viviparous.^[19]

5. HABITAT

It is a freshwater dwelling snail. It is found in almost all types of lowland water bodies, mainly stagnant water and low saline water resources such as rivers, streams, lakes, ponds, wetlands, polluted roadside marshes & ditches,

paddy fields, etc. Can tolerate a maximum salinity of 0.2mg/l.^[2]

6. ECOLOGICAL IMPORTANCE

B. bengalensis is an important component of fresh water ecosystem. It acts as secondary consumer by consuming the planktons as well as producer for the carnivorous aquatic species. This animal performs biofiltration during feeding of microorganism and planktons.^[21] It plays the role of bioindicator species for a large number of ecological parameters.^[16] Their population density has a positive correlation with the temperature, TDS, electric conductivity and salinity. On the other hand pH, hardness, secchi transparency shows a negative correlation with the population density.^{[19][20]} Thermal stress greatly impacts the physiological functioning and growth patterns of *B. Bengalensis*.^[17] HSP70 (Heat Shock Protein), SOD (Superoxide Dismutase) perform as biomarker in heat stress.^{[16][23]} Hence, this species can play a key role for freshwater ecosystem in present climate change and global warming context.

B. bengalensis act as bioindicator for toxin and heavy metal contamination of water bodies. It shows a gender and age specific response to fenvalerate, a synthetic pyrethroid.^[26] Sumicidine, a detergent alters the protein metabolism of the snail.^{[24][25]}

Bellamya bengalensis have greater capacity for zinc, copper and lead accumulation than *Lymnea accuminata* and the accumulated metal concentration in soft body tissues of the snail is higher than the surface water and soil sediments.^[18] This specimen can be used as a candidate for the standardization of the freshwater sediment toxicity test protocol.^[30]

7. NUTRITIONAL VALUES

The use of fresh water molluca as protein-rich food is very much in practice in number of south Asian countries

namely India, Bangladesh, Taiwan, Philippines and Thailand.^[10] *B. bengalensis* has an admirable demand to the people of all the economic classes, more particularly to poor and tribal communities of rural and semi urban areas. The comparatively low cost of this snail has made it a good source of protein to the lower income group people. Not only protein it content a considerable amount of carbohydrate and fat also.^[5]

Table 1: Protein content analysis according to Kjeldahl procedure (AOCS, 1991) of *B. bengalensis* and other edible molluscs, some fish and meat.^{[3][4]}

Item name	Protein content (% dry weight)
Molluscs	
<i>B. bengalensis</i>	48.65 ± 0.85%
<i>Pila globosa</i>	8.27 %
<i>Melania tuberculata</i>	12.36 %
<i>Lamellidens marginalis</i>	6.46 %
<i>Anisus convexiusculus</i>	12.92 %
<i>Helix</i> sp.	8.64 %
Fish	
Carp	42-43 %
Pomfret	19%
Salmon	30%
Mackerel	30%
Meats	
chicken	30%
Mutton	21%
Pork	22%
Beef	28%

Therefore, from the above data it is clear, this significant amount of protein which were not less than (rather, grater than) the fish and red meat communities.

Table 2: Isolation of Protein and Amino acid content in *Bellamya bengalensis* and a parallel comparison was made with the (WHO et.al, 2007) report, on the daily requirement of protein and amino acid for child and adult human.^[3]

em Name	Quantity	Requirement for Adult Human (gm/kg body wt./day) (WHO et.al., 2007)
Length measurement (cm)	3.84 ± 0.26	
Weight measurement (gm)	3.76 ± 0.15	
Crude Protein Content (% dry weight)	48.65 ± 0.85	0.66 to 0.75
Name of Amino Acid (% dry weight)	Quantity(gm./100gm.ofProtein)	Requirement for adult human (gm/kg body wt./day)(WHO et.al., 2007)
Aspartic acid □	6.59± 0.72	--
lutamic acid	7.93 ± 0.61	--
Serine	7.62 ± 0.45	--
Histidine ^{ea}	6.19 ± 0.50	0.010
Glycine	1.85 ± 0.36	--
Threonine ^{ea}	18.89± 0.88	0.015
Arginine ^{ea} c	5.61 ± 0.59	--
Alanine	8.64 ± 0.23	--

Tyrosine ^{eaac}	1.90 ± 0.60	Tyro+Phyala = 0.025
Valine ^{eaac}	3.66 ± 0.12	0.026
Methionine ^{eaas}	0.61 ± 0.39	0.010
Cysteine ^{eaac & eaas}	0.84 ± 0.82	0.004
Isoleucine ^{eaac}	2.70 ± 0.33	0.020
Leucine ^{eaac}	7.51 ± 0.26	0.039
Phenylalanine ^{eaac}	2.10 ± 0.36	Tyro+phyala = 0.025
Lysine ^{eaac}	16.13 ± 0.51	0.030
% of essential amino acid	66.96 (including Cysteine)	

*aspartic acid + asparagine, glutamic acid + glutamine, eaa- essential amino acid, eaac- essential amino acid for children, eaas- sulphur containing essential amino acid, Tyro+Phyala = Tyrosine+Phenylalanine, Values are mean ± SD, n=10. (--) no information is available.

The above table confirms the presence of WHO recommended amount of protein and amino acids in this snail. It contains a large number of amino acids some of them are essential amino acids for humans. These amino acids play vital contribution in controlling human physiological process.^{[3][4]}

There is a great seasonal variation in the nutrient content of the snail. The carbohydrate, protein and fat content [estimated by Kemp et.al. (1954) method, Lowry et.al. (1951) method and Barns and Blackstock (1975) method respectively] was studied during pre monsoon, monsoon and post monsoon periods. All the three parameters were maximum during pre-monsoon (March-June) and minimum during post-monsoon.^[5]

8. ETHNO MEDICINAL VALUES OF *B. BENGALENSIS*

From the immemorial time beings, ethnic people are very conscious about the ethno-medicinal values of *B. bengalensis*. They strongly believe about the functions *B. bengalensis*, which can cure several diseases such as controlling conjunctivitis, night blindness, diarrhoea, stomach upset and chronic gastric disorders, arthritis, joint pain rheumatism, cardiac diseases, controlling blood pressure, asthma, rickets, calcium metabolism, nervousness, giddiness etc.^[6] Depending on the objective of the use, different parts of the animal body, its derivatives, or the whole animal are used.^[27] The interesting points are the people who are living, beneath the poverty level of north-eastern part of our country (Chhattisgarh, Jharkhand, Bihar, West Bengal, Sikkim, Tripura, Manipur, Mizoram etc) depends directly on *B. bengalensis*, as their main earning and edible source.^[4] *In vivo* and *in vitro* studies have provided the support against traditional demands of the snail as immune booster, anti-carcinogenic, anti-inflammatory, cardio tonic.

8.1 Anti-inflammatory, Analgesic and Antipyretic activity: *B. bengalensis* is used for the treatment of arthritis, joint pain, rheumatism etc by the ethnic people. *In vivo* and *in vitro* studies have provided the support against these traditional demands. Study in Wister albino rat and Swiss mice shows a significant anti-

inflammatory, analgesic and antipyretic activity of the lymph secretion of the *Bellamya bengalensis* in a dose-dependent manner.^[7] The extrapallial fluid of *Bellamya bengalensis* also has dose dependent analgesic action.^[10] Its body fluid extract shows dose dependent both the peripheral and central analgesic activity.^[11] The analgesic activity is probably due to inhibitory actions on protease or prostaglandin biosynthetic pathway.^{[10][11]} Hence, prostaglandin synthesis inhibitors or non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used in the treatment of inflammations, arthritis and pain, but serious adverse events have already alerted against repeated use of NSAIDs. Hence, it can be a better natural alternative to develop new safer and effective anti-inflammatory drugs.^[10]

8.2 Apoptotic and Anti-cancer property: In recent era cancer is the third most common cause of death. The first line of defence against cancer is cell cycle regulation and apoptosis. The in-vitro study revealed that the secretion extract of the *Bellamya Bengalensis* plays highly significant role in cell cycle regulation and apoptosis.^{[8][9]} Its anti-hepatocellular carcinoma activity on human hepatic cell line is reported.^[8] Cell cycle analysis revealed that treatment with the secretion extract of the *Bellamya Bengalensis* arrested the human hepatic carcinoma cell and leukemic cell populations in early phase of cell cycle.^{[8][9]} The *B. bengalensis* extract shows hepatoprotective activity in rat against carbon tetra chloride induced hepatotoxicity.^[29]

This apoptotic property of *B. Bengalensis* has a great significance as it can play a crucial role in anti cancer drug development.

8.3 Anti-oxidative property: Free radical scavenging system and antioxidants are very significant area of research in present time as they are directly associated with macromolecular damage. In vitro study suggests a significant free radical scavenging Activity of BBE (*Bellamya bengalensis* Extract) on arsenic exposed human liver cells, lung epithelial cells and brain tissues.^[12] BBE also exhibited dose dependent antioxidant effects in Arsenic induced intestine injury in rat.^[12] The BBE supplementation strongly prevented

arsenic-induced oxidative, necrotic and apoptotic damages to liver tissue.^[13] This protection was favourable to prevent against As-induced oxidative stress. As arsenic induced oxidative stress mainly leads to cancer in human, therefore Arsenic exposure is a major problem to the civilization.^[28] These in vivo and in vitro studies offer strong evidence on the medicinal efficiencies of BBE against oxidative stress induced by arsenic.^[13]

8.4 Hypersensitivity preventive activity: lipid extract of the foot of *Bellamya bengalensis* has a significant role in the prevention of hypersensitivity reaction. An *in situ* dose dependent supplementation of BBL shows inhibition of Reactive Oxygen Species, serum Nitric Oxide, macrophage and TNF α production. Its supplementation led to significant decrease in paw oedema, tissue myeloperoxidase activity as well as decrease in splenic CD4⁺/CD8⁺ ratios in mice. The factor exerting this activity probably is the oleic acid and cyclopropane fatty acid rich lipid.^[14]

8.5 Anti-microbial property: A novel antimicrobial peptide of 1676 Da was purified from *Bellamya bengalensis*. Study on the effect of this peptide on *Staphylococcus epidermidis* resistant to ampicillin and chloramphenicol reveals that it increases the staphylococcal membrane permeability in a dose dependent manner.^[31] Hence, the peptide can be a promising candidate for anti *Staphylococcal* drug development.^[31]

9. CONTRADICTION

Bellamya bengalensis has a significant and proved role in the monitoring of all the ecological and environmental factors of fresh water. Studies exhibit contradiction about the responses of the snail to ecological parameters. According to one study water hardness has a positive effect on the growth and population density of *B. bengalensis* and another study shows the negative correlation among them.^{[19][20]}

10. CONCLUSION

Among all the fresh water edible molluscs *Bellamya bengalensis* has the highest protein content (% dry weight) and it also has a significant ethno medicinal value. In vivo in vitro studies provide supports against its use as an anti inflammatory, anti cancer, anti oxidative, anti microbial factors. In the present era with global warming and industrial pollution it can play an important role as bioindicator species of water quality and biofiltration of water. Therefore it can be concluded that *Bellamya bengalensis* is a fresh water snail with easy availability, cheap market price and immense potential of new drug development and it can be a boon for mankind.

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