Health Promoting Effects of Marine Molluscs: An Overview

Meshram Leena N.

Department of Zoology, Mahatma Phule Arts, Science & Commerce College, Panvel, Dist. – Raigad, Navi Mumbai 410 206, Maharashtra, India

Received: 2nd August, 2023; Accepted: 31st August, 2023; Published online: 3rd October, 2023

https://doi.org/10.33745/ijzi.2023.v09i02.088

Abstract: Marine molluscs are rich in vital nutrients and active secondary metabolites as well as have the ability to enhance immune response. Many species of mollusca were used in traditional medication in different parts of the world. Many marine molluscs exhibit antibacterial, antibiotic, anticancer, anti-Inflammatory, antimicrobial, anti-leukemic, and antioxidant activities and are rich source of bioactive compounds. Extract of shells, whole body or some specific organs have been used for treatment of many ailments such as dyspepsia, digestive impairment, melabsorption syndrome, enlargement of liver hepatomegaly, duodenal ulcer, jaundice, enlarged spleen and liver, asthma and cough, tuberculosis, urinary complaints, and inflammatory disorders. The aim of this review was to collect information from the available literature relating to marine molluscs with respect to health-promoting effects and bioactive compounds.

Keywords: Antibacterial, Anticancer, Anti-Inflammatory, Anti-leukemic, Antimicrobial, Antioxidant, Bioactive compounds, Health, Marine molluscs


https://doi.org/10.33745/ijzi.2023.v09i02.088

This is an Open Access Article licensed under a Creative Commons License: Attribution 4.0 International (CC-BY). It allows unrestricted use of articles in any medium, reproduction and distribution by providing adequate credit to the author(s) and the source of publication.

Introduction

Marine fauna is the sources of unique natural products used as food, fragrances, pigments, insecticides, medicines etc. Many pharmacologically bioactive compounds have been derived from marine invertebrates such as tunicates, sponges, soft corals, sea hares, nudibranchs, bryozoans, sea slugs and other marine organisms. The secondary metabolites derived from number of marine animals possess antibiotic, anti-parasitic, antiviral and anti-cancer activities (Simmons et al., 2005; Giftson and Patterson, 2014).

Molluscs (Latin word mollusc, meaning “soft”) (Anbalagan and Samuel, 2012) are one of the important groups of invertebrates and include soft bodied macro-benthic heterogeneous group of animals, found attached to the bottom of the intertidal region or free swimming (Das, 2017; Pawar and Al-Tawaha, 2017). Marine molluscs consist of around 31,643 species and comprise about 23% of all the named marine invertebrate organisms (Winckworth, 1940). Mussels, oysters,
clams, pearl-oysters, window-pane oysters, ark-shells, whelks, chanks, cowries, squids and cuttlefish have been exploited since time immemorial for food, pearls and shells (Mohamed and Venkatesan, 2017).

Marine molluscs contain a diverse array of active ingredients (carbohydrates, proteins, minerals, lipids, sterols, and nucleosides), which contributes in the medicinal value of these invertebrates. They are rich in vital nutrients and active secondary metabolites and possess health-promoting potential with antiviral, anti-inflammatory, and antimicrobial properties (Cheong et al., 2017; Khan and Yang, 2019). Blunt et al. (2006) and Chandramathi and Thilaga (2018) reported that, marine molluscs contain more than thousands of bioactive compounds such as: peptides, sterols, terpenes, polypropionates, nitrogenous compounds, macrolides, prostaglandins, fatty acids derivatives, alkaloids etc.

Benkendroff (2010) stated that molluscs possess bioactive compounds with anti-tumour, anti-leukemic, and anti-bacterial properties. Further, medicines and bioactive compounds derived from shelled gastropods and bivalves play role as chemical defence against their predators. Marine molluscs are rich in biologically active natural products that provide new potential sources of anti-inflammatory agents (Tarek et al., 2017).

Benkendorff (2010) and Chelladurai (2020) reported that, phylum mollusca is divided into 7 different classes of which four have been labelled as major and three as minor phyla. The four major classes include:

- Polyclapophora: Chiton, Katharina, Mopalia etc.
- Gastropoda: Conch, Cones, Snails, Cypraea etc.
- Bivalvia: Oysters, Clams, Mussels, Scallops etc.
- Cephalopoda: Squids, Octopuses, Cuttlefish etc.

The three minor classes include:

- Monoplacophora (Neopilina)
- Solenogastres (Neomenia)
- Caudofoveata (Chaetoderma, Limifossor).

**Ecological roles of Molluscs (Das, 2017):**

Due to their ubiquitous distribution and enormous species number, molluscs play important ecological roles in aquatic and terrestrial ecosystems of the world--

- Food for human and other animals (echinoderms, fish, birds and mammals).
- Biomonitering and bioindication purposes (Oehlmann and Schulte-Oehlmann, 2002).
- Filtering phytoplanktons and source of food for fishes.
- Oxygenate the bottom by reworking sediments.
- Breaking down organic materials before bacterial re-mineralization.
- Many of them are commercially important.
- Source of drugs and bioactive compounds.

**Literature Search Methods:**

The review was carried out through extensive literature search, using electronic databases, and online search tools, such as EMBASE, Google Scholar, Medline, NCBI, PubMed, Science Direct, Scopus, and Web of Science databases. Data and information was collected from the thorough study of the journal articles, research papers, reports and various literatures. The keywords used for reviewing the literature were the ones that refer to the issues concerning the 'health promoting effects ' and 'marine molluscs'. For literature search, keyword "marine molluscs" is combined with: classification, ecological roles, drugs, and bioactive compounds.

**Health Promoting Effects and Bioactive Compounds of Marine Molluscs:**

The marine environment is a rich source of both biological and chemical diversity. This diversity has been the source of unique chemical compounds with the potential for industrial
Table 1: Bioactive compounds reported in marine molluscs

<table>
<thead>
<tr>
<th>Mollusc fauna</th>
<th>Part of body</th>
<th>Therapeutic activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pearl oyster (Pinctada)</td>
<td>Whole body tissue</td>
<td>• Treatment of tuberculosis, dyspepsia, jaundice, and urinary complaints.</td>
<td>Radhika et al. (2008)</td>
</tr>
<tr>
<td>• Donax faba</td>
<td>Shell extracts</td>
<td>• Antibacterial activity against pathogens</td>
<td>Giftson and Patterson (2014)</td>
</tr>
<tr>
<td>• Hemifusus pugilinus</td>
<td>Soft body tissue</td>
<td>• Antibacterial activity</td>
<td>Arumugasamy and Cyril (2017)</td>
</tr>
<tr>
<td>• Perna viridis (Green Mussel)</td>
<td>Whole body tissue extract</td>
<td>• Anticancer Activity</td>
<td>Praveena and Kaneez (2017)</td>
</tr>
<tr>
<td>• Meretrix meretrix (Great Clam)</td>
<td>Whole body tissue extract</td>
<td>• Antibacterial activity</td>
<td></td>
</tr>
<tr>
<td>• Dicathais orbita</td>
<td>Hypobranchial gland, Egg mass</td>
<td>• Anti-Inflammatory activity</td>
<td>Tarek et al. (2017)</td>
</tr>
<tr>
<td>• Conus achatinus (Gmelin, 1791)</td>
<td>Body tissue</td>
<td>• Bioactive compounds and Antibacterial activity</td>
<td>Chandramathi and Thilaga (2018)</td>
</tr>
<tr>
<td>• Sea slug (Euselenops luniceps) (Cuvier, 1817)</td>
<td>Whole body tissue extract</td>
<td>• Antimicrobial potential</td>
<td>Sivaprakasam et al. (2018)</td>
</tr>
<tr>
<td>• Marine heterobranch molluscs</td>
<td>Whole body tissue</td>
<td>• Anticancer activities</td>
<td>Avila and Angulo-Preckler (2020)</td>
</tr>
<tr>
<td>• Conus magus</td>
<td>Whole body tissue</td>
<td>• Control of the heart disease &amp; pain control.</td>
<td>Chelladurai (2020)</td>
</tr>
<tr>
<td>• Xancus pyrum</td>
<td>Whole body tissue</td>
<td>• Treatment of dyspepsia, digestive impairment, melabsorption syndrome, enlargement of liver hepatomegaly and duodenal ulcer.</td>
<td></td>
</tr>
<tr>
<td>• Harpa conoidalis</td>
<td>Whole body tissue</td>
<td>• Antimicrobial activity</td>
<td></td>
</tr>
<tr>
<td>• Cypraea errone</td>
<td>Whole body tissue</td>
<td>• Treatment of dyspepsia, jaundice, enlarged spleen and liver, asthma and cough.</td>
<td></td>
</tr>
<tr>
<td>• Hemifusus pugilinus</td>
<td>Whole body tissue</td>
<td>• To kill the bacterial and fungal pathogens</td>
<td></td>
</tr>
<tr>
<td>• Brachidonta variabilis</td>
<td>Body tissue extract</td>
<td>• Antimicrobial activity</td>
<td>Sake et al. (2020)</td>
</tr>
<tr>
<td>• Pinctada radiata</td>
<td>Dried body tissue</td>
<td>• Anticancer Activity</td>
<td>Subavathy and Shibana (2021)</td>
</tr>
<tr>
<td>• Turbo bruneus</td>
<td>Whole body tissue</td>
<td>• Antibacterial activity</td>
<td></td>
</tr>
<tr>
<td>• Cypraea annulus</td>
<td>Whole body tissue</td>
<td>• Anticancer activity</td>
<td></td>
</tr>
<tr>
<td>• Babylonia spirata</td>
<td>Whole body tissue</td>
<td>• Antibacterial activity</td>
<td></td>
</tr>
<tr>
<td>• Perna canaliculus</td>
<td>Whole body tissue</td>
<td>• Anticancer activity</td>
<td></td>
</tr>
</tbody>
</table>

Marine organisms such as sponges, tunicates, fishes, soft corals, nudibranchs, sea hares, opisthobranch Molluscs, echinoderms, bryozoans, prawns, shells, sea slugs, and marine microorganisms are sources of bioactive compounds. On the basis of their specific pharmacologic actions, marine drugs are antibacterial, anti-inflammatory, neuroprotective, antiparasitic, antiviral agent, anticancer, analgesic and antimicrobial (Navgire, 2021).
Dang et al. (2015) noted that antiviral compounds are a crucial component of molluscan defences against viruses and have diverse mechanisms of action against a wide variety of viruses, including many human pathogens. Antiviral compounds found in abalone, oyster, mussels, and other cultured molluscs are available in large supply, providing good opportunities for future research and development.

Extensive biodiversity and availability of marine and estuarine molluscs, along with their wide-range of utilities as food and nutraceutical resources developed keen attention of the food technologists and dieticians. Among the phylum mollusca, Bivalvia, Gastropoda and Cephalopoda, were mostly reported for their nutraceutical applications and bioactive properties (Chakraborty and Joy, 2020). Summer et al. (2020) referred the marine molluscs as the ‘A Wealth of Potential Therapeutic Compounds’. The molluscs synthesize a wide variety of bioactive primary and secondary metabolites. More than 1145 compounds had been isolated from marine molluscs, including peptides, sterols, terpenes, polypropionates, macrolides, fatty acid derivatives, nitrogenous compounds, and alkaloids (Avila and Angulo-Preckler, 2020).

Bioactive Compounds Reported in Marine Molluscs:

Table 1 illustrates the bioactive compounds which have been reported from marine molluscs.

Health Promoting Effects of Marine Molluscs:

- Antibacterial activity against pathogens
- Antibiotic activity
- Anticancer activities
- Anti-Inflammatory activity
- Antimicrobial activity
- Antioxidant activities
- Source of Bioactive compounds
- Control of the heart disease & pain control
- To kill the bacterial and fungal pathogens
- Treatment of dyspepsia, digestive impairment, melabsorption syndrome, enlargement of liver hepatomegaly and duodenal ulcer.
- Treatment of jaundice, enlarged spleen and liver, asthma and cough.
- Treatment of tuberculosis and urinary complaints.

Conclusion

Results of this study indicate that molluscs are the most noteworthy group of marine organisms with diverse health promoting effects and an excellent source of bioactive compounds. Various body parts of members of phylum mollusca such as shells, soft tissue, basal parts, mucilage, and even entire organisms also have been used for treatments of different ailments, and many diseases. Body of molluscs are an excellent source of active secondary metabolites and their use as food in daily diet is beneficial in avoiding many ailments and diseases.

Acknowledgements

Encouragement and support provided by Dr. Ganesh A. Thakur, Principal, Mahatma Phule Arts, Science and Commerce College, Panvel, Dist. - Raigad, Navi Mumbai, India is gratefully acknowledged. Author is thankful to The Head, Department of Zoology for providing necessary facilities for the present study. Special thanks to faculties of Department of Zoology for providing valuable suggestions and fruitful discussions on the study topic.

References


