



Molluscs as a Treasure House of Nutraceuticals and Bioactive Compounds

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Abstract

Fish, shellfish, squid and bivalves are just a few of the many species that produce seafood by-products, which are typically thrown away as waste even though they may be used to create novel functional food recipes. The phylum Mollusca includes Cephalopoda, Bivalvia and Gastropoda. These taxa have been primarily studied for their bioactive qualities and potential uses in nutraceuticals. Marine by-products may provide bioactive substances including chitin, collagen, peptides, PUFA, antioxidants and catalysts for the production of biodiesel. Consumer desire for environmentally friendly and healthier food is increasing. Consuming mollusca regularly may help strengthen immunity and lower the risk of several illnesses. This article highlighted the high-value bioactive compounds and nutritional constituents derived from molluscs.

Keywords: Functional foods, Human health, Mollusca, Nutraceuticals

Introduction

Human resources were given to the Molluscs in addition to their nutritional worth, including dyes, shells, decorations and money. Molluscs were considered a nutritious food source and were employed in conventional healthcare in many ancient societies. In Durban, South Africa's traditional medicine market, the most costly marine mollusc was the cephalopod's inside shell (Herbert *et al.*, 2003). For many cultures worldwide, molluscs have long been a source of beneficial items with medical properties. The word 'molluscs' is Latin for "soft". While certain kinds of molluscs have shells, most molluscs are soft-bodied and therefore susceptible to illnesses and predators. At roughly 7% of all living things, molluscs are the second biggest phylum of animals on the planet. Currently, marine molluscs have about 52,000 recognized species with an estimated diversity of a million to two million species (Pechenik, 2023).

Based on their evolutionary study, molluscs were grouped into seven classes: Monoplacophora, Aplacophora, Polyplacophora, Bivalvia, Scaphopoda, Gastropoda and Cephalopoda. Of the seven classes of these soft-bodied

invertebrates, with their bodies divided into feet and visceral sections, the bivalves (oysters, mussels, scallops and clams), cephalopods (octopus, squid and cuttlefish) and gastropods (sea snail, abalone, whelks and cockle) are the economically significant molluscs (Venugopal and Gopakumar, 2017). The intake of marine molluscs is prevalent and recognized as "natural functional foods". Nutraceuticals are bioactive ingredients that are present in foods, medicinal products and dietary supplements that help to alleviate and/or prevent disease. A functional food is characterized as a food items that has additional positive benefits (Anonymous, 2018). In the 1980s, the word "functional food" was used in Japan to refer to foods or food ingredients that were high in nutrients and/or contained elements that could enhance a person's physical and mental well-being. As long as a component has functional effects, foods can be "made" functional by adding, removing, or changing specific components to increase their bioactivity.

The components of foods identified as bioactive compounds have the power to support and modulate regulatory mechanisms in ways that go beyond standard nutritional

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analysis. Even though they fail to have the properties of nutrients, some food-derived bioactive molecules are nevertheless regarded as vital supports for overall health. In simple terms, bioactive compounds are the substances or parts that give food its functionality. Examples of these bioactive substances are vitamins, oligosaccharides, dietary fibres and essential fatty acids. The multitude of bioactivities that marine compounds display, such as their antibacterial and antioxidant, abilities that include wound healing, cholesterol-lowering, protective effects on neurons, anticancer, anti-diabetic, anti-obesity and skin defence; may account for their potential health advantages. In addition, the seafood sector is an important producer of leftovers and byproducts which are transformed into nutritious food with additional value, enhancing food sustainability and boosting the economy. Consumers began using functional foods and nutraceuticals in their regular meals as a preventive healthcare approach against the rising prevalence of lifestyle diseases. Many studies stated that gastropods were the primary target of most chemical research and the separation of bioactive secondary metabolites, with bivalves and cephalopods coming in second and third. As an outcome, we have focused on defining the bioactive metabolites, especially those that come from these three prominent mollusc forms.

Bivalve Molluscs

Omega-3 polyunsaturated fatty acids, such Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA), are frequently present in bivalves. Bivalve molluscs are also potential sources of E and D resolvins, anti-inflammatory compounds that are important in inhibiting the production of inflammatory prostanoids. Along with being utilized as a source of antibacterial and antiviral peptides in ancient Crete, bivalve mussels (Mytilidae) have been the focus of several patent applications in more recent times. Lyprinol®, a lipid fraction of the freeze-dried powder from green-lipped mussel *Perna canaliculus*, is an excellent example of a commercialized product. This medication is being marketed to reduce the inflammatory processes related to arthritis because of its anti-inflammatory effects. It has been clinically demonstrated that the cold extract of the glycosaminoglycan-rich mussel species *P. canaliculus* reduces joint discomfort and increases joint mobility. Under the brand name GlycOmega-PLUS™, it was sold. *Ostrea edulis* oyster shell lysate can be used in the homoeopathic therapy of bone deficiency and offers osteoporosis patients calcium carbonate in a bioavailable form. Oyster powder (*Crassostrea gigas*) is a traditional Chinese medicine used to treat uterine bleeding, headaches dizziness, palpitations, sleeplessness, sweating and leucorrhoea. The natural taurine and zinc extracted from oyster shells (*Crassostrea gigas*, *Ostrea* spp.) have been suggested as dietary supplements for liver issues, diseases of the skin, wound healing, infection resistance and cardiovascular health. The nutritional characteristics of edible oysters (*C. madrasensis*) and green mussels (*P. viridis*) have been previously documented and they have been recommended as a substitute to balance the increased consumption of inflammatory Omega-6 fatty

acids. Another Chinese treatment that is applied topically as an eye ointment and used to cure a variety of skin diseases is *Pinctada* spp. A mother-of-pearl lotion intended for dermatological and cosmetic purposes has been granted a patent. In India, a foot soup is used to treat cardiac ailments and shell powder from freshwater mussels (*Lamellidens* spp.) is utilized to regulate blood pressure, giddiness and dehydration. Oysters had higher PUFA and EPA amounts than mussels and squid, in that order. *Meretrix lusoria* and *M. meretrix*, the Asian hard clam, were regarded as low-value health foods since they revealed significant nutritional value.

Gastropod Molluscs

Trunculariopsis trunculus and other muricid whelks (Muridicae; Caenogastropoda) secrete a purple dye that is used as a remedy for murex and “women’s problems” such include uterine cancer, dysmenorrhea, chronic endometritis, metrorrhagia, leucorrhoea, nymphomania, anxiety and an upbeat mood. The uses of cowrie shells in dental fillings have been assigned a patent and are also used in traditional Chinese medicine. Extracts of freshwater snails (*Bellamya* spp.) are used to cure conjunctivitis and other inflammatory conditions like asthma, rheumatism and arthritis, the eggs of terrestrial apple snails from the Ampullariodoidae family (*Pila* spp.) are used to remedies of rickets. Ziconotide was the first marine medication authorized for the treatment of chronic pain. It is derived from the venom of predatory cone snails. Abalone shell and powder are used in traditional Chinese medicine to treat vertigo, cataracts, hypertension and limb spasms and as a liver tonic to enhance vision. In New Zealand, the dried abalone powder is sold under the nutraceutical brand, which is a say used to describe products derived from food that has been proven to have defence. Promoted advantages to using abalone powder include overall health and sexual augmentation; it also supports blood circulation and the immune system, prevents anaemia and provides vitamins, minerals, omega-3 unsaturated fatty acids etc. Abalone’s haemolymph exhibits antiviral and antibacterial activities against a variety of human infections. Higher levels of protein are found in predatory carnivorous gastropods including *Rapana venosa*, *Thais haemastoma*, *Hexaplex trunculus* and *Chicoreus ramosus*. It was found that the predatory gastropods had less lipid in them than the herbivorous ones. The tissues of the feet had a lower lipid quantity than the visceral tissues, which were thought to be the gastropods’ lipid-storing organs. It has been observed that a variety of minerals, including potassium, sodium, zinc, iron and sulfur, are present in gastropods. Amino acids of the mycosporine class were also extracted from *Aplysia californicas* (Sea hare) protective ink. Aplyronine A, an anticancer chemical, was extracted from *A. kurodai*.

Cephalopod Molluscs

It was found that cephalopods had 80% protein of their entire fleshy content which is considered acceptable for human consumption. Cephalopods were thought to be significant sources of bioactive compounds with considerable potential for bioactivity. It has been revealed that the main carotenoids in cuttlefish and octopus species

are astaxanthin and its ester derivatives. After their isolation from *U. duvauceli*, three antioxidative oxygenated terpenoids with anti-inflammatory properties were identified. These were identified structurally as CIX furano-norditerpenoid XVI, irregular CXV sesquiterpenoid XVII and CXX diterpenoid XVIII. Adenochromines I-III, the pigments, were taken out of *Octopus vulgaris*. It has been observed that *Todarodes pacificus* squid contains arsenolipids 4-5. Cyclophosphamide, a well-known chemotherapy medication, is derived from squid ink. Squid gelatine extract's increased ability to eliminate free radicals and reduce iron led to increased antioxidant activity. Supercritical carbon dioxide (SC-CO₂) extraction was used to de-oil the viscera residues of squid (*Todarodes pacificus*) to isolate and analyze marine lecithin. Phosphatidylcholine and phosphatidylethanolamine were the two major phospholipids found in lecithin extracted from squid viscera. Chiton shells had higher amounts of chitin and chitosan. *Sepia prashadi* cuttlebone have significant quantities of these compounds (Chitin and Chitosan) when compared to other sources, such as crab shells. The sepia ink is used as a remedy for depression.

Conclusion

This article shows that molluscs have a lot of potential for use as natural sources of amino acids, peptides and bioactive proteins. There are several marine mollusc nutraceutical products on the market currently. But to use marine bioactive peptides or protein hydrolysates as functional food additives that promote health. Now recently, there has been an increase in awareness of functional foods and the medicinal benefits of goods among people that have

been marine-purified. Molluscs, the second most prevalent category of creatures with shown healthful potential, are the most significant group of marine species. Since many molluscan species contain a wide range of active chemicals, they are used in traditional medicine throughout the world. The potential of molluscs and their compounds for antiviral, anti-inflammatory, antibacterial and other uses is encouraging, but further research and confirmation are needed to fully harness this source of food, medicine etc. Because of their high nutritional content and potential health benefits, molluscs may be included in our regular meals to strengthen our immune systems and promote overall health.

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