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REVIEW ARTICLE **OPEN ACCESS**

Molluscans: Applications from Basic Life Science to Biotechnology

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ABSTRACT
Molluscans are second the largest phylum of Animalia kingdom and contribute as the promising agents for broadened application for aesthetic zoological science to biotechnology. Molluscans had a great variety of attributes as ecological agent, edible food item, decorative and ornamental entities along with pharmaceutical application making them strong candidate for enhancing the economy of any developing or developed country. The current review summarizes the outstanding properties of molluscs and their applications for wide era of traditional life science to applied field of biotechnology.
Keywords: *Molluscans, Application, Biotechnology*

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INTRODUCTION

In today world the significant part of the world fauna is constitute by mollusks. Among the mollusk 10,000 are of economic importance and they fascinate million of people through their symmetry, coloration and the variety of sea shell are the major interest of man. Molluscs as a food alone plays an important in human world not only today but also since historic time. Majority of marine mollusks are important with respect to commercial purposes and they are broadly divided under two categories viz., (i) edible and (ii) ornamental. Clams, oysters, squids ,mussels ,etc. comes under edible molluskan fisheries which are used worldwide for human consumption[1].Marine mollusks also received special attention because they are not only used as food ,they are also used in other ways such as for making clothes, as a craft, yarn ,to dye cotton, etc. and therefore they are called as natural resources for economic importance [2].

The most fascinating and interesting part of the mollusk are the variety of shells they have, many people collect then to admire the variety of shells and to see their endless beauty, and many people collect them for scientific region, still there is more to learn about and from the shells .In India the information related with economic importance of species is available [3]. In many countries such as India [4]. The Philippines[5][6]and Thailand[7]freshwater mollusks are used as a protein rich food.In some parts of India like in west Bengal, freshwater mollusks play a vital role in boosting up their economy and their tradition, among all the families of west Bengal freshwater mollusks serves as a food for 80.81%population.

MATERIAL AND METHODS

Study areas

In the south-central region of Bangladesh, around the Madhumati river food plain ecosystem one of the most important Beel is the Chanda Beel. For more than 150 aquatic plants and 50 species of birds and to over 100 species of fish and other aquatic plants Chanda Beel serves as a home to them. Fisheries of mollusks, and some aquatic weeds like 'Shaluk' are the natural resources on which the local people are highly dependent for their livelihoods [8].

From wild gastropods collection of ornamental gastropods are done by using specific fishing technique. Different types of nets as well as hand picking and skin diving are used to catch shrimp, crab and fish

which are mainly collected as a sample for making ornaments. There are three general methods such as boiling, burial and sun drying which are used to remove soft body parts of the collected sample. After this we use acid in which those shells are kept whose soft body parts are removed for cleaning them. During the acid wash the shells which are damaged are removed and the shells which remain undamaged and thick are used for making ornaments [9].

SAMPLE PREPARATION AND PRESERVATION

The shells and their edible parts are separated carefully with the help of forceps and scalpels. Then the flash was powdered, dried and crushed and used for analysis. Desiccators are used to preserve the powdered sample. From the shells only mineral was analyzed as they are rich in minerals. In muffle furnace at 600degree Celsius, 0.50gm sample with one drop of nitric acid kept, so with the help of ash sample, we can make stock mineral solution [3].

RESULT AND DISCUSSION

The edible, commercially important gastropods are found in the in shore and interdial waters. In recent years the gastropods are receiving high attention in Indian and foreign markets due to greater demand for meat shell handcrafts [10].

Marine mollusks are valued since very long time. Human used them for religious symbols, tool, medicine, jewelry etc [11]. The bivalves and gastropods are also used as medicine, tools or as religious symbols. In southeast Asia shell craft industries are using large quantities of shell for making pearl-products [12]. All over in ornamental shell trade more than 5000 species of mollusks are involved [10].

COMMERCIAL IMPORTANCE OF MOLLUSCS

1. EDIBLE MARINE MOLLUSCS:

In many countries other than India edible gastropods are very much enjoyed as a food but in India, people don't realize the value of edible gastropods. There are various uses of mollusks like, fish feed, for human consumption, lime fisheries, etc. Mollusks of high nutritious shells and flesh should be used widely across all the countries [9].

From thousands of years it has been known that how health friendly a particular diet is [13] from 1980s only the market of contemporary functional food and nutraceutical begins to grow in Japan [14]. During the investigations and expansions in the field of science the growth and development of food and nutraceutical industry began to grow. [15] Moreover, at current nutraceutical and food industries are very much ahead to customary processed foodmarket [16]. The reason for the growth is their associated health benefits and low health expenditure and this also motivate growers to modify their farming techniques. Marine mollusks are regarded as "natural functional food" because they are highly consumed and their consumption has been rampant [17].

2. BIVALVES

- **Oysters-** In Indian water, eight species of oysters are found out of which only four of them are considered as commercially important. The most important species of common edible oyster that are extensively distributed along the Indian cost are C*. madmsensis , C.gryphoides, Crassostrea madrasensis, C.discoides* and *Saccostrea ciictillata.*These species are commonly found in Ashtamudi, kadalundi, Dharmadam in kerela, Killai Backwaters, Muthupet, and Tuticorin in Tamilnadu,Nethravathi, Kali, Mulky and condapur in Krnataka. From all these water bodies, oysters are highly exploited for edible purpose [10].A good production of oysters is found in most of the estuaries of south India and we can say that the future of oyster production through farming is very bright because the demand for oyster products and oyster meat is increasing day by day.
- **Sea mussels-** Two species of mussels are found worldwide out of which one is brown mussel, *Pema indica* and other is green mussel, *Pernaviridis* and they have great contribution in boosting up the annual income of a country. At Vizhinjam, Muttom, Poovar and Kolachal there is a very good settlement of brown mussels and along the west coast from Quilon to Kanyakumari there is a very limited distribution of brown mussels.Green mussels are present in very large quantity in the thick beds of Cochin, Quilon, Malabar coast between Clicut and Tellicherry and Goa, Karwar, and Gulf of Kutch in west coast at Kakinada and in east in Madras. Mussel fishing is not favorable during monsoon in the month of june-august, except that fishing is done throughout the year.Fishing season for green mussel. and brown mussel are at their peak from November to may [10]. According to study on brown mussel fishery during 1982-84 it was described that mussel meats are only found in internal market but large-scale export is possible if production through farming is achieved[18]. Between Mottom and Kovalam, in the southern part of south-west coast of India important fishing

centres for *P. indica* are located. In brown mussel fishery about 520 active fisherman and 300 catamarans are engaged with the annual production of 500t.

- **Clams**-Some important and widely used and exploited species of clams are *Villoritacyprinoides, M. meretrix, Katelysia opima.* The production of clams estimated annually is approx45, 412 t [19].In almost all maritime states, forming fishery of 30.9% with *Mesodesmaglabratum*, *Anadararhombea, D. cuneata, Tellinasp, D. incarnattis, Tridacana maxima,T.squamosa*are other clams that are exploited worldwide From 62 estuaries, maximum landing of 32,927 t is mainly given by Kerala, among all the maritime states. Among all the maritime states, Kerala gives maximum landing of 32,927 t mainly from 62estuaries. Along the east coast, Vellar estuary with small resources contributre1,087 t and in the Godavari estuary, Kakinada Bay, Andhra and Bheemuni patnam backwaters the annual contribution is of 2,816 t.
- **Giant Clams**

  Tridacna crocea, T. squamosa, Hippopushippopus and *T. maxima* are the species of gaint clams that are reported in India.These species of clams are available in Andaman and Islands, and are exploited for edible purpose. T. maxima and T. squamosa are available in Laccadives *T. squamosa* and T. maxima are available where they were exploited for edible purposes by the local population of the island.

  In south Indian states clams fishery is of sustenance nature and are limited to coastal area along backwaters and estuaries. Clam meat demand is confined to the coastal population, but export demand is increasing. In recent years the export demands for clam meat is increasing day by day. From India in the year 1992a total quantity of 1068.8 t worth Rs. 3.48 crores was exported as dehydrated clam meat and frozen boiled clam [10]

3.GASTROPOPS

- **Chanks-**Among the ornamental and edible and ornamental gastropods the sacred chanks*(Xancuspyrum)*is the most important one. Along the southwest coast of India, Gulf of Mannar, and Andaman Islands sacred chanks are mainly exploited[20].The Government of Tamilnadu on the basis of licensing allow chank fishing at Tuticorin which is the most popular place for chank fishing by Department of Fisheries and they chargeRs.500/- per boat and Rs.100 per diver and were landed at Thiruchendur and Tuticorin landing centres. 'Sangunilam'(local name) or chank beds and 'paars' are those areas where dead corals and coarse sand are present at the bottom. Chanks mainly prefer to feed on small polychaete worms and algae.[21].

  For one year ,from the bycatch of shrimp trawlers analysis of the gastropod samples where done along the Sakthikulangara - Neendakara area of Kerala , in whichten observations were done per month, from June 1993 to May 1994 showed that 29 species along with prawnswere caught in the shrimp trawlers[22]. *Xancuspyrum* (sacred chank), *Babylonia spirata, B. zeylanica* (whelks),*Turritella attenuata, Polystira sp*., *Crassispira sp.*,(screw shells), *Xenophora sp.* (carrier shells).*Bursa spinosa* (purse shells), *Rapanabulbosa* (purples) ,*Tonna dolium* (tun shells), *FicusJicus* (fig shells), *Murex trapa*, *M.virgineus, M.badius, Murex sp.*, (venus combs). *Babylonia spirata, B. zeylanica* (whelks),*Conus glans and Conus sp*. (cone shells) [21].Gastropods belonging to the family Buccinldae viz *Babylonia spirata and B. zeylanica* commomly known as whelk and locally known as 'pravumutta sank, are commercially exploited for edible purposes. At present there is a good demand for frozen meat and shell- on whelk from Japan. During the period of 1993-1994 approximately 300 tonnesofwhelk meat were exported and 500-600 of meat were exported in 1995-1996 period [23].
- **Torchus and Turbo-***Trochus niloticus* and *Turbo marmoratus* occupy a good position due to its large quantity and high economic value in the Andaman and Nicobar Islands. Exploitation of these commercial shells may have been started as early as 1929 [24]. Mainly *Trochus niloticus* are found abundantly in all the islands. According to asurvey it was found that there is abundance of *Trochus nilotcus*in all the islands. The annual production ranges from 100 to 150 t for turban shell and 500 to 690 t for top shell [25].
- **Cephalopods-** In the recent times cephalopods are emerging as a major and valuable resource due to its high demand in the export market, it comprises squids, cuttlefishes and octopuses. Cephalopods are landed. In all the maritime states of India.Fishery has witnessed a phenomenal increase in the landing of cephalopods as Kerala account for 37.17% of the cephalopod landings and ranked first during 1988-1992, followed by Maharashtra (28.98%), Tamil Nadu (13.88%), Gujarat (13.65%) and Maharashtra(28.98%) . On the whole the cephalopod catch was more contributed by west coast that is 85% of the total catch.[26].

  In cephalopod landing the major contribution are of squids (52%) and cuttlefishes (48%) respectively and negligible quantity of octopus were landed. *LoligoduvauceliOrbigny, Sepia aculeate*

Orbigny(22%), *Loligoduvauceliorbigny* (42%)and *Sepia pharaonis Ehrenberg*(20%) are the 3 main species which also have some contribution in cephalopod landings of the country)[27].

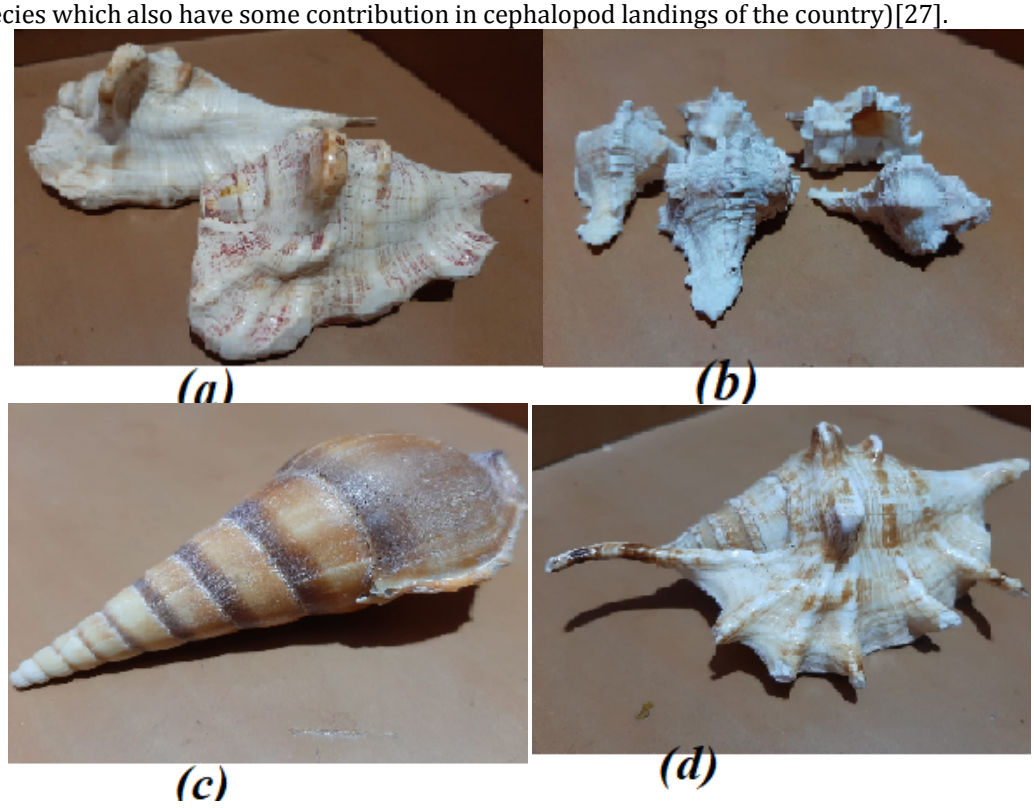

Fig 1. Sea Shells (a)*Queen conch* (b)*Apple murex* (c) *Barbados mitre* (d) *Rooster conch*

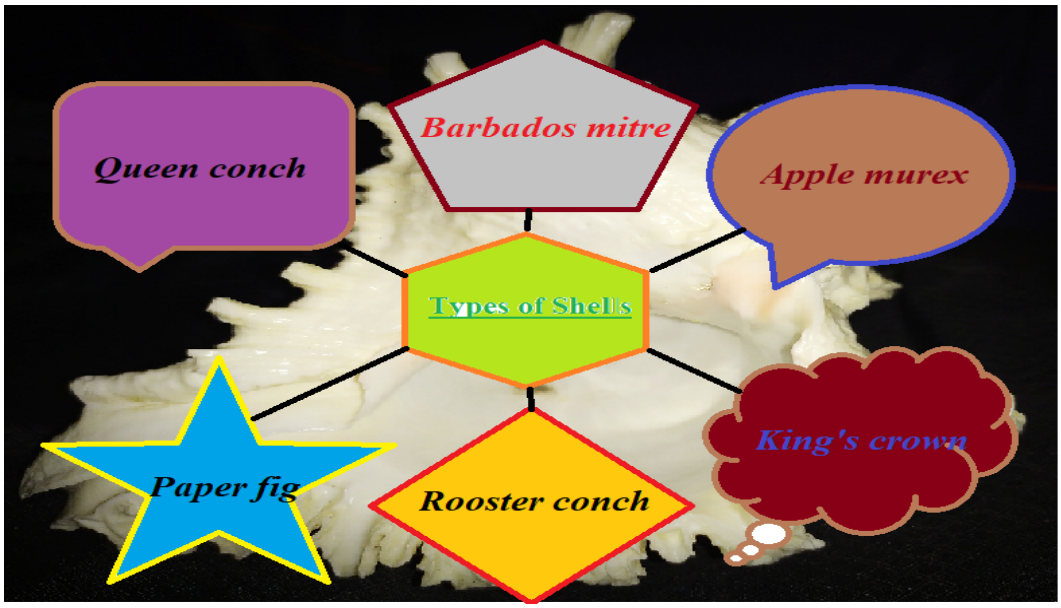

Fig 2. Different types of shells found in India

WORLDWIDE AVAILABILITY OF MARINE MOLLUSCS

In2014 the availability of seafood was167.2 million metric tons (MMT), out of which 4.3 MMT was accounted for cephalopods. Among the fast-growing cephalopods the most marketed squids are, *Illex argentines* (Argentine short-fin squid) and *Dosidicusgigas* (jumbo flying squid); while the quantity of cuttlefish and octopus that are exploited is 300,000t and 350,000t respectively since 2008 [28]. In 2014 the overall production of seafooddue to increase in demand culminates in 73.8MMTwith an appraised market value of US$160.2 billion. Molluscan aquaculture in Asia usually includes farmed squids (*Sepioteu*

this spp., Loligoduvauceli), scallop (Pectenyesoensis), and cuttlefish (*Sepia aculeate and Sepia elliptica)* [28]; while farmedabalone (*Haliotis spp.*) are mainly found in PR China [29].

ORNAMENTAL MARINE MOLLUSCS

Along the south east coast of India majority of gastropods and bivalve have been reported and are known to occur in Ramanathapuram coast. Variety of good quality good quantity of shells are found at the ornamental shell industry of Keelakarai and Rameswaram .Raw materials for these industriesare constituted by shell animals that are found in Palk Bay and Gulf of Mannar.

Table 1. Types of shells, examples and their products

	Examples of mollusks	**Out lets/products**
Ornamental shells	Colourful, large, cheap and mainly include gastropods and same gaint clams	Whole shells are used for decorations
Specimen or "Rare"	Deep water gastropods, mainly narrow endemic, expensive and Few in trade	Item for collection
Shell crafts	*Xanchuspyrum Cowries spp, Babylonia spp., Lambisspp, Strombusspp, Conus spp, etc*	Bangles, shell screen for windows and door curtains, table lamps, domes, beats for the neck, hair pin, necklaces, fancy flower sculptures of gods, flower vases, etc
Commercial shells	*Trochus niloticus I* (commercial trochus), *Turbo marmoratus* - (green snail) and *Pinctada spp*	Shell crafts, Buttons, Jewellary
Industrial shell	Giant clam (*Tridachinidae)*	Constituents of pottery glazes; manufacture of floor tiles

PEARL

The word 'pearl' is derived from the Latin word pirula which means pear that is because of the pear shape of the pearls. The beauty of pearl is an object of adoration and have so much of luster without any cutting or polishing and also help in boosting up the wealth of a country and are counted among the nine gems. Pearl have been one of the most important subjects of modern science-genetic engineering, and has been a subject of folklore all over the world.

In 1973 Central Marine Fisheries Research Institute (CMFRI) at Tuticorin was first to achieve pearl culture in India .In India, Research Centre of CMFRI at Tuticorin was the first to produce a spherical cultured pearl from *Pinctada fucata i*n 1973[30] and also get success in developing a technology for the seed production of this species [31].

Six species of pearl oysters occur along the Indian coasts,

Pinctada sugillata(Reeve)
Pinctada margaritifera(Linnaeus)
Pinctada atropurpurea
Pinctada fucata(Gould)
Pinctada anomioides(Reeve)
Pinctada chemnitzii (Philippi)

Pearl fisheries are mainly contributed by *P. fucata* in the Gulf of Mannar and Gulf of Kutch.

EVENTS IN PEARL FORMATION

The procedure after the nucleus and mantle graft have been inserted in *P.fucata* [32][33]. After insertion, around the nucleus a cup shaped structure of mantle tissue starts spreading. After three days of insertion, inner epidermis and the mesodermal tissue starts degenerating, and leave the outer epidermis to form a pearl sac by itself. After that nucleus is completely enveloped within the seven days and the epithelium become thick due to the secretion of the periostracal material that begins after 15 days and then the prismatic layer starts tolaid down. After40 days, the secretion of nacreous layer begins. Sometimes the process may result into a flawed pearl due to partial or total disruption of stratification.

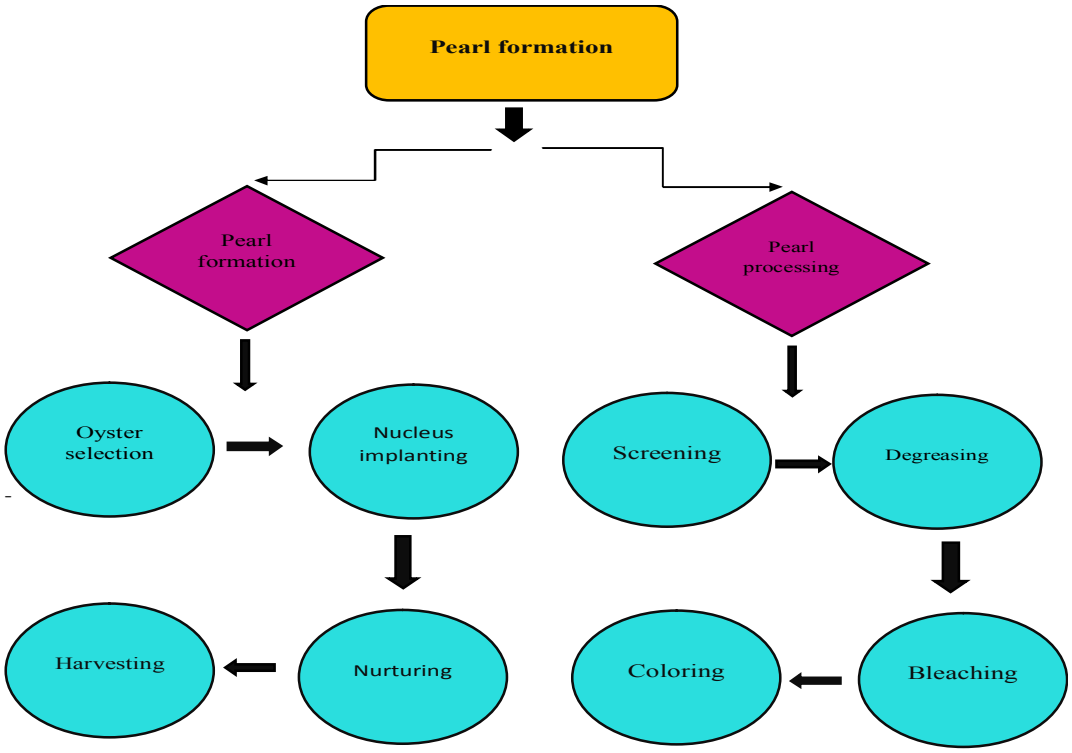

Fig 3. Events in Pearl formation

Pearls are used for many medicinal purposes. They have many antioxidants and anti-flammatory effect and are used in variety of clinical treatment for, tumors, ulceration and cataracts, etc to produce medicine [34].

BIOACTIVITY OF MURICIDAE EXTRACTS AND COMPOUNDS

1. Antimicrobial and Antiviral Activity

The gastropoda mollusks contain humoral factors in their haemolymph which act as an important defence mechanism against the microbial pathogen [35][36][37].Haemocyanin present in the gastropod haemolymph which contain oxygen molecule act as a dominant protein. The replication of Epstein-Barr virus [38] and Herpes simplex virus HSV-1 are inhibited by a glycosylated functional unit of haemocyanin from *Rapanavenosa*.[39].In several other marine species which include *Helix vulgaris* and the crustacean *Carcinusaestuarii,* haemocyanins have less antiviral activity than *Rapanavenosa.* From the haemolymph of *R. venosa* isolation of four proline rich antimicrobial peptides have been done[36]. These studies show the importance and diversity of antimicrobial agents that are isolated from the species of the Muricidae family. The antimicrobial compounds and antimicrobial agents that are so far identified are used for medicinal purposes or as a pharmaceutical drug.

2. Wound Healing and Anti-Inflammatory Activity

Anti- Inflammatory and wound healing properties in addition with anti-microbial properties are found in the extracts of muricidae. The extracts of lipids which contain fatty acids, sterols, Vitamin E, and polyunsaturated fatty acids from the muricid *Rapanavenosa* have a very good healing effect for induce skin burns in wistar rats. From a histological analysis it was revealed that a mice which is treated with *Rapanavenosa* lipid extracts have a reduced healing time of just 13-15 days as compare to the control animals with healing time of about 20-22 days[40]. It was observed that complete regeneration of the dermis, skin epidermis and hypodermis occurred, with newly formed blood vessels and new epithelium, and in the provisional fibrin matrix collagen fibers and basal membrane were observed. Other than lipid, amino acid extracts from *R. venosa* were also found helpful in accelerating the healing property of wound by enhancing the epidermal and dermal neoformation in Wistar rats to accelerate skin wound healing by enhancing dermal and epidermal neoformation in Wistar rats [41].

CONCLUSION

In India, the exploitation and uses of molluscan resources for sea ranching and for fishing are increasing day by day and are helpful in increasing the economy of a country. The huge exploitation of molluscan by

humans may lead to the large-scale destruction of economically valuable mollusks and their egg masses. The attempts for conservation of marine mollusk should be done through sea ranching and sea farming because of their high demand in market and due to their commercial importance. Rules and Regulation should be implemented to conserve these resources by preventing the exploitation of undersized animals and to avoid trawling.

Researchers from their studies and many other surveys concluded that the natural stocks can be increased by sea ranching of the seeds and through their large-scale production. So, for large scale production of mollusks it is important to improve and develop the new technologies, and to create awareness about the importance of mollusks and their contribution in increasing the economy of the country through training and new technology programs.

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