WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 2, 525-537. Review Article ISSN 2277–7105

BIOACTIVE POTENTIAL AND NUTRIOMIC STUDIES OF CRUSTACEANS: A REVIEW

Vasanthi Srinivass Thiruvengadarajan[1*], A. Rajasekaran[2], N. Harshini, P. Kalpana, K. Monisha, R. Sakti Sri and U. Subakurinji

*Professor, Department of Pharmaceutical Analysis, KMCH College of Pharmacy, Coimbatore, Tamil Nadu.

[1]Principal, Department of Pharmaceutical Analysis, KMCH College of Pharmacy, Coimbatore, Tamil Nadu.

Article Received on
29 November 2024,

Revised on 19 Dec. 2024,
Published on 15 Jan. 2025

DOI: 10.20959/wjpr20252-35315

***Corresponding Author**
Vasanthi Srinivass Thiruvengadarajan
Professor, Department of Pharmaceutical Analysis, KMCH College of Pharmacy, Coimbatore, Tamil Nadu.

ABSTRACT

Aquatics provide nutrient rich, bioactive compounds to the mankind which are ecologically and economically sustainable. Specifically, Crustaceans are diverse group of marine and freshwater organisms, are increasingly recognized for their bioactive compounds with significant nutraceutical and pharmaceutical potential. Among crustaceans, crabs are major source of proteins, lipids, essential amino acids, vitamins, minerals, fatty acids [saturated fatty acids, unsaturated fatty acids]. Polyunsaturated fatty acids which include EPA and DHA which involves in reducing risk of coronary heart disease and cancer. It also acts as supplement for omega 3 fatty acids and exhibits antioxidant, antimicrobial, anti-inflammatory, and anticancer activities. Their shells provide valuable bioactive substances such as chitin, chitosan, carotenoids. Increasing awareness of the health benefits of crabs has expanded their export in various edible forms, such as frozen and canned meat. This growth underscores the importance of analysing the bioactive composition of crabs before consumption. This article primarily concentrates on four economically significant crab species from a broader range, specifically *Portunus pelagicus*, *Scylla serrata*, *Scylla tranquebarica*, and *Charybdis feriatus.*

KEYWORDS: *Portunus pelagicus*, *Scylla serrata*, *Scylla tranquebarica*, *Charybdis feriatus*, Omega 3 fatty acids.

INTRODUCTION

The marine environment harbours a vast array of species uniquely adapted to thrive in extreme conditions, making them a treasure trove for marine bioprospecting. Their resilience to temperature fluctuations, pH, salinity, and pollutants positions them as exceptional compounds with bioactive potential for innovative and sustainable pharmaceutical processes.[1] Crustaceans flourish in all habitats, especially in marine ecosystems. They range from tiny, abundant copepods found across oceans to large, valuable species like decapod crustaceans, including crabs, shrimps, and lobsters. Crustaceans are economically valuable, ecologically crucial, and an important source of nutrition and are diverse group of organisms inhabiting saltwater, freshwater, brackish, and terrestrial environments.[2] Crabs are economically significant crustaceans, which are ranked third among seafood, following shrimp and lobsters, due to their esteemed delicacy and nutritional value. Crab tissue contains excellent nutritional components, such as high-quality proteins, lipids, essential amino acids, etc.[3] Crab meat, abundant in vitamins and minerals, is also low in fat and contains Omega-3 polyunsaturated fatty acids (EPA and DHA). Aquatic animal fats serve as excellent sources of essential fatty acids, which the human body is unable to synthesize on its own. These beneficial compounds offer protection against heart disease, support brain function and foetal development, and may contribute to cancer prevention.[4]

DESCRIPTION ON CRAB SPECIES

The blue swimming crab, *Portunus pelagicus*, a member of the Decapoda order, is one of the most common and abundant crustaceans, comprising around 6,000 species across 47 families. The Blue swimming crab, *Portunus pelagicus* landed by a trawler at Kottaipattinam is shown in Fig 1.[30] As the most heavily fished crab species globally, it plays a major role in the world's swimming crab fishery. According to the Food and Agricultural Organization (FAO), the total catch of this species in 2016 was 125,300 tons.[5] The picture of *Portunus pelagicus* is shown in Fig 2.[13]

Fig 1: Blue swimming crab, *Portunus pelagicus* landed by a trawler at Kottaipattinam.

Fig 2: Flower crab, *Portunus pelagicus.*

The crucifix cross crab, *Charybdis feriatus* is commonly found in sublittoral zones, inhabiting muddy and sandy substrates, as well as rocky and stony coastlines, including coral reef flats, at depths ranging from approximately 10 to 60 meters. This species holds significant commercial value, typically being captured using trawl nets, traps, and fixed nets, and is generally marketed in a frozen state.[6] The image of *Charybdis feriatus* is shown in Fig 3.[16]

Fig 3: The crucifix cross crab, *Charybdis feriatus.*

Mud crabs belonging to the genus *Scylla* constitute a prevalent element of the brackish water fauna. Scylla serrata, commonly referred to as the Giant Mud Crab, Green Crab, is a commercially significant crab species found in the estuaries and mangroves of India. Its shell colour typically ranges from deep mottled green to dark brown.

Among them, Giant Mud Crab, *Scylla serrata* is the most extensively distributed species, succeeded by Mangrove Mud Crab, *Scylla tranquebarica*.[7] The Giant mud crab, is regarded as one of the most sought-after and high-value seafood delicacies in Southeast Asian nations.[3] The image of *Scylla serrata* is depicted in Fig 4.[31] The total crab catch in India amounts to 51,305 tons, with a substantial contribution from mud crabs.[8] Mud crab habitat

is strongly associated with mangrove forest ecosystems and estuaries, it is tolerant to varying salinity and temperature.[9]The image of *Scylla tranquebarica* is shown in Fig 5.[32]

Fig 4; Giant Mud Crab, Scylla serrate.

Fig 5; Mangrove Mud Crab, Scylla tranquebarica.

The taxonomical description of the 4 species of crab is stated in Table 1.[10]

Table 1: Taxonomical Description of four species of crab.

TAXONOMY	BLUE SWIMMING CRAB	GIANT MUD CRAB	MANGROVE MUD CRAB	CRUCIFEX CROSS CRAB
FAMILY	Portunidae	Portunidae	Portunidae	Portunidae
ORDER	Decapoda	Decapoda	Decapoda	Decapoda
GENUS	Portunus	Scylla	Scylla	Charybdis
SPECIES	Pelagicus	Serrata	tranquebarica	Feriatus

GEOGRAPHICAL DISTRIBUTION

The geographical range of *Portunus pelagicus* predominantly spans the Indo-West Pacific region, extending from China, Japan, and Korea to the Philippines, and westward to the Straits of Malacca. It is also found in the Northern Territory of Australia, thriving in tropical to subtropical waters.[11] This species is also widespread across East and Southeast Asia.[12] It inhabits the Mediterranean Sea as a Lessepsian migrant and is also distributed across the southern Pacific Ocean, along the shores of Egypt, Mozambique, Kenya, Israel, Lebanon, Turkey, Syria, Cyprus, and the south-eastern coastline of Sicily.[13]

Scylla serrata is the most widely distributed species of the *Scylla* genus, inhabiting tropical and subtropical coastal regions throughout the Indo-West Pacific. Its range extends from the southern coast of South Africa, along the eastern coast of Africa, through the Red Sea, Gulf of Aden, and the Arabian/Persian Gulf, to Southeast and East Asia, the Bay of Bengal,

Indonesia, and the northern Philippine Sea, reaching as far as Australia. The species is also found around oceanic islands in the Indo-Pacific, including the Marianas, Fiji, Samoa Islands, Seychelles, Maldives, and Mauritius. *Scylla serrata* was introduced to the Hawaiian Archipelago between 1926 and 1935, where it has since established a stable population. This species occurs across a broad latitudinal range, unlike the other three species of the genus, which are more concentrated around the equator.[14]

Scylla tranquebarica is distributed in locality of the Indian Ocean, likely near Tranquebar, India. The species range extends across Pakistan (Karachi), Taiwan (Kaohsiung), Vietnam (Nha Trang), Singapore, Malaysia (Sabah and Bako), and the Philippines (Panay).[15]

Charybdis feriata species inhabits the Indo-West Pacific, extending from Japan to Australia, thriving in both tropical and subtropical climates.[16]

MORPHOLOGY AND ANATOMY

The carapace of *Portunus pelagicus* is rough and granulate, featuring a frontal region adorned with four sharply triangular teeth. Each anterolateral margin has nine teeth, with the last tooth being noticeably larger—two to four times the size of the preceding teeth. Males possess elongated chelae, with the larger chela exhibiting a distinctive conical tooth at the base of the fingers. In terms of coloration, males display blue markings, while females exhibit a more subdued green or greenish-brown hue. The male and female morphological image of *Portunus pelagicus* is shown in Fig 7.[17]

Fig 6; Female and Male Portunus pelagicus (Linnaeus, 1758).

The *Scylla serrata*, known for its smooth carapace adorned with pronounced transverse ridges, exhibits a distinctively deep, H-shaped gastric groove. Its frontal lobes are relatively broad and aligned, accompanied by robust, outward-projecting anterolateral teeth. The

species displays a color spectrum from green to greenish-black, with marbled legs often observed. Prominent spines adorn the outer surface of the chelipedal carpus as well as the anterior and posterior dorsal sections of the palm. The image of *Scylla serrata* is shown the Fig 7.[17]

Fig 7; Scylla serrata (Forsskal, 1775)

Scylla tranquebarica was distinguished by its unique morphological characteristics, including a full-bodied shape, a rounded frontal lobe, a robust and subtly curved dactylus, blunted outer and inner propodus spines, the absence of an inner carpal spine, and a smooth body and legs free from polygonal patterns.[18] The coloration ranges from brown to nearly black, with prominently developed spines on the outer surfaces of the chelipedal carpus and palm, similar to *S. serrata*. However, it distinguishes itself from *S. serrata* by possessing acutely triangular frontal teeth, with the median pair projecting slightly forward relative to the lateral pair, and the anterolateral teeth gently curving anteriorly, imparting a less transverse appearance to the carapace. The picture of *Scylla tranquebarica* is depicted in Fig 8.[17]

The *Charybdis feriata*, features an ovate carapace adorned with five distinct teeth along each anterolateral margin. It displays a striking pattern of maroon and whit e longitudinal stripes, often highlighted by a prominent white cross on the median area of its gastric region. Its legs and pincers are further distinguished by an array of scattered white spots. The image of *Charybdis feriata* is shown in the Fig 9.[17]

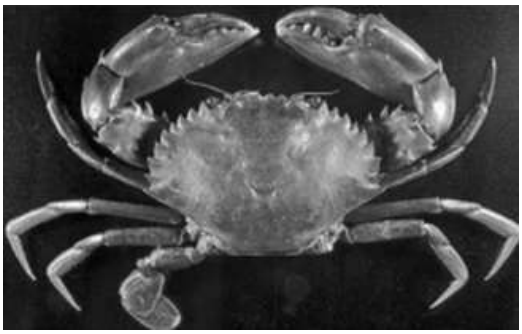


Fig 8: Scylla tranquebarica (Fabricius, 1798).

Fig 9: *Charybdis feriata*, (Linnaeus, 1758).

NUTRITIONAL PARAMETERS

Among consumable aquatic species, crabs are invertebrates distinguished by their segmented bodies. They possess significant economic value, fetching high prices in both domestic and global markets.[19] Numerous crab species are celebrated for their nutrient density, refined flavor, and esteemed status as a delicacy, also contributing significantly to valuable fisheries worldwide.[20] The variations in biochemical composition both between and within crab species can be attributed to factors such as habitat (whether cultured or wild), food sources, seasonal and climatic shifts, and biological differences, including species, size, age, sex, maturity stage, gametogenesis, and spawning cycles. Additionally, environmental factors like temperature, salinity, and contaminants also play a role. The exceptional quality, distinctive taste, and enticing aroma of crab meat have established it as a preferred choice among seafoods, earning a distinguished place on menus globally. Nutritionally, crab meat is remarkable, abundant in highly digestible proteins, indispensable amino acids, free-form amino acids, and beneficial unsaturated fatty acids—particularly long-chain omega-3s. It also serves as a rich reservoir of essential vitamins and minerals, including calcium, iron, zinc, potassium, and phosphorus. These qualities have driven the extensive use of crab meat and its

derivatives as key ingredients in cuisine, as flavour enhancers, and as premium raw materials in crafting various specialty crab products that feature unique and exquisite taste profiles.[21] Furthermore, crabs are noted for bioactive compounds with specific health-promoting properties.[22]

The proximate composition of four species of crabs from various locations is stated in Table 2.

Table 2: Proximate composition of four species of crabs from various locations.

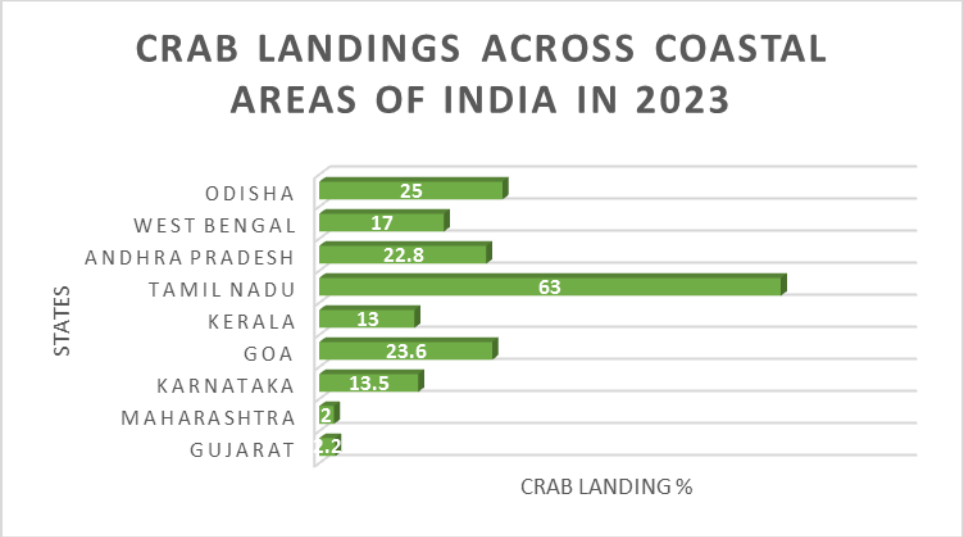
SPECIES NAME	AREA OF COLLECTION	MOISTURE (%)	ASH (%)	PROTEIN (%)	FAT (%)	FATTY ACID (%)
Portunus pelagicus	Rameshwaram[23]	72.76	1.02	17.62	5.33	PUFA 27.38
						MUFA 7.21
						SFA 23.14
						n-3 14.42
						n-6 12.12
						n-3/n-6 1.18
						n-6/n-3 0.84
	Bangladesh[24] (Male Meat)	75.04	2.01	17.32	3.69	_
	Pakistan[25]	76.0	2.0	16.4	1.48	_
Scylla serrata	Bangladesh[26] (Male Wild)	76.95	4.9	17.07	5.81	_
	Pakistan[25]	71.7	2.20	23.3	0.81	_
	Mumbai[27] (Male body)	81.67	1.8	12.22	0.53	PUFA 42.12
						MUFA 17.79
						SFA 41.44
						n-3 31.79
						n-6 10.33
						n-3/n-6 3.308
Scylla tranquebarica	Mumbai [27] (Male body)	81.49	1.61	15.63	0.65	PUFA 32.14
						MUFA 17.01
						SFA 48.03
						n-3 22.54
						n-6 9.6
						n-3/n-6 2.35
Charybdis	Pakistan[25]	81.4	2.50	15.10	0.25	_

feriata	Zhoushan[28] (China)	78.70	4.23	84.83	3.94	PUFA 33.64
						MUFA 28.49
						SFA 37.87
						n-3 2.04
						n-6 1.60
						n-3/n-6 20.01
	Xiapu[28] (China)	77.83	4.41	88.35	3.82	PUFA 29.44
						MUFA 32.84
						SFA 37.73
						n-3 27.73
						n-6 1.71
						n-3/n-6 16.27
	Qionghai[28] (China)	80.26	5.36	74.33	4.07	PUFA 25.87
						MUFA 31.58
						SFA 42.55
						n-3 24.72
						n-6 1.15
						n-3/n-6 21.46
	India [29]	74.11	4.28	20.62	1.06	PUFA 32.66
						MUFA 26.92
						SFA 32.26
						n-3 27.73
						n-6 4.92
						n-3/n-6 2.05

PUFA- Polyunsaturated Fatty Acid; MUFA- Monounsaturated Fatty Acid;
SFA- Saturated Fatty Acid; n-3- Omega -3 fatty acid; n-6- Omega- 6 Fatty Acid;
n-3/n-6 – Omega-3 Fatty Acid/ Omega -6 Fatty Acid;
n-6/n-3- Omega 6 Fatty Acid/ Omega -3- Fatty Acid.

In 2023, the marine fish landings from the mainland coast of India were assessed at 3.53 million tonnes, with crabs accounting for 62,696 tonnes of the total catch. Gujarat achieved

the top position with a significant 64% increase in marine fish landings compared to the year 2022.The marine fish landings of Gujarat, Daman and Diu, Maharashtra, Karnataka, Goa, Kerala, Lakshadweep, Tamil Nadu, Puducherry, Andhra Pradesh, West Bengal and Odisha were estimated as 8.23, 0.91,2.11,6.04, 0.61, 6.33, 0.144, 5.65, 0.51, 1.90, 1.73, 1.30 lakh tonnes respectively. The crab landings across coastal areas of India in 2023 is depicted in the graph 1.[30]



Graph 1; Crab landings across coastal areas of India in 2023.

CONCLUSION

Crabs—*Portunus pelagicus, Scylla serrata, Scylla tranquebarica, and Charybdis feriatus*, hold promising potential as sources of bioactive compounds with various health benefits for humans. The article insights that crabs provide a nutrient-rich profile, including essential amino acids, vitamins, minerals, and polyunsaturated fatty acids like EPA and DHA, which are associated with reducing the risks of coronary heart disease, cancer, antioxidant, antimicrobial, anti-inflammatory, and anticancer properties. This shows their significancy in economic value leading to high prices in both domestic and global markets.

REFERENCE

1. Karthikeyan A, Joseph A, Nair BG. Promising bioactive compounds from the marine environment and their potential effects on various diseases. Journal of Genetic Engineering and Biotechnology, 2022 Dec 1; 20(1): 14.
2. Behringer DC, Duermit-Moreau E. Crustaceans, One Health and the changing ocean. Journal of Invertebrate Pathology, 2021 Nov1; 186: 107500.

3. Sarower MG, Bilkis S, Rauf MA, Khanom M, Islam MS. Comparative biochemical composition of natural and fattened mud crab Scylla serrata. Journal of Scientific Research, 2013 Aug 29; 5(3): 545-53.
4. Islam MB, Sarkar MM, Rahman MR, Khan M, Afroze M, Hasan MA, et al. Fatty Acid Profile of Freshwater Crab (Paratelphusha lamellifrons) from Padma River of Rajshahi City, Bangladesh. Journal of Nutrition & Food Sciences, 2017; 07(06).
5. Wang J, Wang H, Xue J, Yu X, Long X, Wu X, et al. Phospholipidomics quality evaluation of swimming crabs (Portunus trituberculatus) cultured with formulated feed, frozen trash fish, and mixed feed, a non-target approach by HILIC-MS. Journal of Chromatography B., 2021 Jun 26; 1179: 122845–5.
6. Abelló P. The capture of the Indo-Pacific crab Charybdis feriata (Linnaeus, 1758) (Brachyura: Portunidae) in the Mediterranean Sea. Aquatic Invasions, 2006; 1(1): 13–6.
7. The Marine Products Export Development Authority (MPEDA) – Mangrove mud crab: https://mpeda.gov.in/?page_id=734 (Accessed 25th November 2024)
8. CMFRI Annual Report 2011-2012: http://eprints.cmfri.org.in/id/eprint/9053 (Accessed 25th November 2024).
9. Apine E, Turner LM, Rodwell LD, Bhatta R. The application of the sustainable livelihood approach to small scale-fisheries: The case of mud crab Scylla serrata in South west India. Ocean & Coastal Management, 2019 Mar; 170: 17–28.
10. World Register of Marine Species – Scylla serrata https://www.marinespecies.org/aphia.php?p=taxdetails&id=208814 (Accessed 18th October 2024).
11. Sea Life Base - Portunus pelagicus [Ng, P.K.L. 1998. (Ref. 343)]: https://www.sealifebase.se/summary/Portunus-pelagicus.html (Accessed 21st October 2024).
12. Wong KJH, Tao LSR, Leung KMY. Subtidal crabs of Hong Kong: Brachyura (Crustacea: Decapoda) from benthic trawl surveys conducted by the University of Hong Kong, 2012 to 2018. Regional Studies in Marine Science, 2021 Nov; 48: 102013.
13. CMFRI Portunus pelagicus- Joe K. Kizhakudan and Loveson L. Edward: https://eprints.cmfri.org.in/14989/1/Portunus%20%28Portunus%29%20pelagicus.pdf (Accessed 21st October 2024).
14. Alberts-Hubatsch H, Lee SY, Meynecke JO, Diele K, Nordhaus I, Wolff M. Life-history, movement, and habitat use of Scylla serrata (Decapoda, Portunidae): current knowledge

and future challenges. Hydrobiologia [Internet], 2015 Jul 11 [cited 2020 Jan 6]; 763(1): 5–21. Available from: https://link.springer.com/article/10.1007/s10750-015-2393-z

15. Crabs of Japan *Scylla tranquebarica*-Abe 1981: https://web.archive.org/web/20160303204552/http://species-identification.org/species.php?species_group=crabs_of_japan&id=1085 (Accessed 24th October 2024).
16. Sea Life Base- *Charybdis feriata* [Ng,P.K.L.1998. (Ref. 343)]: https://www.sealifebase.se/summary/Charybdis-feriata.html (Accessed 25th October 2024).
17. CMFRI-ICAR sponsored winter school on recent development in taxonomic techniques of marine fishes for conservation and sustainable fisheries management"; http://eprints.cmfri.org.in/id/eprint/15672.
18. Heppi Iromo *et al* Study of Mud Crab Species (Scylla Spp.) In Brackish Waters North Kalimantan Province, 2022 IOP Conf. Ser.: Earth Environ. Sci, 1083: 012049.
19. Morris VJ. Marine Polysaccharides – Food Applications. Trends in Food Science & Technology, 2012 May; 25(1): 53.
20. Wang Q, Wu X, Long X, Zhu W, Ma T, Cheng Y. Nutritional quality of different grades of adult male chinese mitten crab, Eriocheir sinensis. Journal of Food Science and Technology, 2018 Jan 25; 55(3): 944–55.
21. Nanda PK, Das AK, Dandapat P, Dhar P, Bandyopadhyay S, Dib AL, et al. Nutritional aspects, flavour profile and health benefits of crab meat based novel food products and valorisation of processing waste to wealth: A review. Trends in Food Science & Technology, 2021 Jun; 112: 252–67.
22. Hamdi M, Nasri R, Dridi N, Li S, Nasri M. Development of novel high-selective extraction approach of carotenoproteins from blue crab (Portunus segnis) shells, contribution to the qualitative analysis of bioactive compounds by HR-ESI-MS. Food Chemistry [Internet], 2020 Jan 1; 302: 125334. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0308814619314475?casa_token=0we1w_wPCXUAAAAA:iMOICDCVeSa6sLw30vPjA1Jm58iRefTgjJ02pmoHqY_wvTePBkVnobKepaKif0rglECsybVJbjk#s0150
23. Eswaran Rangasamy, VetriVarsha LalBahadur Muthu, Kamali Dhanabalan, Muniasamy Muniyandi. Determination of proximate composition on some edible crabs with special reference to nutritional aspects collected from coastal waters of Rameshwaram, Tamil Nadu. Food Chemistry Advances, 2024 Mar 30; 4: 100686–6.

24. Al Mamun MdZU, Haque T, Ahmed MdS, Satter MA, Begum M, Hossen MdS, et al. Nutritional evaluation of edible swimming crabs Portunus pelagicus (Linnaeus, 1758) and Portunus sanguinolentus (Herbst, 1783) from coastal area of Bangladesh. Journal of Agriculture and Food Research, 2024 Mar; 15: 100972.
25. Umer A, Syed MN, Tarar OM, Mushtaq S, Jalbani N, Saleem N, et al. Biochemical evaluation with reference to nutritional aspects of edible species of crabs collected from the coastal waters of Pakistan. Journal of Food Composition and Analysis, 2021 Jul; 100: 103877.
26. Islam T, Saha D, Bhowmik S, Nordin N, Islam S, Ujjaman Nur AA, et al. Nutritional properties of wild and fattening mud crab (Scylla serrata) in the south-eastern district of Bangladesh. Heliyon, 2022 Jun; 09696.
27. Sreelakshmi KR, Manjusha L, Vartak VR, Venkateswarlu G. Variation in proximate composition and fatty acid profiles of mud crab meat with regard to sex and body parts. Indian Journal of Fisheries, 2016 Jun 28; 63(2).
28. Lu J, Gong Y, Huang Y, Ma H, Zou X, Xia L. Nutritional Analysis and Quality Evaluation in Muscle of Crucifix Crab Charybdis feriatus From Three Wild Populations. Journal of Food Research, 2014 Jan 13; 3(2): 27–7.
29. A. Murali Shankar, E. Srikarnasekar, T. Santhosh Kumar and P. Soundarapandian. (2022). Effect of seasonal changes on the biological composition of Charybdis feriatus. Int. J. Adv. Res. Biol. Sci, 9(5): 185-198.
30. CMFRI Annual Report 2023; https://eprints.cmfri.org.in/18810/ (Accessed 25th November 2024).
31. Sea Life Base- *Scylla serrata* [Ng, P.K.L. 1998. (Ref. 343)]: https://www.sealifebase.se/country/CountrySpeciesSummary.php?c_code=144&Genus=Scylla&Species=serrata (Accessed 26th November 2024).
32. Shelley, C.; Lovatelli, A. Mud crab aquaculture – A practical manual. FAO Fisheries and Aquaculture Technical Paper. No. 567. Rome, FAO, 2011; 78 pp.