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BIOLOGICAL POTENTIAL OF VARIOUS MARINE PEPTIDES: A REVIEW

Ramninder Kaur*[1], Komalpreet Kaur[1], Satvinder Kaur[1], Anju Goyal[2] and Sandeep Arora[2]

[1]G.H.G Khalsa College of Pharmacy, Gurusar Sadhar, Ludhiana.
[2]Chitkara College of Pharmacy, Rajpura.

***Corresponding Author: Prof. Ramninder Kaur**

G.H.G Khalsa College of Pharmacy, Gurusar Sadhar, Ludhiana.

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ABSTRACT

Marine organisms are important sources of bioactive molecules that have been used to treat various diseases. Unusual marine environments are associated with chemical diversity, leading to a resource of novel active substances for the development of bioactive products. Recently, marine-derived bioactive peptides have attracted attention owing to their numerous beneficial effects. Moreover, several studies have reported that marine peptides exhibit various activities, such as antimicrobial, antifungal, antidiabetic, antitumor, antimalarial, antiprotozoal, anti-tuberculosis, and antiviral activities. In the last several decades, studies of marine plants, animals, and microbes have revealed tremendous number of structurally diverse and bioactive secondary metabolites. In this review, we will present the structures and activities of peptides isolated from marine sources (sponges, algae, bacteria, fungi and fish).

KEYWORDS: Bioactive, marine peptides, pharmaceutical.

INTRODUCTION

Marine organisms are rich sources of structurally diverse bioactive compounds with industrial potential. Recently, a great deal of interest has been expressed regarding marine-derived bioactive peptides because of their numerous health beneficial effects. Marine organisms are an immense source of new biologically active compounds.[1] These compounds are unique because the aqueous environment requires a high demand of specific and potent bioactive molecules. A very different kind of substances have been obtained from marine organisms among other reasons because they are living in a very exigent, competitive, and aggressive surrounding very different in many aspects from the terrestrial environment, a situation that demands the production of quite specific and potent active molecules. Diverse peptides with a wide range of biological activities have been discovered.[6]

Oceans, which cover more than 70% of the earth's surface, represent an enormous resource for the discovery of potential therapeutic agents. Over the last several decades, numerous compounds have been found in marine organisms with interesting pharmaceutical activities. Therefore, marine organisms are thought to be a potential source of essential and novel biologically active substances for the development of therapeutics. The diversity of the marine environment has provided a unique source of bioactive chemical compounds that could lead to potential new drugs candidates.[7]

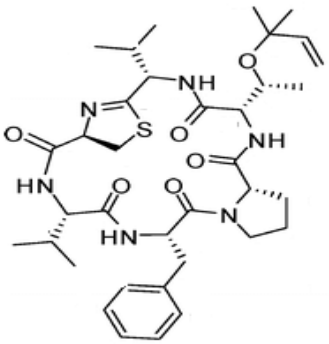
Food proteins and bioactive peptides play a vital role in the growth and development of the body's structural integrity and regulation, as well as having a variety of other functional properties. Peptides are important bioactive natural products which are present in many marine species. Their some marine peptides or their derivatives have high commercial values and had reached the pharmaceutical and nutraceutical markets. A large number of them are already in different phases of the clinical and preclinical pipeline.[8] In particular, marine peptides have attracted a great deal of attention due to their potential effects in promoting health and reducing disease. Marine peptides are specific protein fragments that in addition to acting as sources of nitrogen and amino acids have numerous potential physiological functions. These peptides have been obtained from algae, fish, mollusk, crustacean, crab and marine bacteria and fungus. Bioactive marine peptides based on their structural properties, amino acid composition and sequences have been shown to display a variety of bioactivities such as anti-tumor, antiviral, anticoagulant, antioxidant, immunoinflammatory effects, antimicrobial, antiviral, antitumor, antioxidative, cardioprotective (antihypertensive, antiatherosclerotic and anticoagulant), immunomodulatory, analgesic, anxiolytic, anti-diabetic, appetite suppressing and neuroprotective activities have attracted the attention of the pharmaceutical industry, which attempts to design them for use in the treatment or prevention of various diseases. This contribution presents an overview of the bioactive peptides derived from marine organisms and their biological activities with

potential applications in different areas.[12] Recently marine peptides have opened a new perspective for pharmaceutical developments. Cyclic and linear peptides discovered from marine animals. These facts introduce marine peptides as a new choice for the obtainment of lead compounds for biomedical research. This review presents examples of interesting peptides obtained from different marine sources.

BIOLOGICAL ACTIVITIES

Anticancer activity

Two new cyclic hexapeptides, Mollamides B **(1)** and C **(2)** were isolated from the Indonesian tunicate *Didemnum molle* along with the known peptide keenamide A. The new peptides have been evaluated for their antimicrobial, antimalarial, anticancer, anti-HIV-1, anti-Mtb, and anti-inflammatory activities. Keenamide A and mollamide B show cytotoxicity against several cancer cell lines.



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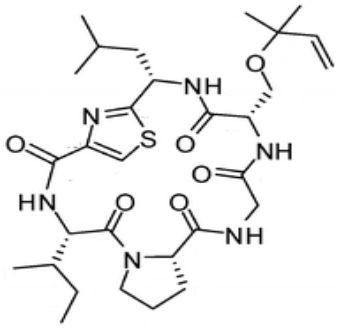

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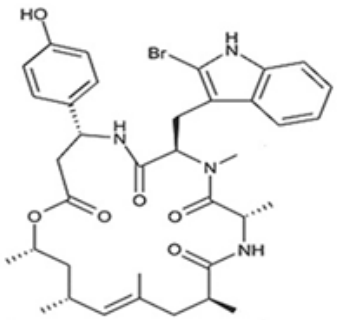
Chemical structures of major marine peptides with apoptotic activity

Jasplakinolide (**3**), Somocystinamide A (**4**), Aplidine (**5**) and Didemnin B (**6**)



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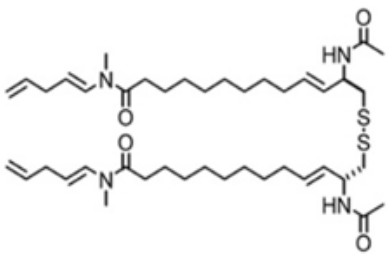

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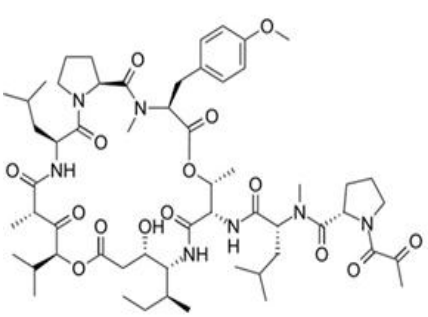

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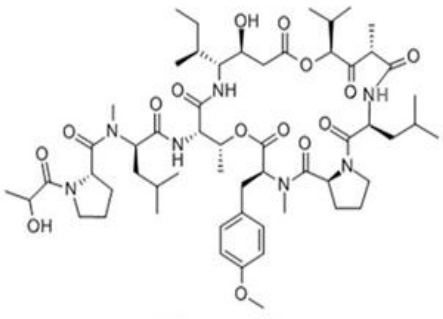

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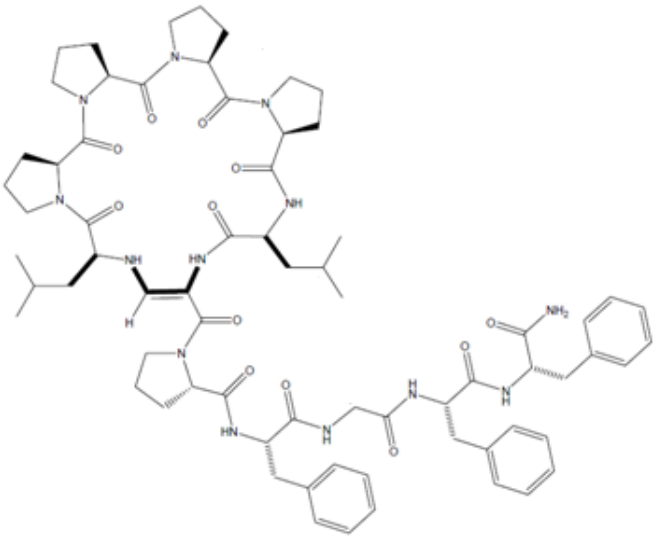
A new cyclic peptide named Callyaerin G **(7)** was isolated from the ethyl acetate fraction of the Indonesian sponge *Callyspongia aerizusa* extract. Callyaerin G was found to exhibit cytotoxic activity when tested against different cancer cell lines.



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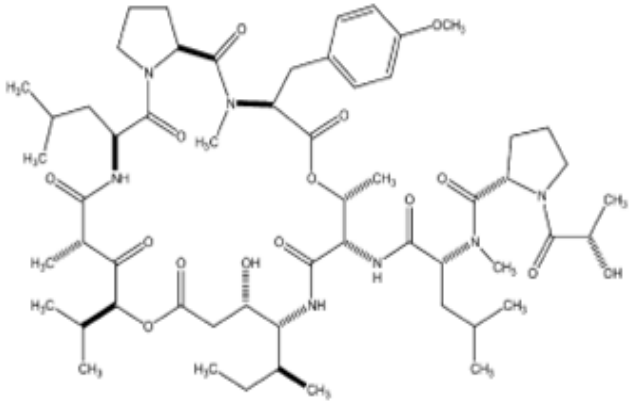
Didemnins are a family of depsipeptides with antitumor, antiviral and immuno-supressive activities primarily isolated from the Caribbean tunicate *Tridemnum solidum*. Didemnin B **(8)** was the most prominent member of the family with the most potent antitumor activity.



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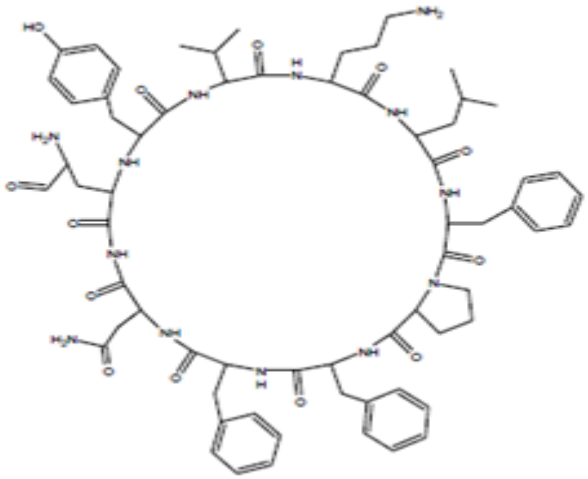
Antibacterial

Tyrocidine-A **(9)** cyclic decapeptide, constituent of tyrothricin was isolated from *Bacillus brevis*. Its structure has been confirmed by synthesis by Ruttenburg et al. and Ohno and Izumiyain. This showed broad spectrum activity and clinically used as topical agent.



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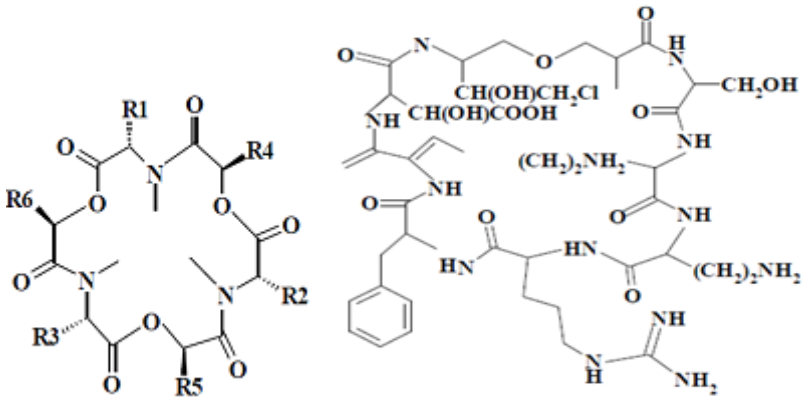
Antitubercular Activity

Four cyclic peptides, namely, Enniatins H **(10)**, I **(10a)**, B **(10b)**, and B4 **(10c)** which are the components of the pathogenic fungus Verticillium hemipterigenum, inhibit growth of M. tuberculosis. Syringomycin E **(11)**, isolated from Pseudomonas syringae pv.Syringae, is found to be active against M. smegmatis.



(11)

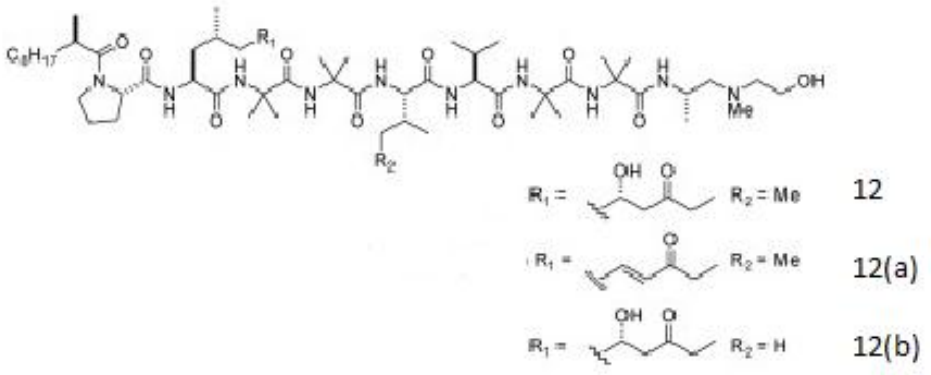
10 R1 = R2 = R3 = R5 = R6 = i-Pr; R4 = s-Bu;

10a R1 = R2 = R3 = R6 = i-Pr; R4 = R5 = s-Bu;

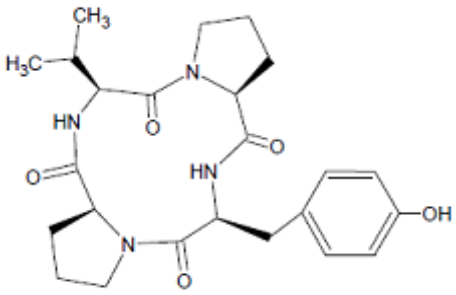
10b R1 = R2 = R3 = R4 = R5 = R6 = i-Pr;

10c R1 = i-Bu; R2 = R3 = R4 = R5 = R6 = i-Pr

Trichoderins A **(12)**, A1 **(12a)**, B **(12b)** from marine sponge derived fungus tichoderma sp.



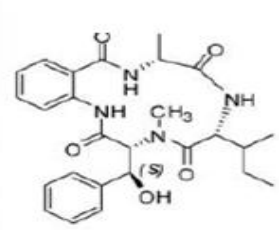
Tyrosinase inhibitors: A novel tyrosinase inhibitor cyclotetrapeptide cyclo [L-Pro-L-Tyr-L-Pro-L-Val] **(13)** was isolated from the lactic bacterium *Lactobacillus helveticus*.



(13)

Antiviral

A new cytotoxic and antiviral cyclic tetrapeptide, asperterrestide A **(14)**, a new alkaloid, terremide C **(15)**, and a new aromatic butenolide, aspernolide E **(16)**, together with 10 known compounds were isolated from the fermentation broth of the marine-derived fungus Aspergillus terreus SCSGAF0162. Compound 13 contains a rare 3-OH-N-CH3-Phe residue and showed cytotoxicity against U937 and MOLT4 human carcinoma cell lines and inhibitory effects on influenza virus strains H1N1 and H3N2.



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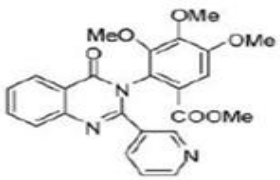

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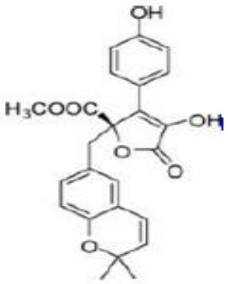

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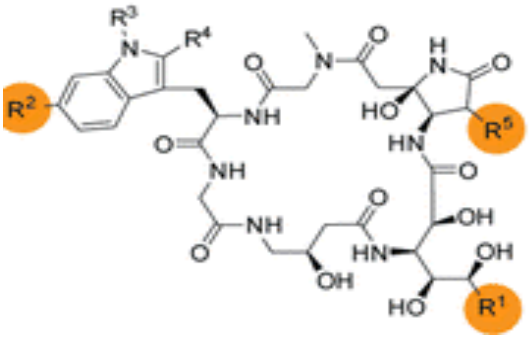
Antifungal:

The microsclerodermins **(17)** are unusual peptide natural products exhibiting potent antifungal activity reported from marine sponges of the genera *Microscleroderma* and *Theonella*.



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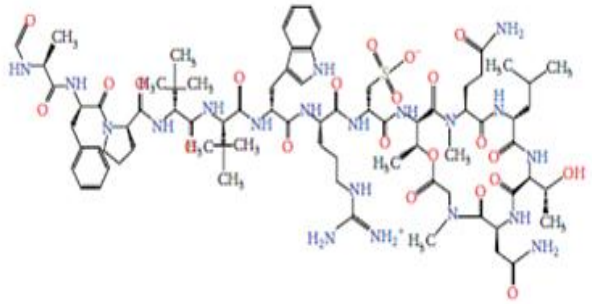
Discodermin A **(18)** from *Discodermia kiiensis* (sponge)



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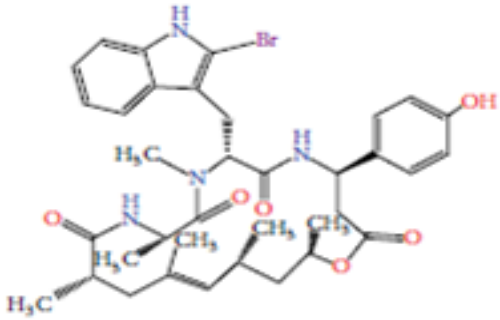
Jaspamide **(19)** from *Jaspis* sp. (sponge)



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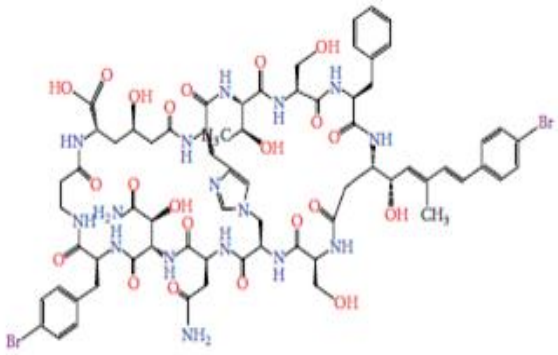
Theonellamide F **(20)** from *Theonella* sp (sponge)



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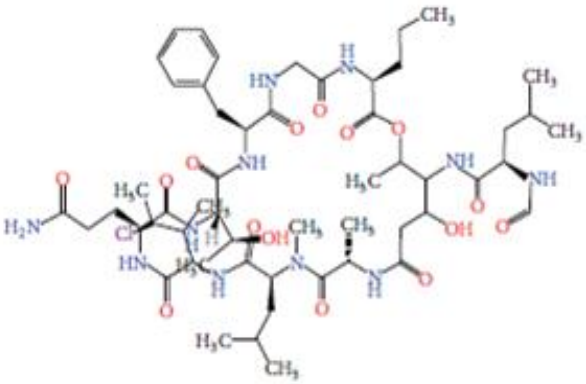
Cyclolithistide A **(21)** *T. swinhoei* (sponge)



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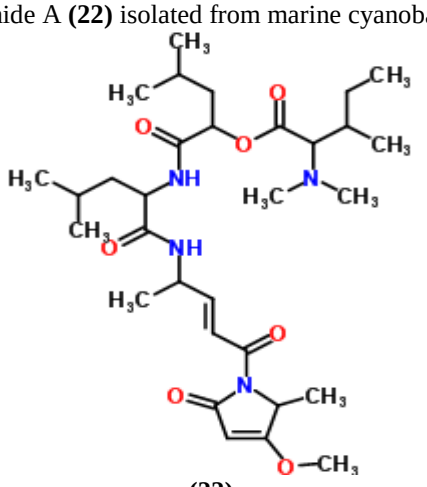
Antimalarial

Gallinamide A **(22)** isolated from marine cyanobacteria



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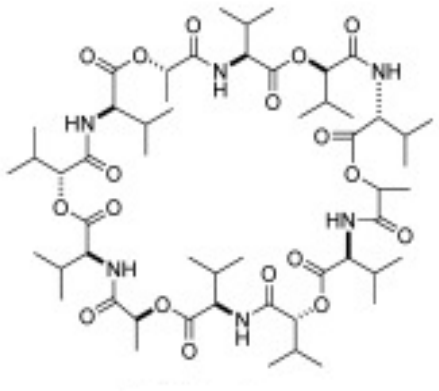
Antileshmanial

Valinomycin **(23)** cyclic despipetides from marine streptomyces sp.



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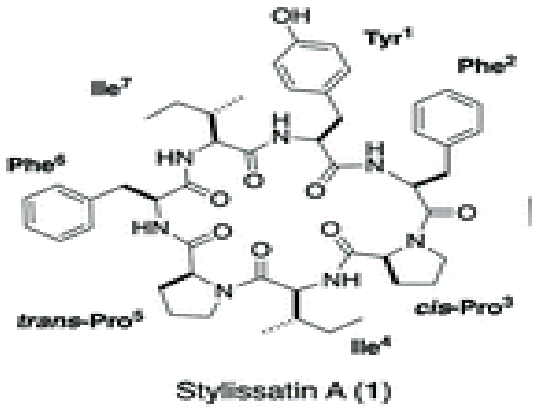
Antiinflammatory

Stylissatin A, an anti-inflammatory cyclic heptapeptide, development of leads for new anti-inflammatory and anti-obesity agents.



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REFERENCES

1. Aneiros, Abel, and Anoland Garateix. "Bioactive peptides from marine sources: pharmacological properties and isolation procedures." Journal of Chromatography B., 2004; 803(1): 41-53.
2. Vladimir V, et al. "The first preparative solution phase synthesis of melanotan II." Beilstein Journal of Organic Chemistry, 2008; 4(39): 1-6.
3. Donia, Marwa S., et al. "Mollamides B and C, cyclic hexapeptides from the Indonesian tunicate Didemnum molle." Journal of natural products, 2008; 71(6): 941-945.
4. Linington, Roger G., et al. "Antimalarial peptides from marine cyanobacteria: isolation and structural elucidation of gallinamide A." Journal of natural products, 2008; 72(1): 14-17.
5. Sagar S, et al. "Antiviral lead compounds from marine sponges." Mainer Drugs, 2010; 8: 2619-2638.
6. Kim, Se-Kwon, and Isuru Wijesekara. "Development and biological activities of marine-derived bioactive peptides: A review." Journal of Functional Foods, 2010; 2(1): 1-9.
7. Lazcano-Pérez, Fernando, et al. "Bioactive peptides from marine organisms: A short overview." Protein and peptide letters, 2012; 19(7): 700-707.
8. Anand, T. Prem, et al. "Bioactive peptides from marine sources-a review." Indian J Innov Dev, 2012; 1: 61-64.
9. Hoffmann, Thomas, et al. "Microsclerodermins from terrestrial myxobacteria: an intriguing biosynthesis likely connected to a sponge symbiont." Journal of the American Chemical Society, 2013; 135(45): 16904-16911.
10. He, Fei, et al. "Asperterrestide A, a cytotoxic cyclic tetrapeptide from the marine-derived fungus Aspergillus terreus SCSGAF0162." Journal of natural products, 2013; 76(6): 1182-1186.
11. Mayer, Alejandro, et al. "Marine pharmacology in 2009–2011: Marine compounds with antibacterial, antidiabetic, antifungal, anti-inflammatory, antiprotozoal, antituberculosis, and antiviral activities; affecting the immune and nervous systems, and other miscellaneous mechanisms of action." Marine drugs, 2013; 11(7): 2510-2573.
12. Cheung, Randy Chi Fai, Tzi Bun Ng, and Jack Ho Wong. "Marine peptides: Bioactivities and applications." Marine drugs, 2015; 13(7): 4006-4043.
13. Sagar S, et al. "Antiviral lead compounds from marine sponges." Mainer Drugs, 2010; 8: 2619-2638.
14. Mayer, Alejandro, et al. "Marine pharmacology in 2009–2011: Marine compounds with antibacterial, antidiabetic, antifungal, anti-inflammatory, antiprotozoal, antituberculosis, and antiviral activities; affecting the immune and nervous systems, and other miscellaneous mechanisms of action." Marine drugs, 2013; 11(7): 2510-2573.
15. Tempelaars, M. H., Rodrigues, S., & Abee, T.. Comparative analysis of antimicrobial activities of valinomycin and cereulide, the Bacillus cereus emetic toxin. Appl. Environ. Microbiol., 2011; 77(8): 2755-2762.
16. Clark, D. P., Carroll, J., Naylor, S., & Crews, P. An antifungal cyclodepsipeptide, cyclolithistide A, from the sponge Theonella swinhoei. The Journal of Organic Chemistry, 1998; *63*(24): 8757-8764.
17. Matsunaga, S., Fusetani, N., Hashimoto, K., & Walchli, M.. Theonellamide F. A novel antifungal bicyclic peptide from a marine sponge Theonella sp. Journal of the American Chemical Society, 1989; 111(7): 2582-2588.
18. Ebada, S., Wray, V., De Voogd, N., Deng, Z., Lin, W., & Proksch, P. Two new jaspamide derivatives from the marine sponge Jaspis splendens. Marine drugs, 2009; 7(3): 435-444.
19. Daphny, C. S., Bibiana, M. A., Vengatesan, R., Selvamani, P., & Latha, S. Antimicrobial Peptides-A milestone for developing antibiotics against drug resistant infectious pathogens. Journal of

Pharmaceutical Sciences and Research, 2015; 7(4): 226-229.
20. Rodriguez, L. M. D. L., Kaur, H., & Brimble, M. A. Synthesis and bioactivity of antitubercular peptides and peptidomimetics: an update. Organic & biomolecular chemistry, 2016; 14(4): 1177-1187.
21. Zheng, L., Lin, X., Wu, N., Liu, M., Zheng, Y., Sheng, J., & Sun, M.. Targeting cellular apoptotic pathway with peptides from marine organisms. Biochimica et Biophysica Acta (BBA)-Reviews on Cancer, 2013; 1836(1): 42-48.
22. Shakeel, E., Arora, D., Jamal, Q., Akhtar, S., Khan, M., Ahmad, K., & Arif, J. M. (2018). Marine Drugs: A Hidden Wealth and a New Epoch for Cancer Management. Current drug metabolism, 2018; 19(6): 523-543.
23. Zheng, L., Xu, Y., Lin, X., Yuan, Z., Liu, M., Cao, S., & Linhardt, R. J. Recent progress of marine polypeptides as anticancer agents. Recent patents on anti-cancer drug discovery, 2018; 13(4): 445-454.
24. Zhang, S., De Leon Rodriguez, L. M., Leung, I. K., Cook, G. M., Harris, P. W., & Brimble, M. A. Total Synthesis and Conformational Study of Callyaerin A: Anti-Tubercular Cyclic Peptide Bearing a Rare Rigidifying (Z)-2, 3-Diaminoacrylamide Moiety. Angewandte Chemie International Edition, 2018; 57(14): 3631-3635.
25. Marques, M. A., Citron, D. M., & Wang, C. C. Development of Tyrocidine A analogues with improved antibacterial activity. Bioorganic & medicinal chemistry, 2007; 15(21): 6667-6677.
26. Zhang, M., Sunaba, T., Sun, Y., Sasaki, K., Isoda, H., Kigoshi, H., & Kita, M. (). Anti-inflammatory marine cyclic peptide stylissatin A and its derivatives inhibit differentiation of murine preadipocytes. Chemical Communications, 2019; 55(38): 5471-5474.