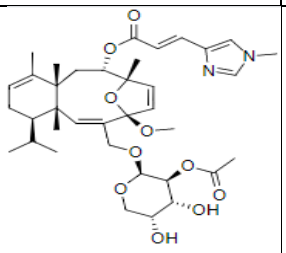
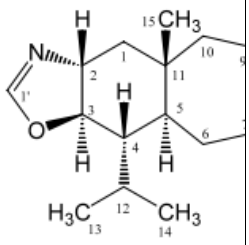
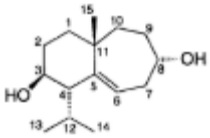
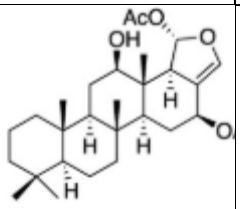
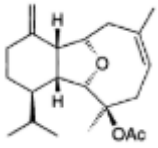
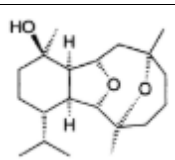
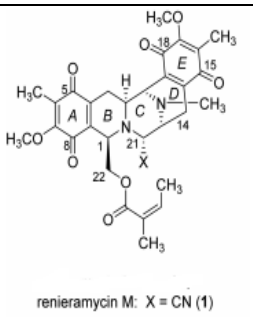
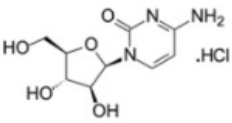
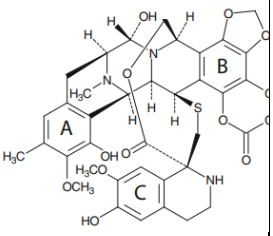
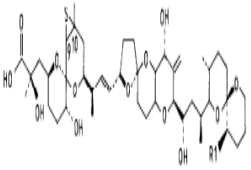
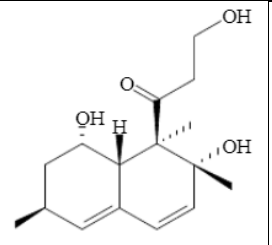
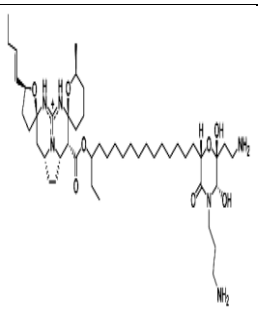
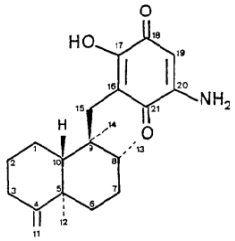
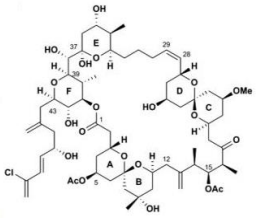
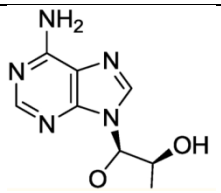
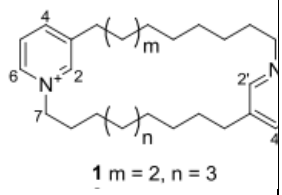
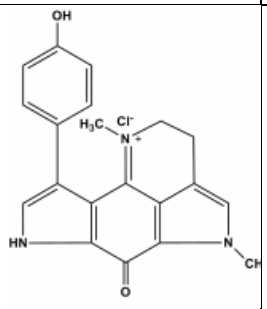
PST:6492 Pharmaceutically important bioactive natural products from marine microbes

Table 1. Phytoconstituents of these bioactive metabolites (antioxidants, flavonoids, etc)

S. No.	Bioactive metabolites	Structure	Extracted from	Pharmacological importance	Reference
1.	Eleutherobin		*Erythropodium caribaeorum and eleutherobia sp.*	Diterpene anticancer agent	[27]
2.	Cladioxazole		*Cladiella sp.*	Alkaloid, sesquiterpene	[28]
3.	Cladidiol		*Cladiella sp.*	Sesquiterpene, acetylcholinesterase inhibition activity	[28]
4.	Heteronemin		*Hyrtios sp*	Sesterterpene, antitumor agent	[29]
5.	(6e)-2α,9α-epoxyeunicella-6,11(12)-dien-3β-ol		*Heterogorgia uatumani*	Diterpenoid, antibacterial	[28]

6.	Polyanthellin a		*Briareum polyanthes*	Antibacterial	[28]
7.	Renieramycin m.		*Reniera*	Anticancer activity	[30]
8.	Cytarabine		*Cryptotheca crypta*	Anticancer agent	[31]
9.	Trabectedin		*Ecteinascidia turbinata*	Antitumour	[32]
10.	Acanthifolicin		*Pandaros acanthifolium*	Methyl ester, inhibit active site of phosphatases	[33]
11.	Decumbenone a		*Aspergillus versicolor*	Polyketides , antioxidant	[34]

12.	Monanchocidin		*Monanchora pulchra*	Induce cell death in mouse epidermal, human cervical cancer and human monocytic leukemia cells	[34]
13.	Smenospongine		*Smenospongia* sp.	Antiangiogenic, antiproliferative, antimicrobial and cytotoxic activity	[34]
14.	Spongistatin 1		*Spirastrella spinispirulifera*.	Induce cytotoxic cell death and inhibit mitosis	[35]
15.	Ara-a (vidarabine)		*Tethya crypta*.	Antiviral	[36]
16.	Cyclostellettamines		*Haliclona sp*	Antibiotic	[29]
17.	Tsitsikammamine c		Zyzzya sp	Antimalarial activity	[37]

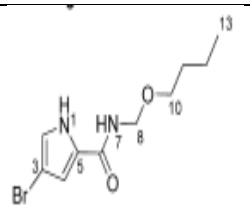
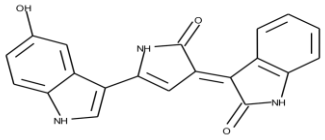
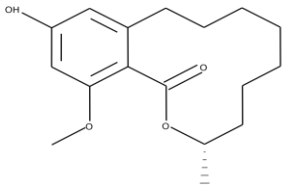
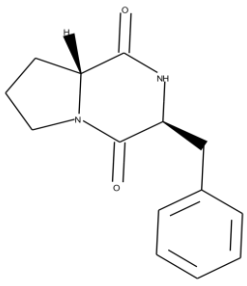
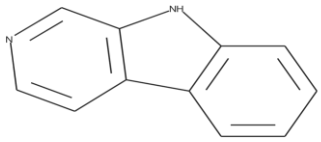
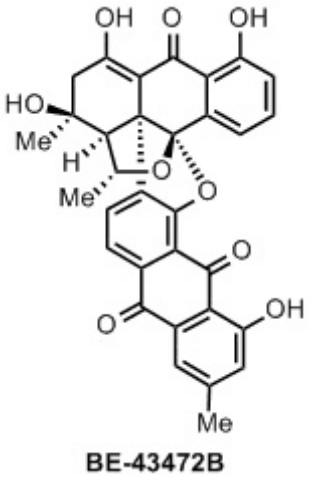
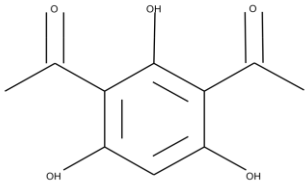
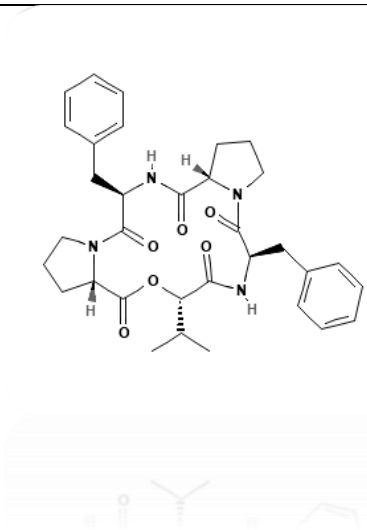
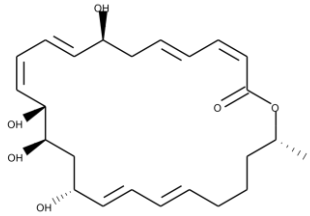
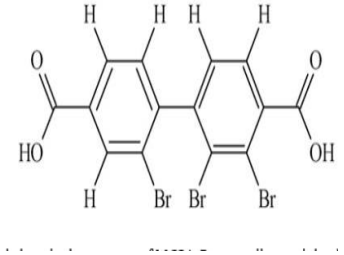
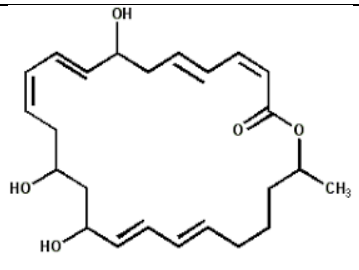
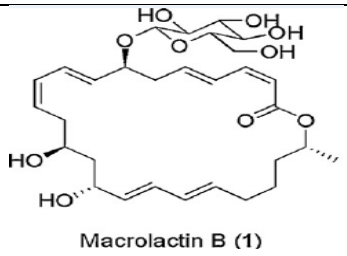
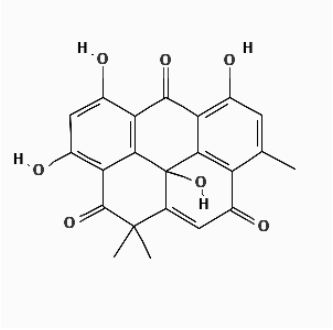
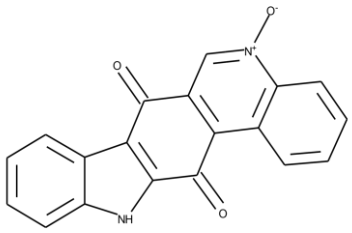
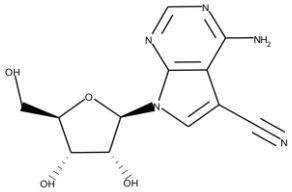
18.	4-bromo-n-(butoxymethyl)- 1h-pyrrole-2-carboxamide		*Agelas mauritiana*	Antibiotic	[37]

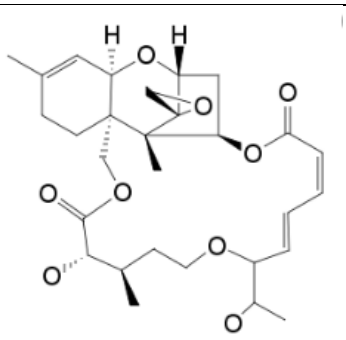
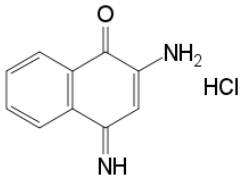
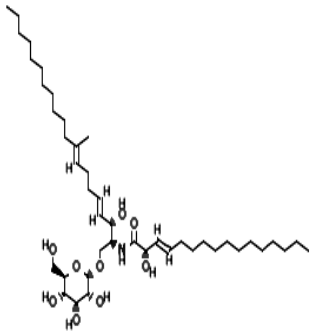
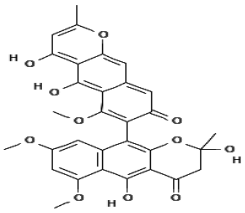
Table 2. Pharmacological significance of some of the natural products obtained from the marine environment

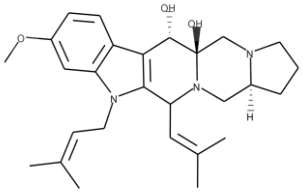
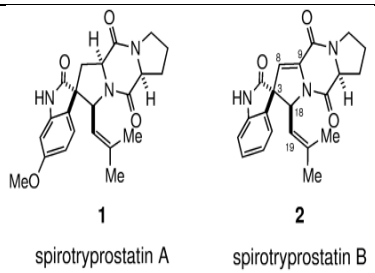
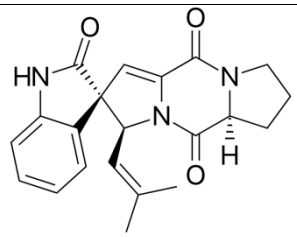
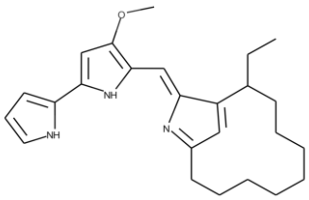
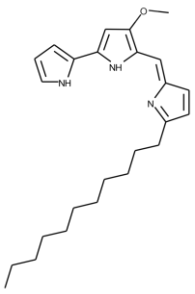
Sl. No.	**Compound**	**Structure**	**Bioactivity**	**Source microbe**	**Reference**
1.	Violacein		Antiprotozoal	Actinomycetes	[38]
2.	Lasiodiplodin		Antimicrobial activity	Endophytic fungus	[37]
3.	Cyclo-(l-pro-l-phe)		Antimicrobial activity	Alcaligenes faecalis a72	[36]

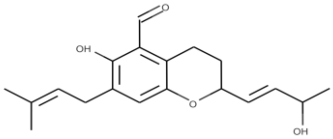
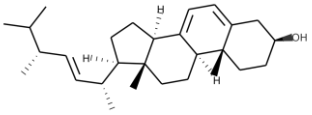
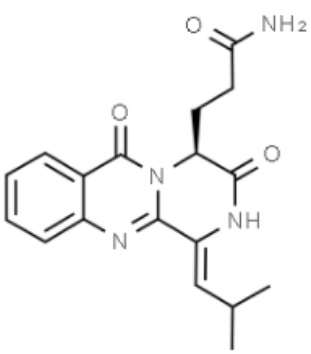
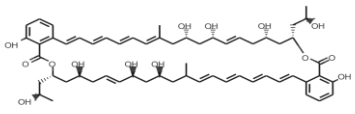
4.	Norharman		Antimicrobial activity	Pseudoalteromonas piscicida	[39]
5.	Be-43472b	 BE-43472B	Antibacterial activity		[40]
6.	Dapg		Antibacterial activity		[41]

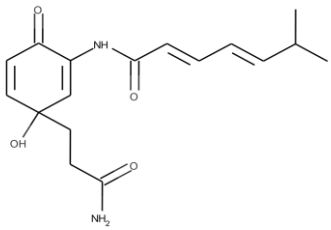
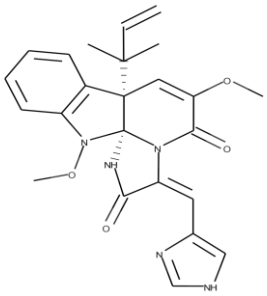
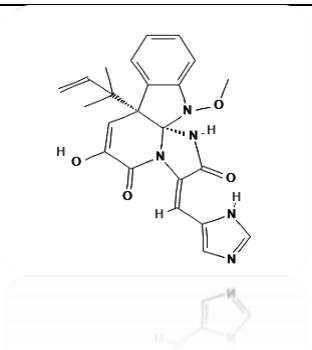
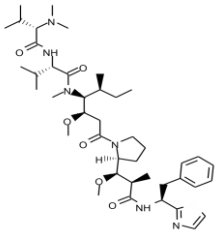
7.	Alternaramide		Antibacterial activity	Fungi	[42]
8.	Pyrone i and ii		Antibacterial activity	Bacteria	[43]
9.	Mc21-b		Antibacterial activity	Bacteria	[44]
10.	Macrolactin s		Antibacterial activity	Bacteria	[44]

11.	Macrolactin B	 Macrolactin B (1)	Antibacterial activity Antilarval		[45]
12.	Resistoflavine		Antibacterial activity Anticancerous	Actinomycetes	[46]
13.	Calothrixin-a		Antimalarial activity Anticancerous	Algae	[47]
14.	Toyocamycin		Antifungal activity	Cyanobacteria	[48]

15.	Roridins a and d		Antifungal activity	Letendraeahelminthicola	[49]
16.	Naphthoquinoneimine		Antifungal activity	Aspergillus niger en-13	[50]
17.	Asperamides a		Antifungal activity	Aspergillus niger en-13	[50]
18.	Nigerasperone c		Antifungal activity	Aspergillus niger en-13	[50]

19.	Fumitremorgin b		Cytotoxic activity	Aspergillus fumigatus	[51]
20.	Spirotryprostatins		Cytotoxic activity	Aspergillus fumigatus	[51]
21.	Spirotryprostatins		Cytotoxic activity	Aspergillus fumigatus	[51]
22.	Metacycloprodigiosin		Cytotoxic activity	Saccharopolyspora sp. Nov.	[51]
23.	Undecylprodigiosin		Cytotoxic activity	Saccharopolyspora sp. Nov.	[51]

24.	Chaetopyranin		Cytotoxic activity	Chaetomium globosum	[51]
25.	Ergosterols		Cytotoxic activity	Rhizopus sp.	[51]
26.	Aurantiomides b and c		Cytotoxic activity	Penicillium aurantiogriseum sp0-19	[44]
27.	Marinomycin a		Antibiotic Antitumour	Actinomycetes	[45]

28.	Daryamide c		Antitumour	Actinomycetes	[44]
29.	Oxaline		Antitumour	Penicillium oxalicum	[45]
30.	Meleagrin		Antitumour Antibacterial	Fungi	[48]
31.	Dolastatin 10 and 15	 dolastatin10	Antitumour Antimicrotubule	Cyanobacteria	[49]

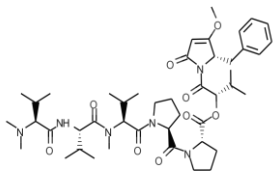
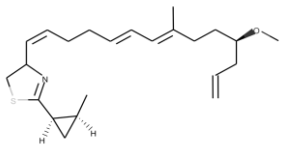
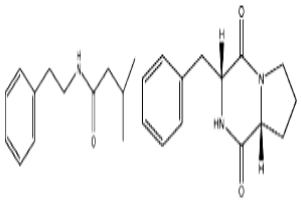
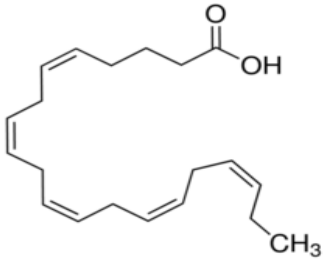
		 dolastatin 15			
32.	Curacin a		Antimicrotubule	Cyanobacteria	[50]
33.	3-methyl-n-(2-phenylethyl) butanamide (11), cyclo (d-prod-phe)		Antifouling	Letendraeahelminthicola	[37]
34.	Eicosapentanoic acid (epa)		Heart disease treatment, anti inflammatory agent	Algae	[37]

Table 3. Micro-organisms biosynthesizing the potential chemical compound with their activities

Microorganism	**Pathway**	**Chemical class**	**Activity**
Aspergillus			

Fish	Nitrogenated compound	fumiquinazoline	cytotoxic
Algae	Terpenoid	Sesquiterpene nitrobenzoate	Antimicrobial
Sponge	Nitrogenated compound Acetate-derived compound	Indole Diketopiperazine Chlorolactone	antitumoral
Leptosphaeria			
Brown alga	Nitrogenated compound	Indole diketopiperazine	Indole diketopiperazine
Green grass	Acetate-derived compound	naphtoquinne	antidopamine
Penicillium			
Fish	Nitrogenated compound	Acyclic peptide	cytotoxic
Green -alga	Nitrogenated compound Acetate-derived compound	Indole Acyl polycetide	Cytotoxic cytotoxic
Offshore sediment	Acetate-derived compound	Aromatic lactone	Inhibitor of cellular growth
Undefined sediment	Nitrogenated compound	Lactame	neutritrogenic
Phoma			
Crab shell	Terpenoid	diterpene	PAF antagonist
Actinomycete			

Coastal sediment	Acetate-derived compound	lactone	
Coelenterate	Nitrogenated compound	depsipeptide	antiinflammatory
Deep-sea sediment	Acetate-derived compound	Bromonaphtoquinone	Antibiotic
Shallow water sediment	Acetate-derived compound Ter	Bromonaphtoquinone and lactone Sesquiterpene	antibiotic
undefined	Nitrogenated compound	Glycosylated macrolide	
Alteromonas			
Crustacean	Nitrogenated compound	Indole	antifugal
Open sea	Nitrogenated compound	Cyclic peptide	Cytotoxic
Sponge	Nitrogenated compound	Macrolactame and amide ester	Anibiotic
Undefined	Nitrogenated compound Nitrogenated compound Nitrogenated compound Nitrogenated compound	Dipyrrole Guanidine Amide ester Cyclic aromatic FA	Antibiotic Toxic Antimicrobial bronchodilalator
Bacillus			

Deep water	Nitrogenated compound	Aminoglycoside	Antimicrobial
Mollusk	Nitrogenated compound	Despsipeptide	cytotoxic
Polychaete	Nitrogenated compound	Cyclic peptide	Antimicrobial
sediment	Nitrogenated compound	N- isocoumarine and cyclic peptide	antitumor
Sponge	Nitrogenated compound	Cyclicdespsipeptide	
Bacteria Gram +			
Deep sea sediment	Acetate-derived compound	Macrolide	Antiviral
Undefined	Nitrogenated compound	Cyclic lysine	Cytotoxic
Pseudomonas			
Fish skin	Nitrogenated compound	Guanidine	Toxic
Polychaete	Nitrogenated compound	Cyclic peptide	Antimicrobial
Red alga	Nitrogenated compound	Cyclic peptide	Antimicrobial
Sponge	Ter Nitrogenated compound	C 50 carotene Diketopiperazine and phenazine amide	Antimicrobial and antibiotic
Tunicate	Nitrogenated compound	Amide	Antimicrobial and antibiotic

Undefined	Nitrogenated compound Nitrogenated compound	Indole and quinolinol Guanidine Diketopiperazine	Antimicrobial and antibiotic Chitinase inhibitor
Streptomyces			
Estuarine sediment	Nitrogenated compound	N- glycosylated flavonoid	Antimicrobial and antibiotic
Fish	Nitrogenated compound	Peptide	Antimicrobial and antibiotic
gorgonian	Acetate-derived compound	FA lactone	cytotoxic
Mollusk	Nitrogenated compound	Macrolactame	Superoxide inhibitor
Shallow water sediment	Nitrogenated compound Acetate-derived compound	Phenazine FA lactone	Antimicrobial
Sediment	Nitrogenated compound	Diketopiperazine pyrrole	Enzyme inhibition
Sponge	Nitrogenated compound	Phenazine and lactone amide	Antimicrobial and antibiotic
Vibrio			
Fish	Nitrogenated compound	indole	
Fish pathogen	Nitrogenated compound	Amide	antimicrobial

sponge	Acetate-derived compound Nitrogenated compound	Bromo diphenyl ether Indole and lactame	antimicrobial
Undefined	Nitrogenated compound	Guanidine and lactame	toxic

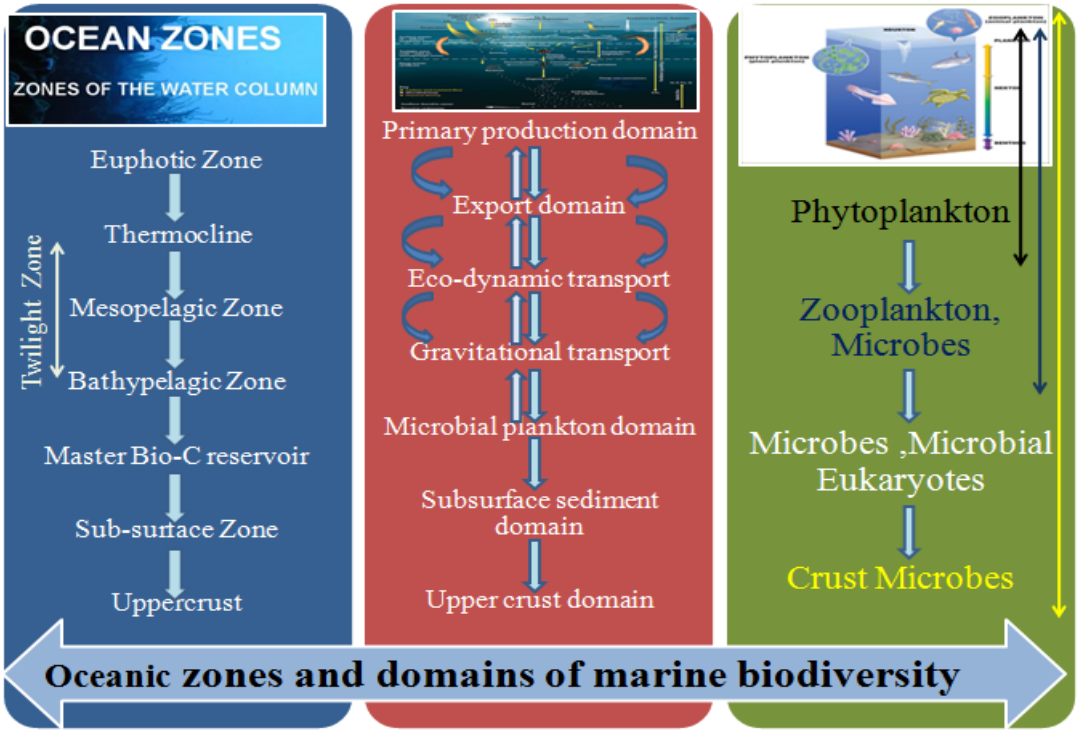


Fig. 1. Ocean zones and domains of marine biodiversity.

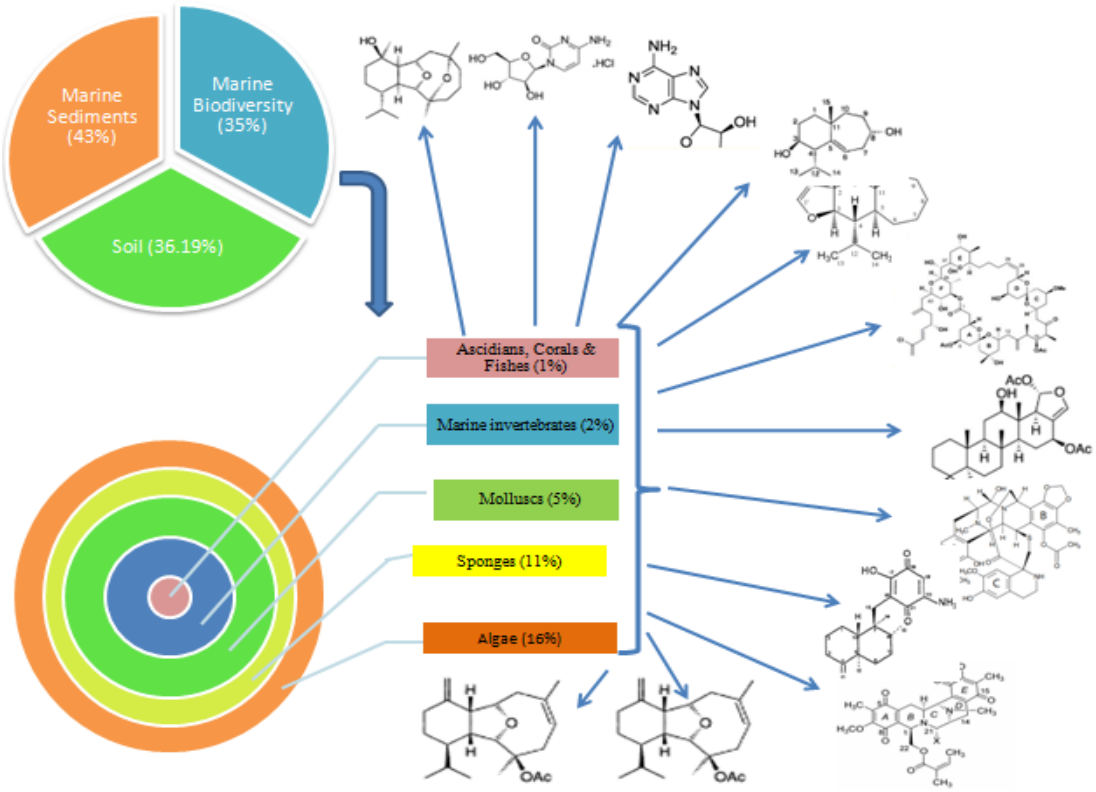


Fig. 2. Percentage distribution of marine biodiversity and their potential application in the extraction of pharmaceutically active metabolites.

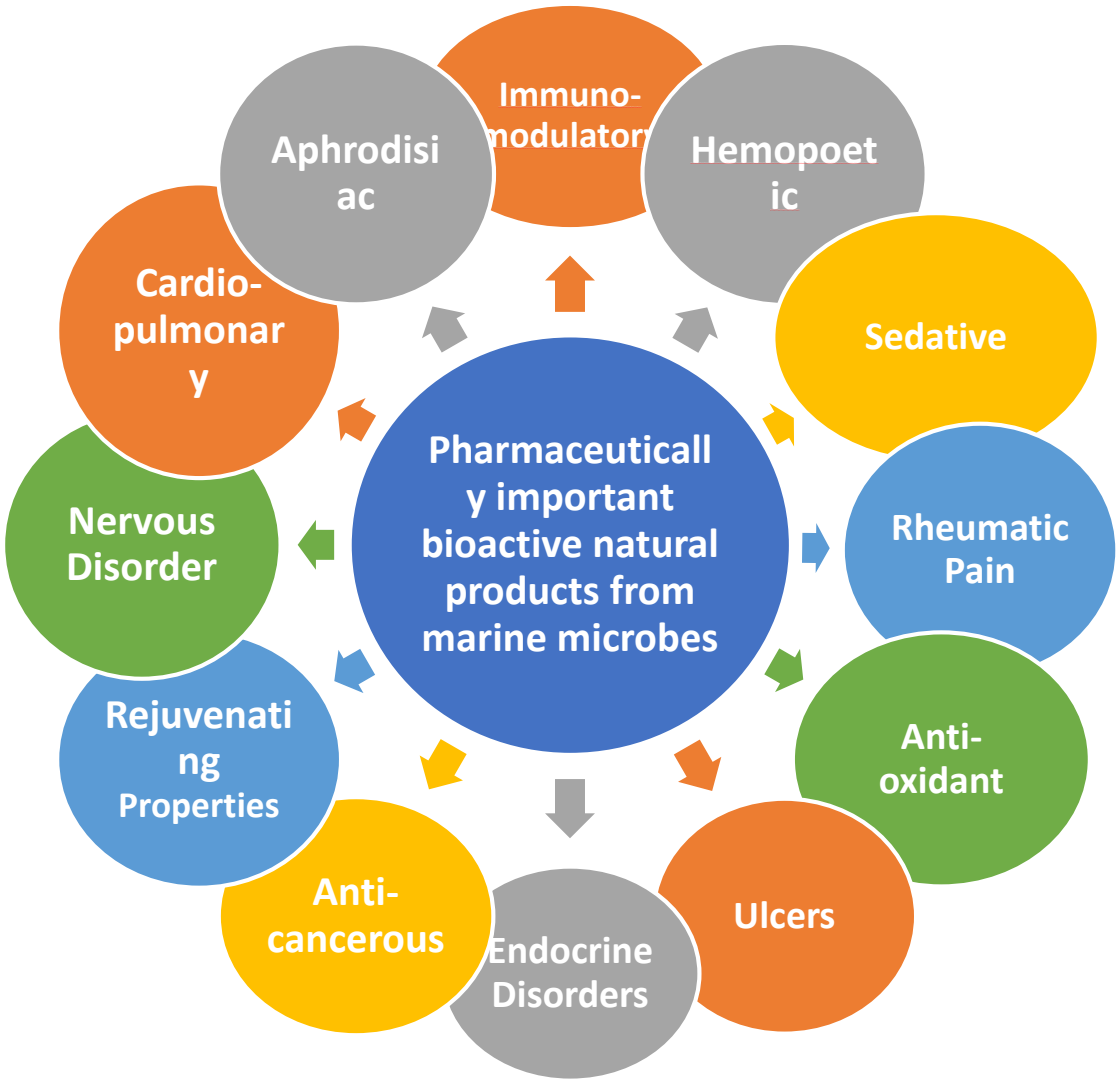


Fig. 3. Pharmaceutical significance of the secondary metabolites obtained from marine microbes.

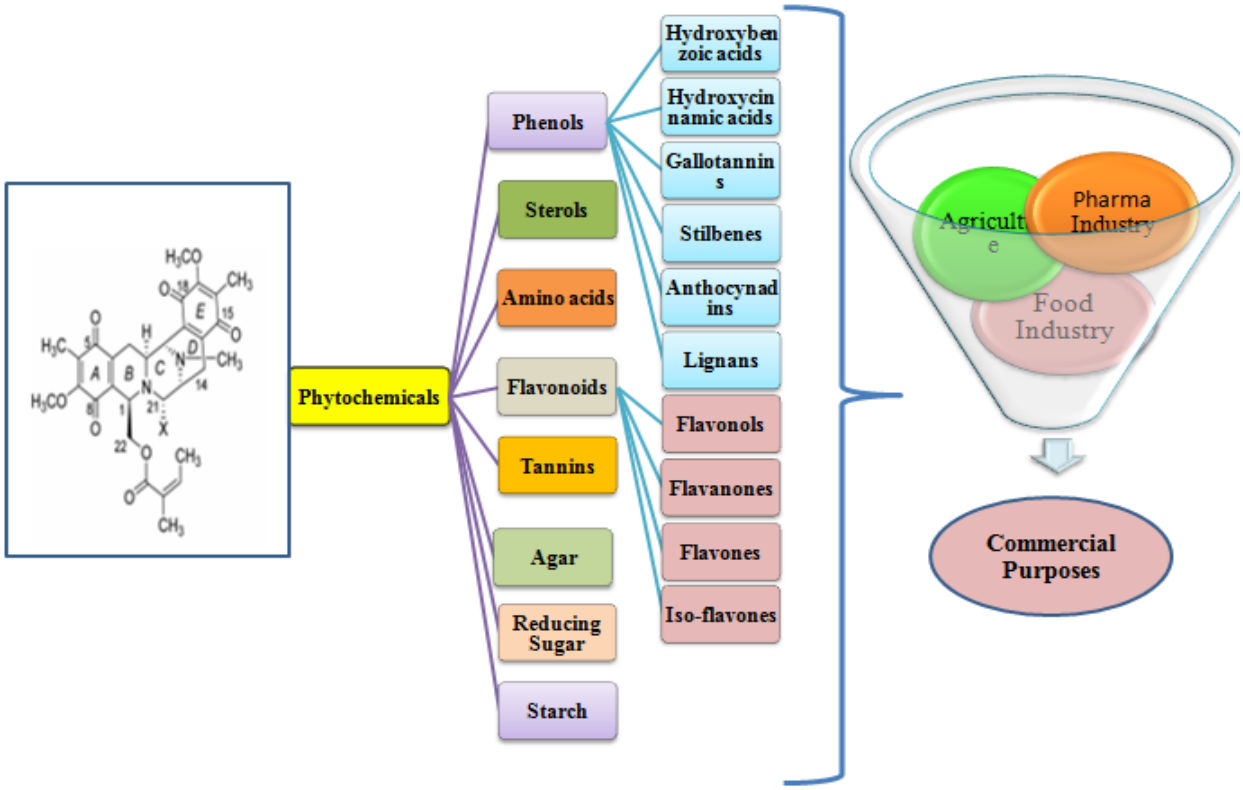


Fig. 4. Applications of bioactive compounds of marine microbes.

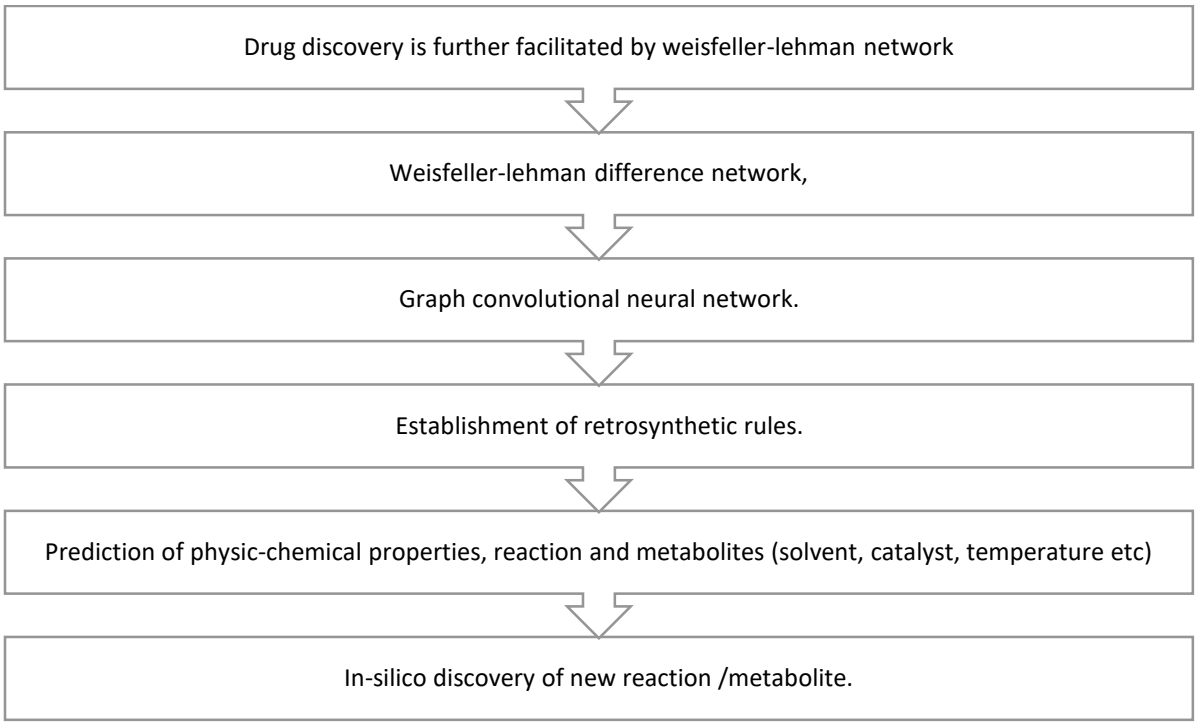


Fig. 5. Flowchart showing the steps involved in drug designing.

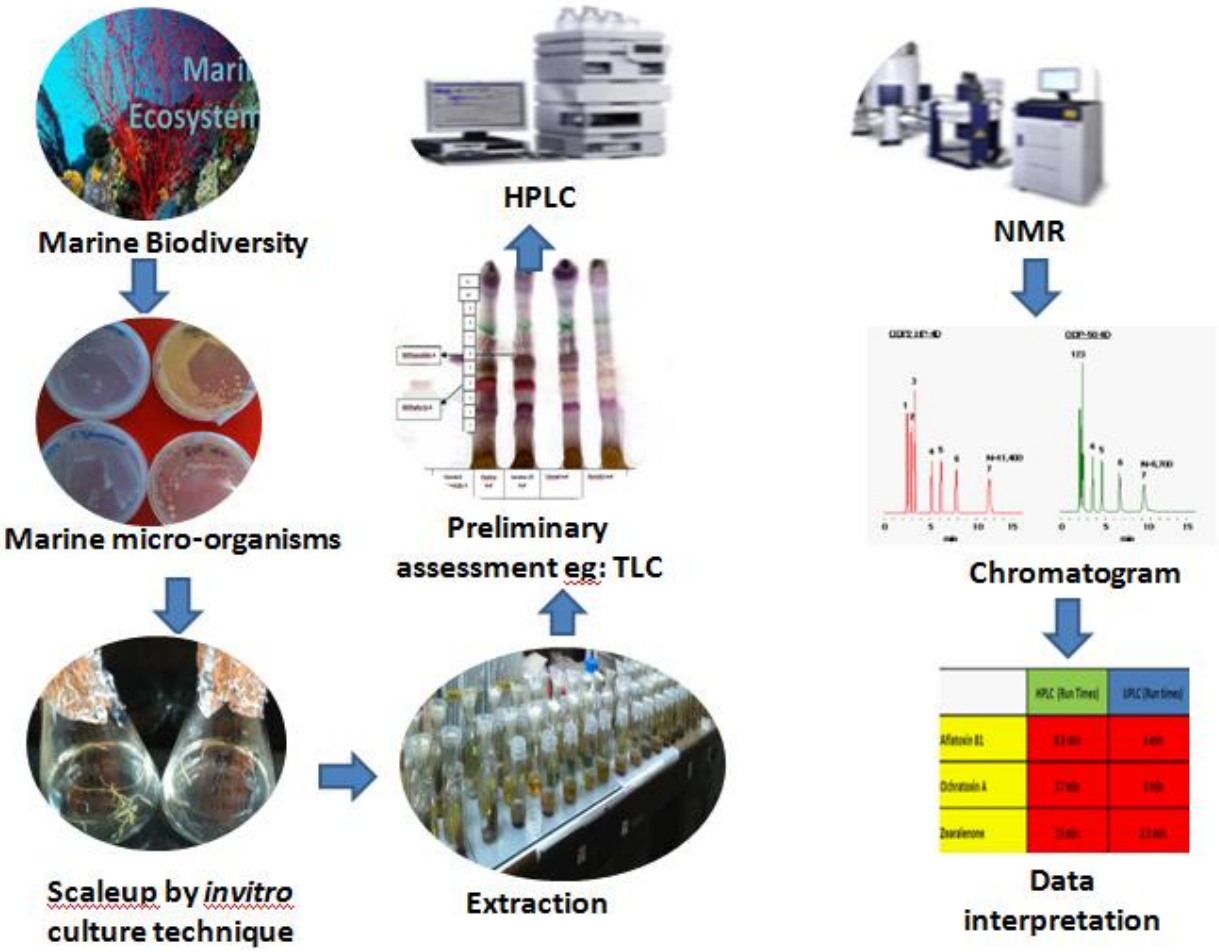


Fig. 6. Flow diagram showing the various steps involved in Isolation, identification and characterization of potential bioactive compounds.