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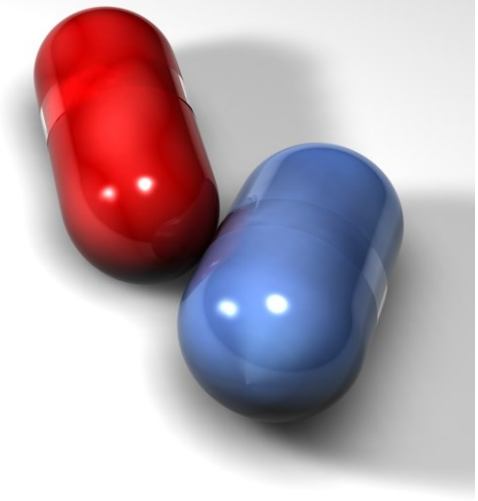

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Letter to the Editor

GC-MS analysis and antibacterial properties of the selected soft corals from South Andaman, India

Sir,

Marine organisms consist of secondary metabolites that serve as a rich source of naturally occurring, bioactive substances with a variety of structural characteristics. Long utilized as sources of various natural chemicals with pharmacological or aesthetic value include a wide range of reef invertebrates, including soft corals (Chao et al., 2011). Alcyonacean corals are classified under the category Octocorallia, which distinguishes these from hexacorallian Scleractinia colonies by implying the presence of polyps with eight tentacles. Alcyonaceans are huge sessile invertebrates with a distinct stalk and a capitulum, or smooth, mushroom-shaped top. Their tissue contains sclerites, which support the colony. Octocorals are found in the majority of benthic habitats, where they are influenced by a variety of environmental conditions, demonstrating their adaptability (van de Water et al., 2018). Sclerite classification has historically been used to identify and categorize the majority of soft coral. There are 35 species of Sarcophyton, and six more have been described (Benayahu et al., 2009).

Soft corals are a highly diverse group of marine organisms that contain a rich source of secondary metabolites. Due to the lack of efficient physical protection in the highly competitive and hostile marine environment, soft corals majorly depend on their secondary metabolites for survival (Shahbudin et al., 2011). The organo-solvent extract produced from various genera of soft corals consists majorly of lipids and sterols, about 90%, and the remaining 10% of the bioactive compounds consists of diterpenes, sesquiterpenes, steroids, terpenoids, and alkaloids (Chao et al., 2011). Soft corals have recently received attention for their pharmacological potential as antioxidants, anti-microbials, anti-cancer, and anti-inflammatory proper-ties (Gomaa et al., 2016; Cooper et al., 2014; Marican et al., 2016).

Andaman and Nicobar Islands' marine ecosystem is unique and understudied, and may have a potential source of antimicrobial agents. There are nearly 300 islands rich in coral reefs, dominated by fringing reefs and few barrier reefs, harboring rich diversity of corals and rare marine species (Laxmilatha et al., 2021). Therefore, it was worthwhile to investigate the antibacterial properties of soft corals against human pathogenic bacteria that often cause infectious diseases.

Soft corals were collected from Burma Nallah (Lat: 11° 34.298'N, Long: 92°44.160'E) by hand-picking method during the inter-tidal survey. Specimens were transferred to the laboratory in plastic containers with sufficient seawater. The released mucus attached rock particles, and sand was washed with sterile seawater. The specimen was identified based on the identification key as described by Janes (2008).

The sample was chopped into small pieces, and 25 g were weighed and soaked in 100 mL of organic solvent Methanol and Ethyl acetate respectively for 48 hours. The crude extract obtained was subjected to vacuum filtration and the resulting filtrate was concentrated using a rotary evaporator (Buchi 2412V0 RII, Switzerland). This crude extract was transferred into air-tight bottles and stored at 4°C till further use.

The investigation of the antibacterial properties of the crude extracts against 12 human pathogenic bacterial species was performed by the agar well diffusion method (Chander et al., 2016). GC-MS analysis of active extracts was carried out on an Alglient© 7890, which is employed for the analysis of compounds. The peaks of the compounds representing mass-to-charge ratio characteristics were compared with the NIST library to identify the corresponding organic compounds.

The results presented in Table I revealed that among the three soft coral methanol extracts, *Sarcophyton trocheliophorum* displayed potential antibacterial activity against the tested organisms. The methanol extract of *S. trocheliophorum* restricted the growth of maximum test pathogens and the highest activity was visualized against *Vibrio fluvialis* (29.7 ± 1.5 mm) followed by *Escherichia coli* (21.3 ± 0.6 mm) and *Salmonella typhi* (15.3 ± 0.6 mm). *Cladiella pachyclados* inhibited seven test pathogens, most active in the case of *Shigella flexneri* (20.3 ± 0.6 mm) followed by *E. coli* (18.3 ± 1.5 mm) and *S. boydii* (17.3 ± 1.5 mm). The compounds of *Sarcophyton ehrenbergi* were moderately effective against tested pathogens and the highest activity was found against *E. coli* (20.0 ± 1.0 mm) followed by *S. sonnei* (15.7 ± 0.6 mm) and *S. typhi* (15.0 ± 1.0 mm). *S. typhi* was found to be sensitive to all the studied soft coral extracts whereas shiga toxin-producin *E. coli* was found to be resistant to all the extracts.

Table I

Antibacterial activity of methanol crude extracts of soft corals (in mm)

Pathogens	*S. ehrenbergi*		*C. pachyclados*		*S. trocheliophorum*	
	50 (µg/mL)	100 (µg/mL)	50 (µg/mL)	100 (µg/mL)	50 (µg/mL)	100 (µg/mL)
E. coli	12.3 ± 0.6	20.0 ± 1.0	13.7 ± 1.2	18.3 ± 1.5	15.3 ± 1.5	21.3 ± 0.6
Shiga toxin-producing *E. coli*	_	_	_	_	_	_
S. flexneri	_	_	13.3 ± 0.6	20.3 ± 0.6	_	13.0 ± 0.0
S. dysentery Type S	_	_	12.3 ± 0.6	15.7 ± 0.6	10.3 ± 0.6	14.3 ± 1.5
S.boydii	_	12.3 ± 1.5	11.3 ± 1.5	17.3 ± 1.5	_	11.7 ± 0.6
S. sonnei	11.7 ± 1.2	15.7 ± 0.6	_	12.7 ± 0.6	_	12.3 ± 1.2
S. typhi	11.3 ± 0.6	15.0 ± 1.0	14.0 ± 0.0	16.3 ± 0.6	11.3 ± 0.6	15.3 ± 0.6
V. cholera	_	_	_	_	_	13.7 ± 1.2
V. fluvialis	_	_	_	_	20.3 ± 0.6	29.7 ± 1.5
A. hydrophila	_	_	11.7 ± 1.2	13.7 ± 1.2	11.3 ± 1.5	15.0 ± 0.6

Table II

Compounds identified from the methanol extracts of soft corals by GC-MS analysis

Species	Compounds	Retention time (min)	Molecular formula	Molecular weight (g/mol)	Peak area (%)
S. ehrenbergi	1-Hexadecanol	31.198	$C_{16}H_{34}O$	242	15.68
	5,8,11,14-Eicosatetraenoic acid, methyl ester, (all-Z)-	38.088	$C_{21}H_{34}O_2$	318	8.50
	Naphthalene, 1,2,3,4-tetrahydro-1,6-dimethyl-4-(1-methylethyl)-, (1S-cis)	23.092	$C_{15}H_{22}$	202	7.35
	Hexadecanoic acid, methyl ester	31.949	$C_{17}H_{34}O_2$	270	5.84
	γ-Linolenic acid, methyl ester	34.834	$C_{19}H_{32}O_2$	292	5.84
	1-Octadecanol	35.053	$C_{18}H_{38}O$	270	4.51
	Batilol	45.400	$C_{21}H_{44}O_3$	344	4.03
C. pachyclados	1-Hexadecanol	31.013	$C_{16}H_{34}O$	242	13.46
	Azuleno[4,5-b]furan-2(3H)-one, 9a-[(acetyloxy)methyl] decahydro-6a,9-dihydroxy-6-methyl-3-methylene	46.754	$C_{17}H_{24}O_6$	324	11.86
	γ-Linolenic acid, methyl ester	34.769	$C_{19}H_{32}O_2$	292	10.57
	5-(7a-Isopropenyl-4,5-dimethyl-octahydroinden-4-yl)-3-methyl-pent-2-enal	45.254	$C_{20}H_{32}O$	288	9.57
	2,5-Furandione, dihydro-3-(2-tetradecenyl)	39.037	$C_{18}H_{30}O_3$	294	7.44
	2-[4-Methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde	44.788	$C_{23}H_{32}O$	324	6.96
	Hexadecanoic acid, methyl ester	31.864	$C_{17}H_{34}O_2$	270	5.33
S. trocheliopho-rum	Hexadecanoic acid, methyl ester	31.856	$C_{17}H_{34}O_2$	270	24.06
	1-Octadecanol	34.956	$C_{18}H_{38}O$	270	11.68
	1-Hexadecanol	30.995	$C_{16}H_{34}O$	242	10.81
	Campesterol	55.081	$C_{28}H_{48}O$	400	7.89
	Thunbergol	34.343	$C_{20}H_{34}O$	290	4.80
	2-Pentenoic acid, 5-(decahydro-5,5,8a-trimethyl-2-methylene-1-naphthalenyl)-3-methyl-, [1S-[1α(E),4aβ,8aα]]	36.295	$C_{20}H_{32}O_2$	304	3.22
	trans-13-Octadecenoic acid, methyl ester	35.188	$C_{19}H_{36}O_2$	296	2.90
	Ergost-5-en-3-ol, acetate, (3β,24R)-	50.221	$C_{30}H_{50}O_2$	442	2.80

GC–MS analysis of methanol extracts of three soft corals revealed the presence of bioactive compounds (Table II). The most abundant compound was 1-hexadecanol, 5,8,11,14-eicosatetraenoic acid, methyl ester, (all-Z)-, naphthalene, 1,2,3,4-tetrahydro-1,6-dimethyl-4-(1-methylethyl)-, (1S-cis)-, azuleno[4,5-b]furan-2(3H)-one, 9a-[(acetyloxy)methyl] decahydro-6a,9-dihydroxy-6-methyl-3-methylene-, γ-linolenic acid, methyl

ester, hexadecanoic acid, methyl ester, 1-octadecanol, campesterol, thunbergol respectively.

The study results of the antibacterial assay, the bioactive compounds of three soft coral extracts inhibited the growth of human pathogenic bacteria. GC-MS analysis revealed bioactive compounds from these three soft corals, and each compound has been structurally characterized so that these metabolites can act as potential pharmaceutical products or lead structures for the development of new drugs in the future. The antibacterial properties of the soft corals from South Andaman are the first of their kind from the islands and they should be further investigated for their application in developing novel bioactive compounds.

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Samson Rokkarukala[1], M. Punnam Chander[2], Raju Mohanraju[1]

[1]Department of Ocean Studies and Marine Biology, Pondicherry University, Brookshabad Campus, Port Blair, Andaman and Nicobar Islands, 744112, India; [2]Model Rural Health Research Unit, Khumulwng, Tripura 799035, India.

Corresponding author:

Email: asmohanrajupu@pondiuni.ac.in

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