IJPSR (2021), Volume 12, Issue 3 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 17 January 2020; received in revised form, 16 June 2020; accepted, 20 June 2020; published 01 March 2021

GC-MS AND FT-IR ANALYSIS OF METHANOLIC EXTRACT OF A MARINE CNIDARIAN *ZOANTHUS SANSIBARICUS* IN SEARCH OF BIOACTIVE COMPOUNDS

Jalpa Raja, Shweta Pathak and Rahul Kundu *

Department of Biosciences, Saurashtra University, Rajkot - 360005, Gujarat, India.

Keywords:

Zoanthus sansibaricus, FT-IR, GC-MS, Bioactive functional groups, Bioactive compounds

Correspondence to Author:
Rahul Kundu

Professor,
Department of Biosciences,
Saurashtra University, Rajkot – 360005, Gujarat, India.

E-mail: rskundu@sauuni.ac.in

ABSTRACT: Present study was aimed to search bioactive functional groups and compounds in the whole animal extract of a marine cnidarians *Zoanthus sansibaricus* by FT-IR and GC-MS. The methanol extract was used to detect bioactive functional groups and compounds. GC-MS of the animal extract was done, and FTIR analysis was thereafter used to identify the functional groups. The bioactive components were identified based on peak values in the region of infrared radiation. Results of GC-MS revealed eight major compounds like Undecane (13.16%), 2,6-Diisopropylnaphthalene (3.47%), Cyclohexasiloxane, dodecamethyl (6.33%), 6, 11-Undecadiene, 1-acetoxy-3, 7-dimethyl (2.84%), n-Hexadecanoic acid (19.91%), Triphenylphosphine oxide (4.34%), beta. -Sitosterol acetate (43.32%) and Dihydroartemisinin,6-deshydro-5-deshydroxin (6.64%). These are bioactive compounds may act as antimicrobial, antiviral, anti-inflammatory, and antioxidant agents. FT-IR analysis results also indicated the presence of functional groups like N-H (amide group), O-H (carboxylic acid and alcohol), C-H (carboxylic acid and alkanes), and C-F (alkyl halide group) in the compounds.

INTRODUCTION: Man has used natural resources for medicinal uses since ancient times, and presently researchers are looking for bioactive compounds from different sources for medicinal use as therapeutic drugs without side effects. The literature survey revealed the presence of various organic molecules from natural sources like in marine animals [1, 2], algae [3, 4], terrestrial plants [5, 6,] and terrestrial animals [7]. These organic molecules are termed bioactive compounds, and their activities were tested for their biological and chemical properties.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.12(3).1593-98

The article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.12(3).1593-98

Many such bioactive compounds from algae, a variety of bacterial species, and from few animals like Porifera, Coelenterate, Molluscs, and Echinoderms are studied and termed as biotoxins having medicinal properties [8-14]. Biological active compounds are experiencing a growing interest in a wide range of applications like geo-medicine, plant science, modern pharmacology, agrochemicals, cosmetics, food industry, nano-bio-science, *etc.*

Compared to terrestrial, marine organisms have more novel and unique structures owing to the complex living circumstance and diversity of species, and the bioactivities are much stronger [15, 16]. Fewer reports are available on the studies of marine natural products synthesized by the animals and plants were metabolized by associated microorganism's [17-20]. Marine animals and plants are more and more research because of the high content of active compounds, as well as the

limitation of bioresources supply from the terrestrial sources [21-24]. GC-MS is a technique used in analyzing plant and animal extracts, and it is an interesting tool for testing the amount of bioactive chemicals in the pharmaceutical or food industry [25, 26]. On the other hand, FTIR is an analytical technique based on absorption in the infrared region, which results in changes in the vibrational and rotational states of the molecules [27]. FTIR is used in this study to quantify the several components absorbing in the mid-infrared region (400-5000 cm^{-1}), present in the *Zoanthus sansibaricus* extract [28]. Therefore, in the present study, an attempt has been made to detect the presence of possible bioactive functional groups and compounds in the *Zoanthus sansibaricus* extract by using FT-IR and GC-MS analysis.

MATERIALS AND METHODS:

Sample Collection and Extract Preparation: Few live specimens of the Cnidarian species, *Zoanthus sansibaricus* were collected during October - December 2018 from Veraval coast (20°55' N and 70°20' E) off Arabian Sea of Gujarat, Western India. The animal species were identified by WoRMS (http://www.marinespecies.org/aphia.php?p=taxdetails&id=138757), and a sample was submitted to the Museum of the Department of Biosciences, Saurashtra University, Rajkot. Immediately upon collection of animals were stored in the 10% polarity methanol. 200 g of whole-body frozen sample was homogenized with 10% methanol, then centrifuged at 5000 rpm for 15 minutes. The supernatant was collected, filtrated, and freeze-dried at 0°C [29].

Isolation and Characterization:

FTIR Analysis: For identifying the functional group in the extract, FTIR technique was followed. 10 mg of dried powder of *Z. sansibaricus* was encapsulated in the 100 mg of KBr pellet in order to prepare a translucent material, and the resultant sample was loaded in the FTIR spectroscope (Shimadzu, IR Affinity1, Japan). The spectroscopy ranges from 400 to 4000 cm^{-1} with a resolution of 4cm1 was performed.

GC-MS Analysis: *Z. sansibaricus* extract was prepared in 10% methanol and analyzed with a GC-MS analyzer (GC-MS-QP 2010 plus Shimadzu, Japan). Helium gas was used as a carrier, and its flow rate was 1 ml/min in split mode (10:1) v/v. Standard GC-MS protocol of Shimadzu equipment was followed for the assay. Mass spectrum of compounds in samples was obtained by electron ionization at 70 eV, and the detector operates in scan mode 50 to 600 Da atomic units. The MS Table was generated through ACQ mode scan within 0.5 seconds of scan interval at speed was 666 and fragments maintained from the 30 to 350 Da. Compound identification was done as per NIST. The component name of the extract materials was identified and calculated the percentage amount by comparing the average peak area to the total area. Unknown components spectrum was compared with the spectrum of the known components stored in the NIST library.

RESULTS AND DISCUSSION: Marine invertebrates, which develop in a different environment from terrestrial animals, are the source of a broad range of pharmacological substances. These bioactive compounds either express constitutively, or the expression is induced by exposure to pathogens [30]. Pharmaceutical potentials particularly in invertebrates, are of great interest due to the excellent property of marine organisms to produce bioactive groups and compounds31. The present study provides a good starting point for the analysis of unique compounds from Cnidarians, which are highly toxic otherwise, for the treatment of human diseases. GC-MS study is the first step towards understanding the nature of active principles. Further studies are needed like isolation, purification, and understanding the structural determination of the chemical compounds responsible for the biological activities, which may be lead to the discovery of drug molecules.

FT-IR Analysis: FT-IR analysis of methanol extract of *Zoanthus sansibaricus* was carried out, and the extract was continuously passing into the FT-IR. The extract was analyzed for identifying the functional groups of the active components based on the peak values in the region of IR radiation. The presence of C-H (alkanes), N-H (amide group), and C-F (alkyl halide group) functional groups was confirmed in the results of FT-IR analysis. The peaks were found at 3322, 2946, 2834, 1449, 1412, 1114, and 1019 cm^{-1} **Fig. 1**. The peak at 3322 cm^{-1} showed Hydroxyl group's presence, whereas 2946 cm^{-1} showed the presence of alkanes and alkyls

group, and 2834 cm^{-1} peaks showed the presence of carboxylic acid, alkanes and alkyls group. The peaks around 1449 cm^{-1} showed the presence of the Methyl group, 1114 cm^{-1} showed the silicon-oxy group, and 1019 cm^{-1} peak showed the methylene group **Table 1**. Detection of bimolecular composition is the technique of FTIR spectroscopy proved to be a reliable and sensitive method.

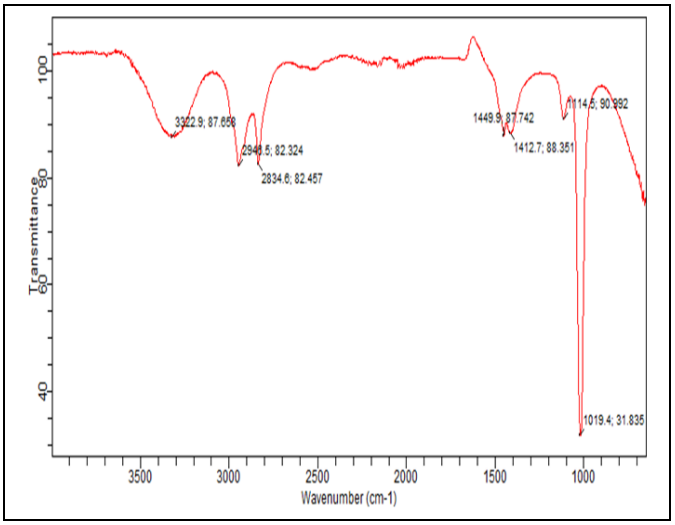


FIG. 1: FT-IR SPECTRUM OF METHANOL EXTRACT OF ANIMAL *ZOANTHUS SANSIBARICUS*

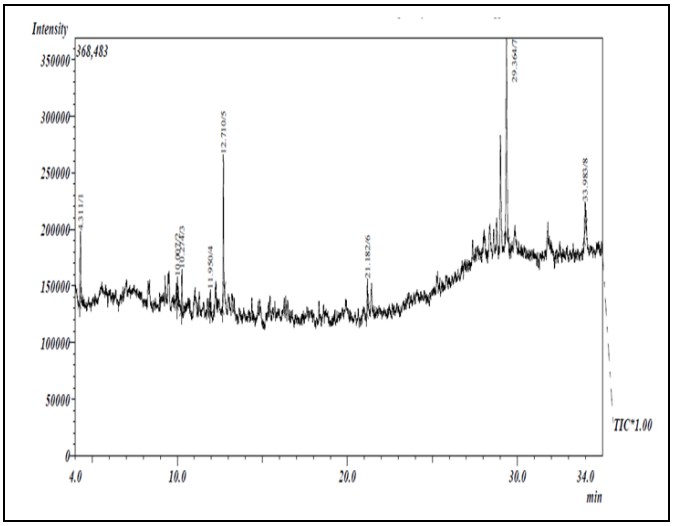


FIG. 2: COMPOUNDS IDENTIFIED FROM METHANOL EXTRACT OF ANIMAL *ZOANTHUS SANSIBARICUS* BY GC-MS ANALYSIS

The presence of strong bands above 3000 cm^{-1} indicates the presence of aromatic ring [32]. The marine animal contains a large amount of primary and secondary metabolites exert a wide range of biological activities on physiological systems [33]. Spectroscopic (FTIR) methods are very rapid and cost-effective than the other conventional methods. Thus, both can be used together or separately to detect the bioactive constituents [34]. Alkaloids present may possess plasmolytic, anticholinergic, analgesic, stimulants, antimalarial and anesthetic activity and has a record of reducing fever and headache [35]. Alkanes protect animals against water loss and protect against microorganisms, and harmful insects [36]. Alkenes are important in the manufacture of plastics, *e.g.*, as fuel and illuminant, and polythene. They serve as raw materials for the manufacture of alcohols. These groups are used for a general anesthetic, artificial ripening of fruits, making poisonous mustard gas, and ethylene-oxygen flame [37].

GC-MS Analysis: The *Z. sansibaricus* extract was prepared in the methanol, and the compounds were identified by the GC-MS technique **Fig. 1**. Retention time (R) and area (%) showed in **Table 1**. Total eight compounds were present in the methanolic extract of *Z. sansibaricus* by the technique of GC-MS. Components present in the *Z. sansibaricus* were Undercane (13.16%), 2,6-Diiso-propylnaphthalene (3.47%), Cyclohexa-siloxane, dodecamethyl (6.33%), 6, 11-Undecadiene, 1-acetoxy-3,7-dimethyl (2.84%), n-Hexadecanoic acid (19.91%), Triphenylphosphine oxide (4.34%), beta.-Sitosterol acetate (43.32%) and Dihydro-artemisinin, 6-deshydro-5-deshydroxin (6.64%) **Table 2**.

TABLE 1: FT-IR ANALYSIS OF METHANOL EXTRACT OF ANIMAL *ZOANTHUS SANSIBARICUS*

Sr. no.	Wave number	Functional group
1	3322	Hydroxyl or alcohol (H-bond OH stretch)
2	2946	Alkanes and alkyls (CH and CH_2 stretching aliphatic)
3	2834	Carboxylic acid, alkanes and alkyls
4	1449	Methyl (Methyl C-H asym./sym. Bend)
6	1114	Silicon-oxy- (SiO_2)
7	1019	Methylene (Cyclohexane ring vibration)

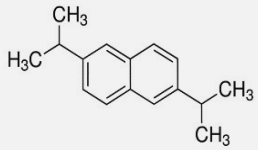
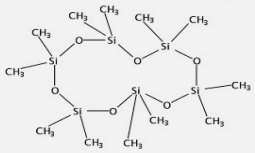
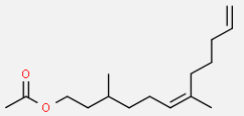
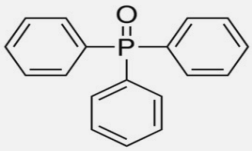
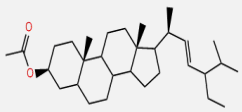
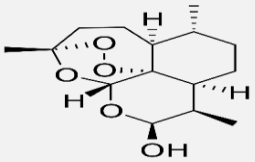
GC-MS is an important tool for the identification of different chemical constituents from animals, and that would be important for the discovery of new therapeutic agents [38]. Bioactive constituents of the long chain were found to be Undercane, 2, 6-Diiso-propylnaphthalene, Cyclohexasiloxane, dodeca-methyl, 6, 11-Undecadiene, 1-acetoxy-3,7-dimethyl, n-Hexadecanoic acid, Triphenyl-phosphine oxide,

beta-Sitosterol acetate and Dihydroartemisinin, 6-deshydro-5-deshydroxin compounds [39, 40]. FTIR analysis has confirmed the presence of carboxylic acid, alkanes, and alkyls, alkanes, alkyl halide, and alcohol groups.

Hexadecanoic acid (palmitic acid) was the most abundant saturated fatty acid found in the animal and reported in previous studies by Rajeswari *et al.*, [41], Anyasor *et al.*, [42] and Omotosho *et al.*, [43] to have anti-oxidant, anti-inflammatory, hypocholesterolemic, anti-androgenic, 5-α reductase inhibitor and hemolytic activities. Jiang *et al.* [44], Gobalakrishnan *et al.* [45], Mgbeje *et al.*, [46] have also observed its anticancer and antimicrobial activities respectively. Cyclohex-asiloxane belongs to an aliphatic amine class. This compound is used for the synthesis of organic compounds such as sulphenamide, a base reagent used as accelerators for vulcanization.

Cyclohexamine is also used as a building block for pharmaceuticals, *e.g.*, mucolytic, analgesics, bronchodilators [47]. Hexadecanoic acid, a fatty acid with potential antimicrobial and anti-diarrheal activities, causes growth inhibition and apoptosis induction in human gastric cancer cells [48, 49, 50].

TABLE 2: GC-MS ANALYSIS OF METHANOL EXTRACT OF ANIMAL *ZOANTHUS SANSIBARICUS*

S. no.	Retention time	Name	Molecular Formula	Molecular Weight	Molecular Structure	Peak area %
1	4.311	Undecane	$C_{11}H_{24}$	156.31		13.16
2	10.007	2,6-Diisopropylnaphthalene	$C_{16}H_20$	212.33		3.47
3	10.274	Cyclohexasiloxane, dodecamethyl	$C_{12}H_{36}O_6Si_6$	444.924		6.33
4	11.950	6,11-Undecadiene, 1-acetoxy-3,7-dimethyl	$C_{16}H_{28}O_2$	252.392		2.84
5	12.710	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256.43		19.91
6	21.182	Triphenylphosphine oxide	$C_{18}H_{15}OP$	278.28		4.34
7	29.364	Beta -Sitosterol acetate	$C_{31}H_{52}O_2$	456.74		43.32
8	33.983	Dihydroartemisinin,6-deshydro-5-deshydrox	$C_{15}H_{22}O_3$	250.33		6.64
						100.00

The rich diversity of marine animals has the potential to discover a number of bioactive compounds from them. The biologically active molecules interfere with the prevention of disease at many different points, which is increase the chances of developing selective drugs against a specific disease.

Marine invertebrates have provided many examples of novel secondary metabolites that possess varied chemical status and potent anti-malarial, anti-inflammatory, anti-carcinogenic, anti-bacterial, anti-fungal *etc.*, activities. Therefore, the results of the present study in this direction using *Z. sansibaricus* are promising.

ACKNOWLEDGEMENT: Authors are thankful to UGC, Govt. of India, New Delhi, for supporting this study through its CAS program of the Department of Biosciences, Saurashtra University, Rajkot, India.

CONFLICTS OF INTEREST: There is no conflict of interest.

REFERENCES:

1. Erickson KL: Constituents of Laurecia. In: Scheuer PJ marine natural products: chemical and biological perspectives. Academic Press, New York 1983; 5: 132-57.
2. Bluden: Biologically active compounds from marine organisms. In: Evans CW, Trease Ed, Phramcognosy 1997; 18-27.
3. Bhakuni DS and Silva N: Biodynamic substances from marine flora. Botanica Marina 1974; 17: 40-51.
4. Borowitzka MA: Microalgae as source of pharmaceuticals and other biologically active compounds. Journal of Applied Phycology 1995; 71(1): 3-15.
5. Farnsworth NR, Henry LK, Svoboda GH, Blomster RN, Yates MJ and Eular L: Biological and phytochemical evaluation of plants. I Biological test procedures and results from two hundred accessions. Journal of Natural Products 1966; 29(2): 101-22.
6. Dhar ML, Dhar MM, Dhawan BN, Mehrotra BN and Ray C: Screening of Indian plants for biological activity part I.Indian Journal of Experimental Biology1968; 6: 232.
7. Magnusson S, Gunderson K and Brandberg A: Marine bacteria and their possible relation to the virus inactivation capacity of seawater. Acta Pathologica Microbiologica Scandinavica1967; 71: 274-80.
8. Gunderson K, Brandon A, Magnsso S and Lycke E: Characterization of a marine bacterium associated with virus inactivating capacity. Acta Pathologica Microbiologica Scandinavica 1967; 71: 281-86.
9. Burkholder RR and Sharma GM: Antimicrobial agents from the sea. Journal of Natural Products 1969; 32:466-83.
10. Caccames S and Azzilona R: Screening for antimicrobial activities in marine algae from Eastern Sicily. Planta Medica 1979; 37: 333-39.
11. Caccamese S, Azzolina R, Furnari G, Cormaci M and Grasso S: Antimicrobial and antiviral activities of some marine algae from Eastern Sicily. Botanica Marina 1981; 24: 365-67.
12. Padmini SR, Sreenivas PR and Karmarkar SM: Antimicrobial substances from brown algae III Efficiency of solvent in the evaluation of antibacterial substances from *Sargassum johntonii*. Botanica Marina 1986; 29: 503-07.
13. Faulkner DD: Marine natural products. Nat. Proc. Res. 1990; 7: 269-09.
14. Abdel NB, Singaba AH, Sinkkonenc, AJ, Ovcharenkoc V and Pihlajac K: Molluscicidal activity and new flavonoids from Egyptian *Iris ermanica* L. (var. alba). Zeitschrift fur Naturforschng 2006; 61c: 57-63.
15. Burgess JG, Jordan EM, Bregu M, Mearns-Spragg A and Boyd KG: Microbial antagonism: a neglected avenue of natural products research. Journal of Biotechnology 1999; 70: 27-32.
16. Proksch P, Edrada RA and Ebel R: Drugs from the seas current status and microbiological implications. Applied Microbiology and Biotechnology 2002; 59: 125-34.
17. Carte BK: Biomedical potential of marine natural products. Bioscience.1996; 46: 271-86.
18. Kohler T, Pechere JC and Plesiat P: Bacterial antibiotic efflux systems of medical importance. Cellular and Molecular Life Sciences 1999; 56: 771-78.
19. Rinehart KL: Antitumor compounds from tunicates. Medicinal Research Reviews 2000; 20: 1-27.
20. Osinga R, Armstrong E, Burgess JG, Hoffmann F, Reinter J and Schumann-Kindel G: Sponge microbe associations and their importance for sponge bioprocess engineering. Hydrobiologia. 2001; 461: 55-62.
21. Ivanova EP, Nicolan DV, Yumoto N, Taguchi T, Okamoto K, Tatsu Y and Yoshikawa S: Impact of conditions of cultivation and adsorption on antimicrobial activity of marine bacteria. Marine Biology 1998; 130: 545-51.
22. Bultel-Ponce V, Berge JP, Debitus C, Nicolas JL and Guyot M: Metabolites from the sponge associated bacterium Pseudomonas species. Marine Biotechnology 1999; 1: 384-90.
23. Hentschel U, Schmid M, Wagner M, Fieseler L, Gernert C and Hack-er J: Isolation and phylogenetic analysis of bacteria with antimicrobial activity from the Mediterra-nean sponges *A. aerophoba* and *Aplysina cavernicola*. FEMS Microbiology Ecology 2001; 35: 305-12.
24. Holmstrom C, Egan S, Franks A, McCloy S and Kjelleberg, S: Antifouling activity expressed by marine surface associated Pseudoalteromonas species. FEMS Microbiology Ecology2002; 41: 47-58.
25. Amlabu E, Ilani P, Ajodo N, Adewusi F, Yakubu S, Cosmos YV, Ache E, Ezekiel KA and Oshiedu S: GC-MS and NMR analysis of the bioactive compounds from the crude extracts of *Walthria indica* and the histopathological changes induced in albino rats challenged with Naja nigricollis venom. Journal of Coastal Life Medicine 2016; 4 (5): 395-02.
26. Guillen PO, Gegunde S, Jaramillo KB, Alfonso A, Calabro K, Alonso E, Rodriguez J, Botana LM and Thomas OP: Zoanthamine alkaloids from the *Zoantharian zoanthus* cf. pulchellus and their effects in neuroinflammation. Marine drugs 2018; 16: 242-52.
27. Elufioye TO and Mada OO: GC-MS, FTIR, UV analysis and *in-vitro* antioxidant activity of a Nigeria polyherbal mixture: Pax herbal bitters. Free Radicals and Antioxidants 2018; 8 (2): 74-81.

28. Amand LE, Kassman H, Karlsson M and Leckner B: Measurement of the concentration of ammonia and ethene in the combustion chamber of a circulating fluidized-bed boiler. Journal of Institute Energy 1997; 70: 25-30.
29. Chen J: Overview of sea cucumber farming and sea ranching practices in China. SPC Beche-de-mer Information Bulletin. 2003; 18: 18-23.
30. Sri Kumaran N, Bragadeeswaran S and Thangaraj S: Screening for antimicrobial activities of marine molluscs Thaistissoti (Petit, 1852) and Babylonia spirata (Linnaeus, 1758) against human, fish and biofilm pathogenic microorganisms. African Journal of Microbiology Research 2011; 5(24): 4155- 61.
31. Keivan Z, Mohammad HF, Nabipour MS, Khosro K, Reza HS and Seyed M: Isolation of a 60 k Da protein with *in-vitro* anticancer activity against human cancer cell lines from the purple fluid of the Persian Gulf Sea hare, Aplysia dactylomela. African Journal of Microbiology Research 2007; 6 (11): 1280-83.
32. Sankaravadivu S, Jothibai MR and Meenakshi VK: Infra-red and Gas Chromatogram-mass spectral studies of colonial Ascidian *Ecteinascidia venui* 16. Meenakshi, 2000. Int J of Chem and Pharm Sci 2013; 4(2): 17-23.
33. Olagunju JA, Fagbohunka BS, Oyedapo OO and Abdul AIA: Effects of an ethanolic root extract of *Plumbago zeylanica* on some serum parameters of the rats. Nigerian Journal of Biochemistry and Molecular Biology 2006; 11: 268-276.
34. Ibrahim M, Hameed AJ and Jalbout A: Molecular spectroscopic study of river Nile sediment in the greater Cairo region. Applied Spectroscopy 2008; 62(3): 306–11.
35. Pietta PG: Flavonoids as antioxidants. Journal of Natural Products 2000; 63: 1035-42.
36. Baker EA, Cutler DF, Alvin KL and Price CE: Chemistry and morphology of plant epicuticular waxes. The plant cuticleJournal of Academic Press London.1982; 139-65.
37. Prasanna G and Anuradha R: Ultraviolet - visible and Fourier Transform-infrared spectroscopic studies on *Drynaria quercifolia* L. rhizome. Asian Journal of Pharmaceutical and Clinical Research 2016; 9 (3): 1-4.
38. Milne A: Inhalational and local anesthetics reduce tactile and thermal responses in *Mimosa pudica* linn. Masui. Journal of Global Pharma Technology 1993; 1190-1193.
39. Singariya P, Kumar P and Mourya KK: Identification of new bioactive compounds by GC-MS and estimation of physiological and biological activity of Kala Dhaman (*Cenchrus setigerus*). International Journal of Pharmaceutical and Biological Science Archives 2012; 3: 610-16.
40. Sithara NV, Komathi S and Rajalakshmi G: Identification of bioactive compounds using different solvents through FTIR studies and GCMS analysis. Journal of Medicinal Plants Studies. 2017; 5(2): 192-94.
41. Rajeswari G, Murugan M and Mohan VR: GC-MS analysis of bioactive components of *Hugonia mystax* L. (Linaceae). Research Journal of Pharmaceutical, Biological and Chemical Sciences 2012; 3 (4): 301-08.
42. Anyasor GN, Onajobi FD, Osilesi O and Adebawo OO: Phytochemical constituents in hexane fraction of *Costus afer* Ker Gawl. Stem. Vedic Research International Phytomedicine 2014; 2 (3): 66-72.
43. Omotoso AE., Olorunfemi EO and Mikailu S: Phytochemical analysis of *Cnidoscolus aconitifolius* (Euphorbiaceae) leaf with spectrometric techniques. Nigerian Journal of Pharmaceutical andApplied Science Research2014; 3 (1): 38-49.
44. Jiang Z, Chen Y, Yao F, Chen W, Zhong S, Zheng F and Shi G: Antioxidant, antibacterial and antischistosomal activities of extracts from *Grateloupia livida* (Harv). Yamada. PLOS One 2013; 8 (11): 80413.
45. Gobalakrishnan R, Manikandan P and Bhuvaneswari R: Antimicrobial potential and bioactive constituents from aerial parts of *Vitis setosa* wall. Journal of Medicinal Plants Research 2014; 8 (11): 454-60.
46. Mgbeje BIA., Asenye EM., Iwara IA and Ebong, PE: Evaluation of phytochemical composition of n-hexane fractions of *Heinsia crinita* crude leave extracts using gas chromatography- mass spectroscopy (GC-MS). World Journal of Pharmacy and Pharmaceutical Sciences 2016; 5(9): 98-07.
47. Karsten E, Erhard H, Roland R and Hartmut H: Amines, aliphatic in Ullmann's encyclopedia of industrial chemistry. Wiley-VCH, Weinheim 2005.
48. Ramprakash VR and Awad AB: Role of Phytosterols in cancer prevention and treatment. Journal of AOAC International 2015; 98(3): 735-38.
49. López-García G, Alegría A, Barberá R and Cilla A: Antiproliferative effects and mechanism of action of phytosterols derived from bioactive plant extracts. Nutraceuticals and Natural Product Derivatives: Disease Prevention and Drug Discovery 2019; 145-65.
50. Bano I and Deora G: Preliminary phytochemical screening and GC-MS analysis for identification of bioactive compounds from *Abutilon fruticosum* Guill and Perr. A rare and endemic plant of Indian Thar Desert. International Journal of Pharmaceutical Science and Research 2020; 11(6): 2671-79.

How to cite this article:
Raja J, Pathak S and Kundu R: GC-MS and FT-IR analysis of methanolic extract of a marine cnidarians *Zoanthus sansibaricus* in search of bioactive compounds. Int J Pharm Sci & Res 2021; 12(3): 1593-98. doi: 10.13040/IJPSR.0975-8232.12(3).1593-98.