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STUDIES ON THE EFFECTS OF RED MACROALGAE EXTRACT ON *ABELMOSCHUS ESCULENTUS* - A NOVEL STRATEGY TO EXPRESS THERAPEUTIC COMPOUNDS

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ABSTRACT

The present work was undertaken using a seaweed liquid fertilizer extracted from the red algae *Coralline mediterranea*. The study plant chosen was *Abelmoschus esculentus* because we had already used the same plant to study the effects of *Kappaphycus alverazii* and we have found out amazing results. Seaweed liquid fertilizer extracted from the red algae *Coralline mediterranea* were having many biologically active compounds like glycosides, flavonoids, anthraquinone, resin and tannins. Antimicrobial activity of ethanolic root extract of the study plant was carried out which showed moderate sensitivity against *E.coli* but the control plant root extract was resistant to *E. coli*. GCMS result of ethanol extract of control plant had some exclusive compounds. They were phenol -2-(1-phenyl ethyl), 1,2- Benzene dicarboxylic acid, bis(2-methyl propyl)ester, hexadeconic acid methyl ester, methyl octadec – 9-enoate, stearic acid methyl ester, linear isopropyl phenol dimer, 9-ocatadienolic acid, methyl ester and diisooctyl phthalate. Untreated but the plants closer to the vicinity of the treated plants had some exclusive compounds. They were 1,3,4-oxadiazol-2-amine,5-phenyl, 1,6-dimethyl(1,2,4)triazole(3,4-c) (1,24) triazin-5(1H)-one, acetone,N2-(4-hydroxy-6-methyl pyrimidine-2-yl)hydrazine, 2-methoxyethyl semithiocarbaxide and 2H-Imidazole-2-thione,1,3-dihydr. All these compounds were absent in the treated plant root extract but it had phenol, 2-amino-4-(1H-1,2,3,4 tetrazole) 1-yl and Hydrazine -2-imidazole as an exclusive compounds. Though the peak compounds for both treated plants and the plants in the adjacent lane of treated were same but amount of 13-Heptadecyn-1-ol was 88.15% in treated

plant root extract which was never ever reported in *Abelmoschus esculentus*. Accordingly in this current research an attempt is made through bioinformatics search tools to predict the target for this ligand 13-Heptadecyn-1-ol and the target was found to be IL-4 receptor. Hence this compound may be used as an anti-inflammatory agent.

KEYWORDS: *Red algae*, *SLF*, *Epigenetics*, GCMS, 13-Heptadecyn-1-ol, IL-4 receptor.

1. INTRODUCTION

Seaweeds are one of the important marine bio-resource and their derivatives are used in agriculture as potential plant growth regulators. Seaweed contains all major and minor plant nutrients, trace elements, vitamins, auxins and other bioactive substances [Jothinayagi and C. Anbazhagan., 2009]. The growth promoting efficiency of fertilizing efficiency of extracts of several marine algae was evaluated in the cereals, pulses and vegetable crops. Seaweeds are broadly classified into three main groupsbased on their pigmentation *Phaeophyta* (brown algae), *Rhodophyta* (red algae), Chlorophyta (green algae). Brown seaweeds are the second most abundant and comprise the majority of seaweeds that reach our shores. *Sargassum*is a genus of marine macroalgae, belongs Family *Sargassaceae*, Order *Fucales*, Class of *Phaeophyceae*, Phylum *Ochrophyta*. of marine algae having biological activity of potential medicinal value. The antibacterial activities have been studied to find out the potential medicinal uses of the algae [Sathya1 et al., 2010]. Seaweeds affect the physical, chemical and biological properties of soil and enhance the moisture holding capacity which in turn influences plant growth and soil health. Brown seaweeds are rich inpolyuronides such as alginates and fucoidans. Alginates and fucoidans are hydrophilic polysaccharides with gelling and chelating properties. Salts of alginic acid combine with the metallic ions in soil to form high molecular weight complexes that absorb moisture, swell, retain moisture and improve crumb structure [**Erulan et al., 2009**]. The result is better soil aeration and capillary activity of soil pores which in turn stimulate the growth of the plant root system as well as boost soil microbial activity [**Sivasankari et al., 2006**].

The antibacterial activity of *Jania rubens*, *Corallina mediterranea* and *Pterocladia capillacea* were analyzed against human pathogenic bacteria by Sonad et l., 2015. In their study, They have studied the phytochemical constituents of seaweeds, such as alkaloids, flavonoids, steroids, terpenoids and phlobatannins. They have estimated phenols, flavonoids, tannins, pigments and mineral contents and determined the hydrogen peroxide scavenging activity, reducing power and total antioxidant activity of various extracts of selected

seaweeds. Phytochemicals were extracted from the three seaweeds using various solvents, such as methanol, ethanol, acetone and chloroform. Among the various extracts, the methanolic extract was found to have the highest reducing power and total antioxidant capacity. We evaluated the seaweeds against *Vibrio fluvialis*, and *Pterocladia capillacea* was the most effective at controlling its growth. The highest zone of inhibition was recorded in the methanol extract. The chemical constituents of the seaweeds were characterized by GC–MS, which showed that they contain organic compounds, such as 1,2-benzenedicarboxylic acid.(Sonad et al., 2015).

Epigenetic regulation can be considered as an additional layer in the genetic regulation of complex systems of the plants that is subject to environmental influence. However, unlike many other regulatory mechanisms, the epigenetic systems have the potential to store information over time—they are a molecular memory. This memory can be viewed as part of a "soft inheritance" system (Richards 2006). The "soft" descriptor refers to the potential for environmental influence and rapid introduction of heritable phenotypic effects; the "hard" inheritance of genetics, in contrast, is relatively insensitive to these external influences. Expression of new characters in the plants due to the influence of the applications of seaweed liquid fertilizers extracted from *Kappaphycus alverazii* on the study plant *Abelmoschus esculintus* indulged us to carry out this present work on the same plant using a new seaweed liquid fertilizer from *Coralline medirerrarinea*.

1. MATERIALS AND METHODS

Collection of Seaweed Material

The seaweed sample *Coralline mediterranea* was collected from Palaverkadu Lake. They were hand-picked and washed thoroughly with seawater to remove all the unwanted impurities, adhering sand particles, epiphytes etc. It is then packed in a plastic bag and transferred to the lab. In lab the collected seaweeds were again washed in fresh water to remove the surface salt and then blotted to remove excess water.

Preparation of seaweed extract

Fresh seaweeds were washed thoroughly to remove all epiphytes and sand particles with tap water and cut into pieces and placed in the blender. After that 100 mL of distilled water was added (ratio of 1:1 (w/v), the mixture then blended until smooth and filtered using filter paper. This seaweed extract was treated as 100% concentration. From the 100%seaweed extract, different concentrations (20%, 40%, 60% and 80%) of seaweed liquid fertilizer (SLF)

were prepared using distilled water. As the seaweed liquid fertilizer contained organic matter, they were stored at 4ºC. The crop plant, selected for the present study was *Ablemoschus esculentus* belonging to the family Malvaceae [**Pise and A.M Sable., 2010**].

BIOCHEMICAL ANALYSIS

The plant growth parameters such as, Total plant height, Shoot height, Root height, Total fresh vegetable weight, Shoot fresh weight, Number of vegetables in plant & Average weight/ vegetable was determined and the results were recorded. The effects of treated and control plants were compared. Analysis of Nutritive values & phytochemicals of *Abelmoschus esculentus* were done. Estimation of protein was by Lowry's method, estimation of carbohydrates was by Anthrone method, Amino acid was estimated by Ninhydrin method and Test for tannins, Test for phlobatannins, glycosides, anthraquinone, terpenes, steroids and Test for Flavanoids were also carried out by standard qualitative methods(**Parthiban et al., 2013**).

EXTRACTION AND ESTIMATION OF ASTAXANTHIN FROM SEAWEED

About 5ml of seaweed extract was mixed with hexane: acetone (3:1) solvent in a laboratory mixer, and the filtrate was filtered using whatmann filter paper and filtrate was collected in a separate conical flask, and 12 ml of petroleum ether was added and 0.73% of NaCl was added, filtrate at the top and NaCl at the bottom, then the epiphase was collected by using separating funnel. Finally washed with water by mixing equal amount of distilled water into the epiphase then the water is separated at the bottom and the above phase was collected, then the petroleum ether is evaporated by kept it in a water bath at 50°C[**Thirumaran et al., 2009**]. Lambda max was found out for the extracted Astaxanthin using UV- Visible spectrophometer by measuring the absorbance between 190nm-1000nm.[**Divya et al., 2012**].

ANTIMICROBIAL TEST

Antibacterial sensitivity assay was done by well diffusion method using Muller Hinton agar. 13g of Muller Hinton agar was mixed with 250ml of distilled water and sterilized in autoclave at 151b pressure for 15 minutes. The sterilized media were poured into petri dishes. The solidified were bored with 5 mm diameter cork beaker. The plates with wells were used for the antimicrobial studies. Ethanol extract were tested against bacterial pathogen namely *E.coli.*

Agar well diffusion method was used to detect microbial activity of root extract against above mentioned bacteria. The culture of bacteria was spread on to the agar plates using L rod. The wells were cut using gel puncture. In the wells the root extract, control and ethanol was added in different concentration ranging from 25µl, 50µl, 75µl and 100µl, After 24 hours incubation zone of inhibition was observed and noted down.

GAS CHROMATOGRAPHY–MASS SPECTROMETRY (GC–MS)

For GC-MS analysis, the samples were injected into a VF-5 ms column (30 m X 0.25 mm i.d with 0.25 µm film thickness), Agilent technologies GC-MS-QP 2010 SHIMADZU model. Following chromatographic conditions were used: Helium as carrier gas, flow rate of 1 mL/min; and the injector was operated at 240°C and column oven temperature was programmed as 70°C at a rate of 10°C/min injection mode. Following MS conditions were used: ionization voltage of EI (8-70ev); ion source temperature of 200°C; interface temperature of 240°C; mass range of 50- 600 mass units.

Identification of compounds

The database of National Institute Standard and Technology (NIST) having more than 62,000 patterns was used for the interpretation of mass spectrum of GC-MS. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library&Wiley8 [**Shahbazi et al., 2015**].

INSILICO APPROACH ON MOLECULAR DOCKING

PubChem

PubChem, is a component of the NIH's Molecular Libraries Roadmap Initiative, and is designed to provide information on biological activities of small molecules. Since the active components of most commercially available medicines are classified as small molecules (generally those with molecular weight less than 500 Daltons), these molecules are particularly important for functional studies at the molecular, cellular and in vivo levels. PubChem's integration with NCBI's Entrez search engine provides sub/ superstructure, similarity structure, bioactivity data and other searching. We have downloaded the ligand structure from pubchem database.

CHEMSKETCH

Chemsketch is a molecular modelling program used to create and modify images of chemical structures. The program offers some advanced features that allow the molecules rotate and apply colour to improve visualization.

OPEN BABEL

Open Babel is a chemical toolbox designed to speak the many languages of chemical data. It's an open, collaborative project allowing anyone to search, convert, analyze, or store data from molecular modeling, chemistry, solid-state materials, biochemistry, or related areas. As the structure of ligand is not in PDB format we use open babel to convert it into PDB.

PDB (PROTEIN DATABANK)

Protein data bank is repository of protein molecule along with their crystallographic structure with various information regarding structural functions, family domains etc. We retrieved our receptor structure from here.

SWISS PDB VIEWER

Swiss pdb viewer is an application that provides a user friendly interface allowing analyzing several proteins at the same time. The proteins can be superimposed in order to deduce structural alignments and compare their active sites or any other relevant parts. Amino acid mutations, H-bond angles and distance between atoms are easy to obtain intuitive graphic and menu interface.

PATCHDOCK

Patch dock performs structure prediction of protein-protein and protein-small molecule complexes. The input is two molecules of any type: proteins, DNA, peptides, drugs. The output is a list of potential complexes sorted by shape complementarity criteria. Molecular docking was done using the patch dock software. It is done to predict the binding of the receptor and the ligand. Target chosen was IL-4 receptor and the ligand was 13-heptadecyn-1-ol.

RESULTS AND DISCUSSION

Influence of seaweed liquid fertilizer extracted from *Coralline mediterraneae* on the study plant *Abelmoschus esculintus* was examined by using various parameters including

nutritive values, phytochemicals and therapeutic compounds present by comparing with an untreated plants. All the parameters studied have shown positive impact on the treated plants.

ESTIMATION OF PROTEIN

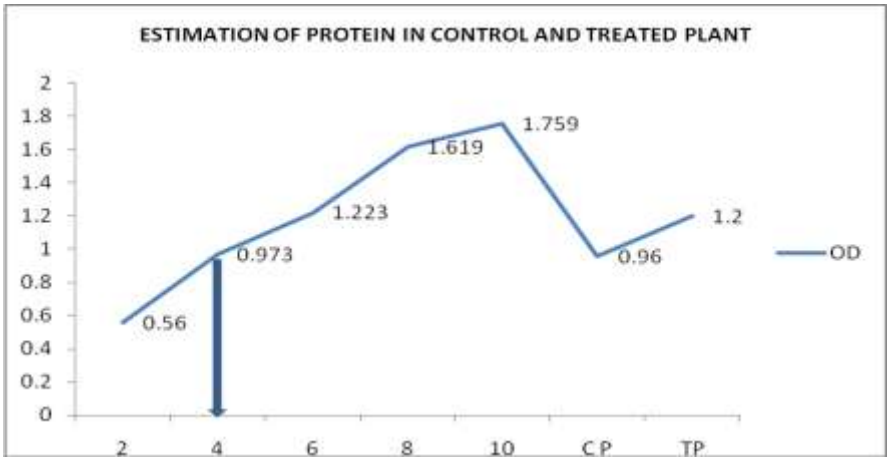


FIG: 1

The concentration of the proteins present in the control plant and the treated plants were calculated using the standard graph and found to be 4mg/ml and 5.3mg/ml respectively. There was 33% increase in the treated plants [**Subash et al 2014**].

EXTRACTION AND ESTIMATION OF ASTAXANTHIN FROM SEAWEED EXTRACT

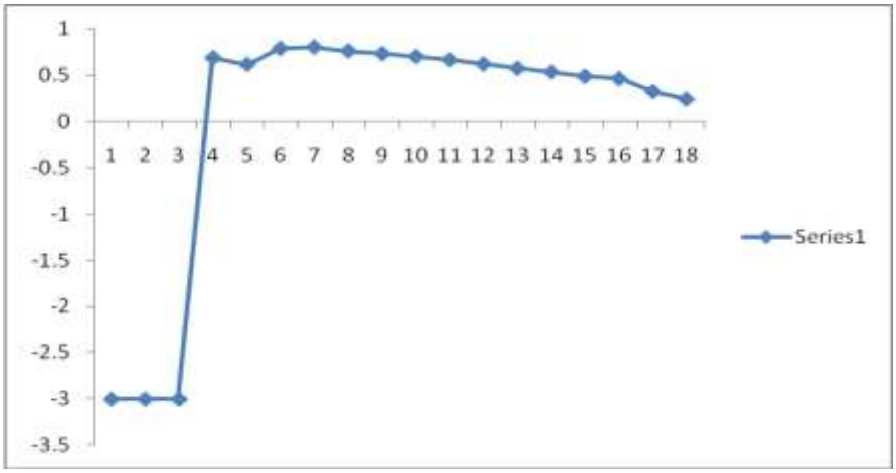


FIG: 2 LAMBDA MAX FOR THE ASTAXANTHIN USING UV – VIS SPECTROPHOTOMETER

As per the report of L.Senthamil& R. Kumeresan, the absorbance maxima for astaxanthin will be at 466nm. In our study, we have found out that the absorbance maxima for the extracts taken from the seaweeds were 450nm, which is almost closer to the previous study.

A) TANNIN

TEST **CONTROL**


B) GLYCOSIDES

TEST **CONTROL**


C) FLAVONOIDS

TEST **CONTROL**


D) ANTHRAQUINONE

TEST **CONTROL**


E) TERPENES

TEST **CONTROL**


G) RESIN

TEST **CONTROL**


G) STEROIDS

TEST **CONTROL**

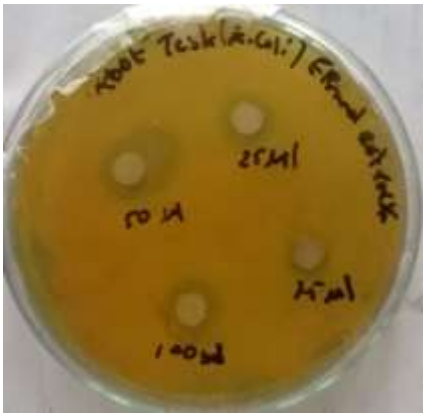
FIG: 3 RESULTS OF PHYTOCHEMICAL ANALYSIS FOR ROOT EXTRACT

TABLE NUMBER: 1 PHYTOCHEMICAL ANALYSIS OF TREATED AND UNTREATED

S.NO	ORGANIC COMPOUNDS	ROOT TEST	ROOT CONTROL	RESULTS
1	Tannin	+	-	Formation of yellow precipitate
2	Glycosides	+	-	Formation of brown precipitate
3	Flavonoids	+	+	Red color formation
4	Anthraquinone	+	+	Red precipitate upper surface was formed
5	Terpenes	-	-	No green color
6	Resin	+	+	Green precipitate upper surface was formed
7	Steroids	-	-	No violet to blue color

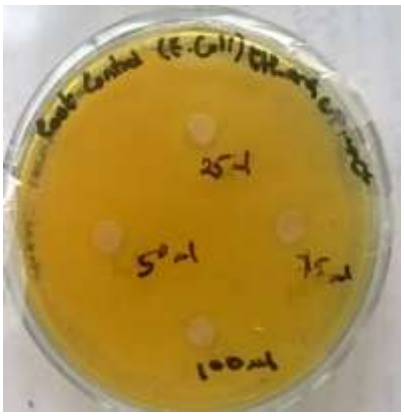
Phytochemical analysis of control and treated plants showed that there were 71% similarity but only two characters such as tannins and glycosides were absent in the control plant root[**Elouaer et al., 2015**].

ANTIBIOTIC SENSITIVITY STUDY OF THE PLANT EXTRACT AGAINST E.COLI



A) ROOT TEST I

B) ROOT TEST II



C) ROOT CONTROL I

D) ROOT CONTROL II

C) FIG NO: 4 ANTIMICROBIAL ACTIVITY

Solvent extraction procedure was carried out and root extracts of *Abelmoschus esculentus* was collected and found the extracts were more soluble in ethanol. The antibacterial effect of the extract on E.coli was tested. The zone of inhibition for the extracts collected from root testfor25µl, 50µl, 75µl and 100µl were 15 mm, 16 mm, 18 mm& 20 mm respectively. Whereas root control and ethanol control was showed no zone of inhibition (Figure No: 4A, B, C & D) [**Sridhar1 and R. Rengasamy**, 2010].

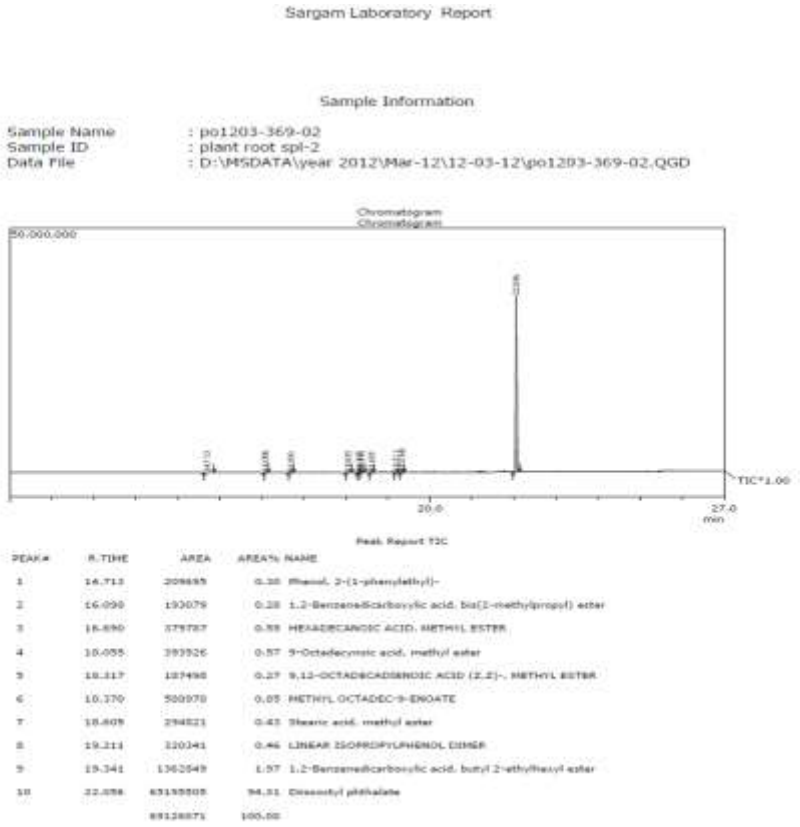


FIGURE NUMBER: 5 *Abelmoschus esculentus* root extract - Untreated

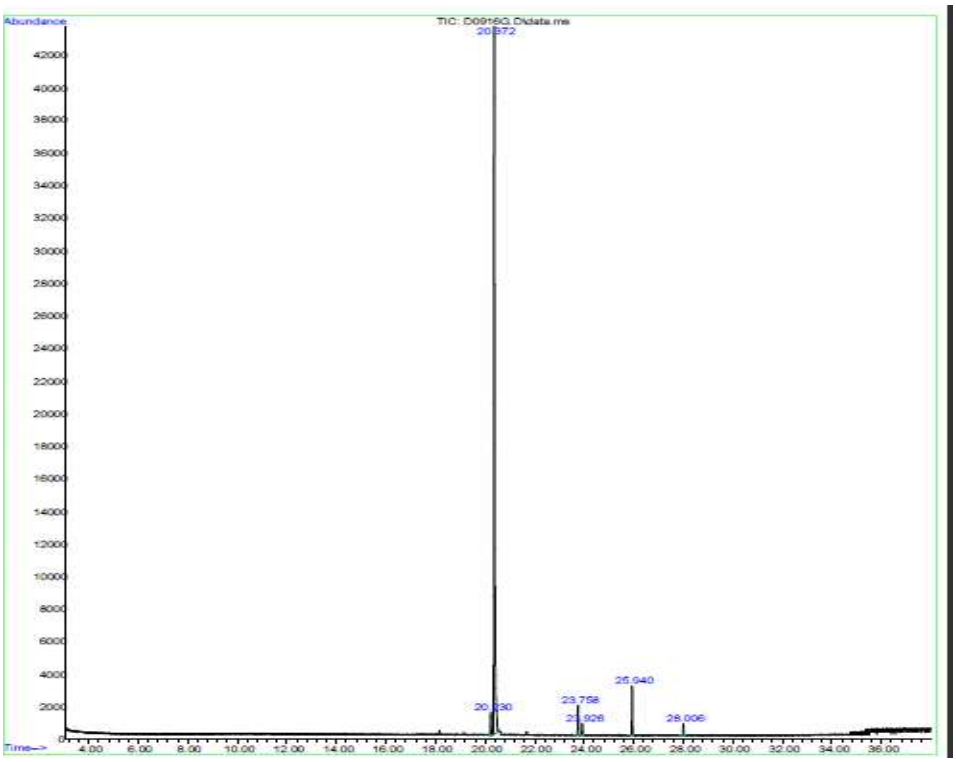
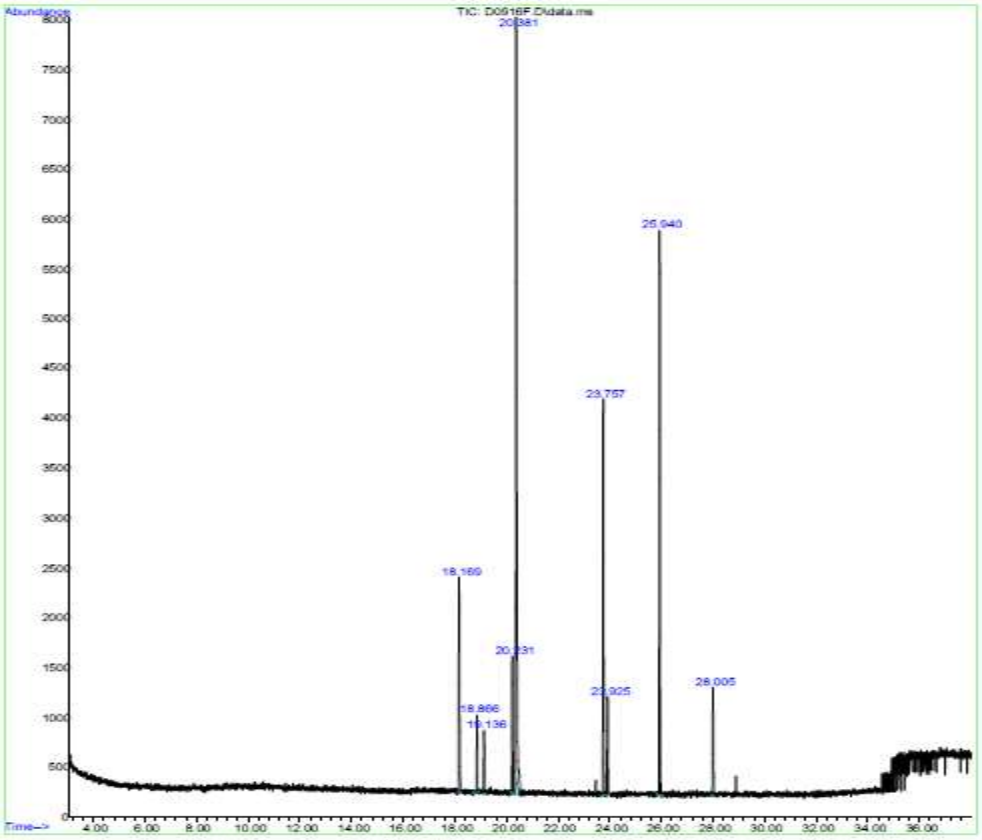


FIG NO: 6 GC-MS RESULTS FOR ROOT TEST I

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
1	20.228	1.96	C:\Database\NIST11.L			
			Phenol, 2-amino-4-(1H-1,2,3,4-tetr	43445	1000362-63-1	5
			azol-1-yl)-			
			2-Methoxyethylsemithiocarbazide	23413	006926-54-1	4
			7-Methylthieno[3,2-b]pyridine	23568	013362-83-9	2
2	20.375	88.15	C:\Database\NIST11.L			
			13-Heptadecyn-1-ol	104159	056554-77-9	50
			Cyclopentylcyclohexane	25423	001606-08-2	40
			Tropinone	17839	000532-24-1	35
3	23.757	3.09	C:\Database\NIST11.L			
			4-Amino-4,5(1H)-dihydro-1,2,4-tria	3577	001003-23-2	4
			zole-5-one			
			3(2H)-Furanone, dihydro-5-methyl-	3733	034003-72-0	4
			4H-Pyran-4-one, tetrahydro-	3708	029943-42-8	3
4	23.925	1.09	C:\Database\NIST11.L			
			Butane	233	000106-97-8	3
			Butane	232	000106-97-8	3
			Butane	234	000106-97-8	3
5	25.941	4.46	C:\Database\NIST11.L			
			2-Hydrazino-2-imidazoline	3592	1000239-54-7	7
			N,N'-Trimethyleneurea	3612	001852-17-1	5
			3(2H)-Furanone, dihydro-5-methyl-	3733	034003-72-0	5
6	28.007	1.25	C:\Database\NIST11.L			
			Pyrrolidine, 1-nitroso-	3617	000930-55-2	4
			p-Dioxane, methylene-	3683	003984-19-8	4

FIG NO: 7 GC-MS RESULTS FOR ROOT OF PLANTS ADJACENT TO TEST LANE



Pk#	RT	Area%	Library/ID	Ref#	CAS#	Qual
1	18.169	10.40	C:\Database\NIST11.L			
			1,3,4-Oxadiazol-2-amine, 5-phenyl-	31817	001612-76-6	9
			Homophthalimide	31847	004456-77-3	9
			1H-Indole-2,3-dione, 1-methyl-	31884	002058-74-4	9
2	18.869	2.28	C:\Database\NIST11.L			
			1,6-Dimethyl[1,2,4]triazolo[3,4-c][1,2,4]triazin-5(1H)-one	34471	1000146-89-4	5
			Quinoline, 2,3,4,4a,5,6-hexahydro-7-methoxy-	34372	019500-64-2	5
			Acetone, N2-(4-hydroxy-6-methylpyrimidin-2-yl)hydrazone	46087	066680-04-4	5
3	19.135	2.26	C:\Database\NIST11.L			
			Acetone, N2-(4-hydroxy-6-methylpyrimidin-2-yl)hydrazone	46087	066680-04-4	5
			Benzenamine, N-ethyl-N-methyl-4-nitro-	46181	056269-48-8	5
			Silane, trimethyl(3-methylphenoxy)	45376	017902-31-7	5
4	20.228	4.77	C:\Database\NIST11.L			
			2-Methoxyethylsemithiocarbazide	23413	006926-54-1	4
			Pyridine, pentamethyl-	23354	003748-83-2	2
			m-Tolyl isothiocyanate	23555	000621-30-7	2
5	20.382	36.27	C:\Database\NIST11.L			
			13-Heptadecyn-1-ol	104159	056554-77-9	53
			Cyclopentylcyclohexane	25423	001606-08-2	38
			3,10-Dioxatricyclo[4.3.1.0(2,4)]dec-7-ene, [1.alpha.,2.alpha.,4.alpha.,6.alpha.]-	17413	050267-08-8	37
6	23.757	14.70	C:\Database\NIST11.L			
			2H-Imidazole-2-thione, 1,3-dihydro-	3591	000872-35-5	5
			N,N'-Trimethyleneurea	3612	001852-17-1	5
			Aminothiazole	3586	000096-50-4	4
7	23.925	3.86	C:\Database\NIST11.L			
			Butane	233	000106-97-8	3
			Butane	232	000106-97-8	3
			Butane	234	000106-97-8	3
8	25.941	20.41	C:\Database\NIST11.L			
			Pyrrolidine, 1-nitroso-	3613	000930-55-2	5
			5-Methoxy-[1,2,3]oxadiazole	3584	1000322-54-7	5
			Hydantoin	3579	000461-72-3	5
9	28.007	5.05	C:\Database\NIST11.L			
			4-Amino-4,5(1H)-dihydro-1,2,4-triazole-5-one	3577	001003-23-2	4
			2H-Pyran-3(4H)-one, dihydro-	3710	023462-75-1	3
			2H-Pyran-2-one, tetrahydro-	3705	000542-28-9	3

GC-MS ANALYSIS for ethanol extract of root test and control showed different types of compounds that have been present in the extract. A peak level indicates the amount of the compound present in the extract. The high peak compound found in treated as well as control was 13-Heptadecyn-1-ol. However the percentage of the compound present in treated was 88.15% whereas it was 36.26% for control plants. Different compounds present in treated plant root extracts were phenol,2-amino-4(1H-1,2,3,4- tetrazole-1-yl and 2-Hydrazine – 2-imidazole. The peak compound was selected for the molecular docking technique. The GC–MS analysis of crude extracts of *J. rubens*, *C. mediterranea* and *P. capillacea* revealed many components, with the main chemical constituents observed in high percentages being 1-(+)-ascorbic acid 2,6-dihexadecanoate, icosapent, trans-13-octadecenoic acid, 3,7,11,15-tetramethyl-2-hexadecen-1-ol heptadecane and 1,2-benzenedicarboxylic acid in *J. rubens;* cholesterol, n-hexadecanoic acid, icosapent, oleic acid, heptadecane and 1,2-benzenedicarboxylic acid in *C. mediterranea*; and n-hexadecanoic acid, cholesterol, heneicosane, tetradecanoic acid, cis-5,8,11,14,17-eicosapentaenoic acid methyl ester, trans-13-octadecenoic acid and 1,2-benzenedicarboxylic acid in *P. capillacea*. 1,2-Benzenedicarboxylic acid may be involved in antagonism against *Vibrio fluvialis*. Antibacterial activities of the algal extracts were reportedly due to the presence of lauric,

palmitic (hexadecanoic acid), linolenic, linoleic, oleic, stearic (octadecanoic acid) and myristic acids (tetradecanoic acid) [Agoramoorthy et al., 2010]. Octadecanoic acid from neem extract was tested on three bacterial strains (*S. aureus*, *E. coli* and *Salmonella* sp.) and showed better inhibition activity against *S. aureus* than *E. coli* and *Salmonella* sp. [Zhong et al., 2010]. The present results were also in agreement with those in other previous reports [Zhou et al., 2010] ; [Sivakumar et al., 2014]. Marine algae are an impending source of an extensive range of polyunsaturated fatty acids, carotenoids, phycobiliproteins, polysaccharides and phycotoxins [Chu., 2012]. It was reported that lipids obstruct microbes by distracting the cellular membrane [Bergasson et l., 2011] of bacteria, fungi and yeasts. These fatty acids may further distress the expression of bacterial virulence, which is significant for establishing infection.

Sherif., et l., 2013 reported that GC/ MS analysis of ethanol extract of *Ziziphus jujuba* seed revealed the existence of 20component, main components were 13-Heptadecyn-1-ol (12.95%), 7-Ethyl-4-decen-6-one (9.73%), Lineoleoyl chloride (8.54%), Linoleic acid (6.37%), 2,5-Octadecadiynoic acid, methyl ester (5.57%) and Palatinol A (4.81%). The results indicated that the ethanolic extract of *Ziziphus jujuba* seed contains a many bioactive components that could have advantage offer a platform of using *Ziziphus jujuba* seed as herbal alternative for the current synthetic antimicrobial agents. There is no literature evidence states the presence of 13-Heptadecyn-1-ol in *Abelmoschus esculentus* has the ability to produce this compound. Hence the presence of this peak compound in *Abelmoschus esculentus* could be certainly due to epigenetic up regulations due to seaweed *Coralline mediterrania* only.

MOLECULAR DOCKING

In order to confirm the existing scenario of the mode of action of 13-Heptadecyn-1-ol, we have performed docking study. Three dimensional coordinates of 4I77 Receptor was retrieved from the RCSB protein databank. Active site of the protein molecule was analyzed and residues were identified. The ligands compounds are retrieved from pubchem database 13-Heptadecyn-1-ol and converted into pdb format by using Openbabel software.

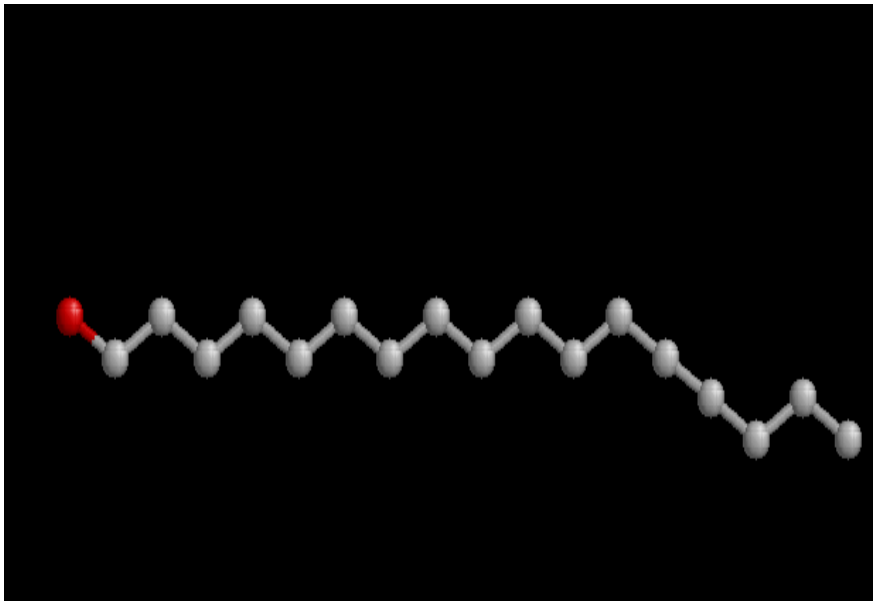


FIG: 6 STRUCTURE OF LIGAND 13-HEPTADECYN-1-OL

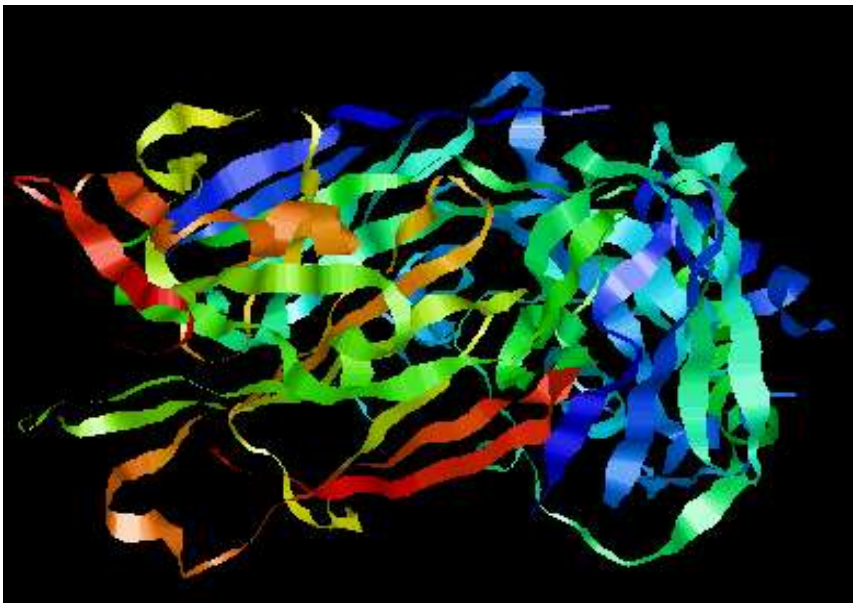
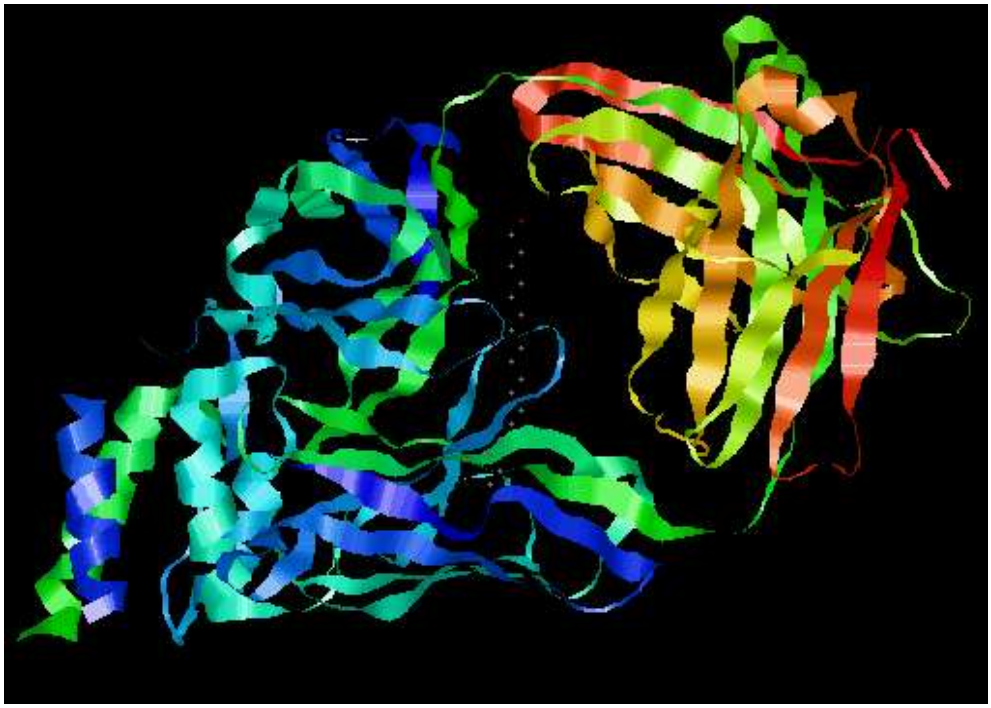


FIG: 7 STRUCTURE OF IL-4 RECEPTOR

TABLE NUMBER: 2 RESULT-BINDING SCORE TABLE FOR PATCH DOCK

Solution No.	Score	Area	ACE	Transformation	PDB file of the complex
1	4890	537.40	-126.46	0.28 0.36 -2.1320.77 26.30 -35.81	result .1.pdb



DOCKING OF LIGAND 13-HEPTADECYN-1-OL WITH IL-4 RECEPTOR

In assessment using Patchdock, the ligand molecule 13-heptadecyn1-ol was successfully bound with the target molecule IL-4 receptor. Their function has potential medication for asthma.[28]

CONCLUSION

Based on our results and observation, we conclude that sargassum has some effects on the seaweed liquid fertilizer on the growth and biochemical composition of *Abelmoschus esculentus.* Seaweed fertilizer is a natural bioactive material water-soluble derived from marine macro algae. Seaweed fertilizer could be absorbed by plant within several hours after application and safe to humans, animals and the environment. Seaweed liquid fertilizers will be useful for achieving higher agricultural production, because the extract contains growth promoting hormones. The seaweed extract prepared from *Sargasssum* was found to be promising in possessing fertilizer activity. Hence, this simple practice of application of eco-friendly seaweed liquid fertilizers to vegetables is recommended to the farmers for attaining better growth and yield over chemical fertilizers. Furthermore, these bioactive compounds and various extracts showed significant therapeutic potential and could be introduced for the preparation of novel functional ingredients in pharmaceuticals for the treatment and or prevention of several disorders. Therefore, further research studies are needed to exploit its

maximum therapeutic potential in the field of medicinal and pharmaceutical sciences for novel and fruitful application.

REFERENCES

1. Agoramoorthy. G, M. Chandrasekaran, Venkatesalu, M.J. Hsu, Antibacterial and antifungal activities of fatty acid methyl esters of the blind your eye mangrove from India, Braz. J. Microbiol., 2007; 38: 739–742.
2. Albertus J. Smit, Medicinal and pharmaceutical uses of seaweed natural products Journal *of Applied Phycology*, 2004; 16: 245–262.
3. Ashtalakshmi G and P. Prabakaran, Molecular docking studies of natural Antimicrobial compound from sargassumwightii against selected targets of pathogens. European journal of pharmaceutical and Medical research 2016; 3(3): 458-462.
4. Arun D., Gayathri P. K A, Review on Seaweeds Phytochemical Analysis and Utilisation of Seaweeds as Bio fertilizer. *Research J. Engineering and Tech. 4(4): 2013.*
5. Bergasson.G, H. Hilmarsson, H. Thormar, H. Thormar (Ed.), Antibacterial, Antiviral and Antifungal Activities of Lipids, John Wiley and Sons Limited, Chichester, United Kingdom, 2011; 47–80.
6. Chu. W.L, Biotechnological applications of microalgae, IeJSME, 2012; 6: 24–37.
7. Divya. K, N. Mary Roja and S.B.padal, Effect of Seaweed Liquid Fertilizer of *Sargassumwightii* on germination, growth and productivity of brinjal. International Journal of advanced research 2012; 2.
8. Elouaer Mohamed Aymen, Latique Salmab, Chernane Halimab, Hanna chi Cherifa and Elkaoua Mimounb, Effect of seaweed extract of *Sargassum vulgare*on germination behaviour of two tomatoes cultivars under salt stress 2015; 2(3): 203-210.
9. El-Sheekh MM, Ismail MM and Hamouda MM Influence of Some Brown Seaweed Extracts on Germination and Cytological Responses of Trigonellafoenum-graecum L. Biotechnol Ind J. 2016; 12(6): 104.
10. Erulan. V, P. Soundarapandian, G. Thirumaran and G. Ananthan Studies on the Effect of Sargassumpolycystum (C.Agardh, 1824) Extract on the Growth and Biochemical Composition of Cajanuscajan (L.) Mill sp. American-Eurasian J. Agric. & Environ. Sci., 2009; 6(4): 392-399.
11. Jothinayagi. N and C. Anbazhagan Effect of seaweed liquid biofertilizer of *Sargassumwightii* on the growth and biochemical characteristics of *Abelmoschus*

esculentus (L.) medikus. *Recent Research in Science and Technology 2009; 1(4): 155–158.*

12. Johnsi Christobel. G, Effect of seaweed extracts (*Sargassumwightii* L.) on the germination and growth of green gram (*Phaseolusaureus* L.)," *Journal of Basic and Applied Biology*, 2008; 2: 105-108.
13. Jothinayagi. N and C. Anbazhagan Effect of seaweed liquid biofertilizer of *Sargassumwightii* on the growth and biochemical characteristics of *Abelmoschus esculentus* (L.) medikus. *Recent Research in Science and Technology 2009; 1(4): 155–158.*
14. Latique S, Chernane H and Mansori M, Seaweed liquid fertilizer effect on physiological and biochemical parameters of bean plant (Phaesolus vulgaris variety Paulista) under hydroponic system. Europ Sci J. 2013; 9(30): 174-91.
15. Parthiban.C, Saranya.C, Hemalatha. A., Kavith.B, and Anantharaman, Effect of Seaweed Liquid Fertilizer of *Spatoglossum Asperpum* on Growth and Pigment content of *vignaradiata* . *International Journal of Recent Scientific Research, 2013; 4(9): 1418- 1421.*
16. Pise N.M and A.M Sable, Effect of seaweed concentrates on the growth and biochemical constituents of Trigonella Foenum-Graecum, L. *Journal of Phytology, 2010; 2(4): 50–56.*
17. Ramapriyadharsini Raman, Sujitha Parthiban, Karthikeyan, Meenakshi Sundaram, Antimicrobial and Anti-inflammatory studies on Sargassum wightii extracts. International Journal of Pharmacy and Pharmaceutical Sciences.
18. Richards *EJ. 2006. Revisiting soft inheritance. Nat Rev Genet 7: 395–402.*
19. Sathya1. B, H. Indu, R. Seenivasan and S. Geetha influence of seaweed liquid biofertilizeron the growth and biochemical composition of legume crop *Cajanuscajan* (L.) Mill sp. *Journal of Phytology, 2010; 2(5): 50–63.*
20. Salma Latique, Mohamed Aymen Elouaer, Halima Chernane, and Mimoun Elkaoua Effect of Seaweed Liquid Extract of Sargassumvulgare on Growth of Durum Wheat Seedlings (*Triticum durum* L) under salt stress.
21. Sivasankari. S, V.Venkatesalu, M.Anatharaj and M.Chandrasekar, Effect of seaweed extracts on the growth and biochemical constituents of vignasinensis 2006; 97: 14.
22. Shahbazi. F, M. Seyyednejad, A. Salimi and A. Gilani, Effect Of Seaweed Extracts On The Growth And Biochemical Constituents Of Wheat. International Journal of Agriculture and Crop Sciences 2015.

23. Subash R. Yende, Uday N. Harle and Bhupal B. Chaugule, Therapeutic potential and health benefits of *Sargassum* species. 2014; 8(15): 1–7.
24. Sridhar. S and R. Rengasamy Studies on the Effect of Seaweed Liquid Fertilizer on the Flowering Plant *Tageteserecta* in Field Trial *advances in bioresearch, 2010; 1[2]: 29 – 3.*
25. Sunarpi, Ahmadjurpi, Rina, Effect of seaweed extracts on growth and yield of rice plants, 2010; 2(2): 73-77.
26. Sutharsan.S, S. Nishanthi and S. Srikrishnah, Effects of Foliar Application of Seaweed (*Sargassumcrassifolium*) Liquid Extract on the Performance of *Lycopersicones culentum* Mill. American-Eurasian J. Agric. & Environ. Sci., 2014; 14(12): 1386-1396.
27. Soad M. Mohy El-Din, Utilization of seaweed extracts as biofertilizers to stimulate the growth of wheat seedlings. Egypt. J. Exp. Biol. (Bot.), 2015; 11(1): 31 – 39.
28. Sivakumar.S.K, D. Masilamani, K.P. Prasanna, Evaluation of marine macro alga, *Ulva fasciata* against bio-luminescent causing *Vibrio harveyi* during *Penaeus monodon* larviculture, Afr. J. Microbiol. Res., 2014; 8: 123–132.
29. Thirumaran. G, M. Arumugam, R. Arumugam and P. Anantharaman, Effect of Seaweed Liquid Fertilizer on Growth and Pigment Concentration of *Abelmoschus esculentus* (l) medikus. American-Eurasian Journal of Agronomy, 2009; 2(2): 57-66.
30. Vigna radiate (L.) Kumar NA, Vanlalzarzova B, Sridhar, Effect of liquid seaweed fertilizer of Sargassumwightiigrev. On the growth and R. wilczek). Recent ResSci Technol. 2012; 4: 40-5.
31. Vijayanand. N, S. Sivasangari Ramya, S. Rathinavel Potential of liquid extracts of Sargassum wightii on growth, biochemical and yield parameters of cluster bean plant. Asian Pacific Journal of Reproduction, 2014; 3(2): 150-155.
32. Zodape. S.T, V J Kawarkhe, J S Patolia and A D Warade, Effect of liquid seaweed fertilizer on yield and quality of okra (*Abelmoschus esculentus* L.) Journal of scientific and industrial research, 2008; 67: 1115-1157.
33. Zhong.P.U, Z. Yu-qun, Y. Zhong-qiong, X. Jiao, J. Ren-yong, Antibacterial activity of 9-octadecanoic acid, hexadecanoic acid–tetrahydrofuran-3,4-diyl ester from Neem oil, Agric. Sci. China, 2010; 9: 1236–1240.
34. Zhou. J, W. Fang, X. Yang, S. Zhou, L. Hu, X. Qi, L. Xie, A non-luminescent and highly virulent *V. harveryi* strain is associated with “bacterial white tail disease” of *Litopenaeus vannamei shrimp,* PLOS ONE, 2012; 2: 29961.