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Fourier Transform Infrared (Ft-Ir) Spectroscopic Analysis of *Spirulina Fusiformis*

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Abstract
Spirulina have been recorded in the region of FT-IR spectra in 3428-3320 cm^{-1} to 620-490 cm^{-1} in the different frequency ranges. In the present study, observation of the total protein, lipid, glycogen and amino acid content was identifying of the *Spirulina*. The different frequency ranges and their different functional groups are analyzed during the study period. *Spirulina* having essential vitamins like Vitamin A (in the form of β -carotene), Vitamin B_{12}. It is also a very rare source of GLA (Gamma Linolenic Acid) an essential fatty acid. Moreover *Spirulina* is a good source of phytochemical. *Spirulina* has potential benefits in the areas of immunomodulation, anti-cancer activity, anti-microbial activity, biochemical, antioxidant and anti-inflammatory protection, cardiovascular health, cellular protection, detoxification from toxicants and drugs probiotic effects.

Keywords: FT-IR, *Spirulina*, GLA, protein, lipid and amino acid.

1. Introduction
The use of IR spectroscopy for the analysis of biological samples was first suggested on 1940s the technique was being successfully explored for the study of biological materials and infect. IR spectroscopy has become an accepted tool for the characterization of biomolecules (Margarita, 2000) [1]. The revival of IR-spectroscopy as a means for characterizing microbial samples were initiated after the development of modern interferometric IR spectroscopy, the availability of low-cost minicomputers and powerful new algorithms for multivariate statistical analysis and pattern recognition methodologies. FT-IR spectroscopy has been shown to be a powerful technique for the study of biological macromolecules and of complex biological systems such as tissues and cells. (Jackson, 1996) [2].
Fourier Transform Infrared (FT-IR) spectrometer is a routine analytical technique
(Maquelin, 2002) [3]. The spectrometers are sophisticated and which use a blackbody radiator as an infrared (IR) photon source, infrared studies are multidisciplinary but more and more attention is paid to biological as well as biochemical investigation. The primary reason is that many common bimolecular, such as nucleic acids, proteins, lipids and carbohydrates have characterized and a known vibrational fingerprints, which has led to several important and extensive investigations of biological samples were analyzed by IR spectroscopy. The field of chemical diversity has become fashionable in drug discovery research on which the development of high-throughput screening and combinatorial chemistry. A major step in the lead generation phase is the ability to quantify the chemical similarity between compounds (Curk, 1994) [4]. Based on the review of the literature there is no study recorded in the *Spirulina*. Hence, an attempt has been made to investigate the phytochemical constituents' of *Spirulina* by FTIR methods.

2. Materials and Methods
2.1. Collection and preparation of *Spirulina*
The dried *Spirulina* was collected from antennae biotec lab commercial form, kadachanendal in Madurai. The *Spirulina* was kept carefully.

Taxonomy

Empire	:	Prokaryota
Kingdom	:	Bacteria
Subkingdom	:	Negibacteria

Phylum	:	Cyanobacteria
Class	:	Cyanophyceae
Subclass	:	Synechococcophycideae
Order	:	Pseudanabaenales
Family	:	Pseudanabaenaceae
Subfamily	:	Spirulinoideae
Genus	:	*Spirulina*
Species	:	*fusiformis*

2.2. FT-IR analysis

The FT-IR studies have been followed by the method described by (Jagmohan, 2005) [5]. The lyophilized resin or powered samples were mixed with dry potassium bromide pellet (KBr) and subjected to a pressure of about $5x10^6$ Pa in an evacuated die to produce a clear transparent disc of diameter 13 mm and thickness 1mm. IR spectra region 4000-400 cm^{-1} were recorded at room temperature on a perkin-Elmer fourier transform spectrometer equipped an air cooled DTGs (deuterated triglycine sulfate) detector. For each spectrum, 100 scans were CO- added at a spectral resolution of 4cm^{-1}. The frequencies for all sharp bands were accurate to 0.01 cm^{-1}

Table 1: FTIR Analysis of *Spirulina fusiformis*

S. No		Frequency ranges(cm^{-1})	Functional Groups
1	3304.49	3500–3200 (s,b)	O–H stretching vibration presence of alcohols, phenols
2	2959.25	3000–2850 (m)	C–H stretching vibration presence of alkenes
3	2926.51	3300–2500 (m)	O–H stretching vibration presence of carboxylic acids
4	2152.15	2260–2100 (w)	–C(triple bond)C– stretching vibration presence of alkynes
5	1655.61	1680–1640 (m)	–C=C– stretching vibration presence of alkenes
6	1544.05	1550–1475 (s)	N–O asymmetric stretching vibration presence of nitro compounds
7	1452.85	1470–1450 (m)	C–H bend stretching vibration presence of alkenes
8	1401.61	1500–1400 (m)	C–C stretching vibration presence of aromatics
9	1384.92	1400–1290 (m)	N–O stretching vibration presence of nitro compounds
10	1241.18	1320–1000 (s)	C–O stretching vibration presence of alcohols, carboxylic acids, esters, ethers
11	1150.05	1300–1150 (m)	C–H wag (–CH2X) stretching vibration presence of alkyl halides
12	1078.83	1250–1020 (m)	C–N s stretching vibration presence of aliphatic amines
13	1039.45	1250–1020 (m)	C–N stretch stretching vibration presence of aliphatic amines
14	873.11	910–665 (s, b)	N–H wag stretching vibration presence of primary, secondary amines
15	699.51	700–610 (b, s)	–C(triple bond)C–H: C–H bend stretching vibration presence of alkynes
16	578.26	690–515 (m)	C–Br stretching vibration presence of alkyl halides

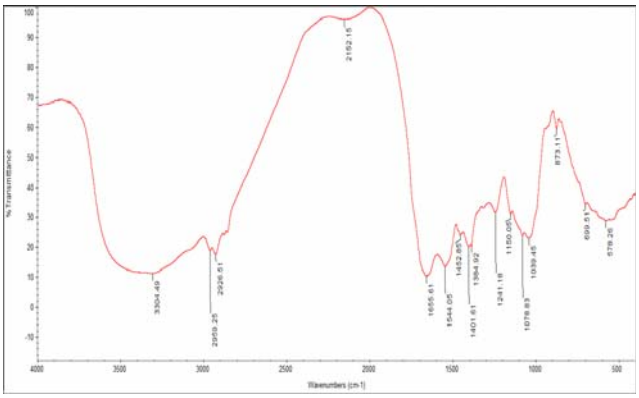

Fig 1: FTIR Analysis of *Spirulina fusiformis*

3. Results

The FT-IR analyze of freshwater algae spiraling powder, represent the following functional groups in which the frequency ranges 3500-3200 cm, 3000–2850 cm, 3300–2500 cm, 2260–2100 cm, 1680–1640 cm, 1550–1475 cm, 1470–1450 cm, 1500–1400 cm, 1400–1290 cm, 1320–1000 cm, 1300–1150 cm, 1250–1020 cm, 910–665 cm, 700–610 cm, and 690–51cm. The functional groups responsible for improving the health and biochemical compounds in *Spirulina fusiformis* were confirmed by FTIR spectra of *Spirulina* species shown (Table 1 & Fig 1).

4. Discussion

FT-IR technique was used for evaluation the type of organic and inorganic complexes in plants. The analyze were carried out on drying and low aching temperature material of different parts of plants. The FT-IR analyzes of *Spirulina* represent the following functional groups. The infra-red spectrum shows a frequency ranges from 3500–3200 (s,b) cm^{-1} representing the O-H stretching vibration, presence of alcohols, phenols. The frequency ranges from, 3000–2850 cm^{-1} peaks are representing in the C-H stretching vibration presence of alkenes. The frequency ranges from 3300–2500 cm^{-1} peak are representing aliphatic O-H stretching vibration presence of carboxylic acids. The frequency ranges from 2260–2100 cm^{-1} peak are representing –C (triple bond) C– stretching vibration (ester alkynes). The following peaks 1680–1640 cm^{-1} are present in the –C=C– stretching vibration present in the alkenes. The frequency ranges from 1550–1475 cm^{-1} peak are present in the N–O asymmetric stretching vibration present in the nitro compounds. The particular frequency ranges from 1320–1000 cm^{-1} C-O stretching, O-H bending vibration presence of alcohols, carboxylic acids, esters, ethers. The following frequency ranges from 1300–1150 cm^{-1}, presence of C–H wag (–CH2X) stretching presence of alkyl halides, the peak range 1250–1020 cm^{-1} present in C–N stretching, presence of aliphatic amines, the peak value representing 910–665 cm^{-1} present in N–H symmetric stretching vibration primary, secondary amines. The frequency ranges from 700-610 cm^{-1} peaks are representing the –C(triple bond)C–H: C–H bend stretching vibration of alkynes components. (Doshi, 2007) [6]. The frequency ranges from 690–515 cm^{-1}peaks are representing in C–Br stretching vibration presence of alkyl halides compounds. The FT-IR analyzed of *Spirulina* having high quantity of proteins, (Dillon, 1995 and Richmond, 1984) [7, 8]. vitamins, phycocyanin and antioxidants substances. The *Spirulina* acting as protective role of atrazine toxicity and gradually recovered in treated fish at the time of supplementation period Based on the systematically analysis of *Spirulina* contains in protein, lipid, carbohydrate, aliphatic

(C-H), Carbonyl (esters and acid), Carbonyl Beta-Unsaturated Ketone amide (C=N), ester, symmetric C-H stretching vibration, halogen compounds (C-Cl) and Iodo compound (C-I). So, the FT-IR spectrum shows more characteristic features. These are phytochemicals may responsible for the medicinal property of the micro algae *Spirulina* further toxicological study.

5. References

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