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FTIR Spectroscopy- a novel approach for identification of bioactive compounds in *Momordica charantia* L.

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A B S T R A C T

Momordica charantia L. is commonly called as bittermelon or balsam pear which is known for its medicinal properties. The plant is a monoecious, tendril bearing vine with yellow flowers. It is widely cultivated in India, China and other places of the world. All parts of the plant are useful for various purposes. Fruit contains phytoconstituents for the treatment of diseases. Various phytochemicals present in fruit extract exhibit antioxidant, anti-diabetic, anti-inflammatory properties. Bittergourd extract contains sterols, terpenoids, saponins, cardiac glycosides, amino acids, etc. which are responsible for its therapeutic applications.

Introduction

Bittermelon is cultivated round the globe especially in India, China and Southeast Asia (Behera *et al.*, 2008). Tendril bearing monoecious plant belongs to the family, Cucurbitaceae. Fruits are bitter in taste with serrated leaf margins. Flowers are yellow in colour whereas, fruits are of different sizes and different colours. Fruits, leaves, roots, and vines are used for the treatment of tooth aches, furuncle and diarrhoea. Fruit juice is helpful in reducing joint pains, jaundice, liver diseases and chronic fevers. Oil extracted from ripened fruits in combination with honey is useful for treating ulcers (Gurdal and Kultur, 2013). Leaves and vines are useful as flavoring agents. Decoctions are widely used for the control of womb diseases, malaria, high blood pressure, dysentery and is also having the antihelminthic properties (Polito *et al.*, 2016). Seeds contain 35 to 40% oil with the predominance of monounsaturated fatty acids (3.33%), saturated fatty acids (36.71%) and polyunsaturated fatty acids (59.96%) (Saeed *et al.*, 2018). Primary metabolites include sugars, chlorophyll and proteins whereas, secondary metabolites like saponins, alkaloids, terpenoids, etc. are responsible for nutraceutical properties (Daniel *et al.*, 2014).

Keseru *et al*., 2016 reported the presence of C-C stretching band at 1548 cm^{-1} and 1324 cm-1, C-O stretching band at 1240 cm-1. The strong peaks at 1647cm^{-1} were assigned to the C=C stretching modes. The very weak band at 1102 cm^{-1} were assigned to the C-O stretching and the same attribution is available for the weak peaks at 1062 cm^{-1} through FTIR spectroscopy. Hlaing and Kyaw, 2005 reported the presence of alkaloids, glycosides, saponins, phenolic compounds, carbohydrates, amino acids and tannins. However, they also reported that cyanogenic glycosides were absent in fruit extract. They further confirmed that charantin, the biologically active compound for the control of diabetes.

Materials and Methods

Collection, identification and processing of plant material

Momordica charantia fruits were collected from the local market, Rajendranagar, Hyderabad, India. The plant species were authenticated by a Botanist and fruit samples of *Momordica charantia* were thoroughly washed with tap water to remove any waste and dust particles. The fruit samples were dried by keeping them in the open air under shade for three weeks till constant weight was achieved. The dried samples were ground to semi-powder form (10 to 20 meshes) using a commercial grinder and were stored in airtight polythene bags in the refrigerator at 4°C for further analysis.

Preparation of fruit extract

200 g. of *Momordica charantia* fruit powder were packed in separate thimbles made up of thick filter paper, placed in Soxhlet extraction apparatus and subjected to continuous hot percolation at different temperatures using the solvent 80% ethanol for about 15-16 hrs (10-12 cycles) until the solution appeared clear. The extracts were then vacuum concentrated under reduced pressure in a rotatory evaporator at 400°C at 30 rpm.

The concentrated extracts were then air-dried, transferred to an airtight container and stored at 40°C until further use. The yield of the extract was determined concerning the original weight of plants. After extraction, the contents of the receiver flask were subsequently transferred to sterilized evaporating bowls, already weighed and placed under the fan for evaporation of the solvent. The residue left in the bowls was again weighed to know the exact amount of extract. The extractability percentage of *Momordica charantia* fruit powder was determined by the following formula. Concentrated *Momordica charantia* fruit powder were taken in the bowls and stored in the refrigerator for subsequent studies. The dry extract was kept in a vacuum desiccator until use.

$$\text{Per cent extractability} = \frac{\text{Total amount of extract obtained}}{\text{Total weight of powder taken for extract}} \times 100$$

Fourier- transform infrared (FTIR) spectroscopy

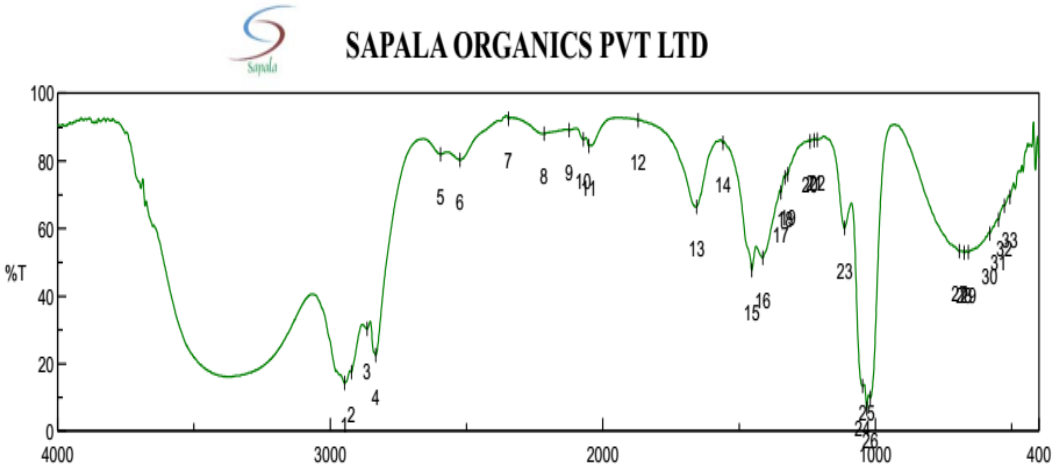
Fourier transform infrared (FTIR) spectroscopic technique was used to identify the presence of functional groups in the fruits of *Momordica charantia* ethanol extracts. FTIR spectrum of samples was performed at Sapala Organics Pvt. Limited, Hyderabad with the Perkin Elmer spectrophotometer system with 32 scans and the resolution was set at 4 cm^{-1}. The diffuse reflectance method was used with TGS detectors to detect peaks ranging from 400-4000 cm^{-1} and their functional groups

Results and Discussion

Ethanolic extract of MCFE revealed the presence of 33 peaks at different wavelengths

during FTIR analysis (Fig.1). Peaks at 2947.66 and 2922.59 cm^{-1} with -OH and -COOH indicated the presence of phenolics and terpenes; peak at 1656.55 cm^{-1} with C=C-H represented charantin and Momordicin, deformed aromatic ring, amino acids and flavonoids; peaks ranging from 506.22 to 580.46 cm^{-1} indicated terpenoids; peaks from 2864.74 to 2947.66 cm^{-1} with C=C functional group indicated flavones, isoflavones and flavanones and peaks at 1559.17 and 1454.06 cm^{-1} with C=C group revealed the presence of flavonols and anthocyanins.

Figure.1 FTIR Absorption Spectra for *Momordica charantia* fruit extract (MCFE)



Results of Peak Find

No.	Position	Intensity	No.	Position	Intensity	No.	Position	Intensity	No.	Position	Intensity
1	2947.66	14.194	2	2922.59	17.3216	3	2864.74	30.1963	4	2832.92	22.3585
5	2594.75	81.8843	6	2524.36	80.1694	7	2345.98	92.3522	8	2214.84	87.9735
9	2123.24	89.026	10	2071.17	86.3164	11	2051.89	84.2697	12	1870.61	91.8687
13	1656.55	66.2622	14	1559.17	85.2463	15	1454.06	47.594	16	1413.57	51.2204
17	1347.03	70.5268	18	1331.61	74.9464	19	1321.96	75.872	20	1240	85.7222
21	1225.54	86.0345	22	1213.01	86.0555	23	1113.69	59.9999	24	1047.16	13.2677
25	1031.73	6.6181	26	1019.19	9.7458	27	692.32	53.1371	28	673.999	52.695
29	659.536	52.8267	30	580.469	58.4546	31	548.649	62.5308	32	527.436	66.5664
33	506.223	69.2254									

FT IR (KBr Disc): vmax (cm^{-1}) 3800-3000 (br, Phenolic –OH or -COOH), 3000-3100 (Ar-H) 1656 (C=C-H), 1357, 1031 (C=C), 659, 506 (C=C Bendings)

Momordica charantia L. known for its multiple uses in treatment of chronic metabolic disorders associated with inflammation and oxidative stress. Identification of phytochemicals provides additional information for the utility in pharmaceutical and nutraceutical industry. In the present study, various functional groups were identified using FTIR spectroscopy which provides useful information for treating various diseases without any side effects.

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Conflict of Interest

The authors declare that there is no competing interest among the authors.

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