Phytochemical Screening and GC-MS Analysis of *Carica papaya* L. Seeds for Anti-Ulcer Activity in Ranchi, Jharkhand

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Abstract- *Carica papaya* L. (Caricaceae) is a well-known medicinal plant traditionally employed for managing various gastrointestinal disorders like ulcer, infection and other ailments in Ranchi District, Jharkhand, India. The present study aimed to evaluate the phytochemical constituents and bioactive compounds of its seeds. Qualitative screening revealed the presence of ten of twelve phytochemicals such as alkaloids, anthocyanin, carbohydrate, flavonoids, tannins, phenols, saponins, glycosides, steroids, and terpenoids. GC-MS analysis of the methanolic seed extract identified 53 bioactive compounds. These identified phytocompounds possesses various biological activities such as anti- inflammatory, antioxidant, anti-ulcer, antimicrobial etc. The results demonstrate the plant's potential as a reservoir of bioactive compounds and its relevance in the development of novel drugs and sustainable healthcare practices.

Keywords: phytochemical screening, C. papaya, methanol, GC-MS, Jharkhand.

INTRODUCTION

Medicinal plants are valuable sources of bioactive compounds with therapeutic potential. Increasing reliance on herbal formulations reflects their efficacy against diverse diseases. In recent times, plant-derived products with anti-inflammatory, antioxidant, and antibacterial activities have gained global importance [1].

Their medicinal and commercial value has prompted pharmaceutical industries to invest in developing cost-effective natural medicines accessible to the wider population [2].

Different plant parts are known to contain distinct bioactive compounds that can be extracted and identified using various methodologies. The advancement of modern analytical techniques has greatly facilitated the identification and characterization of these phytochemicals. Gas Chromatography–Mass Spectrometry (GC–MS) is one such powerful technique widely employed for detecting bioactive constituents in plants. The efficiency of extraction largely depends on the type of solvent used. Polar solvents are generally preferred for extracting phenolic compounds, while non-polar solvents are more effective for isolating lipids, oils, and related metabolites [3].

Carica papaya L., belongs to the family Caricaceae is a soft-stemmed, fast-growing tropical tree commonly found in India and is known for its therapeutic properties and has been used traditionally for medicinal purposes since ages. Ethno-botanically, it is believed that various parts of the plant like leaves, fruits, seeds, latex are frequently utilized in traditional medicine for managing various health conditions. The plant contain several bioactive compounds that exhibit antimicrobial, anti-inflammatory, anti-ulcer, anti-cancer, hepatoprotective and antioxidant properties [4-6].

Peptic ulcers are prevalent gastrointestinal disorders marked by the erosion of the gastric or duodenal mucosa, primarily associated with excessive gastric acid secretion. Main causes of ulcer are emotional disturbance, stressful lifestyle, alcohol consumption, irregular food habits, H.pylori infection etc. It can be treated by lowering the amount of acid in stomach. For

this a number of synthetic drugs are given which have several side effects and less affordable [7-8].

MATERIAL AND METHODS

Collection of Plant Material

Seeds of *Carica papaya* L. were collected from Ranchi, Jharkhand. The samples were washed with tap water followed by distilled water to remove debris, then shade-dried for 3–4 weeks. Dried seeds were ground into fine powder using a mortar and pestle and the powder was stored in airtight containers for further phytochemical and biological analyses.

Authentication

The plant was authenticated by Dr. Kunul Kandir, Professor, Department of Botany, Ranchi University, Ranchi. Taxonomic identification was carried out with reference to *The Botany of Bihar and Orissa* (Vol. I–III). Further confirmation was obtained from the Botanical Survey of India (BSI), Central National Herbarium, Howrah, Kolkata, under reference no. CNH/Tech.II/2024/180.

Preparation of Plant Extracts

10 gm of powdered seeds sample were soaked in 100 mL of methanol maintaining a 1:10 (w/v) ratio. The mixture was shaken intermittently for 6 hours and then kept for 10 days with frequent agitation. After extraction the mixture was decanted and filtered through Whatman No. 1 filter paper. The filtrate was transferred to a beaker covered with perforated aluminum foil to allow solvent evaporation. The resulting semisolid extract was stored in a refrigerator until further analysis.

Preliminary Phytochemical Screening

The aqueous seed extract was subjected to standard qualitative tests to detect the presence of major phytochemical constituents.

GC–MS Analysis

GC-MS analysis of the methanolic extract was performed using a Shimadzu Q-2010 Plus system equipped with a Thermal Desorption System (TD 20). Phytoconstituents were identified by comparing the retention times and mass spectra with reference data from the Wiley-8 and NIST-14 (National Institute of Standards and Technology) libraries. The analysis was conducted at the Advanced Instrumentation Research Facility (AIRF), Jawaharlal Nehru University, New Delhi, in December 2024.

RESULTS AND DISCUSSION

Qualitative screening of the aqueous seed extract of *Carica papaya* L. presented in Table 1 (fig:1-12) revealed the presence of ten out of twelve tested phytochemicals, including alkaloids, flavonoids, saponins, steroids, phenols, tannins, carbohydrates, glycosides, terpenoids, anthocyanins while proteins and phlobatannins were not found in it.

In the research work of Pokhrel S and Karki P. (2021), there is an absence of flavonoids and glycosides in aqueous extract of C. papaya seeds [9].

In the investigation of Singh et. al. (2021) on the Standardization and Phytochemical screening of *Carica papaya* L. seeds, Preliminary phytochemical screening showed the presence of Tannins, Proteins, amino acids, Glycosides, Phenolic compounds, Carbohydrates, Saponins, Alkaloids and Flavonoids [10]. The presence of various phytochemicals such as alkaloids, flavonoids, phenolics, and tannins in multiple studies reinforces the therapeutic relevance of *Carica papaya* seeds.

The GC-MS chromatogram of the methanolic extract of *Carica papaya* seeds presented in table 2 revealed the presence of 53 distinct bioactive compounds that include Hexadecanoic Acid, methyl ester, n-Hexadecanoic acid, 9,12-Octadecadienoic acid (Z,Z)-, methyl ester, 9-octadecenoic acid ,methyl ester, (E)-, Palmitic Acid, Octadecanoic acid, methyl ester, Oleic acid, propyl ester, Stigmast-5-en-3-ol,(3.beta.)-, Glycidyl (Z)-9-Heptadecenoate, sarsasapogenin, 9-octadecenoic acid (Z)-, oxiranylmethyl ester, hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester and their bioactivities are given in table 3.

The previous research work of P Malathi and S Sujitha in 2022, 12 distinct bioactive constituents were reported in aqueous as well as in ethanolic extract of C. papaya seeds**.** The diversity of these compounds suggests that *Carica papaya* could serve as a valuable source of bioactive agents for pharmacological applications [11].

Table 1: Phytochemical Analysis of Aqueous seed extract of *Carica papaya* L.

S. No.	Phytochemicals	Observation	Result
1	Alkaloid	Orange	Present
2	Anthocyanin	Pale pink	Present
3	Carbohydrate	Bluish green	Present
4	Flavonoid	White ppt	Present
5	Glycoside	Brown ring	Present
6	Phenol	Bluish green	Present
7	Phlobotannin	Red ppt	Absent
8	Protein	White ppt	Absent
9	Saponin	Foam	Present
10	Steroid	Green fluorescence	Present
11	Tannin	Bluish green	Present
12	Terpenoid	Reddish brown	Present


Fig 1

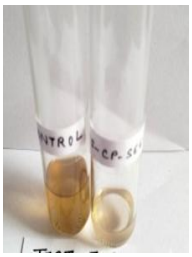
fig 2


fig 3


fig 4

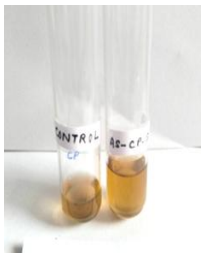
fig 5


fig 6


Fig 7

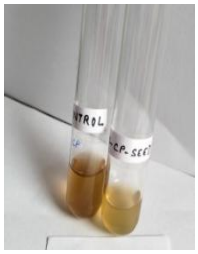
fig 8


fig 9

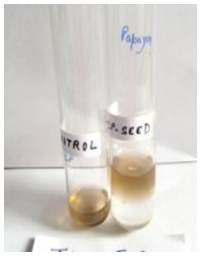
fig 10


fig 11


fig 12

Fig 1-12: Qualitative analysis of C. papaya seeds

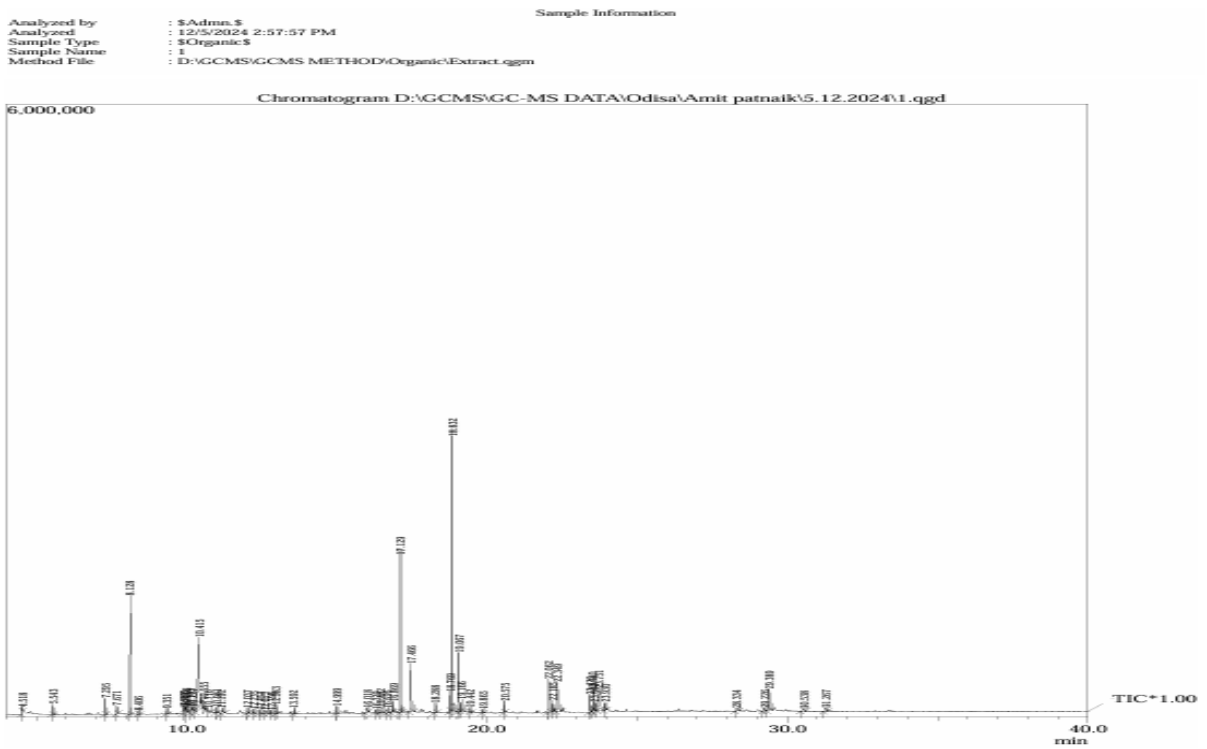

Figure 13: Chromatogram of *Carica papaya* L. seeds by GC MS

Table 2: Phytochemicals Identified in GC-MS Analysis of Methanolic Extract of *Carica papaya* L. seed

Peak#	R.Time	Area	Area%	Name
1	4.518	90818	0.43	1,2,3-Propanetriol
2	5.543	166294	0.78	Butanedioic acid, dimethyl ester
3	7.295	249588	1.18	Benzyl nitrile
4	7.671	177408	0.84	Octanoic acid
5	8.128	1858811	8.76	Naphthalene
6	8.406	59800	0.28	1-Hexanol, 5-methyl-2-(1-methylethyl)-
7	9.351	108906	0.51	Octadecane
8	9.9	125447	0.59	2,6-Octadienoic acid, 3,7-dimethyl-, (E)-
9	9.957	32356	0.15	3,7-Dimethyl-2E,6-octadienoic acid
10	10.008	41405	0.2	1-Hexanol, 5-methyl-2-(1-methylethyl)-
11	10.143	160148	0.76	1-Methylheptyl (Z)-2,2-Dimethyl-3-(2-Methyl
12	10.227	30298	0.14	4-(Dimethoxymethyl)-1,2-Dimethylbenzene
13	10.415	2426268	11.44	Neric acid
14	10.555	120432	0.57	9-Octadecenoic acid (Z)-
15	10.716	85829	0.4	2-Butene, 1,4-dimethoxy-
16	10.981	86195	0.41	Tetradecanoic acid, ethyl ester
17	11.192	147556	0.7	Benzene, 1,1'-oxybis-
18	12.037	77438	0.37	1-Undecanol
19	12.235	59773	0.28	Sulfurous acid, 2-ethylhexyl isohexyl ester
20	12.454	55652	0.26	Phenol, 2,4-bis(1,1-dimethylethyl)-
21	12.615	96598	0.46	Benzaldehyde, 4-(methylamino)-
22	12.798	35649	0.17	Sulfurous acid, 2-ethylhexyl hexyl ester
23	12.983	145661	0.69	Benzaldehyde, 4-(dimethylamino)-
24	13.592	92426	0.44	1-Iodo-2-methylundecane
25	14.999	102724	0.48	Tetradecanoic acid, methyl ester
26	16.018	101592	0.48	(3S,3aR,6R,8aS)-7,7-Dimethyl-8-methyleneoctahydro-1H
27	16.329	119668	0.56	1-Cyclohexene-1-methanol, .alpha.-1-cyclo
28	16.482	100600	0.47	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
29	16.696	115944	0.55	Benzaldehyde, 3-benzyloxy-2-fluoro-4-methoxy-
30	16.869	196220	0.93	2-((2-Methoxyethoxy)carbonyl)benzoic acid
31	17.129	2327997	10.98	Hexadecanoic acid, methyl ester
32	17.466	973827	4.59	n-Hexadecanoic acid
33	18.288	162134	0.76	Palmitic acid, TMS derivative
34	18.769	289340	1.36	9,12-Octadecadienoic acid (Z,Z)-, methyl ester
35	18.832	4273323	20.15	9-Octadecenoic acid, methyl ester, (E)-
36	19.067	883278	4.16	Octadecanoic acid, methyl ester
37	19.166	204831	0.97	Oleic acid, propyl ester
38	19.442	73557	0.35	Ethyl 9-octadecenoate
39	19.865	61028	0.29	9-Octadecenoic acid, (E)-, TMS derivative
40	20.575	180296	0.85	Glycidyl palmitate
41	22.062	720729	3.4	Glycidyl (Z)-9-heptadecenoate
42	22.185	196336	0.93	Petroselinic acid, TMS derivative
43	22.349	748878	3.53	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester
44	23.426	298620	1.41	6-Ethyl-3-decanol, TMS derivative
45	23.54	325238	1.53	9-Octadecenoic acid (Z)-, oxiranylmethyl ester
46	23.604	93707	0.44	2,3-Dihydroxypropyl icosanoate, 2TMS derivative
47	23.751	801806	3.78	9-Octadecenoic acid, 1,2,3-propanetriyl ester, (E,E,E)-
48	23.93	174886	0.82	Octadecanoic acid, 2,3-dihydroxypropyl ester
49	28.334	108973	0.51	Cholest-5-en-3-ol (3.beta.)-, carbonochloridate
50	29.226	103309	0.49	Sarsasapogenin

51	29.389	710555	3.35	Stigmast-5-en-3-ol, (3.beta.)-
52	30.538	96910	0.46	Icosa-9,11-diyne
53	31.267	134162	0.63	Cholest-4-en-3-one
		21211224	100.00	

Table 3 Identified phytochemicals with their biological activities

S. No	Name of Compound	R. Time	Molecular Formula	Molecular Weight (g/mol)	Biological Activities
1	Naphthalene	8.128	$C_{10}H_8$	128.17	Anti-inflammatory, antioxidant, anti-ulcer [12-14]
2	Neric Acid	10.415	$C_{12}H_{22}O_2$	198.31	Wound healing, anti-inflammatory[15]
3	Hexadecanoic acid, methyl ester (Methyl palmitate)	17.129	$C_{17}H_{34}O_2$	270.45	Anti-inflammatory, antioxidant, antiandrogenic, haemolytic[16]
4	n-Hexadecanoic acid (Palmitic acid)	17.466	$C_{16}H_{32}O_2$	256.42	Anti-inflammatory, antioxidant, gastroprotective[16]
5	Palmitic Acid, TMS derivative	18.288	$C_{19}H_{42}O_2Si$	330.62	Anti-inflammatory, anticancer[17]
6	9,12-Octadecadienoic acid (Z,Z)-, methyl ester (Methyl linoleate)	18.769	$C_{19}H_{34}O_2$	294.47	Anti-inflammatory[18]
7	9-Octadecenoic acid, methyl ester, (E)- (Methyl oleate)	18.832	$C_{19}H_{36}O_2$	296.49	Anti-ulcerogenic, anti-inflammatory[19]
8	Octadecanoic acid, methyl ester (Methyl stearate)	19.067	$C_{19}H_{38}O_2$	298.51	Anti-inflammatory, antioxidant, anticancer[20]
9	Oleic acid, propyl ester	19.166	$C_{21}H_{40}O_2$	324.54	Antifungal, antiulcer[21]
10	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester (Glyceryl monopalmitate)	22.349	$C_{19}H_{38}O_4$	330.50	Anti-inflammatory, antioxidant, hepatoprotective[18]
11	Glycidyl (Z)-9-Heptadecenoate	22.575	$C_{20}H_{36}O_3$	324.50	Antibacterial[22]
12	9-Octadecenoic acid, oxiranylmethyl ester	23.540	$C_{21}H_{38}O_3$	338.53	Anti-inflammatory[23]
13	9-Octadecenoic acid,1,2,3-propanetriyl ester (Triolein)	23.751	$C_{57}H_{104}O_6$	884.45	Anti-inflammatory, antioxidant, wound healing[24]
14	Sarsasapogenin	29.226	$C_{27}H_{44}O_3$	416.64	Cytoprotective, acid reduction, anti-inflammatory, antioxidant[25]
15	Stigmast-5-en-3-ol (β-Sitosterol)	29.389	$C_{29}H_{50}O$	414.71	Anti-ulcer, anti-inflammatory, antimicrobial[18]
16	Cholest-4-en-3-one	31.267	$C_{27}H_{44}O$	384.64	Antioxidant[26]

CONCLUSION

The present investigation revealed that the aqueous extract of *carica papaya* L. seeds contains a wide range of phytochemicals, including alkaloids, anthocyanins, flavonoids, carbohydrates, saponins, steroids, phenols, tannins, glycosides and terpenoids. GC–MS analysis of methanolic extract further confirmed the presence of 53 bioactive constituents that indicates its richness as an ethnomedicinal plant. These compounds are known for diverse pharmacological activities, including antimicrobial, antioxidant, antiulcer, anticancer and anti-inflammatory properties. Overall, the findings suggest that *carica papaya* L. possesses significant therapeutic potential and could serve as a valuable source of natural compounds for the development of novel antiulcer pharmaceutical formulations.

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