GC–MS based phytochemical profiling of *Nesphostylis bracteata* (Baker) D. Potter & J. J. Doyle

Avadhoot S. Patil[1,2], Hanmantrao S. Patil[2], Ajit B. Telave[1,*], Jaykumar J. Chavan[3,*]

[1]Post Graduate Research Centre, Department of Botany, Tuljaram Chaturchand College (Autonomous), Baramati - 413402.

[2]Departmant of Botany, Vidya Pratishthan's Arts, Science and Commerce College, Baramati - 413133.

[3]Departmant of Botany, Yashavantrao Chavan Institute of Science, Karmaveer Bhaurao Patil University, Satara – 415001.

Correspondence: drajittelave@gmail.com, jaychavansu@gmail.com

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Abstract

Nesphostylis bracteata (family - Fabaceae) is a critically endangered legume native to the Western Ghats and known for its ethno-botanical and ethno-medicinal significance. The current study focused on identifying phytochemicals from the methanolic extracts of the stem, leaves, and seeds of *N. bracteata* through GC-MS analysis. The GC-MS profile revealed the occurrence of a total of 83 phytochemicals in the stem, leaves, and seeds. Among the identified compounds, 14 were found in all examined plant organs, while 21 were present in at least two of the plant organs of *N. bracteata*. Additionally, several compounds were specifically found to occur in certain plant organs only. Numerous compounds reported in *N. bracteata* are known to have pharmacological properties. To our knowledge, this is the first documentation of the phytochemical components of *N. bracteata*, as there is no existing literature on the phytochemicals associated with this species. The findings from this study will pave the way for the creation of herbal remedies for various ailments using *N. bracteata* extracts, potentially leading to the development of new drugs.

Introduction:

Nesphostylis bracteata is a lesser-known leguminous species belonging to the family Fabaceae, a plant family well known for its ecological importance and chemical diversity (Harborne, 1998). Apart from its nutritional implications, numerous species of Fabaceae are recognized as rich sources of secondary metabolites such as flavonoids, fatty acids, terpenoids, phenolics, and sterols, which are associated with diverse biological activities (Harborne, 1998). Many of these phytochemicals exhibit pharmacological properties including antioxidant, antimicrobial, and anti-inflammatory effects (Pandey and Rizvi, 2009).

Gas chromatography–mass spectrometry (GC–MS) is a reliable and widely applied analytical technique commonly used for the identification of phytochemicals from plant extracts (Adams, 2007, Ghadage et al., 2017; Chavan and Santa-Catarina, 2023). This technique facilitates compound identification through comparison of mass spectra with established spectral libraries, providing accurate qualitative phytochemical information (Koo et al., 2013). Moreover, the application of GC–MS in the plant research has significantly enhanced the understanding of plant-derived bioactive compounds and their nutritional, pharmaceutical and chemotaxonomic relevance (Sasidharan et al., 2011; Chavan et al., 2025).

Despite its potential significance, *N. bracteata* has received very limited scientific attention with respect to phytochemical characterization and metabolite profiling (Kirtikar and Basu, 2005). Therefore, GC–MS profiling of *N. bracteata* is undertaken to establish baseline phytochemical data and to identify major constituents present in the extract. Such information is essential for assessing the therapeutic potential of this underexplored legume and for supporting future studies related to conservation, sustainable utilization and metabolite production.

Materials and methods

Plant material

The plant material of *N. bracteata* was collected from its natural habitat in Panchgani, Maharashtra (India) and shade-dried at room temperature in the laboratory. Following the drying process, the plant parts were ground into a fine powder using a Willy mill and the powder was utilized for subsequent experiments.

Extraction process and instrumentation

The accelerated extraction (AE) was performed to efficiently extract bioactive and other metabolites under controlled temperature and pressure conditions. A powdered sample was loaded into a stainless-steel extraction cell lined with cellulose filters at both ends to prevent particulate loss. Extraction was carried out using methanol as solvent in a 1:1 (w/v) mixture under elevated temperature and pressure to enhance solvent penetration and extraction efficiency. The extraction cell was maintained at a constant temperature (typically 70 °C) and pressure (1000–1500 psi) for a fixed static extraction time of 2 min. Two extraction cycles were applied to ensure complete recovery of metabolites. After extraction, the solvent extract was collected, filtered

and concentrated under reduced pressure using a rotary evaporator. The dried extract was re-constituted in a methanol and stored at low temperature until GC–MS analysis. The GC–MS analysis of extracts were carried out using the TQ 8050 plus with HS-20 (Shimadzu, Japan) equipped with a SHIMADZU SH-Rxi-5Sil MS column and the method of Jagtap et al (2025).

Results and discussion

The GC–MS analysis of the various extracts of the *N. bracteata* resulted in identification of a total of 83 phytoconstituents of which 47, 45 and 44 reported from stem, leaf and seeds respectively. Many among them such as 2-Decenal (E); Dodecanal; Tridecanal; Tetradecanal; cis-7-Tetradecen-1-yl acetate; 3-Heptadecene (Z); 2-Pentadecanone; Pentadecanal; Z,Z-6,28-Heptatriactontadien-2-one; Methyl hexadec-9-enoate; 9-Octadecenamide (Z); Glycidyl oleate; Glycidyl palmitate and Tetracosanoic acid, methyl ester has been commonly reported in all three plant parts. The compounds reported from *N. bracteata* were belonging to diverse compound groups including fatty acid methyl esters (FAMEs), aldehydes, fatty acids, ketones, alcohols, esters, amides, hydrocarbons, lactones, and epoxy lipid derivatives (Table 1-3). These compounds were detected over a retention time range of 4.02 – 48.40 min, indicating a wide distribution of low- to high-molecular-weight metabolites. The 47 phytoconstituents detected in the stem of *N. bracteata* are represented in figure 1 and table 1.

Figure 1: GC-MS chromatogram of stem of *N. bracteata*

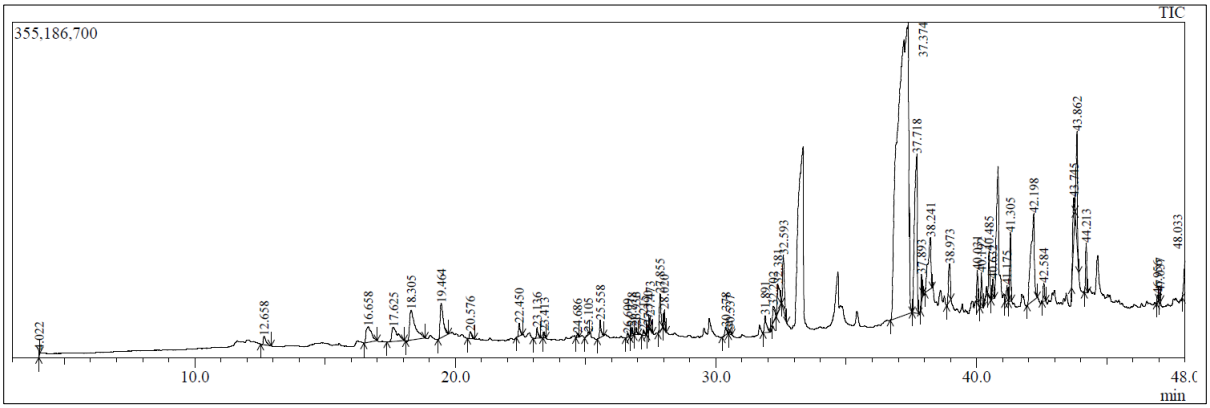

Table 1: List of phytoconstituents identified from stem of *N. bracteata* using GC–MS analysis

Peak No.	Name of the compound	Compound Group	R.T. (min.)	Area	Area (%)
1	1-Methoxy-3-hydroxymethylheptane	Ether / Alcohol derivative	4.022	8515025	0.05
2	Octanoic acid, methyl ester	Fatty acid methyl ester (FAME)	12.658	63522449	0.39
3	2-Decenal (E)	Unsaturated aldehyde	16.658	235595242	1.44
4	2,4-Dodecadienal	Unsaturated aldehyde	17.625	228994123	1.40
5	Cyclohexene, 1-pentyl-	Terpenoid hydrocarbon	18.305	456564140	2.79
6	2-Undecenal	Unsaturated aldehyde	19.464	304443331	1.86
7	Dodecanal	Saturated aldehyde	20.576	40277315	0.25
8	n-Caprylic acid isobutyl ester	Ester derivative	22.450	53024701	0.32
9	Tridecanal	Saturated aldehyde	23.136	39924970	0.24
10	Dodecanoic acid, methyl ester	Fatty acid methyl ester (FAME)	23.413	18615014	0.11
11	1-Hexadecanol	Fatty alcohol	24.656	10919442	0.07
12	Phthalic acid, 2-cyclohexylethyl ethyl ester	Phthalate derivative	25.105	10163373	0.06
13	Tetradecanal	Saturated aldehyde	25.558	77846900	0.48
14	1,11-Heptadecadiene (Z,Z)	Alkene (Hydrocarbon)	26.609	12749168	0.08
15	cis-7-Tetradecen-1-yl acetate	Fatty acetate ester	26.778	33382561	0.20
16	3-Heptadecene (Z)	Alkene (Hydrocarbon)	26.956	26738920	0.16
17	cis-cis-7,10-Hexadecadienal	Unsaturated aldehyde	27.213	22585500	0.14
18	7-Hexadecenal (Z)	Unsaturated aldehyde	27.390	16742794	0.10
19	2-Pentadecanone	Ketone	27.473	4712308	0.29
20	Pentadecanal	Aldehyde	27.855	158302003	0.97
21	Methyl tetradecanoate	Fatty acid methyl ester (FAME)	28.020	53754842	0.33
22	Hexadecanal	Aldehyde	30.378	34108404	0.21
23	Pentadecanoic acid, methyl ester	Fatty acid methyl ester	30.537	1572430	0.10
24	Z,Z-6,28-Heptatriactontadien-	Long-chain ketone	31.891	105947266	0.65

	2-one				
25	9,17-Octadecadienal (Z)	Unsaturated aldehyde	32.202	92665992	0.57
26	cis-9-Hexadecenal	Unsaturated aldehyde	32.381	185377348	1.13
27	Methyl hexadec-9-enoate	Fatty acid methyl ester	32.593	279300580	1.71
28	9-Octadecenoic acid, methyl ester (E)	Fatty acid methyl ester	37.374	8906500448	54.47
29	Heptadecanoic acid, 14-methyl-, methyl ester	Branched fatty acid methyl ester	37.718	121375905	7.42
30	2H-Pyran-2-one, tetrahydro-6-undecyl	Lactone	37.893	6828527	0.42
31	Oleic acid	Fatty acid	38.241	44308787	2.71
32	Acetamide, N-tetradecyl	Amide	38.973	187922544	1.15
33	Methyl 5,13-docosadienoate	Polyunsaturated FAME	40.031	105604016	0.65
34	E,E-2,13-Nonadecadiene-5,14-diol	Alcohol (diol)	40.192	114199184	0.70
35	Octadecanoic acid, 3-octyl-, methyl ester	Fatty acid ester	40.485	70199302	1.04
36	Z-9-Octadecen-7-ol	Unsaturated alcohol	40.632	71965906	0.44
37	2(3H)-Furanone, dihydro-5-tetradecyl	Lactone	41.175	58576054	0.36
38	Eicosanoic acid, methyl ester	Fatty acid methyl ester	41.305	215236870	1.32
39	9-Octadecenamide (Z)	Fatty acid amide	42.198	867323466	5.31
40	Octadecanamide	Fatty acid amide	42.984	68748575	5.31
41	Methyl 5,11,14-eicosatrienoate	Polyunsaturated FAME	43.745	217566243	0.42
42	Glycidyl oleate	Epoxy fatty acid ester	43.862	428823897	1.33
43	Glycidyl palmitate	Epoxy fatty acid ester	44.213	153318696	2.62
44	E,E-2,13-Nonadecadiene-5,14-diol	Alcohol (diol)	46.956	18369714	0.94
45	2-Bromoethoxybromobenzene	Halogenated aromatic compound	47.087	31473415	0.11
46	9-Octadecenoic acid (Z), 2,3-dihydroxypropyl ester	Monoacylglycerol	48.033	298734405	0.13
47	Tetracosanoic acid, methyl ester	Long-chain FAME	48.426	91015339	1.80

The compounds such as Cyclohexene, 1-pentyl-; Phthalic acid, 2-cyclohexylethyl ethyl ester; 1,11-Heptadecadiene (Z,Z); 2H-Pyran-2-one, tetrahydro-6-undecyl; Acetamide, N-tetradecyl; Methyl 5,13-docosadienoate; E,E-2,13-Nonadecadiene-5,14-diol; Octadecanoic acid, 3-octyl-, methyl ester; Z-9-Octadecen-7-ol; E,E-2,13-Nonadecadiene-5,14-diol; 2-Bromoethoxybromobenzene and 9-Octadecenoic acid (Z), 2,3-dihydroxypropyl ester has been only reported from the stem extract of *N. bracteata* (Table 1). The chromatographic profile was dominated by fatty acid methyl esters, with 9-Octadecenoic acid, methyl ester (54.47%) being the most abundant compound, followed by Heptadecanoic acid, 14-methyl-, methyl ester (7.42%), 9-Octadecenamide (5.31%), Octadecanamide (5.31%), and Oleic acid (2.71%) in the stem of *N. bracteata* (Table 1). The chemical diversity reflects a metabolite profile rich in lipid-derived constituents. The predominance of fatty acid methyl esters and free fatty acids in the stem extract indicates that lipid metabolism is a major biochemical feature of *N. bracteata* stem tissue. Relatively high abundance of methyl oleate (9-Octadecenoic acid, methyl ester) suggests its role as a primary storage and structural lipid. Such compounds are known to contribute to membrane architecture, cellular energy balance, and metabolic regulation in plant tissues (Kazaz et al., 2022).

The GC–MS analysis of the leaf extract of *N. bracteata* resulted in the identification of 45 compounds (Table 2; Fig. 2). Out of them, 13 compounds including Octanoic acid, 2-chlorophenyl ester; Dodecane, 2-methyl; 1-Cyclohexene-1-butanal, alpha,2,6,6-tetramethyl; Bis(2-ethylhexyl) phthalate; Methyl 13-cis,9-cis,12-cis-octadecatrienoate; 2-Pentadecanone, 6,10,14-trimethyl; (Z,Z)-9,12-Pentadecadien-1-ol; n-Hexadecanoic acid; cis-9-Hexadecenal; Hexadecanoic acid, 15-methyl-, methyl ester; 6,9-Octadecadienoic acid, methyl ester; Methyl 20-methyl-heneicosanoate and Oleoyl chloride.

Figure 2: GC-MS chromatogram of leaves of *N. bracteata*

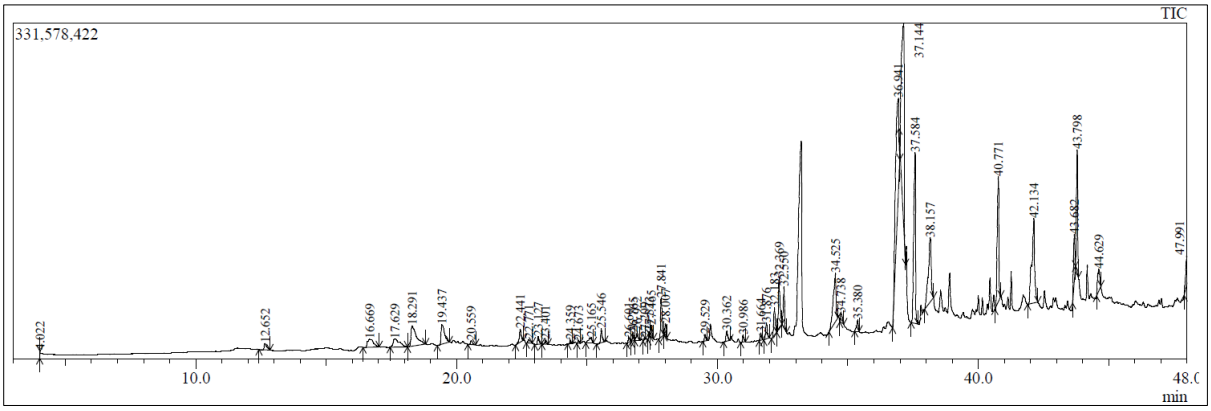

Table 2: List of phytochemicals identified from leaves of *N. bracteata* using GC–MS.

Peak No.	Name	Chemical Group	R. T. (min.)	Peak Area	Area (%)
1	1-Methoxy-3-hydroxymethylheptane	Ether / Alcohol derivative	4.022	2552890	0.03
2	Octanoic acid, methyl ester	Fatty acid methyl ester (FAME)	12.652	40171521	0.50
3	2-Decenal, (E)	Aldehyde (Unsaturated)	16.669	120491936	1.49
4	2,4-Dodecadienal, (E,E)	Aldehyde (Polyunsaturated)	17.629	137680757	1.71
5	2,4-Decadienal, (E,E)	Aldehyde (Polyunsaturated)	18.291	285001155	3.53
6	2-Undecenal	Aldehyde (Unsaturated)	19.437	176150111	2.18
7	Dodecanal	Aldehyde (Saturated)	20.559	20684320	0.26
8	Octanoic acid, 2-chlorophenyl ester	Ester derivative	22.441	65886378	0.82
9	Dodecane, 2-methyl	Alkane (Hydrocarbon)	22.771	2034249	0.25
10	Tridecanal	Aldehyde (Saturated)	23.127	24216115	0.36
11	Dodecanoic acid, methyl ester	Fatty acid methyl ester (FAME)	23.401	12784545	0.16
12	1-Cyclohexene-1-butanal, alpha,2,6,6-tetramethyl	Terpenoid derivative	24.359	7765174	0.10
13	n-Hexadecanol	Fatty alcohol	24.673	7425414	0.09
14	Bis(2-ethylhexyl) phthalate	Phthalate (Plasticizer derivative)	25.165	48570991	0.54
15	Tetradecanal	Aldehyde (Saturated)	25.346	5312126	0.06

16	Methyl 13-cis,9-cis,12-cis-octadecatrienoate	Polyunsaturated fatty acid methyl ester	26.601	16506585	0.20
17	cis-7-Tetradecenyl acetate	Ester (Fatty acetate)	26.765	2564857	0.29
18	3-Heptadecene, (Z)	Alkene (Hydrocarbon)	26.922	34395097	0.48
19	cis-7,10-Hexadecadienal	Unsaturated aldehyde	27.209	6526202	0.08
20	7-Hexadecenal (Z)	Unsaturated aldehyde	27.373	1449002	0.18
21	2-Pentadecanone	Ketone	27.465	36502299	0.45
22	Pentadecanal	Saturated aldehyde	27.841	134087216	1.68
23	Methyl tetradecanoate	Fatty acid methyl ester (FAME)	28.007	34162735	0.42
24	cis-7,10-Hexadecadienal	Unsaturated aldehyde	29.529	21421943	0.27
25	Hexadecanal	Saturated aldehyde	30.362	44333041	0.55
26	2-Pentadecanone, 6,10,14-trimethyl	Terpenoid ketone	30.986	24660563	0.31
27	(Z,Z)-9,12-Pentadecadien-1-ol	Unsaturated fatty alcohol	31.664	25338855	0.31
28	Z,Z-6,28-Heptatriacontadien-2-one	Long-chain ketone	31.876	70476385	0.87
29	9,17-Octadecadienal (Z)	Unsaturated aldehyde	32.183	118146509	1.46
30	cis-9-Hexadecenal	Unsaturated aldehyde	32.369	226086607	2.80
31	Methyl hexadec-9-enoate	FAME	32.550	136874504	1.70
32	n-Hexadecanoic acid	Saturated fatty acid	34.525	338440994	4.19
33	cis-9-Hexadecenal	Unsaturated aldehyde	34.738	46436559	0.58
34	Hexadecanoic acid, 15-methyl-, methyl ester	Branched FAME	35.580	48175345	0.60
35	6,9-Octadecadienoic acid, methyl ester	Polyunsaturated FAME	36.341	1041867092	12.91
36	9-Octadecenoic acid, methyl ester (E)	Monounsaturated FAME	37.144	1207109901	14.96
37	Heptadecanoic acid, methyl ester	FAME	37.784	86052529	0.67
38	Oleic acid	Monounsaturated fatty acid	38.157	507536069	6.29
39	Glycidyl palmitate	Ester derivative	40.771	57282177	0.48
40	9-Octadecenamide (Z)	Fatty acid amide	42.134	618502628	7.67
41	Methyl 5,11,14-eicosatrienoate	Polyunsaturated FAME	43.682	162357236	2.01
42	Glycidyl oleate	Ester derivative	43.798	407036231	5.04
43	Methyl 20-methyl-heneicosanoate	Branched FAME	44.629	12159158	1.51
44	Oleoyl chloride	Acid chloride	47.901	140230020	1.74

		derivative			
45	Tetracosanoic acid, methyl ester	Long-chain FAME	48.409	51998692	0.64

Among the identified constituents, fatty acid–related compounds dominated the chromatographic profile. Major peaks corresponded to 9-Octadecenoic acid, methyl ester (14.96%), 6,9-Octadecadienoic acid, methyl ester (12.91%), Oleic acid (6.29%), n-Hexadecanoic acid (4.19%), and Glycidyl oleate (5.04%). Aldehydes such as 2,4-Decadienal (E,E), 2-Undecenal, Pentadecanal, and cis-9-Hexadecenal were detected in moderate proportions, while minor constituents included hydrocarbons, fatty alcohols, and terpenoid-related compounds. The presence of long-chain fatty acid amides (9-Octadecenamide, 7.67%) and epoxy fatty acid derivatives further contributed to the chemical complexity of the leaf extract (Table 2; Fig. 2). The predominance of fatty acid methyl esters and free fatty acids in the leaf extract suggests that lipid metabolism is a major biochemical pathway in *N. bracteata* leaves. Compounds such as oleic acid, linoleic acid derivatives, and palmitic acid are essential structural components of cellular membranes and play a vital role in maintaining membrane fluidity, photosynthetic efficiency, and stress tolerance (Dutta et al., 2025).

The GC–MS analysis of *N. bracteata* seed extract led to the identification of 44 compounds of which above 50% has been only reported from the seeds (Table 3; Fig. 3). Hydroperoxide, 1-methylhexyl; 2(1H)-Naphthalenone, octahydro-, trans-; Formic acid, decyl 3-methylbut-3-enyl ester; Nonanoic acid, 9-oxo-, methyl ester; 1-Dodecanol; Undecanoic acid, 10-methyl-, methyl ester; 3-Hexadecene (Z); Tridecanoic acid, 12-methyl-, methyl ester; E,E,Z-1,3,12-Nonadecatriene-5,14-diol; 9,12-Octadecadienoyl chloride (Z,Z); Hexadecanoic acid, ethyl ester; 9-Tetradecenal (Z); E,Z-1,3,12-Nonadecatriene; Ethyl oleate; Octadecanoic acid, ethyl ester; Deoxyspergualin; Nonadecanoic acid, methyl ester; Methyl 15-hydroxy-9,12-octadecadienoate; 10,13-Eicosadienoic acid, methyl ester; 6,9-Octadecadienoic acid, methyl ester; 6,9,12-Octadecatrienoic acid, methyl ester; Docosanoic acid, methyl ester and Erythro-7,8-bromochloroasparure are among the compounds only reported in seeds of *N.bracteata* (Table 3).

Figure 3: GC-MS chromatogram of seeds of *N. bracteata*

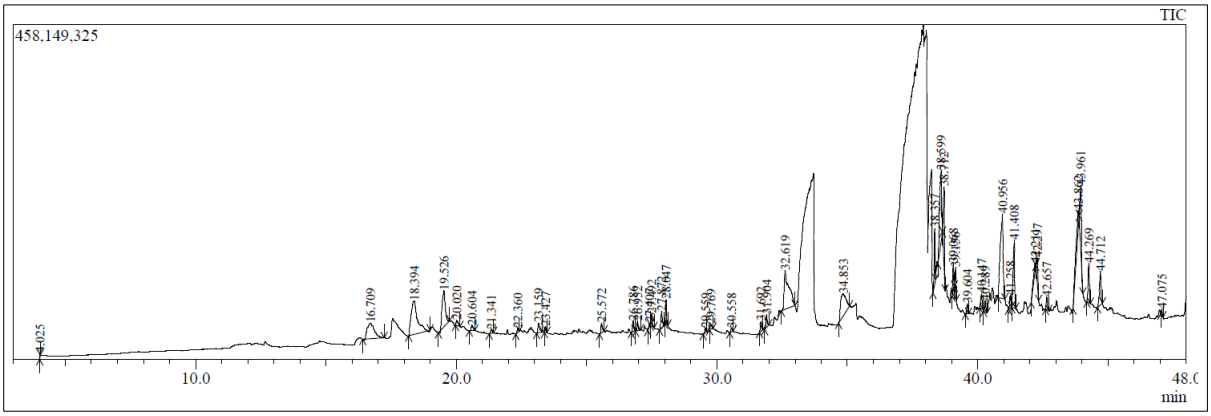

Table 3: List of phytochemicals identified from the seeds of *N. bracteata* using GC–MS.

Peak No.	Name of the Compound	Chemical Class/ Compound Group	R. T. (min)	Peak area	Area (%)
1	Hydroperoxide, 1-methylhexyl	Peroxide	4.025	5187919	0.07
2	2-Decenal (E)	Aldehyde	16.709	403100947	5.41
3	2(1H)-Naphthalenone, octahydro-, trans-	Ketone	18.394	771608284	10.36
4	2-Dodecenal (E)	Aldehyde	19.526	419435538	5.63
5	Formic acid, decyl 3-methylbut-3-enyl ester	Ester	20.020	37546732	0.50
6	Dodecanal	Aldehyde	20.604	33451023	0.45
7	Nonanoic acid, 9-oxo-, methyl ester	Ester	21.341	22423057	0.30
8	1-Dodecanol	Alcohol	22.360	18937379	0.25
9	Tridecanal	Aldehyde	23.159	60527704	0.81
10	Undecanoic acid, 10-methyl-, methyl ester	Ester	23.427	22020352	0.30
11	Tetradecanal	Aldehyde	25.572	50813370	0.68
12	cis-7-Tetradecen-1-yl acetate	Ester	26.786	53351132	0.72
13	3-Heptadecene (Z)	Hydrocarbon (Alkene)	26.952	41762262	0.56
14	3-Hexadecene (Z)	Hydrocarbon (Alkene)	27.407	13509658	1.87
15	2-Pentadecanone	Ketone	27.492	50951412	0.68
16	Pentadecanal	Aldehyde	27.872	92773652	1.25
17	Tridecanoic acid, 12-methyl-, methyl ester	Ester	28.047	96370702	1.29
18	cis,cis-7,10-Hexadecadienal	Aldehyde	29.559	20037226	0.27
19	E,E,Z-1,3,12-Nonadecatriene-	Polyunsaturated	29.769	29987555	0.40

	5,14-diol	alcohol			
20	Pentadecanoic acid, methyl ester	Fatty acid methyl ester	30.558	17113519	0.23
21	9,12-Octadecadienoyl chloride (Z,Z)	Fatty acid derivative	31.692	46576616	0.63
22	Z,Z-6,28-Heptatriacontadien-2-one	Ketone	31.904	63363810	0.85
23	Methyl hexadec-9-enoate	Fatty acid methyl ester	32.619	671271225	9.02
24	Hexadecanoic acid, ethyl ester	Fatty acid ethyl ester	34.853	436111271	5.86
25	9-Tetradecenal (Z)	Aldehyde	38.357	191021321	2.57
26	E,Z-1,3,12-Nonadecatriene	Unsaturated hydrocarbon	38.599	512234817	6.88
27	Ethyl oleate	Fatty acid ester	38.712	309224758	4.15
28	Octadecanoic acid, ethyl ester	Fatty acid ester	39.068	96188802	1.29
29	Deoxyspergualin	Alkaloid / bioactive compound	39.156	88627294	1.19
30	Nonadecanoic acid, methyl ester	Fatty acid methyl ester	39.604	40397785	0.54
31	Methyl 15-hydroxy-9,12-octadecadienoate	Hydroxy fatty acid ester	40.147	70684303	0.95
32	10,13-Eicosadienoic acid, methyl ester	Polyunsaturated fatty acid ester	40.289	48692293	0.65
33	Glycidyl palmitate	Epoxy fatty acid ester	40.956	86657917	1.64
34	2(3H)-Furanone, dihydro-5-tetradecyl-	Lactone	41.258	57985561	0.78
35	Eicosanoic acid, methyl ester	Fatty acid methyl ester	41.408	389688943	5.23
36	6,9-Octadecadienoic acid, methyl ester	Polyunsaturated fatty acid ester	42.211	91774966	1.23
37	9-Octadecenamide (Z)	Fatty acid amide	42.297	111624917	1.50
38	Octadecanamide	Fatty acid amide	42.657	61848243	0.83
39	6,9,12-Octadecatrienoic acid, methyl ester	Polyunsaturated fatty acid ester	43.862	247601848	3.33
40	Glycidyl oleate	Epoxy fatty acid ester	43.961	227921618	3.06
41	Glycidyl palmitate	Epoxy fatty acid ester	44.269	176604954	2.37
42	Docosanoic acid, methyl ester	Long-chain fatty	44.712	194535482	2.61

		acid ester			
43	Erythro-7,8-bromochloroasparure	Halogenated compound	47.075	21686223	0.29
44	Tetracosanoic acid, methyl ester	Very long-chain fatty acid ester	48.477	161394852	2.17

Fatty acid derivatives and esters constituted the dominant chemical group, with major components such as 2(1H)-Naphthalenone, octahydro-, trans- (10.36%), Methyl hexadec-9-enoate (9.02%), E,Z-1,3,12-Nonadecatriene (6.88%), Hexadecanoic acid, ethyl ester (5.86%), Eicosanoic acid, methyl ester (5.23%), and Ethyl oleate (4.15%). Aldehydes including 2-Decenal (E), 2-Dodecenal (E), and 9-Tetradecenal (Z) were also detected in appreciable amounts, reflecting active lipid degradation and oxidation pathways. Cuticular hydrocarbons and wax-related compounds such as 3-Hexadecene (Z), 3-Heptadecene (Z), Docosanoic acid methyl ester, and Tetracosanoic acid methyl ester were present, indicating the accumulation of long-chain lipids associated with protective functions. Additionally, minor yet biologically significant constituents such as Deoxyspergualin (1.19%) and fatty acid amides were detected, highlighting the presence of bioactive secondary metabolites. Importantly, the identification of bioactive metabolites, including Deoxyspergualin, fatty acid amides, epoxy fatty acid esters, and lactones, suggests potential pharmacological and biotechnological value of *N. bracteata* seeds. Such secondary metabolites may act as chemotaxonomic markers and support traditional or prospective medicinal applications. Similarly, the existing literature also suggested that the phytochemical investigations using advanced analytical techniques enhances the thoruogh investigations of flowering as well as lower plant groups (Salunkhe et al., 2013; Harikatha et al., 2023; Shete et al., 2024).

Many compounds identified in the stem, leaves, and seeds of *N. bracteata* have already demonstrated their significance in the field of nutritionals and pharmaceuticals. The phytochemical analysis of all parts of *N. bracteata* shows a metabolite composition that is heavily influenced by lipid-derived compounds, highlighting their functions in maintaining structural integrity, providing defense, and facilitating physiological and metabolic adaptation.

Conclusion

In conclusion, the GC-MS analysis presented a detailed list of phytochemicals present in different plant parts of *N.*

bracteata. This investigation identified a total of 83 phytochemicals belonging to various categories of bioactive compounds such as steroids, terpenes, fatty acids and their esters, alcoholic and phenolic compounds, hydrocarbons etc. Deoxyspergualin, fatty acid amides, epoxy fatty acid esters, lactones, octanoic acid, n-caprylic acid, phthalic acid, pentadecanal, oleic acid, glycidyl palmitate, n-hexadecanoic acid, and eicosanoic acid were the potential bioactive compounds occurred in the stem, leaf and seed extracts of *N. bracteata*. The present study paves the way towards understanding the nature of active phytoconstituents in the plants and this will be helpful for future in depth investigations on discovery of efficient biomolecules from *N. bracteata* and making it a potential source of medicines.

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References

Adams, R. P. (2007). *Identification of essential oil components by gas chromatography/mass spectrometry* (4th ed.). Allured Publishing Corporation.

Chavan J.J. and Santa-Catarina, C. 2023. Multidirectional insights into nutritional, phytochemical, antioxidant capability and multivariate analysis of underutilized edible berry plant (*Salacia macrosperma* Wight) – A novel source for food and pharmaceutical industry. Food Chemistry Advances. 2:100284.

Chavan J.J., Gaikwad, N.B., Jagtap, U.B., Santa-Catarina, C. and Kaur L. 2025. *Salacia* as a functional bioactive food ingredient: Insights into dietary phytonutrients, phytochemistry, health-promoting attributes and innovation potential. Food Bioscience. 71:107125.

Dutta, S., Islam, Z., Das, S., Barman, A., Chowdhury, M., Mondal, B.P., Ajnabi, J. and Manna D. 2025. Harmonizing plant resilience: unveiling the symphony of membrane lipid dynamics in response to abiotic stresses: a review. Discov. Plants 2: 61.

Ghadage, D.M., Kshirsagar, P.R., Pai, S.R. and Chavan J.J. 2017. Extraction efficiency, phytochemical profiles and antioxidative properties of different parts of Saptarangi (*Salacia chinensis* L.)–An important underutilized plant.

Biochemistry and Biophysics Reports 12:79-90.

Harborne, J. B. (1998). *Phytochemical methods: A guide to modern techniques of plant analysis* (3rd ed.). Chapman & Hall.

Harikatha, P., Kodidhela, L.D. and Chavan, J.J. 2023. Preliminary phytochemical screening, quantification of bioactive compounds and antioxidant potential of *Achyranthes aspera* L. leaf powder. Jour Pl Sci Res. 39(1):133-140.

Jagtap, MA., Magdum, A.B., Lugade, V.V., Kamble, P.S., Jayannawar, D.P., Nimbalkar, M.S. and Patil, S.A. 2025. Chemo-profiling by UPLC-QTOF-MS, GC-MS/MS analysis and *in vitro* bioactivity assessment of *Desmodium gangeticum* DC. South African Journal of Botany 185: 277–293.

Kazaz, S., Miray, R., Lepiniec, L. and Baud, S. 2022. Plant monounsaturated fatty acids: Diversity, biosynthesis, functions and uses. Progress in Lipid Research 85: 101138

Kirtikar, K.R. and Basu, B.D. 2005. Indian Medicinal Plants, International Book Distributors.

Koo, I., Kim, S. and Zhang, X. 2015. Comparative analysis of mass spectral matching-based compound identification in gas chromatography-mass spectrometry. J Chromatogr A. 1298: 132-138.

Pandey, K.B. and Rizvi, S.I. 2009. Plant polyphenols as dietary antioxidants in human health and disease. Oxid Med Cell Longev. 2(5):270-8.

Salunkhe, N.B., Kadam, A.P., Aparadh V.T. and Chavan, J.J. 2013. Comparative study of photosynthetic pigments and phenolic content in three *Barleria* species. World J. Pharm. Res. 2(3):626-630.

Sasidharan, S., Chen, Y., Saravanan, S., Sundram, K.M. and Yoga Latha, L. 2011. Extraction, isolation and characterization of bioactive compounds from plants extracts. Afr J Tradit Complement Altern Med. 8(1): 1-10.

Shete, R.S., Wangikar, H.V., Chavan, J.J., Kanade, M.B. and Chavan, S.J. 2024. Bioactive compounds of bryophytes: unveiling antimicrobial properties and therapeutic potential. International Journal of Plant and Environment 10(3):1-4.