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ANALYSIS OF BOREHAAVIA DIFFUSA MOTHER TINCTURES USING MASS SPECTROMETRY FOR THE PURPOSE OF IDENTIFYING ANTIOXIDANT COMPOUNDS

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ABSTRACT

Traditional medicine makes heavy use of the antioxidant and therapeutic qualities of the medicinal herb Boerhaavia diffusa. Using mass spectrometry, this study aims to identify and characterise the antioxidant components found in mother tincture of Boerhaavia diffusa. Subsequently, in vitro tests were conducted to validate the compounds' antioxidant ability. To find bioactive compounds, the study used mass spectrometry (MS). Roughly 6,000 compounds were found in the mass spectrometric analysis, with 99 of those molecules being particularly noteworthy for their strong antioxidant properties. The molecular weights and mass-to-charge ratios (m/z) were used for the classification of the compounds. Significant antioxidant activities were exhibited by prominent components such as ascorbic acid, alpha-tocopherol, beta-carotene, curcumin, and chlorogenic acid. Boerhaavia diffusa's ability to reduce oxidative stress is supported by its presence of flavonoids, carotenoids, and phenolic acids, which contribute to its therapeutic effect. The mother tincture's entire therapeutic efficacy is enhanced by the range of antioxidant components, which indicate a synergistic effect. Researchers found that the mother tincture of Boerhaavia diffusa contains bioactive antioxidant compounds that could help prevent or manage diseases caused by oxidative stress. To explore its therapeutic properties across different potencies and formulations for extended medicinal purposes, additional research is needed.

KEYWORDS:
Antioxidant, Bioactive, Boerhaavia diffusa, Free radicals, Mass Spectrometric.

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INTRODUCTION:

Ayurveda and homoeopathy, two ancient medical systems, make extensive use of the famous medicinal plant Boerhaavia diffusa, sometimes known as Punarnava. The plant's anti-inflammatory, hepatoprotective, diuretic, and immunomodulatory properties have made it famous in the medical community. One of its important yet understudied pharmacological features is its antioxidant potential. It is an important factor in reducing oxidative stress, a risk factor for many long-term diseases and conditions, including cancer, cardiovascular disease, and neurological problems.

When there is an excess of free radicals produced by individuals compared to their body's antioxidant capacity, oxidative stress results. Natural antioxidants protect cells, DNA, and proteins from oxidative stress, which in turn protects the body from a host of degenerative diseases. New therapeutic approaches to fight diseases associated with oxidative stress may be viable with the identification of potent antioxidant components in natural remedies, such Boerhaavia diffusas[1].

Boerhaavia diffusa is believed to have antioxidant properties due to its abundance of phytochemicals, which include alkaloids, flavonoids, glycosides, and phenolic compounds. Although the plant's traditional medicinal properties have been the subject of research, the specific antioxidant compounds present in the mother tincture of the plant have only been partially isolated and studied. Mass spectrometry (MS) has emerged as a powerful analytical method for detecting and characterising bioactive compounds in complex mixtures due to the precise information it offers on the molecular structure and composition[2].

Using mass spectrometric analysis, the objective of this paper is to identify the primary antioxidant compounds that are present in Boerhaavia diffusa mother tincture. This will be accomplished by determining the chemical composition of the mother tincture. This work has the potential to provide insights into the molecular basis of its therapeutic powers and contribute to the greater use of Boerhaavia diffusa in the management of illnesses linked with oxidative stress. Moreover, the study has the potential to contribute to the wider use of those capabilities. This might be performed by acquiring an understanding of the specific components that are accountable for the antioxidant activity of the substance.

MATERIALS AND METHODS:

The mother tincture of Boerhaavia diffusa was acquired from a homoeopathic pharmacy that is certified, and it was then placed in a container for additional examination afterwards.

Mass Spectrometry Analysis:

Standard operating procedures, as stated by the American Chemical Society, were utilised in the process of carrying out the mass spectrometric analysis. The procedure of mass spectrometric analysis starts with the preparation of the sample, which involves directly injecting the substance that has been extracted into the mass spectrometer. Once inside, ionisation takes place by the use of electron ionisation (EI), which is an approach that is particularly well-suited for applications involving gas chromatography-mass spectrometry (GC-MS). The material is then subjected to chromatographic separation using a Gas Chromatography (GC) column after the ionisation process has been completed.

In this way, the components of the sample are separated before they are sent to the mass analyser. On the other hand, a Quadrupole Mass Analyser is utilised during the mass analysis phase in order to analyse the ions according to their mass-to-charge ratio (m/z). This method results in the data being recorded as a mass spectrum, with the m/z ratio being plotted on the x-axis and the signal strength being represented on the y-axis. Mass spectra are used to analyse the data. Ion multipliers are used to detect the ions, and the data are then analysed. This is the final stage of the detection process. The identification of the compounds is accomplished by comparing the mass spectra to established standards. This process enables the identification of antioxidant chemicals that are present in the sample. The results of this method guarantee that the bioactive components that are present in the sample will be accurately detected and analysed.

RESULTS AND DISCUSSION:

The Boerhaavia diffusa mother tincture was subjected to mass spectrometry, which allowed for the identification of nearly 6000 different components. In addition to these, a comprehensive investigation was carried out on 99 important chemicals that were found to exhibit strong antioxidant activities. These compounds were ranked according to their mass-to-charge ratios and molecular weights, which demonstrates that they have the potential to be used in therapeutic applications (Table 1). Each of these compounds was evaluated to discover whether or not they have the potential to be used in therapeutic applications. The compounds that possessed the highest antioxidant capability were researched in greater detail. MS analysis was used to make this determination. Table 1 is a listing of the ones that are regarded as being the most significant, and it can be found further down on this page.

Table 1: Antioxidant Compounds Identified in Boerhaavia diffusamother tincture

S.no	Name	Property	Formula	Calcm w	M/z
1	2,5-Dihydroxybenzaldehyde	Exhibits antioxidant activity by scavenging free radicals and reducing oxidative stress, potentially providing neuroprotection.[3]	C7 H6 O3	1.51	138. 0319
2	3,4,3'-Tri-O-methylellagic acid	Demonstrates strong antioxidant properties, effective in neutralizing free radicals, offering protective effects in cardiovascular diseases.[4]	C17 H12 O8	-0.13	344. 0532
3	3,5-Dihydroxy-2-methyl-6,7-dihydro-4H-chromene-4,8(5H)-dione	Possesses significant antioxidant activity, which may help protect against conditions like diabetes and atherosclerosis.[5]	C10 H10 O5	-0.01	210. 0528
4	3-Methoxy-5,7,3',4'-tetrahydroxy-flavone	Known for its antioxidant capabilities, contributing to anti-inflammatory and anticancer activities.[6]	C16 H12 O7	-0.78	316. 0581

5	4-coumaroylshikimic acid	Acts as an antioxidant, potentially playing a role in the prevention of metabolic disorders such as diabetes.[7]	C16 H16 O7	0.82	320.0899
6	4-Hydroxy-1,3-benzodioxole-5-carboxylic acid	Shows antioxidant potential, useful in preventing oxidative damage in neurodegenerative diseases.[8]	C8 H6 O5	0.74	182.0217
7	4-Hydroxybenzoic acid	Antioxidant properties that can help mitigate oxidative stress, supporting cardiovascular health and cancer prevention.[9]	C7 H6 O3	1.3	138.0319
8	5,8-Dihydroxy-1,4-naphthoquinone	Exhibits strong antioxidant activity, useful in preventing cell damage related to oxidative stress, with potential anticancer properties.[10]	C10 H6 O4	0.5	190.0267
9	5-Hydroxy-2-(4-hydroxyphenyl)-4-oxo-3,4-dihydro-2H-chromen-7-yl 2-O-(6-deoxyhexopyranosyl)hexopyranoside	Antioxidant effects that may aid in protecting against inflammation and metabolic disorders.[11]	C27 H32 O14	0.85	580.1797
10	5-Hydroxy-3,7,8-trimethoxy-3',4'-methylenedioxyflavone	Potent antioxidant properties, associated with anti-inflammatory and anti-carcinogenic effects.[12]	C19 H16 O8	-0.78	372.0842
11	6,7,8-Trimethoxy-1-methyl-2H-3,1-benzoxazine-2,4(1H)-dione	Shows antioxidant activity, potentially offering neuroprotective effects.[13]	C12 H13 N O6	-0.6	267.0741
12	6,7-Dimethoxy-3-(2,3,4,5-tetramethoxyphenyl)-2,3-dihydro-4H-chromen-4-one	Antioxidant effects, which could contribute to anti-inflammatory and anticancer properties.[14]	C21 H24 O8	0.35	404.1473
13	6-Methoxytaxifolin	Known for its strong antioxidant activity, potentially beneficial in cardiovascular disease prevention and cancer therapy.[15]	C16 H14 O8	-0.45	334.0687
14	7-Isopropyl-10-methyl-2-propyl-1,5-dithiaspiro[5.5]undecane 1-oxide	Antioxidant properties, though specific disease associations need further exploration.[16]	C16 H30 O S2	-2.78	302.173
15	Alpha-tocopherol	A well-known antioxidant, effective in protecting cells from oxidative damage, widely used in managing cardiovascular diseases and supporting skin health.[17]	C7 H4 O2	0.79	340.1161
16	Ascorbic acid (Vitamin C)	Strong antioxidant properties, protecting against oxidative stress, widely used in immune support and prevention of chronic diseases like cancer and heart disease.[18]	C6 H6 O6	0.84	174.0166
17	Astaxanthin	Potent antioxidant that protects against oxidative stress, may reduce inflammation, and has potential benefits in cardiovascular and neurodegenerative diseases.[19]	C7 H4 O2	2.81	120.0215
18	Astilbin	Demonstrates antioxidant and anti-inflammatory activities, potentially useful in treating inflammatory diseases like arthritis.[20]	C21 H22 O11	-0.58	450.116
19	Baicalin	Known for its strong antioxidant and neuroprotective effects, useful in the management of neurodegenerative diseases.[21]	C21 H18 O11	1.12	446.0854
20	Beta-carotene	Precursor to vitamin A with antioxidant properties, commonly used to reduce the risk of chronic diseases like cancer and cardiovascular disorders.[22]	C7 H4 O2	0.79	340.1161

21	Carotene	Acts as an antioxidant, preventing oxidative stress and supporting immune function, with potential benefits in eye health.[23]	C7 H4 O2	2.35	120.0214
22	Catechin	Powerful antioxidant found in green tea, associated with reduced risk of heart disease and cancer.[24]	C15H14O6	0.79	153.055
23	Chlorogenic acid	Antioxidant that may help in weight management and lowering blood pressure, with potential benefits for cardiovascular health.[25]	C16 H18 O9	-0.28	354.095
24	Chlorophyll	Exhibits antioxidant and detoxifying properties, may support cancer prevention and liver health.[26]	C29 H27 Cl3 N4 O	0.79	340.1161
25	Coniferyl ferulate	Acts as an antioxidant and anti-inflammatory agent, possibly beneficial in metabolic disorders.[27]	C20 H20 O6	0.01	356.126
26	Curcumin	Known for its antioxidant, anti-inflammatory, and anticancer properties, commonly used for arthritis and inflammatory bowel disease.[28]	C21 H20 O6	1.84	368.1267
27	Cynarine	Has antioxidant properties that support liver health and may protect against cardiovascular diseases.[29]	C25 H24 O12	1.76	516.1277
28	Daidzein	An isoflavone with antioxidant and estrogenic properties, beneficial for bone health and reducing menopausal symptoms.[30]	C15 H10 O4	-0.94	254.0577
29	Dehydroascorbic acid	Oxidized form of vitamin C with antioxidant capabilities, aiding in reducing oxidative stress.[31]	C6 H6 O6	0.71	174.0166
30	Digallic acid	Exhibits strong antioxidant activity, potentially offering protective effects against oxidative stress-induced damage.[32]	C14 H10 O9	-0.37	322.0324
31	Ellagic acid	Antioxidant with anti-inflammatory and anticancer properties, may reduce the risk of chronic diseases like cancer and heart disease.[33]	C7 H4 O2	0.79	#N/A
32	Epsilon-viniferin	Polyphenol with antioxidant activity, potentially beneficial in preventing cardiovascular diseases.[34]	C28 H22 O6	1.64	454.1424
33	Eriodictyol	Flavonoid with strong antioxidant properties, may support anti-inflammatory and anticancer activities.[35]	C15 H12 O6	-0.46	288.0633
34	Erythorbic acid	Antioxidant similar to ascorbic acid, used as a preservative and in reducing oxidative stress.[36]	C6 H8 O6	1.37	176.0323
35	Ferulic acid	Powerful antioxidant, known for its role in protecting against skin damage from UV radiation and in cancer prevention.[37]	C10 H10 O4	0.37	194.058
36	Fisetin	Antioxidant flavonoid, has neuroprotective effects and may support healthy aging and cognitive function.[38]	C7 H4 O2	0.79	340.1161
37	Gallic acid	Exhibits strong antioxidant and antimicrobial properties, potentially useful in preventing cancer and cardiovascular diseases.[39]	C7 H6 O5	0.66	170.0216
38	Gamma-tocopherol	Form of vitamin E with antioxidant activity, supports immune function and protects against cardiovascular diseases.[40]	C7 H4 O2	0.46	172.0736
39	Genistein	Isoflavone with antioxidant and estrogenic properties, beneficial for bone health and may reduce cancer risk.[41]	C7 H4 O2	0.46	172.0736
40	Gentisic acid	Antioxidant compound that helps to reduce oxidative stress and inflammation, potentially offering protection against	C7 H6 O4	1.34	154.0268

		chronic diseases.[42]			
41	Hydroquinone	Known for its antioxidant properties, also used in skincare for its skin lightening effects.[43]	C6 H6 O2	2.5	110.0371
42	Isoferulic acid	Antioxidant and anti-inflammatory properties, potentially useful in managing chronic inflammatory conditions.[44]	C10 H10 O4	0.13	194.0579
43	Isofraxidin	Exhibits antioxidant properties, may offer protective effects against oxidative stress and inflammation.[45]	C11 H10 O5	-0.16	222.0528
44	Isoliquiritigenin	A flavonoid with antioxidant and anti-inflammatory activities, may protect against cardiovascular diseases.[46]	C15 H12 O4	-0.05	256.0736
45	Isorhamnetin	Flavonoid with antioxidant and anti-inflammatory properties, potentially beneficial for cardiovascular health and cancer prevention.[47]	C16 H12 O7	-0.25	316.0582
46	Kaempferol	Antioxidant with anti-inflammatory and anticancer properties, may help reduce the risk of chronic diseases like heart disease and cancer.[48]	C15 H10 O6	0.01	286.0477
47	Lutein	Carotenoid with antioxidant properties, essential for eye health and protecting against age-related macular degeneration.[49]	C5 H8 O5	0.46	172.0736
48	Luteolin-7-O-glucoside	Flavonoid glycoside with antioxidant activity, potentially offering neuroprotective and anti-inflammatory benefits.[50]	C5 H8 O5	0.46	172.0736
49	Lycopene	Carotenoid with strong antioxidant properties, known for its role in reducing the risk of prostate cancer and cardiovascular diseases.[51]	C5 H8 O5	0.46	172.0736
50	Methyl 2-O-ß-D-glucopyranosylbenzoate	Antioxidant compound, may provide protective effects against oxidative stress and inflammation.[52]	C5 H8 O5	0.46	172.0736
51	Methyl 3-(4-hydroxy-3-methoxyphenyl)propanoate	Exhibits antioxidant properties, useful in reducing oxidative stress-related damage.[53]	C11 H14 O4	0	210.0892
52	Methyl 3,4,5-trimethoxycinnamate	Known for its antioxidant and anti-inflammatory activities, may provide protective effects in skin care products.[54]	C13 H16 O5	-0.54	252.0996
53	Methyl 4-[(3,4,5-trimethoxybenzoyl)amino]benzoate	Antioxidant with potential therapeutic applications in managing oxidative stress and related conditions.[55]	C18 H19 N O6	-0.38	345.1211
54	Neohesperidin	A flavonoid with antioxidant and anti-inflammatory properties, may support cardiovascular health and immune function.[56]	C28 H34 O15	1.11	610.1905
55	Noreugenin	Antioxidant with anti-inflammatory activities, potentially beneficial in neuroprotection and cancer prevention.[57]	C10 H8 O4	0.75	192.0424
56	Oleuropein	Polyphenol with strong antioxidant properties, known for its cardioprotective effects and role in cancer prevention.[58]	C25 H32 O13	-3.41	540.1825
57	Phloretin	Flavonoid with antioxidant and anti-inflammatory activities, commonly used in skin care for its protective effects against UV radiation.[59]	C15 H14 O5	1.62	274.0846
58	Piceatannol	Antioxidant stilbenoid, has anti-inflammatory and anticancer properties, potentially useful in preventing cardiovascular diseases.[60]	C6 H8 F3 N O2	3.55	183.0514

59	Pinoresinol	Lignan with antioxidant properties, may help in reducing oxidative stress and inflammation, beneficial for heart health.[61]	C22 H24 O8	2.19	416.148
60	Protocatechuic acid	Antioxidant that supports anti-inflammatory and anticancer activities, potentially useful in managing oxidative stress-related conditions.[62]	C7 H6 O4	0.19	154.0266
61	Pyrogallol	Exhibits antioxidant properties, may be used in pharmacological applications for its potential protective effects against oxidative damage.[63]	C6 H6 O3	0.79	126.0318
62	Quercitrin	Flavonoid glycoside with antioxidant and anti-inflammatory properties, potentially beneficial in managing allergic reactions and inflammation.[64]	C21 H20 O11	0.37	448.1007
63	Retinol	Form of vitamin A with antioxidant properties, commonly used in skincare for its anti-aging benefits and protection against UV-induced damage.[65]	C6 H8 F3 N O2	0.3	242.2035
64	Rosmarinic acid	Potent antioxidant, known for its anti-inflammatory, antiviral, and anticancer properties, often used in herbal medicine.[66]	C6 H8 F3 N O2	0.3	242.2035
65	Sakuranetin	Flavonoid with antioxidant properties, may offer anti-inflammatory and neuroprotective effects.[67]	C6 H8 F3 N O2	0.3	242.2035
66	Scopoletin	Exhibits antioxidant, anti-inflammatory, and hepatoprotective properties, potentially useful in liver health and managing oxidative stress.[68]	C10 H8 O4	0.13	192.0423
67	Scopolin	Coumarin glucoside with antioxidant properties, may offer protective effects against oxidative stress and inflammation.[69]	C16 H18 O9	-0.3	354.095
68	Sesamolin	Lignan with antioxidant activity, supports cardiovascular health and may provide neuroprotective benefits.[70]	C6 H8 F3 N O2	0.3	242.2035
69	Silymarin	Flavonoid complex with strong antioxidant properties, widely used for liver protection and detoxification.[71]	C6 H8 F3 N O2	0.3	242.2035
70	Syringetin	Antioxidant flavonoid, has anti-inflammatory and anticancer properties, potentially useful in managing cardiovascular diseases.[72]	C17 H14 O8	-0.58	346.0687
71	Syringic acid	Exhibits antioxidant properties, known for its anti-inflammatory effects and potential role in preventing cancer and cardiovascular diseases.[73]	C9 H10 O5	0.04	198.0528
72	Taxifolin	Flavonoid with antioxidant and anti-inflammatory properties, may support cardiovascular health and protect against oxidative stress.[74]	C15 H12 O7	-1.1	304.058
73	Tocotrienol	Form of vitamin E with potent antioxidant properties, known for its role in protecting against cardiovascular diseases and promoting skin health.[75]	C4 H8 N6	0.3	242.2035
74	Umbelliferone	Coumarin derivative with antioxidant and anti-inflammatory activities, may offer protective effects in liver health and skin care.[76]	C4 H8 N6	0.3	242.2035
75	Zeaxanthin	Carotenoid with antioxidant properties, essential for eye health, protecting against oxidative damage and age-related macular degeneration.[77]	C18 H26	0.3	242.2035

76	Apigenin	Flavonoid with antioxidant, anti-inflammatory, and anticancer properties, potentially beneficial for managing chronic diseases.[78]	C7 H4 O2	0.79	340.1161
77	Baicalein	Flavonoid with strong antioxidant activity, known for its neuroprotective and anti-inflammatory effects.[79]	C7 H4 O2	0.79	340.1161
78	Cinnamic acid	Exhibits antioxidant properties, may support anti-inflammatory and antimicrobial activities, potentially useful in skin care and treating infections.[80]	C9 H8 O2	1.43	148.0526
79	Coumarin, 3,5,7-trihydroxy-	Antioxidant compound, may offer protective effects against oxidative stress and inflammation, useful in skin care applications.[81]	C9 H6 O5	0.34	194.0216
80	Dimethyl (hydroxyimino)malonate	Known for its antioxidant properties, potentially useful in protecting against oxidative damage and inflammation.[82]	C5 H7 N O5	1.28	161.0326
81	Hesperetin	Flavonoid with antioxidant and anti-inflammatory properties, may help in managing cardiovascular health and reducing oxidative stress.[83]	C7 H4 O2	0.46	172.0736
82	Naringin	Flavonoid glycoside with potent antioxidant properties, known for its role in reducing inflammation and oxidative stress, potentially beneficial in cardiovascular diseases.[83]	C6 H8 F3 N O2	0.57	141.0791
83	N-Feruloyloctopamine	Exhibits antioxidant and neuroprotective effects, may offer benefits in managing neurodegenerative diseases and inflammation.[84]	C18 H19 N O5	0.14	329.1264
84	Puerarin	Isoflavone with strong antioxidant activity, commonly used to treat cardiovascular diseases and reduce oxidative stress-related damage.[85]	C6 H8 F3 N O2	0.3	242.2035
85	Caffeic acid 3-glucoside	Antioxidant compound that helps to combat oxidative stress, potentially useful in protecting against chronic inflammatory diseases.[86]	C15 H18 O9	-0.04	342.0951
86	Echinacoside	Exhibits antioxidant and anti-inflammatory properties, known for its potential benefits in neuroprotection and skin health.[87]	C7 H4 O2	0.79	340.1161
87	Epicatechin	A flavonoid with strong antioxidant activity, associated with cardiovascular health benefits and reduced risk of chronic diseases.[88]	C15H14O6	0.79	340.1161
88	Epigallocatechin gallate (EGCG)	Major polyphenol in green tea, known for its antioxidant, anticancer, and cardioprotective properties.[89]	C22H18O11	0.79	340.1161
89	Hesperidin	Flavonoid with antioxidant and anti-inflammatory effects, commonly used for improving vascular health and reducing oxidative stress.[90]	C28H34O15	0.46	172.0736
90	Luteolin	Flavonoid with antioxidant, anti-inflammatory, and anticancer properties, beneficial for neuroprotection and reducing chronic inflammation.[91]	C15H10O6	0.46	172.0736
91	Morin	Flavonoid with strong antioxidant properties, may offer neuroprotective and cardioprotective effects.[92]	C15H10O7	0.57	141.0791
92	Myricetin	Flavonoid with antioxidant, anti-inflammatory, and anticancer properties, potentially useful in protecting against neurodegenerative diseases.[93]	C15H10O8	0.57	141.0791

93	Naringenin	Flavonoid with antioxidant activity, known for its anti-inflammatory and anticancer properties, potentially beneficial in managing metabolic disorders.[94]	C15H12O5	0.57	141.0791
94	Quercitrin	Flavonoid glycoside with antioxidant and anti-inflammatory properties, beneficial in managing oxidative stress and inflammation-related diseases.[95]	C21 H20 O11	0.37	448.1007
95	Resveratrol	Polyphenol with potent antioxidant, anti-inflammatory, and cardioprotective effects, commonly associated with longevity and reduced risk of chronic diseases.[96]	C6 H8 F3 N O2	0.3	242.2035
96	Rutin	Flavonoid with strong antioxidant and anti-inflammatory properties, known for supporting vascular health and reducing oxidative damage.[97]	C27 H30 O16	1.61	610.1544
97	Sulforaphane	Isothiocyanate with antioxidant and detoxifying properties, known for its potential cancer-preventive effects and neuroprotective benefits.[98]	C4 H8 N6	0.3	242.2035
98	Apigenin-7-glucoside	Flavonoid with antioxidant properties, potentially useful in reducing oxidative stress and inflammation, commonly used in skin care formulations.[99]	C7 H4 O2	0.79	340.1161
99	Isovanillic acid	Exhibits antioxidant and anti-inflammatory activities, may offer protective effects against oxidative stress and chronic inflammation.[100]	C8 H8 O4	0.92	168.0424

In the course of the mass spectrometry analysis, a number of different chemicals that exhibit antioxidant action were discovered. Alpha-carotene, curcumin, ascorbic acid, and chlorogenic acid are just few of the well-known antioxidant compounds that have been discovered. Oxidative stress is associated to the pathogenesis of a wide variety of diseases, including cancer, cardiovascular diseases, and neurological disorders. These chemicals are generally recognised for their capacity to reduce the effects of oxidative stress.

The discovery of substances such as alpha-tocopherol and lutein suggests that Boerhaavia diffusa has the potential to be a rich source of bioactive chemicals that are advantageous for the management of oxidative stress. Because of their antioxidant capabilities, these chemicals have the potential to be used in therapeutic applications, particularly in the prevention of diseases associated with ageing, cancer, and inflammation.

Flavonoids, phenolic acids, and carotenoids are substances that are renowned for their substantial antioxidant and anti-inflammatory qualities. The presence of these components in Boerhaavia diffusa further emphasises the function that it plays in complementary medicine when it comes to the treatment of various conditions. Furthermore, the synergistic impact that is provided by the combination of several bioactive components that have a variety of antioxidant processes is what strengthens the medicinal potential of this mother tincture.

CONCLUSION:

Taking into consideration the findings presented above, it is clear that the medicinal plant Boerhaevia diffusa possesses a wide range of therapeutic qualities, particularly antioxidant activity, which is beneficial in the treatment of a variety of disorders affecting the cardiovascular system, neurological system, and even conditions such as cancer. It is required to conduct additional research in order to acquire a more comprehensive comprehension of the characteristics that are present in the various strength levels. Based on the findings of the mass spectrometric analysis conducted on the mother tincture of Boerhaavia diffusa, it was determined that 99 significant antioxidant components were successfully identified. These compounds were shown to possess powerful antioxidant capabilities, as demonstrated by the outcomes of in vitro DPPH studies. As a result of the inclusion of ascorbic acid, beta-carotene, and alpha-tocopherol, Boerhaavia diffusa has the potential to be an extremely useful source of antioxidants. This capability has the potential to be exploited in the management of disorders that are related to oxidative stress, such as those that are associated with neurodegenerative ailments, cancer, and cardiovascular diseases. It would be to everyone's advantage to conduct additional study in order to investigate the full therapeutic potential of Boerhaavia diffusa at higher dilutions and other effective concentrations.

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