Evaluation Of Bioactive Compounds in *Desmidorchis Indica* Stem Extract Using Spectroscopic and Chromatographic Techniques

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Abstract: Desmidorchis indica is a small fleshy herbs and umbels terminal belonging to the Apocynaceae family. Extraction is the first step of any medicinal plant study, plays a significant and crucial role on the final result and outcome. In the present study to investigate the qualitative analysis of different extracts (aqueous, ethanol, hexane, hydro-ethanolic and petroleum ether) of Desmidorchis indica stem. Among the various extracts, the hydro-ethanolic extract of Desmidorchis indica stem contains a higher concentration of phytochemicals than other extracts and is used for subsequent studies. The UV-VIS spectroscopy revealed that the characteristic peak indicates the presence of various phytochemicals in the extract. The results of FTIR analysis showed the presence of alcohol, phenol, alkynes, alkenes, aromatic, carboxylic acid, aromatic and aliphatic amines groups in Desmidorchis indica stem extract. HPLC analysis of the hydro-ethanolic extract of Desmidorchis indica stem revealed that the presence of kaempferol, quercetin, epigallocatechin and hypersoide. Thirty compounds were identified in extract of Desmidorchis indica stem by GC-MS analysis. The prevailing compounds are n-hexadecanoic acid, 1-octadecanol, cis-11-eicosenoic acid, heptadecanoic acid, oleic acid, octadecanoic acid, 12,15-octadecadiynoic acid, methyl, 9-octadecenoic acid, eicosanoic acid, 2-methyl-z,z-3,13-octadecadienol, di-(9-octadecenoyl)-glycerol, hexadecanoic acid, 2,3-dihydroxypropyl ester and docosanoic acidwere found in this Desmidorchis indica stem. Overall, it can be concluded that Desmidorchis indica stem is a rich source of phytochemicals confirmed through qualitative, quantitative, spectroscopic and chromatographic techniques.

Keywords: Desmidorchis Indica, Phytochemicals, Qualitative, Quantitative, Spectroscopic and Chromatographic Techniques

1. INTRODUCTION

Natural products are currently of considerable significance due to their unique attributes as a significant source of therapeutic phytochemicals and their efficacy, safety and minimal side effects **(Swamy and Akhtar, 2019)**. Medicinal plants are key sources of raw materials for both modern and traditional medicines and have been used to cure human ailments for many years. These medications serve as an important source of new bioactive compounds, such as antimicrobial agents **(Batool *et al.,* 2018)**.

Plant-derived substances have recently attracted great interest, owing to their versatile applications. Medicinal plants are the richest source of bioactive compounds used in traditional and modern medicine as nutraceuticals and food supplements, pharmaceutical intermediates and chemical entities for synthetic drugs **(Velavan, 2015; WHO, 2009).**

Bioactive compounds are substances with strong action potential synthesized by the secondary metabolism of plants. These components are extremely important since their production is closely related to plant responses to imposed diversities over time **(Vivaldo *et al.,* 2017)**. A diversity of compounds is detected in large amounts in plant materials such as flowers and fruits, vegetables, nut-based, leaves, roots, etc. **(Demoliner *et al.,* 2020; Botella *et al.,* 2021)**.

Plants constitute a range of bioactive compounds, such as phenolics, flavonoids, anthocyanins, terpenes and terpenoids, etc. Plants are known to contain phytochemicals of pharmacological relevance and as such have been utilized in the treatment and management of various diseases. **(Boncan *et al.,* 2020; Yonekura-Sakakibara *et al.,* 2019; Cosme *et al.,* 2020; Cappellini *et al.,* 2021).** These elements have a high potential for application and are

widely explored for their various benefits to human health and the environment. Chromatography is a technique where the molecules are separated based on their size, shape and charge **(Heftmann, 1992)**.

GC-MS has found usefulness as a tool which qualifies for the effective separation of phytochemicals **(Kopka, 2006).** Fourier Transform Infrared determines the vibrations of bonds within chemical functional groups and generates a spectrum that can be considered as a biochemical or metabolic "fingerprint" of the sample **(Mariswamy *et al.,* 2012)**.

FTIR and GC-MS techniques have become firmly established as key technological metabolic profiling of medicinal plants **(Hemalatha *et al.,* 2016).** Several authors describe the use of HPLC for characterization and quantification of secondary metabolites in plant extracts, mainly phenol compounds, steroids, flavonoids, alkaloids **(Reis Ede *et al.,* 2014).** Our present research is focused on evaluation of bioactive compounds in *Desmidorchis indica* stem extract using qualitative, quantitative, spectroscopic and chromatographic techniques.

2. MATERIALS AND METHODS

2.1. Collection of Plant Materials

The *Desmidorchis indicain* stem was collected from Kathattipatti (Palaiyapatti North), Sengipatti Village at Thanjavur District in the month of December-2022. The *Desmidorchis indicain* stem was first washed well and dust was removed from the stem. The stem was cut into small pieces and dried at room temperature for 3 weeks. The dried stem was made a fine powder using a mixer grinder. The stem powder was kept in air tight container and used for various phytochemical analysis.

2.2. Preparation of Plant Extracts

10grams of *Desmidorchis indica* stem powder were used for extraction. Extraction was performed with cold extraction using the maceration method into different solvents such as aqueous, ethanol, hexane, petroleum ether and hydro-ethanolic (Ethanol and water) (70:30) for 24 hours using the "intermittent shaking" method to obtain extracts. The extracts were further filtered using Whatman filter No 1 paper and filtrate was used for phytochemical analysis.

2.3. Determining Extraction Yield

Extraction yield (%) = W1/W2×100; Where W1 is the mass of extract and W2 is the mass of the leaf powder. The yield of extraction was 13.20% (1.32/10 x 100).

2.4. Qualitative Phytochemical Analysis

Preliminary phytochemical screening was carried out by using standard procedure followed by **Sofowara (1993), Trease and Evans (1989)** and **Harborne (1973, 1984).**

2.5. Quantitative Phytochemical Analysis

The amounts of total phenolic contents of *Desmidorchis indica* stem were determined by the spectrophotometric method of **Kim *et al*., (2003)** with slight modification. The total flavonoids assay was conducted according to **Katasani (2011)** using Aluminium chloride colorimetric method. The total Tannins assay was conducted according to **Bajaj and Devsharma (1977)** method. Total saponins contents in *Desmidorchis indica* stem materials were estimated by colorimetric methods **(Hiai *et al.,* 1976).**

2.6. UV-Visible Spectroscopic and FTIR Analysis

The hydro-ethanolic extract of *Desmidorchis indica* stem was examined under UV and visible spectrophotometer analysis. The extract was scanned in the wavelength ranging from 190-1100nm using Perkin Elmer Spectrophotometer and the characteristic peaks were detected. FTIR analysis was performed using Spectrophotometer system, which was used to detect the characteristic peaks in ranging from 400-4000 cm^{-1} and their functional groups. The peak values of the UV and FTIR were recorded. Each and every analysis was repeated twice for the spectrum confirmation.

2.7. HPLC Analysis

Flavonoids fractions were analyzed by using a HPLC method **(Weerasak Samee *et al*., 2007; Paranthaman *et al*., 2012).** The HPLC analysis of *Desmidorchis indica* stem extract were carried out with Chromatographic system (Shimadzu Class-VPV6.14SP2, Japan) consist of autosampler with 20µl fixed loop and an UV-Visible detector. The gradient elution of solvent A [water-acetic acid (25:1 v/v)] and solvent B (methanol) had a significant effect on the resolution of compounds. As a result, solvent gradients were formed, using dual pumping system, by varying the proportion of solvent A [water-acetic acid (25:1, v/v)] to solvent B (methanol). Solvent B was increased to 50% in 4 min and subsequently increased to 80% in 10 min at a flow rate of 1.0 mL/min. The samples were run for 25min. and detection was done at 280 nm by UV detector (Lamp-D2). All chromatographic data were recorded and processed using autochro-software.

2.8. GC MS Analysis

1gram of *Desmidorchis indica* stem powder were used for extraction. Extraction was performed with cold extraction using the maceration method into and hydro-ethanolic (ethanol and water) (70:30) for 24 hours using the “intermittent shaking” method to obtain extracts. The extracts were further filtered using Whatman filter No 1 paper and filtrate was used for GCMS analysis. GC MS analysis was carried out on Shimadzu 2010 plus comprising a AOC-20i auto sampler and gas chromatograph interfaced to a mass spectrometer instrument employing the following conditions: column RTX 5Ms (Column diameter is 0..32mm, column length is 30m, column thickness 0.50µm), operating in electron impact mode at 70eV; Helium gas (99.999%) was used as carrier gas at a constant flow of 1.73 ml /min and an injection volume of 0.5 µl was employed (split ratio of 10:1) injector temperature 270 ºC; ion-source temperature 200 ºC. The oven temperature was programmed from 40 ºC (isothermal for 2 min), with an increase of 8 ºC/min, to 150ºC, then 8ºC/min to 250ºC, ending with a 20min isothermal at 280ºC. Mass spectra were taken at 70eV; a scan interval of 0.5 seconds and fragments from 40 to 450 Da. Total GC running time is 51.25min.

The relative percentage amount of each component was calculated by comparing its average peak area to the total areas. Software adopted to handle mass spectra and chromatograms was a Turbo Mass Ver 5.2.0 **(Srinivasan *et al*., 2013).**

2.9. Identification of Components

Interpretation on GCMS was conducted using the database of National Institute Standard and Technology (NIST) having more than 62,000 patterns. The spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained **(Dr. Dukes, 2013).**

3. RESULTS AND DISCUSSION

3.1. Phytochemicals Qualitative and Quantitative Analysis

The World Health Organization reported that 80% of the world population depend on traditional medicine for their primary health care needs **(Tugume and Nyakoojo, 2019).** The majority of treatment methods in traditional medicine utilizes biologically active herbal extracts and their phytoconstituents which inherit a vast range of medicinal and pharmacological properties against numerous chronic as well as acute diseases and disorders **(Shirsath and Goswami, 2020).**

Medicinal plants are an abundant source of secondary metabolites (Phytochemicals). Typically, bioactive compounds of plants are produced as secondary metabolites. Every living body, from one cell bacterium to million cell plants, processes diverse chemical compounds for their survival and subsistence. All compounds of biological system can be divided into two broad arenas. One is primary metabolites, which are the chemical substances aimed at growth and development, such as carbohydrates, amino acids, proteins and lipids. Another is secondary metabolites, which are a group of compounds other than primary metabolites believed to help plant to increase their overall ability to survive and overcome local challenges by allowing them to interact with their surroundings **(Harborne, 1993).**

The qualitative and quantitative studies of bioactive compounds from plant materials mostly rely on the selection of proper extraction method. Extraction is the first step of any medicinal plant study, plays a significant and crucial role on the final result and outcome. In the present study to investigate the qualitative analysis of different extracts (Aqueous, ethanol, hexane, hydro-ethanolic and petroleum ether) of *Desmidorchis indica* stem. **Table 1** represent the yield of various extracts. The yield of extracts of aqueous, ethanol, hexane, hydro-ethanol and petroleum ether were 9.84%, 12.35%, 5.46%, 15.65% and 6.23% respectively. The highest yield observed in hydro-ethanolic extracts due to the extraction power of hydro-ethanol.

The results confirm in the presence of tannin, saponin, flavonoids, steroid, terpenoids, triterpenoids, anthroquinone, polyphenol, glycoside and coumarins while alkaloids, emodins and anthocyanins were absent in ethanol, hydro-ethanolic and aqueous extracts of *Desmidorchis indica* stem. The hexane and petroleum ether extracts of *Desmidorchis indica* stem showed the presence of steroids, terpenoids and polyphenol while tannin, saponin, flavonoids, triterpenoids, alkaloids, anthroquinone, glycoside, coumarins, emodins and anthocyanins were absent **(Table 2)**.

Among the various extracts, the hydro-ethanolic extract of *Desmidorchis indica* stem contains a higher concentration of phytochemicals than other extracts and is used for subsequent studies. Quantitative analysis of phenol, flavonoid, tannin and saponin content in hydro-ethanolic extract of *Desmidorchis indica* stem **(Table 3 and Figures 1-4)**.

Table 1: Yield of various extracts of *Desmidorchis indica* stem

Extracts	Weight of (W1) crude extract (g)	Weight of (W2) Sample taken (g)	Yield of Extract (s) (%)
Aqueous	0.984	10	9.84
Ethanol	1.235	10	12.35
Hexane	0.546	10	5.46
Hydro-ethanol	1.565	10	15.65
Petroleum ether	0.623	10	6.23

Table 2: Phytochemicals qualitative analysis of stem extract of *Desmidorchis indica*

S. No	Phytochemicals	Extracts				
		Aqueous	Ethanol	Hexane	Hydro-ethanolic	Petroleum ether
1	Tannin	++	++	-	++	-
2	Saponin	++	++	-	++	-
3	Flavonoids	+	++	-	++	-
4	Steroids	++	++	+	++	+
5	Terpenoids	++	+	+	++	+
6	Triterpenoids	++	+	-	++	-
7	Alkaloids	-	-	-	-	-
8	Anthroquinone	+	++	-	++	-
9	Polyphenol	++	++	+	++	+
10	Glycoside	++	++	-	++	-
11	Coumarins	++	++	-	++	-
12	Emodins	-	-	-	-	-
13	Anthocyanins	-	-	-	-	-

(-) Absent, (+) Present and (++) High concentration

Table 3: Quantitative analysis of phenol, flavonoid, tannin and saponin content in hydro-ethanolic extract of *Desmidorchis indica* stem

Name of Extract	Total phenol (Milligrams of Gallic acid (GAE) equivalents per gram)	Flavonoid (Milligrams of quercetin equivalents per gram)	Tannin (Milligrams of tannic acid equivalents per gram)	Saponin (Milligrams of Quillaja equivalents per gram)
Hydro-ethanolic	191.66 ± 13.41	164.77 ± 11.53	87.54 ± 6.12	126.42 ± 8.84

Values are expressed as Mean ± SD for triplicates

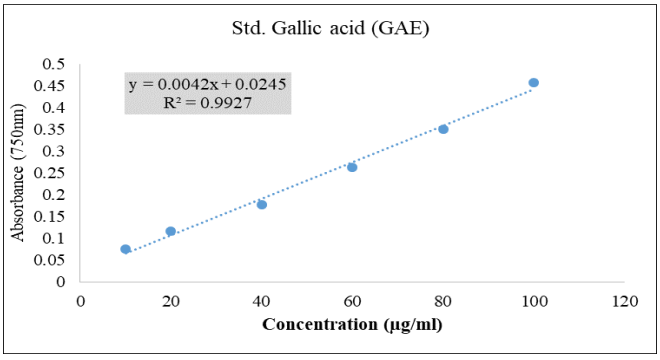

Figure 1: Standard Curve for Phenol using Gallic acid

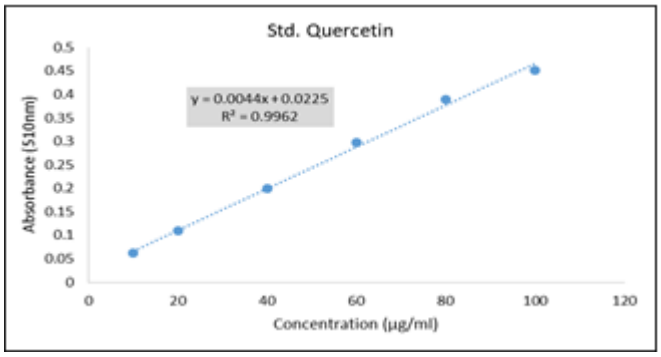

Figure 2: Standard Curve for flavonoid using Quercetin

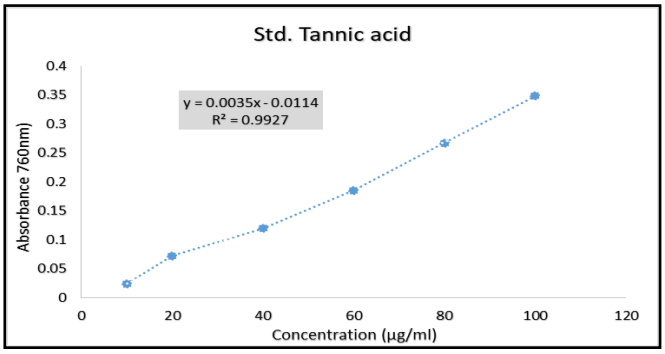

Figure 3: Standard Curve for tannin using Tannic acid

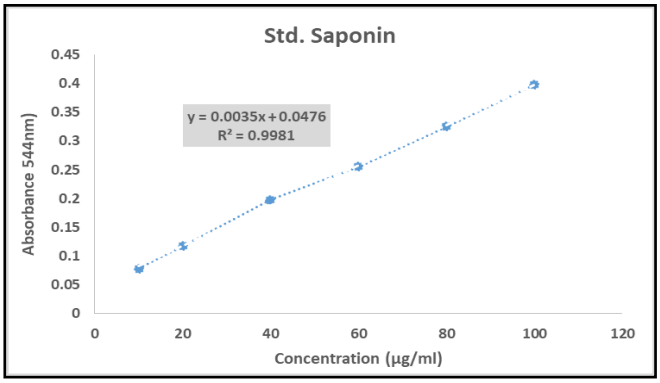

Figure 4: Standard Curve for saponin using Saponin

Phenolic compounds play an essential role in plants and foods. These compounds are well known for their biological and pharmaceutical activities. These compounds act as colorants and antioxidants. Research on phenolic compounds is mainly focused on their antioxidant properties. These compounds showed significant effects on chronic degenerative diseases, such as central neurodegenerative disorders, cataracts, macular degeneration (age-related), diabetes mellitus, cardiovascular complication, and cancer **(Ajay Kumar *et al.,* 2023).**

Flavonoids are considered as health promoting and disease preventing dietary supplements. It is now considered as an indispensable component in a variety of nutraceutical, pharmaceutical, medicinal, cosmetic and other applications. Many flavonoid compounds are shown to have an antioxidative activity, free radical scavenging capacity, cardioprotective, antidiabetic, anti-inflammatory, anti-allergic while some other flavonoid compounds exhibit potential antiviral activities. More recently flavonoids are proven to be the most effective as an anti-cancer

agent, through apoptosis by induction of cell cycle arrest and inhibition of key enzymes involved in tumor promotion **(Karak, 2019).**

Saponins are steroid or triterpenoid glycosides, common in a large number of plants and plant products that are important in human and animal nutrition. Several biological effects have been ascribed to saponins. Saponins also to have the analgesic, anti-nociceptive,antioxidant activity, to impair the digestion of protein, to cause hypoglycemia and to act as antifungal and antiviral agents **(Sapna *et al.,* 2009).**

3.2. Ultraviolet-visible Spectroscopy Analysis

In the UV-VIS spectra the appearance of one or more peaks in the region from 200 to 400 nm is a clear indication of the presence of unsaturated groups and heteroatoms such as S, N, O **(Njokua *et al.,* 2013).** The UV-VIS profile of *Desmidorchis indica* stem extract was studied over the 190 to 1100nm wavelength due to the sharpness of the peaks and proper baseline. The profile showed the peak at 205.8, 288.6 and 320.8 with the absorption 3.541, 0.88 and 0.768 respectively **(Figure 5 and Table-4)**. This finding is supported by **Costa *et al.,* (2015)**. The UV-VIS spectroscopy revealed that the characteristic peak indicates the presence of various phytochemicals in the extract.

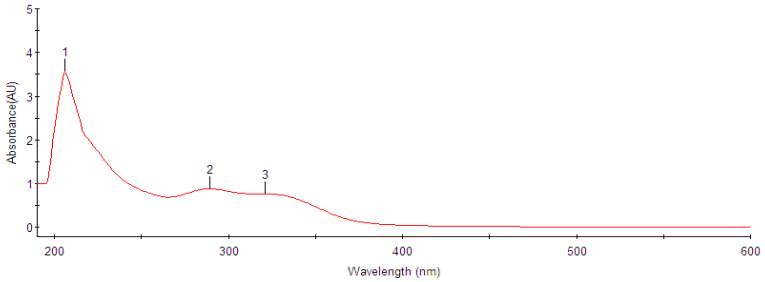

Figure 5: UV-Visible spectrum analysis of *Desmidorchis indica* stem extract

Table 4: UV-Visible spectrum analysis of *Desmidorchis indica* stem extract

Peaks	Wavelength (nm)	Absorbance (AU)
1	205.8	3.5814
2	288.6	0.8820
3	320.8	0.7687

3.3. FTIR Analysis

The FTIR spectrum was used to identify functional groups of the active components present in plant samples based on the peaks values in the region of IR radiation. The results of FTIR peak values and functional groups were represented in **figure 6** and **table 5.**

The results of FTIR analysis showed the presence of alcohol, phenol, alkynes, alkenes, aromatic, carboxylic acid, aromatic and aliphatic amines groups in *Desmidorchis indica* stem extract. Interpretation of IR spectra obtained from extract was achieved by comparing the spectral data with references from identification of functional groups **(Alara *et al.,* 2018; Sravan Kumar *et al.,* 2015).**

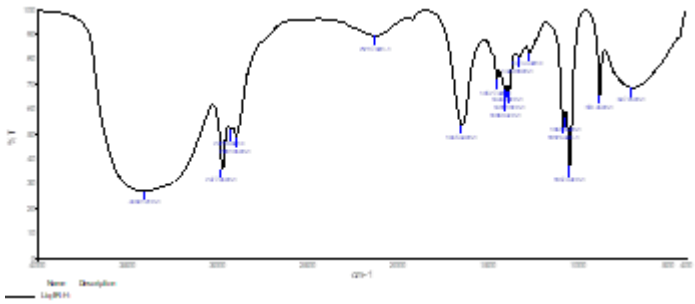

Figure 6: FTIR spectrum analysis of *Desmidorchis indica* stem extract

Table 5: FTIR spectrum analysis of *Desmidorchis indica* stem extract

Frequency cm^{-1}	Bond	Functional group
3409.12	O-H stretch, H-bonded	Alcohols, Phenols
2977.94, 2928.66, 2901.04	O-H stretch	Carboxylic acids
2128.74	-C≡C- stretch	Alkynes
1645.39	-C=C- stretch	Alkenes
1452.73, 1406.03	C-C stretch (in-ring)	Aromatics
1329.00, 1273.33	C-N stretch	Aromatic amines
1082.63, 1065.88, 1047.39	C-N stretch	Aliphatic amines
879.39, 697.26	C-H “loop”	Aromatics

3.4. HPLC Analysis

Figure 7 shows the chromatograms of the *Desmidorchis indica* stem extract containing flavonoid compounds obtained at wavelengths of 280nm. **Table 6** show the retention times of peaks for each flavonoid compound for every wavelength, respectively. Flavonoids present in the extract were identified by comparing chromatographic peaks with the retention time (Rt) with previous literature and identified the flavonoid compound present in the *Desmidorchis indica* stem extract. HPLC analysis of the hydro-ethanolic extract of *Desmidorchis indica* stem revealed that the presence of kaempferol, quercetin, epigallocatechin and hypersoide.

Several researchers explained the use of HPLC for the quantification and characterization of secondary metabolites of plant extracts **(Kaewseejan *et al.*, 2015; Garg, 2021; Bārzdiņa *et al.*, 2022).**

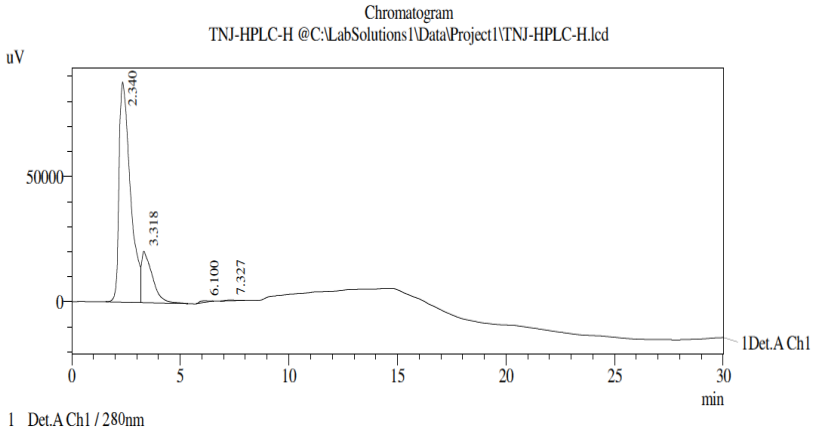

Fig.7: HPLC profile of *Desmidorchis indica* stem extract

Table.6: HPLC profile of *Desmidorchis indica* stem extract

Peak	Ret. Time	Area	Height	Area %	Height %	Compounds identified by literature *
1	2.340	3188462	87924	81.145	80.372	Kaempferol
2	3.318	709239	20441	18.050	18.685	Quercetin
3	6.100	19746	696	0.503	0.636	Epigallocatechin
4	7.327	11873	336	0.302	0.307	Hypersoide
Total		3929320	109396	100.000	100.000	

***Baram Ahmed Hamahameen and Banaz Jamal, (2013) and Tapan Seal (2016)**

Kaempferol has extensively highlighted the antioxidant, antimicrobial, anticancer, neuroprotective, and hepatoprotective activity **(Sneh Punia Bangar *et al*., 2022).** Quercetin has various biological properties, including antioxidant, anti-inflammatory, antibacterial, antiviral, radical-scavenging, anticancer, gastroprotective, and immune-modulatory activities **(Anand David *et al*., 2016).**

A number of preclinical *in vivo* and *in vitro* experiments as well as clinical trials have shown a wide range of biological and pharmacological properties of polyphenolic compounds such as anti-oxidative, antimicrobial, anti-allergic, anti-diabetic, anti-inflammatory, anti-cancer, chemoprotective, neuroprotective and immunomodulatory effects.

Epigallocatechin gallate controls high blood pressure, decreases blood cholesterol and body fat and decreases the risk of osteoporotic fractures **(Bartosikova and Necas, 2018)**. Hyperoside use in treating multiple diseases, such as sepsis, arthritis, colitis, diabetic nephropathy, myocardial ischemia–reperfusion, pulmonary fibrosis, and cancers **(Qi Wang *et al*., 2022).**

Identification of bioactive compounds in *Desmidorchis indica* stem by GC MS analysis

Thirty compounds were identified in extract of *Desmidorchis indica* stem by GC-MS analysis **(figure 8).** The active principles with their retention time (RT), molecular formula, molecular weight (MW) and concentration (%) are presented in Table 6. The prevailing compounds are n-hexadecanoic acid, 1-octadecanol, cis-11-eicosenoic acid, heptadecanoic acid, oleic acid, octadecanoic acid, 12,15-octadecadiynoic acid, methyl, 9-octadecenoic acid, eicosanoic acid, 2-methyl-z,z-3,13-octadecadienol, di-(9-octadecenoyl)-glycerol, hexadecanoic acid, 2,3-dihydroxypropyl ester and docosanoic acid were found in this *Desmidorchis indica* stem.

The presence of various bioactive compounds justifies the use of the plant for various ailments by traditional practitioners. However, phytochemical constituents and subjecting its biological activity represent in **table 7**. In the phytoconstituent evaluation and chemotaxonomic research of medicinal plants containing biologically active components, GCMS is significant **(Shalini and Ilango, 2021).** Structural assignment of GC retention data of compounds is based on spectral matching with NIST library (National Institute of Standards and Technology). The small peaks may be attributed to the compounds present in small quantities as well as disintegrated major compounds.

The peaks related to low retention times are mainly low polar plant compounds **(Satapathy *et al.*, 2009; Kalavathi, 2023). Table 8** represents the biological activity compounds identified in *Desmidorchis indica* stem using GCMS.

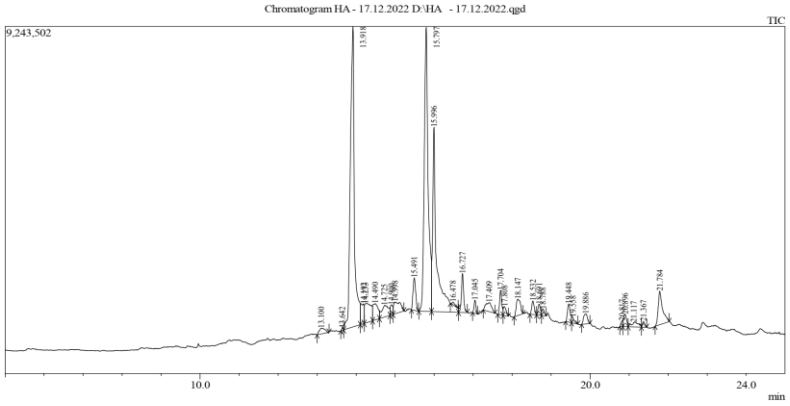

Fig. 8: GC-MS Chromatogram of *Desmidorchis indica* stem extract

Table 7: Identification of active compounds in *Desmidorchis indica* stem extract using GCMS

Peak	R. Time	Area %	Height %	Molecular Formula	Molecular Weight	Name of the compounds
1	13.100	0.73	0.49	$C_{11}H_{20}O$	168	10-Undecenal
2	13.642	0.12	0.19	$C_{11}H_{17}NO_4$	227	2-Nitro-2-(3-oxobutyl) cycloheptanone
3	13.918	27.53	26.41	$C_{16}H_{32}O_2$	256	n-Hexadecanoic acid
4	14.192	1.49	1.71	$C_{10}H_{20}O_2$	172	Octanoic acid, ethyl ester
5	14.233	2.90	1.69	$C_8H_{16}O_2$	144	Cyclooctane-1,4-diol, cis
6	14.490	1.81	1.45	$C_{18}H_{38}O$	270	1-Octadecanol
7	14.725	1.79	1.02	$C_{20}H_{38}O_2$	310	cis-11-Eicosenoic acid
8	14.900	0.58	0.88	$C_{17}H_{34}O_2$	270	Heptadecanoic acid
9	14.998	1.74	1.03	$C_{10}H_{20}O_2$	172	Decanoic acid, 2-propenyl ester
10	15.491	1.98	2.87	$C_{19}H_{38}O_3$	314	Octadecanoic acid, 6-hydroxy-,
11	15.797	25.53	24.97	$C_{18}H_{34}O_2$	282	Oleic Acid
12	15.996	16.93	16.21	$C_{18}H_{36}O_2$	284	Octadecanoic acid
13	16.478	0.15	0.23	$C_{19}H_{30}O_2$	290	12,15-Octadecadiynoic acid, methyl
14	16.727	2.04	3.42	$C_{22}H_{35}NO_4$	377	Hexadecanoic acid, 4-nitrophenyl
15	17.045	0.56	1.15	$C_{17}H_{31}F_3O$	308	1,1,1-Trifluoroheptadecen-2-one
16	17.409	1.18	0.78	$C_{17}H_{31}F_3O_2$	324	Trifluoroacetic acid, n-heptadecyl
17	17.704	1.20	2.15	$C_{35}H_{68}O_5$	569	Hexadecanoic acid, 2-hydroxy-1,3-propanediyl ester
18	17.808	0.58	0.78	$C_{12}H_{24}O_2$	200	cis-1,2-Cyclododecanediol
19	18.147	1.56	1.42	$C_{18}H_{34}O_2$	282	9-Octadecenoic acid (Z)-
20	18.532	0.77	1.20	$C_{16}H_{30}O$	238	Cyclopentadecanone, 4-methyl-
21	18.691	0.59	0.95	$C_{20}H_{40}O_2$	312	Eicosanoic acid
22	18.788	0.35	0.58	$C_{13}H_{24}O_2$	212	10-Methyldodecan-5-olide
23	19.448	1.17	1.60	$C_{19}H_{36}O$	280	2-Methyl-Z,Z-3,13-octadecadienol
24	19.558	0.31	0.51	$C_{12}H_{24}$	168	2-Undecene, 2-methyl-
25	19.886	0.87	0.89	$C_{32}H_{62}O_2$	478	9-Octadecenoic acid (Z)-, tetradecyl
26	20.817	0.26	0.50	$C_{10}H_{20}O_4$	204	4-t-Butoxy-3-hydroxy-butyric acid, ethyl ester
27	20.896	0.83	1.09	$C_{39}H_{72}O_5$	621	DI-(9-Octadecenoyl)-glycerol
28	21.117	0.80	0.38	$C_{19}H_{38}O_4$	330	Hexadecanoic acid, 2,3-dihydroxypropyl ester
29	21.367	0.30	0.51	$C_{22}H_{44}O_2$	340	Docosanoic acid
30	21.784	3.36	2.96	$C_{19}H_{38}O_4$	330	Glycerol 1-palmi

Table 8: Biological activity compounds identified in *Desmidorchis indica* stem using GCMS

R. Time	Name of the compounds	Biological activity**
13.918	n-Hexadecanoic acid	Antioxidant, Hypocholesterolemic Nematicide, Anti-Androgenic Flavour, Pesticide, Lubricant, Haemolytic 5-Alphareductase Inhibitor, antipsychotic, Potent Antibacterial Agent, Antimalarial And Antifungal
14.490	1-Octadecanol	Antimicrobial, antioxidant, anticancer
14.725	cis-11-Eicosenoic acid	Antimicrobial, Anti-inflammatory, anti-oxidant,
14.900	Heptadecanoic acid	Antioxidant, antifungal, surfactant
15.797	Oleic Acid	Anti-inflammatory, Anti-androgenic, Antidiabetic, Cancer preventive, Hypocholesterolemic, 5-Alpha reductase inhibitor
15.996	Octadecanoic acid	Lower LDL Cholesterol level, Antioxidant and anti-inflammatory
16.478	12,15-Octadecadiynoic acid, methyl	Anti-inflammatory, Antimicrobial
18.147	9-Octadecenoic acid	Anticancer, antimicrobial Anemiagenic, Insectifuge, Antiandrogenic, Dermatitigenic
18.691	Eicosanoic acid	Arachidic acid is used for the production of detergents, photographic materials and lubricants
19.448	2-Methyl-Z,Z-3,13-octadecadienol	Pesticide, herbicide, insecticide, pheromone
20.896	DI-(9-Octadecenoyl)-glycerol	Antimicrobial, Insectifuge
21.117	Hexadecanoic acid, 2,3-dihydroxypropyl ester	Cytotoxic, Antimicrobial
21.367	Docosanoic acid	Skin Conditioning Agent, Emulsifying agent, Surfactant, Flavour

**Source: Dr. Duke's phytochemical and ethnobotanical databases [Online database].

Due to existence of phenolic compounds and flavonoids, plant holds antioxidant activity on human fitness. Phenols, flavonoids and tannins are act as antioxidant compounds which play a role as free radical scavengers. Flavonoids are a set of polyphenolic compounds and exploit the inhibition of oxidative and hydrolytic enzymes **(Pourmorad *et al.,* 2006; Patel *et al.,* 2010)**. Tannins also accelerate the remedy for lesions in addition to irritated mucous membranes **(Salah *et al.,* 1995).** Terpenoids, as vitamins, act as regulators of metabolism and play a protective role as antioxidants along with it acquires antimicrobial, antiallergic and antiinflammatory activity **(Wagner and Elmadfa, 2003; Kalavathi, 2023a)**. Saponins seize the unique possession of precipitating then coagulating red blood cells **(Sodipo *et al.,* 2000).** According to numerous reports, glycosides retain the ability to lower the blood pressure **(Dhar *et al.,* 1979).**

n-Hexadecanoic acidact as antioxidant, hypocholesterolemic nematicide, anti-androgenic flavour, pesticide, lubricant, haemolytic 5-alphareductase inhibitor, antipsychotic, potent antibacterial agent, antimalarial and antifungal activities. 1-Octadecanol possess potential antimicrobial, antioxidant and anticancer activities. Cis-11-Eicosenoic acid have antimicrobial, anti-inflammatory and antioxidant activities. Heptadecanoic acid shows potent antioxidant, antifungal and surfactant. Oleic Acid that play an important role in anti-inflammatory, anti-androgenic, antidiabetic, cancer preventive, hypocholesterolemic, 5-alpha reductase inhibitors. Octadecanoic acid reduce the LDL Cholesterol level, antioxidant and anti-inflammatory activity. 12,15-Octadecadiynoic acid, methyl exhibit as anti-inflammatory and antimicrobial activities. 9-Octadecenoic acid showed anticancer, antimicrobial, anemiagenic, insectifuge, antiandrogenic and dermatitigenic. Eicosanoic acid is used for the production of detergents, photographic materials and lubricants. 2-Methyl-Z,Z-3,13-octadecadienol act as pesticide, herbicide, insecticide, pheromone activities. DI-(9-Octadecenoyl)-glycerol reported as antimicrobial and Insectifuge activities. Hexadecanoic acid, 2,3-dihydroxypropyl ester shows cytotoxic, and antimicrobial activities. Docosanoic acid act as Skin Conditioning Agent, emulsifying agent and surfactant **(Dr. Duke's, 2013).**

CONCLUSION

Overall, it can be concluded that *Desmidorchis indica* stem is a rich source of phytochemicals confirmed through qualitative, quantitate, spectroscopic and chromatographic techniques, which are accountable for its wide range pharmacological activities including anticancer, antiobesity, hypolipidemic, antidiabetic, antimicrobial, anti-inflammatory and antioxidant activities. HPLC analysis of the hydro-ethanolic extract of *Desmidorchis indica* stem revealed that the presence of kaempferol, quercetin, epigallocatechin and hypersoide. Thirty compounds were identified in extract of *Desmidorchis indica* stem by GC-MS analysis. The present work has been carried out with an intention to throw light on the uses and also to emphasize on their ability to act as therapeutic sources.

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