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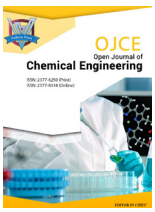

ARTICLE

MOLECULES AND FUNCTIONS OF ROSEWOOD: *DALBERGIA LOUVELII*

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ABSTRACT

Taking Dalbergia louvelii as an example, this paper uses PY-GC-MS, TDS-GC-MS and GC-MS techniques to study and analyze the components, so as to provide a theoretical basis for its high value utilization. Studies have found that Dalbergia louvelii contains many ingredients that are beneficial to the human body. Of which 7-Methyl-Z-tetradecen-1-ol acetate has the effect of antipyretic cough. Phytic acid and hex-3-yl isobutyl ester showed significant antitumor activity for MGC-803, MCF-7 and A549 cells. Butylated Hydroxytoluene significantly inhibited the occurrence of γ-GT positive disease in the liver.

KEYWORDS

Pterocarpus; Dalbergia louvelii; PY-GC-MS; GC-MS; TDS-GC-MS.

1. INTRODUCTION

Dalbergia louvelii mainly grows in Madagascar, belonging to Leguminosae Dalbergia. Dalbergia louvelii is a loose material, its growth round is not obvious. The wood heartwood is purple or dark purple, and it becomes dark purple the long time. Dalbergia louvelii's wood high strength, hardness, delicate structure, dense, with luster. Wood texture black and purple, with strong corrosion resistance and durability, and it is a very precious furniture and crafts materials [1]. Traditionally, Dalbergia louvelii is considered to be a useful timber with human health functions. Therefore, the Dalbergia louvelii powder was analyzed by PY-GC-MS, TDS-GC-MS, TG and FT-IR; The extractives of ethanol, ethanol/benzene and ethanol/methanol in the Dalbergia louvelii were analyzed by GC-MS and FT-IR; It explains its effective components on human body [2].

2. MATERIALS AND METHODS

2.1 Materials

The experimental sample Dalbergia louvelii came from Madagascar. Dalbergia louvelii was beaten into powder and ethanol, ethanol/benzene (1:2) and ethanol/methanol (1:1) were chromatographically pure.

2.2 Experimental methods

2.2.1 Extraction method

Part of the Dalbergia louvelii powder was weighed and bottled, then added to ethanol, ethanol / benzene and methanol solvent, then boiled in a water bath until boiling, and heated for 4 hours. The filtrate is then concentrated in a rotary evaporator.

2.2.2 FT-IR analysis

Three kinds of Dalbergia louvelii concentrate and powder were put into FT-IR for detection [3].

2.2.3 TG analysis

The Dalbergia louvelii powder was analyzed by TGA. The carrier gas used in the experiment is high purity nitrogen. The temperature of TG starts at 40°C and rises to 250°C at a rate of 5°C/min.

2.2.4 GC-MS analysis

Three concentrates of Dalbergia louvelii were analyzed by GC-MS. Elastic quartz capillary column, carrier gas is He. The GC temperature starts at 50°C, rises to 250°C at a rate of 8°C/min, and then rises to 300°C at a rate of 5°C/min.

2.2.5 TDS-GC-MS analysis

In this experiment, the powder of Dalbergia louvelii was tested and analyzed by thermal desorption (TDS-GC/MS). The initial temperature of TDS is 30°C, retained for 1 min, and rises to 100°C at a rate of 10°C/min, maintained for 5 mins, then rises to 200°C at a rate of 10°C/min, maintains the initial temperature of transmission line at -50°C, maintains 0.1 min, and then rises to 230°C at a rate of 10°C/s, maintains for 1 min. Gas chromatography-mass spectrometry (Agilent GC-MS 7890B 5977A). The temperature program of gas chromatography is set as follows: the initial temperature is 50°C, which rises to 250°C at the rate of 8°C/min, and then rises to 300°C at the rate of 5 °C/min. The scanning mass range of mass spectrometry program is from 30 amu to 600 amu, the ionization voltage is 70 ev, the ionization current is 150 muA, the ion

source temperature is set to 230℃, and the quadrupole temperature is 150 ℃. The analysis standard library is analyzed by NIST14.L database.

2.2.6 PY-GC-MS analysis

The powder of Dalbergia louvelii was detected and analyzed by pyrolysis (PY-GC/MS) technology (CDS5200-TRACE1310 ISQ). The carrier gas used in the experiment is high purity helium, and the pyrolysis program is set as follows: heating rate of 20℃/ms to 500℃, pyrolysis 15 s, pyrolysis product conveyor line and injection valve temperature set to 300℃; specification of capillary column (TR-5MS) is 30 m × 0.25 mm ×0.25 um; shunt ratio of shunt mode is set to 1:60, shunt rate is 50 mL/min. GC program temperature starts at 40℃ for 2 min, rises to 120℃ at a rate of 5℃/min, then rises to 200℃ at a rate of 10 per min, and remains for 15 min. The temperature of ion source (EI) is 280℃ and the scanning range is from 28 amu to 500 amu.

3. RESULTS AND ANALYSIS

3.1 FT-IR analysis

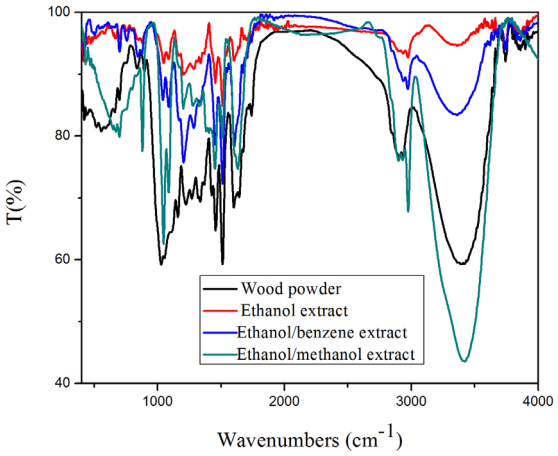

Figure 1: FT-IR spectra of Dalbergia louvelii powders and three extracts.

Figure 1 is the infrared spectra of Dalbergia louvelii powder and extract. At 3360 cm^{-1}, there is O-H stretching vibration, indicating the existence of cellulose, phenols, alcohols and carboxylic acids [4]. The spectra at 2900 cm^{-1} show that there is C-H, indicating that the spectral Ken energy is cellulose and hemicellulose. The spectrum of 1738 cm^{-1} is C=O tensile vibration, indicating that it contains lipids and ketones [5,6]. The infrared spectrum of 1462 cm^{-1} is C-H vibration of CH_3 and CH_2 in lignin and ether compounds [7,8]. Infrared spectrum 817 cm^{-1} is the vibration of G-type C-H outside the ring.

3.2 TG analysis

Figure 2 shows the thermogravimetric curve of Dalbergia louvelii. The mass loss of Dalbergia louvelii is faster in the temperature range of 30-60℃, mainly due to the evaporation of water and a small amount of oil; the continuous endothermic process of wood flour at 60-200℃; The pyrolysis reaction of Dalbergia louvelii is more intense. When the temperature is 200-250℃, the quality decreases rapidly.

3.3 GC-MS analysis

The following three figures are the total ion chromatograms of Dalbergia louvelii under three different solvent extracts.

The chemical constituents of the extracts were analyzed by GC-MS [9]. The ethanol extract of Dalbergia louvelii was analyzed by GC-MS. A total of 42 peaks were found and 4 compounds were identified. 48 peaks and 9 compounds were identified in the analysis of benzene and ethanol extracts by GC-MS. 72 peaks and 4 compounds were identified in the determination of ethanol/methanol extracts. Tables 1, 2 and 3 were the results of GC-MS analysis of three extracts of Dalbergia louvelii.

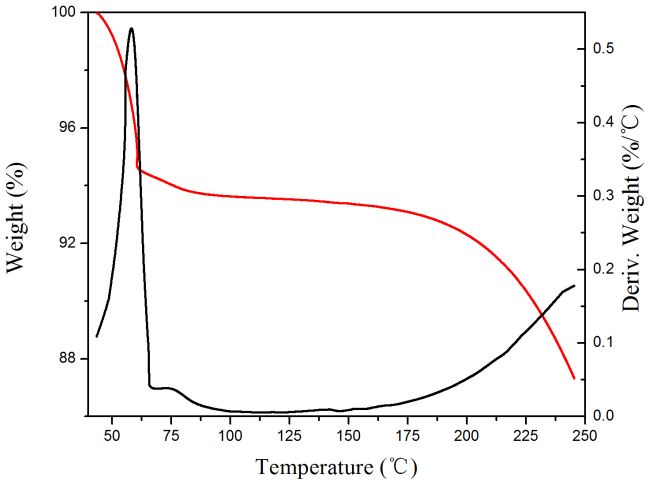

Figure 2: Dalbergia louvelii's TG curve.

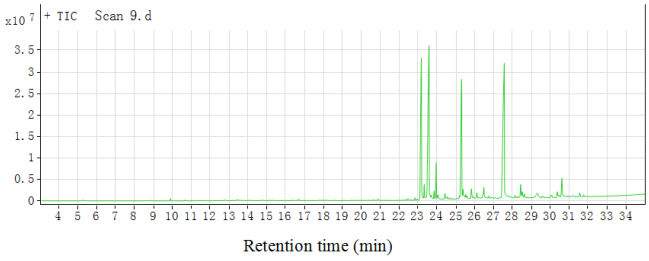

Figure 3: Total ion chromatogram of ethanol extractives of Dalbergia louvelii.

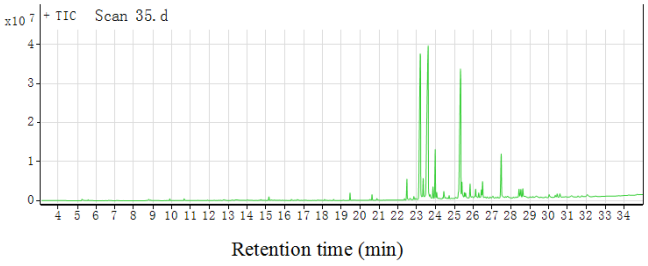

Figure 4: Total ion chromatogram of ethanol/benzene extractives of Dalbergia louvelii.

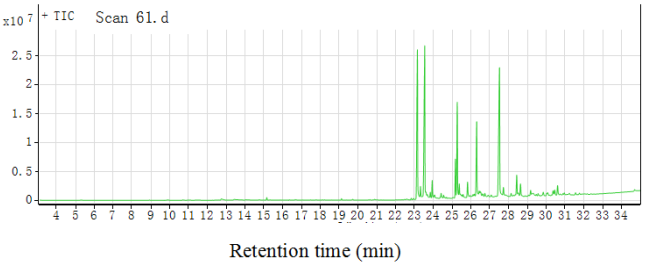

Figure 5: Total ion chromatogram of ethanol/methano extractives of Dalbergia louvelii.

Table 1: Ethanol extractives of GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	9.912	0.55	Benzaldehyde diethylacetal
2	16.678	0.56	Cryptomeridiol
3	25.307	55.54	Isoparvifuran
4	28.432	4.9	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

Table 2: Ethanol/Benzene extractives of GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	5.248	0.75	Benzaldehyde
2	8.799	0.64	Benzoic acid
3	10.668	0.62	2-Propenal, 3-phenyl-
4	15.164	0.91	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
5	19.466	1.74	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
6	20.63	1.36	Dibutyl phthalate
7	25.32	66.82	Isoparvifuran
8	26.426	2.32	4H-1-Benzopyran-4-one, 2,3-dihydro-5,7-dihydroxy-2-phenyl-, (S)-
9	28.425	2.37	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

Table 3: Ethanol/methanol extractives of GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	12.751	2.05	1,4-Benzenediol, 2-methoxy-
2	15.164	1.1	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
3	25.275	50.85	Isoparvifuran
4	28.432	11.73	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

3.4 TDS-GC-MS analysis

The active components of Dalbergia louvelii were analyzed by TDS-GCMS [10]. A total of 64 peaks were identified by TD-GCMS, of which 31 compounds were identified. The following table shows the results of gas chromatography analysis of Dalbergia louvelii powder.

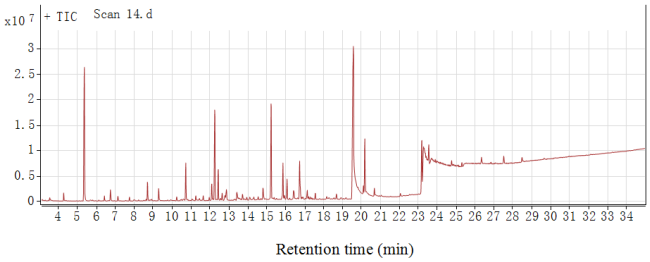

Figure 6: Total ion chromatogram of Dalbergia louvelii powder.

3.5 PY-GC-MS analysis

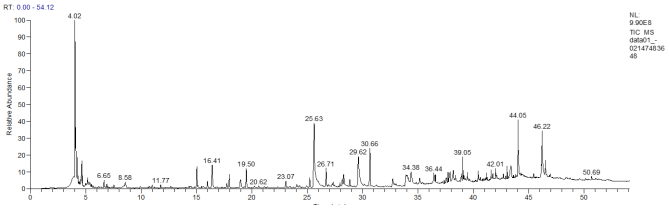

Figure 7: Relative abundance curve of the Dalbergia louvelii powder.

The composition of Dalbergia louvelii powder was analyzed by Py-GC-MS [11]. A total of 50 chromatographic peaks were found, and 10 compounds could be identified. Table 5 is the result of Py-GC-MS analysis of Dalbergia louvelii powder.

Table 4: Dalbergia louvelii powder of TDS-GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	4.272	1.68	Styrene
2	5.368	40.45	Benzaldehyde
3	6.427	1.13	Benzene, 1-propenyl-
4	6.742	2.93	Benzene, (methoxymethyl)-
5	7.133	1.12	Acetophenone
6	7.75	0.81	Nonanal
7	8.695	4.59	2-Propen-1-one, 1-phenyl-
8	9.288	3.01	Ethanol, 1-(2-butoxyethoxy)-
9	10.246	0.79	2-Butanone, 4-phenyl-
10	10.725	9.31	(Z)-3-Phenylacrylaldehyde
11	11.254	1.16	Formamide, N,N-dibutyl-
12	11.645	1.06	Phenol, 3,4-dimethoxy-
13	12.098	4.6	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate
14	12.25	27.01	Ethanol, 2-(2-butoxyethoxy)-, acetate
15	12.439	7.52	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
16	12.552	0.52	1-Propanone, 3-hydroxy-1-phenyl-
17	12.64	1.7	Hydrocoumarin
18	13.422	2.83	4-Methoxybenzene-1,2-diol
19	14.795	4.24	5-tert-Butylpyrogallol
20	15.224	26.93	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
21	15.854	8.85	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate

22	15.93	1.13	Phenol, 2,6-dimethoxy-4-(2-propenyl)-
23	16.068	4.94	Cedrol
24	16.736	12.48	2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
25	17.14	2.61	7-epi-cis-sesquisabinene hydrate
26	17.203	0.65	7-Methyl-Z-tetradecen-1-ol acetate
27	17.555	1.43	Tridecanoic acid, 12-methyl-, methyl ester
28	18.677	1.42	Tetradecane, 2,6,10-trimethyl-
29	19.572	10	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
30	20.101	1.61	Phthalic acid, hex-3-yl isobutyl ester
31	20.177	14.86	Hexadecanoic acid, methyl ester
32	20.681	1.36	Phthalic acid, 5-methylhex-2-yl butyl ester

Table 5: Dalbergia louvelii powder of PY-GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	5.17	7.33	Benzene
2	19.50	40.03	Phenol, 2-methoxy-
3	25.63	38.10	Catechol
4	28.17	5.32	1,2-Benzenediol, 3-methoxy-
5	28.84	28.29	Phenol, 4-ethyl-2-methoxy-
6	32.73	7.27	Phenol, 2,6-dimethoxy-
7	33.92	10.63	1,2,3-Benzenetriol
8	34.03	7.80	1,2,3-Benzenetriol

9	34.12	7.07	1,2,3-Benzenetriol
10	37.72	6.01	Butylated Hydroxytoluene
11	38.91	2.75	Dodecanoic acid
12	41.61	5.12	Ethanone, 1-(4-hydroxy-3,5-dimethoxyphenyl)-

3.6 Function of Dalbergia louvelii wood

From the above analysis, we can get some useful compounds for human body. The PY-GC-MS, TDS-GC-MS and GC-MS techniques were used to qualitatively analyze the Dalbergia louvelii, and the related compounds were obtained. Cryptomeridiol can treat neurodegenerative diseases, such as Alzheimer's disease [12]. Isoparvifuran-it has protective properties against acetaminophen-induced necrosis of renal tissue. Benzaldehyde has inhibitory effects on the activity of phenoloxidase from larvae [13,14]. Benzene, 1,2,3-trimethoxy-5- (2-propenyl) - can reduce blood esters, antimicrobial, antioxidant and anti-thrombosis. 1,2-Benzenedicarboxylic acid, bis (2-methylpropyl) ester is of a pharmaceutical nature and it can be used as an anticancer drug [15]. Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester has the characteristics of detoxification, but also can treat liver and stomach discomfort, red eyes and mouth sores. Cedrol has a clear sedative effect [16]. 2-Naphthalenemethanol, decahydro-.alpha.,. Alpha., 4a-trimethyl-8-methylene-, [2R- (2.alpha., 4a.alpha., 8a.beta.)] - have cough and phlegm, Blood stasis, detoxification and diuretic and other effects [17]. 7-epi-cis-sesquisabinene hydrate can be used as spleen and stomach Deficiency. 7-Methyl-Z-tetradecen-1-ol acetate has the effect of antipyretic cough [18]. Phytic acid and hex-3-yl isobutyl ester showed significant antitumor activity (tumor growth inhibition rates of 57.3%, 42.0% and 42. 4%, respectively) for MGC-803, MCF-7 and A549 cells [19,20]. Butylated Hydroxytoluene significantly inhibited the occurrence of γ-GT positive disease in the liver [21].

4. CONCLUSION

Three extracts of samples were analyzed by GC-MS and samples were analyzed by TD-GCMS and PY-GC/MS. It was proved that some substances contained in Dalbergia louvelii could treat diseases and promote human health. For example,7-epi-cis-sesquisabinene hydrate can be used as spleen and stomach Deficiency. 7-Methyl-Z-tetradecen-1-ol acetate has the effect of antipyretic cough. Phytic acid and hex-3-yl isobutyl ester showed significant antitumor activity for MGC-803, MCF-7 and A549 cells. Butylated Hydroxytoluene significantly inhibited the occurrence of γ-GT positive disease in the liver.

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Juntao Chen, Junwei Lou and Changyu Ni's contribution as same as the first author, they were also co-first authors.

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