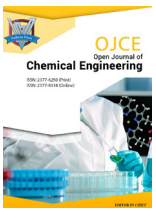
ZIBELINE INTERNATIONAL PUBLISHING

Open Journal of Chemical Engineering (OJCE)

DOI: http://doi.org/10.7508/ojce.01.2018.15.20

ISSN: 2377-6250 (Print)
ISSN: 2377-8318 (Online)
CODEN : OJCEB4



CrossMark

MOLECULES AND FUNCTIONS OF ROSEWOOD: *DALBERGIA ODORIFERA*

Lishu Wang[1, 2#], Juntao Chen[2#], Changyu Ni[2#], Junwei Lou[3#], Yueyun Zhou[1], Yimin Tan[1], Wanxi Peng[1, 2*]

[1]College of Architecture & Urban Planning, Hunan University of Technology, Zhuzhou 412007, China
[2]College of Materials Science and Engineering, Central South University of Forestry and Technology, Changsha 410004, China
[3]School of Architectural Engineering, Zhejiang Business Technology Institute, Ningbo 315012, China
[#]Co-first coauthors
**Correspondence Author E-mail: pengwanxi@163.com*

ARTICLE DETAILS

Article History:

Received 09 May 2018
Accepted 19 June 2018
Available online 21 July 2018

ABSTRACT

Pterocarpus has certain human health function. In this paper, *Dalbergia odorifera* as an example, we study its human health components by using PY-GC-MS, TDS-GC-MS and GC-MS. The composition of known human health functions was studied by reviewing the literature. Phenol, 2, 6-dimethoxy -4-(2-propenyl)-can be used as high-grade spices, and it can also be used as cosmetics and food industry's high value-added materials. Isospathulenol is characterized by its strong antibacterial inhibitory capacity. Phenol, 4-ethyl-2-methoxy-can protect neurons from excitotoxicity by inhibiting N-methyl-D-aspartate channels consisting of NR1 / NR2B.

KEYWORDS

Pterocarpus; *Dalbergia odorifera*; PY-GC-MS; GC-MS; TDS-GC-MS; health care ingredients.

1. INTRODUCTION

Dalbergia odorifera mainly grows in China's Hainan Province, belonging to the Leguminosae Dalbergia. *Dalbergia odorifera* is the endangered species, and it is listed as the national two key protection of wild plants in China. *Dalbergia odorifera* heartwood was reddish brown, sapwood was light yellow, high strength wood, hardness, fine texture and beautiful, and it is used to produce classical hardwood furniture, handicrafts and musical instruments of high quality materials. *Dalbergia odorifera* has a woody flavor, the wood can be distilled to produce spices. *Dalbergia odorifera* is more medicinal value, the wood soaked in water with blood pressure, lowering blood pressure effect. In addition, *Dalbergia odorifera* also has a moderator and blood stasis to stop bleeding effect. Therefore, the *Dalbergia odorifera* powder was analyzed by PY-GC-MS, TDS-GC-MS and TG; The extractives of ethanol, ethanol / benzene and ethanol / methanol in the *Dalbergia odorifera* were analyzed by GC-MS; To determine the active molecules of *Dalbergia odorifera*, figurative effect of human care function.

2. MATERIALS AND METHODS

2.1 Materials

The *Dalbergia odorifera* used in the experiment are first pulverized and then tested with the obtained wood powder. The ethanol, benzene and methanol used in the experiments were purely chromatographed. Quantitative filter paper should be extracted with ethanol for 12 h. The three extracts used in the experiment were ethanol, ethanol / benzene (volume ratio of 1:2) and ethanol / methanol (volume ratio of 1:1).

2.2 Experimental methods

2.2.1 Extraction method

The crushed and processed *Dalbergia odorifera*'s powder was weighed 3 parts and the mass was 10g (accuracy was 1.0 mg). A well-weighed powder and 250ml of ethanol, ethanol / benzene (1:2 by volume) and ethanol / methanol (1:1 by volume) were added in the three round bottom flasks respectively. And then refluxed at 85°C, 82°C and 80°C for 4.5 hours. The obtained extractives was subjected to suction filtration on a circulating water type vacuum pump (YUHUA SHZ-D (III)) using a quantitative filter paper subjected to ethanol extraction treatment for 12 hours. Finally, the obtained extractives was steamed and concentrated by a rotary evaporator (YUHUA RE-2000A).

2.2.2 TG analysis

The powder of *Dalbergia odorifera* was analyzed by thermogravimetric analyzer (TGA Q50 V20.8 Build 34). The carrier gas used in the experiment was high purity nitrogen and the nitrogen release rate was 60 ml / min. The temperature program of TG starts at 40°C and rises to 250°C at a rate of 5°C / min. During the test, the sample's weight (%), Deriv. Weight (% / °C) were recorded [1].

2.2.3 GC-MS analysis

The three extractives were analyzed using a gas chromatography-mass spectrometer (Agilent GC-MS 7890B 5977A). Column HP-5MS (30 m×250 μm×0.25 μm). Elastic quartz capillary column, the carrier gas used for high purity helium, flow rate of 1mL / min. The split ratio is 20:1. The temperature program of the GC 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. MS program scan mass range of 30amu-600amu, ionization voltage of 70eV, ionization current of 150 μA electron ionization (EI). The ion source and

the quadrupole temperature were set at 230°C and 150°C, respectively.

2.2.4 TDS-GC-MS analysis

Dalbergia odorifera' powder was analyzed with thermal desorption-gas chromatography-mass spectrometry. TDS starting temperature of 30°C, for 1 min, at 10°C / min rate rose to 100°C, keep 5 min, then 10°C / min rate rose to 200°C, the transmission line temperature of 230°C. CIS starting temperature of -50°C, hold 0.1min, and then 10°C / s rate rose to 230°C, keep 1min. Gas Chromatography-Mass Spectrometer (Agilent GC-MS 7890B 5977A). The temperature program of the GC 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. MS program scan mass range of 30amu-600amu, ionization voltage of 70 eV, ionization current of 150 μA electron ionization (EI). The ion source and the quadrupole temperature were set at 230°C and 150°C, respectively. The analytical standard library was analyzed by NIST14L.

2.2.5 PY-GC-MS analysis

The powder of *Dalbergia odorifera* was analyzed by thermal cracking-gas chromatography-mass spectrometry (CDS5200-trace1310 ISQ). The carrier gas used for high purity helium, the pyrolysis temperature was 500°C, the heating rate was 20°C / ms, and the pyrolysis time was 15 s. The pyrolysis product transfer line and the injection valve temperature are set to 300°C; Column TR-5MS; Capillary column (30 m×0.25 mm×0.25 μm); Shunt mode, split ratio of 1:60, shunt rate of 50 mL / min. The temperature of the GC program starts at 40° C for 2 min, rises to 120°C at a rate of 5°C / min, and then rises to 200°C at a rate of 10°C / min for 15 min. Ion source (EI) temperature of 280°C, scanning range of 28 amu-500 amu.

3. RESULTS AND ANALYSIS

3.1 TG analysis

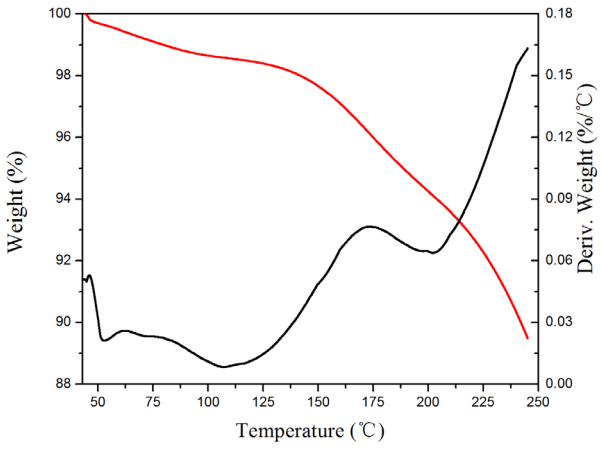


Figure 1: *Dalbergia odorifera*'s TG curve.

Figure 1 shows the TG curve of the *Dalbergia odorifera*. 30°C-90°C temperature section in the figure, the quality of *Dalbergia odorifera* change faster, mainly for water and a small amount of oil evaporation; 90°C-130°C temperature section is the continuous endothermic process of wood flour; *Dalbergia odorifera* powder more violent pyrolysis reaction in the 130°C-250°C temperature, making the quality of wood powder decreased faster.

3.2 GC-MS analysis

Figures 2, 3, 4 show the total ion chromatograms of the extractives of ethanol, ethanol / benzene and ethanol / methano, respectively.

The chemical constituents of three extractives of *Dalbergia odorifera* were determined by GC-MS qualitative analysis technique [2]. A total of 37 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol extractives of *Dalbergia odorifera*, and 10 compounds were identified; A total of 34 peaks were isolated by GC-MS gas chromatographic analysis of the Ethanol / benzene extractives, and 16 compounds were identified; A total of 43 peaks were isolated by GC-MS gas chromatographic analysis of the Ethanol / methanol extractives, and 17 compounds were identified. Table 1, 2, 3 were the results of GC-MS analysis of extractives of ethanol, ethanol / benzene and ethanol / methanol of *Dalbergia odorifera*.

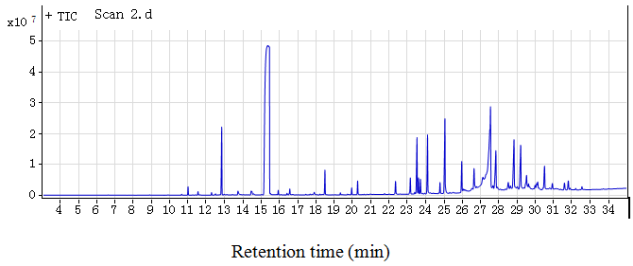


Figure 2: Total ion chromatogram of ethanol extractives of *Dalbergia odorifera*.

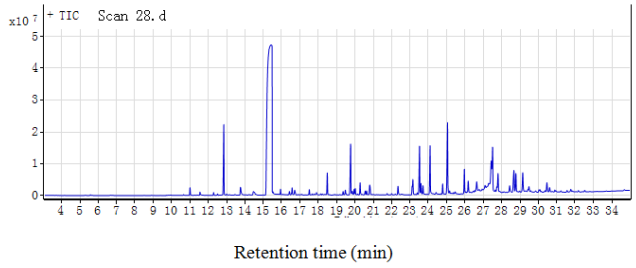


Figure 3: Total ion chromatogram of ethanol / benzene extractives of *Dalbergia odorifera*.

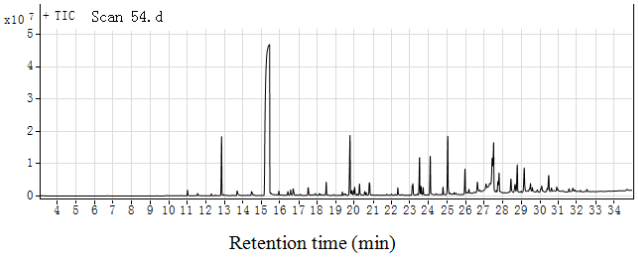


Figure 4: Total ion chromatogram of ethanol / methano extractives of *Dalbergia odorifera*.

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

No.	Retention time (min)	Peak area (%)	Compounds
1	11.011	0.66	2(3H)-Furanone, 5-butyldihydro-4-methyl-, cis-
2	12.848	5.94	Methyleugenol

3	13.741	0.68	4-Methoxybenzene-1,2-diol
4	15.371	10	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
5	16.574	0.57	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
6	22.351	1.39	Benzeneethanol, .beta.-ethenyl-
7	23.16	1.56	cis-Trismethoxyresveratrol
8	23.528	5.68	Phenol, 4-methyl-2-[5-(2-thienyl) pyrazol-3-yl]-
9	24.104	5.81	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
10	25.973	3.04	Dibenz[a,c]cycloheptane, 1,2,9-trimethoxy-
11	27.836	6.25	
12	28.833	7.71	

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

No.	Retention time (min)	Peak area (%)	Compounds
1	11.011	0.65	2(3H)-Furanone, 5-butyldihydro-4-methyl-, cis-
2	12.855	6.08	Methyleugenol
3	13.76	1.24	4-Methoxybenzene-1,2-diol
4	14.466	1.03	Phenol, 2,6-dimethoxy-4-(2-propenyl)-
5	15.429	10	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
6	16.574	0.62	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
7	16.717	0.65	2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
8	19.763	5.1	Tricyclo[4.4.0.0(2,7)]dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-, stereoisomer
9	20.805	1.27	Ledene oxide-(I)
10	22.344	0.84	Benzeneethanol, .beta.-ethenyl-

11	23.16	1.34	cis-Trismethoxyresveratrol
12	23.522	4.57	Phenol, 4-methyl-2-[5-(2-thienyl) pyrazol-3-yl]-
13	24.098	4.39	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
14	24.783	0.81	cis-Trismethoxyresveratrol
15	25.967	2.06	Dibenz[a,c]cycloheptane, 1,2,9-trimethoxy-
16	27.798	1.94	10,11-Dihydro-2,3,6-trimethoxydibenz(b,f)oxepin-10-one
17	28.432	0.69	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin
18	28.768	1.91	6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol
19	29.15	2.3	3,7-Dihydroxy-2-(3,4-dimethoxyphenyl)-4H-chromen-4-one

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

No.	Retention time (min)	Peak area (%)	Compounds
1	13.018	3.11	Methyleugenol
2	15.463	9.52	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
3	22.269	10	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
4	26.983	1.3	Homopterocarpin

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

No.	Retention time (min)	Peak area (%)	Compounds
1	4.10	50.49	Carbamic acid, monoammonium salt
2	4.12	56.71	Carbamic acid, monoammonium salt
3	4.91	14.85	Acetic acid
4	5.33	19.68	2-Propanone, 1-hydroxy-
5	11.25	9.43	Styrene
6	15.86	18.83	Benzofuran

7	19.84	71.67	Phenol, 2-methoxy-
8	29.17	2.32	Phenol, 4-ethyl-2-methoxy-
9	35.41	6.74	Methyleugenol
10	39.83	2.05	Phenol, 2,6-dimethoxy-4-(2-propenyl)-
11	41.33	3.82	Phenol, 2,6-dimethoxy-4-(2-propenyl)-

3.3 TDS-GC-MS analysis

There is the total ion chromatogram of the *Dalbergia odorifera* powder in Figure 5.

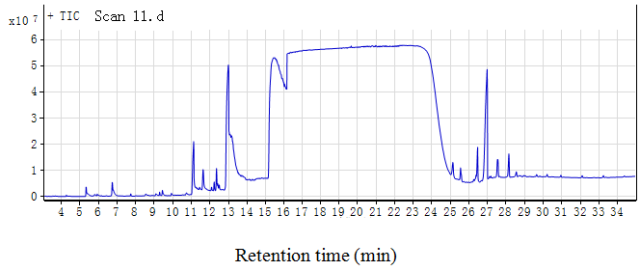


Figure 5: Total ion chromatogram of *Dalbergia odorifera* powder.

The chemical constituents of *Dalbergia odorifera* powder were determined by TDS-GC-MS qualitative analysis technique [3]. A total of 4 peaks were isolated by TDS-GC-MS gas chromatographic analysis of *Dalbergia odorifera* powder, and 3 compounds were identified; Table4 shows the results of TDS-GC-MS analysis of *Dalbergia odorifera* powder.

3.4 PY-GC-MS analysis

There is the Relative abundance curve of the *Dalbergia odorifera* powder in Figure 6.

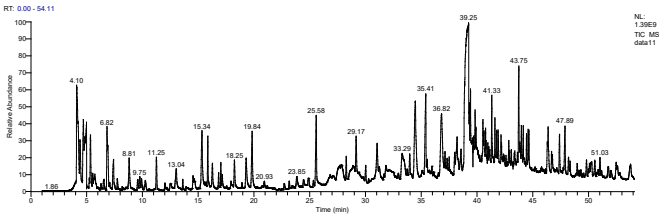


Figure 6: Relative abundance curve of the *Dalbergia odorifera* powder.

The chemical constituents of *Dalbergia odorifera* powder were determined by PY-GC-MS qualitative analysis technique [4]. A total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of *Dalbergia odorifera* powder, and 9 compounds were identified; Table 5 shows the results of PY-GC-MS analysis of *Dalbergia odorifera* powder.

3.5 Function of *Dalbergia odorifera* wood

Pterocarpus is often used to make high-end furniture. Pterocarpus and Pterocarpus products have a certain human health function. The PY-GC-MS, TDS-GC-MS and GC-MS techniques were used to qualitatively analyze the *Dalbergia odorifera*, and the related compounds were obtained. By reviewing the relevant literature and reports, we have obtained the proven, human health function composition. Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-has medicinal value, can be used as anti-oxidation, anti-inflammatory, anti-thrombosis and lower blood lipids [3]. Phenol, 2,6-dimethoxy-4-(2-propenyl)-can be used as high-grade spices, and it can also be used as cosmetics and food industry's high value-added materials [4]. 2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-,[2R-(2.alpha.,4a.alpha.,8a.beta.)]- it has a high value in the application of medicine,and it has cough and phlegm, detoxification and diuretic and other effects [5]. Isospathulenol is characterized by its strong antibacterial inhibitory capacity [6]. Homopterocarpin -it inhibits the activity of cancer cells. It can kill human laryngeal cancer cells and human hepatocellular carcinoma cells at high concentrations [7,8]. Phenol, 4-ethyl-2-methoxy-can protect neurons from excitotoxicity by inhibiting N-methyl-D-aspartate channels consisting of NR1 / NR2B [9,10].

4. CONCLUSION

GC-MS analysis, a total of 37 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol extractives of *Dalbergia odorifera*, and 10 compounds were identified; a total of 34 peaks were isolated by GC-MS gas chromatographic analysis of ethanol / benzene extractives, and 16 compounds were identified; a total of 43 peaks were isolated by GC-MS gas chromatographic analysis of ethanol / methanol extractives, and 17 compounds were identified.

TDS-GC-MS analysis, a total of 4 peaks were isolated by TDS-GC-MS gas chromatographic analysis of *Dalbergia odorifera* powder, and 3 compounds were identified.

PY-GC-MS analysis, a total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of *Dalbergia odorifera* powder, and 9 compounds were identified.

Through access to the literature and related reports, we clear the *Dalbergia odorifera* contains human health ingredients and functions. Phenol, 2,6-dimethoxy-4-(2-propenyl)-can be used as high-grade spices, and it can also be used as cosmetics and food industry's high value-added materials. Isospathulenol is characterized by its strong antibacterial inhibitory capacity. Phenol, 4-ethyl-2-methoxy-can protect neurons from excitotoxicity by inhibiting N-methyl-D-aspartate channels consisting of NR1 / NR2B.

ACKNOWLEDGMENTS

This research was supported by the Planned Science and Technology Project of Hunan Province, China (No.2016SK2089; No.2016RS2011), Major scientific and technological achievements transformation projects of strategic emerging industries in Hunan Province (2016GK4045), Academician reserve personnel training plan of lift engineering technical personnel of Hunan Science and Technology Association (2017TJ-Y10).

REFERENCES

[1] Shao, Q., Liu, H., Zhang, A., Wan, Y., Hu, R. 2015. Analysis of volatile components extracted from the peels of four different Chinese pomelos using TDS-GC-MS. Journal of the Science of Food & Agriculture, 94(15), 3248-3254.

[2] Jiye A., Johan T., Jonas Gullberg, Annika I.J., Pär J. 2005. Extraction and GC / MS Analysis of the Human Blood Plasma Metabolome. Analytical Chemistry, 77(24), 8086-94.

[3] Naher, S., Alam, M.S., Rahman, M.M., Aziz, S. 2013. Comparative studies on physico-chemical properties and GC-MS analysis of essential

oil of myristica fragrans. Journal of Statistical Software, 62(2), 345-346.

[4] Li, Q., Peng, K., Zhang, D.Q. 2011. Determination of bioactive components of 600°c pyrolyzate from acetone / ethanol extractives of moso bamboo root by Pyrolysis-GC / MS. Key Engineering Materials, 480-481, 484-489.

[5] Tu, Y.Q., Yang, R.P., Zhu, H.L., Wang, B.H., Peng, T. 2009. GC-MS Analysis of the Chemical Components of Essential Oils in Ligularia. Melanocephala Journal of Southwest University.

[6] Al-Ja'fari, A.H., Vila, R., Freixa, B., Tomi, F., Casanova, J., Costa, J., Canigueral, S. 2011. Composition and antifungal activity of the essential oil from the rhizome and roots of Ferula hermonis. Phytochemistry, 72, 11-12, 1406.

[7] Kan, Y.M., Zhu, Q., Chen, L., Wang, R.D., Li, X., Hong, M.F. 1994. Effect of homopterocarpin separated from Glycyrrhiza pallicdiflora onhuman's throat cancer cell (HE_p-2). Chinese Pharmaceutical Journal.

[8] Li, W.D., Kan, Y.M., Hong, M., Zhu, Q. 2001. The inhibitory effects of homopterocarpin and medicarpin on Humans liver cancer cells in vitro. Journal of Shenyang Pharmaceutical University, 18(3), 211-212.

[9] Fukumori, R., Nakamichi, N., Takarada, T., Kambe, Y., Matsushima, N. 2010. Inhibition by 2-methoxy-4-ethylphenol of Ca2+ influx through acquired and native N-methyl- D-aspartate-receptor channels. Journal of Pharmacological Sciences, 112(3), 273.

[10] Mi, C., Zhang, Z.W., Huang, Y.F. A fast automated vision system for container corner casting recognition. Journal of Marine Science and Technology, 24(1), 54-60.