Ekoloji 28(108): 51-55 (2019)

LETTER TO THE EDITOR

Molecules Effect of Rosewood: Dalbergia Cochinchinensis

Lishu Wang[1,2#], Wanxi Peng[1,2*], Yimin Tan[1*], Yueyun Zhou[1*], Juntao Chen[3], Changyu Ni[3], Junwei Lou[4]
[1]College of Architecture & Urban Planning, Hunan University of Technology, Zhuzhou, 412007, China
[2] College of Forestry, Henan Agricultural University, Zhengzhou 450002, China
[3]Furniture and Art Design Institute, Central South University of Forestry and Technology, Changsha 410004, China
[4]School of Architectural Engineering, Zhejiang Business Technology Institute, Ningbo 315012, China
[*] Email: pengwanxi@163.com

In this paper, the human health components of *Dalbergia cochinchinensis* are studies via PY-GC-MS, TDS-GC-MS, and GC-MS. The composition of known human health functions was studied by reviewing available literature. 2-Methoxy-4-vinylphenol has a strong anti-inflammatory effect, which is mediated via inhibition of NF-KB and MAPK activation and histone acetylation; Apocynin is a naturally occurring methoxy-substituted catechol that is used as an inhibitor of NADPH oxidase. It can reduce superoxides produced by activated neutrophils and macrophages, and its phagocytic capacity is not affected.

1 Introduction

Dalbergia cochinchinensis Pierre's main producing areas are Thailand and Cambodia. It belongs to Leguminosae Dalbergia. D. cochinchinensis is a diffuse porous material, the growth wheel is not obvious, and the heartwood has dark brown stripes. D. cochinchinensis has characteristics of high gloss, hardness, corrosion resistance, straight texture, delicate structure, and uniformity. D. cochinchinensis is often used in the production of advanced furniture, craft carvings, and musical instruments. In everyday life, D. cochinchinensis is often considered as useful timber with human health care functions. Therefore, D. cochinchinensis powder was analyzed via PY-GC-MS, TDS-GC-MS, TG, and FT-IR; the extractives of ethanol, ethanol/benzene and ethanol/methanol were analyzed via GC-MS and FT-IR; this was done to determine the active molecules of D. cochinchinensis, figurative effect of human care function.

2 Material and methods

2.1 Materials

The D. cochinchinensis used in the experiment was produced in Cambodia. Samples used in this experiment were 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 extractives 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 D. cochinchinensis powder was weighed three parts and the mass was 16 g (accuracy was 1.0 mg). A well-weighed powder and 300 ml of ethanol, ethanol/benzene (1:2 by volume) and

ethanol/methanol (1:1 by volume) were added in the three round bottom flasks respectively. The mixture was then refluxed at 85°C, 82°C, and 80°C for 4.5 h. The obtained extractives were 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 h. Finally, the obtained extract was steamed and concentrated via rotary evaporator (YUHUA RE-2000A).

2.2.2. Ft-ir analysis

D. cochinchinensis powder and the concentrated extractives refluxed by three types of extractants were subjected to FT-IR detection (ThermoFisher Nicolet, 670FT-IR) (Botha and Strydom 2003, Ge et al. 2017a, 2017b, 2016, Jiang et al. 2017, Chen et al. 2017, Lou et al. 2017, Peng et al. 2017a, 2017b, 2017c, 2016, 2012a, 20122b, 2011, Li et al. 2017a, 2017b, Awaad et al. 2017, Popiolek and Biernasiuk 2017).

2.2.3. Tg analysis

The powder of D. cochinchinensis was analyzed via 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 15°C and increased to 250°C at a rate of 5 °C/min (Bassilakis 2001, Ge et al. 2017a, 2017b, 2016, Jiang et al. 2017, Chen et al. 2017, Lou et al. 2017, Peng et al. 2017a, 2017b, 2017c, 2016, Lam et al. 2019).

2.2.4 Gc-ms analysis

The three extracts were analyzed via gas chromatography-mass spectrometer (Agilent GC-MS 7890B 5977A) (Ge et al. 2017a, 2017b, 2016, Jiang et al. 2017, Chen et al. 2017, Lou et al. 2017, Soylemez and Pakyurek 2017, Peng et al. 2017a, 2017b, 2017c, 2016, 2012a, 2012b, 2011, Ouyang et al. 2017, Li et al. 2017a, 2017b, Awaad et al. 2017, Popiolek and Biernasiuk 2017).

2.2.5 Tds-gc-ms analysis

The D. cochinchinensis powder was analyzed via thermal desorption-gas chromatography-mass spectrometry (Ge et al. 2017a, 2017b, Jiang et al. 2017, Chen et al. 2017, Lou et al. 2017, Peng et al. 2017a, 2017b, 2017c, 2016).

2.2.6 Py-gc-ms analysis

The powder of D. cochinchinensis was analyzed via thermal cracking-gas chromatography-mass spectrometry (CDS5200-trace1310 ISQ) (Ge et al. 2017a, 2017b, Jiang et al. 2017, Chen et al. 2017, Lou et al. 2017, Gao et al. 2017, Venckus et al. 2017, Peng et al. 2017a, 2017b, 2017c, 2016).

3 Results

3.1. Ft-ir analysis

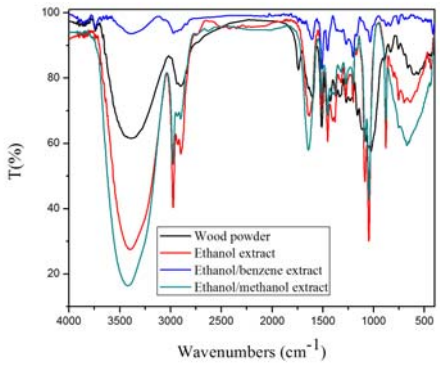

Fig. 1 FT-IR spectra

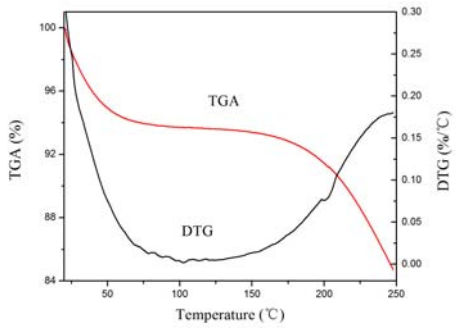

Fig. 2 TG curve.

Fig. 1 shows the infrared comparison spectra of the D. cochinchinensis powder and the three extractives. The

infrared spectrum of 3360 cm-1 is the O-H stretching vibration in the cellulose, phenol, alcohol, carboxylic acid compounds (Iwaki 2000, Ranjan et al. 2017). The infrared spectrum of 2900 cm-1 is C-H stretching vibration and C-H bending vibration in cellulose and hemicellulose. The infrared spectrum of 1738 cm-1 is the C=O stretching vibration in the hemicellulose, lipid, and ketone compounds (Ito and Nakanaga 2010). At 1425 cm-1 of the infrared spectrum is lignin, CH2 bending vibration and CH2 shear vibration in cellulose (Maroni et al. 2005). The infrared spectrum of 1266 cm−1, 1227 cm−1, and 817 cm−1 are the G-ring and the acyloxy CO-O stretching vibratio, the C-C and C-O stretching vibration, G-ring and C-H external bending vibration (Ricca et al. 2011).

3.2. Tg analysis

Fig. 2 shows the TG curve of the D. cochinchinensis. 15℃-70℃ temperature section in Fig. 2, the quality of D. cochinchinensis changes faster, mainly for water and a small amount of oil evaporation ; 70℃-160℃ temperature section is the continuous endothermic process of wood flour; D. cochinchinensis powder had a more violent pyrolysis reaction in the 160℃-250℃ temperature range, leading to a faster decrease of wood powder quality.

3.3 GC-MS analysis

A total of 33 peaks were isolated via GC-MS gas chromatographic analysis of the ethanol extract of D. cochinchinensis, and four compounds were identified. The results show that the components are: Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol -3-yl]- (9.78%), cis-Trismethoxyresveratrol (4.81%), Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (1.77%), and Dibenz[a,c] cycloheptane, 1,2,9-trimethoxy- (0.41%).

A total of 47 peaks were isolated via GC-MS gas chromatographic analysis of the Ethanol/benzene extract, and seven compounds were identified. The results show that the components are: Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]- (7.53%), cis-Trismethoxyresveratrol (4.25%), Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-(2.21%),S-Indacene-1,7-dione, ,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl- (1.52%), 6a,12a-Dihydro-6H-(1,3)dioxolo(5,6)benzofuro(3,2-c)chromen-3-ol (1.15%), 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (0.4%), Dibenz[a,c]cycloheptane, and 1,2,9-trimethoxy- (0.36%).

A total of 55 peaks were isolated via GC-MS gas chromatographic analysis of the Ethanol/methanol extract, and nine compounds were identified. (Karaoui et al. 2018) The results show that the components are: Ethanone, 2-hydroxy-1,2-bis(4-methoxyphenyl)- (18.17%), Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]- (5.56%), cis-Trismethoxyresveratrol (3.3%), Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (2.07%), S-Indacene-1,7-dione, 2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl- (1.29%), Quinolin-8-amine, 5,6-dimethoxy-4-methyl- (0.85%), Dibenz[a,c]cyclohexane, 2,4,7-trimethoxy- (0.31%), and 10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin (0.27%).

3.4 TDS-GC-MS analysis

A total of 66 peaks were isolated via TDS-GC-MS gas chromatographic analysis of D. cochinchinensis powder, and 27 compounds were identified.

The results of TDS-GC-MS show that the components mainly are: Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (22.28%), 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (22.2%), cis-Trismethoxyresveratrol (7.11%), 7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione (4.07%), 2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]- (3.58%), Benzaldehyde (2.32%), Dibenz[a,c]cyclohexane, 2,4,7-trimethoxy- (1.77%), .alpha.-Bisabolol (1.68%), and 1,4-benzenediol, 2,5-dimethoxy- (1.07%)

3.5 Py-gc-ms analysis

The elative abundance curve of D. cochinchinensis powder. The chemical constituents of D. cochinchinensis powder were determined via PY-GC-MS qualitative analysis technique (Gao et al. 2013). A total of 50 peaks were isolated via PY-GC-MS gas chromatographic analysis of D. cochinchinensis powder, and 13 compounds

were identified.

The PY-GC-MS results show: Ammonium acetate (8.45%), Carbamic acid, monoammonium salt (7.11%), 2-Methoxy-4-vinylphenol (5.26%), Benzoic acid, 4-hydroxy- (4.79%), 3-Hydroxy-4-methoxybenzoic acid (4.47%), Vanillin (1.62), Phenol, 2-methoxy- (1.23%), Catechol (1.06%), Phthalic anhydride (0.75%), Apocynin (0.69%), Benzaldehyde, 4-hydroxy-3,5-dimethoxy- (0.41%), and Pyrrolidine, 2-butyl-1-methyl- (0.28%).

4 Conclusion

GC-MS analysis, a total of 33 peaks were isolated via GC-MS gas chromatographic analysis of the ethanol extractives of D. cochinchinensis, and four compounds were identified; a total of 47 peaks were isolated via GC-MS gas chromatographic analysis of ethanol/benzene extractives, and seven compounds were identified; a total of 55 peaks were isolated via GC-MS gas chromatographic analysis of ethanol/methanol extractives, and nine compounds were identified.

TDS-GC-MS analysis, a total of 66 peaks were isolated via TDS-GC-MS gas chromatographic analysis of D. cochinchinensis powder, and 27 compounds were identified.

Via PY-GC-MS gas chromatographic analysis, a total of 50 peaks were isolated for D. cochinchinensis powder, and 13 compounds were identified.

References

Awaad AS, Alafeefy AM, Alasmary FA S, El-Meligy RM, Zain ME, Alqasoumi SI (2017) Novel essential amino acid-sulfanilamide hybrid as safe anti-ulcerogenic agent with anti-helicobacter pylori activity. Saudi Pharmaceutical Journal 25 (7):967-971.

Bassilakis R, Carangelo RM, Wójtowicz MA (2001) TG-FTIR analysis of biomass pyrolysis. Journal Fuel 80:1765-1786.

Botha A, Strydom AC (2003) DTA and FT-IR analysis of the rehydration of basic magnesium carbonate. Journal of Physical Chemistry Letters 71:987-996.

Chen JT, Ni CY, Lou JW, Peng WX (2017) Molecules and Functions of Rosewood: Diospyros celebica. Arabian Journal of Chemistry. https://doi.org/10.1016/j.arabjc.2017.12.033

Gao N, Li A, Quan C, Du L, Duan Y (2013) TG–FTIR and Py–GC/MS analysis on pyrolysis and combustion of pine sawdust. J. Journal of Analytical and Applied Pyrolysis 100:26-32.

Gao W, Kanna MRR, Suresh E, Farahani MR (2017). Calculating of degree-based topological indices of nanostructures. Geology, Ecology, and Landscapes 1(3):173-183.

Ge SB, Chen XM, Li DL, Liu ZL, Ouyang H, Peng WX, Zhang Z (2017a) Hemicellulose Structural Changes during Steam Pretreatment and biogradation of Lentinus Edodes. Arabian Journal of Chemistry. https://doi.org/10.1016/j.arabjc.2017.12.022

Ge SB, Li DL, Wang LS, Peng WX (2016) Understanding the Bioconversion of Quercus baronii Wood during the Artificial Cultivation of Lentinus edodes. BioResources 11(3):7654-7671.

Ge SB, Ma JJ, Jiang SC, Liu ZL, Peng WX (2017b) Potential use of different kinds of carbon in production of decayed wood plastic composite. Arabian Journal of Chemistry https://doi.org/10.1016/j.arabjc.2017.12.026.

Ito F, Nakanaga T (2010) Observation of the high-resolution spectrum of the N–H bending vibration of ketenimine CH2 CNH. Journal of Molecular Spectroscopy 264:100-104.

Iwaki LK (2000) Ultrafast vibrational energy redistribution within C–H and O–H stretching modes of liquid methanol. Journal of Physical Chemistry Letters 321:419-425.

Jiang SC, Ge SB, Peng WX (2017) Preparation and Properties of novel flame-retardant PBS wood-plastic composites. Arabian Journal of Chemistry. https://doi.org/10.1016/j.arabjc.2017.12.023.

Karaoui I, Arioua A, Idrissi AEA, Hssaisoune M, Nouaim W, Ouhamchich KA, Elhamdouni D (2018). Assessing land use /cover variation effects on flood intensity via hydraulic simulations: A case study of oued el abid watershed (Morocco). Geology, Ecology, and Landscapes 2(2):73-80.

Lam SS, Mahari WAW, Ma NL, Azwar E, Kwon EE, Peng WX, Chong CT, Liu ZL, Park YK (2019) Microwave pyrolysis valorization of used baby diaper. Chemosphere 230:294-302

Li DL, Ge SB, Peng WX, Wu QD, Wu JG. (2017a) Chemical structure characteristics of wood/lignin composites during mold pressing. Polymer Composites 38 (5):955–965.

Li L, Xue XC, Wei WZ, Wang YH, Li DL, Peng WX (2017b) Systematic characterization of volatile organic

components and pyrolyzates from Camellia oleifera seed cake for developing high value-added products. Arabian Journal of Chemistry, https://doi.org/10.1016/j.arabjc.2017.12.031

Lou JW, Chen JT, Ni CY, Peng WX (2017) Molecules and functions of rosewood: Pterocarpus cambodianus. Arabian Journal of Chemistry. https://doi.org/10.1016/j.arabjc.2017.12.030

Maroni P, Papageorgopoulos DC, Sacchi M, Dang, TT, Beck RD (2005) Gas-surface reactivity of methane in the symmetric C-H stretch vibration on Ni. Journal of Molecular Spectroscopy 94.

Ouyang H, Hou K, Wang L, and Peng WX (2017) Optimization protocol for the microwave-assisted extraction of antioxidant components from Pinus elliottii needles using response surface methodology. BioResources 12(1):478-494.

Peng WX, Ge SB, Ebadi AG, Hisoriev H, Esfahani MJ (2017a) Syngas production by catalytic co-gasification of coal-biomass blends in a circulating fluidized bed gasifier. Journal of Cleaner Production 168:1513-1517.

Peng WX, Li DL, Zhang ML, Ge SB, Mo B, Li SS, Ohkoshi M (2017b) Characteristics of antibacterial molecular activities in poplar wood extractives. Saudi Journal of Biological Sciences 24(2):399–404.

Peng WX, Liu ZL, Motahari-Nezhad M, Banisaeed M, Shahraki S, Beheshti M (2016) A detailed study of oxy-fuel combustion of biomass in a circulating fluidized bed (CFB) combustor: Evaluation of catalytic performance of metal nanoparticles (Al, Ni) for combustion efficiency improvement. Energy 109:1139-1147.

Peng WX, Wang LS, Mirzaee M, Ahmadi H, Esfahani MJ, Fremaux S (2017c) Hydrogen and syngas production by catalytic biomass gasification. Energy Conversion and Management 135:270–273.

Peng WX, Wang LS, Wu FJ, Xu Q (2011) 3-(4-Bromophenyl)-4-(4-hydroxyanilino)furan-2(5H)-one. Acta Crystallographica Section E-Structure Reports 67 (9):O2329-U206.

Peng WX, Wang LS, Xue Q, Wu QD, Xiang SL (2012a) TD-GC-MS Analysis on Thermal Release Behavior of Poplar Composite Biomaterial Under HighTemperature. Journal of Computational and Theoretical Nanoscience 9 (9):1431-1433.

Peng WX, Zhang ZF, Lin Z, Ohkoshi M, Chang JB, Gu FL, Zhu XW (2012b) Molecular Characteristics of Biomedical and Bacteriostasis Extractives of Illicium verum Fruit. Journal of Pure and Applied Microbiology 7(3):2017-2024.

Popiolek L, Biernasiuk A (2017) Synthesis and investigation of antimicrobial activities of nitrofurazone analogues containing hydrazide-hydrazone moiety. Saudi Pharmaceutical Journal 25(7):006.

Ranjan R, Paswan MK, Prasad N (2017) CFD based analysis of a solar air heater having isosceles right triangle rib roughness on the absorber plate. International Energy Journal 17(2):57-74.

Ricca A, Bauschlicher CWJ, Allamandola LJ (2011) The infrared spectroscopy of polycyclic aromatic hydrocarbons with five- and seven-membered fused ring defects. Astrophysical Journal 729:94.

Soylemez S, Pakyurek AY (2017) Responses of rootstocks to nutrient induced high ec levels on yield and friut quality of grafted tomato greenhouse conditions. Applied Ecology and Enviromental Research 15 (3):759-770.

Venckus P, Kostkeviciene J, Bendikiene V (2017) Green algae chlorella vulgaris cultivation in municipal wastewater and biomass composition. Journal of Environmental Engineering and Landscape Management 25(1):56-63.