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ARTICLE

MOLECULAR STRUCTURE AND FUNCTIONS OF ROSEWOOD: *PTEROCARPUS ERINACEUS*

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ABSTRACT

Pterocarpus (rosewood) is often used to construct high-end furniture. It also contains factors that affect human health. These components were studied in Pterocarpus erinaceus Poir by using PY-GC-MS, TDS-GC-MS, and GC-MS, together with a review of the literature. 3-O-Methyl-d-glucose can protect pancreatic B cells against alloxan toxicity, and can also improve the dry tolerance of keratinocytes. 7-Epi-cis-sesquisabinene hydrate has been used for treatment of spleen, stomach, and abdominal disorders, and diarrhea. 6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a -octahydro-naphthalen-2-ol has antifungal and antitumor activity.

KEYWORDS

Pterocarpus erinaceus, PY-GC-MS, GC-MS, TDS-GC-MS, rosewood.

1. INTRODUCTION

Pterocarpus erinaceus Poir (rosewood), grown in the Gambia, Côte d'Ivoire, Guinea Bissau, and other African countries, belongs to the Leguminosae, Papilionoideae, Pterocarpus L. Pterocarpus erinaceus Poir is the hollow material; heartwood is orange with dark stripes; sapwood is light yellow. The wood from Pterocarpus erinaceus Poir has high strength, hardness, and strong durability characteristics[1-3]. Pterocarpus erinaceus Poir is often used to produce high-end furniture and a variety of handicrafts; it also has a traditional herbal use. The Pterocarpus erinaceus Poir powder was analyzed by pyrolysis-gas chromatography-mass spectrometry (PY-GC-MS), thermodesorption-gas chromatography-mass spectrometry (TDS-GC-MS), thermogravimetric analysis (TG), and Fourier transform infrared spectroscopy (FT-IR). Extracts of ethanol, ethanol/benzene, and ethanol/methanol from the Pterocarpus erinaceus Poir were analyzed by GC-MS and FT-IR to determine the active molecules of Pterocarpus erinaceus Poir.

2. MATERIALS AND METHODS

2.1 Materials

Samples of Pterocarpus erinaceus Poir were first pulverized to a wood powder. Ethanol, benzene, and methanol were purified by chromatography on quantitative filter paper 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)[4,5].

2.2 Experimental methods

Extraction Method. The crushed and processed Pterocarpus erinaceus Poir powder was divided into three parts, each weighing 10 g (accuracy was 1.0 mg). 250 ml each of ethanol, ethanol/benzene (1:2 by volume), and ethanol/methanol (1:1 by volume) were added to the powder in three round-bottom flasks, respectively, and then refluxed at 85°C, 82°C, and 80°C for 4.5 hours. The obtained extracts were subjected to suction filtration on a circulating water type vacuum pump (YUHUA SHZ-D (III)) using quantitative filter paper that had been subject to ethanol extraction treatment for 12 hours, as described above. Finally, the obtained extract was steamed and concentrated by a rotary evaporator (YUHUA RE-2000A).

FT-IR Analysis. Pterocarpus erinaceus Poir powder and the concentrated extract refluxed by three kinds of extractants were subjected to FT-IR detection (ThermoFisher Nicolet, 670FT-IR). The scanning of each powder was collected at a spectral resolution of 4 cm^{-1}; the spectral range was 400 cm^{-1}-4000 cm^{-1}[6,7].

TG Analysis. The powder of Pterocarpus erinaceus Poir was analyzed by thermogravimetric analyzer (TGA Q50 V20.8 Build 34). The carrier gas was high purity nitrogen, released at a rate of 60 ml/min. The temperature program of TG began at 30°C and rose to 250°C at a rate of 5°C/min. During the test, the sample's weight (%), Deriv. Weight (%/°C) were recorded[8,9].

GC-MS Analysis. The three extracts were analyzed by a gas chromatography-mass spectrometer (Agilent GC-MS 7890B 5977A) with an elastic quartz capillary column HP-5MS (30 m × 250 μm × 0.25 μm). The carrier gas was high purity helium, flow rate of 1 mL/min. The split ratio is 20:1. The temperature program of the GC started at 50°C , rose to 250°C at a rate of 8°C/min, and then rose to 300°C at a rate of 5°C/min. MS program scanned a mass range of 30 amu—600 amu, ionization voltage of 70 eV, ionization current of 150 μA electron ionization (EI). The ion source and the quadrupole temperatures were set at 230°C and

150°C, respectively[10,11].

TDS-GC-MS Analysis. The Pterocarpus erinaceus Poir powder was analyzed with thermal desorption-gas chromatography-mass spectrometry [Gas Chromatography-Mass Spectrometer (Agilent GC-MS 7890B 5977A)]. The TDS starting temperature was 30°C, for 1 min, at 10°C/min rate rose to 100°C, kept for 5 min, then with rate of 10°C/min rose to 200°C, the transmission line temperature of 230°C. CIS starting temperature was -50°C for 0.1 min, and then with rate of 10°C/s rose to 230°C, kept for 1 min.

The temperature of the GC began at 50°C, rose to 250°C at a rate of 8°C/min, and then rose to 300°C at a rate of 5°C/min. The MS program scanned a mass range of 30 amu-600 amu, ionization voltage of 70 eV, and 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 NIST14.L[12,13].

PY-GC-MS Analysis. The powder of Pterocarpus erinaceus Poir was analyzed by thermal cracking-gas chromatography-mass spectrometry (CDS5200-trace1310 ISQ). The carrier gas was 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 were 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 began at 40°C for 2 min, rose to 120°C at a rate of 5°C/min, and then rose 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[14,15].

3. RESULTS AND DISCUSSION

3.1 Analysis of FT-IR

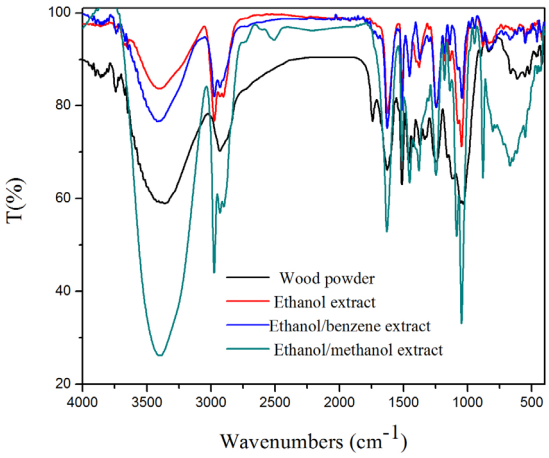

Figure 1: FT-IR Comparison Spectra of Pterocarpus erinaceus Poir Powders and Three Extracts.

Figure 1 shows the infrared comparison spectra of the Pterocarpus erinaceus Poir powder and the three extracts. The infrared spectrum of 3360 cm^{-1} is the O-H stretching vibration in the cellulose, phenol, alcohol, and carboxylic acid compounds[16,17]. The infrared spectrum of 2900 cm^{-1} is C-H stretching vibration and C-H bending vibration in cellulose and hemicellulose[18,19]. The infrared spectrum of 1738 cm^{-1} is the C=O stretching vibration in the hemicellulose, lipid, and ketone compounds. The infrared spectrum of 1462 cm^{-1} is the C-H bending vibration and the asymmetric bending vibration of CH3 and CH2 in lignin and ether compounds. The infrared spectra of 1266 cm^{-1} and 1227 cm^{-1} are the G-ring and the acyloxy CO-O stretching vibration, and the C-C and C-O stretching vibration[20-22].

3.2 Analysis of TG

Figure 2 presents the TG curves of Pterocarpus erinaceus Poir. At the 30°C-80°C section, the quality of Pterocarpus erinaceus Poir changes faster, mainly due to water and a small amount of oil evaporation; the 80°C-210°C section represents the continuous endothermic process of wood flour; Pterocarpus erinaceus Poir powder has a more violent pyrolysis reaction in the 210°C-250°C zone, resulting in a fast decrease of the quality of wood powder.

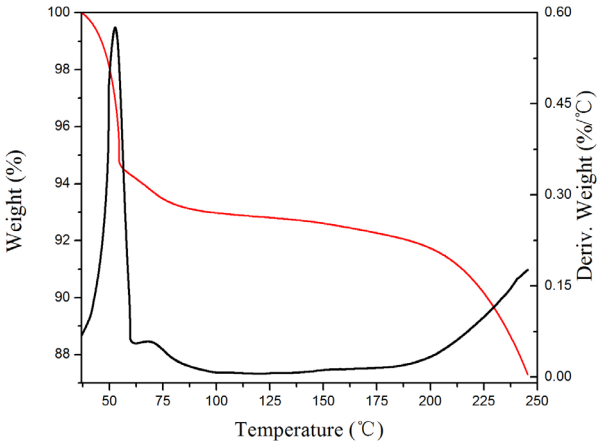

Figure 2: Pterocarpus erinaceus Poir TG curves.

3.3 Analysis of GC-MS

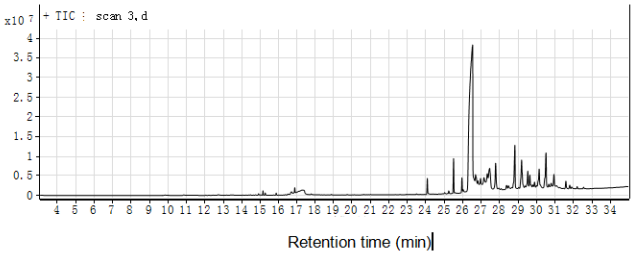

Figure 3: Total ion chromatogram of ethanol extract of Pterocarpus erinaceus.

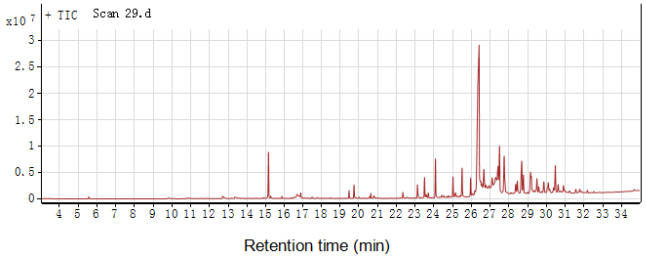

Figure 4: Total ion chromatogram of ethanol/benzene extract of Pterocarpus erinaceus.

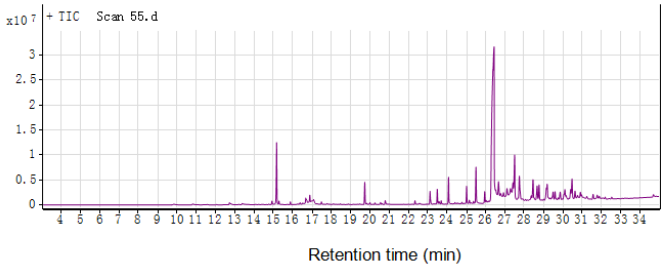

Figure 5: Total ion chromatogram of ethanol/methano extract of Pterocarpus erinaceus.

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

Peak number	keep time (min)	Peak area (%)	Compounds
1	17.092	1.57	3-O-Methyl-d-glucose
2	17.305	3.15	3-O-Methyl-d-glucose
3	17.377	1.26	3-O-Methyl-d-glucose
4	24.078	1.98	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
5	28.826	8.18	6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol

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

Peak number	Keep time (min)	Peak area (%)	Compounds
1	5.578	0.52	.alpha.-Methylstyrene
2	9.847	0.81	m-Guaiacol
3	10.83	0.78	Resorcinol
4	12.725	0.91	1,4-Benzenediol, 2-methoxy-
5	13.372	1.31	4-Methoxybenzene-1,2-diol
6	15.164	10.46	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
7	16.885	1.37	5-Azulenemethanol, 1,2,3,3a,4,5,6,7-octahydro-. alpha.,.alpha.,3,8-tetramethyl-, [3S-(3.alpha.,3a.beta.,5.alpha.)]-
8	19.466	1.55	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
9	19.731	3.05	Tricyclo[4.4.0.0(2,7)]dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-, stereoisomer
10	20.63	0.94	Dibutyl phthalate

11	22.338	1.3	Benzeneethanol, .beta.-ethenyl-
12	23.496	4.55	Phenol, 4-methyl-2-[5-(2-thienyl) pyrazol-3-yl]-
13	24.078	8.57	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
14	25.954	3.99	Dibenz[a,c]cycloheptane, 1,2,9-trimethoxy-
15	28.774	5.93	6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol

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

Peak number	Keep time (min)	Peak area (%)	Compounds
1	10.824	0.61	Resorcinol
2	12.732	1.02	1,4-Benzenediol, 2-methoxy-
3	13.385	0.99	4-Methoxybenzene-1,2-diol
4	14.931	0.82	4-Methoxy-3-methylphenylacetic acid
5	15.171	11.39	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
6	16.678	2.65	Cryptomeridiol
7	19.738	3.95	Tricyclo[4.4.0.0(2,7)]dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-, stereoisomer
8	23.489	2.56	Phenol, 4-methyl-2-[5-(2-thienyl) pyrazol-3-yl]-
9	24.078	4.57	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
10	28.451	4.94	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin
11	28.813	2.88	6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol
12	29.188	3.71	6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol

Figures 3, 4, and 5 show the total ion chromatograms of the extracts of ethanol, ethanol/benzene, and ethanol/methanol, respectively. Tables 1, 2, and 3 list the results of GC-MS analysis of extracts of ethanol, ethanol/benzene, and ethanol/methanol of Pterocarpus erinaceus Poir.

The chemical constituents of three extracts of Pterocarpus erinaceus Poir were determined by GC-MS qualitative analysis. A total of 29 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol extract of Pterocarpus erinaceus Poir, and three compounds were identified: 6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol (8.18%); 3-O-Methyl-d-glucose (5.98%); and Benzene, 1,3-dimethoxy -5-[(1E)-2-phenylethenyl]- (1.98%).

A total of 71 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol/benzene extract, and 15 compounds were identified: Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (10.46%); Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]- (8.57%), 6a,12a-Dihydro-6H-(1,3) dioxolo(5,6)benzofuro(3,2-c)chromen-3-ol (5.93%); Phenol, 4-methyl-2-[5-(2-thienyl) pyrazol-3-yl]- (4.55%); Dibenz[a,c] cycloheptane, 1,2,9-trimethoxy- (3.99%); Tricyclo[4.4.0.0(2,7)]dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-, stereoisomer (3.05%); 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (1.55%), 5-Azulenemethanol,1,2,3,3a,4,5,6,7 -octahydro-.alpha.,.alpha., 3,8-tetramethyl-, [3S-(3.alpha.,3a.beta.,5.alpha.)]- (1.37%); 4-Methoxybenzene- 1,2-diol (1.31%); Benzeneethanol, .beta.-ethenyl- (1.3%), Dibutyl phthalate (0.94%), 1,4-Benzenediol, 2-methoxy- (0.91%); m-Guaiacol (0.81%); Resorcinol (0.78%); and .alpha.-Methylstyrene (0.52%).

A total of 55 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol/methanol extract, and 11 compounds were identified: Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (11.39%); 6a,12a-Dihydro- 6H-(1,3)dioxolo(5,6)benzofuro(3,2-c)chromen-3-ol (6.59%); 10,11-Dihydro- 10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin (4.94%); Benzene, 1,3-dimethoxy-5- [(1E)-2-phenylethenyl]- (4.57%); Tricyclo[4.4.0.0(2,7)] dec-8-ene-3-methanol, .alpha.,.alpha.,6,8-tetramethyl-, stereoisomer (3.95%); Cryptomeridiol (2.65%); Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]- (2.56%); 1,4-Benzenediol, 2-methoxy- (1.02%); 4-Methoxybenzene-1,2-diol (0.99%); 4-Methoxy-3-methylphenylacetic acid (0.82%); and Resorcinol (0.61%).

3.4 Analysis of TDS-GC-MS

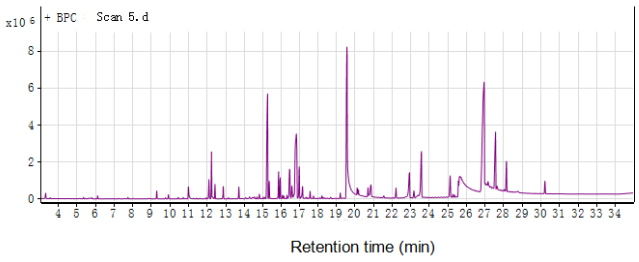

Figure 6: Total ion chromatogram of Pterocarpus erinaceus Poir powder.

Figure 6 shows the total ion chromatogram of Pterocarpus erinaceus Poir powder. The chemical constituents of Pterocarpus erinaceus Poir powder were determined by TDS-GC-MS qualitative analysis. A total of 68 peaks were isolated by TDS-GC-MS gas chromatographic analysis of Pterocarpus erinaceus Poir powder, and 26 compounds were identified.

Table 4 tabulates the TDS-GC-MS analysis of Pterocarpus erinaceus Poir powder. The components are: Homopterocarpin (85.64%); Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- (41.79%); 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester (25.45%); 5-Azulenemethanol, 1,2,3,3a,4,5,6,7 -octahydro-.alpha.,.alpha.,3,8-tetramethyl-, [3S-(3.alpha.,3a.beta.,5.alpha.)]- (21.08%); .beta.-Guaiene (10.67%); 9-Octadecenamide, (Z)- (10.6), Ethanol, 2-(2-butoxyethoxy)-, acetate (10.25%); 2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha., 8a.beta.)]- (10%); 4H-1-Benzopyran-4-one, 2-(3,4-dimethoxyphenyl)-7-hydroxy- (9.93%); .tau.-Cadinol (8.47%); 7-epi-cis-sesquisabinene hydrate (8.05%); 6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol (7.95%); Guaiol (7.44%); 1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl- (6.85%); 1-Heptatriacotanol (5.13%); Methyleugenol (3.65%); and Cedrol (3.04%), Also 2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde (2.85%); Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester (2.78%); 2-((2R,4aR,8aS)-4a-Methyl-8-methylenedecahydronaphthalen-2-yl)prop- 2-en-1-ol (2.67%); Resorcinol (2.18%); Ethanol, 1-(2-butoxyethoxy)- (1.49%); m-Guaiacol (0.78%); and 1H-2,8a-Methanocyclopenta[a]cyclopropa[e] cyclodecen-11-one, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a,6-trihydroxy-1,4 -bis(hydroxymethyl)-1,7,9-trimethyl-, [1S-(1.alpha., 1a.alpha., 2.alpha., 5.beta.,5a.beta., 6.beta.,8a.alpha.,9.alpha., 10a.alpha.)]- (0.71%).

3.5 Analysis of Py-GC-MS

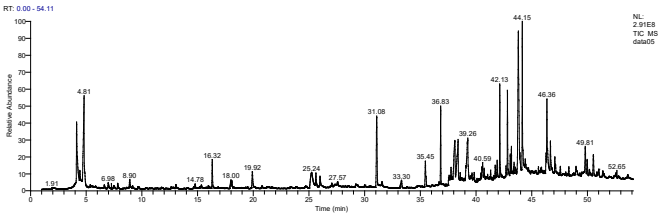

Figure 7: Relative abundance curve of the Pterocarpus erinaceus Poir powder.

Figure 7 shows the relative abundance curve of the Pterocarpus erinaceus Poir powder. The chemical constituents of Pterocarpus erinaceus Poir powder were determined by PY-GC-MS qualitative analysis technique. A total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of Pterocarpus erinaceus Poir powder, and seven compounds were identified.

Table 5 shows the results of PY-GC-MS analysis of Pterocarpus erinaceus Poir powder. The components are: Ammonium acetate (50.63%); Carbamic acid, monoammonium salt (47.63%); 2-Methoxy-4-vinylphenol (32.94%); Catechol (11.38%); Phenol, 2-methoxy- (11.20%); 3-Hydroxy-4-methoxybenzoic acid (4.03%); and Benzaldehyde, 4-hydroxy-3,5-dimethoxy- (2.93%).

Table 4: Pterocarpus erinaceus Poir powder of TDS-GC-MS analysis.

Peak number	Keep time (min)	Peak area (%)	Compounds
1	9.301	1.49	Ethanol, 1-(2-butoxyethoxy)-
2	9.931	0.78	m-Guaiacol

3	11.002	2.18	Resorcinol
4	12.25	10.25	Ethanol, 2-(2-butoxyethoxy)-, acetate
5	12.439	2.78	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
6	12.88	3.65	Methyleugenol
7	14.102	1.65	.beta.-Guaiene
8	14.304	3.76	.beta.-Guaiene
9	14.443	2	.beta.-Guaiene
10	14.569	2.67	2-((2R,4aR,8aS)-4a-Methyl-8-methylenedecahydronaphthalen-2-yl)prop-2-en-1-ol
11	14.695	0.56	.beta.-copaene
12	14.821	1.89	.beta.-Guaiene
13	15.048	1.37	.beta.-Guaiene
14	15.274	41.79	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
15	15.363	6.85	1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl-
16	15.451	0.72	1-Heptatriacotanol
17	15.955	7.44	Guaiol
19	16.081	3.04	Cedrol
20	16.207	0.87	1-Heptatriacotanol
21	16.585	8.47	.tau.-Cadinol
22	16.825	10	2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
23	16.976	21.08	5-Azulenemethanol, 1,2,3,3a,4,5,6,7-octahydro-.alpha.,.alpha.,3,8-tetramethyl-, [3S-(3.alpha.,3a.beta.,5.alpha.)]-
24	17.152	8.05	7-epi-cis-sesquisabinene hydrate

25	17.316	0.83	1-Heptatriacotanol
26	17.392	0.85	1-Heptatriacotanol
27	17.568	6.03	6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol
28	17.845	0.56	1-Heptatriacotanol
29	18.098	0.56	2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde
30	18.198	1.92	6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol
31	18.324	1.78	2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde
32	18.513	0.51	2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde
33	18.665	1.3	1-Heptatriacotanol
34	18.917	0.71	1H-2,8a-Methanocyclopenta[a]cyclopropa[e]cyclodecen-11-one, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a,6-trihydroxy-1,4-bis(hydroxymethyl)-1,7,9-trimethyl-, [1S-(1.alpha.,1a.alpha.,2.alpha.,5.beta.,5a.beta.,6.beta.,8a.alpha.,9.alpha.,10a.alpha.)]-
35	19.547	25.45	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
36	25.118	10.6	9-Octadecenamide, (Z)-
37	26.945	85.64	Homopterocarpin
38	28.142	9.93	4H-1-Benzopyran-4-one, 2-(3,4-dimethoxyphenyl)-7-hydroxy-

Table 5: Pterocarpus erinaceus Poir Powder of PY-GC-MS analysis.

Peak number	Keep time (min)	Peak area (%)	Compounds
1	4.14	47.63	Carbamic acid, monoammonium salt
2	4.81	50.63	Ammonium acetate
3	19.92	11.20	Phenol, 2-methoxy-

4	25.99	11.38	Catechol
5	31.08	32.94	2-Methoxy-4-vinylphenol
6	39.26	4.03	3-Hydroxy-4-methoxybenzoic acid
7	40.73	2.93	Benzaldehyde, 4-hydroxy-3,5-dimethoxy-

4. PTEROCARPUS ERINACEUS POIR EFFECTS ON HUMAN HEALTH

Pterocarpus and Pterocarpus products can affect human bodily functions. PY-GC-MS, TDS-GC-MS, and GC-MS were used to analyze Pterocarpus erinaceus Poir qualitatively. The obtained compounds were compared with reviews in relevant literature. 3-O-Methyl-d-glucose can protect pancreatic B cells against the toxicity of alloxan, and can also improve the dry tolerance of keratinocytes[23,24]. Benzene,1,2,3-trimethoxy-5-(2-propenyl) has anti-oxidation, anti-inflammatory, anti-thrombosis, and blood lipid-lowering properties[25]. 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester has been used for the synthesis of anti-cancer drugs[26]. Cryptomeridiol is a natural product of anti-Alzheimer's disease and antispasmodic nature, and has a significant medicinal value[27]. Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester can detoxify red eyes, mouth sores, and liver and stomach discomfort.[28] 2-Naphthalenemethanol,decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-,[2R-(2.alpha.,4a.alpha.,8a.beta.)] has detoxifying and diuretic actions against cough and phlegm[29-32]. 7-Epi-cis-sesquisabinene hydrate can be used for the treatment of spleen, stomach, and abdominal pain, and diarrhea[30,33]. 6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a-octahydro-naphthalen-2-ol has antifungal and antitumor activity[31,34].

5. CONCLUSION

GC-MS gas chromatographic analysis of the ethanol extract of Pterocarpus erinaceus Poir isolated 29 peaks, and three compounds were identified; a total of 71 peaks were isolated by GC-MS gas chromatographic analysis of ethanol/benzene extract, and 15 compounds were identified; a total of 55 peaks were isolated by GC-MS gas chromatographic analysis of ethanol/methanol extract, and 11 compounds were identified. A total of 68 peaks were isolated by TDS-GC-MS gas chromatographic analysis of Pterocarpus erinaceus Poir powder, and 26 compounds were identified. A total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of Pterocarpus erinaceus Poir powder, and 7 compounds were identified.

As reported in the literature, Pterocarpus erinaceus Poir contains ingredients that affect human bodily functions. 3-O-Methyl-d-glucose protects pancreatic B cells against the toxicity of alloxan, and also improves the dry tolerance of keratinocytes. 7-Epi-cis-sesquisabinene hydrate can be used for the treatment of spleen, stomach, and abdominal pain, and diarrhea. 6-Isopropenyl-4,8a-dimethyl-1,2,3,5,6,7,8,8a -octahydro-naphthalen-2-ol has antifungal and antitumor activity. This research was supported by Major scientific and technological achievements transformation projects of strategic emerging industries in Hunan Province (2016GK4045), and Academician reserve personnel training plan of lift engineering technical personnel of Hunan Science and Technology Association(2017TJ-Y10).

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