INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

Molecules and Their functions

Volume 14, Issue 1 Jan-Feb: 2017

K.SRAVANI ASSISTANT PROFESSOR, DEPT. OF CHEMISTRY, GDMM COLLEGE OF ENGINEERING AND TECHNOLOGY A.P, INDIA

G.DHAVALA KUMARI ASSISTANT PROFESSOR, DEPT.OF CHEMISTRY, GDMM COLLEGE OF ENGINEERING AND TECHNOLOGY

Abstract

Pterocarpus and Pterocarpus products have certain human health function. In this paper, Diospyros celebica Bakh 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. 3-O-Methyl-d-glucose has a certain conservation property, and it can protect the pancreatic B cells against the toxicity of alloxan. P-Cresol plays a role in endothelial dysfunction in uremic patients, and it can repair wounds and reduce endothelial pro-gression. 2(3H)-Furanone, 5-methyl- has certain biological resistance, and has high antimicrobial activity against NCIM 2501 and NCIM 5021.

1. Introduction

Diospyros celebica Bakh is mainly grown in Sulawesi, Indone-sia, belonging to Ebenaceae, Diospyros. Diospyros celebica Bakh is the best of the Diospyros ebenum Koenig, and the par-adise bird, the red dragon fish collectively known as the three national treasures of Indonesia, known as ‘‘the black pearl in the wood”. Diospyros celebica Bakh grows mainly in the annual drought, rare rain cliff; Because of its poor growth environment, Diospyros celebica Bakh has a long period of material, generally take hundreds or even thousands of years. Diospyros celebica Bakh is evergreen broad-leaved trees, with tree height up to 40 m and DBH up to 1 m. Diospyros celebica Bakh wood for the hollow material, heartwood and sapwood are significantly different, heartwood was black, the surface with shiny and deep and white stripes. Wood with high strength, big hardness, corrosion resistance and strong insect resistance, air dry density of 1.09 g/cm^3. Diospyros celebica Bakh can emit fungal and antibiotics and other natural molecules and it enter the body to inhibit and kill the body of native viruses and bacteria, with human health function. In this paper, the Diospyros celebica Bakh powder was ana-lyzed by PY–GC–MS, TDS–GC–MS, TG and FT-IR; The extracts of ethanol, ethanol/benzene and ethanol/methanol in the Diospyros celebica Bakh were analyzed by GC–MS and FT-IR. To determine the active molecules of Diospyros celebica Bakh, figurative effect of human care function.

2. Materials and methods

2.1. Materials

Diospyros celebica used in the experiment was produced inIndonesia. When we do the experiment, the Diospyros celebica Bakh are first pulverized and then tested with the obtained wood powder. The ethanol, benzene and methanol used in the exper-iments were purely chromatographed. Quantitative filter paper should be extracted with ethanol for 12 h. The three

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

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 Diospyros celebica Bakh's powder was weighed 3 parts and the mass was 10 g (accuracy was 1.0 mg). A well-weighed powder and 250 mL of ethanol, etha-nol/benzene (1:2 by volume) and ethanol/methanol (1:1 by vol-ume) were added in the three round bottom flasks respectively. And then refluxed at 85 LC, 82 LC and 80 LC for 4.5 h. The obtained extract was subjected to suction filtration on a circu-lating water type vacuum pump (YUHUA SHZ-D (III)) using a quantitative filter paper subjected to ethanol extraction treat-ment for 12 h. Finally, the obtained extract was steamed and concentrated by a rotary evaporator (YUHUA RE-2000A).

2.2.2. Ft-ir method

Diospyros celebica's 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} and the spectral range was 400–4000 cm^{1}

2.2.3. TG method

The powder of Diospyros celebica was analyzed by thermo-gravimetric 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 30 LC and rises to 250 LC at a rate of 5 LC/min. During the test, the sample's weight (%), Deriv. Weight (%/LC) were recorded.

2.2.4. GC–Ms method

The three extracts were analyzed using a gas chromatography-mass spectrometer (Agilent GC–MS 7890B 5977A). Column HP-5MS (30 m 250 lm 0.25 lm). Elastic quartz capillary column, the carrier gas used for high purity helium, flow rate of 1 mL/min. The split ratio is 20:1. The temperature program of the GC starts at 50 LC, rises to 250 LC at a rate of 8 LC/min, and then rises to 300 LC at a rate of 5 LC/min. MS program scan mass range of 30–600 amu, ionization voltage of 70 eV, ionization current of 150 lA electron ionization (EI). The ion source and the quadrupole temperature were set at 230 LC and 150 LC, respectively.

2.2.5. TDS–GC–MS method

The Diospyros celebica' powder was analyzed with thermal desorption–gas chromatography–mass spectrometry. TDS starting temperature of 30 LC, for 1 min, at 10 LC/min rate rose to 100 LC, keep 5 min, then 10 LC/min rate rose to 200 LC, the transmission line temperature of 230 LC. CIS starting temper-ature of 50 LC, hold 0.1 min, and then 10 LC/s rate rose to 230 LC, keep 1 min. Gas Chromatography-Mass Spectrometer (Agilent GC–MS 7890B 5977A). The temperature program of the GC starts at 50 LC, rises to 250 LC at a rate of 8 LC/min, and then rises to 300 LC at a rate of 5 LC/min. MS program scan mass range of 30—600 amu, ionization voltage of 70 eV, ionization current of 150 lA electron ionization (EI). The ion source and the quadrupole temperature were set at 230 LC and 150 LC, respectively. The analytical standard library was analyzed by NIST14.L.

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

2.2.6. PY–GC–MS method

The powder of Diospyros celebica 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 LC, the heating rate was 20 LC/ms, and the pyrolysis time was 15 s. The pyrolysis pro-duct transfer line and the injection valve temperature are set to 300 LC; Column TR-5MS; Capillary column (30 m 0.25

mm 0.25 lm); Shunt mode, split ratio of 1:60, shunt rate of 50 mL/min. The temperature of the GC program starts at 40 LC for 2 min, rises to 120 LC at a rate of 5 LC/min, and then rises to 200 C at a rate of 10 LC/min for 15 min. Ion source (EI) temperature of 280 LC, scanning range of 28–500 amu.

3. Results and analysis

3.1. Ft-ir analysis

Fig. 1 shows the infrared contrast spectra of the Diospyros celebica Bakh powder and the three extracts. The infrared

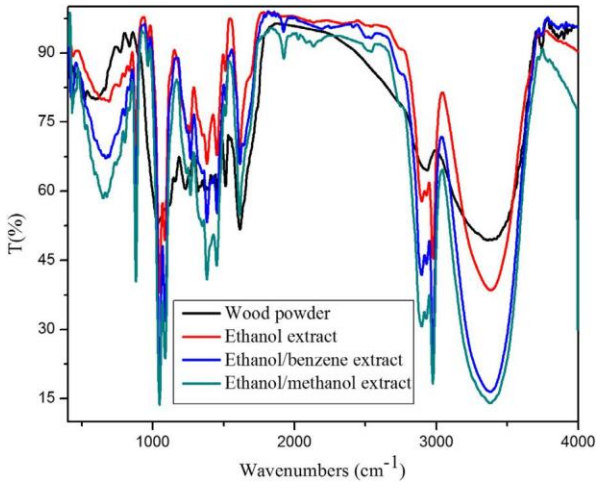


Fig. 1 FT-IR comparison spectra of Diospyros celebica Bakh powders and three extracts.

spectrum of 3360 cm ^{1} is the OAH stretching vibration in the cellulose, phenol, alcohol, carboxylic acid compounds (Iwaki and Dlott, 2000; Shamsudin et al., 2017). The infrared spec-trum of 2900 cm ^{1} is CAH stretching vibration and CAH bending vibration in cellulose and hemicellulose. The infrared spectrum of 1738 cm ^{1} is C,O stretching vibration in hemi-cellulose, lipid, ketone compounds (Gomti et al., 2004; Rahman et al., 2017; Khan et al., 2017); There is the lignin aro-matic carbon skeleton vibration at 1600 cm ^{1}, 1510 cm ^{1}. The infrared spectrum of 1425 cm ^{1} is the CH_2 bending vibration and the CH_2 shear vibration in the lignin, the cellulose (Ito and Nakanaga, 2010). The infrared spectrum of 1370 cm ^{1} is the CAH stretching vibration in the cellulose and hemicellu-lose. Infrared spectrum of 1266 cm ^{1} is the G-ring CAH out-side

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

the bending vibration (Schlemmer et al., 2005; Ghafar et al., 2017). The infrared spectra of 1126 cm ^{1} and 1033 cm ^{1} are CAH aromatic in-plane bending vibrations (Maroni et al., 2005; Aziz and Hanafiah, 2017).

3.2. Tg analysis

Fig. 2 shows the TG curve of the Diospyros celebica Bakh. 40– 80 LC temperature section in the figure, the quality of Diospy-ros celebica Bakh change faster, mainly for water and a small amount of oil evaporation; 120–180 LC temperature section is

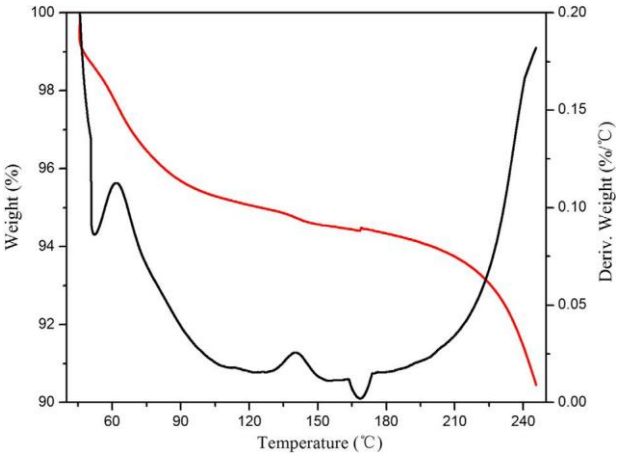
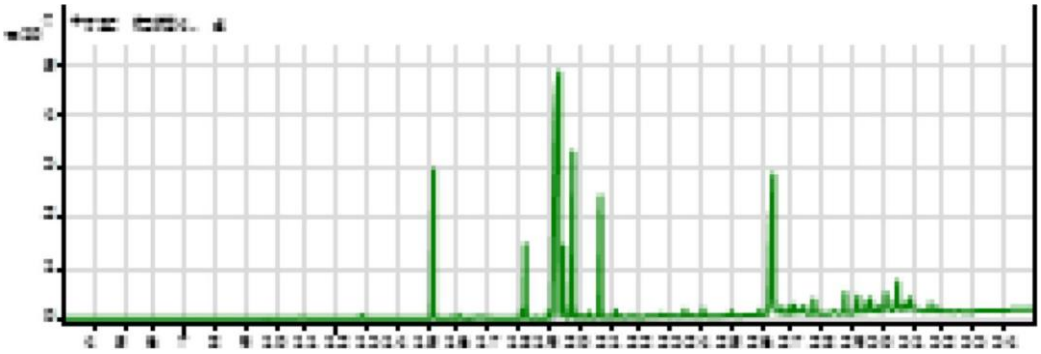


Fig. 2 Diospyros celebica bakh's tg curve.



INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

the continuous endothermic process of wood flour; Diospyros celebica Bakh powder more violent pyrolysis reaction in the 190–250 LC temperature, making the quality of wood powder decreased faster.

3.3. GC–MS analysis

Figs. 3–5 show the total ion chromatograms of the extracts of ethanol, ethanol/benzene and ethanol/methano, respective.

The chemical constituents of three extracts of Diospyros cel-ebica Bakh were determined by GC–MS qualitative analysis technique (Jiye et al., 2005; Halim and Phang, 2017). A total of 34 peaks were isolated by GC–MS gas chromatographic analysis of the ethanol extract of Diospyros celebica Bakh, and 8 compounds were identified; A total of 45 peaks were iso-lated by GC–MS gas chromatographic analysis of the Ethanol/ benzene extract, and 7 compounds were identified; A total of 39 peaks were isolated by GC–MS gas chromatographic anal-ysis of the Ethanol/methanol extract, and 10 compounds were identified. Tables 1–3 were the results of GC–MS analysis of extracts of ethanol, ethanol/benzene and ethanol/methanol of Diospyros celebica Bakh.

3.4. TDS–GC–MS analysis

There is the total ion chromatogram of the Diospyros celebica Bakh powder in Fig. 6.

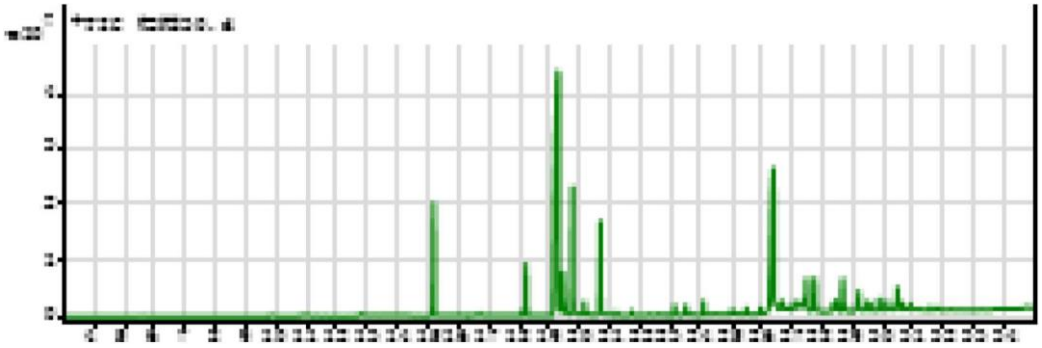
The chemical constituents of Diospyros celebica Bakh pow-der were determined by TDS–GC–MS qualitative analysis technique (Shao et al., 2015; Hassan et al., 2017). A total of 39 peaks were isolated by TDS–GC–MS gas chromatographic analysis of Diospyros celebica Bakh powder, and 7 compounds were identified; Table 4 shows the results of TDS–GC–MS analysis of Diospyros celebica Bakh powder.

3.5. PY–GC–MS analysis

There is the Relative abundance curve of the Diospyros cele-bica Bakh powder in Fig. 7.

The chemical constituents of Diospyros celebica Bakh pow-der were determined by PY–GC–MS qualitative analysis tech-nique (Gao et al., 2013; Sukor et al., 2017). A total of 50 peaks were isolated by PY–GC–MS gas chromatographic analysis of Diospyros celebica Bakh powder, and 9 compounds were Retention time (min)

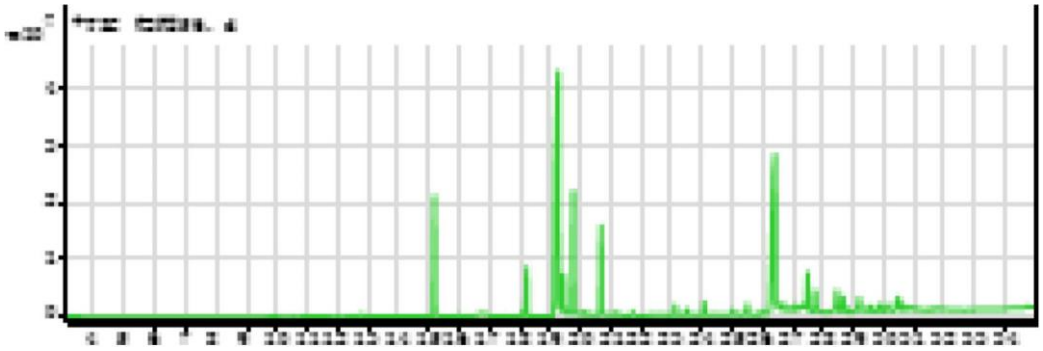
Fig. 3 Total ion chromatogram of ethanol extract of Diospyros celebica bakh.



INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

Retention time (min)

Fig. 4 Total ion chromatogram of ethanol/benzene extract of Diospyros celebica bakh.



Retention time (min)

Fig. 5 Total ion chromatogram of ethanol/methano extract of Diospyros celebica bakh.

Table 1 Ethanol extract of GC–MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	15.203	15.11	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
2	18.231	6.63	Naphthalene, 2,3-dimethoxy-
3	19.486	6.16	2-Acetyl-3,5-dimethylbenzo(b)thiophene
4	20.702	13.49	Quinolin-8-amine, 5,6-dimethoxy-4-methyl-
5	21.193	0.6	Ethanone,1-(7-hydroxy-5-methoxy-2,2-dimethyl-2H-1-benzopyran-8-yl)-
6	22.12	0.4	3-O-Methyl-d-glucose
7	26.388	34.91	Ethanone, 2-hydroxy-1,2-bis(4-methoxyphenyl)-
8	28.749	2.33	6a,12a-Dihydro-6H-(1,3)dioxolo(5,6)benzofuro(3,2-c)chromen-3-ol
9	29.176	2.23	6a,12a-Dihydro-6H-(1,3)dioxolo(5,6)benzofuro(3,2-c)chromen-3-ol

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

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

No.	Retention time (min)	Peak area (%)	Compounds
1	15.19	14.35	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
2	18.217	6.44	Naphthalene, 2,3-dimethoxy-
3	20.152	1.5	2-Acetyl-3,5-dimethylbenzo(b)thiophene
4	20.676	12.71	Quinolin-8-amine, 5,6-dimethoxy-4-methyl-
5	22.31	1.21	1H-Cycloprop[e]azulene, 1a,2,3,5,6,7,7a,7b-octahydro-1,1,4,7-tetramethyl-, [1aR-(1a.alpha.,7.alpha.,7a.beta.,7b.alpha.)]-
6	24.072	1.77	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
7	27.726	5.83	S-Indacene-1,7-dione, 2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl-

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

Table 3 Ethanol/Methanol extract of GC–MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	15.19	15.67	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
2	18.101	0.67	5-(4-Methylphenyl)furan-2-carboxylic acid
3	18.224	6.46	Naphthalene, 2,3-dimethoxy-
4	19.44	4.17	2-Acetyl-3,5-dimethylbenzo(b)thiophene
5	20.676	12.1	Quinolin-8-amine, 5,6-dimethoxy-4-methyl-
6	21.23	1.01	p-Cresol
7	24.072	1.66	Benzene, 1,3-dimethoxy-5-[(1E)-2-phenylethenyl]-
8	26.21	1.22	9-Octadecenoic acid (Z)-, methyl ester
9	27.727	3.01	S-Indacene-1,7-dione, 2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl-
10	28.438	3.33	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

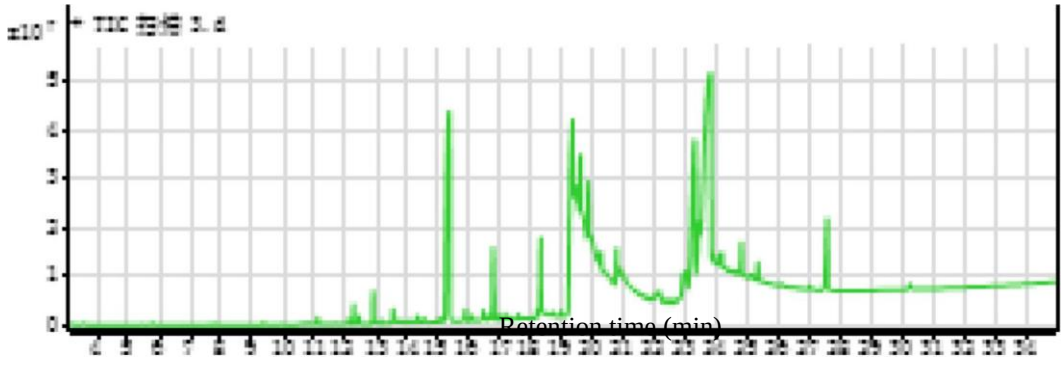


Fig. 6 Total ion chromatogram of Diospyros celebica bakh powder.

Table 4 Diospyros celebica bakh powder of TDS–GC–MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

1	12.262	1.03	Ethanol, 2-(2-butoxyethoxy)-, acetate
2	12.892	1.84	Methyleugenol
3	13.535	1.1	4-Methoxybenzene-1,2-diol
4	15.35	40.98	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
5	16.762	5.75	2-Naphthalenemethanol, decahydro-.alpha.,. alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
6	18.312	6.77	Naphthalene, 2,3-dimethoxy-
7	25.117	1.33	Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]-

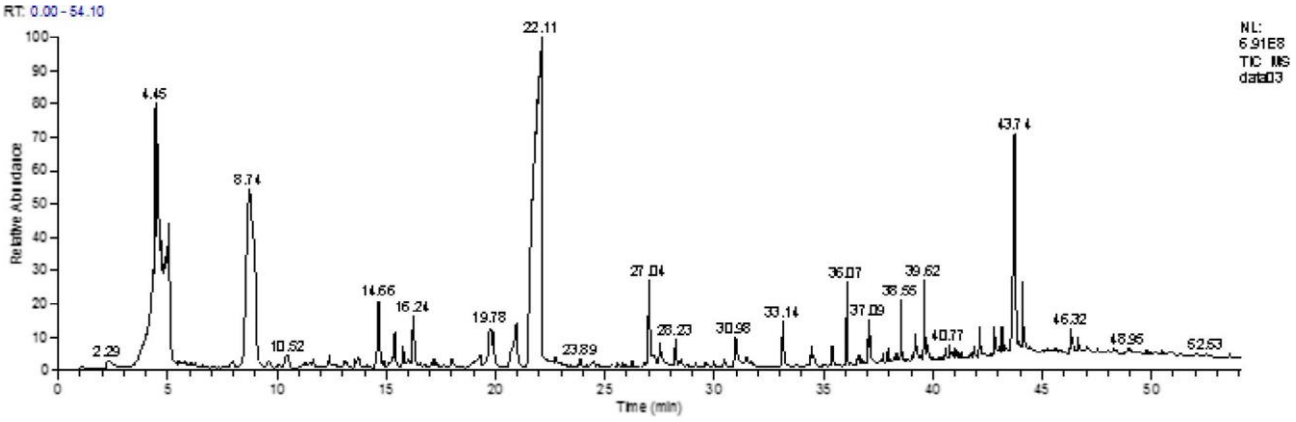


Fig. 7 Relative abundance curve of the Diospyros celebica bakh powder.

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

Table 5 Diospyros celebica bakh powder of PY–GC–MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	4.53	55.34	Acetic acid, oxo-, methyl este
2	10.52	2.16	2(3H)-Furanone, 5-methyl-
3	14.66	12.56	2-Furancarboxaldehyde, 5-methyl-
4	19.31	3.85	Pentanoic acid, 4-oxo-
5	21.83	120.01	Levoglucosenone
6	22.13	47.78	Levoglucosenone
7	27.04	10.86	1,4:3,6-Dianhydro-a`-d-glucopyranose
8	27.51	22.47	5-Hydroxymethylfurfural
9	33.14	32.24	Phenol, 2,6-dimethoxy-
10	38.55	17.09	2-Propanone, 1-(4-hydroxy-3-methoxyphenyl)-

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

identified; Table 5 shows the results of PY–GC–MS analysis of Diospyros celebica Bakh powder.

3.6. Functional analysis

Pterocarpus is a high-end, expensive furniture materials collec-tively. 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 Diospyros celebica Bakh, and the related compounds were obtained. By reviewing the relevant literature and reports, we have obtained the proven, human health function composi-tion. 6a,12a-Dihydro-6H-(1,3)dioxolo(5,6)benzofuro(3,2-c) chromen-3-ol is a biologically active molecule with anti-angiogenic activity (Mathi et al., 2016). Benzene, 1,2,3-trimethoxy-5-(2-propenyl)- has medicinal value, with antioxidant, anti-inflammatory, anti-thrombosis and hypolipidemic effect (Naher et al., 2013). 3-O-Methyl-d-glucose has a certain conservation properties, and it can protect the pancreatic B cells against the toxicity of alloxan (Malaisse-Lagae et al., 1983; Norris et al., 2006). P-Cresol plays a role in endothelial dysfunction in uremic patients, and it can repair wounds and reduce endothelial progression (Dou et al., 2004). 2-Naphthalenemethanol, decahydro-. alpha., .alpha., 4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]- with medicinal efficacy of cough and phlegm, detoxification (Tu et al., 2009). 1H-Cycloprop[e]azulene, 1a,2,3,5,6,7,7a,7b-octahydro-1, 1,4,7-tetramethyl-, [1aR-(1a.alpha.,7.alpha.,7a. beta.,7b.alpha.)]- has protective effect on acetaminophen-induced necrosis of renal tissue (Sarumathy et al., 2011). 2(3H)-Furanone, 5-methyl- has certain biological resistance, and has high antimicrobial activity against NCIM 2501 and NCIM 5021 (Jadhav et al., 2010).

4. Conclusion

GC–MS analysis, a total of 34 peaks were isolated by GC–MS gas chromatographic analysis of the ethanol extract of Diospy-ros celebica Bakh, and 8 compounds were identified; a total of 45 peaks were isolated by GC–MS gas chromatographic analysis of ethanol/benzene extract, and 7 were identified; a total of 39 peaks were isolated by GC–MS gas chromato-graphic analysis of ethanol/methanol extract, and 10 com-pounds were identified.

TDS–GC–MS analysis, a total of 39 peaks were isolated by TDS–GC–MS gas chromatographic analysis of Diospyros celebica Bakh powder, and 7 compounds were identified.

PY–GC–MS analysis, a total of 50 peaks were isolated by PY–GC–MS gas chromatographic analysis of Diospyros cele-bica Bakh powder, and 9 compounds were identified.

Through access to the literature and related reports, we clear the Diospyros celebica Bakh contains human health ingre-dients and functions. 6a,12a-Dihydro-6H-(1,3)dioxolo(5,6)ben zofuro(3,2-c)chromen-3-ol is a biologically active molecule with anti-angiogenic activity. Benzene, 1,2,3-trimethoxy- 5-(2-propenyl)- has medicinal value, with antioxidant, anti-inflammatory, anti-thrombosis and hypolipidemic effect. 3-O-Methyl-d-glucose has a certain conservation properties, and it can protect the pancreatic B cells against the toxicity of alloxan. P-Cresol plays a role in endothelial dysfunction in uremic patients, and it can repair wounds and reduce endothelial progression. 2-Naphthalenemethanol, decahydro-. alpha., .alpha.,

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

4a-trimethyl-8-methylene-, [2R-(2.alpha., 4a. alpha., 8a.beta.)]- with medicinal efficacy of cough and phlegm, detoxification.

Acknowledgments

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

References

Aziz, N.I.H.A., Hanafiah, M.M., 2017. The potential of palm oil mill effluent (POME) as a renewable energy source. Acta Sci. Malay. 1
(2), 09–11.

Basheer, A.O., Hanafiah, M.M., Abdulhasan, M.J., 2017. A study on water quality from Langat river, Selangor. Acta Sci. Malay. 1 (2), 01–04.

Bassilakis, R., Carangelo, R.M., Wo´jtowicz, M.A., 2001. TG-FTIR analysis of biomass pyrolysis. J. Fuel 80, 1765–1786.

Botha, A., Strydom, C.A., 2003. DTA and FT-IR analysis of the rehydration of basic magnesium carbonate. J. J. Therm. Anal. Calori. 71, 987–996.

Dou, L., Bertrand, E., Cerini, C., Faure, V., Sampol, J., 2004. The uremic solutes p-cresol and indoxyl sulfate inhibit endothelial proliferation and wound repair. J. Kidney Int. 65, 442–451.

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. J. Anal. Appl. Pyrol. 100, 26–32

Ghafar, F., Nazrin, T.N.N.T., Salleh, M.R.M., Hadi, N.N., Ahmad, N., Hamzah, A.A., Yusof, Z.A.M., Azman, I.N., 2017. Total phenolic content and total flavonoid content in moringa oleifera seed. Sci. Heritage J. 1 (1), 23–25.

Gomti, D.T., Das, A., Kumar, K., 2004. Raman anisotropic bandwidth study of C = O stretching vibration of methyl isobutyl ketone: role of van der Waals' volume of the interacting systems. J. Spectrochim. Acta A 60, 211–216.

Halim, H., Abdullah, R., Nor, M.J.M., Aziz, H.A., Rahman, N.A., 2017. Comparison between measured traffic noise in Klang Valley, Malaysia and existing prediction models. Eng. Heritage J. 1 (2), 10–14.

Halim, N.I.A., Phang, I.C., 2017. Salicylic acid mitigates pb stress in Nicotiana tabacum. Sci. Heritage J. 1 (1), 16–19.

Hassan, S.R., Zaman, N.Q., Dahlan, I., 2017. Influence of seed loads on start up of modified anaerobic hybrid baffled (MAHB) reactor treating recycled paper wastewater. Eng. Heritage J. 1 (2), 05–09.

Ismail, H., Hanafiah, M.M., 2017. Management of end-of-life electri-cal and electronic products: the challenges and the potential solutions for management enhancement in developing countries context. Acta Sci. Malay. 1 (2), 05–08.

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

Ito, F., Nakanaga, T., 2010. Observation of the high-resolution spectrum of the N-H bending vibration of ketenimine CH_2 CNH. J. J. Mol. Spectrosc. 264, 100–104.

Iwaki, L.K., Dlott, D.D., 2000. Ultrafast vibrational energy redistri-bution within C–H and O–H stretching modes of liquid methanol. J. Chem. Phys. Lett. 321, 419–425.

Jadhav, D.Y., Sahoo, A.K., Ghosh, J.S., Ranveer, R.C., Mali, A.M., 2010. Phytochemical detection and in vitro evaluation of tamarind fruit pulp for potential antimicrobial activity. J. Int. J. Trop. Med. 5, 68–72.

Jiye, A., Trygg, J., Gullberg, J., Johansson, I.A., Jonsson, P., 2005. Extraction and GC/MS analysis of the human blood plasma metabolome. J. Anal. Chem. 77, 8086–8094.

Khan, I.U., Sajid, S., Javed, A., Sajid, S., Shah, S.U., Khan, S.N., Ullah, K., 2017. Comparative diagnosis of typhoid fever by polymerase chain reaction and widal test in southern districts (Bannu, Lakki Marwat and D.I.Khan) of Khyber Pakhtunkhwa, Pakistan. Acta Sci. Malay. 1(2), 12–15.

Malaisse-Lagae, F., Sener, A., Malaisse, W.J., 1983. Contrasting modes of action of d-glucose and 3-O-methyl-d-glucose as protec-tors of the rat pancreatic B-cell against alloxan. J. BBA – Mol. Cell Res. 762, 36.

Maroni, P., Papageorgopoulos, D.C., Sacchi, M., Dang, T.T., Beck, R.D., 2005. State-resolved gas-surface reactivity of methane in the symmetric C-H stretch vibration on Ni(100). J. Phys. Rev. Lett. 94.

Mathi, P., Veeramachaneni, G.K., Raj, K.K., Talluri, V.R., Bokka, V. R., 2016. In vitro and in silico characterization of angiogenic inhibitors from Sophora interrupta. J. J. Mol. Model. 22, 247.

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. J. J. Stat. Softw. 62, 345–346.

Norris, M.M., Aksan, A., Sugimachi, K., Toner, M., 2006. 3-O-methyl-D-glucose improves desiccation tolerance of keratinocytes. J. Tissue Eng. 12, 1873–1879.

Rahman, N.A., Halim, H., Gotoh, H., Harada, E., 2017. Validation of microscopic dynamics of grouping pedestrians behavior: from observation to modeling and simulation. Eng. Heritage J. 1 (2), 15– 18.

Razali, M.A.A., Said, F.M., 2017. Red pigment production by monascus purpureus in stirred-drum bioreactor. Sci. Heritage J. 1

(1), 13–15.

Sarumathy, K., Rajan, M.S.D., Vijay, T., Jayakanthi, J., 2011. Evaluation of phytoconstituents, nephro-protective and antioxi-dant activities of Clitoria ternatea. J. Bentomol. Res. 1, 164–172.

Schlemmer, S., Asvany, O., Giesen, T., 2005. Comparison of the cis-bending and C–H stretching vibration on the reaction of $C_2H^+_2$ with H_2 using laser induced reactions. J. Phys. Chem. Chem. Phys. 7, 1592–1600.

Shamsudin, N.H., Wong, C.H., Rahman, R.N.Z.R.A., Ali, M.S.M., 2017. Tight repression of elastase strain K overexpression by Pt7 (A1/O4/O3) shuttle expression system. Sci. Heritage J. 1 (1), 20–22.

INTERNATIONAL JOURNAL OF COMPUTATIONAL AND MATHEMATICAL IDEAS [IJCMI] ISSN: 0974-8652

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. J. J. Sci. Food Agr. 94, 3248–3254.

Sukor, N.S.A., Jarani, N., Fisal, S.F.M., 2017. Analysis of passengers' access and egress characteristics to the train station. Eng. Heritage J. 1 (2), 01–04.

Tu, Y.Q., Yang, R.P., Zhu, H.L., Wang, B.H., 2009. GC–MS Analysis of the Chemical Components of Essential Oils in Ligularia Melanocephala. J. J. Southwest University.