



ISSN: 2329-6119 (Print)
ISSN: 2329-6100 (Online)
CODEN: AFMDD7



ARTICLE

MOLECULES AND FUNCTIONS OF ROSEWOOD: *DALBERGIA CEARENENSIS*

Wanxi Peng^{1,3*}, Juntao Chen^{1,3}, Junwei Lou², Changyu Ni³

¹Henan Agricultural University, School of Forestry, Zhengzhou 450002, China

²Zhejiang Business Technology Institute, School of Architectural Engineering, Ningbo 315012, China

³Central South University of Forestry and Technology, School of Materials Science and Engineering, Changsha 410004, China

*Correspondence Author E-mail: pengwanxi@163.com

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ARTICLE DETAILS

ABSTRACT

Article History:

Received 27 May 2020
Accepted 29 June 2020
Available online 30 July 2020

Pterocarpus is a high-end, expensive furniture materials collectively. In this paper, *Dalbergia cearensis* Ducke as an example, we study its human health components by using PY-GC-MS, TD-GC-MS and GC-MS. The composition of known human health functions was studied by reviewing the literature. Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-has antioxidant, anti-inflammatory, anti-thrombosis and lower blood lipids. 1,2-Benzenedicarboxylic acid, bis (2-methylpropyl) ester has its medicinal value and it can be used as a synthetic anticancer drug. Phenol, 2-methoxy-5-(1-propenyl)-, (E)-can be used to treat chest and stomach pain and irregular menstruation. 1-Heptatriacotanol has the effect of anti-hypercholesterolemia.

KEYWORDS

Pterocarpus, *Dalbergia cearensis*, PY-GC-MS, GC-MS, TD-GC-MS, health care ingredients.

1. INTRODUCTION

Dalbergia cearensis Ducke mainly grows in Brazilian, belonging to the Leguminosae Dalbergia, *Dalbergia cochinchinensis* Pierre. *Dalbergia cearensis* is in the arbor, the trunk straight. Wood for the semi-ring hole material, the growth wheel is not obvious, the tube hole is small but evenly distributed, and it can be seen magnifying glass. The flexural strength and compressive strength of *Dalbergia cearensis* were high at 1.195 g/cm³. *Dalbergia cearensis*'s noble furniture and handicrafts, was known as "King Wood". Traditionally, the *Dalbergia cearensis* is considered to be beneficial to the human health function of wood. Therefore, the *Dalbergia cearensis* powder was analyzed by PY-GC-MS, TD-GC-MS, TG and FT-IR; The extractives of ethanol, ethanol/benzene and ethanol/methanol in the *Dalbergia cearensis* were analyzed by GC-MS and FT-IR; To determine the active molecules of *Dalbergia cearensis*, figurative effect of human care function.

2. MATERIALS AND METHODS

2.1 Materials

The *Dalbergia cearensis* used in the experiment was produced in Brazil. When we do the experiment, the *Dalbergia cearensis* 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 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 *Dalbergia cearensis*'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, 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 FT-IR analysis

Dalbergia cearensis's powder and the concentrated extractives 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 4cm⁻¹ and the spectral range was 400 cm⁻¹-4000 cm⁻¹ (1).

2.2.3 TG analysis

The powder of *Dalbergia cearensis* 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 60ml/min. The temperature program of TG starts at 25°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].

2.2.4 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 30 amu-600 amu, 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. Figures 3, 4, 5 show the total ion chromatograms of the extractives of ethanol, ethanol/benzene and ethanol/methano, respectively.

2.2.5 TD-GC-MS analysis

The *Dalbergia cearensis*' 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 0.1 min, 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 30 amu-600 amu, 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 NIST14. L. There is the total ion chromatogram of the *Dalbergia cearensis* powder in Figure 6.

2.2.6 PY-GC-MS analysis

The powder of *Dalbergia cearensis* 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. There is the Relative abundance curve of the *Dalbergia cearensis* powder in Figure 7.

3. RESULTS AND ANALYSIS

3.1 FT-IR analysis

Figure 1 shows the infrared comparison spectra of the *Dalbergia cearensis*' 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^[2]. 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 hemicellulose, lipids, ketones^[3]. There is the lignin aromatic carbon skeleton vibration at 1600 cm⁻¹, 1510 cm⁻¹. The 1425 cm⁻¹ of the infrared spectrum is the CH₂ bending vibration and the CH₂ shear vibration in the lignin and the cellulose^[3]. The infrared spectra of 1126 cm⁻¹ are C-H aromatic in-plane bending vibrations^[4,5].

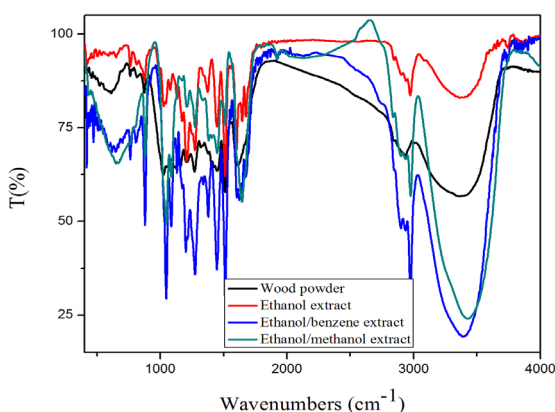


Figure 1: FT-IR spectra of *Dalbergia cearensis* powders and three extractives.

3.2 TG analysis

Figure 2 shows the TG curve of the *Dalbergia cearensis*. 25°C-75°C temperature section in the figure, the quality of *Dalbergia cearensis* change faster, mainly for water and a small amount of oil evaporation; 75°C-185°C temperature section is the continuous endothermic process of wood flour; *Dalbergia cearensis* powder more violent pyrolysis reaction in the 185°C-250°C temperature, making the quality of wood powder decreased faster.

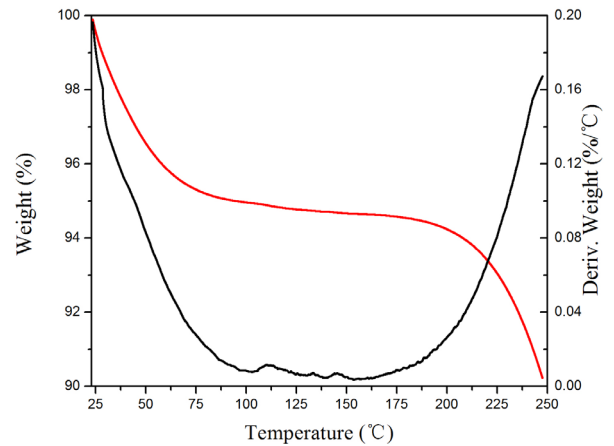


Figure 2: *Dalbergia cearensis*'s TG curve.

3.3 GC-MS analysis

Figures 3, 4, 5 show the total ion chromatograms of the extractives of ethanol, ethanol/benzene and ethanol/methano, respectively.

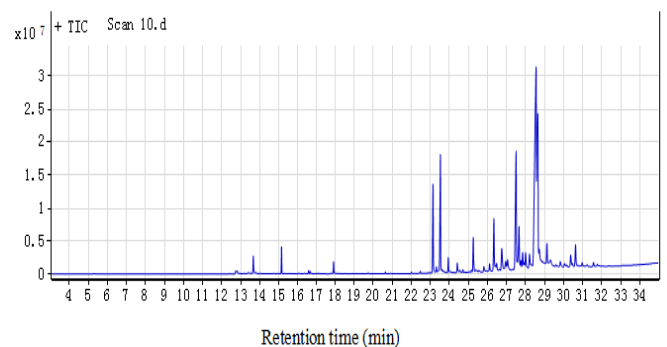


Figure 3: Total ion chromatogram of ethanol extractives of *Dalbergia cearensis*.

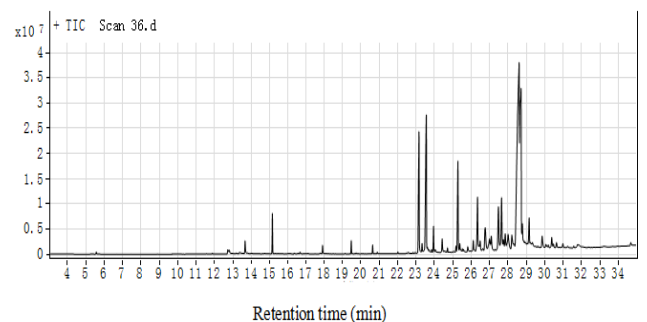


Figure 4: Total ion chromatogram of ethanol/benzene extractives of *Dalbergia cearensis*.

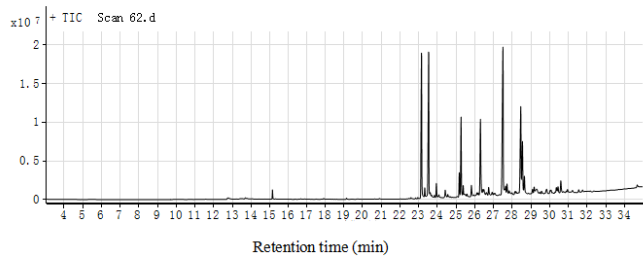


Figure 5: Total ion chromatogram of ethanol/methano extractives of *Dalbergia cearensis*.

The chemical constituents of three extractives of *Dalbergia cearensis* were determined by GC-MS qualitative analysis technique^[6]. A total of 55 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol extractives of *Dalbergia cearensis*, and 7 compounds were identified; A total of 54 peaks were isolated by GC-MS gas chromatographic analysis of the Ethanol/benzene extractives, and 9 compounds were identified; A total of 76 peaks were isolated by GC-MS gas chromatographic analysis of the Ethanol/methanol extractives, and 6 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 cearensis*.

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

No.	Retention time (min)	Peak area (%)	Compounds
1	12.751	0.55	1,4-Benzenediol, 2-methoxy-
2	13.398	0.62	4-Methoxybenzene-1,2-diol
3	13.683	3.41	Benzaldehyde, 3-hydroxy-4-methoxy-
4	15.171	4.07	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
5	16.594	0.62	Benzoic acid, 4-hydroxy-3-methoxy-, ethyl ester
6	16.678	0.56	2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
7	26.75	7.23	10,11-Dihydro-10-hydroxy-2,3-dimethoxydibenz(b,f)oxepin
8	29.124	7.37	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

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

No.	Retention time (min)	Peak area (%)	Compounds
1	12.771	0.78	1,4-Benzenediol, 2-methoxy-
2	12.829	0.73	1,4-Benzenediol, 2-methoxy-
3	13.431	1.47	4-Methoxybenzene-1,2-diol
4	15.164	3.44	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-

5	23.522	77.17	Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]-
6	25.262	38.39	Isoparvifuran
7	28.451	54.46	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin
8	28.548	33.51	10,11-Dihydro-10-hydroxy-2,3,6-trimethoxydibenz(b,f)oxepin

3.4 TD-GC-MS analysis

There is the total ion chromatogram of the Dalbergia cearensis powder in Figure 6.

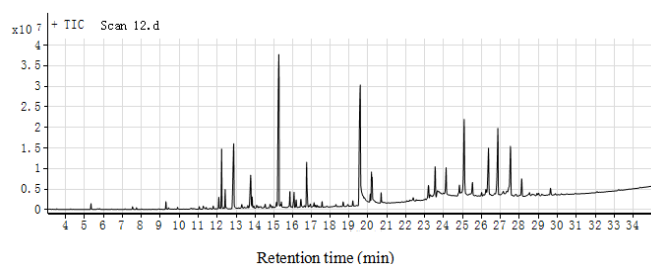


Figure 6: Total ion chromatogram of Dalbergia cearensis powder.

The chemical constituents of Dalbergia cearensis powder were determined by TD-GC-MS qualitative analysis technique^[7]. A total of 72 peaks were isolated by TD-GC-MS gas chromatographic analysis of Dalbergia cearensis powder, and 23 compounds were identified; Table 4

shows the results of TD-GC-MS analysis of Dalbergia cearensis powder.

3.5 PY-GC-MS analysis

There is the Relative abundance curve of the Dalbergia cearensis powder in Figure 7.

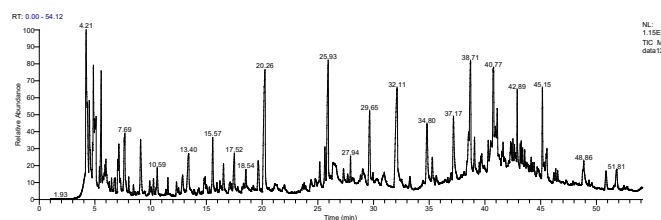


Figure 7: Relative abundance curve of Dalbergia cearensis powder.

The chemical constituents of Dalbergia cearensis powder were determined by PY-GC-MS qualitative analysis technique^[8]. A total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of Dalbergia cearensis powder, and 8 compounds were identified; Table 5 shows the results of PY-GC-MS analysis of Dalbergia cearensis powder.

Table 3: Dalbergia cearensis powder of TD-GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	5.343	1.82	Benzaldehyde
2	7.536	1.06	Phenol, 2-methoxy-
3	9.301	2.62	Ethanol, 1-(2-butoxyethoxy)-
4	9.918	0.88	m-Guaiacol
5	11.065	0.84	2(3H)-Furanone, 5-butyldihydro-4-methyl-
6	12.098	4.15	2,2,4-Trimethyl-1,3-pentandiol diisobutyrate
7	12.25	19.88	Ethanol, 2-(2-butoxyethoxy)-, acetate

8	12.439	6.43	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
9	12.892	41.67	1,4-Benzenediol, 2-methoxy-
10	13.787	20.86	Vanillin
11	13.863	3.63	Phenol, 2-methoxy-5-(1-propenyl)-, (E)-
12	15.148	2.63	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
13	15.274	95.96	Benzene, 1,2,3-trimethoxy-5-(2-propenyl)-
14	15.867	6.25	2,2,4-Trimethyl-1,3-pentanediol diisobutyrate
15	16.081	6.33	Cedrol
16	16.195	2.81	Benzenamine, 4-isothiocyanato-N,N-dimethyl-
17	16.749	20.78	2-Naphthalenemethanol, decahydro-.alpha.,.alpha.,4a-trimethyl-8-methylene-, [2R-(2.alpha.,4a.alpha.,8a.beta.)]-
18	16.938	1.96	1-Heptatriacotanol
19	17.14	2.24	1-Heptatriacotanol
20	17.82	0.55	1H-2,8a-Methanocyclopenta[a]cyclopropano[e]cyclodec-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.,10.alpha.)]-
21	18.299	1.06	1H-2,8a-Methanocyclopenta[a]cyclopropano[e]cyclodec-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.,10.alpha.)]-
22	19.585	10	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
23	20.114	2.51	Phthalic acid, butyl dodecyl ester
24	23.542	12.18	Phenol, 4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]-
25	25.08	47.47	cis-Trismethoxyresveratrol

26	26.857	39.21	3-Hydroxy-2-(4-hydroxy-3-methoxyphenyl)-4H-chromen-4-one
27	28.117	7.09	4H-1-Benzopyran-4-one, 2-(3,4-dimethoxyphenyl)-7-hydroxy-

Table 4: *Dalbergia cearensis* powder of PY-GC-MS analysis results.

No.	Retention time (min)	Peak area (%)	Compounds
1	5.11	2.49	Acetic acid
2	5.56	6.03	2-Propanone, 1-hydroxy-
3	9.91	3.22	2-Furanmethanol
4	12.86	4.95	2(5H)-Furanone
5	20.26	15.71	Phenol, 2-methoxy-
6	29.65	7.86	Phenol, 4-ethyl-2-methoxy-
7	35.27	17.53	Phenol, 2-methoxy-4-propyl-
8	42.89	5.41	Phenol, 2,6-dimethoxy-4-(2-propenyl)-

3.6 Function of *Dalbergia cearensis* wood

Pterocarpus and Pterocarpus products have a certain human health function. The PY-GC-MS, TD-GC-MS and GC-MS techniques were used to qualitatively analyze the *Dalbergia cearensis*, 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 antioxidant, anti-inflammatory, anti-thrombosis and lower blood lipids^[9]. 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^[10]. 1,2-Benzenedicarboxylic acid, bis (2-methylpropyl) ester has its medicinal value and it can be used as a synthetic anticancer drug^[11]. Benzaldehyde has inhibitory effects on larval phenoloxidase activity^[12]. Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester has the effect of heat and detoxification, but also for the treatment of liver and stomach discomfort and red mouth^[13]. Phenol, 2-methoxy-5- (1-propenyl) -, (E) - can be used to treat chest and stomach pain and irregular menstruation^[14]. Cedrol has a distinct sedative effect^[15]. 1-Heptatriacotanol has the effect of anti-hypercholesterolemia^[16].

4. CONCLUSION

GC-MS analysis, a total of 55 peaks were isolated by GC-MS gas chromatographic analysis of the ethanol extractives of *Dalbergia cearensis*, and 7 compounds were identified; a total of 54 peaks were isolated by GC-MS gas chromatographic analysis of ethanol/benzene extractives, and 9 compounds were identified; a total of 76 peaks were isolated by GC-MS gas chromatographic analysis of ethanol/methanol extractives, and 6 compounds were identified.

TD-GC-MS analysis, a total of 72 peaks were isolated by TD-GC-MS gas chromatographic analysis of *Dalbergia cearensis* powder, and 23 compounds were identified.

PY-GC-MS analysis, a total of 50 peaks were isolated by PY-GC-MS gas chromatographic analysis of *Dalbergia cearensis* powder, and 8 compounds were identified.

Through access to the literature and related reports, we clear the *Dalbergia cearensis* contains human health ingredients and functions. Benzene, 1,2,3-trimethoxy-5- (2-propenyl) - has antioxidant, anti-inflammatory, anti-thrombosis and lower blood lipids. 1,2-Benzenedicarboxylic acid, bis (2-methylpropyl) ester has its medicinal value and it can be used as a synthetic anticancer drug. Phenol, 2-methoxy-5- (1-propenyl) -, (E) - can be used to treat chest and stomach pain and irregular menstruation. 1-Heptatriacotanol has the effect of anti-hypercholesterolemia.

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).

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