Original article

Chemical components and functions of *Taxus chinensis* extract

Zhe Hu, Jun-Tao Chen, Shuai-Cheng Jiang, Zhenling Liu, Sheng-Bo Ge, Zhongfeng Zhang

School of Materials Science and Engineering & Hunan Green Home Engineering Research Center, Central South University of Forestry and Technology, 410004 Changsha, China

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ABSTRACT

Taxus chinensis is a National level protected plant and has been for a long time, since it grows slowly and has low regenerative capacity. Consequently, no large base of raw material forest of taxus was formed. This study used *Taxus chinensis* as the study object, for analyzing the chemical composition of *T. chinensis* extract via fourier transform infrared spectroscopy (FT-IR) and gas chromatography/mass spectrometry (GC/MS). 37 types of chemical components were detected. These were mainly ethers (asarone, dibutyl phthalate, diisobutyl phthalate), alcohols (nerolidol, Myo-inositol, 4-C-methyl-, *trans*-Sinapyl alcohol), acids (3,4-dimethoxycinnamic acid, palmitic acid, oleic Acid), flavonoids (macckiain, formononetin), ketone (4-hydroxy-.beta.-ionone, pseudobaptigenin), phenols (methyleugenol), esters (triacetin), aldehydes (sinapinaldehyde), and pyridines (alpha-methylstyrene). This chemical component could be directly or indirectly used for bioengineering, pharmaceutical engineering, the cosmetic industry, and other chemical industries.

1. Introduction

Taxus chinensis is endemic to China and its main distribution is in the provinces south of the Yangtze River Basin. *T. chinensis* is a member of the family Taxaceae and the genus Taxus. All species of taxus contain highly toxic ingredients but provide a potentially rich source of biological active diterepenoids (Li et al., 2008; Qiu et al., 2009) They grow slowly and are protected at National level. Taxol (paclitaxel) has been one of the best natural anticancer drugs in the past few decades (Mu and Feng, 2003). It has been widely used for the treatment of breast cancer, lung cancer, ovarian cancer, and part of head and neck cancer. The supply of taxol is extracted from taxus bark (Shen et al., 2017). Relying on other chemical component from taxus due to the scarcity of taxol, slow growth and low paclitaxel. Therefore, study of the extract of chemical components and functions of *T. chinensis* has become very meaningful.

2. Material and methods

The material of this study was obtained from the *T. chinensis* trunk. First, we ground three parts of the material (bark, sapwood, and heartwood of *T. chinensis*) in a micro plant grinding machine to obtain wood powder, and the powder was put into a drying oven, set at a temperature of 100 °C and dry for 6 h to evaporate all free water from the sample.

Then, we used four different experiment levels: "0" represented the untreated wood powder; "1", "2", and "3" represented the material for the extraction experiment using ethanol, ethanol & methanol, and ethanol & benzene as solvent (Table 1).

2.1. FT-IR analysis

The dried *T. chinensis* powder was filtered through a 200-mesh sieve. This experiment used pure KBr as a solid dispersion medium (Mi et al., 2019). The finely ground *T. chinensis* powder was dispersed in KBr at 1:100. The range of the spectrum was set to 400–4000 cm^{-1} (Castaldi et al., 2010; Li et al., 2017a, 2017b; Maréchal and Chanzy, 2000).

2.2. GC/MS analysis

The chromatographic column was HP-5MS (30 m × 250 μm × 0.25 μm), capillary column was elastic quartz, carrier gas was high purity He, flow rate was 1 mL/min, and the

Table 1
Sample number.

	Solvent	Bark	Sapwood	Heartwood
Untreated	–	B_0	S_0	H_0
Extractive	Ethanol	B_1	S_1	H_1
	Ethanol & Methanol	B_2	S_2	H_2
	Ethanol & Benzene	B_3	S_3	H_3

shunting mode was used with a split ratio of 20:1. The temperature of GC program started at 50 °C, increased to 250 °C at a rate of 8 / min, increased to 300 at a rate of 5 /min. MS program scanning quality range was 30–600 amu, ionization voltage was 70 eV, and ionization current (EI) was 150 μA. The ion source temperature was 230 , quadrupole temperature was 150 (Daferera et al., 2000; Ma et al., 2008a, 2008b; Wang et al., 2005).

3. Results and discussion

3.1. Analysis of FT-IR

This analysis used materials extracted via different slovents. Due to the ubiquitous solvent effect, interactions between sample molecules and solvent molecules would change the frequency and intensity of vibration of the sample molecule (Peng et al., 2017a, 2017b). For the same raw material, this may thus obtain different results due to the different solvents.

Fig. 1 and Table 2 show the results of FT-IR spectra of *T. chinensis* bark. We could see that in different experimental levels, the same part of the FT-IR spectrum of wood powder differed. The spectrograms show that transmittance of B_0 was 76.24% at 3341 cm^{-1}, transmittance of B_1, B_2, and B_3, respective were 61.07%, 58.31%, and 43.87% at 3441 cm^{-1} (O–H stretching vibration). Furthermore, according to other studies we know that the characterized absorption peaks of cellulose were 2900 cm^{-1}, 1425 cm^{-1}, 1370 cm^{-1}, and 895 cm^{-1}. Transmittance of B_0 was 85.21% at 2934 cm^{-1}, transmittance of B_1, B_2, and B_3, respective were 81.58%, 79.75%, and 68.29% at 3441 cm^{-1} (C–H stretching vibration). At 1370 cm^{-1} (C–H flexural vibration), transmittance of B_0, B_1, B_2, and B_3 were 89.58%, 78.30%, 79.73%, and 68.95%, respectively. This showed that cellulose was hydrolyzed to differently extent and it was hydrolyzed more in mixed solvent of ethanol and benzene.

At 1618 cm^{-1} (benzene ring stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 79.15%, 61.62%, 60.32%, and 45.55%, respectively. At about 1518 cm^{-1} (benzene ring stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 89.43%, 71.92%, 72.44%, and 59.73%, respectively (Peng et al., 2017a, 2017b). At about 1454 cm^{-1} (benzene ring stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 88.22%, 76.08%, 77.88%, and 65.47%, respectively. At 1317 cm^{-1} (S-ring, 5-substituted G-ring), transmittance of B_0, B_1, B_2, and B_3 were 88.48%, 76.85%, 77.60%, and 66.90%, respectively. This shows that the transmittance of B_1 was close to B_2 and their transmittances were weaker than that of B_0. The transmittance of B_3 was the weakest. This shows that lignin was partially hydrolyzed in the mix solvent of ethanol and benzene, and a small amount of hydrolyed in the ethanol solvent and the mixed solvent of ethanol and methanol.

At about 1056 cm^{-1} (C–O Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 81.61%, 66.46%, 65.02%, and 53.70%, respectively. In combination with the above data, this shows that hemicelluloses was partially hydrolyzed by organic solvents (Ma et al., 2008a, 2008b; Río et al., 2007; Schwanninger et al., 2004).

Fig. 2 and Table 3 show the results of FT-IR spectra of *T. chinensis* sapwood. The characterized absorption peaks of cellulose, at about 2898 cm^{-1} (C–H Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 79.08%, 86.75%, 78.24%, and 81.12%, respectively. At about 1426 cm^{-1} (CH$_2$ Flexural vibration, CH$_2$ Scissor vibration), transmittance of B_0, B_1, B_2, and B_3 are 80.59%, 86.04%, 81.34%, and 75.80%, respectively. At about 1373 cm^{-1} (C–H Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 are 81.78%, 89.72%, 84.33%, and 77.23%, respectively. The results show that cellulose was hydrolyzed in small amount. The characterized absorption peaks of hemicellulose, at 1742 cm^{-1} (C=O Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 85.05%, 79.01%, 75.14%, and 79.02%, respectively. The results show that a small amount of hemicellulose was hydrolyzed. The characterized absorption
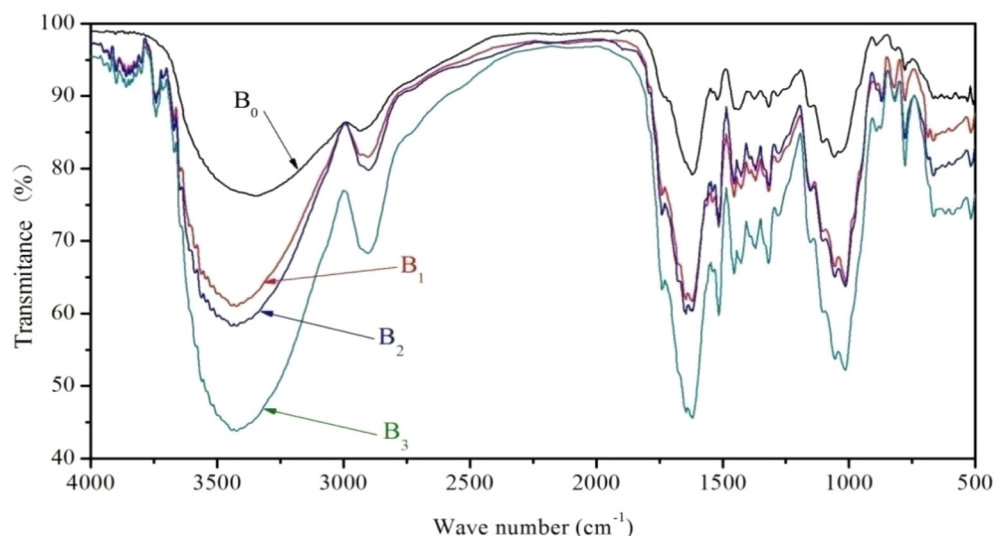

Fig. 1. FT-IR spectrum of *T. chinensis* bark under four treatment methods.

Table 2
Analytical results of FT-IR spectra of *T. chinensis* bark.

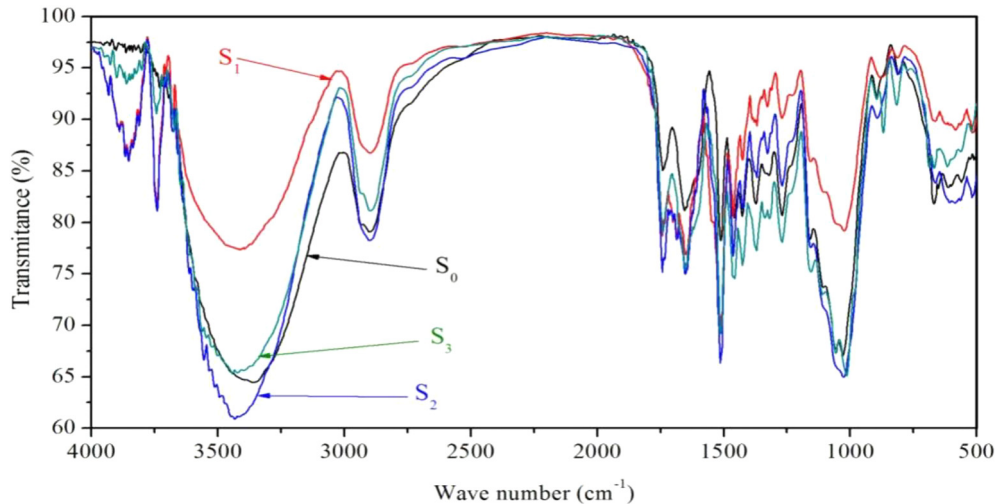| Absorption peak attribution	Absorption peak (cm^{-1})				Chemical component
	B_0	B_1	B_2	B_3	
O–H Stretching vibration	3341	3441	3441	3441	Cellulose, Hemicellulose, carboxylic acid, alcohol
C–H Stretching vibration	2934	2903	2903	2903	Cellulose
Benzene ring stretching vibration	1618	1618	1618	1618	Lignin
	1522	1516	1516	1516	Lignin
	1452	1454	1454	1454	Lignin
C–H Flexural vibration	1373	1369	1369	1369	Cellulose, Hemicellulose
S-ring, 5-substituted G-ring	1317	1317	1317	1317	Lignin
C–O Stretching vibration	1059	1056	1056	1056	Cellulose, Hemicellulose

Fig. 2. FT-IR spectrum of *T. chinensis* sapwood under four treatment methods.

Table 3
Analytical results of FT-IR spectra of *T. chinensis* sapwood.

Absorption peak attribution	Absorption peak (cm^{-1})				Chemical component
	S_0	S_1	S_2	S_3	
O–H Stretching vibration	3360	3412	3412	3412	Cellulose, Hemicellulose, carboxylic acid, alcohol
C–H Stretching vibration	2899	2897	2899	2897	Cellulose
C=O Stretching vibration	1742	1742	1744	1740	Hemicellulose
	1655	1653	1653	1653	Lignin
Benzene ring stretching vibration	1512	1512	1514	1512	Lignin
C–H Flexural vibration, CH$_2$, CH$_3$ Asymmetric flexural vibration	1458	1462	1462	1456	Lignin
CH$_2$ Flexural vibration, CH$_2$ Scissor vibration	1427	1425	1425	1427	Cellulose, Lignin
C–H Stretching vibration	1373	1379	1369	1371	Cellulose, Hemicellulose,
G-ring, Acyloxy CO–O stretching vibration	1269	1271	1269	1269	Lignin
C–O Stretching vibration	1030	1024	1026	1014	Cellulose, Hemicellulose, Lignin

peaks of lignin, at about 1653 cm^{-1} (C=O Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 81.14%, 76.87%, 74.97%, and 75.48%, respectively. At 1512 cm^{-1} (benzene ring stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 78.23%, 70.36%, 66.33%, and 69.21%, respectively. At about 1460 cm^{-1} (C–H Flexural vibration, CH$_2$, CH$_3$ asymmetric flexural), transmittance of B_0, B_1, B_2, and B_3 were 80.44%, 80.52%, 76.73%, and 74.56%, respectively. The results show that a small amount of lignin was hydrolyzed.

Fig. 3 and Table 4 show the results of FT-IR spectra of *T. chinensis* heartwood. The characterized absorption peaks of cellulose, at about 2902 cm^{-1} (C–H Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 75.01%, 81.94%, 82.15%, and 92.46%, respectively. At about 1426 cm^{-1} (CH$_2$ Flexural vibration, CH$_2$ Scissor vibration), transmittance of B_0, B_1, B_2, and B_3 were 76.57%, 84.74%, 78.73%, and 91.43%, respectively. The results

show that a small amount of cellulose was hydrolyzed. The characterized absorption peaks of hemicellulose, at 1740 cm^{-1} (C=O Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 85.26%, 87.79%, 75.88%, and 85.02%, respectively. The results show that a small amount of hemicellulose was hydrolyzed. The characterized absorption peaks of lignin, at about 1650 cm^{-1} (C=O Stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 77.63%, 83.51%, 67.08%, and 84.60%, respectively. At 1513 cm^{-1} (Benzene ring stretching vibration), transmittance of B_0, B_1, B_2, and B_3 were 70.47%, 81.23%, 65.93%, and 77.87%, respectively. At about 1458 cm^{-1} (C–H Flexural vibration, CH$_2$, CH$_3$ Asymmetric flexural), transmittance of B_0, B_1, B_2, and B_3 were 74.74%, 84.23%, 76.30%, and 87.96%, respectively. The results show that lignin was partially hydrolyzed in the mix solvent of ethanol and methanol, and a small amount of hydrolyed in the others solvent.
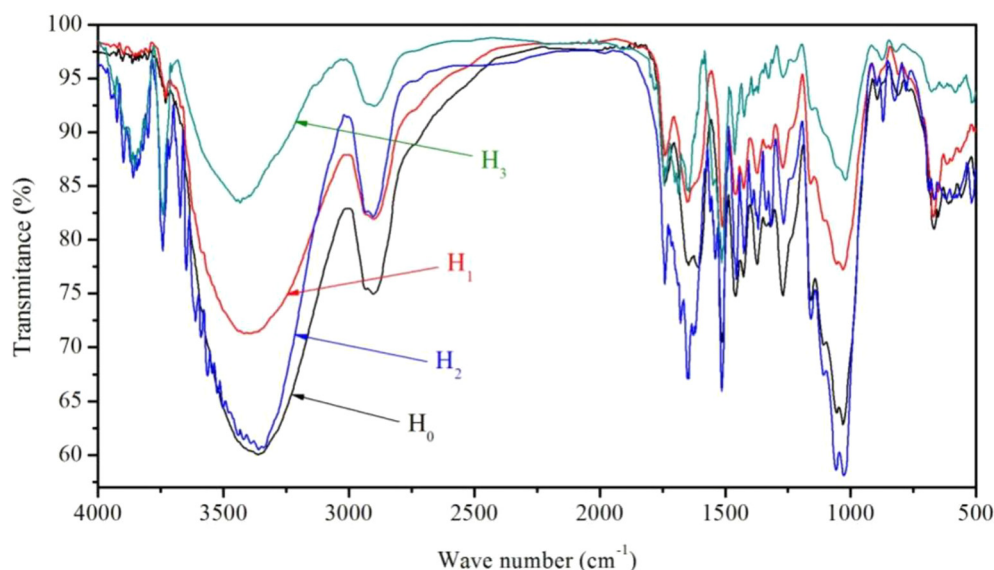
Fig. 3. FT-IR spectrum of *T. chinensis* heartwood under four treatment methods.

Table 4
Analytical results of FT-IR spectra of *T. chinensis* heartwood.

Absorption peak attribution	Absorption peak (cm^{-1})				Chemical component
	H_0	H_1	H_2	H_3	
O–H Stretching vibration	3360	3393	3360	3433	Cellulose, Hemicellulose, carboxylic acid, alcohol
C–H Stretching vibration	2907	2900	2900	2897	Cellulose
C=O Stretching vibration	1740	1740	1740	1744	Hemicellulose
C=O Stretching vibration	1647	1651	1651	1653	Lignin
Benzene ring stretching vibration	1514	1512	1514	1514	Lignin
C–H Flexural vibration, CH_2, CH_3 Asymmetric flexural vibration	1458	1456	1456	1462	Lignin
CH_2 Flexural vibration, CH_2 Scissor vibration	1427	1427	1425	1423	Cellulose, Lignin
G-ring, Acyloxy CO-O stretching vibration	1271	1271	1267	1271	Lignin
C-O Stretching vibration	1030	1030	1030	1020	Cellulose, Hemicellulose, Lignin

According to FT-IR analysis, the absorption peaks did not indicate significant migration. This indicates that in the extraction process, the chemical components of the samples did not change too much.

3.2. Analysis of GC/MS

Table 5 shows that: via analysis of GC–MS, in the bark of *T. chinensis*, the experiment of extracting with ethanol solution, nine types of chemical components which occupied 53.93% of total peaks areas were identified. There were benzene,1,2,3-trime thoxy-5-(2-propenyl)- (47.50%), 4,6-diamino-3-[4-methoxyben zyl]-1H-pyrazolo[3,4-d]pyrimidine (3.21%), 1,2-Benzenedi-carboxylic acid, butyl 8-methylnonyl ester (0.63%), nerolidol (0.55%) and estra-1,3,5(10)-trien-17.beta.-ol (0.55%).

In the experiment of extracting the mixed solution of ethanol and methanol, seven types of chemical components were identified which occupied 31.82% of total peaks areas. There were benzene,1,2,3-trimethoxy-5-(2-propenyl)- (29.89%) and asarone (0.53%).

In the experiment for extracting the mixed solution of ethanol and benzene, 15 types of chemical components were identified, which occupied 59.32% of total peaks areas. These were: benzene,1,2,3-trimethoxy-5-(2-propenyl)- (46.23%), 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) (3.11%), 4,6-dia mino-3-[4-methoxybenzyl]-1H-pyrazolo[3,4-d]pyrimidine (3.11%), dibutyl phthalate (2.32%), alpha-methylstyrene (0.59%), 3,4-

dimethoxycinnamic acid (0.59%), nerolidol (0.58%) and 4-hydroxy-.beta.-ionone (0.43%).

Table 6 shows that via analysis of GC–MS, in the sapwood of T. chinensis, the experiment of extracting with ethanol solution, eight types of chemical components were identified, which occupied 35.09% of total peaks areas. These were benzene,1,2,3-trime thoxy-5-(2-propenyl)- (30.61%), gamma-sitosterol (2.29%) and 1 h-2,8a-Methanocyclopenta[a]cyclopropa[e]cyclodecen-11-one,1 a,2,5,5a,6,9,10,10a-octahydro-5,5a,6-trihydroxy-1,4-bis(hydroxy methyl)-1,7,9-trimethyl-,[1S-(1.alpha.,1a.alpha.,2.alpha.,5.beta.,5a. beta.,6.beta.,8a.alpha.,9.alpha.,10a.alpha.).]- (1.20%).

In the experiment for extracting the mixed solution of ethanol and methanol, seven types of chemical components were identified, which occupied 41.02% of total peaks areas. These were benzene,1,2,3-trimethoxy-5-(2-propenyl)- (18.24%), s-indacene-1, 7-dione,2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl- (14.46%), mac-ckiain (5.12%) and 4,6-diamino-3-[4-methoxybenzyl]-1H-pyra zolo[3,4-d]pyrimidine (2.57%).

In the experiment for extracting the mixed solution of ethanol and benzene, 13 types of chemical components were identified, which occupied 43.62% of total peaks areas. These were benzene,1,2,3-trimethoxy-5-(2-propenyl)- (29.69%), Myo-inositol, 4-c-methyl- (5.16%), gamma-sitosterol (2.52%), diisobutyl phtha-late (2.13%) and dibutyl phthalate (1.49%).

Table 7 shows that vie analysis of GC–MS, in the heartwood of *T. chinensis*, the experiment of extracting with ethanol solution, 12 types of chemical components were identified, which occupied 43.28% of total peaks areas. These were formononetin (17.71%),

Table 5
Analytical results of *T. chinensis* bark powder by GC/MS.

No.	Compound	B₁ RT (min)	B₁ Area (%)	B₂ RT (min)	B₂ Area (%)	B₃ RT (min)	B₃ Area (%)
1	.alpha.-Methylstyrene	–	–	–	–	5.51	0.59
2	Triacetin	–	–	–	–	11.83	0.29
3	Methyleugenol	12.76	0.32	12.76	0.23	12.75	0.27
4	Benzene,1,4-dimethoxy-2,3,5,6-tetramethyl-	14.51	0.33	14.51	0.36	14.51	0.39
5	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	15.12	47.50	15.12	29.53	15.14	46.23
				15.19	0.36		
6	4-Hydroxy-.beta.-ionone	15.19	0.46	–	–	15.19	0.43
7	Asarone	–	–	15.22	0.53	–	–
8	Nerolidol	15.22	0.55	–	–	15.23	0.58
9	4-Allyl-2,6-Dimethoxyphenol	–	–	15.82	0.15	–	–
10	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	–	–	16.48	0.31	16.48	0.25
11	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl)	–	–	–	–	19.39	3.31
12	3,4-Dimethoxycinnamic acid	–	–	–	–	19.89	0.59
13	2,2-Dimethyl-6-methylene-1-[3,5-dihydroxy-1-	–	–	–	–	20.45	0.26
14	Estra-1,3,5(10)-trien-17.beta.-ol	20.46	0.55	20.46	0.35	–	–
15	1,2-Benzenecarboxylic acid, butyl 8-methylnonyl ester	20.55	0.63	–	–	–	–
16	Dibutyl phthalate	–	–	–	–	20.55	2.32
17	.gamma.-Sitosterol	–	–	–	–	25.59	0.34
18	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.)]-	25.72	0.38	–	–	25.72	0.36
19	4,6-Diamino-3-[4-methoxybenzyl]-1H-pyrazolo[3,4-d]pyrimidine	27.33	3.21	–	–	27.33	3.11

Table 6
Analytical results of *T. chinensis* sapwood powder via GC/MS.

No.	Compound	S₁ RT (min)	S₁ Area (%)	S₂ RT (min)	S₂ Area (%)	S₃ RT (min)	S₃ Area (%)
1	.alpha.-Methylstyrene	–	–	–	–	5.51	0.61
2	Triacetin	–	–	–	–	11.83	0.19
3	Methyleugenol	12.76	0.19	–	–	12.75	0.25
4	Benzene,1,4-dimethoxy-2,3,5,6-tetramethyl-	14.51	0.23	14.51	0.30	14.51	0.23
5	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	15.11	30.61	15.12	18.10	15.12	29.69
				15.18	0.14		
6	4-Hydroxy-.beta.-ionone	15.18	0.18	–	–	15.19	0.19
7	6-epi-Shyobunol	15.22	0.16	–	–	15.22	0.22
8	Myo-Inositol, 4-C-methyl-	–	–	–	–	17.61	5.16
9	Diisobutyl phthalate	–	–	–	–	19.39	2.13
10	Dibutyl phthalate	–	–	–	–	20.55	1.49
11	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	–	–	20.85	0.23	–	–
12	2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)*hexa*-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde	23.62	0.23	–	–	23.29	0.21
						23.62	0.25
13	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.)]-	25.50	1.2	23.62	0.1	24.18	0.21
						24.38	0.27
14	.gamma.-Sitosterol	25.68	2.29	–	–	25.50	0.52
						25.68	2.00
15	4,6-Diamino-3-[4-methoxybenzyl]-1H-pyrazolo[3,4-d]pyrimidine	–	–	27.33	2.57	–	–
16	S-Indacene-1,7-dione,2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl-	–	–	27.67	14.46	–	–
17	Macckiain	–	–	28.67	1.62	–	–
				29.11	3.50		

Myo-inositol, 4-C-methyl- (8.19%), pseudobaptigenin (5.40%), pseudobaptigenin (4.79%), macckiain (2.32%), nerolidol (1.51%), dibenz[a,c]cyclohexane,2,4,7-trimethoxy- (1.07%) and oleic acid (0.82%).

In the experiment for extracting the mixed solution of ethanol and methanol, 10 types of chemical components were identified, which occupied 12.14% of total peaks areas. There were benzene,1,2,3-trimethoxy-5-(2-propenyl)- (4.69%), Myo-inositol, 4-C-methyl- (3.79%) and nerolidol (1.27%).

In the experiment for extracting the mixed solution of ethanol and benzene, 10 types of chemical components were identified, which occupied 40.00% of total peaks areas. These were Myo-inositol, 4-C-methyl- (14.48%), nerolidol (7.04%), gamma-sitosterol (4.99%), 1,2-benzenedicarboxylic acid, bis(2-methylpropyl) easter (3.82%), 3-O-methyl-d-glucose (3.33%), dibutyl phthalate (2.76%), benzene,1,2,3-trimethoxy-5-(2-propenyl)- (1.81%) and alpha-methylstyrene (0.91%).

In conclusion, the extractive chemical components differed depending on the solvent used and the part of the wood. The chemical components of bark were the least, only about 10% of the whole tree; therefore, the extracts of bark were fewest. There was less cellulose and pentose in the bark. Heartwood had more organic solvent extraction and fewer lignin and cellulose than sapwood.

Table 7
Analytical results of *T. chinensis* heartwood powder via GC/MS.

No.	Compound	H$_1$		H$_2$		H$_3$	
		RT (min)	Area (%)	RT (min)	Area (%)	RT (min)	Area (%)
1	.alpha.-Methylstyrene	–	–	–	–	5.51	0.91
2	Triacetin	–	–	–	–	11.83	0.37
3	Benzene,1,4-dimethoxy-2,3,5,6-tetramethyl-	–	–	14.45	0.28	–	–
4	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	14.12	0.42	15.03	4.69	15.09	1.81
		15.09	0.28				
5	Nerolidol	15.21	1.51	15.15	1.27	15.21	7.04
6	Phenol,2,6-dimethoxy-4-(2-propenyl)	–	–	15.77	0.19	–	–
7	[1,1′-Bicyclopropyl]-2-octanoic acid, 2′-hexyl-, methyl ester	–	–	16.26	0.11	16.35	0.49
				16.32	0.09		
8	Benzene,1,2,3-trimethoxy-5-(2-propenyl)-	–	–	16.44	0.13	–	–
9	3-O-Methyl-d-glucose	–	–	–	–	17.23	3.33
10	Myo-Inositol, 4-C-methyl-	18.76	8.19	18.18	3.79	18.39	2.50
						18.44	0.81
						18.75	7.91
						18.80	3.26
11	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) easter	–	–	–	–	19.39	3.82
12	Palmitic acid	20.46	0.31	–	–	–	–
13	Dibutyl phthalate	–	–	–	–	20.55	2.76
14	Sinapinaldehyde	20.82	0.18	20.78	0.3	–	–
15	*trans*-Sinapyl alcohol	–	–	20.90	0.46	–	–
16	Oleic Acid	22.56	0.82	–	–	–	–
17	Phenol,4-methyl-2-[5-(2-thienyl)pyrazol-3-yl]-	–	–	23.38	0.83	–	–
18	1H-Cyclopropa[3,4]benz[1,2-e]azulene-5,7b,9,9a-tetrol,1a,1b,4,4a,5,7a,8,9-octahydro-3-(hydroxymethyl)-1,1,6,8-tetramethyl-,5,9,9a-triacetate,[1aR-(1a.alpha.,1b.beta.,4a.beta.,5.beta.,7a.alpha.,7b.alpha.,8.alpha.,9.beta.,9a.alpha.)]-	25.64	0.28	–	–		
19	.gamma.-Sitosterol	–	–	–	–	25.67	4.99
20	Dibenz[a,c]cyclohexane,2,4,7-trimethoxy-	25.87	0.47	–	–	–	–
		26.55	0.60				
21	S-Indacene-1,7-dione,2,3,5,6-tetrahydro-3,3,4,5,5,8-hexamethyl-	27.67	4.79	–	–	–	–
22	Macckiain	29.12	2.32	–	–	–	–
23	Formononetin	31.57	17.71	–	–	–	–
24	Pseudobaptigenin	32.00	5.40	–	–	–	–

3.3. Functions of chemical components

Triacetin is also called Glyceryl Triacetate. It can be used as a cosmetic biocide, solvent and plasticizer of cosmetic. Experts have concluded that the use of triacetin in cosmetic formulations is safe. It is often used as a carrier for flavors and fragrances (Fiume, 2003). Transesterification of triacetin and methanol can be used with homogeneous alkali catalysts to produce biodiesel (López et al., 2005).

Methyleugenol has many functions, such as anti-fungal, anti-bacterial, anti-nematode, toxic effects on pathogens, and causing antifeedant and anti-pollination in insect herbivores (Huang et al., 2002; Tan and Nishida, 2012). As an added flavoring substance, methyleugenol is also a component present in the traditional diet (Smith et al., 2002).

Isolated asarone can function against excitotoxic neuronal death in primary cultured rat cortical cells. It has neuroprotective action (Cho et al., 2002). Asarones from the rhizomes of *Acorus tatarinowii* is considered as a new drugs for treating depression (Han et al., 2013), Asarone is the active components in Acorus tatarinowii Schott, which is the traditional Chinese medicine and has been used to treat epilepsy for several thousands of years (Deng et al., 2010).

Nerolidol is widely used in different industries, used in food flavoring, detergents and cleansers (Chan et al., 2016) Nerolidol has antifungal activity (Lee et al., 2007) and antiulcerogenic activity (Klopell et al., 2014a, 2014b). It can be used for the skin to improve skin lesions infected by *M. gypseum*. Nerolidol may be an effective supplement to topical antifungal drugs for clinical relief of dermatophytosis. Significantly improved oxidative stability using 4-allyl-2,6-dimethoxyphenol as an additive (Klopell et al., 2014a, 2014b). 3,4-Dimethoxycinnamic acid is a prospective dietary compound for prophylaxis of neurodegenerative diseases (Zanyatkin et al., 2017).

Dibutyl phthalate is used as a plasticizer in elastomers, resin solvent, textile lubricating agent and adhesives. Dibutyl phthalate can also be used as a perfume solvent in the production of cosmetics and as a lubricant for aerosol valves, a skin emollient, a suspension agent for solids in aerosols, and an antifoamer. Dibutyl phthalate is known to be a developmental and reproductive toxicant. It may have an adverse effect on the uterus of rodents, at least in part of which is responsible for the loss of early embryos (Ema et al., 2000; Higuchi et al., 2003).

For FT-IR analysis, the absorption peaks did not migrate significantly. This shows that the chemical components of the samples did not change severely in the process of extraction. The absorption peak of FT-IR had some change due to the difference of extract solvents, and the chemical components were hydrolyzed to some extent.

In the analysis of GC/MS, 37 types of chemical components were detected. The extractive chemical components were different depending on the solvent used and the part of the wood. The chemical components of bark were fewest with only about 10% of the whole tree; therefore, the extracts of bark were the fewest. There was less cellulose and pentose in the bark. Heartwood had more organic solvent extraction and fewer lignin and cellulose than sapwood.

The following is part of the chemical components and functions:

Triacetin can be used as a cosmetic biocide, solvent in cosmetic formulations, plasticizer, and is commonly used as carrier for flavors and fragrances. Methyleugenol has anti-fungal, anti-bacterial, anti-nematode, and toxic effects on pathogens and is a traditional diet and as added flavoring substance. Asarone has neu-

roprotective action and it is a new therapeutic agent for curing depression. Nerolidol is widespread across shampoos, perfumes, detergents, cleansers, food flavoring, and antifungal drugs. 3,4-Dimethoxycinnamic acid can prevent neurodegenerative diseases. Dibutyl phthalate is used as a plasticizer in elastomers, textile lubricating agent, resin solvent, and in safety glass, printing inks, paper coatings, adhesives, skin emollient, and lubricants for aerosol valves.

Conflict of interest

All the authors hereby agreed and confirm that there is no conflict of interest for this research work and publication of this paper.

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