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LETTER TO THE EDITOR

Molecule of *Torreya Grandis* Bark Extractives for Medicine

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Torreya grandis can only survive in China because of its unique living habits. In recent years, because of the increasing demand for wood, the social value of *Torreya grandis* has become progressively high. However, people ignored the use of its bark, believing that only the timber was of value. In order to explore a new way to utilize the resources of Chinese *Torreya* bark, methanol and ethanol were used to extract the powder of Chinese *Torreya* bark. The extracts were analyzed by Fourier transform infrared spectroscopy (FT-IR) and gas chromatography-mass spectrometry (GC-MS). The pyrolysis products of catalytic cracking products and high efficiency extraction products were studied by GC-MS. The results showed that the extracts from the bark of *Torreya grandis* contain a large number of bioactive components, and these substances can be advantageous for human use. The chemical constituents of different extracts from the bark of *Torreya grandis* were studied, and a theoretical basis for the rational utilization of the bark was provided.

Torreya grandis bark, FT-IR, GC-MS

I Introduction

Torreya grandis belongs to the genus *Torreya* of Taxaceae and is an evergreen coniferous tree (Zhang et al. 2017, He et al. 2016). The trunk is straight and the crown is a wide oval. The bark is grayish-brown, exhibiting a shallow longitudinal crack (Wang et al. 2018). The seed is the famous dried fruit *Torreya grandis*. After being fried, it has a delicious taste and a crispy texture. Parts of *Torreya grandis* can also be used for treating hookworm, ascaris, tapeworm disease, wormy abdominal pain, children's chancre, constipation, and so on (Liu et al. 2018). Torreya grandis seeds contain 41.89% oil, 10% protein, 28% carbohydrate, 2.6% ash and 13.51% other substances. Torreya grandis wood has compact structure, fine texture, moderate hardness, elasticity, durability, non-cracking, waterproof and moisture-proof making it an excellent choice of wood for construction, shipbuilding, and furniture (Duan et al. 2017, Yu et al. 2017).

The annual yield of *Torreya grandis* is relatively large, and the bark remains after processing (Shen et al. 2016). *Torreya* bark is used as firewood or dumped into fields, ditches, or garbage areas, causing environmental pollution. However, if the bark of *Torreya grandis* can be utilized efficiently and adequately, the environmental pressure can be alleviated to a certain extent (He et al. 2016, Zhu et al. 2016). *Torreya grandis* can only grow in China because of its unique growing habits. Unfortunately, attention is only given to the value of its timber instead of the bark in its manufacturing process.

The bark of *Torreya grandis* is first extracted, and then methanol and ethanol are prepared for further chemical extraction. Fourier transform infrared spectroscopy (FT-IR) and gas chromatography-mass spectrometry (GC-MS) were used to study the functional group changes of extracts from the bark of *Torreya grandis*, as well as the types of pyrolysis products (Gao et al. 2017). The composition and function of extracts from the bark of *Torreya grandis* under different extraction conditions were analyzed, providing a new method of utilization for high-grade wood and bark resources of *Torreya grandis*.

II Material and Methods

Experimental Materials

Torreya samples were collected from the Xixia Forest District in Henan Province. The bark was taken and processed into powder of 40-60 meshes by a pulverizer. It was then baked at 55ºC under a vacuum of 0.01 MPa, and dried for use (Wang et al. 2018). The powder of *Torreya grandis* bark was extracted by methanol and ethanol (chromatography purity), which were, respectively, named as B1 and B2.

Methanol and Ethanol Extraction

10 g samples (accuracy: 0.1 mg) were weighed into extraction bottles, and 300 mL methanol and ethanol solution were respectively added into these bottles. The mixture was extracted with a mixed solvent extraction system (FOSS) (Ge et al. 2018). Extraction conditions: soak at room temperature for 12 h, followed by extraction at 55ºC for 5 h, extract the filter paper with methanol and ethanol solution, and, finally, filter the methanol and ethanol extract filtrate from the bark of the *Torreya* tree. The filtrate was extracted at 45ºC, 0.01 MPa vacuum evaporation, and concentrated to 10 mL (Liu et al. 2018).

FT-IR Analysis

The molecular absorption of methanol and ethanol extracts infrared light was recorded by the infrared spectrometer, and the infrared spectra was collected, and the spectrum smoothing and baseline were corrected (Bazin et al. 2018). Infrared spectroscopy usually places the wave (σ) as the abscissa, indicating the location of the absorption peak, the transmittance (T%) is measured along the vertical axis to show absorption intensity (Parolo et al. 2017, Lam et al. 2019).

GC-MS analysis

GC-MS determination: The GC automatic sampler was injected with 10 μL ethanol extract. The specifications of the elastic quartz capillary column are 30 m × 250 μm × 0.25 μm, the carrier gas used was high purity helium, and column flow rate was set at 1 mL/min. The split ratio is 2:1 (Luo et al. 2017). The temperature program of the GC starts at 50°C, and the heating is increased to 130°C at a rate of 5 ºC/min without stopping, followed by heating to 180ºC at a rate of 2 °C/min without stopping, and then finally heating to 300ºC at a rate of 30 ºC/min, with a holding time 5 min (Xie et al. 2018). Mass spectrometry conditions: 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 temperature is 230ºC, the quadrupole temperature is 150ºC, and the scanning starting point is 50-600ºC (Ge et al. 2018).

III Results and Analysis

Infrared spectroscopic analysis

The infrared spectra of Torreya grandis bark methanol and ethanol extracts were observed and compared (Figure 1). It was found that the number of absorption peaks in the infrared spectrum of the methanol extract was much greater than the ethanol extract, and the infrared spectra of the two extracts were similar (Leal et al. 2015). In the infrared spectra of methanol extracts from *Torreya* bark, absorption peaks appear at around 3690-3350 cm^{-1}, 3210-3140 cm^{-1}, 1740-1520 cm^{-1}, and 1310-1250 cm^{-1}.(Gao and Wang, 2017) These absorption peaks correlate with the stretching vibration of hydroxyl group, the stretching vibration of C=C in benzene ring, and the stretching vibration of carbonyl group. These substances may be alcohols, phenols, carboxylic acids, aromatic compounds, or amides (Mikkonen et al. 2018). The absorption peaks of ethanol extracts from *Torreya grandis* bark appear in the vicinity of 3510-3250 cm^{-1}, 2990-2820 cm^{-1}, 1680-1410 cm^{-1}, and 1000 cm^{-1}. They belong to the hydroxyl absorption band, C-H bond stretching vibration, unsaturated C=C stretching vibration, and C-O bond stretching or bending vibration. They may contain alcohols, saturated hydrocarbons, unsaturated hydrocarbons, or ethers (Sallman et al. 2018, Haas et al. 2018).

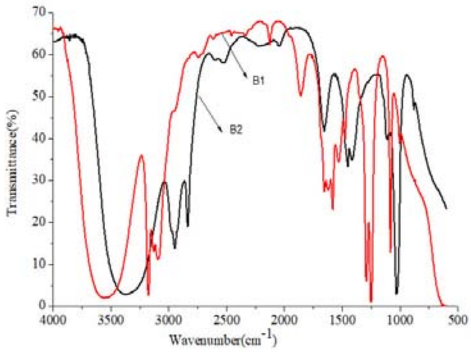

Figure 1. FTIR spectra of Torreya grandis bark methanol and ethanol extracts

Temperament analysis of ethanol extract

16 substances were found from 40 peaks from the ethanol extract of Torreya grandis bark (Figure 2). D -Mannose (5.77%) can be used in cell culture and molecular biology and biochemical reagent sweeteners (Zhang et al. 2017). 5-Hydroxymethylfurfural (32.29%) can be used to detect metabolites of glucose inf usion. Furfural (3.46%) is the raw material of furan acrylic acid, furfuran amine fumaric acid, adipic aci d, furfuryl alcohol, and other intermediates, which are widely used in the synthesis of pharmaceuticals, p esticides, veterinary drugs, dyes, and other fine chemicals. However, it can also be used to synthesize fu rfural resin, furan resin, rubber vulcanization accelerator, rubber and plastic antioxidants, preservatives, an d so on (Koszucka et al. 2018). Further it can also be found as a food flavoring for GB 2760-96, whic h is mainly used in the preparation of various flavors found in items such as bread, butter, hard candy, and coffee (Mi et al. 2019). Some derivatives of furfural have strong bactericidal ability, and their bacte riostatic spectrum is quite broad(Fu and Liu 2017, Özkaynak. 2018). The contents of some substances w ere higher, though their functions are still unknown. These substances include beta.-D-Glucopyranose, 4-O-.beta.-D-galactopyranosyl- (12.35%); Melezitose (5.31%); 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-m ethyl- (4.90%); Butanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetra methyl-11-oxo-1H-2,8a-methanocyclopenta[a]cyclopropa[e]cyclodecen-6-yl ester, [1aR-(1a.alpha.,2.alpha.,5.bet a.,5a.beta.,6.beta.,8a.alpha.,9.alpha.,10a.alpha.)]- (2.58%); 1H-2,8a-Methanocyclopenta[a]cyclopropa[e]cyclode cen-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.a lpha.,1a.alpha.,2.alpha.,5.beta.,5a.beta.,6.beta.,8a.alpha.,9.alpha.,10a.alpha.)]- (22.66%); and so on. These sub stances are in need of further study.

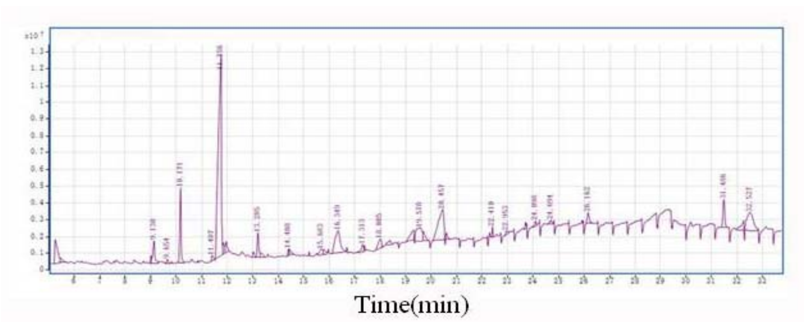

Figure 2. Total ion chromatography of ethanol extract from *Torreya grandis* bark

IV Conclusions and Discussion

The infrared transmittance of *Torreya mandshurica* bark extracted by methanol and ethanol solvent changed in varying degrees. FT-IR analysis showed that the absorption peaks of *Torreya grandis* bark mainly distributed in 3620-3310 cm^{-1}, 3120-3050 cm^{-1}, and 1710-1465 cm^{-1}, where the methanol extracts contained more peaks. In addition, the decrease in absorption peaks may be attributable to the extraction of some compounds from the extract.

The GC-MS results showed that 16 substances were detected from 40 peaks. Some of these substances are of great use in the medical, chemical, and food industries. For example, Furfural is an important organic chemical raw material, which can be used to produce maleic anhydride, glyceric acid, furfuryl alcohol, and tetrahydrofuran. The raw materials of intermediates are widely used in the synthesis of fine chemicals such as medicine, pesticides, veterinary drugs, spices, rubber additives, and preservatives, among many others. However, there are still some substances requiring further scientific research because their functions are unknown in the existing conditions.

From the above analysis, it can be determined that the infrared spectra of methanol extracts from the bark of *Torreya grandis* are more significant and have a greater number of absorption peaks. GC-MS of ethanol extracts is closely related to infrared spectroscopy. The effective components of ethanol extracts have many functions, which are reflected in all aspects of life. In conclusion, *Torreya grandis* bark is a kind of high quality forest biomass resources, which has broad sustainable utilization potential.

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