CATALPA OVATA G. DON. POTENTIAL MEDICINAL VALUE OF LEAVES

by

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Catalpa ovata G. Don. has a certain degree of appreciation because of its unique tree shape and wide crown. It also has certain adaptability. This experiment uses organic materials such as Fourier transform infrared (FT-IR) spectroscopy, gas chromatography-mass spectrometer (GC-MS), learning content management system, thermal desorption - GC-MS, termal gravimetric analyzer and other modern techniques to extract organic reagents from Catalpa ovata G. Don's Leaves. The original powder was tested differently and analyzed, investigated. To explored and developed its potential medicinal value, and better understood its use in biomedicine, as well as perfumery and chemical industries, providing some research for further and in-depth research basis.

Key words: *Catalpa ovata G. Don., leaves QTOF-LCMS biomedicine spices*

Introduction

Catalpa ovata G. Don. is a *Bignoniaceae Catalpa* arbor plant, up to 15 m. *Catalpa ovata G. Don.* is well-formed, the crown is developed, the leaves are large, and there is a certain shading effect. The spring and summer trees are full of small yellow flowers and the autumn and winter seasons are fruitful. The pods are suspended and resemble the garlic moss. Called the garlic moss tree, it has a certain ornamental value. It can be used as a street tree, a shade tree, and a factory or landscaping [1]. *Catalpa ovata G. Don.* has strong environmental adaptability, has certain anti-pollution ability, grows fast, and can be cultivated by using corners. Hi warm, the soil is better with deep, moist and fertile sand; it is cold-resistant and not resistant to drought and thinness. *Catalpa ovata G. Don.* is resistant to extensive management and is a low-carbon tree [2-4].

The poet Ni Yuan of the Yuan Dynasty once wrote a poem about the *Catalpa ovata G. Don.* The poem shows a picture of the swaying, low-pitched, dripping, heart-breaking sentimental, depicting the delicate flowers of the original scent. Like the sea, but the infatuation of love scenes. Liu Zongyuan also sighed sang, in order to express his own homesickness, the

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ancients usually use the *Morus alba L.* and *Catalpa ovata G. Don.* connotations to express the feelings of homesickness. With the witness and precipitation of history, the *Morus alba L.* and *Catalpa ovata G. Don.*'s culture has been fully integrated into the sentiment, and there is a spiritual blood to continue [5].

Catalpa ovata G. Don. has certain medicinal value, edible leaves are young; wood white is slightly soft, can be used for furniture, making the bottom of the piano; root bark or bark, fruit, wood, leaves can be used as medicine. *Catalpa ovata G. Don.*'s leaves, with leaves into the medicine bitter taste; cold detoxification; insecticidal itching. Catalpa ovata G. Don. is a flowering tree, which is a kind of tree species that is currently lacking in garden landscape and has good medicinal value. Therefore, the market prospects of *Catalpa ovata G. Don.* are very impressive [6, 7].

Material and methods

Experimental materials

The test raw materials were collected from the mountainous area of Luanchuan County, Luoyang City, Henan Province. The leaves of *Catalpa ovata G. Don.* were broken into powder by a pulverizer, and then 10 g of sample powders and 300 ml of different organic reagents (methanol, ethanol, benzene/ethanol, water/ethanol, distilled water of 100 °C and distilled water of 40 °C) mixed and dissolved, extracted in a water bath and concentrated by a rotary evaporator, and then the concentrated extract is tested. The original powder is passed through a sieve of 120 meshes. It is finely divided and freeze-dried for the detection of the original sample.

Experimental methods

The experimental process is shown in fig. 1.

Figure 1. Experimental technology route

The FT-IR analysis

The sample extract droplets of 1-2 ml were fused and ground in KBr powder. The samples were crushed into sheets by a tablet press. The FT-IR spectra of the extracted samples were obtained by FT-IR spectrophotometer (Thermo Fisher Scientific IS10) [8, 9].

Learning content management system (QTOF-LCMS) analysis

LC: The chromatographic column was Agilent Eclipse Plus C18 (2.1 × 100 mm, 1.8 μm). Mobile phase-Positive ion mode: 0.10% (v/v) formic acid (A), acetonitrile with 0.10% (v/v) formic acid (B). Negative ion mode: 1mM ammonium fluoride (or ammonium formate) (A), acetonitrile (B). Flow rate: 0.30 mL/min. Column temperature: 40 °C. Post time: 5 minute. Gradient elution: [Time (min), B (%)] was [0, 5], [2, 5], [20, 100], [25, 100] in turn.

MS: Ion source: AJS ESI. Detection mode: Positive ion mode/Negative ion mode. Drying gas flow (L/min): 15 L/min (QTOF6550)/ 7 L/min (QTOF6530/6545). Drying gas temperature: 200 °C (QTOF6550)/ 325 °C (QTOF6530/6545). Nebulizer gas flow: 35 psig. Sheath gas velocity: 11 L/min. Sheath gas temperature: 350 °C. Capillary voltage: 3.5 kV (Positive ion mode)/3.0 kV (Negative ion mode). Fragmentor voltage: 0 kV (Positive ion mode)/1.5 kV (Negative ion mode). Scan mass range program: 50-1200 m/z. Reference ion: 121.0509 (64.0158), 922.0098 (Positive ion mode); 112.9855 (68.9958), 1033.9881 (Negative ion mode) [10-12].

Thermal desorption - gas chromatography-mass spectrometer (TD-GC-MS) analysis

TDS: The initial temperature was 30 °C, retained for 1 minute, raised to 100 °C at a rate of 10 °C/min, retained for 5 minute, and then increased to 200 °C at a rate of 10 °C/min, not retained. The transmission line temperature is 230 °C.

CIS: The initial temperature was –30 °C, retained for 0.1 minute, then raised to 230 °C at a rate of 10 °C/s for 1 minute.

Under the condition of splitless flow, the carrier gas for HP-5MS (30 m × 250 μm × 0.25 μm) is high-purity helium gas, the gas flow rate is 1 ml/min, and the set column temperature program is: start 30 °C, Not retained, then raised to 100 °C at a rate of 10 °C/min, not retained, and then increased to 250 °C at a rate of 8 °C/min, not retained, and then increased to 5 °C/min to 280 °C, retained for 2 minute [13-15].

The TGA

The original powder of the sample was analyzed by a TGA (TGA Q50 V20.8 Build 34). The nitrogen release rate was 20 ml/min, Gas pressure is 2.2 bars. The temperature program of TG starts from 30 °C and rises to 850 °C at three rates of 10 °C/min, 20 °C/min, and 30 °C/min, respectively [16, 17].

Results and discussion

Analysis of FT-IR

By analyzing the infrared spectra of the leaves of *Catalpa ovata G. Don.* in three different organic solvent extracts, fig. 2, it was found that the absorption peaks of the three reagent extracts were mainly concentrated at 3500 cm^{-1}-3250 cm^{-1}, 3000 cm^{-1}--2850 cm^{-1}, 1800 cm^{-1}-1600 cm^{-1}, and 1100 cm^{-1}-1000 cm^{-1}. By analyzing the infrared absorption peak, it is found that functional groups may be contained in the sample, and through these functional groups, the types of substances that may be contained are found. The wavelength of the first strong absorption peak is concentrated between 3500 cm^{-1} and 3250 cm^{-1}. This wavelength range may contain hydroxyl groups and N-H groups, which may be inferred to contain alcohol phenols, amines and amides. The second strong absorption

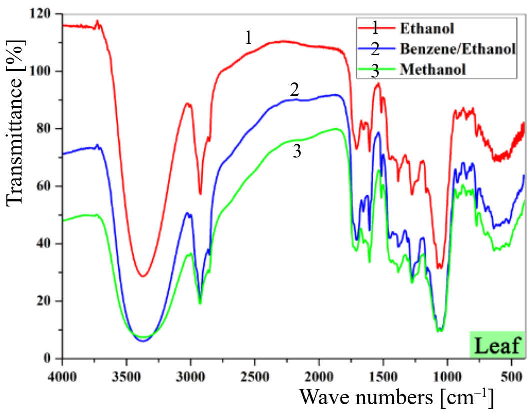

Figure 2. Infrared ion spectrum of extracts from the leaves of *Catalpa ovata G. Don.*

peak has a wavelength between 3000 cm^{-1} and 2850 cm^{-1} and may contain carboxyl groups and C-H groups, among which acid species and aromatic hydrocarbon compounds may be present; third strong absorption peak, the wavelength is concentrated between 1800 cm^{-1} and 1600 cm^{-1}, and there is a peak wave generated by the C=O double bond and C=C double bond stretching vibration absorption. It is speculated that there may be alcohol and ether; the last absorption peak, the wavelength is between 1100 cm^{-1} and 1000 cm^{-1}. This interval belongs to the fingerprint area, which may be caused by the telescopic vibration of the C-O bond, the C-C bond and the C-N bond. Through the analysis and research of infrared spectroscopy, it is found that the main chemical components contained in the sample may be alcohol, phenol, alkali, amine, amide, acid, ether and other compounds [18-20].

Analysis of QTOF-LCMS

The QTOF-LCMS analysis and detection of the five extracts of the leaves of *Catalpa ovata G. Don.,* fig. 3. Tryptamine; 2, 3, 5-Trimethylpyrazine; Ethyl salicylate were detected in all five extracts. Tryptamine is used in the biological and pharmaceutical fields; 2, 3, 5-Trimethylpyrazine is a state-approved food flavor that can be used to formulate food flavors such as cocoa, chocolate and fried nuts; Ethyl salicylate is also temporarily permitted in the country. Edible flavors are mainly used to prepare artificial cinnamon oil and berry flavors such as blackberry, black currant and strawberry. They can also be used to prepare soap flavors and pharmaceuticals. In addition, they can replace or modify the methyl ester aroma in toothpaste and oral products Fragrance [21-23]. Homoplantaginin is also detected in ethanol extract, which has antibacterial effect, has certain antitussive and expectorant effects, and has moderate inhibitory effect on common pathogens such as Staphylococcus aureus and Pneumococci in chronic bronchitis in vitro. Bloomatin was detected in distilled water/ethanol extract, which protects the liver and promotes platelet aggregation. Glycitin is detected in methanol extract, which has antibacterial, antiviral and estrogen-like effects, can prevent osteoporosis, prevent cardiovascular and cerebrovascular diseases, prevent cancer and reduce the number of tumors. It also reduces or avoids menopausal syndrome caused by estrogen reduction, as well as anti-aging and alcoholism. Morin was detected in distilled water extract at 100 °C, which has anti-cancer, anti-inflammatory, immunomodulatory and anti-oxidative effects. Deoxycholic acid was detected in distilled water extracts at 40 °C, which can be used in the field of bacteriology

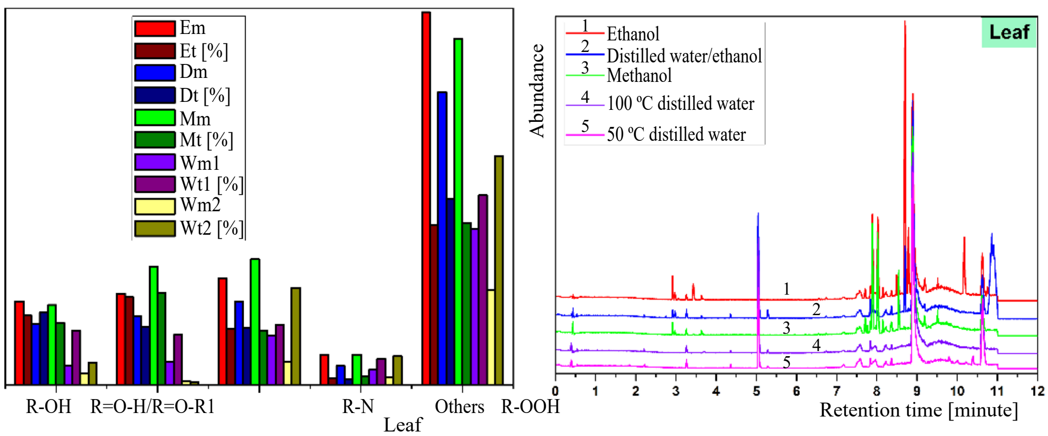

Figure 3. Liquid chromatography-mass spectrometry for the detection of ion spectrum and material classification of leaves of *Catalpa ovata G. Don.*

and enzymology, and sometimes used as a choleretic drug and as a solubilization of β-adrenergic receptors [24-27].

Note: *R-OH* means alcohols and phenols, *R=OH/R=O-R1* means aldehydes and ketones, *R-OOH* means acids, and *RN* means alkaloids. *Other* means other compositions. *Em* represents the number of molecules of the ethanol extract; *Et*represents the relative content of the ethanol extract, *Dm* represents the number of molecules of the distilled water/ethanol extract, *Dt* represents the relative content of the distilled water/ethanol extract, *Mm* indicates the molecular number of the methanol extract, *Mt* indicates the relative content of the methanol extract, *Wm1* indicates the molecular number of the water extract (extracted at 100 °C), *Wt1* indicates the relative content of the water extract, *Wm2* represents the number of molecules of the water extract (extracted at 40°C), *Wt2* represents the relative content of the water extract.

Analysis of TD-GC-MS

By thermal desorption gas chromatography mass spectrometry and detection of the powder of *Catalpa ovata G. Don.* fig. 4, it was found that the higher content and function Pyrazole, 1, 4-dimethyl-(6.96%); Octadecanoic acid(4.81%); Cyclohexanol, 2-methyl-5-(1-methylethenyl)- (4.43%); Phytol(3.35%); Acetic acid (4.23%); Phenol (2.30%); n-Hexadecanoic acid (2.27%); Isobornyl acetate (2.15%). Pyrazole, 1, 4-dimethyl- can be used as a herbicide; Cyclohexanol, 2-methyl-5-(1-methylethenyl) – is mainly used to prepare mint flavors and artificial spices [28]; Acetic acid is mainly used in the production of vinyl acetate and acetic anhydride. Acetate and cellulose acetate, etc., are widely used in the paint industry, and can also be used in the manufacture of drugs (aspirin and pesticides), as acidifiers, flavoring agents and fragrances in the food industry [29]; Phytol can be used in biochemical research, and can synthesize vitamin E and vitamin K1; Phenol can be used to make resin, synthetic fiber, synthetic rubber and plastic, or used in the production of medicines, pesticides, etc., and can also be used as a fragrance [30]; Isobornyl acetate is mainly used in the perfume industry and can be used as Berry and various fruit flavors (very small), usually used as a flavoring agent for soaps, talcum powders, toilet waters, air sprays, *etc.* [31].

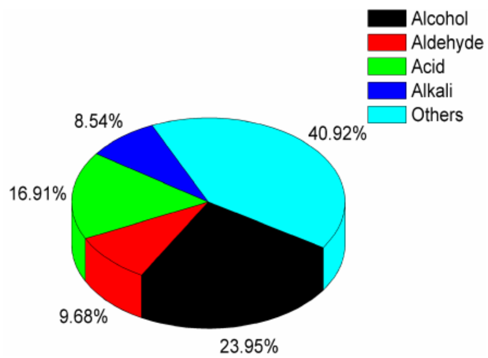

Figure 4. Detection of material classification map of *Catalpa ovata G. Don.* leaves by TD-GCMS

Analysis of TG-DSC

Figure 5 is a TGA and DTG curve for the leaves of *Catalpa ovata G. Don.* at elevated temperatures at different rates. To study the leaves of *Catalpa ovata G. Don.*, we conducted a TGA test. As can be seen from fig. 5, the weight loss process of leaf pyrolysis can be divided into three stages. The weight loss ratio of the first stage between 30-150 °C, 10 °C/min, 20 °C/min, 30 °C/min rate is roughly 2.68%, 2.07%, 1.63%, this stage is mainly the moisture in the sample Evaporation and the escape of some low molecular volatiles, the weight loss of the sample is small [32]; the second stage is between 150-540 °C, with the temperature increase in 10 °C/min, 20 °C/min, 30°C/min, the weight loss ratio at the min rate is approximately 62.7%, 62.91%, and 62.94%. During the combustion phase of the remaining components, the lignin,

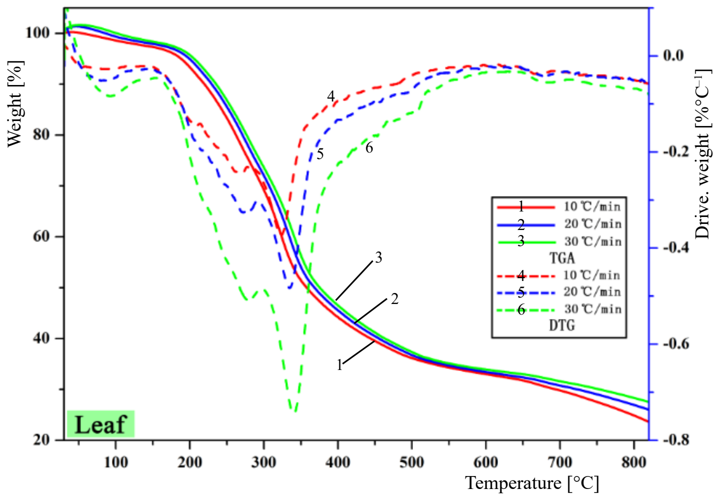

Figure 5. The TGA and DTG thermal curves of leaves of *Catalpa ovata G. Don.*

cellulose, and hemicellulose in the leaves of *Catalpa ovata G. Don.* are rapidly cracked and produce a large amount of volatilization sexual gas, causing serious weight loss of the sample [33]; the weight loss ratio of the third stage between 540-820 °C, 10 °C/min, 20 °C/min, 30 °C/min rate is approximately 11.01%, 9.00%, 7.90%, this The differential curve of the stage is relatively flat, indicating that the pyrolysis rate is relatively stable, the sample has a slight weight loss, and the weight loss is mainly due to a small amount of polymer depolymerization and recombination in the sample [34]. The weight loss of the samples in these three stages showed different properties, with different kinetic parameters and reaction mechanism. The final residual mass at 10 °C/min, 20 °C/min, and 30 °C/min was approximately 23.61%, 26.02%, 27.53%. In the whole process, the rate of weight loss of the sample is different with the heating rate. The faster the rate, the more serious the loss in the serious weight loss stage of the sample, but the smaller the weight loss in the first stage and the third stage, the remaining weight of the final sample is about many. TGA test shows that Catalpa ovata G. Don. has certain thermal stability, and also has high resource utilization potential and relatively efficient utilization [35].

Conclusion

The leaves of *Catalpa ovata G. Don.* were tested by various detection methods. The results of FTIR showed that the leaves of *Catalpa ovata G. Don.* may contain alcohol phenols and amides. A variety of active ingredients such as substances, acid substances, etc., the discovery of these active ingredients is conducive to the future study of the leaves of *Catalpa ovata G. Don.*; through the QTOF-LCMS test, it found that the five extracts contain a large amount of activity Ingredients, which can be used in the development of biology and medicine. Some of these substances have a certain antibacterial effect and can be used for antitussive and expectorant. The TD-GC-MS detected the active ingredient contained in the cleavage molecule of the leaf powder sample of *Catalpa ovata G. Don.* at 30-280 °C. The active ingredients can be used in the paint industry, food industry, perfume industry and the development of biomedicine; TGA test found that the leaf powder of *Catalpa ovata G. Don.* has good thermal stability. Through the analysis of the TGA test results, it was found that the leaves of *Catalpa ovata G. Don.* contained a large number of active ingredients. The discovery of these components promotes the development of *Catalpa ovata G. Don*, and increases the value of *Catalpa ovata G. Don*'s resource utilization, improves its economic efficiency, excavates its potential value, promotes its resource development and reuse, and lays a foundation for the future research and utilization of *Catalpa ovata G. Don*.

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