

## Chapter 13

# *Gastrodia elata* Blume. 天麻 (Tianma, *Gastrodia* Tuber)

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### 13.1 Botanical Identity

Tianma, the steamed and dried rhizome of *Gastrodia elata* Blume. (Orchid Family), is one of the most popular traditional Chinese medicines and a famous foodstuff in China. It was first recorded in Shen-nung-pen-tsao-ching as a high-grade drug and widely used for the treatment of headache, dizziness, vertigo, convulsion, hypertension and other neurodegenerative diseases [1]. The orchid *G. elata*, lacking green leaves and chlorophyll, is a saprophytic perennial herb and it grows in the glades or at the edge of forests in humid mountain areas with the altitude of 400–3200 m. This species lives in symbiotic association with the honey mushroom (*Armillariella mellea*) and its whole growth cycle except for florescence, is in the underground [2]. The wild *G. elata* distributed in China's southwest, northeast and central regions, and especially, the rhizomes collected in the western *Guizhou*, southern *Sichuan* and northeastern *Yunnan* are considered to be the genuine medicinal material with good prestige. Due to the increasing market demand, natural reserves of *G. elata* have drastically decreased and the species has been listed as rare and endangered one in China and even around the world. Since the 1970s, *G. elata* has been extensively cultivated in *Shaanxi*, *Anhui*, *Sichuan*, *Guizhou* and *Yunnan*, and to date, *Lueyang* in *Shaanxi* province, has become the biggest production base all over the country.

The rhizome is harvested from early winter to late spring, washed clean immediately, steamed thoroughly, spread out and dried at a lower temperature. Traditionally, the rhizome collected prior to late December was considered to have the better quality than those before early April. The dried rhizome could be brought from the medicinal market as the crude material and they are characterized by ellipsoid or

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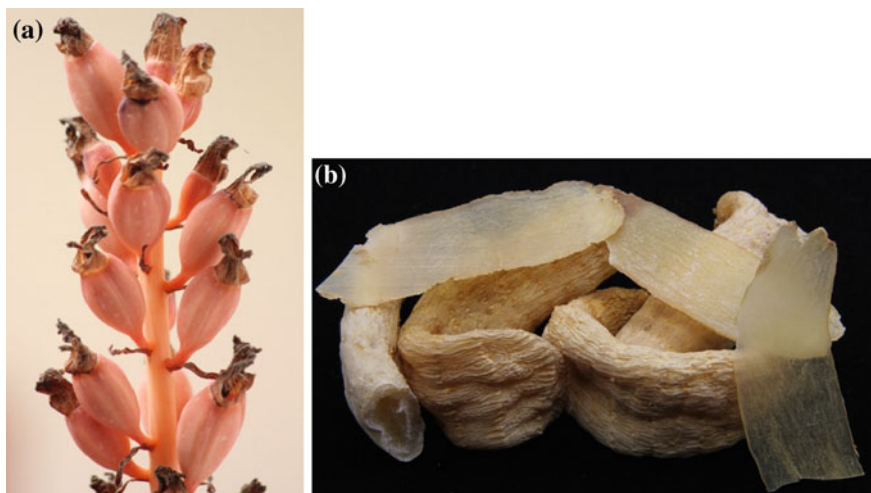


Fig. 13.1 Fruiting plant (a) and dried roots with slices (b) of Tianma

slat-shaped, slightly compressed, shrunken and somewhat curved, 3–15 cm long, 1.5–6 cm wide, 0.5–2 cm thick (Fig. 13.1). The crude material is further processed by softening thoroughly or steaming soft and then cutting into thin slices and drying. The dried slices are also processed for the different medicinal purposes according to the traditional techniques such as by frying, stewing, soaking with wine and etc.

## 13.2 Chemical Constituents

The rhizome of *G. elata* contains a variety of constituents including phenolic glycoside, organic acid, volatile oil, sterol, polysaccharide and etc. Among them, phenolic glycosides are considered as main bioactive compounds in the fresh or steamed and dried rhizome as well as the commercial products from the medicinal market. As the representative of this class of constituents, gastrodin (**1**) and its aglycone gastrodigenin (4-hydroxybenzyl alcohol, **2**) are paid much attention to their direct extraction from natural resources, through chemical synthesis and biotransformation as well as their bioactivities such as anticonvulsant, sedative, and analgesic actions. Because of its easy water solubility and significant activity, gastrodin has been used intravenously and intramuscularly in clinical practice in China. Closely related components, including 4-hydroxybenzaldehyde, vanillyl alcohol, vanillin, and 4-hydroxybenzyl methyl ether, and the compounds containing two or more 4-hydroxybenzyl alcohol moieties (**3**) as well as citric acid tricarboxylic acid ester parishin (**4**), parishin F (**5**), dicarboxylic acid esters parishin B (**6**), C (**7**), D (**8**) and monocarboxylic acid ester parishin E (**9**) and G (**10**) are also present in this species [3–5] (Fig. 13.2). In addition, the presence of minor

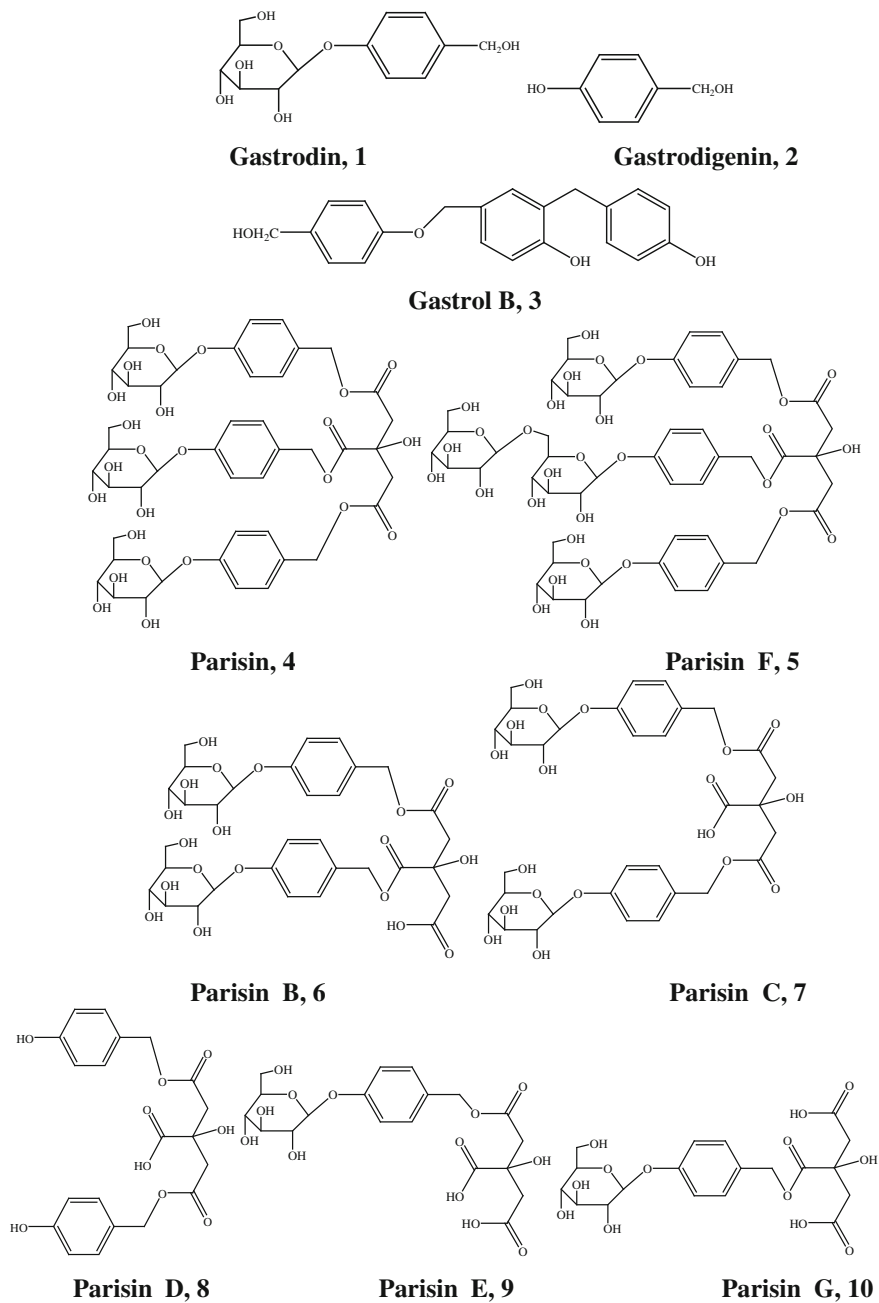


Fig. 13.2 Representative phenolic compounds isolated from Tianma

component 5-hydroxymethylfurfuralin in steamed and dried rhizome resulted from the derivatization of carbohydrate by processing the fresh rhizome.

### 13.3 Pharmacological Studies

As an important medicinal herb to control convulsion, epilepsy, tetanus, headache and dizziness, paralyzed limbs and other neurodegenerative disorders [1], Tianma showed various pharmacological effects including anticonvulsant, sedative, analgesic, neuroprotective, antioxidative and immunomodulatory activities as well as anti-aging, anti-hypertension, expanding the coronary blood vessel, improving peripheral circulation and learning memory and etc. [6]. The antiepilepsy mechanism of Tianma or its active constituents such as gastrodin, gastrodigenin, 4-hydroxybenzaldehyde, vanillyl alcohol and vanillin, appear to act via the  $\gamma$ -aminobutyric acid (GABA) pathway, either through inhibition of degradative enzymes of GABA or by an effect on the GABAA/benzodiazepine receptor [7]. The therapeutic action related to cardiovascular system resulted from the antioxidative activity of Tianma or its active ingredients.

### 13.4 TCM Applications and Dietary Usage

#### 13.4.1 TCM Applications

As one of 34 famous and expensive Chinese Traditional Medicines announced by China, Tianma could be used in a single form or in combination with other herbs for the treatment of convulsion, epilepsy, tetanus, headache and dizziness, paralyzed limbs, and other neurodegenerative disorders. There are hundreds of manufacturers making single Tianma or its formula preparations in China. The former includes Quan Tianma tablets, capsules and a series of gastrodin tablets, capsules, oral liquid and injections. The latter have Tianma tablets, capsules, pills, injections and concentrated capsules as well as Tianshu capsule, Dachuanxiong pill and oral liquid, etc.

Quan Tianma capsule is composed of single crude material, tall gastrodia tuber, and is widely used to treat headache, dizziness and paralyzed limbs. The drugs derived from single chemical entity gastrodin are clinically available not only in oral administration, but also in intravenous and intramuscular forms such as Gastrodin injection and capsule. Tianshu capsule and a series of Dachuanxiong preparations are composed of two herbal ingredients: Chuanxiong (rhizome of *Ligusticum chuanxiong* Hort.) and Tianma (rhizome of *G. elata*) with a ratio of 4:1 (W/W). It is mainly used for treating the blood stasis type of headache by promoting blood circulation and pain relief. Tianma Gouteng capsule is prepared from twelve herbal components: Tianma (rhizome of *G. elata* Blume), Gouteng

(stem and twig of *Uncaria rhynchophylla* (Miq.) Miq. Ex Havil), Shijueming (shell of *Haliotis diversicolor* Reeve), Zhizi (fruit of *Gardenia jasminoides* Ellis), Huangqin (root of *Scutellaria baicalensis* Georgi), Niuxi (root of *Achyranthes bidentatae* Blume), Duzhong (bark of *Eucommia ulmoides* Oliv.) processed with salt, Yimucao (the whole plant of *Leonurus japonicus* Houtt.), Sangjisheng (leaf and twig of *Taxillus chinensis* (DC.) Danser), Shouwuteng (stem of *Polygonum multiflorum* Thunb.) and Fuling (sclerotium of *Poria cocos* (Schw.) Wolf.). It is used for the headache and dizziness caused by hypertension.

### 13.4.2 Dietary Usages [8]

Besides the important therapeutic action, Tianma has the great nutrition and health value. It is often used as famous culinary and dietary material. Tianma candy and packed Tianma slice are favorite of many people and it is a good alternative to present them to the family or friends. In addition, some culinary and dietary forms are listed as followed.

#### 13.4.2.1 Tianma Wine

Tianma Duzhong wine is made by soaking Tianma (rhizome of *G. elata* Blume, 50 g), Duzhong (bark of *E. ulmoides* Oliv., 50 g), and Mugua (fruit of *Chaenomeles speciosa* (Sweet) Nakai, 50 g) in 500 g of Chinese spirit for more than a week to drink daily for strengthening the body. Compound Tianma Yiyin wine and Renshen Tianma wine are also legally authorized to be available on the Chinese medicinal market, which are prepared with Tianma combining with other herbs and alcohol. Daily intake amount can be based on indication of each drug.

#### 13.4.2.2 Tianma Tea

Tianma mixed with other herbs can be used for the preparation of the healthy tea. For example, Tianma Chuanxiong tea, which was composed of Tianma (rhizome of *G. elata* Blume, 3 g), Chuanxiong (rhizome of *L. chuanxiong* Hort., 10 g), Baizhi (root of *Angelica dahurica* (Fisch.) Benth. et Hook., 3 g) and spring tea (3 g).

#### 13.4.2.3 Tianma Used as Culinary and Dietary Material

When it is used as culinary and dietary material, fresh rhizome of *G. elata* is more preferred than dried one. It is often enjoyed as main ingredients for making soup or porridge with various foodstuffs such as meat, fish, chicken and rice, etc. Tianma Gouqi soup can be prepared as followed: Fresh rhizome of *G. elata* (25 g) and

Gouqi (fruit of *Lyciumbarbarum* L., 12 g) are boiled for 20 min and then mixed with pork (220 g). Tianma Dazao porridge was prepared with fresh Tianma (rhizome of *G. elata* Blume, 50 g), rock candy (50 g), Dazao (fruit of *Ziziphus jujuba* Mill., 14 pieces) and rice (200 g).

### 13.5 Clinical Evidences

Multiple studies in humans have been reported that it is directly related to the use of Tianma or its formula preparations for the treatment of various diseases. However, much of the literatures are difficult to interpret due to incomplete study design descriptions, discrepancies and inconsistencies among preparations of Tianma. The large-scale, multi-centered and randomized blind method of RCTs is still to be adopted.

Three trials in humans evaluated the preparations containing Tianma in multiple disease states. One study described its effect on senile vascular dementia. 60 patients with senile vascular dementia were divided into three groups, and Tianma Cuzhi granules were given to each group for 2 months (four times, three times and twice a day). The scores on the Mini-Mental State Examination of all tested patients treated with drugs were improved as compared with baseline [9]. In a randomized controlled clinical trial in the treatment of diabetic peripheral neuropathy, 36 patients were treated with reinforced Tianma Duzhong capsules, containing Tianma (rhizome of *G. elata* Blume) and Duzhong (bark of *E. ulmoides* Oliv.), and another 26 patients in the control group were treated with 40 mg of aspirin daily. Both symptoms and electromyographic changes were significantly improved in the capsule-treated group [7]. A meta-analysis of randomized control trials on the effect of Tianshu capsule in treatment of migraine, including a total of 10 studies including 937 migraine patients, indicated it had a higher effective rate in treating migraine, and there is no significant heterogeneity between Tianshu capsule group and control group. Tianshu capsule alone compared to conventional therapy also showed the advantages, and there was low heterogeneity [10].

### 13.6 Safety Evaluation and Toxicity Issue

Toxicity of Tianma in humans is very low. When it is overcommitted or inappropriately used, there will be suffering from some side effects including skin rash, vertigo, chest tightness, shortness of breath, nausea and vomiting, etc. Acute toxicity in animals is also low. The LD<sub>50</sub> in adult mice injected intraperitoneally with crude Tianma extract was 51.4–61.4 g/kg [7]. Although Tianma is a relatively safe herbal medicine often used as the culinary and diet purposes, it is still strongly recommended to use it under the proper condition.

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