

Chapter 71

Houttuynia cordata Thunb

鱼腥草 (Yuxingcao, *Houttuynia*)

Qi-wei Zhang

71.1 Botanical Identity

Houttuynia cordata Thunb, the sole species in the genus *Houttuynia* of the Lizardtail family (Saururaceae), is a perennial herb. Since its stems and leaves smell of fish after rubbing, it earns the nickname Yuxingcao (“fishy grass”).

The stems of fresh herb of *H. cordata* are cylindrical, 20–45 cm long, 2.5–4.3 mm in diameter; the upper part is green or purplish-red, the lower part white; the nodes are distinct, glabrous or sparsely pubescent with rootlets on the nodes of lower part. The leaves are alternate; the lamina is cordate, 3–10 cm long, 3–11 cm wide; the apex is acuminate, and the margin is entire; the upper surface of the lamina is green with densely distributed glandular dots; the lower surface often purplish-red; the petioles are slender and can accrete with stipules at the base of petioles to form sheaths. The spike is terminal. The odor of the herb is fishy; the taste is astringent [1].

The Lizardtail family consists of four genera and eight species. They are distributed in the Asia and North America with three genera in China. The genus *Houttuynia* has only one species, i.e. *Houttuynia cordata*. It is broadly distributed in the southeast, southwest and central areas of China, from eastern Taiwan to southwestern Yunnan and Tibet, as well as to northern Shaanxi and Gansu, with a concentration in Sichuan, Hubei, Hunan, Jiangsu, etc. Basic and primary process is to remove foreign matter, wash-cleaning rapidly, cut into sections for fresh herb, and sun-dried [1] (Fig. 71.1).

Q. Zhang (✉)

China Academy of Chinese Medical Sciences,

Institute of Chinese Materia Medica, Beijing 100700, China

e-mail: zhangqw1955@163.com



Fig. 71.1 The flowering plant (a) and crude drug (b) of Yuxingcao

71.2 Chemical Constituents

The chemical constituents in Yuxingcao, except nutrition ones, have also been investigated. The researches have mainly focused on its volatile oils, flavonoids, phenols, and so on. Below is a brief introduction to these research results.

71.2.1 Volatile Oils

The oil extracted by steam distillation is yellowish, and its content is about 0.03 % in the fresh herb, and about 0.04 % in the dried herb.

A GC-MS instrument analyzed the volatile oils. Sixty-eight chemical components were separated from the aboveground part of the herb, and 48 compounds were identified. The sum of peak areas identified was more than 90 % of the total peak areas. The main 17 compounds were decanoyl aldehyde (**1**), 2-undecanone (**2**), decanal, n-tridecylaldehyde, decylformate, β -myrcene, bomeol acetate, geraniol acetate, decanoic acid, α -pinene, tridecyl aldehyde, 1-dodecanol, 2-tridecanone, β -pinene, D-limonene, nonanol, 2-dodecanone. Their peak areas were about 87 % of the total peak areas [2].

71.2.2 Flavonoids

It was reported that the flavonoids in this herb included quercetin, quercitrin, isoquercitrin, hyperin, afzelin, and rutin. In recent years, the chemical constituents were investigated in the water-soluble portion of the fresh herb. Five flavonoid constituents were separated and identified; three of them were quercetin-3-O- β -D-galactoside-

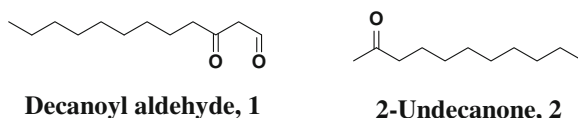


Fig. 71.2 Representative compounds in Yuxingcao

7-O- β -D-glucoside, kaempferol-3-o- α -L-rhamnopyranosyl-(1 \rightarrow 6)- β -D-glucopyranoside, quercetin-3-O- α -L-rhamnopyranosyl-7-O- β -D-glucopyranoside [3].

71.2.3 Phenols

Five phenol compounds were separated in the n-butanol portion from methanol extract of fresh Yuxingcao, and identified as chlorogenic methyl ester, (E)-4-hydroxy-4-[3'-(β -D-glucopyranosyloxy)butylidene]-3,5,5-trimethyl-2-cyclohexen-1-one, 2-(3,4-dihydroxyphenyl)ethyl- β -D-glucopyranoside, p-hydroxyphenethyl- β -D-glucoside, 4-(β -D-glucopyranosyloxy)-3-hydroxybenzoic acid [4].

71.2.4 Others

It was reported that cordarine, chlorogenic acid, palmitic acid, linoleic acid, stigmastan-4-en-3-one, 5 α -stigmastan-3,6-dione, and succinic acid were separated and identified from Yuxingcao.

The chemical structures of representative compounds are shown in Fig. 71.2.

71.3 Pharmacological Studies

71.3.1 Antibacterial Effects

The dilute juice of fresh Yuxingcao showed antibacterial activity against *Salmonella typhi*, *S. paratyphi A*, *Shigella flexneri*, *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Peumococcus pneumoniae* and *S. albus*. The volatile oils extracted from fresh Yuxingcao exerted some inhibition against *Streptococcus heamoliticus*, *S. aureus*, *Pseudomonas aeruginosa*, and *E. coli*.

71.3.2 Antiviral Effects

Yuxingcao injection (the volatile oil solution) can cause the inhibition of influenza A1 virus nucleoprotein gene expression [5]. Another research showed that Yuxingcao had the in vitro anti-cytomegalovirus effect [6].

71.3.3 Antioxidant Effects

The total flavonoids of Yuxingcao possessed strong antioxidant capacity and high free radical scavenging activities. The total antioxidant capacity of the herb is stronger than that of BHT. The SC50 values of DPPH radical, superoxide anion radical and hydroxyl radical were found to be 12.0, 14.4, and 12.8 $\mu\text{g/mL}$ respectively [7].

The total flavonoids in Yuxingcao extracted with 70 % ethanol exerted high free radical scavenging activities. The concentration of the flavonoids had positive relativity with its antioxidant capacity.

71.3.4 Anti-inflammatory Effects

The anti-inflammatory effects of volatile oils in Yuxingcao were studied, and the results showed that the volatile oils inhibited the mice ear edema, rat paw swollen and rat granuloma. The volatile oils also inhibited the inflammation factors (TNF- α and IL-1).

Another research indicated that 80 % ethanol extract of Yuxingcao decreased the chemotactic ability of HMC-1 cells in response to stem cell factor by inhibiting the NF-kappa B activation, and the herb extracts might be useful for treating mast cell-induced inflammatory diseases [8].

71.3.5 Antipyretic Effects

Yuxingcao injection possessed obvious antipyretic effect on yeast-induced fever rats and the effect was in a dose dependent manner. The antipyretic mechanisms might be due to inhibiting the increase of cAMP in hypothalamus and promoting the release of AVP in ventral septal area (VSA) [9].

71.3.6 Organ Protection Effects

The study indicated that Yuxingcao injection could reduce urinary protein content and renal pathologic changes of membranous nephritis rats. Another research showed that Yuxingcao protected against the renal lesion in diabetic rats through inhibiting the expression of TGF- β 1 and enhancing the expression of BMP-7. It was reported that Yuxingcao volatile oils can reduce connective tissue growth factor and improve adiponectin in diabetic rats, which may be the mechanism of the herb on relieving renal impairment in diabetic rats.

71.4 TCM Applications and Dietary Usage

More than two thousand years ago, Chinese ancestors used Yuxingcao as a potherb. From the time of Wei-Jin dynasty (AD 220–316), it was formally accepted for medical use, and was named after *Houttuynia* in the ancient Chinese medical books. Since ancient times, Yuxingcao has played a dual role: as a medicine and as a food, helping people to preserve health, prevent and treat diseases.

71.4.1 TCM Applications

In traditional Chinese medicine, the action of Yuxingcao is to remove toxic heat, promote drainage of pus, and relieve dysuria. It is used to treat lung abscesses with purulent expectoration, heat in the lung with cough and dyspnea, acute dysentery, acute urinary infection, carbuncles and sores [1].

The following is a brief introduction to internal and external use of Yuxingcao.
Internal Use:

For treatment of pulmonary abscess and coughing with purulent and bloody sputum, take 250 g of the fresh herb, get juice by pounding, take three times a day for three days.

For treatment of heat cough, take 60 g of the fresh herb (or 20 g of the dried herb), brew in boiling water or decoct with water, add some sugar and drink as tea. For cough with yellow phlegm, it can relieve cough and dispel phlegm.

For treatment of heat stranguria, take 100 g of the fresh herb and some sugar, decoct with water, and take once a day.

For treatment of acute dysentery, take 50–100 g of the fresh herb (a half for the dried herb), decoct with water, take once a day.

For treatment of urinary tract infection, frequent and painful urination, take 50 g of the fresh herb (or 30 g of the dried herb), decoct with water.

External Use:

For treatment of hemorrhoid with swelling and pain, take 100 g of the dried herb (or 300 g of the fresh herb), add 1000 ml of water, decoct the herb to make a soup, fumigate and wash the affected part with the soup once or twice a day for three to four days.

For the treatment of carbuncle and furuncle, take the fresh herb, pound it to apply on affected part; or take the dried herb, grind it into powder and blend with honey to apply. This can cure carbuncle and deep-rooted ulcer, relieve pain and drain pus.

71.4.2 Dietary Usages

Yuxingcao is the plant that can be used as medicine and food. It is on the list of medicine and food materials that ratified by the Ministry of Health of China, and draws attention of the public.

The nutrition constituents in Yuxingcao include proteins, fat, carbohydrates, and minerals. It was reported that the contents of protein, crude fat, soluble carbohydrates and ashes were 2.72, 1.86, 1.42, and 1.08 % respectively. The determination results of mineral elements in the herb show it contains a great deal of Calcium, Magnesium, Potassium, and a little of Iron, Zinc, Copper, Manganese. It contains 574 mg of Calcium, 156 mg of Magnesium, 309 mg of Potassium per 100 g of the herb.

When Yuxingcao is used as food, the fresh stems and leaves are often picked before the plant is abloom in the spring and summer. The underground roots and stems are also edible. Though the stems and leaves of the plant smell of fish, for the people who are used to it, the more concentrated the odor, the greater the preference.

Wash the stems and leaves before serving, use them alone or mix with lettuce and carrots to make cold dishes. They can also be used to stew meat, boil noodles, cook gruel, prepare soups, and make fillings. Here are two commonly used recipes:

Cold dressed “fishy grass”: Take 250 g of the fishy grass. Clean them and slice them into small sections. After pickling in salt, mix in garlic spread, sesame oil, vinegar, and monosodium glutamate.

Stir-fry “fishy grass” and asparagus lettuce: Take 100 g of fresh fishy grass. Clean them, slice into small sections and sprinkle a little salt on them for pickling. Take one asparagus lettuce and peel off its skin. Clean it and cut it into fine shreds. Heat the wok and add oil. Add ginger and green onion, and stir a while. Add fishy grass and asparagus lettuce, and stir-fry. Add garlic and salt to taste.

In Guangdong, Guangxi and Fujian, Yuxingcao is also decocted to make cold tea. The herbal cold tea can help clear away heat and quench thirst.

As a kind of wild vegetable, Yuxingcao can supply human body not only with proteins, fat, carbohydrates, vitamins and minerals, but also with biological active

components, such as volatile oils, flavonoids. These components can help clear away heat, facilitate diuresis, and inhibit pathogenic microorganism. Therefore, it has the food treatment and health care function. Here are some food therapy recipes.

Pork tripe stuffed with fishy grass: Take 150 g of fresh fishy grass (or 50 g of the dried one) and put it into pork tripe. Cook soup with them. Eat the soup once a day for three days. It can cure phthisis, cough and night sweats.

Stir-fry fishy grass: Eating the stir-fried fishy grass can relieve swelling and sore throat for people with amygdalitis and pharyngitis

Fishy grass and egg soup: Take 50 g of fishy grass and decoct with water. Remove the dregs to get the decoction. Put one raw egg in the boiling decoction. Drink once a day for 15 days. It can treat tuberculosis with fever and cough with purulent and bloody sputum.

71.5 Clinical Evidences

Yuxingcao injection (the herb steam distillation liquid plus cosolvent) is often used clinically for the treatment or adjuvant treatment of bacteria- and virus-induced inflammation, such as bronchitis, pneumonia, enteritis, and acute urinary tract infection, epidemic keratoconjunctivitis.

71.6 Safety Evaluation and Toxicity Data

The LD50 of the Yuxingcao decoction in mice by intraperitoneal injection was 51.0 g/kg. For the overall assessment of the safety of fresh Yuxingcao juice, acute toxicity test in mice and rats, Ames test, micronucleus test of bone marrow cells in mice, and sperm shape abnormality test of mice were carried out. The results showed that the fresh Yuxingcao juice was free from toxin, and had no acute toxicity and mutagenicity.

Up to now, there are no reports of adverse reactions for the oral administration of Yuxingcao and its preparations.

In recent years, most ADR (adverse drug reaction) cases were induced by IV drop of Yuxingcao injection. Since Yuxingcao injection was approved for marketing in China in 1988, annual consumption is near 0.3 billion injections, patients who took the injection are more than 5 billion person-time. Up to April 13, 2006, the National Adverse Drug Reaction Monitoring Center has found 494 ADR cases of Yuxingcao injection, including near 100 cases of serious ADRs. This indicates a very low rate of ADR. The clinical manifestations of ADRs include skin swelling, itching, rashes, aversion to cold, fevers, cold shivers, chest distress, palpitation, dyspnea, pulmonary edema, and anaphylactic shock, etc. These symptoms can be relieved soon after the drug is stopped and there are no after-effects.

References

1. Pharmacopoeia Committee of P. R. China (2010): Pharmacopoeia of the People's Republic of China, 2010 Ed. Volume I. China Medical Science and Technology Press, Beijing
2. Zheng et al (2007) Analysis of volatile oil of *Houttuynia cordata* by GC-MS. J TCM Univ Hunan 27(S1):116–120 (in Chinese)
3. Meng et al (2006) Study on chemical constituents of flavonoids in fresh herb of *Houttuynia cordata*. China J Chin Mater Med 31(16):1335–1337 (in Chinese)
4. Meng et al (2007) Study on chemical constituents of phenols in fresh herb of *Houttuynia cordata*. China J Chin Mater Med 32(10):929–931 (in Chinese)
5. Sun et al (2008) Effect of Yuxingcao on influenza A1 virus nucleoprotein gene. Chin Gen Pract 11(21):1939–1940 (in Chinese)
6. Wang et al (2007) An experimental study the *in vitro* anti-cytomegalovirus effect of the traditional Chinese medicine *Houttuynia*. Herald Med 26(6):579–581 (in Chinese)
7. Li et al (2008) Absorption and separation of macroporous resin for total flavonoids of *Houttuynia cordata* thumb. and its antioxidant activities. Food Res Dev 29(1):47–50 (in Chinese)
8. Kim et al (2007) The inhibitory effect of *Houttuynia cordata* extract on stem cell factor-induced HMC-1 cell migration. J Ethnopharmacol 112(1):90–95
9. Wang et al (2007) Effects of Yuxingcao injection on contents of c-AMP in hypothalamus and AVP in ventral septal area in fever rats. Chin J Clin Pharmacol Ther 12(1):78–81 (in Chinese)