

# Application of Classical Prescriptions of Rhizome Chinese Herbal Medicines for Medicine and Food Homology and Development Status of Its Modern Food

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**Abstract** The efficacy, application and compatibility of five kinds of Chinese Herbal Medicines medicine (including yam, licorice, *Platycodonis Radix*, *Polygonati Rhizoma*, and *Pueraria Lobata*) for medicine and food homology in the past five years were systematically searched and summarized, and the current situation of their food development was reviewed to provide theoretical basis for the research and development of this kind of CHMs for health care.

**Key words** Medicine and food homology, Efficacy, Food development, Rhizome traditional Chinese medicine

## 1 Introduction

Medicine and food homology is a summary of the relationship between medicine and food and its application. Medicine is used as food, and food is as medicine. Food relies on medicine, and medicine assists food. The substance as both food and medicine not only has nutritional value, but also can prevent and cure diseases<sup>[1]</sup>. Seen from the references in major databases, the term first appeared in *A Brief Talk on Dietary Therapy for Cancer Patients* published in 1984<sup>[2]</sup>. At present, the substances that are both food and medicine are collectively called "medicine and food homology"<sup>[3]</sup>. In a series of policy documents, such as the *National Nutrition Plan during 2017–2030 and Healthy China Action (2019–2030)*, issued by the Central Committee of the Communist Party of China and the State Council, it is clearly proposed that it is necessary to encourage and promote the research and development of food as traditional Chinese medicine, traditional food and nutrition products and other food as medicine<sup>[4]</sup>. Japan first put forward the concept of "functional food", and promulgated the *Nutrition Improvement Law*, *Health Functional Food System* and other laws and regulations regarding food as health products. The U.S. Food and Drug Administration (FDA) regulates that the claims of dietary supplements include health, nutrition, and functional claims<sup>[5]</sup>.

Materials for medicine and food homology are rich in polysaccharides, proteins, fats, vitamins and other components, and have good medical and nutritional value<sup>[6]</sup>. According to different medicinal parts, Chinese herbal medicines (CHMs) for both medicinal and food use mainly includes roots, stems, leaves, flowers, fruits and seeds<sup>[7]</sup>. "Rhizome CHMs" refer to a class of medicinal materials whose medicinal parts include plant roots or roots with some rhizomes as well as underground stems of plants or under-

ground stems with few roots<sup>[8]</sup>. Rhizome CHMs for medicine and food homology has a long history of application, and has been widely used in many ancient medical books and classical prescriptions. Most of the current studies focus on the pharmacological effects of fruit CHMs for medicine and food homology<sup>[9]</sup>, the activity, pharmacological effects and safety evaluation of flower CHMs for medicine and food homology<sup>[10–11]</sup>, and the safety evaluation of whole grass CHMs for both medicinal and food use<sup>[12]</sup>, while studies on rhizome CHMs for medicine and food homology are scattered. However, this kind of CHMs had been widely used in modern life, and is produced into various foods such as bread and pastry, potato chips, candy, tea and beverages. In this paper, the application, compatibility rules and current development status of this kind of CHMs prescriptions will be summarized to provide a reference for the development and application of this kind of CHMs.

## 2 Rhizome CHMs for medicine and food homology

**2.1 Yam** Yam is the dried tuber of *Dioscorea opposita* thunb., a long-growing herb in Dioscoreaceae family. It has the effects of invigorating qi and nourishing stomach, promoting fluid and benefiting lungs, tonifying kidney and arresting seminal emission<sup>[13]</sup>.

**2.1.1 Application in ancient prescriptions.** As one of the earliest Chinese medicines included in a book on materia medica, yam can be used alone or combined with other supplements or drugs as decoction and powder, can also be directly made into a patent medicine, has the effects of strengthening spleen, tonifying lungs, and strengthening kidney, and is used to treat spleen and stomach weakness, reduced appetite and burnout, infantile malnutrition, deficiency cough, diabetes and other diseases. Many tonics containing yam, such as Liuwei Dihuang Pills, Qiju Dihuang Pills, Guipi Decoction, Shenling Baizhu Powder, etc., are also widely used in modern Chinese medicine, and are often as food in daily life, such as yam porridge or yam-based dishes. Bazhen cake, a life-prolonging food that has been passed down since the Ming Dynasty, is a cake made mainly of 8 Chinese herbs (such as yam,

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hawthorn and malt) and rice flour. It is used to treat spleen and stomach weakness, abdominal distention, yellowness and thin skin, loose stool and diarrhea of the elderly and children, and has a remarkable effect<sup>[14]</sup>.

**2.1.2 Present situation of modern food development.** Yam, as a food for medicine and food homology, has a high nutritional value, and has been developed for various foods at present. Zhang Yuanxing *et al.*<sup>[15]</sup> determined the best formula of yam and red date biscuits. Sun Jia *et al.*<sup>[16]</sup> used purple yam, low gluten flour, xylitol and butter as the main raw materials to produce starchy food purple yam crisp biscuits. It has also been developed and produced into various drinks. Liu Ribin *et al.*<sup>[17]</sup> made a compound drink with high nutritional value using yam and wolfberry as raw materials. Sun Jia<sup>[18]</sup> used pure milk and purple yam as the main raw materials to determine the best process of purple yam yogurt. Li Dawei *et al.*<sup>[19]</sup> brewed yam vinegar. Lu Fang *et al.*<sup>[20]</sup> developed a complex alcoholic beverage using yam and mulberry yellow as raw materials. Of course, there are other foods, including canned yam<sup>[21]</sup>, yam jelly<sup>[22]</sup>, sweet plum flavored purple potato yam sandwich potato chips<sup>[23]</sup>, yam instant powder<sup>[24]</sup>, yam jam<sup>[25]</sup>, yam bean<sup>[26]</sup>, yam potato puree<sup>[27]</sup>, *etc.*

**2.2 Licorice** Liquorice is dried roots and rhizomes of leguminous plants *Glycyrrhiza uralensis* Fisch., *G. Inflata* Bat. or *G. glabra* L.<sup>[13]</sup>.

**2.2.1 Application and compatibility in ancient prescriptions.** Liquorice has many effects, such as harmonizing various medicines, detoxifying, tonifying deficiency, relieving cough and moistening lungs, *etc.*, is neutral in medicinal property, and is a common CHMs tonifying qi<sup>[28]</sup>. Licorice, as the "basic herbal medicine" in CHMs, has the classic theory of "nine of the ten prescriptions contain licorice", which is considered as one of the most important CHMs. The combination of liquorice and some Chinese herbs can play a role in reducing toxicity and enhancing effect. In the *Sheng Nong's Herbal Classic*, the application of licorice has been recorded in detail, and more than 70 of the 113 prescriptions in the *Treatise on Febrile Diseases* involve licorice<sup>[29]</sup>. In the peony and licorice decoction as Zhongjing's classic prescription, licorice and peony are used together for relieving pain and helping supplement Yin and blood. Cassia twig and licorice decoction helps tonifying the deficiency of heart-yang deficiency. The detoxification effect of licorice in Zhongjing's Shengma Biejia decoction can be used to fight against yin-yang toxin. In addition, licorice combined with ephedra, almond, and gypsum can treat phlegm-heat cough, and cold drink cough can be treated if it is combined with dried ginger and asarum.

**2.2.2 Present situation of modern food development.** As a herb for medicine and food homology, licorice is also widely used as a health food and natural sweetener<sup>[30]</sup>. The dandelion liquorice set yogurt made by Yan Biyun *et al.*<sup>[31]</sup> has the effects of clearing heat and detoxifying, diuresis and anti-inflammation and a high nutritional value. The glycyrrhiza polysaccharide drink prepared by Ma Yanhua *et al.*<sup>[32]</sup> has the function of stomach protection. The com-

plex beverage of roselle, tangerine peel and licorice developed by Shao Liping<sup>[33]</sup> has the functions of helping digestion, regulating qi and eliminating phlegm. The compound drink made of rose, radix paeoniae alba, and licorice by Wang Liqiong *et al.*<sup>[34]</sup> has the health effects of invigorating spleen and protecting liver, moistening lungs and regulating qi, and nourishing the skin.

**2.3 Platycodonisi Radix** Platycodonisi Radix is the dried roots of *Platycodon grandiflorum* (Jacq.) A. DC. in the platycodon family<sup>[13]</sup>. It is bitter and hot in taste and neutral in nature. Its effect on the lungs is obvious. It has the functions of expelling lungs, expelling phlegm, clearing throat and expelling pus. It is a widely used edible Chinese herbal medicine.

**2.3.1 Application and compatibility in ancient prescriptions.** In the *Lingshu · Meridians and Treatise on Febrile Diseases*, it is mentioned that Platycodonisi Radix has the effect of releasing lungs and soothing throat. In the *Synopsis of Golden Chamber and Treatise on Febrile and Miscellaneous Diseases*, it is mentioned that Platycodonisi Radix can treat lung carbuncle, is an essential drug for detoxification and purulent discharge, and has the effect of expelling phlegm and purulent discharge<sup>[35]</sup>. In the *Treatise on Febrile and Miscellaneous Diseases*, ten prescriptions contain Platycodonisi Radix, such as Platycodonisi Radix decoction, Sanwubai powder, *etc.* About the compatibility of Platycodonisi Radix: the compatibility of Platycodonisi Radix and licorice can expel heat, relieve throat and discharge pus; the compatibility of Platycodonisi Radix and fritillary can eliminate phlegm. The compatibility of Platycodonisi Radix and Aurantii Fructus Immaturus is used in Painong powder and Sishi Jiajian Caihu Yinzi, and are commonly used in the clinical treatment of stagnation of phlegm, qi stagnation, chest and abdominal distension. In Hou's black powder and yam pills, the compatibility of Platycodonisi Radix with Atractylodes Macrocephalae Rhizoma and Fructus Ziziphi Jujubae can tonify middle qi and cure systemic asthenia diseases<sup>[36]</sup>.

**2.3.2 Present situation of modern food development.** Since 2002, in the *List of Items as Both Food and Medicine* published by the National Health and Family Planning Commission, Platycodonisi Radix is classified as a drug for both medicinal and food use. It is mild and widely used. Platycodonisi Radix is widely used as cold mixed vegetables, canned vegetables, preserved fruits, and pickles in Northeast China, South Korea, Japan, and other places<sup>[37]</sup>. Platycodonisi Radix contains a variety of essential amino acids, such as lysine and glutamic acid, *etc.*<sup>[38]</sup>. Chen Honghui *et al.*<sup>[39]</sup> used corn whisk and Platycodonisi Radix as raw materials to make corn whisk and platycodon complex drink; it is sweet and sour, and has a good health function.

**2.4 Polygonati Rhizoma** Polygonati Rhizoma is the dried rhizome of *Polygonatum kingianum* Coll. et Hemsl., *P. sibiricum* Red or *P. cyrtoneura* Hua<sup>[13]</sup>. It has the functions of invigorating spleen, moistening lungs, invigorating qi and so on. As a drug for medicine and food homology, Polygonati Rhizoma is a valuable tonic medicine in history. It is considered to be an "elixir for immortality and prolonging life" and a tonic<sup>[40]</sup>, and is widely used

in the development of health food.

**2.4.1 Application and compatibility in ancient prescriptions.** As a drug for medicine and food homology, Polygonati Rhizoma can be used as both medicine and food. In the *Dietetic Materia Medica*, it is recorded that the roots, leaves, flowers and fruit can be as food. *Southern Yunnan Materia Medica* record that Polygonati Rhizoma can tonify deficiency and replenish essence. Ancient books all record that Polygonati Rhizoma has the effects of supplementing qi, tonifying deficiency, delaying aging, and strengthening muscles and bones<sup>[41]</sup>. The compatibility of Cistanches Herba and Polygonati Rhizoma can tonify lower energizer, nourishing yin and blood. The compatibility of Polygonati Rhizoma and Dipsaci Radix has the function of tonifying liver and kidney, invigorating spleen and stomach, and replenishing qi and blood. The compatibility of Polygonati Rhizoma and ginseng has a synergistic effect. The compatibility of Polygonati Rhizoma and Radix Astragali has the effect of invigorating spleen and supplementing qi. The compatibility of *Pleuropteris multiflorus* and Polygonati Rhizoma has the effect of tonifying qi, nourishing liver and kidney, and replenishing qi and blood. The combination of the fruit of Chinese wolfberry and Polygonati Rhizoma has the function of tonifying kidney, spleen and qi and nourishing yin. The compatibility of Asparagi Radix and Polygonati Rhizoma can tonify lungs and kidney, nourishing yin and reducing internal heat. The combination of Polygonati Odorati Rhizoma and Polygonati Rhizoma can boost qi and nourish yin<sup>[42]</sup>.

**2.4.2 Present situation of modern food development.** In addition to medicinal use, Polygonati Rhizoma can also be used as food, and is included in the list of "drugs for both medicinal and food use"<sup>[43]</sup>. At present, there are 450 kinds of health care products of Polygonati Rhizoma, including Polygonati Rhizoma wine, sugar, tea, solid beverage, preserved fruit, tofu, etc.<sup>[44-46]</sup>. Presently, the health care products of Polygonati Rhizoma developed by the food industry mainly include functional drinks, yogurt, biscuits or pastries, etc.<sup>[47]</sup>. He Peiyu *et al.*<sup>[48]</sup> suggested that Polygonati Rhizoma can be used in rice wine, instant tea, sour soy milk, health wine, health vinegar and other health food, and has the effects of safety and health, rich taste, anti-oxidation, anti-aging, relieving fatigue, nourishing appearance and beautifying appearance. Wang Min *et al.*<sup>[49]</sup> proposed that the current popular products of Polygonati Rhizoma include Polygonati Rhizoma oral liquid, enzyme, paste, etc. In addition, Gao Tianyu *et al.*<sup>[50]</sup> studied the preparation process of silk chicken medicated diet with *Polygonatum sibiricum* and Polygonatum Odoratum, and obtained the best preparation process. Yu Genrong *et al.*<sup>[51]</sup> developed leisure preserved fruit with Polygonati Rhizoma. Zhang Song *et al.*<sup>[52]</sup> optimized the formula of steamed bread made from polygonatum and adlay powder, and developed steamed bread with good sensory properties. Feng Hua<sup>[53]</sup> made Polygonati Rhizoma paste with Polygonati Rhizoma as raw material. Xu Hongqing *et al.*<sup>[54]</sup> produced Polygonati Rhizoma peach cake with good crispness. There are many kinds of drinks made from Polygonati Rhizoma. Dai Xin

*et al.*<sup>[55]</sup> made polygonatum yogurt with yellow essence and milk as the main raw materials. Ye Wenfeng *et al.*<sup>[56]</sup> developed a natural beverage with a unique flavor of polygonatum. Liu Ribin *et al.*<sup>[57]</sup> developed a compound beverage made from Polygonati Rhizoma, yam and Chinese wolfberry. Yuan Linxiang *et al.*<sup>[58]</sup> developed a compound beverage with Polygonati Rhizoma, mulberry and wolfberry as the main raw materials. Zhang Jianping *et al.*<sup>[59]</sup> developed a wine with Polygonati Rhizoma and apple as raw materials.

**2.5 Pueraria Lobata** Pueraria Lobata is the dried roots of the leguminous plant *Pueraria lobata* (Willd.) Ohwi. It has the effects of resolving the flesh, abatement of fever, thirst quenching, promoting eruption, etc.<sup>[13]</sup>. In 2002, the former Ministry of Health of the People's Republic of China included Pueraria Lobata in the list of the first batch of items as both medicine and food. It has high dietary nutritional value, good health care and medicinal functions<sup>[60]</sup>, and is known as "Asian ginseng"<sup>[61]</sup>.

**2.5.1 Application and compatibility in ancient prescriptions.** The medicinal function of Pueraria Lobata was recorded in many books and firstly in the Shennong's Herbal Classic in the Eastern Han Dynasty. In the Newly Revise Materia Medica, *Herbal Supplements*, and *Compendium of Materia Medica*, there are records of medicinal use of Pueraria Lobata in different periods in different periods<sup>[62]</sup>. In *Chinese Pharmacopoeia*, there are more detailed records about the efficacy of Pueraria Lobata, and it has the effect of abatement of fever, promoting fluid and quenching thirst, promoting eruption, raising yang and preventing diarrhea, activating meridians and collagatories, eliminating alcohol and poisons. In the *Treatise on Febrile Diseases* and *Synopsis of Golden Chamber*, there are records of Pueraria Lobata decoction, Pueraria Lobata and Pinelliae Rhizoma decoction, and so forth, and as classical famous prescriptions of Pueraria Lobata, they have been handed down to the present<sup>[63-64]</sup>. In the *Valuable Prescriptions for Emergency and Supplement to Valuable Prescriptions*, Pueraria Lobata and Coptidis Rhizoma decoction, Pueraria Lobata and Gentianae Radix decoction, etc. can be seen<sup>[65-66]</sup>. The compatibility of Pueraria Lobata with Semen Hoveniae, Schisandrae Chinensis Fructus, Lucid Ganoderma, and Radix Salviae Miltiorrhizae had an auxiliary protective effect on chemical liver injury. The compatibility with Radix Astragali, yam, Mori Folium, and bitter gourd can regulate blood sugar. The combination with Radix Salviae Miltiorrhizae, Fiveleaf Gynostemma Herb, Folium Ginkgo, Alismatis Rhizoma and Fructus Crataegi has the health function of regulating blood fat. The compatibility with Chinese wolfberry, Radix Astragali and American ginseng can enhance immunity. The combination with Eucommiae Cortex and Radix Salviae Miltiorrhizae has the health function of regulating blood pressure<sup>[67]</sup>.

**2.5.2 Present situation of modern food development.** Pueraria Lobata, which is a food and processing raw material with very local characteristics, can be processed into a lot of special food or accessories in addition to being as stir-fried vegetables or soup. Lezhenou<sup>[68]</sup> determined the optimal compatibility ratio for making

low-sugar pueraria biscuits. Xu Yan *et al.*<sup>[69]</sup> made yogurt with purple potato and *Pueraria lobata* using a certain proportion of purple potato, *P. lobata* and raw milk. Li Rong *et al.*<sup>[70]</sup> determined the proportion of making pueraria yellow wine. Wang Yongzhi<sup>[71]</sup> made kudzu black rice sports drink using kudzu root and black rice. Liu Yan *et al.*<sup>[72]</sup> used kudzu powder as raw material to prepare kudzu chrysanthemum noodles fish. Wang Qiangyi<sup>[73]</sup> added kudzu powder to make kudzu cake. Zhang Shouyu *et al.*<sup>[74]</sup> determined the best process for making kudzu yam health bread.

## 2.6 Others

**2.6.1 Polygonati Odorati Rhizoma.** Polygonati Odorati Rhizoma is the dry rhizome of *Polygonatum odoratum* (Mill.) Druce in the Liliaceae family<sup>[13]</sup>. Its main functions are to help produce saliva and slake thirst, and nourish yin to moisten dryness. Its medicinal value is rich, and it can be used as both medicine and food, so it has a wide prospect of development and application. At present, some new products have been developed, especially health food and health drink. Zhang Kai *et al.*<sup>[75]</sup> detected the nutrition and bioactive components of Polygonati Odorati Rhizoma based on the *Reference Intake of Dietary Nutrients of Chinese Residents*, and concluded that Polygonati Odorati Rhizoma meets the healthy dietary needs of modern people and can be promoted as a high-quality dietary raw material. Zhao Liying *et al.*<sup>[76]</sup> extracted *Polygonatum odoratum* polysaccharide with hot water and made a mixed drink with apple juice, pineapple juice and kiwi juice.

**2.6.2 Ginger.** Ginger mainly refers to the rhizome of *Zingiber officinale* Rosc., and has a pungent taste and warm nature, as well as the effects of dispelling cold, relieving exterior syndrome, reducing reflux and stopping vomiting<sup>[13]</sup>. As a typical medicinal and edible plant, ginger is often used as a condiment and food material in daily life. Qiang Shuting *et al.*<sup>[77]</sup> pointed that the existing ginger products on the market now include flavored ginger juice, canned ginger, ginger beer, pickled ginger sprouts, curry powder, *etc.* Wang Chao *et al.*<sup>[78]</sup> made ginger juice sweet tea with ginger juice, milk, white granulated sugar and black tea powder as raw materials. Chen Jing<sup>[79]</sup> prepared a new compound health drink with schisandra, longan, ginger and black tea as the main raw materials. Han Cuiping *et al.*<sup>[80]</sup> made ginger milk tea with fresh ginger, milk and organic green tea as raw materials.

## 3 Summary and prospects

With the increase of people's attention to physical health, many foods with health care effects have gradually entered the public's vision, and such products are mostly made from CHMs for medicine and food homology. In this paper, based on the references about the compatibility, application and food development of CHMs for medicine and food homology in the past 5 years, 5 kinds of common rhizome CHMs for medicine and food homology were summarized. The tonic prescriptions containing yam include Liuwei Dihuang pills, Guipi decoction, Shenling Baizhu powder, *etc.*, and the food includes biscuits, drinks, cans, potato chips, yogurt, *etc.* Peony licorice soup, and laurel branch licorice soup

are classic licorice prescriptions, and licorice has also been developed for yogurt, drinks and other health food. There are 10 platycodon platycodon prescriptions recorded in *Treatises on Febrile and Miscellaneous Diseases*, which are often used in the development of cold mixed vegetables, canned vegetables, preserved fruits, and pickles. The compatibility of Polygonati Rhizoma and other traditional Chinese medicine has different effects, and Polygonati Rhizoma has been developed as wine, vinegar, milk and other drinks, as well as dried fruit, steamed bread, peach cake and other food. Pueraria Lobata prescriptions can be seen in books such as *Treatise on Febrile Diseases*, *Synopsis of Golden Chamber*, and *Valuable Prescriptions for Emergency*, and Pueraria Lobata is also made into bread, cakes, biscuits, yogurt, drinks and other food in daily life. Polygonati Odorati Rhizoma and ginger for medicine and food homology have also been developed as various drinks. Certain progress has been made in the development of medicine and food homology, but there are still some problems such as single product form, limited efficacy and sources, and being not widely popularized in the market. Presently, it should be applied in food development according to the compatibility law of various medicines, and ancient classic prescriptions should be continued to make it play a more effective role through enhancing efficiency and reducing toxicity. Meanwhile, it is necessary to increase the publicity of the advantages of medicine and food homology study and constantly develop new types of food, and provide a reference for the development of Chinese herbal medicine resources and the development of traditional Chinese medicine modernization.

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