Review on Phytochemistry, Pharmacological Action and Clinical Application of Rhizoma Phragmitis

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Abstract. Rhizoma phragmitis (RP) is *Phragmites communis Trin.* fresh or dried root, which is also widely used in daily life. In China, eating Rhizoma Phragmitis has been around for 2000 years, and there are numerous traditional dietary therapy methods. Studies have shown that Rhizoma Phragmitis contains a variety of active ingredients, including polysaccharides, organic acids, flavonoids, steroids, phenylpropanoids, terpenoids, alkaloids, as well as various vitamins and trace elements. Pharmacological studies have shown that the rhizoma has antioxidant, antibacterial, anti-inflammatory and other activities. Additionally, it has been found to have protective effects on kidney and liver. This review aims to systematically summarize the phytochemistry, pharmacology, traditional applications, and folk diet therapy methods of rhizoma, laying the foundation for further research.

Keywords: Rhizoma Phragmitis; Homology of Medicine and Food; Chemical Composition; Pharmacological Effects; Clinical Application.

1. Introduction

Rhizoma phragmitis (RP) is the fresh or dried rhizoma of Phragmites communis Trin, as shown in Fig. 1. RP has cold property and sweet taste, and it has the effects of clearing heat, purging fire, generating fluid, stopping thirst, stopping vomiting, and promoting diuresis [1-4].Modern pharmacological studies have shown that RP also has the effects of anti-oxidation, anti-bacteria [5], anti-inflammation[6], and protecting kidney and liver [7]. RP is distributed in all parts of China, preferring warm and humid environments. It often grows in low-lying areas near rivers, lakes, ponds, ditches and streams, and forest environment is not suitable for the growth of RP. RP can be harvested in all seasons, and the white and fleshy RP are the best. Baiyangdian area in Baoding City, Hebei Province is rich in reed resources. Since ancient times, it has been known as ' The hometown of reeds, the best in Hebei '. As a characteristic medicinal material in Hebei Province, it is one of the important sources of rhizoma medicinal materials in northern China [8,9].

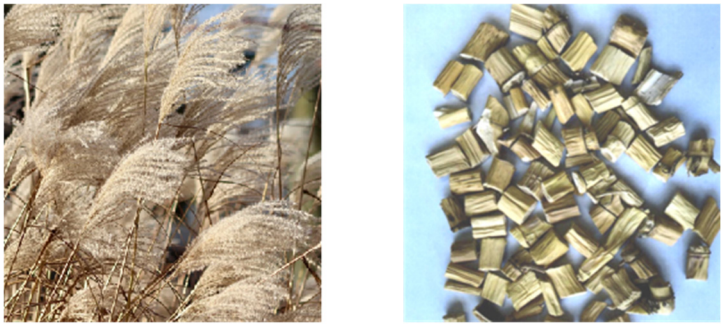

Fig 1. Photos of the original and dried RP

As a traditional Chinese medicine, RP has a long history of medicinal and edible use. In the past, research on RP focused on environmental protection, chemical composition, pharmacological effects and mechanisms of action. This article will review the history, dietary therapy, chemical composition, pharmacological effects and clinical application of rhizoma reed, and provide a basis and reference for further comprehensive and systematic research on rhizoma reed.

2. Historical Use

It is recorded in the 'Shennong Herbal Scripture' that RP has a cold property, affecting the lung and stomach meridian, which has various functions, including clearing heat and reducing fire, producing fluid to quench thirst, relieving irritation, stopping vomiting and promoting diuresis. It is primarily used for the treatment of fever, bronchitis, urinary tract infection, and to alleviate vomiting and other diseases[10]. Pharmacological experiments has shown that phenolic acid components in RP have the ability to clear heat, antivomiting, antibacterial and anti-inflammatory.These effects are consistent with the therapeutic effect of treating fever and antivomiting [11-13].

'Bencao Jingjizhu ' recorded: ' RP is also known as reed roots, and has cold property and sweet taste. It mainly treats diabetes and heat. ' [14].

During the Northern and Southern Dynasties, Tao Hongjing 's ' Famous Doctor Biography ' recorded that RP had the effects of clearing away heat and detoxifying, promoting fluid production and relieving thirst. It was often used to treat fever, thirst, lung carbuncle, vomiting, lung heat cough.

Sun Simiao, a doctor in the Tang Dynasty, recorded the medicinal value of RP in detail in his book ' Qianjin Fang '. He pointed out that RP has the effects of clearing heat, eliminating vexation, relieving thirst, relieving cough and hemostasis, and can be used to treat symptoms such as thirst, vexation, cough and bleeding caused by various fevers. He also emphasized the role of RP in the treatment of laryngeal paralysis and believed that RP can ' remove the lump in the throat ', which has a positive effect on laryngitis, tonsillitis and other pharyngeal diseases.

In addition, the medicinal value of RP was recorded in the two medical classics of ' Taiping Shenghui Fang ' and ' Taiping Huimin Heji Ju Fang ' during the Song Dynasty. These books described the various uses of RP in detail, including the treatment of various lung diseases, colds, laryngitis, sores on the tongue, stomach fire and toothache, etc. In addition, the ancients also used Lugen Decoction to treat lung abscesses and vomiting.

Fig 2. Ancient medical books of RP

RP is included in the 'Lu' item of the grass section of the 'Compendium of Materia Medica' . Li Shizhen believed that RP was the root of reed. According to the ' Compendium of Materia Medica ' , RP has a cold property and a sweet taste, and it enters the lung and stomach meridians. It has the effects of clearing heat and purging fire, generating fluids, stopping thirst, relieving irritability,

stopping vomiting and promoting diuresis. It is often used to treat fever and thirst, lung heat cough, lung carbuncle and expectoration, stomach heat vomiting, heat and astringent pain. Its efficacy records are basically as follows : ‘ Notes on Herbal Classics ’ [15].

The efficacy records of rhizoma in ancient books have hardly changed. They are nothing more than the effects of clearing heat, purging fire, generating fluid, alleviating thirst, relieving discomfort, stopping vomiting, and promoting diuresis. It has hemostatic effect only in Qianjinfang, as shown in Fig. 2.

3. Dietary Prescription of Rhizoma Phragmitis

As a traditional Chinese medicine, RP is more common on people's daily table. It has a long history of wide application in China. It is not only used to treat various diseases, but also as a food ingredient.

In Europe, eating RP is used to treat mouth ulcers, hyperacidity, stomach pain, heartburn and nausea.

It is widely used as a food ingredient in Korea because of its heat-clearing, detoxifying, and thirst-quenching properties. It can be used with a variety of vegetables, meat and herbs to make a variety of delicious and healthy soups, pickles and beverages.In addition, RP is also widely used in the fields of beauty and skin care. It is considered to be a natural antibiotic and anti-inflammatory agent that can enhance skin immunity and alleviate skin problems such as skin allergies and eczema. It can also help clean the skin, reduce pores, dilute wrinkles and increase skin elasticity[16].

Here are some common ways to eat RP [17,18] .

3.1 Rhizoma Phragmitis Porridge

It has the effect of relieving heat heat, stomach, nourishing Yin and relieving pain. All stomach problems with abdominal burning, pain, irritability, bitter mouth and dry throat, can be used.

3.2 Rhizoma Phragmitis and Mung Bean Soup

It has the function of producing fluid and moistening lung, reducing fire and relieving heat. It is suitable for internal heat and dry mouth.

3.3 Rhizoma Phragmitis Ophiopogon Drink

It has the function of producing fluid and clearing heat, nourishing Yin and moistening dryness. It is suitable for cancer patients with dry mouth, poor appetite and poor stool after radiotherapy, and can obviously reduce the side functions after radiotherapy. Also suitable for diabetes, lung dryness hemoptysis and bronchitis.

3.4 Rhizoma Phragmitis Drink

It has the function of clearing fire and detoxifying. It is suitable for halitosis caused by internal heat and stomach fire.

3.5 Rhizoma Phragmitis, and Olives Drink

It has the function of heat clearing and surface relieving, ventilating lung. It is suitable for prevention and treatment of influenza.

3.6 Rhizoma Phragmitis Water Chestnuts and Snow Pear Drink

It has the function of clearing heat, producing fluid and relieving summer-heat . It is suitable for heat stroke.

3.7 Three Root Soup

Kudzuvine root, RP, Couchgrass root are cool, can relieve fever, produce liquid, eliminate annoyance, diuresis, cooling blood and clearing heat, reduce blood pressure. They are particularly

suitable for menopausal women, individuals prone to anger, frequent alcohol and tobacco users, and those seeking to nourish their skin. It can also be used as part of the daily diet for middle-aged and elderly people.

4. Chemical Composition

The chemical constituents of RP are complex, including polysaccharides, small molecular organic acids, flavonoids, steroids, phenylpropanoids, terpenoids, alkaloids, etc., as well as a variety of vitamins and trace elements [19-23], as shown in Table 1.

Table 1. The functional factors isolated from RP

Classes	No.	Compounds	Formula	Refs.
Saccharides	1	α - D - glucose	$C_6H_{12}O_6$	[23]
	2	β - D - glucose	$C_6H_{12}O_6$	
	3	D - xylose	$C_5H_{10}O_5$	
	4	L - xylose	$C_5H_{10}O_5$	
	5	L - (+) - arabinose	$C_5H_{10}O_5$	
	6	fructose	$C_6H_{12}O_6$	[24]
	7	n - butyl - O - β - D - pyranofructoside	$C_{10}H_{20}O_6$	
Flavonoid	8	isoliquiritin	$C_{21}H_{22}O_9$	[24]
	9	6" - O - acetylated glycyrrhizin	$C_{23}H_{24}O_{10}$	
	10	liquiritin	$C_{21}H_{22}O_9$	
	11	licorice chalcone A	$C_{21}H_{22}O_4$	
	12	alfalfa-7-O-rutinoside	$C_{29}H_{32}O_{18}$	
	13	syringaldehyde	$C_9H_{10}O_4$	
	14	tricin	$C_{17}H_{16}O_7$	
Steroid	15	stigmaster - 1 - en - 3 - one	$C_{29}H_{48}O$	[25]
	16	24 - methylcholesterol	$C_{29}H_{50}O$	
	17	stigmaster - 1, 23 - dien - 3 - ol	$C_{29}H_{48}O$	
	18	24 - ethylcholsterol	$C_{30}H_{52}O$	
	19	β - sitosterol	$C_{30}H_{52}O$	[26]
	20	6' - O - acetylated - β - carotenoid	$C_{37}H_{62}O_7$	[24]
Organic acid	21	caffeic acid	$C_9H_8O_4$	[23]
	22	ferulaic acid	$C_{10}H_{10}O_4$	
	23	syringac acid	$C_9H_{10}O_5$	
	24	gentian acid	$C_7H_6O_4$	
Phenylpropanoids	25	arutaridine A	$C_{17}H_{24}O_{10}$	[27]
	26	arutaridine B	$C_{17}H_{24}O_{10}$	
	27	(+) - candelabra lignans - 9' - O - β - D - glucopyranoside	$C_{28}H_{38}O_{12}$	[24]
	28	p - hydroxycinnamic acid	$C_9H_8O_3$	
	29	trans ferulic acid	$C_{10}H_{10}O_4$	
	30	(-) - candelan lignans - 9' - O - β - D - glucopyranoside	$C_{28}H_{38}O_{12}$	
	31	(-) - 8' - epicanavalin - 4 - enyl - β - glucopyranoside	$C_{30}H_{40}O_{14}$	
	32	(+) - candelan - 4 - enyl resin - β - D - glucopyranoside	$C_{30}H_{40}O_{14}$	
	33	(7R, 8S) - guaiacylglycerol	$C_{10}H_{14}O_5$	
	34	(7S, 8S) - guaiacylglycerol	$C_{10}H_{14}O_5$	
Other	35	β-caryophyllene	$C_{15}H_{24}$	[23]
	36	taraxerol	$C_{30}H_{50}O$	
	37	taraxerone	$C_{30}H_{48}O$	
	38	cedar camphor	$C_{15}H_{26}O$	
	39	simiarenol	$C_{30}H_{50}O$	
	40	riboflavin	$C_{17}H_{20}N_4O_6$	

4.1 Saccharides

Polysaccharides are the most abundant chemical constituents in RP. [28] Cellulase has been applied to extract polysaccharides from RP. Orthogonal experiments were used to optimize the extraction conditions. The polysaccharide content from RP was determined using sulfuric acid-phenol colorimetry, which was found to be approximately 1.686%.[29] This includes R-Poly I, R-Poly II and

R-Poly III [20]. It also includes some monosaccharides such as α-D-glucose, β-D-glucose, D-xylose, L-xylose, L-(+)-arabinose, etc. [23].

Fructose and n-butyl-O-β-D-pyranofructoside were isolated from RP, both of which were newly discovered compounds [24].

4.2 Flavonoids

Researchers have isolated seven new compounds in the RP, including isoliquiritin, 6"-O-acetylated glycyrrhizin, liquiritin, licorice chalcone A, alfalfa-7-O-rutinoside, alfalfin-7-O-nehesperidin and syringaldehyde [24], and also including wheat flavin [30].

4.3 Phenypropanoids

According to the collected literature, several phenylpropanoid compounds were present in RP[23].

Two new phenylpropanoid glycosides, named Arutaridine A and Arutaridine B, were isolated from RP. They were identified as (2'R) - 3' - (β - D - glucose) - 2' - hydrox - 1' - (4 - hydroxy - 3,5 - dimethoxyphenyl) - 1' - acetone, (2'S) - 3' - (β - D - glucose) - 2' - hydroxy - 1' - (4 - hydroxyl - 3,5 - dimethoxyphenyl) - 1' - acetone, respectively [27].

Twelve phenylpropanoid compounds were isolated. They are (+)-candelabra lignans - 9' - O - β - D - glucopyranoside, p - hydroxycinnamic acid, trans - ferulic acid, (-) - candelan lignans - 9 - O - β - D - glucopyranoside, (-) - candelan lignans - 9' - O - β - D - glucopyranoside, (-) - 7' - outside - candelan lignans - 9' - O - β - D - glucopyranoside, (-) - 8' - epicanavalin - 4 - enyl - β - glucopyranoside, (+) - candelan - 4 - enyl resin - β - D - glucopyranoside, syringolin - 4' - O - β - D - glucopyranoside 2,3 - dihydroxy - 1 - (4 - hydroxy - 3,5 - dimethoxyphenyl) - 1 - acetone, (7R, 8S) - guaiacylglycerol, and (7S, 8S) - guaiacylglycerol. The last nine of which are newly discovered compounds [24].

4.4 Steroid

A study has identified four steroidal structures in RP, including stigmaster - 1 - en - 3 - one, 24 - methylcholesterol, stigmaster - 1,23 - dien - 3 - ol and 24 - ethyl cholesterol [25]. β - sitosterol and carotenoside were isolated by column chromatography [26]. Further isolation and identification identified carotenoside as 6’ - O - acetylated - β - carotenoid[24].

4.5 Organic Acid

The organic acids in RP include caffeic acid, ferulic acid, syringac acid and gentian acid[23].

4.6 Other

The terpenoids in RP mainly include β - caryophyllene, taraxerol, taraxerone, cedar camphor[23], and simiarenol [24]. The alkaloids in RP mainly consist of riboflavin, including phranisines A and phranisines B[23].

5. Pharmacological Function

At present, the known pharmacological functions of RP include anti-oxidation activity, antibacterial activity, liver and kidney protection, anti-tumor activity, improvement of lipid metabolism and antipyretic action, as shown in Fig. 3.

5.1 Antioxidant Function

Medical research has found that many diseases, such as aging and diabetes, are caused by free radicals[23]. The antioxidant effect of polysaccharides is often achieved a variety of mechanisms , rather than a single pathway. The occurrence of antioxidant effects in organisms is a complex phenomenon.[31] The antioxidant effect is also associated with flavonoids and phenylpropanoids in RP[24,32].

RP polysaccharide exhibits a strong reduction ability, which is only slightly lower than that of ascorbic acid[24,33]. The antioxidant activity of RP polysaccharide was investigated using the DPPH radical method, hydroxyl radical method and inhibition of nitration. The results showed that RP polysaccharide had a good scavenging capacity for DPPH free radicals and hydroxyl free radicals. It can effectively block the synthesis of nitrosamines and also has a certain scavenging capacity for sodium nitrite.[34]

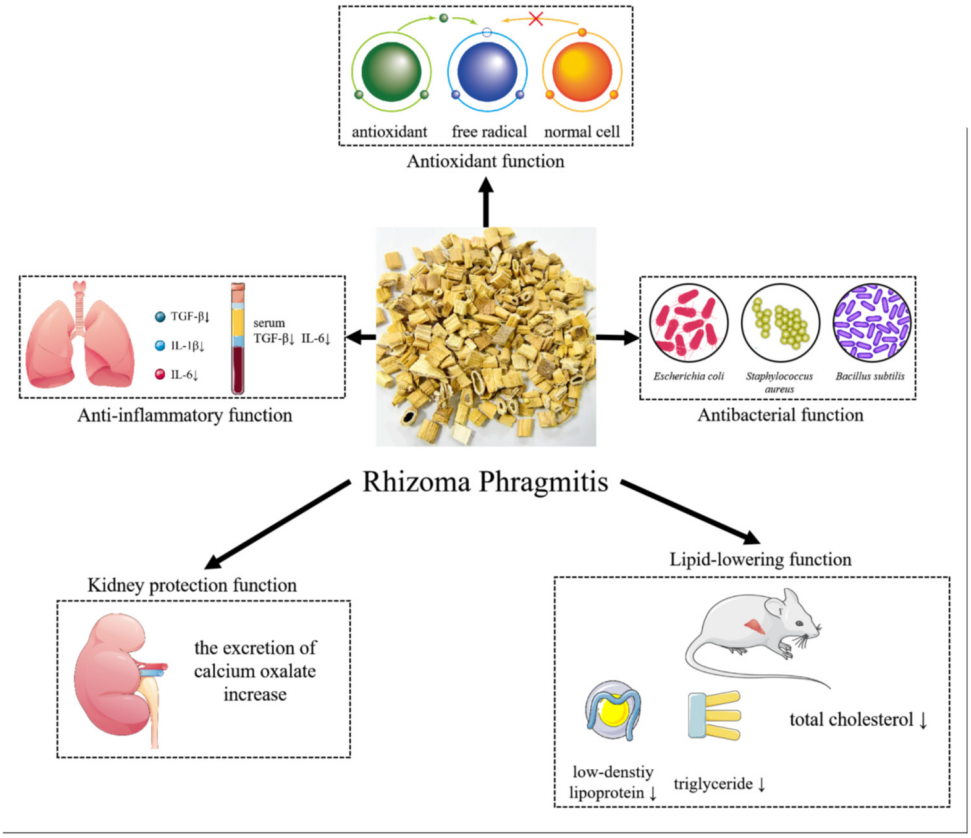

Fig 3. Pharmacological function of RP

5.2 Antibacterial Function

When studying the polysaccharides of RP, researchers discovered that the oligosaccharides in RP exhibited specific antibacterial function[35], which had the most significant inhibitory effect on Staphylococcus aureus, followed by Bacillus subtilis and Escherichia coli.

RP polysaccharide (with a mass concentration of 15 mg/mL) extracted using ultrasound assistance by Yao Yicai, exhibits high sensitivity to yeast and Staphylococcus aureus, and moderate sensitive to Bacillus subtilis and Aspergillus niger[5].

RP contains approximately 51% of polysaccharides. Currently, there are numerous studies on its extraction process[8], but the research on its antibacterial mechanism is limited. The immune organs of the body mainly include central organs such as the thymus and the bursa of Fabricius, as well as peripheral organs such as lymph nodes and the spleen. Cellular immunity mediated by T cells and humoral immunity mediated by B cells are important immune responses of the body. Studies have confirmed that many traditional Chinese medicines contain immunoreactive substances and a variety of nutrients. These substances can not only enhance the function of the mononuclear phagocyte system (MPS), but also enhance T cell function and play a crucial role in combating bacterial infections. Enhancing the antibodies in the humoral immune system can improve the body's ability to defend against bacteria and exotoxins, promote cell phagocytosis function, and thus indirectly inhibit bacterial growth. [36]

Furthermore, flavonoids also exhibit a clear antibacterial function.

5.3 Anti-inflammatory Function

Chronic bronchitis is a prevalent and frequently occurring non-specific chronic respiratory system disease, which can lead to airway inflammation. The primary clinical symptoms include coughing, expectoration, with or without chest tightness and shortness of breath [37]. At present, Western medicine primarily relies on antibiotics and anti-infection measures for treatment. While it is possible to achieve a noticeable improvement in the short term, chronic bronchitis is prone to recurring attacks. If antibiotics are frequently used, the sensitivity of an increasing number of drug-resistant strains to antibiotics will be reduced, greatly hindering future treatment [38]. Furthermore, certain side functions also restrict the universality of clinical application [39]. Traditional Chinese medicine has clear advantages in treating chronic bronchitis due to its flexible methods, positive therapeutic effects, and promising prospects [40].

Fresh RP can reduce serum levels of TGF-β and IL-6. The specific mechanism was illustrated in Fig. 4, showing the down-regulation of TGF-β in lung tissue and the protein levels of IL-1β and IL-6, which can alleviate the pathological changes and fibrosis of lung tissue. Additionally, it downregulated the protein expression of TGF-β and IL-6, as well as the mRNA levels of TGF-β in 16HBE cells induced by CSE. These results indicated that fresh RP can prevent chronic bronchitis airway inflammation and promote cell repair by inhibiting the TGF-β signaling pathway[41,42].

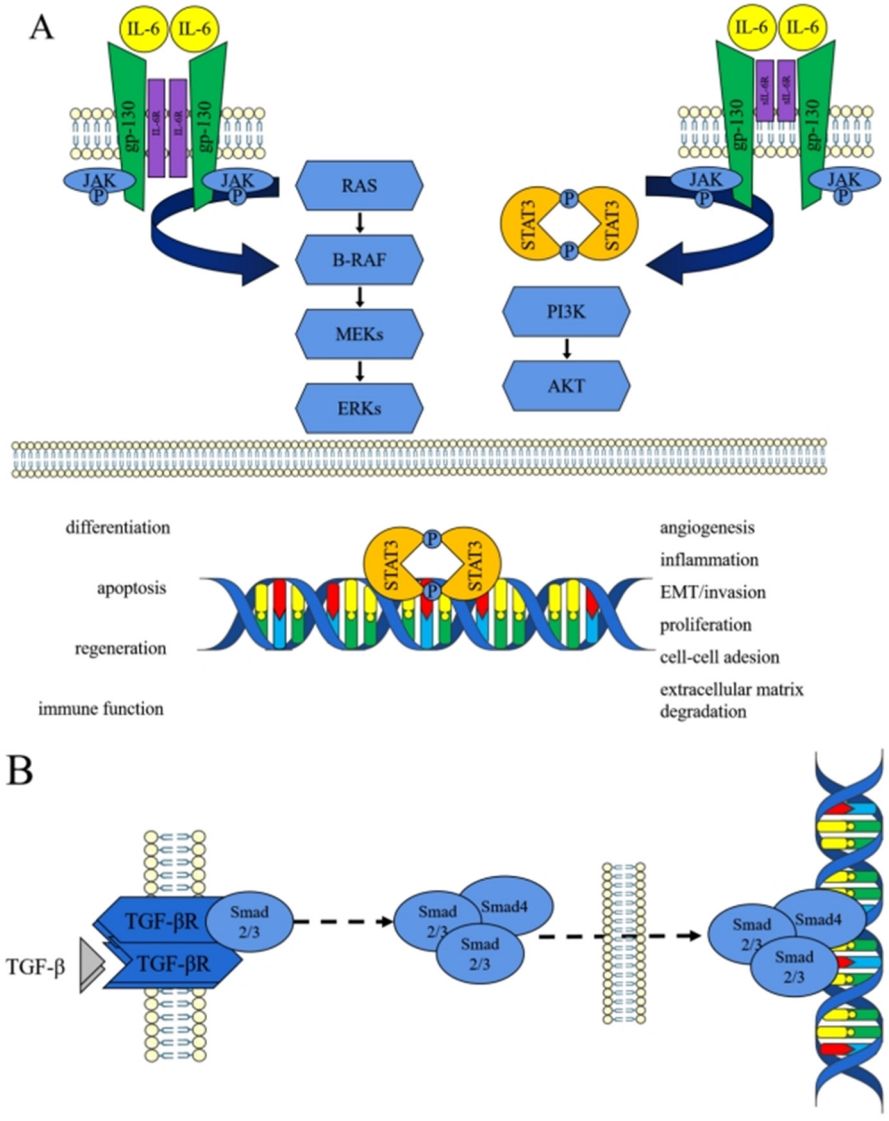

Fig 4. Inflammatory factor signaling pathways: (A) IL-6 signaling pathways; (B) TGF-β signaling pathways.

The expression of histamine, IL-8, MPC-1, Ccl5 and RANTES were significantly reduced following treatment with RP solution. The study demonstrated that the RP solution had an inhibitory effect on cytokine-induced inflammation. Additionally, stigmastan-3,5-diene-7-one (ST) was isolated from the RP. Studies have shown that ST in RP has anti-inflammatory activity, and this activity is achieved by inhibiting the activation of NF-κB [43].

Phytophaemagglutinin (PHA) in RP can stimulate lymphocyte transformation in mice with SRBC-induced delayed type hypersensitivity (DTH) mice, thereby enhancing immune functions [44]. The PHA-stimulated lymphocyte transformation experiment involves using PHA to activate lymphocytes and transform them into lymphoblasts in mice after intramuscular injection. The lymphoblastic transformation rate is used as an indicator to assess the impact of the test drug on cellular immune function [45].

5.4 Liver Protection

The function of liver protection is divided into two categories. One example is liver disease caused by a high-fat diet and acute alcoholic liver injury. The polysaccharide of RP can enhance liver lipid metabolism, thereby achieving the goal of liver protection [46]. The second example is inhibiting liver fibrosis. In experiments where carbon tetrachloride injured hepatocytes, leading to lung fibrosis, the polysaccharide of RP significantly enhanced RP's ability to counter liver damage and reduced the level of toxins[23].

5.5 Kidney Protection

The kidney is a vital metabolic organ in the body. Kidney damage is primarily caused by impaired metabolism and the inability to remove toxins, some of which can lead to the overproduction of free radicals and result in kidney damage[23]. Studies have shown that the protective function of RP polysaccharide on liver and kidney injury in cadmium-poisoned mice may be associated with the antioxidant properties of the RP polysaccharide. By binding to replacing enzyme sulfhydryl groups, cadmium displaces intracellular enzyme metals, reduces the activity of antioxidant enzymes in the body, diminishes the body's ability to scavenge free radicals, and causes oxidative damage [47]. Glutathione (GSH) can eliminate free radicals in the body and safeguard the cell membranes of the liver and kidney [48]. RP polysaccharide exhibits strong antioxidant function and free radical scavenging functions. Experimental results demonstrated that RP polysaccharide can elevate the content of GSH and enhance the body's antioxidant capacity, thereby indirectly contributing to renal protective effects[49].

Another factor that affects kidney health is kidney stones. Calcium oxalate stones are the most common type of urinary stones. At present, the treatment of calcium oxalate stones is only at the surgical level. Due to the high recurrence rate of calcium oxalate stones, there is an urgent need for effective drugs to inhibit and prevent their formation. However, the human body lacks oxalate-degrading enzymes and cannot effectively break down excessive oxalate in the body. Once the oxalate content in the body increases, the risk of developing calcium oxalate stones also increase [50]. The extract of RP can enhance the excretion of calcium oxalate and inhibit the formation of stones, thereby reducing the risk of kidney stones [51].

5.6 Antitumor Function

Cancer is one of the major public health problems in the world [52]. The current reality continues to drive the reform and innovation of cancer treatment methods, with numerous examples of discovering anticancer drugs from traditional Chinese medicine.

The polysaccharide component of RP exhibits a strong inhibitory effect on tumors. Three types of polysaccharide components were isolated and purified from the polysaccharide sample of RP, namely R-PolyI, R-PolyII and R-PolyIII. The cytotoxicity experiment demonstrated that the three RP polysaccharide components exhibited strong inhibitory effects on Hela cells and B16 cells [28].

The study aimed to investigate the impact of RP polysaccharide on the cell activity of non-small cell lung cancer A549 cell line. The results indicated that the most effective condition for inhibiting the proliferation of A549 cells using RP polysaccharide was a concentration of 100 μg/mL after 48 hours, which demonstrated a significant inhibitory effect [53,54].

5.7 Promote the Glycolipid Metabolism

Diabetes is a metabolic disease that is seriously harms human health, mainly manifested as hyperglycemia due to insufficient insulin secretion and/or insulin resistance. Many studies have found that diabetes is closely associated with cancer, cardiovascular and cerebrovascular diseases, and has become one of the primary causes of human mortality. Although the medications used to lower blood sugar in clinical settings have certain therapeutic effects, most of them also have certain side functions. Therefore, the focus of attention has shifted to the development of natural active ingredients with high efficiency and low toxicity that can regulate blood sugar.

The diabetic mice induced by streptozocin (STZ) were fed by gavage with the ethanol extract of RP, and the alterations in kidney structure and the levels of monocyte chemoattractant protein-1 (MCP-1) and Transforming growth factor-β1 (TGF-β1) in kidney tissue were observed. The study revealed that the ethanol extract of RP has a renal protective function on STZ induced diabetes in mice, and its mechanism may be associated with the inhibition of MCP-1-TGF-β1 pathway [55]. In addition, the polysaccharide of RP can significantly regulate the abnormal glucose metabolism in diabetes mice and improve abnormal lipid metabolism caused by the disorder of blood glucose metabolism [56].

The ethanol extract of RP has been shown to increase the expression of glycogen synthase in the livers of STZ-induced diabetic mice and reduce the expression of GSK-3β. This reduction objectively decreases the likelihood of phosphorylation inactivation of glycogen synthase, increases the relative content of glycogen synthase, and enhances the synthesis of liver glycogen [57,58]. Additionally, it has a reparative effect on damaged islet cells, which can better promote the islets to exert their normal effect and reduce blood glucose levels [59]. Some experiments have also shown that trace elements can regulate glucose levels and indirectly affect glucose metabolism by regulating insulin function. In the condition of diabetes, there is a disorder in the metabolism of Cu^{2+}, Ca^{2+} and Fe^{2+}, and the alcohol extract of RP has a certain intervention effect on this [60].

The polysaccharides, flavonoids, steroids and other compounds contained in RP can significantly improve the metabolism of lipids, and can significantly reduce the levels of triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL) [20].

5.8 Antipyretic Action

Fever refers to an adaptive response induced by the body's temperature setting point moving up under the coordination of the immune system and nervous system. The mechanism involves the stimulation of pyrogen, which moves the central temperature setting point up [61]. It is typically assessed by changes in the levels of certain inflammatory factors. Fever also increases the production and release of inflammatory factors and prostaglandins in the body, leading to systemic inflammation and an elevated body temperature [62].

The experiment demonstrated that the RP aqueous extract acted on the heat control center of the hypothalamus, reducing the synthesis of prostaglandins by inhibiting the activity of cyclooxygenase. This mechanism achieves the function of lowering body temperature [62,63].

6. Clinical Application

6.1 Treating Colds

RP powder has excellent functions in preventing and treating colds. It works quickly, has a strong antipyretic function, and has almost no side functions. Fresh RP combined with mint leaves for tea can help treat patients with wind cold and sore throat.

6.2 Treating Bronchitis

In traditional Chinese medicine theory, bronchitis is considered a cough disease., RP can treat both acute and chronic bronchitis, as well as mixed, bacterial, and viral infections of bronchitis. RP's effectiveness in treating bronchitis has been widely recognized.

6.3 Treating Halitosis

Halitosis is mostly caused by a dry mouth, which is often the result of fever, injury to the salivary glands, or reduced saliva production. This can lead to tongue dryness and decreased saliva flow. RP has a cold property and a sweet taste, which can help clear heat and promote fluid production. The use of RP and rock sugar decoction can effectively treat halitosis.

6.4 Treatment of Acute and Chronic Hepatitis and Cholecystitis

RP has the function of clearing heat and dampness, removing jaundice, protecting the liver, reducing transaminase levels, clearing heat in the gallbladder, reducing inflammation, and promoting bile secretion. It has a beneficial effect in the treatment of acute and chronic hepatitis and cholecystitis.

6.5 Treatment of Acute Tonsillitis

Rhubarb combined with RP has excellent therapeutic effects on acute tonsillitis. The side effects included temporary diarrhea after taking the medicine. A few patients were accompanied by borborygmus and abdominal pain, which were relieved after defecation. No other adverse reactions were observed.

7. Conclusion and Prospect

As a commonly used traditional Chinese medicine in clinical practice, RP has demonstrated effective treatment for a variety of diseases. It is particularly essential in the combined treatment of respiratory diseases. RP is widely distributed around the world, with a low cost, low toxicity, and minimal side effects. The polysaccharide components in RP have a beneficial pharmacological function, providing antioxidant and liver protection effects. However, the functions of other active components are not yet well understood. Therefore, it is of great significance to study the systematic chemical composition and pharmacological research of RP. Through systematic research into its chemical composition, screening and tracking of pharmacological activity, the material basis of its effects is determined. This lays a foundation for quality control research of RP and further compound research.

Although RP has a long history of clinical application in ancient China, modern pharmacology is still needed to study its traditional uses, such as its antiemetic and diuretic effects. Finally, as a traditional medicinal and edible herb, RP has many uses, including medicine, food, cosmetics and more. It has significant clinical application value and research potential.

In summary, as the biological activity and clinical application of RP are studied in depth, and with the continuous development of medicine, food, health care products, cosmetics and other fields, RP will have greater utilization value and development space.

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