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Research progress on development and utilization of medicinal resources of Apocynum venetum L.

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Abstract: *Apocynum venetum L.* as a treasure of traditional Chinese medicine, has significant medicinal effects, combining the functions of calming the liver, calming the mind, dissipating heat, and diuresis. This article collects, organizes, and analyses various literature on Apocynum, including ancient Chinese herbal classics, pharmacopoeias, etc. It provides the latest and comprehensive review of the botany, chemical composition, traditional uses, pharmacological activity, and safety of Apocynum to evaluate its pharmacological uses, explore its therapeutic potential, and future research directions, in order to provide guidance for the development of the Apocynum industry.

1. Introduction

Apocynum venetum L. ,which has a variety of other names, such as wild hemp, safflower grass, flower wild tea, red hemp, tea plant, red willow tea, zelacquer tea, etc., belongs to the Apocynaceae family, which is a perennial erect herb or semi-shrub genus[1]. In 1952, Dong Zhengjun, a famous agricultural and forestry economist, first discovered *Apocynum venetum L.* in Lop Po region of Xinjiang Region, and then it was officially named as "Apocynum venetum"[2] by the scientific community. Apothecum apothecum is finely classified into two genera and three species: P*oacynum Baill* and *Apocynum L.* The three species are specifically *Apocynum venetum L.*, *Apocynum L. Poacynum pictum (Schrenk) Baill* and *Poacynum hendersonii (Hook.f.) Woodson*. At present, only *Poacynum hendersonii (Hook.f.) Woodson* and *Apocynum venetum L.* are widely used in the development field[3].

2. Biological characteristics and ecological value of Apocynum

Apocynum exhibits excellent environmental adaptability, light tolerance, drought tolerance, saline-alkali tolerance, and strong cold resistance. It is especially suitable for thriving in extreme ecology such as saline-alkali land and desert, showing its strong survival toughness[4]. Apocynum

has a distinctive root system. Its taproot is developed and strong, dark brown, and deeply sticks into the soil, reaching a depth of 0.5 to 3.0 meters. The stem is straight and upright, and the height of the plant is between 0.5 and 1.3 meters; The leaves are arranged uniquely, mainly opposite, occasionally near opposite or alternate, and show elliptical lanceola-shaped morphology. Inflorescence structure is rich, cyme terminal or axillary, calyx is divided into five split, corolla is bell-shaped, pink or lavender in color, emitting fragrance, the base is a tubular structure, containing bisexual flowers, stamens are five attached to the base of corolla tube. The fruit form is a follicle, growing in pairs, slender columnar, containing small seeds, the top of the seed is densely covered with white slender villous hair, the whole plant is rich in milk. The greening period is from late March to mid-April, the flowering period is from June to August, and the seeds mature in September. The annual growth cycle is about 180 days[5]. In addition, Apocynum seeds varied significantly across regions, with significant differences[6] in seed length, thickness, width, and size index, seed coat proportion, 1000-seed weight, and the length and number of seed appendages.

The double-layer epidermis of Apocynum leaves is covered with a palisade tissue, which effectively inhibits water loss. It has excellent plant characteristics, and has multiple abilities such as drought resistance, cold resistance, heat resistance, wind and sand fixation and salt and alkali resistance. Because of its high height, it is not easy to completely cover it by wind and sand, so it has advantages and more obvious effects than planting grass in ecological restoration. Compared with the high cost and complex management challenges associated with traditional forestation measures, Apocynum has the advantages of low cost, short growth cycle and high survival rate, which makes Apocynum an ideal ecological restoration plant. In the field of environmental protection, Apocynum can not only effectively conserve water and soil, reduce soil erosion, but also improve soil structure and improve soil quality. At the same time, it can help to prevent wind and sand fixation, reduce sand disasters, and have a positive regulatory effect[7] on local climate. The cold-tolerant and salt-tolerant characteristics of Apocynum have been used in the cultivation of excellent crops such as cotton. Some researchers[8,9] have innovated cross-species gene transfer attempts, and the DNA fragments of Apocynum were successfully introduced into Luxin No.6. After fine artificial preparation and strict screening, two new lines with excellent salt-alkali tolerance were finally bred. In addition, researchers[10,11] such as Shen Fafu and Liu Fengzhen also genetically improved cotton with Apocynum DNA and successfully bred a germplasm line with resistance to both Helicoverpa armigera and aphidi gossypium. This insect-resistant germplasm not only significantly shortened the survival period of the primary generation of Helicoverpa armigera, but also effectively hindered its growth and development, thereby greatly reducing the harm of helicoverpa armigera to cotton.

3. Geographical distribution of Apocynum

Apocynum exhibits a wide range of ecological adaptability and is commonly found in a variety of habitats, such as saline wasted-land, desert margin, river banks, alluvial plains, and surrounding reservoirs and lakes. Its growth habit closely conforms to the characteristics of warm temperate desert climate with drought, hot, and sufficient sunshine, and shows excellent drought, saline-alkali, cold, and high temperature tolerance. Based on these characteristics and the specific environmental and resource conditions in each region, Zhang Shaowu[12] and other scholars have conducted in-depth analysis and carefully divided the natural distribution of Apocynum in China into three regions.

(1) The arid distribution areas of white flax and kenaf in northwest China

This geographic division is clearly defined in the west of the Wushaoling Mountains and the west of the Helan Mountains. It covers the Hexi Corridor area of Gansu Province, the vast western

territory of the Inner Mongolia Autonomous Region, the core area of the Tarim Basin of the Xinjiang Uygur Autonomous Region and some specific areas in northern Xinjiang, and also includes the Qaidam Basin in Qinghai Province and other key geographical units. In this region, the annual precipitation is generally scarce and generally lower than the critical value of 250 mm. This region is a typical arid climate region. Under this special environment, the white hemp population forms a wide continuous distribution zone, while the kenaf population only shows a sparse and isolated distribution in the local microenvironment.

(2) Semi-arid distribution area of kenaf in the north

It is distributed in the north of the Daxing 'anling → Tongliao → Yulin → Lanzhou line, with annual precipitation of about 400 mm. In this area, the main crop is red hemp, with only a small amount of white hemp.

(3) The semi-humid and humid distribution areas of kenaf in coastal and inland areas

This area is mainly in the eastern coastal areas, including the north of the Qinling Mountains, the northern coast of Jiangsu Province, most of Shandong province and Beijing and Tianjin cities, etc., and the distribution area is all kenaf. It was originally distributed in large areas and grew luxurily. Due to the construction of industrial transportation and farmland development in recent years, it has been destroyed, the area of many places has been greatly reduced, and some areas have even gradually disappeared.

Due to its excellent ecological adaptability, Apocynum has been widely distributed across the temperate and cold temperate ecological zones of the northern Hemisphere, and its natural distribution has been recorded in the hinterland of Central Asia, the edge of the Mediterranean Sea, the Mongolian Plateau, the Iranian Plateau and the whole of China, among which China is the country with the most concentrated distribution.

4. The appellation and investigation of Apocynum in ancient Chinese Medicine

The name "Luobu ma" originates from Dong Zhengjun's first scientific recognition of a plant with excellent fiber characteristics in Xinjiang in 1952, in view of its lush growth in Lop Nur region. In the inland areas of our country, this plant refers to Apocynum in particular, and its regional nomenclature is diverse, reflecting the rich differences in regional culture and ecological cognition. Specifically, in northern Jiangsu, northern Anhui, western Shandong and Eastern Henan, it is commonly known as "Zeqi" kenaf. In the southern part of Hebei and the coastal area of Shandong province, it is named as tea. Shanxi and northern Shaanxi are called tea flowers; And in Shaanxi Guanzhong, it is also affectionately known as wild tea, red root grass or red flower grass. It is worth noting that in Xinjiang, Gansu Hexi Corridor and Ningxia and other regions, both Han and Hui residents refer to "Luobu ma" and "Luobu Bai ma" as wild ma. In the academic work Comprehensive Utilization of Apocynum, an important discovery is described in detail, that is, the initial record of Apocynum can be traced back to the ancient book "Rescue Materia Medica", specifically under the item "Zeqi". Through careful comparison of the morphological characteristics of the drawings in the book and the Apocynum, it is found that the two are highly similar. Therefore, it is confirmed conclusively that the historical title of Apocynum in ancient literature is "Zeqi"[13].

The origin of the word "Ze qi" can be traced back to the classic medical book Shennong Bencao Jing (Shennong's Classic of Materia Medica), which has relevant records. Furthermore, in the historical document Hua Tuo Liezhuan (Annals of the Three States: The Biographies of Hua Tuo), it is mentioned that Ze qi was left behind by Hua Tuo for prolonging life, which may contain some components or ideas related to Ze Qi. In addition, in the Book of the Later Han Dynasty, Ze Qi was also given the name of Qi leaf, also known as Ze qi ma. In addition, in the Later Han Shu, Ze Qi was given the name of Qi ye, which was also called Ze Qi Ma. The characteristics of Ze Qi and Qi

ye mentioned in the books of Life-saving Bencao, Puji Fang, Zheng lei Bencao, Liang Tao Hongjing's Mingyi Bie Lu, Ji Zhu of Bencao Jing, Su Gong's Xin Xiu Bencao, Cui shi Qi Yao Fang, Tujing Bencao, Rihuazi, Bencao Tujing, Bencao Gang mu Shiyi in the Tang Dynasty were all the same as those of Apocynum. There are significant differences between the "Zeqi" referred to at present and the entity described in ancient books. Specifically, the "Zeqi" mentioned in many medical classics, such as ancient medical books, actually refers to the plant species of Apocynum, rather than euphorbia seedlings in general cognition. A detailed examination of ancient literature shows that in classic works such as Tujuku Bencao (Materia Medica) and Treasure Trove on (On the Treasure), the term "ze qi" was mistakenly identified with "maoeryan", which highlights the complexity and ambiguity of plant naming and classification before the Ming Dynasty, especially the confusion of the boundary between "ze qi" and Apocynum and euphorbia. Further analysis finds that further analysis found that the pharmacological properties of Euphorbia daesulfides and "Zeqi" are completely different from those of Apocynum root and Apocynum leaf. The stems and leaves of Maoeryan plant contain toxicity, which clearly indicates that it cannot be used as a drug[14] for long-term or daily use.

Ancient people had a rough understanding of plants, and their names were often confused, so that Apocynum was excluded from medicinal use. Until the 1960s and 1970s, based on the widespread practice of using Apocynum tea to alleviate vertigo, and the in-depth clinical trial results of its leaves in the treatment of hypertension and neurosis, Apocynum leaf was included in the Chinese Pharmacopoeia for the first time in 1977, which marked the official authority of the medicinal efficacy of this plant confirmed and officially promoted.

5. Use of Apocynum in traditional Chinese medicine and modern indications

5.1. Use of Apocynum in traditional Chinese medicine

Apocynum, as a traditional medicinal material, is a treasure of traditional Chinese medicine and Uygur medicine, and its application history has a long history. Zhu Di, the Emperor Taizu of the Ming Dynasty, wrote in his book for Saving Famine Bencao (, Materia Medica for Saving Famine). Under the heading of Ze lacquer, it is unique to record its use for "saving hunger": "Picking leaves and young stems, frying them, soaking them in water, washing them with oil and salt for food preparation, and picking young leaves, stewing them and drying them in the sun for tea". In the ancient book Huatuo Lianzhuan (Annals of The Three Kingdoms), there is a detailed record that taking something for a long time can drive out the three worms in the body, adjust the five zang organs, and make the body light and not white, showing the wonderful health. In addition, another esteemed medical text, the Cui Shi Qiyao Fang, explicitly delineates the therapeutic applications of 'qī yè,' indicating its efficacy in alleviating conditions such as water retention and abdominal distension, dyspnea, cough, and urinary difficulties characterized by thick and red urine. Tujing Bencao (, Illustration Classics of Materia Medica) elaborates on the medicinal properties of Zeqi leaves, focusing on the symptoms of water swelling, wheezing, coughing, shortness of breath, and hematuria. Zhao Xue-min's Bencao Gongmu Shiyi (Compendium of Materia Medica) eulosed "Zeqi leaf" as "promoting water and eliminating disease as gods. When the elderly cough and spit, cough will stop and phlegm will also be eliminated". It can be traced back to the Ming Yi Bielu (bielu of the Ming Dynasty) of the Wei period of The Three Kingdoms, which recorded the method of wrapping Apocynum leaves in infant to treat feeling or shortness of breath, highlighting its natural power to heal diseases without medicine and its strangeness of self-healing. According to the Compendium of Materia Medica (Compendium of Materia Medica), this herb can help to relieve diuresis and dampness[15]. The Pharmacopoeia[16] of the People's Republic of China has an authoritative record that Apocynum effects cover "clearing heat and water, calming the liver and

calming the mind, and treating hypertension, vertigo, palpitation, insomnia, dyslipidemia, neurasthenia, and relieving edema and oliguria". In the Illustrated Guide[17] to Chinese Medicinal Plants, Apocynum leaves are summarized as follows: "The tender leaves are steamed, fried and tanned, and then turned into tea drink, which has the remarkable effect of refreshing and reducing fire, preventing dizziness and strengthening the heart." Shaanxi Chinese Herbal Medicine detailed that Apocynum[18] leaf "has the characteristics of refreshing and cooling, reducing fire and diuresis, strengthening heart and lowering blood pressure, and specially treating heart diseases, hypertension, neurasthenia, nephritis and edema".

Apocynum is more popular in traditional Uygur medicine, especially in Lop Nur region of Xinjiang, China. Uyghur Materia Medica recorded that Apocynum has the properties[19] of clearing heat, cooling blood, diuresis, relieving dryness, anti-inflammation, swelling and relieving anxiety. The formula composed of Apocynum leaves (9 g), celery seeds (6 g), sea buckthorn fruit (4.5 g), saphenous wood (4.5 g), chamomile (3 g) and adiantum (3 g) can be used to cure hypertension, dizziness and neuralgia; Another recommended formula consisting mainly of Apocynum leaf, grape and pronged sugar is thought to be useful for treating inflammation, swelling and hepatitis, although the pharmacological rationale for these indications needs further demonstration, of course.

In particular, its roots are rich in cardiac glycosides, phenolic compounds, steroids and triterpenoids. The synergistic effects of these components have shown significant antihypertensive and lipid-lowering effects, heart rhythm regulation, vertigo relief, anti-inflammatory and cough relief, enhancement of myocardial function, promotion of diuresis, and inhibition of allergic reactions. The stems and flowers also contain cardiac glycosides, phenols and flavonoids, which together give them significant value in the field of treatment and health care.

5.2. The health care function of Apocynum Fiber in Chinese medicine

The increasing demand for natural fibers such as cotton and ramie in the textile industry has driven the development of alternative sources, and Apocynum fiber is one of the options[20]. The fiber is mainly in the stem, and to strengthen the fiber, the leaves of Apocynum are usually removed in summer to allow the stem to develop, and Apocynum is biodegradable and therefore environmentally friendly and has good application prospects. As a unique phloem fiber, its structure is deeply hidden in the phloem tissue layer of the stem. The fiber is famous for its slender and shiny characteristics, showing a loose fiber bundle morphology. The length of Apocynum fiber shows significant variability, and its range is widely distributed between 10 and 40 mm. While the average length of Apocynum fiber is stable in the range of 20-25 mm [21]. Fabrics made from Apocynum fiber can emit infrared rays with a wavelength of about 8-15um and effectively resist ultraviolet rays, making it the preferred fiber for underwear in the textile industry. Apocynum is known as the "king of wild fibers" because of its great potential[22]. Apocynum fabric has been reported to help with hypertension and coronary heart disease, and has antibacterial effects. It has a certain relieving and stabilizing effect[23,24] on arthralgia, hypertension, periarthritis of shoulder and fatigue. Apocynum fiber, as a kind of fiber material with pharmacological properties, is deeply rooted in the theoretical framework of "internal disease and external treatment" in traditional Chinese medicine. According to this concept, Apocynum fiber is finely blended with other fiber materials, which plays a certain therapeutic role[25-28] through the absorption of drugs by the human body after wearing. Textiles made from its fibers absorb more ultraviolet rays, keep warm and have higher air permeability, so they are usually blended with cotton or chemical fibers[29-33] at a ratio of 35 to 65 percent, respectively.

5.3. Other TCM health effects of Apocynum

Apocynum shows rich edible potential and wide application value. As a raw material of health food, such as Apocynum flavored cigarettes, fresh drinks, characteristic chocolate and health chewing gum, it has won the favor and praise[34-36] of consumers. Apocynum can also be used to make tea. Its tea drinks not only have significant effects of clearing heat and fire and relieving dizziness, but also show a comprehensive health care effect of calming the mind, promoting sleep, strengthening diuretic function and strengthening the constitution.[37,38] The smoke containing 30% Apocynum leaves can reduce nicotine content and reduce tracheitis[39–42] caused by smoking. Through the precise matching of Apocynum leaf and tobacco, the " Apocynum new tobacco" is created, which effectively reduces the release of nicotine and other harmful substances, retains the soothing characteristics of tobacco, and gives it the health function of relieving asthma and cough, eliminating phlegm and moistening lung, regulating blood lipids, stabilizing blood pressure and enhancing coronary blood flow, and achieving the double effect[43] of reducing damage and enhancing.

Apocynum is a high-quality honey plant with a long flowering period and a large amount of flowers. Its fragrances and fragrances give birth to the nectar of Apocynum. It is rich in pharmacological essence such as flavonoid glycosides, cardiac glycosides, amino acids and multiple organic acids, and integrates vitamins, enzymes, glucose, fructose and natural aromatic factors to become a good choice for medical and food homologous products. It makes the medicinal value more easy to be absorbed and transformed[44–46] by the human body.

Apocynum can also be used as feed for cattle and sheep. When it is green again in late April, the leaves and young stems are the forage grasses preferred by horses, cattle, sheep and other livestock. In summer, there is white milk in the leaves and stems of Apocynum. The results showed that the dietary admixture of 10% Apocynum could significantly promote the weight gain of Tan sheep, reduce the content of triglyceride and total cholesterol in serum, improve the meat quality, and make it healthier[47–49] to eat.

6. Modern medical research and indications of Apocynum

Apocynum leaves are rich in flavonoids, tannins, acids, alkanes, fatty acid esters, alcohols and other chemical components, showing a wide range of pharmacological[50,51] activities. Modern studies have revealed its multiple health benefits[52,53], such as lowering blood pressure, regulating blood lipids, anticoughing and expectorant, diuretic and anti-inflammatory, sleeping and sedative, antidepressant, immune strengthening, anti-aging and antibacterial. Apocynum leaf contains key active ingredients, represented by flavonoids (flavonoids, flavonols) and glycosides (quercetin, isoquercettin, hyperoside, astragalin), which are closely related[54,55] to clinical efficacy. Apocynin A-D are four new phenylpropy[56]l glycosides isolated from Apocynin leaves, while apocynin I and II are two new violaceoside glycoside compound [57]sides refined from processed apocynin leaves. Apocynin leaves are rich in minerals and ash elements, including relatively high levels of sodium (6mg/g), magnesium (5mg/g), calcium (1mg/g) and iron (0.2mg/g), manganese (0.5mg/g), potassium (0.08mg/g) and copper (0.03mg/g), and aluminum (0.0002mg/g[58],These contents vary slightly depending on harvest season, planting environment, etc.

Apocynum extract has been verified by many studies to have significant cholesterol-lowering and antihypertensive effects. Their neuroleptic effects, including sedative, antidepressant and anxiolytic effects, have been studied in animal models, and their activities may be due to the synergistic[59] effects of antioxidant, free radical scavenging and diuretic mechanisms. The antihypertensive efficacy of Apocynum extract has been verified in multiple rat models, and the underlying mechanisms are clear. Long-term treatment with Apocynum extract (70mg/ rat, at least

40 days) was observed to reduce[60] blood pressure in spontaneously hypertensive, nephrectomized and salt-sensitive hypertensive rats. An in vitro study showed that at a concentration of 1mg/mL, ethanol extract of Apocynum had an effect[61] on increasing the pulse and contractility of isolated guinea pig atria. Existing literature has shown that the hepatoprotective effect of Apocynum is due to the free radical scavenging[62] activity of flavonoids, and there may be a variety of effective mechanisms, such as antihypertensive effect and improvement of insulin allergy, which may be due to the hepatoprotective effect[63-65] of Apocynum. Several data have shown that Apocynum can inhibit the formation of free radicals, protect the exogenous antioxidants in low-density lipoprotein, and inhibit the formation of advanced glycation end products, thereby providing protection[66–68] against many cardiovascular diseases. A randomized, double-blind, parallel-group study showed that Apocynin leaf extract showed significant improvement in 47 patients with mild depression after 8 weeks of treatment, indicating the potential therapeutic[69] effect of apocynin on patients with mild depression. The potential anti-anxiety[70-72] effect of Apocynum extract was demonstrated in mice treated with Apocynum ethanol extract. In addition, Apocynum leaf extract by oral administration, abdominal injection and the combination of the two can prolong the average survival time of the animals, increase the survival rate and increase the white blood cell count. It is suggested that Apocynum leaf has a certain degree of anti-radiation effect and anti-radiation effect[73-76].

In recent years, Apocynum has attracted more and more attention. Many studies have confirmed the traditional use of Apocynum from the aspects of chemical composition and pharmacological action. In recent years, efforts have been made in China to develop the therapeutic application of oral formulations containing Apocynum leaf powder and other herbs such as wild chrysanthemum and Rhizome vermicularis, and the combination of the two is a promising antihypertensive formulation[77-80]. Up to now, Apocynum related drugs that have received regulatory approval and officially circulated in the market cover Apocynum tea, Apocynum antihypertensive tablets, etc.[81-86].

7. Constraints and suggestions for the development of Apocynum pharmaceutical industry

7.1. Toxic and side effects of Apocynum

Apocynum belongs to the Apocynum family and has certain toxicity. There are few reports on the systemic toxicity and safety evaluation of Apocynum. Some researchers have systematically carried out the comprehensive assessment of acute, subacute and chronic toxicity of commercial Apocynum tea. It is believed that the 50% lethal dose of acute oral toxicity of Apocynum tea is greater than 10g/kg[87,88].At the same time, based on the pooled analysis of multiple clinical studies, it was confirmed that patients with depression could take 50 mg Apocynum a leaf extract daily as part of their daily treatment regimen from 2 weeks to 3.5 years without any side[89–91] effects. One case of Apocynum tea induced hypoglycemia and one[92] case of photosensitive drug eruption[93] caused by compound Apocynum tablets have been reported. Further toxicological research and expansion of clinical trials are necessary to comprehensively evaluate the potential and value of Apocynum as a new treatment for nervous system diseases.

The research on drug interactions of apocynin is still limited and needs to be further studied. A Japanese study concluded that single or multiple doses of 3.3mg/kg apocynin extract showed that apocynin does not induce changes in commonly used drugs (CYP3A4) and P-glycoprotein, indicating that the possibility of adverse drug interactions of apocynin is limited, but further studies[94] are needed.

7.2. Active ingredients of Apocynum

The discovery that the leaves, roots, stems, flowers and other tissues of Apocynum are rich in diverse functional active ingredients has greatly enhanced its potential application value in the fields of medicine and healthcare, and has attracted wide public attention. However, the current understanding of the specific structure and content of these active substances among materials, tissue specificity, and differences in growth and development stages is still patchy and insufficient. However, there is still a lack of systematic and in-depth exploration on how to optimize the extraction process to maximize the recovery and purity of the active ingredients, as well as the specific mechanism and pathway of these ingredients in biological systems. The quality control and evaluation system for Apocynum-based health products is not yet perfect, and there is a lack of unified and scientific detection standards and methods.

7.3. There are no medicine-specific varieties

At present, most Apocynum resources are retained in their native wild environment, and few cultivars have been deeply selected and optimized. This situation seriously restricts the possibility of large-scale artificial planting of Apocynum as an agricultural crop, and then affects the reliability and sustainability of raw material supply. The application of mechanization and automation technology is still in its infancy, with low efficiency and high cost. It not only fails to give full play to the advantages of modern agricultural technology, but also becomes a bottleneck problem hindering the efficient development of Apocynum industry. In addition, white flax and kenaf are mixed in the market, and the varieties and qualities of medicinal Apocynum flax are quite different. At present, there are “Ge bao” flax series used for Apocynum tea processing, and “Boxinumu” flax series used for Apocynum fiber processing, but the medical-specific varieties or genotypes have not been found.

7.4. Recommendations

It is recommended to further study the biochemical and physiological mechanisms of Apocynum, especially its cardioprotective, liver-protective and neuroprotective effects, determine the mode of action, biological pharmacodynamic scale, drug (metabolic) kinetics and physiological pathways of specific functional compounds in Apocynum, conduct safety verification and clinical trials, and strive to be widely used in medical practice as soon as possible.

Additionally, we can start from the connection hub between breeding and processing, evaluate superior Apocynum genetic resources and cultivate varieties (raw materials), select and breed superior Apocynum types specifically for medical and healthcare purposes, utilize the rich Apocynum genetic resources to fully utilize the resources, make genetic breeding and improvement more targeted, and widely used in medical and healthcare [95].

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