Modern Research Progress of Jujube Leaves

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Abstract. Jujube is a unique tree species native to China. It has strong adaptability and can grow in drought, sand and alkali. It is cultivated throughout the country and is mainly produced in Henan, Hebei, Shandong, and Shaanxi. Jujube leaves are extremely rich in chemical composition and have significant medicinal value. Through consulting the relevant data in recent years, the chemical substances in jujube leaves have been summarized and analyzed, their pharmacological mechanisms have been deeply discussed, and the application of jujube leaves in medical and health care has been explored, providing theoretical basis for the clinical application, new drug development and comprehensive utilization of jujube leaves.

Jujube cultivation throughout the country, and large production. The study of jujube mostly tends to its fruit, jujube fruit has a high value of food and medicinal, has received widespread attention. In contrast, the study of jujube leaves is very rare. According to reports, jujube leaves are rich in flavonoids, triterpenoids and minerals, vitamins, proteins, carbohydrates, amino acids, etc., and their nutritional value and medicinal value are very high. Jujube leaf as a rich potential resource has been buried by people for many years. According to statistics, the average annual output of jujube leaves per acre of jujube is 200kg. However, such rich natural resources are abandoned after the jujube has matured every year, resulting in a serious waste of resources.

Chemical Composition

Flavonoids

Flavonoids \cite{1} compounds are the main chemical constituents in jujube leaves. According to the literature, rutin and quercetin are flavonoids that have been identified in jujube leaves. The content of rutin is relatively high and it is the main component of flavonoids, other flavonoids include naringin, scutellarin, hesperidin, etc.

Triterpenoids \cite{2,3}

Among them, the highest content of oleanolic acid, betulinic acid and ursolic acid, the three compounds of saponin I-VI, ziziphus saponin I-III, and jujube saponin B are the teramarene type triterpene glucoside. There are also jujubasaponins and ziziphin saponins. Most
triterpenoids have good biological activity, such as anti-cancer, anti-diabetic, anti-inflammatory, anti-oxidation and so on.

**Mineral Elements**[^4]

The mineral elements in jujube leaves mainly include K, Ca, Mg, Na, Mn, Cu, Fe, and Zn, among which the contents of K, Ca and Mg are high.

**Vitamins**

The content of Vc in jujube leaves is very rich. The relevant research records that the content of Vc per 100g of fresh jujube leaves can reach 300-500mg, which is many times higher than the content of Vc in some fruits that are more common in life, in addition to vitamin B1. Vitamin B2 etc.

**Amino Acid**

There are many kinds of amino acids in jujube leaves, such as: aspartic acid, threonine, serine, glutamic acid, glycine, alanine, valine, isoleucine, phenylalanine, lysine Acid, arginine, proline, etc.

**Other Ingredients**

Methylheptenone, 4,-dimethylpyrimidine, 6-methyl-3,-pentadien-2-one, 2-ethyl-5-methylpyrazine, 2, -dimethyl Chitothole, these substances are the main aroma components in jujube leaves[^5]. The aroma components in jujube leaves are mostly alcohols, esters, ketones, alkanes, and heterocyclic compounds, and are mainly heterocyclic and ketones. As much as half of the aroma components of the leaves, the jujube leaves also contain chemical components such as proteins and fats.

**Pharmacological Effects**

**Reduce Myocardial Oxygen Consumption**[^6]

The vanillic acid metabolites released from the acid methylation of jujube leaf protocatechus can bind to coenzyme A and partially block the mitochondrial coenzyme A, which to some extent impedes the oxidation of fatty acids, promotes the normal operation of cardiac myocytes and protects the heart. Protocatechol protects the heart by lowering the heart rate and reducing the oxygen consumption of cardiomyocytes.

**Anti-Aging**

Zhou Xinping et al.[^7] and others have shown that flavonoids in jujube leaves can significantly increase the activity of antioxidant enzymes such as superoxide dismutase in aging mice. The mechanism may be related to the removal of harmful substances released by injured cells in the body and the removal of oxygen free radicals. The ability related to, to a certain extent, inhibited the loss of trace elements in aging animals and the decline of nervous system, endocrine system function, has a significant effect on the aging model of mice induced by D-galactose.
Calm and Hypnosis

The study found that the total flavonoids of jujube leaves can significantly reduce the latency of mice to sleep, significantly prolong the sleep time of mice, inhibit the behavior of mice, showing a significant sedative and hypnotic effect. [8]

Anti-oxidation

Since flavonoids contain phenolic hydroxyl groups in the molecular structure, they are usually oxidized during the reaction process and belong to reducing compounds. Therefore, they have a certain degree of antioxidant activity [9]. In addition to flavonoids, polysaccharides and vitamins in jujube leaves still have antioxidant capacity. Polysaccharides can eliminate free radicals and inhibit lipid peroxidation. Vitamin C also has strong ability to scavenge free radicals.

Clinical Application

Jujube leaf medicine has a long history in China, “Doctors do not record”: hot acne; “Japan Hanako Materia Medica”: governance children's heat, Jiantang bath. And Gefen Zizijia and the treatment of tumors; “Bencao Quyuan”: Wash, sputum, sputum, rotten feet, knot poison, Zhizhi pasteurization; “Shen Nong Ben Cao Jing”: Jujube leaves covered with ephedra can make sweating; “Tang Materia Medica”: “Do not record” Say, Jujube leaves loose clothes to make people vomit; After treatment of childhood gas, the heat does not break: Take jujube leaves, ephedra, light blue, fragrant drums, accompanied by boy urination, fry five minutes, discard the residue, three or four times a day. Fire burning sores: Jujube leaves and chrysanthemums are decocted with water and scrubbed with swine bile water; Treatment of fever and pruritus: Take one liter of jujube leaf, one good tale, two or two, add a few bowls of water, and cook the time of the three musks.

The Health Effects of Jujube Leaves

Flavonoids are the main components of jujube leaves, due to the flavonoids in the cardiovascular system, digestive system, immune system, liver and kidney protection, anticoagulant, analgesic, anti-inflammatory, antioxidant [10,11], anti-aging, Anti-tumor, prevention and treatment of osteoporosis and other important contributions, for many years the study of jujube leaf flavonoids is on the rise. Jujube leaf is known as “Oriental Sleeping Leaf” [12]. As a medicine and food homologous product, it has attracted much attention in recent years. Jujube leaf tea not only calms the nerves, eliminates irritability, but also has good curative effect on the prevention and treatment of hypertension. Leaf tea also has a good alleviating effect on insomnia, headaches and other symptoms caused by high blood pressure. Proper drinking can improve sleep quality. The rich content of Vc in jujube leaves can improve the body's immunity against cancer cells, and it also contributes to the fatty acid and promotes the elimination of cholesterol from the body. And as the main chemical constituents of jujube leaves, flavonoids have good curative effect on prevention and treatment of arteriosclerosis and coronary heart disease. Therefore, jujube leaf tea has great development and utilization value as a nutrient, medical care and health care product.
The Application of Jujube Leaf in Food and Animal Husbandry

Tamarind type triterpene glucoside in jujube leaves has an acyl functional group structure, which has a significant sweet inhibition effect [13,14]. It can not only inhibit the sweetness produced by glucose, fructose, glycine, sodium saccharin, aspartame, naringin, and dihydrochalcone, but also has a certain antiseptic effect. This natural pollution-free sweetness inhibitor and preservatives also greatly extend the shelf life of foods while solving the uncomfortable feeling caused by the sweetness of desserts. The content of protein and fat in jujube leaves is relatively high, and the crude protein content can be as high as 20%. In the history of our country, jujube leaves have been used to feed livestock instead of fodder. The jujube leaves are crushed and mixed in feed to feed livestock, especially it is a sheep that can not only promote the rapid growth and development of sheep, but also increase the productivity.

Outlook [15-17]

Jujube leaves contain various chemical components such as wax alcohol, protopine and berberine, which are mild and non-toxic, have certain anesthetic effects, and have the effects of detoxification, swelling, and pain relief. With the continuous breakthrough in the study of jujube leaves, many chemical components in jujube leaves have been gradually excavated. So far, research on jujube leaves has achieved good results. Flavonoids are abundant, and they have long been the main components of jujube leaves. Focus and focus on its extraction process and antioxidant activity. In recent years, cancer and aging have become a worldwide problem. Studies have shown that cancer and aging are closely related to the production of excessive free radicals in the body, and flavonoids can effectively remove excessive free radicals in the body. The stronger the body's antioxidant capacity, the body is healthier. In addition, vitamin C in jujube leaves is also an important antioxidant in the body. However, there is no relevant report on jujube leaf in cosmetics. Women pursue a young and beautiful fashion, and the rich antioxidant ingredients in jujube leaves must have a very broad application market if they are incorporated into cosmetics. It is a worthy research direction.

The detailed records of the pharmacological action and clinical application in the records of jujube leaves are few. The nutritional value and medicinal value of jujube leaves are very high. They have been achieved in jujube leaf tea, jujube leaf feed and food additives and can be used as medicines. Food homologous. However, the study of jujube leaf in health wine has not been reported. At the same time, jujube leaf as a green plant, which must contain a lot of pigment, many of the pigment additives in the food industry today are synthesized by chemical substances, seriously threatening human health, natural pollution of jujube leaves. The plant pigments have a wide range of uses both in the food industry and industrial production, but there is no record of the extraction and utilization of pigments in jujube leaves. There are many chemical compositions in jujube leaves, but the extraction techniques of various chemical components in jujube leaves are not very mature, and there are problems such as complicated extraction process and low extraction rate. There are still many unknown components in jujube leaves that have not yet been discovered by people. They are waiting for researchers to explore further, explore the mechanism of their pharmacological effects, explore ideas for the development of new drugs, and provide reliable theoretical basis for clinical drug use.
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