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The Potential of Traditional Chinese Medicine in Cancer Treatment: Taking Astragalus as an Example

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Abstract:

This article aims to explore the potential and application prospects of Astragalus membranaceus (AM), a traditional Chinese medicine (TCM), in anti-tumor therapy. In recent years, the incidence rate of cancer has continued to rise, with high mortality rates for malignant tumors such as pancreatic cancer. Astragalus, as a traditional medicinal herb for nourishing qi and supporting vital energy, has been found to contain various active ingredients such as polysaccharides, astragaloside IV, and flavonoids, which exhibit direct or indirect anti-tumor effects. Through an analysis of existing research, this article points out that astragalus polysaccharides can interfere with the tumor cell cycle and inhibit proliferation, astragaloside IV can inhibit epithelial-mesenchymal transition (EMT) to block metastasis, and flavonoids alleviate oxidative stress through antioxidation. Additionally, astragalus can protect bone marrow mesenchymal stem cells from radiation damage, reverse paclitaxel resistance in breast cancer, enhance the efficacy of chemotherapy, and maintain good safety. Despite societal skepticism about the efficacy of botanical drugs, scientific evidence demonstrates that astragalus has significant value in assisting radiotherapy and chemotherapy and improving patients' quality of life. Future clinical research is needed to verify its efficacy in humans and optimize medication regimens, promoting astragalus to become an important adjuvant in the integrated treatment of tumors with traditional Chinese and Western medicine.

Keywords: traditional Chinese medicine; astragalus membranaceus; active ingredients.

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1. Introduction

Nowadays, more and more people are struggling with cancer. For example, in America, there were about 1.8 million people who got cancer in 2022, and there's one decedent per 3.74 people. Especially pancreatic cancer, with 60 thousand patients per year and approximately 65% mortality [1]. In that case, some traditional Chinese medicines (TCMs) have been considered as a type of solution against some cancers. Astragalus membranaceus (AM), as an ancient but prestigious herb, which has been used and prescribed for useful purposes by the traditional Chinese doctor, is one of them. Its dry root has been considered an important Qi-invigorating herb, and mainly used as a solution for diarrhea, weakness after a serious illness, and abscesses [2]. Nowadays, scientists have discovered that there are many biologically active ingredients, such as Astragalus polysaccharide (APS), Astragaloside, and some other flavonoids. They can improve the cardiovascular function, decrease the damage caused by oxidative action, and the most important and most useful function of them is that they can exhibit antitumor activity, both directly and indirectly. But since these cures are all plant-based, they have been widely questioned by society about the efficacy of this type of medication. As a result, most people will prefer Western medicine (WM) when cancer occurs. According to research, the main factor that influences elders to choose Chinese medicine is that they do not have a full understanding of the technology used in TCM. Also, the opposite thinks that the Chinese medication's efficacy is not that effective, or it is just way too slow to influence the symptoms [3].

Recently, scientists have done some experiments on mice, which reflected that AM may have some use in liver cancer [4]. The discovery of how this type of traditional herb can be used in the fight against human cancer and what advantages it has is very meaningful for overcoming cancer and the integration of TCM and WM.

2. The Composition Basis of AM

2.1 Analysis of Active Ingredients

2.1.1 APS

APS is a chemical which was been proven to suppress the cancer cells' proliferation. In one review, Yang et al. pointed out that APS can decelerate the cancer cell's proliferation by influencing the abnormal regulation of the cell proliferation cycle caused by the cancer cell [5]. Since this cycle is a main reason that causes the cell's mutation to the cancer cell, as a result, it has the possibility of preventing the spread of the cancer when advanced cancer happens [6].

2.1.2 Astragaloside

Astragaloside is a group of chemicals which used in modern Chinese medicine and health care products frequently. However, it can also be used to suppress the process of metastasis of cancer. EMT is the main process that directly causes the spread of the cancer. During that process, abnormal tissue can become aggressive and break out into the circulatory system. But, studies reflected that it can prevent the EMT from happening both in normal and abnormal cells [6]. In one study, researchers proved that astragaloside is capable of attenuating HG-induced EMT by inhibiting the TGF-β1 and Smad pathway in renal PTCs [7].

2.2 Analysis of Other Ingredients

Besides those specific ingredients used in cancer curing, AM also has other ingredients that are common to medicine.

Flavonoid compounds, as compounds found in many TCMs, have been proven by the scientific community to have significant antioxidant and anti-aging effects. According to research, flavonoids in AM can also inhibit glutamate-induced damage to PC12 neuronal cells by increasing the activity of antioxidant enzymes such as superoxide dismutase and glutathione peroxidase. In addition, it also exhibits activity in scavenging 1,1-diphenyl-2-trinitrochalcone free radicals. In the atherosclerotic model caused by diet, it significantly reduces the cholesterol level in plasma, reduces the fat in the aorta, and eliminates hydroxyl free radicals and superoxide.

2.3 Pharmacological Action

Those chemicals are the main components of useful chemicals in AM in Pharmacology. Traditionally, people discovered some usefulness in them, such as tonifying deficiency, relieving edema, etc [2]. But nowadays, their function in enhancing immunomodulatory is appearing. For example, Astragaloside has been proven to it can protect the stem cells inside the bone marrow from radiation by regulating some gene expressions about genes, such as B-cell lymphoma-2 (Bcl-2) [8].

3. The Mechanism of Action of AM in Curing Cancer

3.1 Direct Effect on Cancer

No matter the way it is, improving cancer treatment is al-

ways the first task for medicine. If the medicines can improve or even cure the cancer, then it will be suitable for a useful medicine for those highly depressed patients.

Research shows that one of the main reasons for the cancer's spread is the abnormal regulation of the cell proliferation cycle [5]. The normal cell cycle regulation is coordinated by a complex network of interactions between enzymes, cytokines, and cell cycle signaling pathways. But when cancer happens, this cycle will become abnormal and begin to help the cancer cells grow. As a result, it will cause the tumor's initiation [5]. In an experiment, scientists discovered that APSs can suppress the bladder cancer cells' proliferation by letting the UM-UC-3 cell cycle stop in the G0/G1 phase [9].

3.2 Indirect Auxiliary Effect

During the process of curing cancer, the patient's physical health will be influenced by the drugs used in the process. Those auxiliary effects can't just improve the patient's feeling, but also can decrease the possibility of patients suffering from sequelae.

3.2.1 The protection of the bone marrow

Table 1. Comparison of the bone mesenchymal stem cells (BMSCs) proliferation at different time periods in different groups (x ± s,n = 6) [10].

Group	Dose(μg·mL-1)	1d	2d	3d	4d	5d
Blank	0	0.29 ± 0.02	0.48 ± 0.07	0.80 ± 0.04	0.98 ± 0.04	1.22 ± 0.06
AS-L	25	0.36 ± 0.04	0.50 ± 0.02	0.84 ± 0.09	0.87 ± 0.04	1.04 ± 0.03*
AS-M	50	0.24 ± 0.04	0.54 ± 0.04	0.82 ± 0.11	0.91 ± 0.04	1.15 ± 0.02
AS-H	75	0.19 ± 0.07	0.19 ± 0.07	0.72 ± 0.04*	0.88 ± 0.06*	1.11 ± 0.07*

Zhang et al. discovered that astragalus can protect the bone marrow from radiation [10]. They used radiation to interfere with the cells, but used different chemicals to treat every group (except the blank group). According to the data during the day 4 and day 5 routine incubation, the AS-L group and the AS-H group both reflected to have significant suppression of the BMSCs' proliferation; as a result, their data differences all have statistical significance. Thus, the AS-M group became the best concentration (Table 1).

Table 2. Expression of BMSCs proliferation ability (OD value) in each group (x ± n, n = 4) [10].

Group	1d	2d	3d	4d	5d
Blank	0.28 ± 0.04	0.47 ± 0.02	0.74 ± 0.02	1.08 ± 0.03	1.26 ± 0.06
AS-M	0.25 ± 0.05	0.52 ± 0.02	0.72 ± 0.02	0.90 ± 0.02	1.16 ± 0.03
Radiation	0.21 ± 0.08	0.41 ± 0.02*	0.54 ± 0.02*	0.76 ± 0.02*	0.88 ± 0.02*
Radiation + AS	0.23 ± 0.04	0.46 ± 0.03	0.62 ± 0.01#	0.84 ± 0.02	0.96 ± 0.03*

On the fifth day, the proliferation rate of the radiation group had a relatively significant decrease compared to the blank group ($P<0.05$), and from the third to the fifth day, the cell proliferation rate of the radiation + AS group had a significant increase.($P<0.05$) The above data differences all have statistical significance (Table 2) [10]. As a result, the astragalus has some protective effect on broken BMSCs [10]. According to the phenomenon that modern society will use radiotherapy to treat cancer, this can help to protect the patient's hematopoiesis and prevent them from leukemia caused by radiation. As a result, patients can become relatively fitter and will not be more likely to have blood problems or other sequelae.

3.2.2 The strengthening effect of astragaloside IV in breast cancer drugs

Chemotherapy, as a method of treating cancer, has been widely used. In the treatment of breast cancer, paclitaxel (PTX), as an anti-microtubule chemotherapeutic agent, has become an important drug for the treatment of breast cancer. However, this kind of substance is easy to make tumors develop drug resistance, which can not achieve the expected therapeutic effect. In Huang et al.'s experiment, astragaloside IV can effectively slow down tumor resistance to paclitaxel. During this experiment, female mice were selected as the experimental objects and divided into three groups. For the first time, MCF-7 cells and MCF7-CSC cells were injected into the mammary fat pad of the experimental group and the control group (n=7). After 21 days, they were euthanized, and the growth was observed. The second time, the mice were divided into an experi-

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mental group and a control group (n=7). The above cells were injected into the mammary fat pad of mice. When the tumor volume reached 100 mm, PTX was used in each group. Twenty-one days later, they were euthanized, and their growth was observed. In the third experiment, MCF7-CSC was injected into the mammary fat pad of mice. When the tumor volume reached about 100mm, the mice were randomly divided into a control group and a treatment group (n=6): control group, ASIV group, PTX group, and PTX combined with ASIV group. After 21 days, the mice were euthanized and the tumor conditions were observed. The results showed that asiv significantly increased the role of PTX in the treatment of breast cancer by inhibiting the stemness of breast cancer cells and increasing the apoptosis of cancer cells caused by PTX, and had no significant effect on the weight and other health conditions of mice. In general, ASIV can significantly assist in the treatment of breast cancer [11].

4. Conclusion

In summary, AM has demonstrated substantial potential as a complementary agent in cancer care, supported by evidence of both direct antitumor activity and indirect protective effects on patients. Its bioactive components—APS, Astragaloside, and flavonoids—target key cancer-related processes: APS disrupts abnormal cell cycles to halt proliferation, Astragaloside inhibits EMT to prevent metastasis, and flavonoids provide antioxidant support that alleviates oxidative stress, a factor in cancer progression. Beyond direct tumor targeting, AM addresses critical unmet needs in conventional cancer therapy: it shields bone marrow mesenchymal stem cells (BMSCs) from radiation damage, preserving hematopoietic function and reducing radiotherapy-induced sequelae like leukemia risk; it also enhances chemotherapeutic efficacy by reversing paclitaxel resistance in breast cancer, without compromising patient health (e.g., no adverse effects on mouse weight in studies). While societal skepticism about TCM efficacy persists, the scientific data on AM—from cell studies to in vivo mouse experiments—validates its role as more than a traditional remedy. As a safe, plant-based option, AM bridges TCM and WM offering a way to improve treatment tolerability and outcomes. Future research should focus on clinical trials to confirm its efficacy in humans and optimize dosage protocols. Ultimately, AM has the potential to become a standard auxiliary therapy in oncology, particularly for patients undergoing radiotherapy or chemotherapy, ensuring better quality of life while enhancing the fight against cancer.

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