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Application of New Technologies in Natural Drug Extraction

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Abstract: In recent years, with the support of rapid socio-economic progress in China, significant achievements have been made in the field of science and technology. Various modern information technologies have become increasingly mature and widely applied in various fields of society and people's actual lives, including the field of medical pharmaceuticals. Extraction is a key step in the production of natural drugs into pharmaceutical products, and the effectiveness of extraction directly affects the quality and production cost of natural drugs and pharmaceuticals. Based on this, this paper analyzes the current new technologies in the extraction of natural drugs: dynamic warm soaking technology of traditional Chinese medicine, cellulase hydrolysis, semi-bionic extraction, supercritical fluid extraction, heating-free extraction, ultrasonic extraction, microwave technology, etc., for reference.

1. Introduction

The so-called natural medicine mainly refers to the process of processing natural raw materials through a series of methods, using various technological means and advanced technological equipment, and finally making them into drugs or semi-finished products. The specific process of natural drug extraction is as follows. First, pre-treatment of natural raw materials. Secondly, separate and extract natural raw materials. Finally, concentrate and dry to a medicament. In recent years, with the widespread application of new drugs such as injections and aerosols in medical work, the effective extraction of natural drugs has become a key factor for the sustainable development of the modern pharmaceutical industry [1]. Therefore, the author believes that conducting a specific analysis of the new technologies and application methods that exist in the current natural drug extraction process has strong practical significance.

2. Dynamic Warm Soaking Technology of Traditional Chinese Medicine

The dynamic warm soaking technology of traditional Chinese medicine is mainly a technical method that utilizes modern mechanized equipment to forcibly cycle and extract natural drugs. Specifically, the leaching solvent at a certain temperature is forcibly circulated from top to bottom in the extraction tank, causing it to flow and leach, ultimately promoting the relative motion speed

of the solid and liquid. The essence of its technology is to use the frictional force between solid and liquid motion to accelerate the renewal rate of the interface layer, thereby promoting the thinning of the diffusion interface, making it easier for solutes in natural drug tissues to diffuse towards the solvent.

The characteristics of the dynamic warm leaching process technology for traditional Chinese medicine are as follows. Firstly, the leaching temperature is lower than the boiling point of the extraction solvent. Therefore, this technology can effectively prevent the excessive gelatinization and swelling of starch, colloidal substances, and other substances contained in natural drugs from affecting the leaching rate and quality of extracted solutes. Secondly, natural medicinal herbs can be crushed into appropriately sized coarse particles. This can not only increase the surface area of medicinal materials, but also reasonably avoid problems such as difficulty in solvent flow and excessive leaching of starch and gelatinous substances caused by excessive crushing of natural medicinal materials. Thirdly, the leaching time is relatively short [2]. Therefore, the dynamic warm leaching process technology of traditional Chinese medicine adopts a forced circulation method during the extraction and extraction of solvent, resulting in a relatively short diffusion equilibrium time between solid and liquid. Fourthly, the amount of leaching solvent is reduced.

Compared to the traditional process of natural drug extraction, the dynamic warm immersion process of traditional Chinese medicine can effectively shorten the drug extraction time, increase the drug extraction amount, reduce energy consumption, and achieve higher extraction efficiency.

3. Cellulase Hydrolysis

Cellulase hydrolysis is mainly a kind of complex enzymes that hydrolyze cellulose into water-soluble sugars, which can effectively break the Glycosidic bond of glucose to form cellulase hydrolysis. Since the cell wall of most natural drugs is composed of cellulose, the dense cell wall of plant cells will be destroyed after the destruction of the Glycosidic bond by cellulase hydrolysis, so as to facilitate the extraction of effective drug ingredients in plant cells.

The comparative study and analysis were carried out on whether cellulase was added in the extraction process of Cullen corylifolium, and the results showed that the yield of Psoralen increased by nearly 23% in the group added cellulase compared with the group without cellulase. Taking the production process of shiitake mushroom polysaccharides as an example, it can be found that shiitake mushrooms are sequentially treated with cellulase and trypsin, and after soaking in water, the extraction rate is improved by nearly 38% and 67% compared to single enzyme and water soaking extraction, making it easier to purify. Chlorogenic acid is proposed in honeysuckle, and cellulase hydrolysis can improve the extraction rate of honeysuckle extract and Chlorogenic acid . The combination of cellulase and pectinase has little effect on the extraction rate of Chlorogenic acid, but can significantly improve the extraction rate of natural drugs.

At present, a natural drug manufacturing factory in Shanghai, China has successfully produced Shengmai Oral Liquid using cellulase hydrolysis, and relevant fields are still conducting in-depth research on cellulase hydrolysis.

4. Semi-bionic Extraction

Some Chinese herbal extracts contain a large amount of weak organic acids, weak organic base, etc., which are mostly in molecular and ionic states in liquid [3]. However, due to the high lipophilicity of Chinese herbal extracts that exist in molecular form, they are more easily absorbed. Therefore, there are certain differences in the absorption degree of different drugs during the drug transformation process, which may affect the drug efficacy. The semi-bionic extraction method is mainly based on the biological Pharmaceutics to simulate the human oral state and the environment

for drug administration and transformation, which is a new technical method for the extraction of natural drugs that successfully pass through the digestive tract. Usually, the semi-bionic extraction method uses a certain pH of acidic water for drug extraction, followed by alkaline water for extraction, filtration, concentration, and ultimately preparation of the drug.

In the process of natural drug extraction and preparation of Paeonia pain-relieving granules, the semi-bionic extraction method has more application advantages compared to traditional water decoction methods. Taking Berberine and total alkaloids as indicators, the application of semi-bionic extraction method and water boiling method was compared. The results showed that semi-bionic extraction method had more advantages than water boiling method. It can be seen that the semi-bionic extraction method has good application prospects in the extraction and production of traditional Chinese medicine granules, and is more scientific and feasible.

5. Supercritical Fluid Extraction

The supercritical fluid extraction method mainly refers to a technical method that uses the fluid under the supercritical state as the extraction solvent of natural drugs to extract effectively from liquid or fixed natural drugs and separate the extracts. The most commonly used supercritical fluid is CO_2, which has the following characteristics:

Firstly, CO_2 is colorless, odorless, non-toxic, non-corrosive, non-flammable and explosive, and can be recycled multiple times, with a wide range of practical operations. Secondly, by adjusting pressure, temperature, and other factors, the density of supercritical CO_2 can be effectively changed, thereby changing its ability to dissolve effective substances in natural drugs and selectively extracting specific components from natural drugs. Thirdly, the supercritical fluid extraction method needs to be applied in a lower temperature environment, and the temperature is closer to the indoor temperature, so it is more suitable for the extraction of thermosensitive drug ingredients. Fourthly, supercritical fluid extraction can effectively adjust the size of natural drug extraction particles by virtue of the nucleation effect of the fluid. Fifthly, the supercritical fluid extraction method is more suitable for the extraction of lipophilicity and small-molecular-weight natural drugs. For the extraction of natural drug substances with large polarity and molecular weight, entrainers are needed [4].

Taking the extraction of artemisinin from Artemisia annua using supercritical CO_2 fluid as an example, the extraction rate is as high as 95%, while the magazine content in natural drug extraction is relatively low. This, to some extent, indicates that the purity and yield of artemisinin extracted by supercritical fluid extraction are higher. The supercritical fluid extraction method was used to analyze the extraction results of single medicine Chuanqiu, Angelica sinensis, compound Angelica sinensis, Chuanqiu, etc. It can be found that the extraction efficiency of compound medicine is significantly higher than that of single medicine. Although the application of supercritical fluid extraction has a high investment cost, it has a good application prospect in the extraction and separation of natural drugs.

6. Heating-Free Extraction Process

The heating-free extraction process mainly involves applying pressure to the solvent of the soaking medicine using the pressure alternating method, thereby forcibly changing the geometric shape of plant cells and improving the solution exudation efficiency on both sides of the cell wall. It is a new technological method for natural drug separation and removal of solids and impurities. The heating free extraction process has shown advantages in saving drug resources, reducing extraction costs, and saving energy in practical applications, making it more suitable for chemical cost extraction and separation processes that have undergone changes when exposed to heat [5].

Compared with the traditional alcohol extraction process, the heating free extraction process can improve the resin extraction efficiency of Dracaena draco by 23% to 25%.

7. Ultrasonic Extraction Method

The ultrasonic extraction method mainly uses the energy generated by ultrasonic vibration as the extraction medium of natural drugs to generate great pressure in the air to shatter the plant cell wall and the whole organism, thus accelerating the speed of active ingredient in plants entering the solvent. Ultrasound has multiple levels of force. Utilizing mechanical action, emulsification, diffusion, etc. can also accelerate the effective release, diffusion, and dissolution of substances inside plant cell walls to a certain extent. Due to the fact that the process of shattering plant cell walls is a physical phenomenon and there is no obvious chemical reaction during the drug soaking process, the active substances present in the soaked natural drugs will remain in their original state for a short period of time [6]. The reasonable application of ultrasonic extraction method in natural drug extraction can improve the crushing speed, shorten the breaking time, and thus improve the extraction efficiency of natural drugs. The ultrasonic extraction method was used to effectively extract polysaccharides from Elaeagnus angustifolia. Compared with traditional extraction methods, the extraction rate increased by nearly 50%.

8. Microwave Technology

Microwave technology mainly refers to ultrahigh frequency electromagnetic waves with vibration frequencies between 300MZ and 300GHZ. It has strong penetrating power and can rapidly transform polar molecules, ions, etc. of the irradiated material into tears and mutual friction in microwave electromagnetic fields, ultimately achieving the purpose of heating. In fact, microwave technology is a kind of plant cell disruption technology, which uses microwave heating to cause the polar substances inside the plant cells to generate a lot of heat. The internal temperature of the cells rises rapidly, and the pressure generated by liquid gasification will break the cell membrane and cell wall, resulting in the reduction of water content in the cell interior and cell wall, dissolution and release of organic substances in the temporal part of the cells. It can be seen that microwave technology is more suitable for extracting thermally stable natural pharmaceutical substances.

Using microwave technology can extract free anthraquinone from rhubarb. Compared to traditional water decoction extraction methods, the extraction efficiency of free anthraquinone has been improved by nearly 2 times, and the extraction time has been shortened from 120 minutes to about 30 minutes. This indicates that microwave technology has the characteristics of fast extraction, high quality and efficiency, and energy conservation [7].

9. Conclusion

In summary, based on the existing new technologies in natural drug extraction discussed earlier, it can be concluded that different drug extraction technologies have different characteristics, application advantages, and applicability. These new technologies are reasonably applied in the natural drug extraction process, which can maximize the effectiveness and efficiency of natural drug extraction, and have a certain positive significance for promoting the innovative development of China’s medical pharmaceutical and medical industries. However, currently these new technologies are mostly limited to the extraction of single natural drugs, and the attention and research and development efforts for compound drugs are relatively weak, resulting in unclear extraction mechanisms. Therefore, it is difficult to use large-scale industrial batch extraction production. To address this issue, it is still necessary for relevant practitioners and biotechnology

researchers to innovate and deeply develop new technologies for natural drugs based on different natural medicinal materials, extraction processes, application effects, and other aspects.

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