

Introduction to microwave extraction

1 Microwave extraction mechanism

The mechanism of microwave extraction can be considered from two aspects. On the one hand, the microwave radiation process is a high-frequency electromagnetic wave that penetrates the extraction medium and reaches the internal vascular bundle and the glandular system of the material. Due to the absorption of microwave energy, the internal temperature of the cells rises rapidly, causing the internal pressure of the cells to exceed the capacity of the cell wall to expand and the cells to rupture. The active components in the cells flow freely, and the extraction medium captures and dissolves at a lower temperature. The extracted material is obtained by further filtration and separation. On the other hand, the electromagnetic field generated by the microwave accelerates the diffusion rate of the extracted component to the interface of the extraction solvent. When water is used as the solvent, the water molecules rotate at high speed to become an excited state under the microwave field, which is a high energy unstable state, or Water molecules vaporize to enhance the driving force of the extracted components; or the water molecules themselves release energy back to the ground state, the released energy is transferred to other substances, accelerates its thermal motion, and shortens the molecules of the extracted components from the inside of the material to the extraction solvent. The time of the interface increases the extraction rate several times, while also reducing the extraction temperature to maximize the quality of the extraction.

A further document is described as follows: Since the frequency of the microwave is related to the frequency of molecular rotation, the microwave energy is a non-ionizing radiant energy that causes molecular motion caused by ion migration and dipole rotation. When it acts on the molecule, it promotes the rotational motion of the molecule. If the molecule has a certain polarity at this time, it will generate instantaneous polarization under the action of microwave electromagnetic field, and do the polarity changing motion at a speed of 245 million times per second. , thereby generating vibration and tear of the bond and mutual friction and collision between the particles, promoting better contact and reaction of the active part (polar part) of the molecule, and rapidly generating a large amount of heat energy, causing the cell to rupture and causing the cell liquid to overflow. Come and diffuse into the solvent.

2 microwave extraction advantages

Conventional thermal extraction is carried out from the outside to the inside by means of heat conduction, heat radiation, etc., while microwave extraction is simultaneously heated inside and outside by dipole rotation and ion conduction. Compared with traditional thermal extraction, traditional thermal extraction has the following characteristics:

- a, high quality, can effectively protect functional components in food, medicine and other chemical materials;
- b, large output;
- c, high selectivity to the extract;
- d, save time, can save 50% to 90% of the time;
- e, less solvent (can be 50% to 90% less than conventional methods);
- f, low energy consumption.

Although the application research of microwave radiation technology in food extraction industry and chemical industry has only started in just a few years, the existing research results and application results are enough to show the following advantages:

- a, reaction or extraction is fast;
- b, high yield, good product quality;
- c, post-processing is convenient;
- d, safety;
- e, no pollution, belonging to green engineering;
- f, the production line is simple in composition and saves investment;

Microwave extraction technology is a new technology for the extraction of active ingredients from food and traditional Chinese medicine. It is reported that microwave extraction started later than supercritical extraction. The first literature on microwave technology applied to organic compound extraction was published in 1986. R. NGEDYE et al. placed samples in ordinary household microwave ovens by selecting power files, time and solvent. Type, in just a few minutes, can extract the target material that takes several hours or even ten hours to heat. In 1987, G ANGLER extracted cotton solid sugar from cottonseed and extracted soy ate from beans. In the early 1990s, the Microwave Assisted Process (MAP) was developed by the Canadian Ministry of Environmental Protection and Canada's CWT-TRA N. It has been widely used in spices, condiments, natural pigments, Chinese herbal medicine, cosmetics and soil analysis. And in 1992, it began to obtain patent licenses from the United States, Mexico, Japan, Western Europe, and South Korea. The use of large production lines to extract effective substances in mint and seaweed has been successful.

The microwave extraction efficiency is high, the purity is high, the energy consumption is small, the waste is generated, the operation cost is small, and the environmental protection requirements are met. Can be widely used in Chinese herbal medicine, spices, health foods, cosmetics, cosmetics, tea drinks, seasonings, pectin, high-viscosity chitosan and other industries, currently in China's microwave extraction has been used in a number of Chinese herbal medicines invading production lines Such as Pueraria, tea, ginkgo and so on. Microwave extraction has been listed as one of the 21st century food processing and traditional Chinese medicine pharmaceutical modernization technology. Researchers at a Chinese medicine research institute have used microwave extraction methods to treat hundreds of Chinese medicines. Whether it is extraction speed, extraction efficiency or extraction quality, it is much better than conventional processes.

3 Comparison of microwave extraction with other extraction methods

Microwave extraction technology has obvious advantages over other existing extraction techniques. The chemical solvent extraction method consumes a large amount of energy, consumes a large amount of materials, takes a long time, has low extraction efficiency, and has large industrial pollution. Supercritical fluid extraction is greatly improved in extraction efficiency, but the method requires complicated equipment, narrow solvent selection range, high pressure vessel and high pressure pump, so the investment cost is high, and it is difficult to establish a large-scale extraction production line.

Foreign researchers have studied the applicability of microwave-assisted extraction of various pesticides from plant samples. Under the optimized conditions of 10 min microwave irradiation and 50% maximum power, the recovery rate of microwave extraction and traditional

supercritical extraction (SFE) insecticides is not much different, but the solvent and time are obviously saved, and multiple samples can be processed simultaneously. At the same time, the research shows that the optimal recovery rate of microwave extraction is closely related to the extraction temperature, the matrix of the plant sample and the type of pesticide. For different samples and different insecticides, the corresponding extraction temperature and time are used to obtain the ratio of supercritical High recovery of extraction is completely feasible.

Comparison of recovery rate and time between traditional methods and microwave-assisted extraction

Compound recovery rate /% time required

Traditional microwave traditional microwave

Natural fat (food) 100 98 > 3h Antinutritives 40 100 ?3h Insecticide (soil) 90 100 Microwave extraction rough process:

Material selection - cleaning - crushing - microwave extraction - separation - concentration - drying - powdering - products

4 Introduction to Microwave Extraction Equipment

There are two types of equipment used for microwave extraction: one is a microwave extraction tank and the other is a continuous microwave extraction line. The main difference between the two is that the materials are processed in batches, similar to multi-function extraction tanks, and the other is an extraction equipment that works in a continuous manner. The specific parameters are generally designed by the manufacturer according to the requirements of the manufacturer. There are two types of microwave frequencies used: 2450MHz 915MHz

At present, Leader Machinery Microwave Technology Development Co., Ltd. has developed a series of products for microwave extraction. The microwave power ranges from 1 kW to 100 kW, and the volume ranges from 0.1 cubic to 3 cubic meters. The extraction solvent may be a strong polar solvent such as water, methanol, ethanol, propanol, diethyl ether or acetone. Weakly polar solvents can also be used depending on the materials and processes. It has been applied by many food manufacturers and pharmaceutical manufacturers with good results. The series has stable performance, high degree of automation, strong environmental adaptability, simple operation and GMP compliance. The microwave leakage index of this series of equipment is lower than 1mw/cm², which is in line with the European and American indicators.