

# Research progress of microwave drying technology and equipment for agricultural products

Abstract: Taking the microwave drying technology as the research object, the research status of [microwave drying equipment](#) in agricultural products processing was expounded, and some technical problems such as uneven drying and partial burning in microwave drying were put forward. Then, the research progress of hot air microwave fluidized drying, vacuum microwave drying, freeze microwave drying and other combined technologies and equipment were introduced. Finally, by analyzing the advantages and disadvantages of different processing technology, it is pointed out that microwave combined drying technology is the development trend of [microwave drying industry for agricultural](#) products.

Key words: agricultural products; microwave drying; equipment; research progress 0  
Introduction

Drying is an important means to ensure the quality of agricultural products. It is also a common food processing technology. China's agricultural products are relatively scattered, and the processing level is backward, resulting in a large number of losses in the transportation, storage and marketing links after harvest. Timely and effective post-harvest drying is of great significance to reduce the production costs and economic losses of grain, fruits and vegetables, edible fungi and other agricultural products.

In recent years, the demand for dehydrated fruits and vegetables has been increasing rapidly both in China and in the international market. The dried products after dehydration are not only convenient for transportation, storage and sale, but also improve the added value of agricultural products, and have great market potential and development space. It is particularly important to improve the drying technology level of agricultural products.

Microwave drying, as a kind of radiation drying, is a new generation of drying technology. Compared with traditional convective drying and contact drying, it has the advantages of fast drying speed, high efficiency and energy saving, sensitive reaction and easy control. In the late twentieth Century, with the popularity of high-power magnetron, microwave drying technology developed rapidly. Combining with the research progress of microwave drying technology and equipment at home and abroad, this paper expounds the current situation of microwave combined equipment, and points out the common problems and prospects in the drying process.

## 1 Characteristics of microwave drying of agricultural products

Microwave is an electromagnetic wave with wavelengths ranging from 1 mm to 1 m. It has the characteristics of linear propagation, spatial attenuation and good metal reflectivity. The commonly used microwave frequencies are 915 MHz and 2450 MHz. That is to say, when a microwave of 2450 MHz is applied to the material, the direction of the electric field changes 2.45 billion times per second, and the polar molecule oscillates 2.45 billion times.

When the polar medium is not added to the electric field, its dipoles move in a chaotic way, and the whole external electricity is neutral. After applied electric field, the dipoles are rearranged in a directional manner, so that the disorderly moving dipoles become polarized molecules with certain orientation and regular arrangement. In this way, the applied electric field gives the dipole potential energy, and once the direction of the electric field is changed, the direction of the dipole arrangement will also change.

Under the action of alternating electric field, this kind of oscillation is disturbed and hindered by intermolecular forces, which results in friction heat and macroscopic microwave heating effect. For polar substances, the nature of microwave heating can be considered as polar molecules from the microwave field to obtain potential energy and then convert into heat energy. The frequency of electromagnetic field is very high. The frequency of polar molecules vibrate is very large, and the heat generated is considerable.

The whole process replaces the specific heat source with the penetration effect of electromagnetic energy, which is often used to dry materials with strong thermal sensitivity. In recent years, microwave drying has been widely studied in dehydrated vegetables and fruits. Theoretical calculation shows that the penetration depth of wood with high moisture content reaches 16 cm at 915 M microwave frequency. These unique advantages of microwave are attracting more and more attention. There are also some common problems in microwave drying, such as uneven drying, large color difference and deformation, and difficult to control the final moisture content. The difference between the material structure and the microwave field distribution in drying chamber will affect the equilibrium of dehydration. In fruit and vegetable drying,