

# Research Progress of Microwave Drying and Low Frequency Ultrasound Cooperative Drying of Fruits and Vegetables

Drying is an important means of processing agricultural products. Drying agricultural products is conducive to the storage of agricultural products, but also can reduce transportation costs.

## [Safe and efficient fruit and vegetable drying machine](#)

The output of fruits and vegetables in China ranks first in the world and occupies the largest share in international trade, among which dehydrated fruits and vegetables account for about one third of the total export trade of fruits and vegetables in China.

## [Microwave drying machinery and equipment](#)

Dehydration of fruits and vegetables can reduce the activity of bacteria and fungi in the materials, and consequently can be stored at ambient temperature for a long time.

Reasonable drying methods can retain the nutritional value, good color and taste of fruits and vegetables to the greatest extent, so as to realize the deep processing of agricultural products of origin. At the same time, drying removes most of the quality of fresh fruits and vegetables, which can reduce the storage and transportation costs of fruits and vegetables

[2]. At present, the traditional hot air is still the main drying method of fruits and vegetables. The product is called drying fruits and vegetables for short. However, there are some problems in traditional hot air drying, such as long drying time, high energy consumption, low heat and mass transfer efficiency, etc.



It is necessary to develop new efficient combined drying technology to meet the requirements of energy saving, high efficiency, green safety, low carbon, high quality, intelligent precision and

high quality products. At present, there are many methods of combined drying, such as hot air combined drying, microwave combined drying, vacuum freeze-drying, ultrasonic synergistic treatment and pressure differential synergistic treatment [5-7]. These drying methods have different energy supply modes.

The heat transfer of hot air drying is mainly through the air heat transfer of drying medium. Water evaporates from the material surface, and then diffuses from the material interior to the material surface. Microwave heating is full volume heating. Under the action of high-frequency electromagnetic field, it causes the movement and friction between the molecules of the material, which makes the water evaporate quickly. Vacuum freeze-drying is to freeze the moisture in the material into solid ice, heating in a vacuum environment to sublimate the moisture in the material directly. Ultrasound synergistic drying is a drying method in which ultrasound synergizes with other drying methods.

Ultrasound is a kind of sound wave whose frequency is more than 20 kHz. The interaction between ultrasound and medium produces thermal, mechanical and cavitation effects, thus strengthening the drying process of materials.

Thermal effect makes the energy absorbed by the material continuously and the temperature of the material rise; mechanical effect makes the material compress and stretch repeatedly, which makes the structural effect force greater than the adhesion force on the surface of the water to promote the water removal; cavitation effect is that cavitation bubbles grow continuously under the action of ultrasonic wave, and eventually break up and produce instantaneous high temperature and pressure locally