Study on the effect of microwave and high temperature instantaneous steam blanching pretreatment on enzyme activity and quality of Agaricus bisporus before drying

Agaricus bisporus is one of the most widely cultivated edible fungi in the world. According to statistics, the annual output of Agaricus bisporus in China is 2.184 million tons in 2012, which is one of the largest edible mushrooms in annual output. Agaricus bisporus is not only delicious and nutritious, but also contains a variety of bioactive substances. Fungus and Mushroom Microwave Drying machine

However, the quality of Agaricus bisporus tends to deteriorate during storage and transportation, such as browning, umbrella opening and decay. At present, freeze-drying (FD) is considered to be the most effective way to produce high-quality dehydrated food. Microwave drying machinery and equipment

It can maintain the original color, texture, nutrition and flavor of food to the greatest extent. However, there are many problems in freeze-drying, such as high energy consumption, long production cycle and high production cost.

While maintaining the sensory, nutritional and flavor quality of the products, the study of energy-

saving drying technology with high efficiency for Agaricus bisporus has important theoretical guiding significance for the intensive processing of Agaricus bisporus. Using Agaricus bisporus as raw material, three different combined drying methods, freeze-drying combined with hot air drying (FD+AD), freeze-drying combined with vacuum drying (FD+VD) and freeze-drying combined with microwave vacuum drying (FD+MVD),

were used to investigate the effects of different drying methods on the color, texture, microstructure, nutrient retention and energy consumption of Agaricus bisporus slices. The results showed that there were no significant differences in L value, a value, average volume density and hardness between FD+VD and FD+MVD dried Agaricus bisporus slices under 38% water content conversion point and FD+MVD dried products. Besides the relatively low content of vitamin C in FD+MVD products, FD+VD and FD+MVD dried Agaricus slices had no significant differences.

The two combined drying methods were superior to FD+AD in the retention of nutrients such as total sugar, soluble sugar and soluble protein. Compared with FD, the three combined drying methods can reduce the power consumption by 34.51%, 36.36% and 35.27% respectively while ensuring the quality of bisporus mushroom slices, but only FD + MVD drying method can significantly shorten the drying time (35.63% shorter than freeze drying).

In addition, there is no significant difference between the micro-pore structure of FD + MVD products and FD products. Therefore, FD+MVD is an efficient, energy-saving and quality-guaranteed combined drying method suitable for dehydration of Agaricus bisporus. The effects of drying parameters such as freeze-drying temperature (20, 30, 40), paving thickness (1, 2 and 3 layers), drying pressure (70 Pa, 100 Pa and 130 Pa), microwave power density (20 W/g, 40 W/g and 60 W/g) on the drying kinetics of Agaricus bisporus slices during FD and FD+MVD processing were studied and compared.

The mass transfer dynamics and rehydration characteristics of FD and FD+MVD drying process of Agaricus bisporus slices were described by using suitable classical mathematical models, and the effective water diffusivity (Deff) during drying process was calculated. The results showed that the freeze-drying temperature, the number of layers, drying pressure and microwave in the later stage of combined drying of FD and FD+MVD of Agaricus bisporus slices were determined. Power density has a significant effect on the drying rate, and the drying rate increases significantly with the increase of freeze-drying temperature,

the decrease of layers, the decrease of pressure during freeze-drying process and the increase of microwave power density. Through non-linear regression analysis, Page model fits the water content curve of FD process best, while Logarithmic model fits the water content curve of MVD process best at the later stage of FD+MVD. The mathematical models of FD dynamic drying are MRFD=exp(-kFDt1.383), kFD= 0.012T-0.177LFD-0.005V+0.844, R2= 0.970. These two mathematical models can accurately predict the relationship between water ratio and drying time in FD and FD+MVD processes. At the same time, according to Fick's second law, the effective water diffusion coefficient of MVD process in the later stage of FD+MVD is about 10 times that of FD process. This further proves the superiority of FD+MVD process from the point of mass transfer dynamics.

Peleg model can predict the hydrodynamic characteristics of FD and FD+MVD dehydrated Agaricus bisporus slices. The equilibrium moisture content of FD+MVD dried Agaricus bisporus slices during rehydration is very close to that of FD products, which proves that the rehydration ability of these two different drying methods is similar. The non-volatile components such as soluble sugar (alcohol), free amino acid, flavoring nucleotide and organic acid were determined during FD and FD+MVD drying of Agaricus bisporus. The variation of non-volatile components in the two drying methods was studied and compared.

EUC was introduced to different drying stages of Agaricus bisporus. The taste grade of mushrooms was evaluated. The results showed that the EUC value of Agaricus bisporus and the contents of most non-volatile components, such as mannitol, L-glutamic acid, L-histidine, L-glutamine, L-phenylalanine, 5'-GMP, 5'-AMP and organic acid, increased significantly in the sublimation stage of FD process, and decreased significantly in the resolution stage of FD process and MVD stage of FD+MVD. Compared with FD-dried Agaricus bisporus tablets, FD+MVA-dried Agaricus bisporus tablets had relatively low soluble sugar (alcohol) content, but the content of free amino acids, especially those which contributed significantly to EUC,

was significantly higher than that of FD products, and similar to that of fresh samples. There was no significant difference in the content of flavor nucleosides and organic acids between the two drying methods. In addition, FD and FD+MVD are dried.