Study on quality and vitrification of rice under hot air and microwave drying

Analysis of drying process

Based on the measurement and data processing of water loss in the process of repeated samples of hot air and microwave drying equipment, the process variation of moisture content in hot air and microwave drying can be obtained.

Variation of moisture content in Rice during hot season and microwave drying

The fitting equations of number function and exponential function are respectively

LnYM = cm - km t (1)

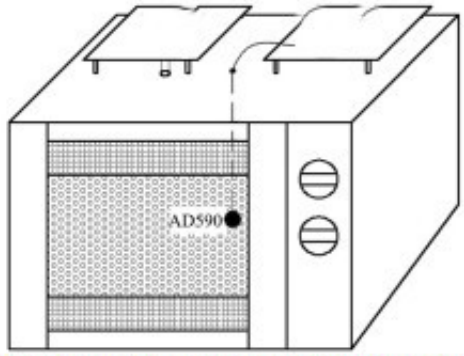
Y = C e km (2)

The current value and coefficient value of YM and CM-dry base moisture content,%k-time influence coefficient, S-1

T - time, s

The mass transfer of wind and microwave is different from that of the granular layer.

The heat transfer is mainly carried out by convection and heat conduction. The temperature of each particle increases gradually due to the temperature difference between the particle and the drying medium, and then transmits to the interior of the particle to promote the evaporation of water. In the early stage of drying, the dynamic temperature difference between the outside and the inside of each particle is large, and the overall dewatering rate is large; but with the drying process, the dewatering rate decreases slowly because of the increase of heat and mass transfer resistance and the decrease of evaporation cross-section area of the multi-layer structure of each particle. However, the microwave drying of paddy grain not only accelerates the internal water temperature rise and evaporation rate, but also reduces the effect of external heat input on the shrinkage of the pore structure of the outer husk.



Schematic diagram of microwave drying temperature control system

The dewatering performance of rice microwave drying equipment is also related to the dielectric coefficients of moisture, protein, amylose and so on. The dielectric coefficients of water are higher than those of protein and amylose. Microwave drying can selectively absorb microwave energy and promote rapid evaporation of moisture in rice grains. Therefore, microwave drying has better thermodynamic strengthening effect than hot air drying. The dehydration rate of microwave drying is faster than that of hot air drying because rice grains are dried by different heat sources. The surface and interior of grains are affected by different thermal forces, which not only promote the internal dewatering process, but also change the internal tissue composition and quality of grains. This will affect the germination quality and vitrification transformation performance of rice embryos. Further analysis is needed.

2.2 comparison of near infrared quality components between rice hot-air and microwave drying

SPSS single factor analysis of variance of protein, amylose content and moisture content of fresh paddy and its hot-air, middle and end components during microwave drying were repeated. The least square mean and variance of quality components during hot-air and microwave drying were obtained by comparing them with Duncan method.

3 Mean values and variance values of principal components during hot air and microwave drying of rice

Hot air drying microwave drying

Min dry base moisture content protein content amylose content dry base moisture content protein content amylose content

29.09 + 0. 19C 12.33 + 0. 08A 9.90 9.90 0.36 29.09 + 0. 19C 12.33 0.08 0.08 9.90 9.90

24022.78 [0.19] B 12.68 [0.13] B 9.78 [0.30] 10.86 [1.88] B 12.12 [0.18] 9.02 [0.31].

60020.42 + 0. 63A 12.60 + 0. 09B 9.92 9.92 0.55 4.31 + 0. 11a 12.35 0.10 0.10 9.93 9.93

Note: different letters in the same column indicate significant difference (P

From Table 3, we can see that the average protein content of Peizaifeng fresh rice and its hot air, microwave drying middle and end samples ranged from 12.12% to 12.68%, and the amylose content of the samples ranged from 12.12% to 12.68%.

The value ranged from 9.02% to 9.93%. The results were consistent with the changes of moisture content, protein and amylose content in indica rice detected by Liu Jianxue [3,9-10]. With the significant decrease of moisture content in drying process, the mean values of moisture content, protein and amylose content in hot air and microwave drying process changed only slightly, but the difference was not significant. After hot air drying, the protein content of rice was significantly changed compared with that of fresh rice.

The results showed that hot air and microwave drying could not only remove the internal moisture content of the grains, but also significantly affect the properties of the endosperm and germ tissues in the grains.

Compared with Zhou Jicheng's conclusion that the protein changes little during low-power and long-time drying of rice, the results obtained in this study can be well corresponded to his conclusion [4]. Similar to the results of protein detection, the amylose content of Yuzataifeng rice was in the low amylose content and quality range of hybrid indica rice, which was in good agreement with the results of Cai Xuemei and other indica rice quality studies [3,9-10].

2.3 comparison of germination rate between hot air and microwave drying rice

By using SPSS one-way ANOVA, this paper compares the germination rates of fresh paddy and its components at the end of hot air and microwave drying with Duncan method [17], and obtains the least squares mean and standard deviation between the germination quality and its components at the end of drying, as shown in Table 4.

Table 4 mean value and standard deviation of rice germination rate under hot air and microwave drying

Tab.4 Mean value and standard deviation of rice germination ratio by hot air and microwave drying

Quality components

Sample Name Drying Time/min Germination Rate Dry Base Moisture/%Protein Mass Fraction/%Amylose Mass Fraction/%

XG 0.65 + 0. 19a 29.09 + 0. 19C 12.33 + 0. 08A 9.90 + 0.36

HX2 6000.93 + 0. 03C 20.42 + 0. 63b 12.60 + 0. 09B 9.92 +