Using Electrical Conductivity to Determine Water Mobility Affected by Various Thermal Treatments

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ABSTRACT

Water mobility is one of the most important topics in food area. In previous research, water mobility can be increased by various thermal treatments; however, quantitative analysis of water mobility could not be found except using expensive NMR. The objects of this research are: using electrical conductivity to determine water mobility, studying moisture transform by various thermal treatments, and establishing a mathematical model by investigating conductivity, porosity, free water ratio during thermal processes. Fresh potato and carrot cylinders (1cm in height, 2.5cm in diameter) were heated to 50 or 80oC by conventional (hot water bath), microwave or ohmic heating. Physical properties of treated samples, such as electrical conductivity, porosity, electrolyte content (ash) were measured, and the relationship of significantly different by using statistic tools in order to determine the amount of free moisture increase. Data showed that all thermal treatments resulted in increasing electrical conductivity, from 0.0032 (control) to 0.0800S/m for potato and from 0.0027 (control) to 0.0749S/m for carrot; higher temperature obviously caused stronger conductivity increase, which indicates high water mobility. Conventional hot water bath caused the highest increase, due to long processing time. Electrolyte content (ash)changes affected by thermal treatment were found not significant, whereas porosity data showed increases of 0.2631 to 0.5557 and 0.1649 to 0.2166 for potato and carrot, respectively. High temperature treatments resulted in high porosity, and ohmic heating showed the strength to collapse sample structure. A mathematical model was finally established to describe the relationship of all variables. The porosity increase could not totally reflect the electrical conductivity increase, which indicates certain amount of bound water was transformed to free water. By modeling the variable relationship, water mobility status could be easily determined by using electrical conductivity for the future development.

Keywords : water mobility ; free water ; electrical conductivity

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