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温度对火柿电学特性的影响

Effects of temperature on electrical parameters for ‘Huoshi’ persimmon fruit

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中文摘要:

为了研究温度对完整果实电学特性的影响,利用LCR仪和平行板电极在100 Hz~3.98 MHz频率范围测试了火柿果实电学参数的温度特性,利用生物学和电磁理论解释了电学参数频率特性和温度特性变化机制。结果表明,果实阻抗、电感和低频电导($f \leq 15.8$ kHz)随频率呈幂函数关系变化;电容呈波动性变化。当果实温度从10℃升高至40℃,阻抗下降了28% (3.98 MHz)~38% (1 kHz),电感下降了30% (3.98 MHz)~38% (1 kHz),电容升高了43% (3.98 MHz)~56% (1 kHz),电导呈上升趋势。建立了阻抗、电容、电感与果实温度间的线性关系式,可用于不同温度下果实电学参数预测。该研究频率范围,果实组织结构不均一性、电场对果肉细胞穿透能力差异和介电损耗的主导因素变化是影响果实电学参数频率特性的主要原因;离子传导是主导电学参数温度特性的主要因素。

英文摘要:

In order to investigate the effects of temperature on electrical parameters for ‘Huoshi’ persimmon fruit, variation of electrical parameters with temperature of intact ‘Huoshi’ persimmon fruit was studied over a frequency range from 100 Hz to 3.98 MHz with LCR meter and parallel plate electrode. Frequency and temperature characteristics of electrical properties were also illuminated by biology and electromagnetism theories. The results showed that fruit impedance, inductance and low frequency ($f \leq 15.8$ kHz) conductance varied in exponential form with the increase of frequency. As the fruit temperature risen from 10℃ to 40℃, fruit impedance decreased from 28% at 3.98 MHz to 38% at 1 kHz, the inductance 30% at 3.98 MHz to 38% at 1 kHz, while the capacitance increased from 43% at 3.98 MHz to 56% at 1 kHz, and the conductance had an increasing trend. Linearly correlation equations were built between fruit temperature and electrical parameters for the prediction of electrical parameter values at different temperatures. Frequency properties of fruit electrical parameters were attributed to the in-homogeneity of fruit structure, penetrating capacity variance of the electric field to the flesh and the variation of dominant dielectric loss factors at different frequency ranges, while the ionic conduction accounted for the temperature behavior of the electrical parameters.

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