Title Temperature and moisture dependent dielectric properties of legume flour associated with dielectric heating

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Abstract

Dielectric properties data are important in developing thermal treatments using radio frequency (RF) and microwave (MW) energy and are essential in estimating heating uniformity in electromagnetic fields. Dielectric properties of flour samples from four legumes (chickpea, green pea, lentil, and soybean) at four different moisture contents were measured with an open-ended coaxial probe and impedance analyzer at frequencies of 10–1800 MHz and temperatures of 20–90 °C. The dielectric constant and loss factor of the legume samples decreased with increasing frequency but increased with increasing temperature and moisture content. At low frequencies and high temperatures and moisture contents, negative linear correlations were observed between the loss factor and frequency on a log-log plot, which was mainly caused by the ionic conductance. At 1800 MHz, the dielectric properties data could be used to estimate the legume sample density judging from high linear correlations. Loss factors for the four legume samples were similar at 27 MHz, 20 °C and low moisture contents (e.g. <15 g/100 g). At the highest moisture content (e.g. 20 g/100 g) soybean had the highest loss factor at 27 MHz and 20 °C, followed by lentil, green pea, and chickpea. The difference in loss factor among the four legumes did not show clear patterns at 915 MHz. Deep penetration depths at 27 MHz could help in developing large-scale industrial RF treatments for postharvest insect control or other applications that require bulk heating in legumes with acceptable heating uniformity and throughputs.