Title Dielectric properties of cowpea weevil, black-eyed peas and mung beans with respect to the development of radio frequency heat treatments

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Abstract

In developing radio frequency (RF) and microwave (MW) disinfestation treatments for chickpeas and lentils, large amounts of product infested with cowpea weevil must be treated to validate treatment efficacy. To accomplish this, black-eyed peas and mung beans are being considered for use as surrogate host legumes, since they are better hosts for cowpea weevil when compared with the target legumes. Dielectric properties are very important parameters for developing RF and MW treatments and may be used to estimate heating uniformity and penetration depth. Dielectric properties of black-eyed pea and mung bean flours at four moisture content levels as well as cowpea weevil immature stages and adults were measured with an open-ended coaxial probe and impedance analyser at frequencies of 10–1800 MHz and temperatures of 20–60 °C. For both insect and legume samples, the dielectric constant and loss factor decreased with increasing frequency but increased with increasing temperature and moisture content. Comparison of the dielectric loss factor of insects with that for legumes at commonly used industrial frequencies of 27 (RF) and 915 (MW) MHz showed that cowpea weevils should differentially heat faster than the legumes, with the differential heating reduced in MW heating when compared to RF heating. Penetration depths calculated for black-eyed peas and mung beans suggested that RF treatment had much larger penetration depth than MW treatment, and continuous industrial-scale RF treatment protocols could be developed to disinfest these products.