
COMPARATIVE MEASUREMENT OF DIELECTRIC PROPERTIES OF FOOD POWDERS AT MICROWAVE FREQUENCIES BY OPEN-ENDED COAXIAL PROBE AND CAVITY PERTURBATION TECHNIQUE

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The dielectric properties of paprika, curry, corn starch and semi-skimmed milk, with moisture contents in the range of 5.63 to 7.74 % (dry basis), were determined by open-ended coaxial probe and cavity perturbation technique. The knowledge of these properties is essential to optimize the microwave heating process of such food powders. For the experiments with the open-ended coaxial probe, the system was coupled to a Vector Network Analyzer (VNA) with dedicated software. A custom-made device was built to improve contact between the coaxial probe and the surface of the tested materials. Then, a reflected signal (S_{11}) was obtained by the VNA for frequencies in the 915–2450 MHz range, from which the dielectric constant and loss factor were deduced. Two resonant microwave cavities were designed using straight WR975 and WR340 waveguides, for the 915 and 2450 MHz frequencies, respectively. Quartz tubes were partially filled with products and placed inside the microwave applicators to account for small perturbation in resonant cavity. The S_{11} signal was measured by VNA and the shift in frequency was related to the dielectric constant, while the decrease in the quality factor (Q) was assigned to the loss factor. The results showed that the dielectric constant (ϵ_r') tend to increase with the decrease in frequency. The ϵ_r' for paprika, measured at 2450 MHz by the coaxial probe and cavity perturbation technique, was of 1.06 ± 0.09 and 1.72 ± 0.00 , respectively. At 915 MHz, the ϵ_r' obtained by coaxial probe was of 1.53 ± 0.09 and 1.96 ± 0.00 with cavity perturbation technique. The other products showed the same tendency for ϵ_r' , and the loss factor (ϵ_r'') ranged from 0.02 to 0.36 for all powders. Open-ended coaxial probe requires close contact between the sample and the probe; therefore, this system was not fit for measuring the dielectric properties of the tested powders (air gaps between the probe and the samples). The cavity perturbation technique has been proven to be reliable for many foods, specially at low moisture contents, but requires a specific microwave applicator to be designed for each evaluated frequency.