

## Microcontroller-based moisture meter for ginger

### ABSTRACT

This paper describes the development of a simple method to determine the permittivity and moisture content (m.c.) of ginger. The measurement system consists of a microwave sensor, directional coupler and a PIC microcontroller. The microwave sensor is a square flanged open-ended coaxial (OEC) sensor made from SMA stub contact panel with outer diameter (O.D) 4.10 mm. The microwave oven drying method was used to determine the actual m.c. of the ginger. All data acquisition, processing and display were accomplished using a PIC16F690 microcontroller programmed using Flowcode software. The actual values of the permittivity of ginger were obtained by using the Agilent (now Keysight Technologies) 85070B dielectric probe along with a HP 8720B Vector Network Analyzer (VNA). The results showed good relationships between m.c., permittivity (dielectric constant (  $\epsilon'$  )) and loss factor (  $\epsilon''$  )) and reflected voltage. The calibration equations between reflected voltage and m.c. have been established for the sensor. The measurement system provides a simple, fast and accurate technique to predict m.c.,  $\epsilon'$  and  $\epsilon''$  of ginger from reflected voltage measurements alone. The accuracy in determination of m.c.,  $\epsilon'$  and  $\epsilon''$  in ginger was within 2.9%, 2.7%, and 3.6%, respectively.

**Keyword:** Microcontroller; Moisture content; Open-ended coaxial sensor; Permittivity; Reflected voltage