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# Development of an Instrument for Measurement of Thermal Conductivity and Thermal Diffusivity of Tropical Fruit Juice

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**Abstract :** Knowledge of the thermal properties of foods is of fundamental importance in the food industry to establish the design of processing equipment. However, for tropical fruit juice, there is very little information in literature, seriously hampering processing procedures. This research work describes the development of an instrument for automated thermal conductivity and thermal diffusivity measurement of tropical fruit juice using a transient thermal probe technique based on line heat principle. The system consists of two thermocouple sensors, constant current source, heater, thermocouple amplifier, microcontroller, microSD card shield and intelligent liquid crystal. A fixed distance of 6.50mm was maintained between the two probes. When heat is applied, the temperature rise at the heater probe measured with time at time interval of 4s for 240s. The measuring element conforms as closely as possible to an infinite line source of heat in an infinite fluid. Under these conditions, thermal conductivity and thermal diffusivity are simultaneously measured, with thermal conductivity determined from the slope of a plot of the temperature rise of the heating element against the logarithm of time while thermal diffusivity was determined from the time it took the sample to attain a peak temperature and the time duration over a fixed diffusivity distance. A constant current source was designed to apply a power input of 16.33W/m to the probe throughout the experiment. The thermal probe was interfaced with a digital display and data logger by using an application program written in C++. Calibration of the instrument was done by determining the thermal properties of distilled water. Error due to convection was avoided by adding 1.5% agar to the water. The instrument has been used for measurement of thermal properties of banana, orange and watermelon. Thermal conductivity values of 0.593, 0.598, 0.586 W/m^o C and thermal diffusivity values of 1.053 ×□10□^(-7), 1.086 ×□10□^(-7), and 0.959 ×□10□^(-7) □m/s□^2 were obtained for banana, orange and water melon respectively. Measured values were stored in a microSD card. The instrument performed very well as it measured the thermal conductivity and thermal diffusivity of the tropical fruit juice samples with statistical analysis (ANOVA) showing no significant difference (p>0.05) between the literature standards and estimated averages of each sample investigated with the developed instrument.

**Keywords :** thermal conductivity, thermal diffusivity, tropical fruit juice, diffusion equation
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