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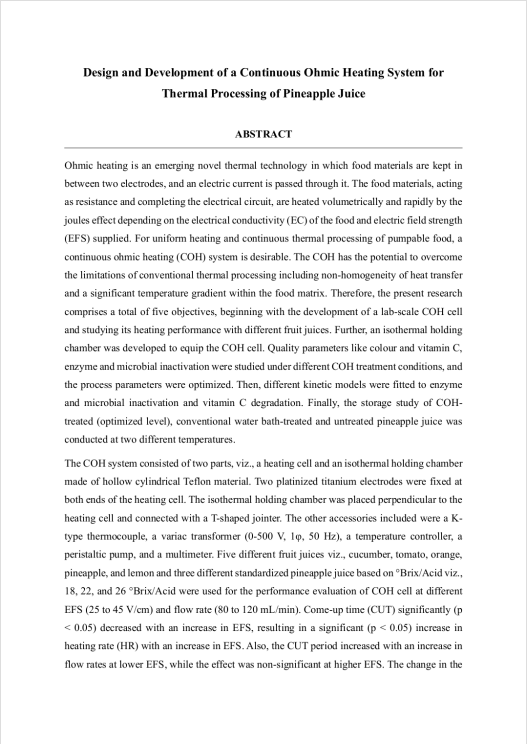

Design and Development of a Continuous Ohmic Heating System for Thermal Processing of Pineapple Juice

ABSTRACT

Ohmic heating is an emerging novel thermal technology in which food materials are kept in between two electrodes, and an electric current is passed through it. The food materials, acting as resistance and completing the electrical circuit, are heated volumetrically and rapidly by the joules effect depending on the electrical conductivity (EC) of the food and electric field strength (EFS) supplied. For uniform heating and continuous thermal processing of pumpable food, a continuous ohmic heating (COH) system is desirable. The COH has the potential to overcome the limitations of conventional thermal processing including non-homogeneity of heat transfer and a significant temperature gradient within the food matrix. Therefore, the present research comprises a total of five objectives, beginning with the development of a lab-scale COH cell and studying its heating performance with different fruit juices. Further, an isothermal holding chamber was developed to equip the COH cell. Quality parameters like colour and vitamin C, enzyme and microbial inactivation were studied under different COH treatment conditions, and the process parameters were optimized. Then, different kinetic models were fitted to enzyme and microbial inactivation and vitamin C degradation. Finally, the storage study of COH-treated (optimized level), conventional water bath-treated and untreated pineapple juice was conducted at two different temperatures.

The COH system consisted of two parts, viz., a heating cell and an isothermal holding chamber made of hollow cylindrical Teflon material. Two platinized titanium electrodes were fixed at both ends of the heating cell. The isothermal holding chamber was placed perpendicular to the heating cell and connected with a T-shaped jointer. The other accessories included were a K-type thermocouple, a variac transformer (0-500 V, 1φ, 50 Hz), a temperature controller, a peristaltic pump, and a multimeter. Five different fruit juices viz., cucumber, tomato, orange, pineapple, and lemon and three different standardized pineapple juice based on °Brix/Acid viz., 18, 22, and 26 °Brix/Acid were used for the performance evaluation of COH cell at different EFS (25 to 45 V/cm) and flow rate (80 to 120 mL/min). Come-up time (CUT) significantly ($p < 0.05$) decreased with an increase in EFS, resulting in a significant ($p < 0.05$) increase in heating rate (HR) with an increase in EFS. Also, the CUT period increased with an increase in flow rates at lower EFS, while the effect was non-significant at higher EFS. The change in the

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