Post-doctoral fellowship / Research plan

Evaluation of the continuous flow microwave processing of liquid foods

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Introduction

Continuous thermal processing of liquid foods objectives the inactivation of spoilage and pathogenic microorganisms as well as enzymes. However, the high temperature causes quality loss of the product. Continuous flow microwave heating is an emerging technology that offers high energy transfer rate and can minimize the undesired effects of the heating stage. Moreover, microwave energy has a non-thermal effect on enzyme inactivation, which can reduce the processing temperature, thus improving retention of thermo labile constituents and sensorial characteristics [1-4]. Research is required in order to study and evaluate the feasibility of the liquid food processing using microwave technology under continuous flow. It is important to characterize the product/microwave interaction and to examine the time-temperature profiles in the continuous system.

Objectives

- Test the new continuous flow microwave HTST/UHT processing unit in order to determine the operational range and best procedures.
- Evaluate the time-temperature profiles of the continuous flow microwave system under different operational conditions (flow rate and temperature) using model foods.
- Determine the dielectric properties of a liquid food as affected by microwave frequency and temperature. Considered products: green coconut water, orange juice and apple juice.
- Determine the best operational conditions based on product quality and shelf-life evaluation.

Materials and Methods

The main equipment to be used in this research is the Microwave UHT/HTST unit (Microthermics, USA). This pilot-scale unit can process liquid foods at flow rates between 48 and 180 L/h. It comprises: product pump, pre-heater heat exchanger, focused microwave heater at (2450 MHz, 6 kW, final temperature range: 60 to 150 ºC), holding tubes, cooler heat exchanger and back-pressure valve. The system has a touch screen with centralized controls and integrated data acquisition package.

Thermocouples provide the temperatures of the product after every stage of processing, as well as the inlet and outlet temperature of the heating and cooling media. The recorded temperatures and flow rates will be used to check the energy balances at every stage. Moreover, the combination of the temperature distribution with the residence time distribution (based on the internal volume) provides the time-temperature history of the product, which can be used to evaluate the lethality and the degradation of quality [5].

Because of the complexity of the processing equipment, preliminary tests using model foods such as distilled water, CMC solutions or glycerin solutions, will be required to understand the operation procedures, to verify the ranges of the operation variables and to train the personnel. Some liquid foods to be tested are: green coconut water, orange juice and apple juice.

The dielectric properties (dielectric constant and dielectric loss factor) of the chosen product will be determined for a wide frequency range that comprises the industrial frequencies (915 and 2450 MHz) and for various temperatures between 0 and 125 ºC. This will be accomplished through a network analyzer with a dielectric probe kit (Agilent, USA) [6].

Finally the chosen food will be processed at different conditions and the quality of the final product will be evaluated in order to determine the best conditions. Nutrient concentration, color parameters, enzymatic activity will be the main variables of interest [7].

Activities and Schedule

Activity	1st semester	2nd semester	3rd semester	4th semester
1. Bibliographical research	X			
2. Preliminary tests	X			
3. Evaluation of time-temperature profiles		X		
4. Determination of the dielectric properties			X	
5. Study of continuous processing and product			X	X

References

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