Kinetic study: thermal destruction of Clostridium sporogenes PA 3679 in concentrated maple sap

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Maple sap is a liquid extracted from maple trees in early spring. The sap is practically sterile while extracted from the tree, however rapidly contaminated during handling and processing. Typically, microbial load varies from 104 to 106 (CFU/ml) while harvesting. Raw sap undergoes reverse osmotic process for concentration, meanwhile this operation also concentrates the microorganisms present in the sap. Enrichment of microorganisms affects quality of the sap and its derived products remarkably. Consumption of concentrated maple sap as a novel soft natural drink has increased considerably in recent years worldwide but mainly in North America. Adequate process is required in order to eliminate the microorganisms and stabilize the quality of the concentrated maple sap for further consumption. Thermal process is a safe preservation technique, however severe thermal processing may affect negatively the quality of the product for consumer acceptance. Therefore, it is important to evaluate the right thermal processing parameters such as D and Z values for a given product and processing technique.
Spores of Clostridium sporogenes PA 3679 strain and selected TPGY culture media were used as a surrogate to evaluate the thermal destruction kinetic parameters of spores in phosphate buffer and concentrated maple sap (10, 20 and 30 °Brix) over a range of temperature (90 to 105°C). Concentrated sap (pH 7.91±0.15) was first filtered using a 0,45 µm filter under vacuum resulted in no microbial counts before inoculation (7 log/ml). Capillary tubes and oil bath were then used as conventional thermal processing to study sterilization kinetic parameters. D-values for concentrated maple sap varied from 6.57±0.50 to 0.35±0.06 min depending on the sap concentration and temperature with an average z-value of 7.84±0.42 °C. However, using phosphate buffer, D-values (3.01±0.16 min) were almost double of those obtained for different concentrated sap (1.58±0.13 min) at 100°C. The result of this study can be used by maple sap industries to design and perform a safe thermal process for pasteurization and/or sterilization of concentrated sap. It could also serve as a bench mark in the development of advanced green technologies such as Ohmic heating.
Keywords:, Maple Sap, C. sporogenes, Thermal Destruction, Kinetic Parameter