A newly designed ohmic heating cell for establishing microorganism destruction kinetics

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Ohmic heating is a rapid and volumetric internal heating process based on the generation of heat within a food matrix due to its resistance to the passage of an electrical current. A long-standing interesting research was carried out on the evaluation of the efficiency of this process to inactivate microorganisms. Early literature has been inconclusive on the nonthermal effects of this process compared with conventional thermal heating. This discrepancy is the result of using different complicated ohmic heating systems and the unkown behaviour of microorganism's under the combined effect of heating and electrical field. Therefore, this study was aimed to design a new laboratory scale ohmic heating system able to assess easily the death kinetic of microorganisms as the capillary tubes used for conventional thermal process. A new small cell of 3 ml active volume was designed and validated in our laboratory. The gap between the two electrodes is only 3 cm which leads to fast heat of food liquids in a continuous applied voltage gradient ranging from 20 to 90 (V/cm) while maintaining the target temperature during holding time. Trials with salt and sugar solutions were performed to define the coldest spot of the cell as one of the main critical processing factor. Model solutions were heated under agitation at various temperatures up to 120 ºC and at different voltage gradients. Uniformity of temperature in the cell was confirmed by comparative temperature measurements at different locations inside the cell. Come-up times (CUT) for the 3 ml of liquid varied from 10 to 50 seconds which is comparable to those obtained using capillary tubes in conventional thermal bath. CUT depends on the electrical conductivity of food, target temperature, voltage gradient and proportional–integral–derivative (PID) temperature control loop. Death kinetics of selected microorganisms was tried under defined ohmic heating conditions while monitoring coldest point time-temperature profile. Obtained kinetic parameters (D and Z values) were compared with conventional thermal bath. This new developed ohmic cell is an appropriate and practical tool for establishing the microbial destruction rate under ohmic heating comparing to conventional thermal process.
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