

ABSTRACT

The effects of high pressure processing, on physicochemical attributes and microbial inactivation kinetics of natural microbiota in black tiger shrimp was investigated within the range of 100-600 MPa/3-15 min/30 °C. The color parameters L^* (lightness) and b^* (yellowness) increased but a^* (redness) decreased with both pressure and holding time increment; imparted brighter and mildly cooked appearance to shrimp muscle. Pressure-induced lipid oxidation accelerated at pressure treatments >300 MPa. Hardness was found to be influenced by both pressure level and holding time. Among the group of microorganisms studied, pressure sensitivity of *E. coli* was found to be maximum, whereas, aerobic mesophiles were least sensitive (z_p values of 421 MPa and 714 MPa; ΔV values of $-18.60 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$ and $-9.13 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$, respectively).

Further the effect of process variables (300-600 MPa/0-15 min/30-60 °C) on the inactivation kinetics of inoculated pathogens (*E. coli* 0157:H7, *L. innocua* ATCC 33090, and *S. aureus* ATCC 29213) and polyphenoloxidase (PPO) enzyme activity in black tiger shrimp was studied. *S. aureus* was found to be the most baroresistant among the three pathogens studied and all the pathogens were eliminated beyond 50 °C. PPO enzyme was found to be sensitive to both pressure and temperature upto 50 °C, above which no significant difference was observed in the inactivation rates.

A central composite rotatable design was applied to evaluate the effect of processing parameters on inactivation rate of *S. aureus*, physical properties (color and texture) of shrimp and to optimize the process conditions to achieve maximum bacterial inactivation with minimal changes in quality attributes. The results revealed that processing conditions significantly affected the inactivation rate, hardness, color and the experimental data has been adequately fitted into a second-order polynomial model with regression coefficients (R^2) of 0.922, 0.874 and 0.945, respectively. The optimized condition satisfying the processing targets was obtained as: pressure, 361 MPa; time, 12 min and temperature, 46 °C. The adequacy of the model equations for predicting the optimum response values was verified effectively by the validation data.

The shrimp samples vacuum packed in low density polyethylene (LDPE), ethylene vinyl alcohol (EVOH) and multilayer metalized polyester (MMP) pouches treated at optimized high pressure condition were examined for different quality attributes during storage at 4 °C, 15 °C and 25 °C for 30 days. Based on sensory and microbiological results, the high pressure treated samples stored at 4 °C in EVOH, MMP and LDPE films showed a shelf-life of 30, 27 and 18 days, respectively, as compared to 6 days for untreated samples. The samples showed a shelf-life of 6 days stored at 15 °C and less than 3 days at 25 °C. Among the three packaging materials employed, EVOH film was adjudged to be best in preserving the quality of shrimp.

Keywords: Black tiger shrimp; High pressure processing; Microbial destruction kinetics; Enzyme inactivation kinetics; Quality; Response surface methodology; Refrigerated storage; Shelf- life, Packaging