BIO-DATA

The author received her Bachelor degree in Agricultural Engineering followed by Master's degree in Processing and Food Engineering from Punjab Agricultural University, Ludhiana, Punjab, in 2006 and 2009 respectively. She received Senior Research Fellowship under National Agricultural Innovation Project-Indian Council of Agricultural Research (NAIP-ICAR) funded project entitled "High pressure processing of high value perishable commodities" at Indian Institute of Technology Kharagpur in September 2009. She enrolled in the doctoral program at Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur in January 2010. She cleared the 'National Eligibility Test (NET)' conducted by ICAR in 2010. She joined as Assistant Professor in 2013 in Department of Food Engineering, National Institute of Food Technology Entrepreneurship and Management (NIFTEM). She has filed two patents, published nine research papers in international peer reviewed journals, two books, three book chapters and presented two papers in international and one in National conference.

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CONTENTS

LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation/Symbol	Description
A_f	Accuracy factor
A_t	Enzyme activity at time *t*
A_0	Enzyme activity before pressure treatment
A_{PE}	Enzyme activity after pulse pressurization
Adj.	Adjusted
ANOVA	Analysis of variance
AOAC	Association of official analytical chemists
ATP	Adenosine triphosphate
β	Shape factor
C	Control
°C	Degree centigrade
CCRD	Central composite rotational design
CFU	Colony forming unit
d_i	Desirability function
D_i	Overall desirability function
D_P	Decimal reduction time
E_a	Activation energy
ΔE^*	Total color change
E. coli	*Escherichia coli*
et al.	And others
EVOH	Ethylene vinyl alcohol
Fig.	Figure
g	Gram
h	Hour
HPP	High pressure processing
Hx	Hypoxanthine
H_2S	Hydrogen sulphide
k	Microbial death rate constant
K	Kelvin
kg	Kilogram
kJ	Kilo joule
L	Litre
LDPE	Low density polyethylene
L. innocua	*Listeria innocua*
Log	Logarithm
m	Metre

Abbreviation/Symbol	Description
mm	Millimetre
min	Minute
MMP	Multilayer metalized polyester
Mol	Mole
MDA	Malondialdehyde
MPa	Megapascal
nm	Nanometer
N_t	Microbial population after time *t* treatment
N_0	Initial number of microorganisms before pressure treatment
N_{PE}	Microbial population after pulse treatment
ND	Not determined
OAS	Overall acceptability sensory
p	Probability of accepting null hypothesis
P	Pressure
Pa	Pascal
PE	Pulse effect
PTM	Pressure transmitting medium
%	Percent
PPO	Polyphenoloxidase
R	Universal gas constant
R^2	Coefficient of determination
RA	Relative activity
ref	Reference
RMSE	Root mean square of error
RSM	Response surface methodology
s	Second
S. aureus	*Staphylococcus aureus*
SCADA	Supervisory control and data acquisition
SD	Standard deviation
SE	Standard error of mean
SEM	Scanning electron microscopy
sp.	Single species
spp.	Plural form of species
SSE	Sum of square of error
T	Temperature
TBA	Thiobarbituric acid

Abbreviation/Symbol	Description
TMA-N	Trimethylamine nitrogen
TMAO	Trimethylamine oxide
TPA	Texture profile analysis
TVB-N	Total volatile basic nitrogen
V_{a}	Activation energy
WVP	Water vapor permeability
μm	Micrometer
δ	Shape factor
ΔV	Activation volume
z_p	Pressure sensitivity

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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 -18.60×10^{-5} m^3 mol^{-1}and -9.13×10^{-5} m^3 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 found to be the best packaging material for preserving the quality of high pressure processed shrimp.

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