ABSTRACT

Rohu (*Labeo rohita*) belongs to Cyprinidae family, is a highly relished freshwater bony fish having unique flavour, texture, and protein with good amino acid profile. Fish after harvesting and its subsequent cessation of life, is subjected under ice or frozen conditions either for storage or transportation. The stored fish quality is very much concerned to public health. Thus, present study was focused to explore the freshness of Rohu (stored at 5, 0 and -5^{o}C) and its characterisation, kinetic modeling, and non-destructive parameterisation. At first, chemical freshness parameters were characterised, and the result showed that pH increased continuously for the sample stored at 0 and -5^{o}C whereas it was increased up to 22 days and then declined at 5^{o}C storage. TVB-N value of fresh Rohu was 4.57±0.321mg/100g and upon 42 days of storage at 5, 0, -5^{o}C; was found to be 46.56±0.994, 28.69±0.231, and 10.09±0.115mg/100g, respectively. TMA-N values for all samples increased significantly ($p<0.05$) in all the samples. The FFA and TBA were also significantly affected by the storage temperature and duration. The above chemical freshness parameters were studied to explore the pattern of their formation in Rohu muscle. In the subsequent phase, the storage period was reduced to 24 days; 5 and 0^{o}C storage temperature was considered for the major range of storage conditions and further -5^{o}C was undertaken just for comparing the dynamics between the limited frozen and refrigerated status of Rohu. Then, morphological, thermal transition and GC analysis were executed to explore in-depth understanding of the changes brought under muscle matrix during storage. SEM analysis indicated the muscle morphology in terms of collagen fibres, microfibrils and scattered cells which were affected during storage because of the enzymatic degradation of collagenous and sarcoplasmic proteins. Qualitatively, FT-IR spectra also validated TVB-N, TMA-N, TBA and FFA formation in the form of amide A, B, amide I, II, III, IV, amines and lipid band change. GC analysis signified the presence of methyl palmitate-12 in a higher percentage followed by cis 9-oleic acid methyl ester -18, methyl linoleate-20, methyl stearate-16, and methyl linolenate-24. These fatty acids decreased throughout the storage period compared to fresh sample (0 day). Afterward, kinetic modeling of biogenic volatiles attributed the n^{th} ($n<1$) order, a best fit model to predict TVB-N and TMA-N (5 and 0^{o}C storage). The activation energy response of the n^{th} ($n<1$) order of biochemical changes was 176.20 (TVB-N) and 11.46 kJ/mol (TMA-N). The zero-order kinetic was found to be the best fit model for representing the colour of the gills at -5°C and 5°C storage temperatures, whereas the first order at 0°C. The nth-order kinetics was found to be the best fit model for representing the hardness at 0, and 5^{o}C, and first-order kinetics for -5°C storage temperature. The best kinetics of microbial changes (TVC) was represented by Gompertz model (5^{o}C) and modified Gompertz model (0 and -5^{o}C). Then, a non-destructive model was developed as a capacitive sensor which produced capacitance of the sample and further converted into dielectric constant (K) data ranged 4.20 –29.48. K continuously decreased for the sample storage at -5^{o}C and initially it decreased (up to 11, 15 days of storage at 5^{o}C, 0^{o}C, respectively) and then increased continuously. An ANN-based predictive model was successfully exercised to correlate the dielectric constant with the chemical freshness parameters.

Keywords: Rohu, Chemical Freshness, Volatiles, Lipid oxidation, DSC, GC, FT-IR, SEM, Hardness, Colour, Mathematical Modeling, Capacitive Sensing Module, ANN and GPR Analysis.