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Comparison of Proteomic Changes and Meat Quality between Fresh and Freeze-Thawed Pork Loins

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Objectives

Proteomic studies help us to understand various biochemical changes in meat and meat products. In the present study, a comparison of proteomic changes between fresh and freeze-thawed pork loins were performed to identify protein markers that relate to pork quality.

Materials and Methods

Longissimus thoracis m. (n = 10, the 6th through 12th *thoracic vertebrae*) were taken from pigs (Yorkshire×Landrace×Duroc, 82.2±4.3 kg carcass weight) in a commercial slaughterhouse at 24 h postmortem. The loins were cut into 3 pieces of 3.0 cm thickness each and randomly allocated to 3 treatments: FR0 (no storage); FR5 (5 d of cold storage at 0°C); and FT5 (frozen at –20°C for 4 d and thawed at 0°C for 1 d). All the chops were vacuum packed in plastic bags. Meat quality characteristics such as pH, meat color (CIE L*, a*, b*, chroma and hue), drip loss and Warner-Bratzler shear force (WBSF) were analyzed. The proteins extracted from the pork loin chops were digested with trypsin, and the digested peptides were separated using LC-ESI/MS (Thermo Fisher Scientific, MA). To quantify the MS/MS spectra, MaxQuant software (ver. 1.5, Max Planck Institute of Biochemistry, Germany) was run with normalization of MS spectra followed by the label-free quantification (LFQ). Peptides and proteins were derived from the SwissProt database (*Sus scrofa*; 66493 sequences). The LFQ intensities were compared between the treatments, and significant differences were accepted at –10×log(P-value) > 13.0. The meat quality data were analyzed with an ANOVA in SAS software (ver. 9.4; SAS Inst. Inc., Cary, NC), and differences among the treatments were considered to be significant at $P < 0.05$.

Results

The values of CIE L* decreased from 54.30 (FR0) to 49.98 (FT5; $P < 0.01$) by freeze-thawing, whereas pork loins stored at 0°C were not different from those in the FR0 treatment ($P > 0.05$). In contrast, the value of CIE a* did not change by freeze-thawing ($P > 0.05$), but the FR5 samples showed a higher CIE a* (7.08) value than the other treatments ($P < 0.05$). CIE b*, chroma and hue values were increased by both cold storage and freeze-thawing ($P < 0.05$). Both WBSF (3.65 kg/cm^2) and drip loss (5.61%) were increased by freeze-thawing ($P < 0.05$), but FR0 was not significantly ($P > 0.05$) different from FR5 in terms of WBSF (2.77 kg/cm2) or drip loss (2.77%). These results indicate that 5 d of cold storage affected the pork loin color intensity very slightly, but freeze-thawing reduced the lightness of the pork loin despite of 5 d of storage. Furthermore, freeze-thawing lowered the water-holding capacity and the tenderness. A total of 29 proteins were seen to be significantly different among the treatments ($P < 0.05$). Levels of metabolic enzymes such as glyceraldehyde-3-phosphate dehydrogenase, pyruvate kinase, fructose-bisphosphate aldolase A and adenylate kinase isoenzyme 1 decreased during storage regardless of the treatments ($P < 0.05$). Structural proteins such as actin, troponin T and desmin were also decreased in both FR5 and FT5, but the other structural proteins, including myosin-4 and troponin I, were decreased in FT5 only.

Conclusion

The deterioration of pork loin quality was observed at 5 d of cold storage and freeze-thawing. The levels of sarcoplasmic proteins including metabolic enzymes were decreased by cold storage or freeze-thawing; however, myofibrillar proteins such as myosin-4 and troponin I could be decreased by freeze-thawing.

