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Biochemical and Gelation Properties of Mechanically Separated Pork

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Objectives

Mechanically separated pork (MSP) is an underused low value by-product that is produced by applying pressure to separate soft muscle tissue from bones. It demonstrates poor gelation properties despite similar chemical composition to hand deboned pork. The objectives of this study were to explore the physicochemical, biochemical, and gelation properties of MSP and the effect of freezing rate on quality of MSP during frozen storage.

Materials and Methods

The MSP was produced from pork picnic bones 1 d after slaughter using a ProTEN linear press (Marel, Iceland) and BAADER soft separator (Germany). The MSP (17.0% protein, 18.9% fat) was frozen in a blast freezer (in 25 kg waxed boxes) to –20°C at 3 different rates: held at 4°C for 4 h before blast freezing (MSP-DL: MSP delay), blast frozen immediately (MSP-STD: MSP standard), or pre-chilled by a heat exchanger before packing and blast freezing (MSP-PC: MSP pre-chill).

Meats were collected on 3 production days as replicates. For each replicate, 2 boxes of MSPs were sliced and stored at –18°C. Boneless pork picnic (PP, 18.0% protein and 14.6% fat) from the same production day was coarsely ground, vacuum packed and stored at –30°C. Lipid oxidation and protein solubility were determined. Samples were also prepared and imaged by transmission electron microscopy (TEM). Natural actomyosin (NAM) was extracted (20 mg/g) for SDS-PAGE and dynamic rheological profiles (heating cycle: 25 to 85°C at 1°C/min) following 1, 4, 7 mo of frozen storage with complete set of data shown from rep 1. Data was analyzed using a mixed model with storage time as a repeated measurement.

Results

After pre-chilling, the temperature of MSP-PC was ~1°C, while MSP-DL or STD packed directly after deboning were at ~8°C. TEM imaging revealed that PP tissue had well preserved sarcomere structure with closely packed actin-myosin filaments bundles. But MSP showed randomly oriented, curved and twisted actin-myosin filaments indicating high level of ultrastructural disruption.

The percentage of soluble myofibrillar protein for PP was 53% of total protein, and significantly higher ($P < 0.05$) than that of MSP-DL, STD, and PC with 44, 46, 45% respectively at 1 mo storage. Soluble myofibrillar protein significantly decreased ($P < 0.05$) for all samples during frozen storage (42, 33, 33, and 34%, respectively after 4 mo).

The NAM electrophoresis profile showed that the intensity of the myosin heavy chain band from MSPs was only about 65% of that of PP following 4 to 7 mo of frozen storage. Multiple additional bands from 130 to 150 kDa and new 9 kDa and 17 kDa bands were observed in NAM from MSPs indicating degradation. During rheological analysis, the slope of storage modulus (G') of NAM from MSPs was much lower than that of PP after 58°C, showing the lower elasticity of gel, and poorer development of a 3-D network.

The MSP-PC had slightly lower lipid oxidation (~0.8 mg malondialdehyde (MDA)/kg meat) compared with MSP-DL and STD (~1.1 mg MDA/kg meat) during 1 to 7 mo of storage period, with values remaining quite stable during storage.

Conclusion

The results showed that gelation ability of MSPs was decreased by the mechanical separation process, not only because of the decrease in extractable myofibrillar protein, but also the degradation of myosin heavy chain. The initial freezing rate didn't play a major role in gelation behavior.