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Changes in Properties of Bovine and Porcine Myosins during Postmortem Aging

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Background:

Myosin in muscle proteins is well-known to play important roles in making meat products such as sausages. Especially, gelation properties of myosin are involved in the development of texture of sausages (1). Heat-induced gelation of myosins is thought to be brought about by the successive heat-denaturation of their heads (S-1) and rods. The denaturation of myosin heads leads to their aggregation, and then the denaturation of myosin rods results in the formation of the network by their interactions.

In Japan, meats stored at 4 ℃ for several days and imported under vacuum-packing from foreign countries are used for making sausages. Various changes in muscle proteins occur during postmortem aging of beef and pork at low temperature. However, there are few studies on the effect of postmortem aging on physico-chemical properties and heat-induced gelation of bovine and porcine myosins.

Objectives:

This work was accomplished to examine effects of postmortem aging on shear modulus of heat-induced gels of bovine and porcine myosins, and to analyze the changes in physico-chemical properties of both myosins during postmortem aging.

Materials and methods:

Postmortem aging of bovine and porcine muscles-Beef and pork loins stored at low temperature for 3 and 2 days, respectively, after slaughter were obtained, and were then stored at 4 ℃.

Isolation of porcine and bovine myosins-Bovine and porcine muscles (*M. longissimus. dorsi*) stored at 4 ℃ for 3, 5, 7 and 9 days after slaughter were minced and homogenized with Hasselbach-Schneider buffer (pH 6.4), whose volume was 3 times the weight of minced meat. The homogenate was diluted two times with distilled water, and centrifuged at 3,000 x g for 10 min. The supernatant was also diluted two times with distilled water, and centrifuged at 10,000 x g for 15min. The precipitate was washed twice with 0.1 M KCl/10 mM PIPES buffer (pH 6.5) and suspended in the same buffer.

Measurement of shear modulus of heat-induced myosin gels-Shear modulus was measured by the procedures described by Yasui *et al.* (2) in order to examine the strength of heat-induced gels made from bovine and porcine myosins. 0.5 % (w/v) of bovine or porcine myosin solution (0.5 M KCl/20 mM PIPES buffer (pH 5.2-6.5)) was heated at 65 ℃ for 20 min to form a gel.

Turbidity measurement-Effects of heating on turbidity of myosin solution were examined using a spectrophotometer (SHIMAZU, UV-250). The absorbance of 0.1 % (w/v) of bovine or porcine myosin solution (0.6 M KCl/50 mM K-phosphate buffer (pH 6.5)) at 340 and 660 nm was measured during heating from 30 to 80 ℃ at 3 ℃/min.

Measurement of hydrophobicity-Effects of heating on hydrophobicity of myosins were measured according to the methods reported by Boyer *et al.* (3). Three milliliter of 0.004 % (w/v) bovine or porcine myosin solution (0.6 M KCl/50 mM K-phosphate buffer (pH 6.5)) was heated at each temperature from 30 to 80 ℃ for 5 min and cooled on ice. Ten microlitter of 1 mM cis-parinaric acid (cPA) or 5 mM 8-anilino-1-naphthalene-sulphonic acid (ANSA) was added into each solution. The fluorescence of cPA- or ANSA-protein complex was measured with a spectrofluorometer.

Measurement of CD spectrum-Effects of heating on CD spectra of bovine and porcine myosins were analyzed employing a CD spectrometer (Jasco J-720W). 0.005 % (w/v) of bovine or porcine myosin solution (0.6 M KCl/50 mM K-phosphate buffer (pH 6.5)) was heated from 15 to 75 ℃.

Results and discussion:

Changes in gel strength during postmortem aging-The strength of heat-induced gel made from bovine myosin solution was largest at pH 6.0, while that of heat-induced gel made from porcine myosin solution was largest at pH 6.2. The gel strength of the former was larger than that of the latter during postmortem aging. The strength of heat-induced gel made from bovine or porcine myosin at 3 days after slaughter was largest during postmortem aging. This value of bovine and porcine gels gradually decreased as postmortem aging was longer. Especially, the strength of heat-induced gel made from bovine myosin at 9 days after slaughter decreased rapidly.

Changes in turbidity and hydrophobicity of myosins by heating during postmortem aging-Aggregation of myosin by heating was analyzed by changes in turbidity of bovine and porcine myosin solutions at 340 and 660 nm. Both myosins isolated from beef and pork during postmortem aging started aggregating at about 45 ℃. The velocity of aggregation of bovine myosin was larger than that of porcine one. The turbidity of bovine myosin solution after heating was larger than that of porcine one. The turbidity of bovine myosin solution after heating did not change during postmortem aging. On the other hand, the turbidity of porcine myosin solution after heating increased as postmortem aging was longer.

The hydrophobicity of both myosins increased by heating. The hydrophobicity of bovine myosin after heating did not change during postmortem aging. On the other hand, the hydrophobicity of porcine myosin after heating increased as postmortem aging was longer, especially it increasing rapidly at 7 and 9 days after slaughter. From the results in the measurements of turbidity and hydrophobicity, the conformation of head (S-1) in porcine myosin seemed to change during postmortem aging.

Changes in CD spectra of myosins by heating during postmortem aging- Effects of heating on α-helix contents of bovine and porcine myosins were examined by the analyses of CD spectra. The α-helix contents of both myosins decreased by heating. The observation of molar ellipticity at 222 nm showed that the decrease in α-helix contents of porcine myosin by heating did not change during postmortem aging. On the other hand, the decrease in α-helix contents of bovine myosin by heating became larger at 9 days after slaughter, suggesting that the conformation of rod in bovine myosin changed during postmortem aging.

Conclusion:

The conformation of rod in bovine myosin changed during postmortem aging for 9 days, while the conformation of head (S-1) in porcine myosin changed. These changes in both myosins resulted in the decrease of the strength of their heat-induced gel during postmortem aging.

References:

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(3) Boyer, C., Joandel, S., Ouali, A. and Culioli, J., *J. Sci. Food Agric.*, **72**, 367-372 (1996)

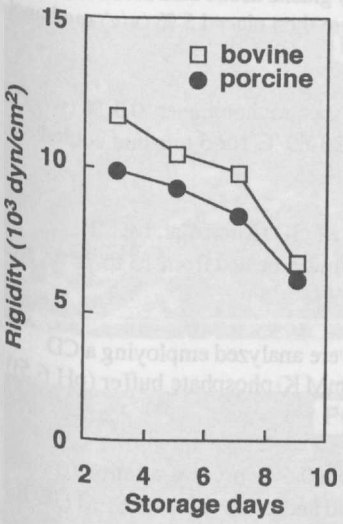

Fig. 1. Changes in rigidity of the heat- induced gels of bovine and porcine myosins during postmortem aging

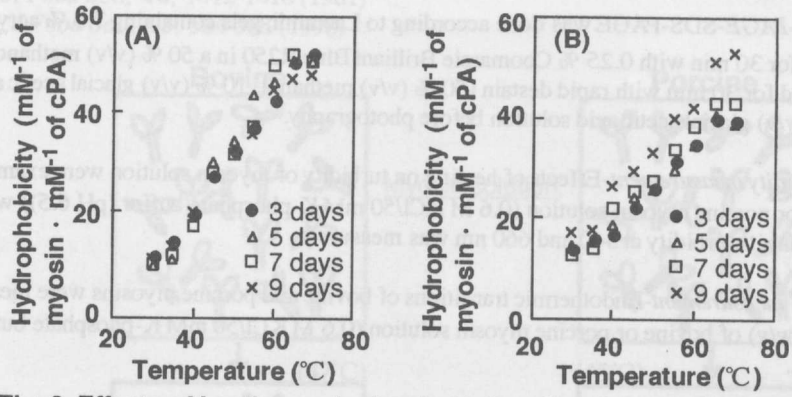

Fig. 2. Effects of heating on hydrophobicity of bovine (A) and porcine (B) myosins prepared from muscles during postmortem aging

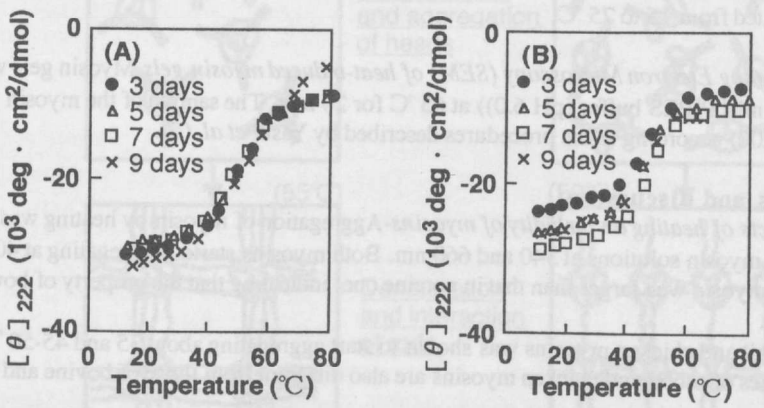

Fig. 3. Effects of heating on [θ] 222 of bovine (A) and porcine (B) myosins prepared from muscles during postmortem aging