Affecting factor of the natural casing toughness and tenderizing method for the Chinese hog casings

Wenjun Liu, Satomi Tsutsuura, Tadayuki Nishiumi

Graduate School of Science and Technology, Niigata University, Niigata, Japan

Objectives: Casings greatly influence the texture of sausages. Natural casings are preferred for their moderate elasticity and unique texture. But natural casing has uneven texture quality characteristics. Casings too tough and too soft are not acceptable for consumers and manufacturers, respectively. The textural quality of natural casings usually appeared to be induced by the differences in animal origins and/or slaughter age. Especially in sheep casing products, sometimes there are mixed goat casings. The present study used sheep casings from New Zealand and China and goat casings from China to investigate the affecting factor of natural casing toughness. On this basis, the Chinese hog casing, generally considered as tough, attempted to improve the tenderizing quality and to examine the collagen structure changes.

Materials and Methods: Salted natural hog casings (36-38 mm in diameter), sheep casings (20-22 mm), goat casings (20-22 mm) from China, and sheep casings (20-22 mm) from New Zealand were used. All materials were obtained from a natural casing retailer. They were washed and desalted in running water for 1 hour to subject a series of analyses. The desalted casings were cut into one layer sheet (cutting along one designated side of the cylindrical curved casing to another side to the middle of the sheet), and the toughness of each casing sheet was measured by using a rheometer (NM-2002J Rheotech) at the middle position. The tough- ness was indicated by the maximum load value (breaking stress, N) when a columnar plunger with a diameter of 3 mm was loaded perpendicularly, and the plunger broke through the casing. The casings' powdered dried-defatted matter was heated for 70 min at 77 ℃ in distilled water and separated into heat-soluble and insoluble fractions by twice centrifugations. The individual sample fractions were then hydrolyzed in 6 N HCl for 24 hours at 110 ℃, and the hydroxyproline contents of the hydrolysates were deter- mined. The total concentration of natural casings collagen for each sample was determined by adding the amounts of heat-soluble and insoluble collagen. The percentage of soluble collagen in each casing sample was calculated. The casing was fixed with a 2% paraformaldehyde-2.5% glutaraldehyde solution (0.1 M phosphate buffer, pH7.4). According to the cell-maceration/ scanning electron microscope (SEM) method, the fixed samples were treated with a 10% NaOH aqueous solution for five days and then washed with distilled water for three days. The sample was treated with the tannin-osmium method, dehydrated with an alcohol system, and the solution was replaced with t-butyl alcohol to freeze-dried. Then, gold and palladium were vapor-deposited, and the sample was observed using a SEM. The desalted hog casings (36-38 mm in diameter) from China were soaked in 0.2 M citric acid at 25, 40, 45, and 55 ℃ for 1 hour and washed 24 hours with running water. And then, the toughness test and the collagen structure ob- servation were carried out using the methods described above.

Results and Discussion: The breaking stress in the goat casing from China is significantly higher ($P<0.01$) than in sheep casings from China and New Zealand. It is considered that the difference in animal species causes variation in toughness. Compared to the sheep casings from China and New Zealand, the goat casings from China have a higher ($P<0.01$) total collagen content and a lower ($P<0.01$) collagen heat solubility. In goat casings from China, their thickness and the consisting collagen fibers' density and diameter were the highest. These results suggest that the toughness of the natural casing could be influenced by the collagen fibers' histological structure and thermodynamic stability. Therefore, the natural casing can be tenderized by damaging treatment of collagen fibers' structural and/or thermodynamical strength. To tenderize the Chinese hog casing, it was soaked in 0.2 M citric acid at 25, 40, 45, and 55 °C for 1 hour. As a result, it was shown that soaking in 0.2 M citric acid at 55 ℃ for 1 hour had significantly tender- ized the Chinese hog casing. In addition, the collagen fiber structure observation using a SEM showed no changes at 0.2 M citric acid, 20 and 40 ℃ 1-hour treatment. But the collagen fibers/fibrils were weakened at the increased temperature of 45 °C, and the effect becomes more noticeable when the temperature rises to 55 ℃. From this result, the tough hog casing became tender after the soaking treatment of 0.2M citric acid (55 ℃ for 1-hour), because of the collagen fibers' structure destruction. It is reverse proof that the hardness of natural casing is affected by the heat and/or structural stability of collagen fibers.

Key words: Natural casing, Toughness, Collagen, Tenderizing