MECHANICAL AND BIOCHEMICAL PROPERTIES OF NATURAL SAUSAGE CASING TREATED WITH TRISODIUM PHOSPHATE

S. Nakae*[1], T. Osida[1], T. Nishiumi[2], H. Yun[3] and R. Sakata[1]

[1] *School of Veterinary Medicine, Azabu University, Sagamihara 229-8501, Japan*
[2]*Faculty of Agriculture, Niigata University, Niigata 950-2181, Japan*
[3] *New Asia Trading Co., Ltd., Osaka 541-0055, Japan*

Key Words: Sheep casing, phosphate, collagen, hydroxyproline, tenderization

Introduction

Casing is an intestine membrane used for stuffing sausage. Natural and artificial casings are presently in use for this purpose. Animal origin casing may be obtained from sources such as hogs, sheep, goats, cows and horses. Artificial casings contain vinylidene chloride, cellulose and collagen, offer moderate bite-resistance and possess special texture, a property shown essential for human consumption. Natural casing is thus preferable to the artificial type. Natural casing is also superior in aeration (smoke permeability) and elasticity. But there are certain factors that may give rise to lack of uniformity in quality, such as animal age. Thus, processes to ensure adequate tenderization and quality uniformity in other regards have thus become required world-wide (Reichert, 1998).

Currently, natural casing is treated by enzymes and/or organic acids (lactic acid, acetic acid and citric acid, Sakata *et al*., 1998) and/or trisodium phosphate (TSP) at casing plants (Houben *et al*., 2005). TSP is a phosphate which gives alkaline aqueous solution. In Japan, this compound is used as a food additive and may serve as a source of brine, emulsifier agent and binding accelerator. But application of this compound for sausage casing industry is presently based on experience. The present study examines the mechanical and biochemical properties of Chinese sheep casing treated with TSP (TSP casing). Casing strength was taken as a mechanical property and the heat solubility of collagen, as a biochemical property in this study.

Materials and Methods

1. Strength evaluation

Sheep casing processed in China was used in this study after being washed in water for desalting for a period of more than 6 hours in the summer season or 12 hours in the winter. The casing was divided 2 into portions, TSP casing soaked in 1% TSP solution, 5 parts water to 1 part casing by weight and the other, casing placed in distilled water as the control. The TSP-treated casing was maintained at 5°C, followed by washing in water for 10 min. Casing strength was measured in all cases with a Rheometer (Creep Meter Model RE2-33005S, YAMADEN, Tokyo). Maximum force and breaking strain of all samples were determined, each 60 times.

2. Solubility of collagen with heat application

The casing sample was frozen and crushed with liquid nitrogen, defatted and dried using a mixture solution of chloroform and methanol (2:1) (Nishiumi *et al*., 2005). The powder thus obtained was used as dried defatted matter (DDM). DDM was heated at 70 min for 77°C to extract the collagen and subsequently separated into a supernatant and residue by centrifugation ($700 \times g$, 30 min). The supenatant was hydrolyzed by an equivalent volume of concentrated HCl and the residue was hydrolyzed by 6N HCl at 110°C for 24 hr. Hydroxyproline content was then measured spectrophotometrically. Hydroxyproline is present only in collagen protein and collagen-like substances and consequently, determination of collagen content is carried out based on hydroxyproline content in casing. The solubility of collagen with heat application may be found based on the thermostability of casing. Soluble collagen (A) content with heating was computed using the supenatant while that for the insoluble collagen (B), using the residue. Total collagen content was expressed as (A) + (B). The solubility of collagen with heating was derived as, soluble collagen content / total collagen × 100 (%).

3. Statistical analysis

The *t*-test of the SAS system was used for this purpose. The control and TSP casings were examined to find any significant difference in maximum force and breaking strain, and both casings were examined to determine soluble, insoluble and total collagen content as well as solubility with heat application.

Results and Discussion

1. Strength evaluation

Table 1 presents values for maximum force and breaking strain, both significantly greater in the control compared to TSP casing. **Figure 1** shows the waveform when casing was broken mechanically. Broken casing thus exhibited less maximum force and breaking strain than the control. TSP casing may thus possibly become more fragile due to TSP.

2. Solubility of collagen with heating

Soluble collagen was 10.98 (control) and 11.74 (TSP casing) mg/g DDM whereas insoluble collagen was 615.64 (control) and 532.48 (TSP casing) mg/g DDM, these values differing significantly (**Table 2**). A comparison of the two casings indicated TSP casing to contain more soluble collagen but less insoluble collagen, since the casing was seen to change by TSP and the solubilization of collagen was noted to accelerate. Total collagen was 626.62 (control) and 544.22 (TSP casing) mg/g DDM. The solubility of collagen with heating was 1.75 (control) and 2.16 (TSP casing) %, the latter value being significantly higher (**Table 2**). The same was noted for soluble collagen. The control would thus appear to have greater thermostability.

Table 1. Control and TSP casing strength values

	Control		TSP	
	Mean	SD	Mean	SD
Maximum force (g)	573.23[a]*	107.55	436.15[b]	94.96
Breaking strain (%)	41.23[a]	4.62	38.05[b]	5.83

*Means with different superscripts differ significantly (*P* <0.001).

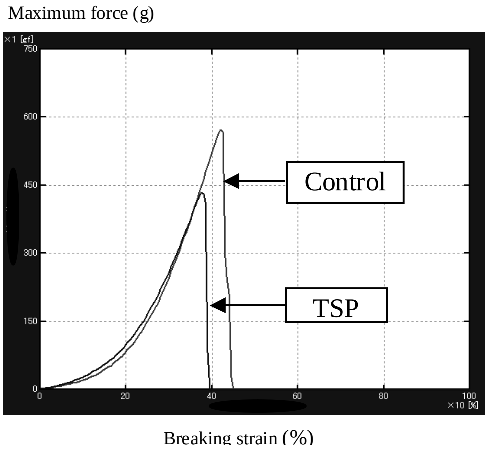

Figure 1. Strength wave patterns for sheep casing treated with and without TSP.

Table 2. Collagen solubility with heating in control and TSP casing

	Control		TSP	
	Mean	SD	Mean	SD
Soluble collagen (mg/gDDM)	10.98[b]*	0.25	11.74[a]	0.22
Insoluble collagen (mg/gDDM)	615.64[a]	10.94	532.48[b]	15.14
Total collagen (mg/gDDM)	626.62[a]	10.84	544.22[b]	15.24
Collagen solubility with heating (%)	1.75[b]	0.06	2.16[a]	0.05

*Means with different superscripts differ significantly (*P* <0.001).

Conclusions

Maximum force and breaking strain of casing were found to decrease. Collagen solubility with heating increased with TSP. TSP casing should thus show greater fragility and ease of collagen dissolution with heat application. TSP-treated casing may thus be concluded to be tenderized by this treatment, since maximum force and breaking strain decreased with reduction in collagen thermostability. Histological analysis and sensory evaluation should be conducted to clarify the mechanism for the action of TSP.

References

1. Houben, J. H., Keizer, G. and Bakker, W. A. M. (2005). Effect of trisodium phosphate on slip and textural properties of hog and sheep natural sausage casing. *Meat Science*, *69*, 209-214.
2. Nishiumi, T., Nojiri, T., Yosihara, T., Ichinoseki, S., Suzuki, A., Tanabe, M. and Sakata, R. (2005). High pressure with or without organic acids for tenderizing of Chinese hog casing. *Proceedings of the 51st International Congress of Meat Science and Technology*, T80.
3. Reichert, E. J. (1998). Methods of tenderizing edible sausage casing of animal origin. *Fleischwirtschaft, 76*, 393.
4. Sakata, R., Segawa, S., Morita, H. and Nagata, Y. (1998). Tenderization of hog casing: Application of organic acids and proteases. *Fleischwirtschaft*, *78*, 703-704.