51st International Congress of Meat Science and Technology
August 7-12, 2005 – Baltimore, Maryland USA

HIGH PRESSURE WITH OR WITHOUT ORGANIC ACIDS FOR TENDERIZING OF CHINESE HOG CASINGS

T. Nishiumi*[1], T. Nojiri[1], T. Yoshihara[1], S. Ichinoseki[1],
A. Suzuki[1], M. Tanabe[2] and R. Sakata[3]

Faculty of Agriculture, Niigata University, Niigata, 950-2181, JAPAN[1]
Central Research Institute, Itoham Foods Inc., Moriya, 302-0104, JAPAN[2]
School of Veterinary Medicine, Azabu University, Sagamihara, 229-8502, JAPAN[3]

Key Words: natural sausage casing, high pressure, organic acid, mechanical strength, collagen fiber

Introduction

In the meat industry, natural casing is preferred for the manufacture of sausage owing to its desirable texture. But such casing varies in quality, particularly with respect to strength and elasticity. Hog casing from China has far greater toughness compared to that from other countries (Sakata *et al*., 1998, Nishiumi *et al*., 1999). An appropriate method is being sought to tenderize this casing in consideration of the low price for its mass production.

Objectives

The previous study indicated that the thermal and structural stabilities of collagen fibers could be determined based on the mechanical strength of natural casing (Nishiumi *et al*., 2001). Thus, in the present, attempt was made to soften collagen through application of high pressure and various organic acids. The authors thus sought to establish a method to achieve the best results by such application to provide tenderer Chinese hog casing.

Methodology

Materials: Analysis was conducted on hog casing (32-34 mm in diameter) from China after being washed and desalted in running water.

Mechanical strength measurement: Mechanical strength of the casing prior to and following high pressure and acid treatment was measured using a Rheometer (Fudoh NMR-2002J, Tokyo). The peak breaking point of casing strength was found using a cylindrical plunger 3-mm in diameter inserted into the casing.

High pressure treatment: Desalted casing was packed in a polyethylene bag, sealed with distilled water and pressurized using an isostatic press (Nikkiso KK, Tokyo) under the following conditions: pressure, 100-500 MPa; time, 5-60 min; temperature, 20-70ºC.

Organic acid treatment: For acid application, desalted casing was immersed in lactic acid, acetic acid or citric acid solution at various concentrations ranging from 0.05 to 1.0 M for 10 min and then washed in running water for 30 min.

High pressure and organic acid application in cinjunction: For this treatment, desalted casing was placed in a polyethylene bag, sealed with one of the three organic acid solutions mentioned above, pressurized with 200 MPa for 10 min and then washed in running water for 30 min.

Scanning electron microscopy (SEM): Structure and arrangement of collagen fibers on the surface of casing before and after treatment were observed with a scanning electron microscope (Hitachi S-430, Tokyo). All SEM specimens were prepared according to the cell-maceration method (Ohtani *et al*., 1988).

Results & Discussion

Chinese hog casing ranged from 650-1,050 g, with mean value being 833 g. The casing is thus shown much tougher compared to other countries, being in the range, 600-700 g (Nishiumi *et al*., 2001).

The effects of high pressure under various experimental conditions on hog casing strength are shown in Table 1. This treatment brought about significant tenderizing of Chinese hog casing under optimum conditions of 200 MPa, 10 min and 20-40ºC.

Effects of three organic acid solutions at various concentrations on hog casing strength are also shown in Table 2. Acetic acid had no effect while 0.2 M lactic and citric acids both proved to be effective tenderizers.

Table 3 shows nearly all the treatments in this study to lessen hog casing strength. High pressure and organic acid treatment in conjunction was found to most effectively tenderize hog casing in consideration of the reduction in mean and standard error of the relative breaking strength.

The structure and arrangement of collagen fibers on the surface of the casing are presently being investigated by SEM and the relation of these parameters to casing tenderization by the present treatments will be taken up in a future study.

Conclusions

High pressure and organic acid treatment conducted individually or in conjunction was clearly shown to significantly tenderize tough Chinese hog casing, the latter proving most effective. High pressure effectively rendered uniformly tender casing.

References

Nishiumi, T. and Sakata, R. (1999) Histological and biochemical evaluation of connective tissue of natural hog and sheep casings. Proc. 45th Int. Cong. Meat Sci. Techonol., vol. 1, pp.174–175.

Nishiumi, T., Sato, Y., Suzuki, A. and Sakata, R. (2001) Effect of connective tissue on mechanical properties of natural hog and sheep casings. Final Reports for Research Grants for Meat and Meat Products, 19: 207–213.

Ohtani, O., Ushiki, T., Taguchi, T. and Kikuta, A. (1988) Collagen fibrillar networks as skeletal frameworks: a demonstration by cell-maceration/scanning electron microscope method. Arch. Histol. Cytol., 51: 249–261.

Sakata, R., Segawa, S., Morita, H. and Nagata, Y. (1998) Verbesserung der Zartheit von Schweine-Naturdärmen. Einsatz von organishen Säuren and Protease. Fleischwirtshaft, 78: 371–372.

Tables and Figures

Table 1. Effects of high pressure on relative breaking strength of Chinese hog casing

Pressure (20ºC, 10 min)		Time (200 MPa, 20ºC)		Temp. (200 MPa, 10 min)	
0.1 MPa	100	0 min	100	20ºC	87.1±11.1*
100 MPa	94.5±11.8	5 min	91.1±13.5*	40ºC	86.9±11.3*
150 MPa	91.3±11.3*	10 min	87.1±11.1*	50ºC	90.0±12.1*
200 MPa	87.1±11.1*	20 min	88.9±11.4*	60ºC	86.6±12.4*
300 MPa	89.9±12.7*	30 min	91.6±11.0*	70ºC	84.8±11.9*
400 MPa	96.1±10.8	45 min	94.4±11.2		
500 MPa	94.7±16.4	60 min	90.9±11.2		

*, $P<0.05$.

Table 2. Effects of organic acids within specified concentration range on relative breaking strength of hog casing

Lactic acid (20ºC, 10 min)		Acetic acid (20ºC, 10 min)		Citric acid (20ºC, 10 min)	
0 M	100	0 M	100	0 M	100
0.05 M	98.6±11.5	0.05 M	96.6±14.9	0.05 M	99.1±16.8
0.1 M	97.9±13.3	0.1 M	98.4±11.4	0.1 M	93.7±14.2
0.2 M	82.8±14.7*	0.2 M	98.2±20.6	0.2 M	82.1±15.2*
0.5 M	93.0±13.9	0.5 M	98.5±14.7	0.5 M	94.3±14.8
1.0 M	95.5±11.0	1.0 M	96.4±12.5	1.0 M	93.0±10.7

*, $P<0.05$.

Table 3. Relative breaking strength for the treatment modes

Treatment	Relative BS
No treatment	100
HP (200 MPa, 20ºC, 10 min)	87.1±11.1*
LA (0.2 M, 20ºC, 10 min)	82.8±14.7*
AA (0.2 M, 20ºC, 10 min)	98.2±20.6
CA (0.2 M, 20ºC, 10 min)	82.1±15.2*
HP+LA (0.2 M, 200 MPa, 20ºC, 10 min)	81.0±13.8*
HP+CA (0.2 M, 200 MPa, 20ºC, 10 min)	78.0±13.8*

BS, breaking strength; HP, high pressure; LA, lactic acid; AA, acetic acid; CA, citric acid; *, $P<0.05$.