3-P9

GEL STRENGTH ENHANCEMENT OF SAUSAGES BY TREATING WITH MICROBIAL TRANSGLUTAMINASE

Michio Muguruma[a], Katsuhiko. Tsuruoka[b], Hirofumi. Fujino[c], Satoshi Kawahara[a], Kiyoshi Yamauchi[a] Sueo Matsumura[d] and Takahiko Soeda[e]

[a] Laboratory of Food Science and Nutrition, Department of Biological Resource Sciences, Faculty of Agriculture, Miyazaki University, Miyazaki 889-2192, [b] Division of Bioresource and Bioenviromental Sciences, Graduate School, Kyushu University, Fukuoka 812-8581, [c] Department of Food and Nutrition, Higashi Chikushi Junior College, Kitakyushu, 803-8511, [d] Department of Basic Allied Medicine, Faculty of Health Science, Kobe University School of Medicine, Kobe, 654-0142 and [e] Food research and Development Laboratories, Ajinomoto Co., Inc., Kawasaki 210-0801 Japan

Keywords: Chicken , Pork , Sausage, Transglutaminase, Texture,

Background:

Gelation of muscle protein contributes to desirable texture and stabilization of fat and water in processed meat and meat products. Because of an increasing awareness of health and weight problems associated with excess dietary fat, consumers are demanding lower fat products. Poultry processors are meeting this demand with poultry and poultry products containing reduced amount of fat. Chicken is now being used to manufacture many further processed products traditionally made from pork. The texture of sausages is an important quality which influences their preference and palatability. It has been difficult to obtain a desirable gel strength manufactured from chicken.

Transglutaminase (TGase; protein-glutamine γ−glutamyltransferase, EC 2.3.2.13) can catalyze the formation of ε-(γ-glutamyl) lysyl crosslinks among food proteins . This enzyme has been expected to be useful for improvement of rheological properties of food 1, 2).

Objectives:

Our objectives are to improve texture properties of chicken sausages by mixing with pork meat and by incubating with microbial TGase and to determine the extent of such improvement by measuring shear force of sausages , extractability of proteins from each sausage mix, cross-linking of muscle proteins and the formation of ε-(γ-glutamyl) lysyl [GL] crosslinking.

Materials and Methods

TGase was prepared from the culture broth of a variant of Streptoverticillum mobaranse as previously described 3). Sausages were prepared from pork loin meat and chicken breast meat . Meat was minced in a grinder, followed by chopping with 2% NaCl, 0.3% sodium pyrophosphate, 0.3% sorbic acid and 40% distilled water for 90 sec. The amounts of their additives and water were based on initial weight of ground meat. In the experiment with TGase, TGase was dissolved to 1% in water and added to a final concentration of 0.002% during chopping. Sausage batter was stuffed into 25 mm diameter polyvinylidene chloride tubes. Then the tubes were sealed and heated at 40°C for 30min , 50°C for 30 min or 80°C for 30 min. Gel strength of sausages was measured with a creep meter (Rheoner RE-33005, Yamaden Co., Tokyo, Japan) at 25°C. Extractability of protein from sausage mix was determined as previously described4). To examine the molecular species of extracted protein constituents, SDS-polyacrylamide gel electrophoresis (SDS-PAGE) was carried out on gradient slab gels (7.5-17.5 % acrylamide) at 30 mA employing the discontinuous buffer system of Laemmli5). Determination of ε-(γ-glutamy)lysine [GL] content was performed according to the method of Sato et al.6).

Results and Discussion

The effects of TGase on breaking stress of sausages heated for 30 min at 40°C, 50°C or 80°C were investigated (Fig. 1). Breaking stresses formed at high heating temperature (50°C and 80°C) were higher than those formed at low heating temperature (40°C). The breaking stress of pork sausage with TGase was higher than that of chicken sausage. Addition of pork to chicken with TGase significantly increased the breaking stress of mixed sausage. Figure 2 shows the amounts of protein extracted with Guba Straub-ATP solution from sausage mix heated at 40°C for 30min with or without TGase. The species of protein extracted from sausage mix were determined by SDS-PAGE (Fig.3). Shear force increased and extractability of proteins decreased in the presence of TGase. The breaking stress decreased correspondingly with the reduction of protein extractability. TGase caused the crosslinking of

the myosin heavy chain(MHC) so that the polymerized myosin became difficult to extract in extracting solution. Therefore, the intensity of MHC bands decreased with TGase reaction at 40°C. Myosin light chain and α-actinin also decreased with the storage time. Based on the evidence that MHC disappeared (Fig.3) in the SDS-PAGE gels, we could assume that the catalytic action of TGase occurred in the sausage mix during reaction at 40°C. Fig.4 shows the contents of GL in sausage mix heated at 40°C for 30 min. The level of GL in pork sausage mix was relatively higher than that in chicken sausage mix. The GL content, which is generated by catalytic action of TGase, increased in pork and chicken sausage mixes after addition of TGase. It is considered that breaking stress and GL crosslink are increased, and the extractabilities of MHC are decreased correspondingly by TGase reaction.

These results suggest that the texture of chicken sausages is improved through the formation of GL crosslinks by added TGase in pork and chicken sausages.

Conclusions

Consumer demand for processed poultry meat products has increased. In this experiment, pork , chicken and pork-chicken sausages were manufactured by including microbial TGase. Effect of TGase was evaluated by measuring shear force of sausages and extractability of proteins from them. Shear force increased and extractability of proteins decreased in the presence of TGase. The intensity of MHC bands decreased in the presence of TGase. TGase caused the crosslinking of MHC so that the polymerized myosin became difficult to extract in extracting solution. Myosin light chain and α-actinin also decreased. Formation of the GL crosslink was observed and the content of the GL crosslink increased with TGase treatment. The texture of chicken sausages was improved by addition of TGase and pork muscle.

References

1) Motoki, M and Nio, N. (1983) *J. Food Sci.*, 48: 561-566. 2) Sakamoto, H., Kumazawa, Y., Toiguchi, S., Seguro, K., Soeda, T. and Motoki, M. (1995) *J. Food Sci.*, 60: 300-304. 3) Ando, H., Adachi, M., Umeda,K., Matsuura, A., Nonaka, M., Uchio, R., Tanaka, H and Motoki, M. (1989) *Agric. Biol. Chem.*, 53: 2613-2617. 4) Muguruma, M., Katayama,K., Nakamura, M and Yamaguchi, M. (1987) *Meat Sci.*, 21: 99-109. 5) Laemmli, U.K. (1970) *Nature*, 227: 680-685. 6) Sato,K., Tsukamasa,Y., Imai,C., Otsuki,K., Shimizu,Y. and Kawabata,M. (1992) *J. Agric. Food Chem.*, 40 806-810.

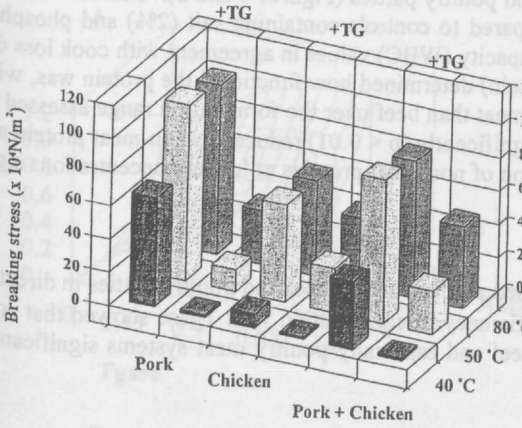

Fig. 1 Effect of transglutaminase (TG) on breaking stress of sausages heated at various temperatures for 30 min.

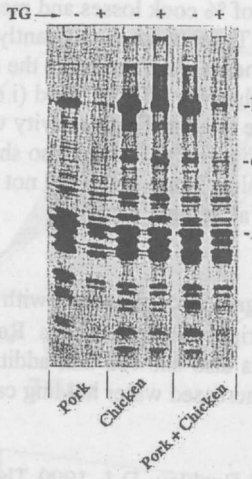

Fig. 3 SDS-PAGE pattern of proteins extracted with Guba Straub-ATP solution from sausage mix heated at 40 °C for 30 min.

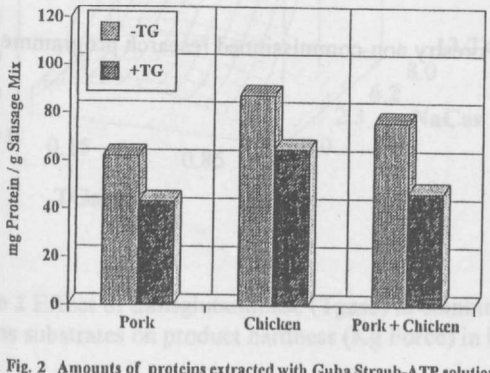

Fig. 2 Amounts of proteins extracted with Guba Straub-ATP solution from sausage mix heated at 40 °C for 30 min.

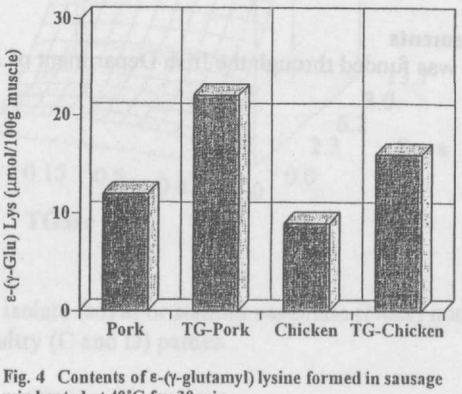

Fig. 4 Contents of ε-(γ-glutamyl) lysine formed in sausage mix heated at 40°C for 30 min.