COMPARATIVE STUDY BETWEEN THE EFFECTS OF ADDING POLY (γ-GLUTAMIC ACID) AND TRANSGLUTAMINASE ON THE TEXTURAL QUALITY AND COOKING YIELD OF SAUSAGE

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Introduction

Sausages make up the majority of meat products that comprise the category of “ready foods.” From the acceptability point of view, consumers are highly concerned about the important attributes of sausage such as quality of texture, taste and color. Sausage texture is an important characteristic that significantly influences a product’s palatability and consumer acceptance (Muguruma et al, 2003). Microbial transglutaminase (MTG) is well known for improving of the texture of many meat products such as sausage made of chicken, beef and pork. The functional properties of MTG make it a beneficial protein-binding agent, positively helping the functionality of proteins to improve the texture and gelation of meat products that are treated mechanically (Ahhmed et al., 2007). Prospectively, we attempted to use poly(γ-glutamic acid) (PG) as a gelation tool and as a contributive substrate to improve the texture, as well as other quality traits, of meat products. We conducted this research to determine the influential functions of MTG and PG on the texture and cooking yield in pork sausage, as well as the usefulness of MTG and PG in meat manufacturing in order to present healthier food with high textural quality

Materials and Methods

Meat used in this study was ham from local Japanese pigs. The pigs were slaughtered in a local slaughtering-house at 6 months of age. The cuts were kept in a refrigerator for 4 days to give the muscle opportunity to be stretched and the pH was determined to be 5.6. The sausages were made by mincing the hams after removing the fatty tissues and then 250g of meat were mixed with 50ml of distilled water, 4.5g of NaCl, 0.3g ascorbic acid and 0.05g sodium nitrite. Other protein-binding substrates were added in different ratios, such as PG, MTG and poly phosphate (PP). PG was added to the mixtures at three levels. 0.5%, 1.0% and 1.5%. MTG was also added singly to the mixtures at two levels 0.83% and 1.67% and PP was added at one level 0.4%. The concentrations of MTG was evaluated and found to be 3.4 mg/ml. The meat paste was stuffed in sheep casings and divided into two groups; this division was based on the heat treatment. The first set was cooked at 70°C for 30 min and the other group was incubated at 40°C for 30 min.

The samples cooked at 70°C were subjected to textural test by using a knife and a creep meter plunger (Yamaden RE2-33005S, Tokyo, Japan). Cooking yield was also determined by checking the weight of the sample before being heated. Yet the samples’ weight was also examined after the substance was subjected to heat treatments. This difference in weight was regarded as the cooking yield. However, samples incubated in 40°C were used for SDS-PAGE, It was carried out on gradient slab gel (5-15% acrylamide) with 2-mercaptoethanol at 20 mA/gel using the discontinuous buffer system.

Results and Discussion

One of the major purposes of this study was to find more additives that can be utilized to improve meat texture, while not having a deleterious effect on human health. We intentionally attempted to use PG and MTG as additives to improve textural properties and cooking yield in order to avoid any material that can have a harmful effect on our health, such as phosphate and sodium chloride.

Figure 1 shows the improvement in the textural properties. PG gradually affected on the share force values of the sausages, instrumentally determined by a knife and/or plunger. The values were decreased as the PG ratio increased. MTG positively demonstrated good share force values when determined by a knife and plunger of a creep meter. The values in samples treated with 0.833 and 1.67% MTG were increased significantly ($P < 0.05$) when compared to the control samples. Likely, PP drastically improved the textural properties of sausages. The effectiveness of the PG and MTG on the textural properties of the sausages was measured by mixing PG at different ratios (0.5, 1.0 and 1.5) with a fixed ratio of MTG (1.67%). Values of the breaking strength significantly increased ($P < 0.05$) in a mixed sample of PG and MTG, at 0.5 and 1.67%, respectively. Irregardless of the original breaking strength, these values were slightly increased in mixed samples with PG and MTG, 1.0, 1.5 and 1.67%, respectively. To summarize the effects of MTG and PP, the values of breaking strength and share force determined by both a knife and a plunger, resulted in a significant increase in the texture (Figure 1).

Figure 2 shows values of cooking yield of samples treated with PG, MTG and PP. Cooking yields of samples treated by the 1.0 and 1.5 % solutions were slightly improved. However, treat samples with MTG had a negative affect on the cooking yield, resulting in a decrease in the values. Furthermore, the effect of PP on the cooking yield was much greater than the control, PG and MTG samples. Yet, the effectiveness of the combination of PG and MTG on cooking yield was also determined and the values of samples treated with 1.0 and 1.5 % of PG with 1.67% of MTG were significantly improved when compared to control samples ($P < 0.05$) (Figure 2).

For further investigation of crosslinking in myosin heavy chain (MHC) bands, we have conducted a SDS-PAGE test. The MHC bands in samples treated with PP did not change and remained as large as in control samples. Similarly, the bands of samples treated with PG did not change and the band remained almost the same as in control samples. However, bands of MHC in samples treated with MTG showed a significant decrease, with the bands decreasing as the MTG ratio increased. The bands in samples treated with a mixture of PG and MTG have also been decreased (Figure 3).

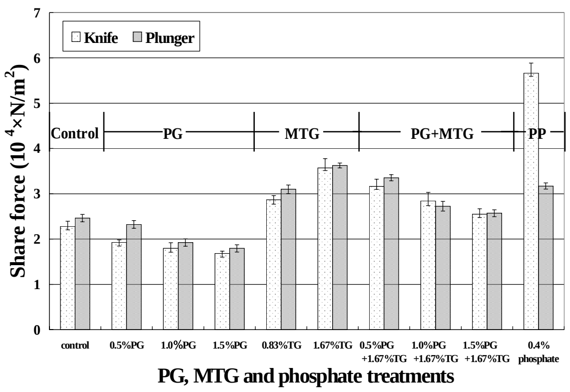

Figure 1. Values of breaking strength and share force of samples treated with PG, MTG and PP.

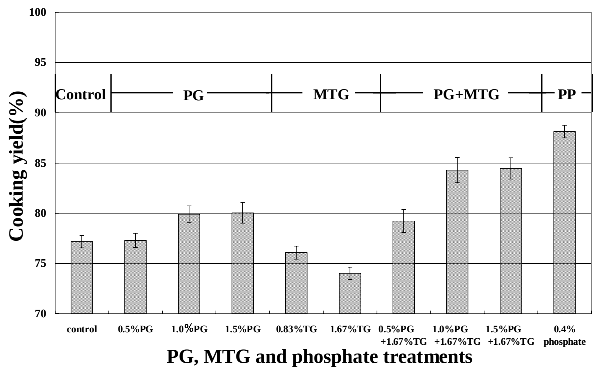

Figure 2. Changes in cooking yield values of samples treated with PG, MTG and PP.

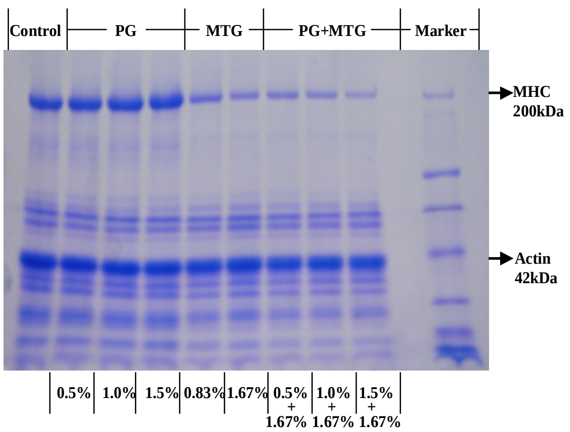

Figure 3. SDS-PAGE pattern of samples treated with PG, MTG and PP. The samples were dissolved in Guba-straub-ATP solution.

Conclusions

From the quality point of view, data suggests that PG served as a good substrate to improve cooking yield, yet failed to improve textural properties. MTG positively influenced textural properties. However, MTG showed less improvement in the cooking yield when compared to control, PG and PP samples. Fortunately, PP was also found to be good substrate because it improved both the textural properties and cooking yield. Data also suggest that the process of mixing PG with MTG is a beneficial, profitable process because they found to be contributive substrates. That is because the values of the share force, breaking strength and cooking yield in the sample treated with mixture of PG and MTG were improved when compared to control samples

References

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