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Effects of microbial transglutaminase and starch on the gelation of salted squid muscle paste

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Introduction

Squid mantle muscle has been characterized by low gel-forming capacity due to high metalloproteinase activity, which causes preferential degradation of myosin during thermal gelation. It is therefore important to improve the gel strength by the activation of endogenous transglutaminase (TGase), which induces setting effect, under the conditions where proteinases are inactivated. We reported that squid metalloproteinases were inactivated at setting temperature of 40°C or above (Park *et al.*, 2003). However, the expected setting effect was not obtained at 40°C because the addition of Ca^{2+} to squid muscle paste caused a great activation of calpain as well as the activation of endogenous transglutaminase.

In this report, microbial TGase (MTGase), a Ca^{2+}-independent enzyme, was added to squid muscle paste to induce setting without the addition of Ca^{2+}. In order to improve the gel strength, potato starch was also added to the squid muscle paste.

Materials and methods

Live squid, *Todarodes pacificus*, was gutted and skinned. Mantle muscles were dissected and mixed with 0.5 M NaCl and 20 mM Tris-HCl (pH 7.2) atthe final concentration. The mixture was ground in a food cutter to produce a homogeneous paste at 0°C. The de-aerated paste (100 mg protein/g-paste) was heated to 80°C at the heating rate of 2°C/min for dynamic rheological measurements. Setting at 40°C for 60 min was included. Breaking strength and strain of 2-step heated gels at 90°C for 20 min after setting at 40°C or 50°C were also measured. MTGase, a reagent grade, was supplied by Ajinomoto Co. Inc.

Summary of results

Thermal gelation of squid paste with or without $CaCl_2$ was monitored using dynamic viscoelastic measurements. The storage modulus (G'), the elastic component, increased slightly with $CaCl_2$ due to the degradation of myosin by activated calpain. MTGase (5 unit) cross-linked myosin heavy chain and greatly increased G' value at 80°C without the addition of $CaCl_2$. The increase in breaking strength and strain of squid gels produced by 2-step heating with MTGase resulted in strong elastic gels (Fig.1 a).

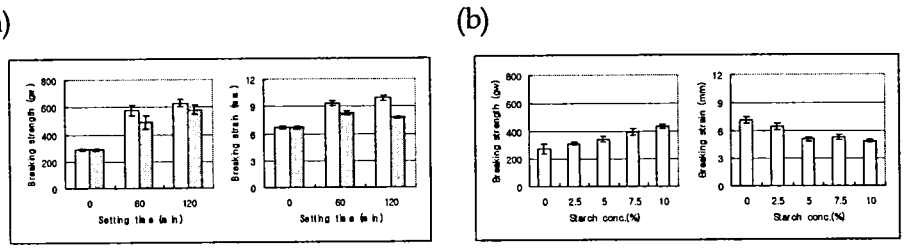

Figure 1. Effect of setting and starch concentration on the thermal gelation of squid muscle paste. (a) Squid meat paste (100mg protein/g, 5ui MTGase, 0.5M NaCl, pH 7.2) was incubated at 40℃and 50℃ for up to 120 min prior to heating at 90℃ for 20 min. Setting temperature: □, 40℃; ▨, 50 ℃. (b) Squid muscle pastes (100mg protein/g, 0.5M NaCl, pH 7.2) with starch at various concentrations were heated at 90℃ for 20 min.

The effects of starch on the rheological properties of thermal squid gels were investigated. The addition of 5% starch showed no influence on *modori* (gel weakening) around 45°C, while it increased G' and G''(loss modulus) at high temperatures above 70°C. The breaking strength of heated gels at 90°C for 20 min increased as an increase in the amounts of starch, but the breaking strain decreased (Fig.1 b). The results showed that starch increased in the hardness and fragility of thermal squid gel.

In the case of the addition of both MTGase and starch to squid muscle paste, the heated gels produced by 2-step heating method showed higher breaking strength and strain due to the formation of cross-linked myosin. However, an increase in the amount of starch deteriorated gel texture, which was characterized by lower breaking strength and strain.

References

S. Park, S. Cho, T. Yoshioka, M. Kimura, H. Nozawa, and N. Seki. 2003 Influence of endogenous proteases and transglutaminase on thermal gelation of salted squid muscle paste. *J. Food Sci.*, 68: 2473-2478.