Effect of Transglutaminase on the Functional and Textural Properties of Chicken Surimi

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Introduction

It has been reported that transglutaminase(TGase) from plasma, liver and microorganism can catalyze the formation of glutamyl-lysine bonds in myosin and also between myosin and actin, myosin and fibronectin, and fibrin and actin. These results can not be directly related to myosin in meat system since the proteins are treated with enzyme under different condition from the meat system(Cohen et al., 1979; Kahn and Cohen, 1981). Therefore, the present study is undertaken to determine if transglutaminase can catalyze covalent bond formation under conditions more relative to chicken meat systems. the purpose is to investigate the effects of crosslinking of muscle proteins catalyzed by TGase on the functional and textural properties of chicken meat and surimi. The objectives of the present study are to determine 1) Factors affecting gel formation of muscle proteins in chicken surimi by TGase, 2) polymerization of muscle proteins by TGase with SDS-PAGE analysis, and 3) Functional properties of muscle proteins in chicken surimi and SEM micrograph.

Materials and Methods

Chicken surimi was prepared according to the procedures described by Pan(1990). TGase (TG-S) enzyme was obtained from Ajinomoto Co.,Inc. Company Ltd. The samples were prepared with the washed chicken surimi added 2.5 % sodium chloride as the control. to which 0.4 % (3 units) TGase was added as the treatment. WHC and OHC of the samples were determined by the method of Ockerman(1984).L, a, b value of the samples were measured by Hunter Colorimeter. The protein-protein interaction was measured by SDS-PAGE. Using the method of Joseph et al (1992). The microstructure of the TGase induces gel was absented by SEM. The physical properties of the gels were measured by rheometer (Fudoh, Japan). The data were analyzed using SAS(1994).

Results and Discussion

The results showed that TGase could be used to improve WHC but did not affect oil holding capacity (Table 1). This result was similar to the report of Tkura(1980) but different from the result of Soyeda(1992). Soyeda indicated that TGase could be used to unprove the stability of emulsion. The author think that TGase could be used to polymerize the proteins though the formation of intermolecular crosslinks that do not affect their functional properties but only could improve gel strength. Viscosity of chicken surimi was improved by TGase addition The gel strengths and hardness were improved by TGase.

Brightness of cooked chicken surimi of both treatment and control was higher than uncooked sample and a value of both samples decreased but b value increased (Table 2). This was in agreement with the report of Nrelisne et al., (1995). They indicated that TGase was added to the product and caused discoloration of the muscle products.

SDS-polyacrylamide gel electrophoretrogram of crosslinking of reaction products for various proteins were analyzed by SDS-polyacrylamide gel electrophoresis to detect the presence of polymers formed by intermolecular crosslinks catalyzed by TGase.

Fig. 1 showed that as the reaction proceeds the monomer fractions of myosin heavy chain diminished disappeared while this result was the same as the finding of Joseph et al.(1992) that there was 60 % myosin diminished from SDS-polyacrylamide electrophoretogram, but there was no presence of polymers and present on the band above 200 Kda of the gel. This difference may by caused by the difference in the concentration of acrylamide used to prepare the gel. Hareph et al.,(1992) also indicated that the presence of polymers was easily obtained at 37 ℃. In addition, electrophoregram was detected some subunits components between 200 Kda and 160 Kda from the TGase treated sample disappeared remarkably. Fig. 2 shows microstructure of uncooked chicken surimi. SEM of the gel of TGase treated sample had a denser and small diameter of holes of microstructure, in the other word, had a firmer texture. However, microstructure of the gel for the cooked chicken surimi showed a denser and firmer structure.

Conclusion

In conclusion, TGase can modify chicken surimi and enhances WHC, gelling ability of chicken meat and the structure of the gel became more denser. Meanwhile, it was found that myosin heavy chain on the gel decreased, whether this finding was related to crosslinks of various proteins on meat. There are further work needs to be done, it was also found TGase did not affect on Actin.

References

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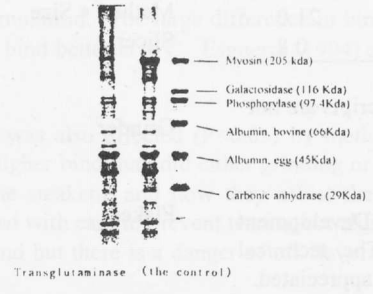
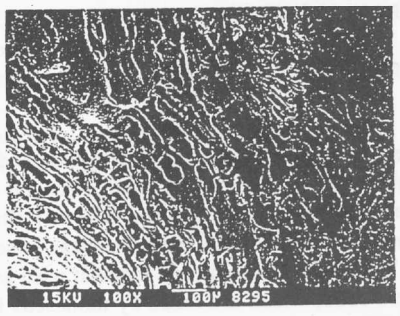
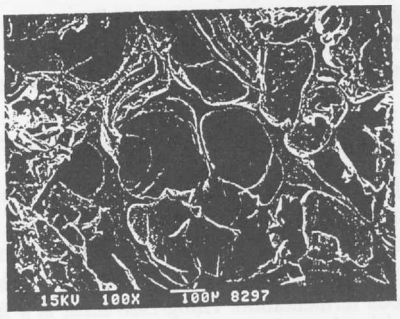


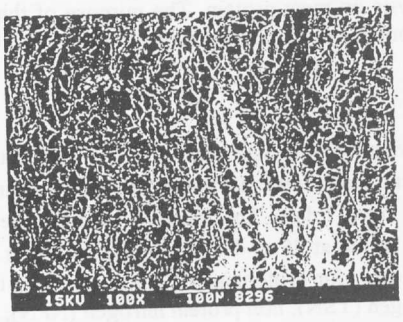
Figure 1. The SDS-PAGE electrophoretogram of chicken surimi gel with or without transglutaminase.



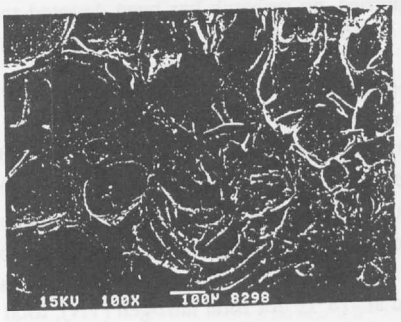
uncooked chicken surimi (the control)



Cooked chicken surimi (the control)



Uncooked chicken with Transglutaminase



Cooked chicken surimi with Transglutaminase

Figure 2. The microstructure of uncooked or cooked chicken surimi with or without transglutaminase

Table 1 Effect of addition of TGase on the functional properties of chicken surimi

Items	Control	Treatment
WHC *	40.28 ± 1.89^{b}	45.01 ± 1.29^{a}
OHC **	36.67 ± 0.88	36.03 ± 0.55
Gel strength (g)	74.60 ± 6.19^{b}	92.75 ± 5.06^{a}
Gel hardness (dyn/cm^2)	372619.20 ± 30912.70^{b}	463278.35 ± 25263.05^{a}
Viscosity	1720.00 ± 201.87^{b}	3200.00 ± 430.11^{a}

Mean ± SD

* WHC=water holding capacity

** OHC=oil holding capacity

^{ab} means within the same row without the same superscript letters are significantly different ($P<0.05$).

Table 2 Effect of addition of TGase on color of chicken surimi

Items	Control	Treatment
Uncooked		
L	49.61 ± 0.99^{ay}	52.28 ± 1.00^{by}
a	-1.97 ±-0.67^{x}	-1.86 ±-0.92^{x}
b	9.05 ± 0.57^{y}	9.55 ± 0.44^{y}
Cooked		
L	72.99 ± 1.44^{ax}	74.73 ± 0.75^{bx}
a	-3.94 ±-0.98^{y}	-4.32 ±-1.15^{y}
b	13.37 ± 0.96^{x}	13.72 ± 0.98^{x}

Mean ± SD

^{ab} means within the same row without the same superscript letters are significantly different ($P<0.05$).

^{xy} means within the same item and column without the same superscript letters are significantly different ($P<0.05$).