Structural Changes of Collagen During Heating

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I. INTRODUCTION

Heating is a major method for meat products processing, which changes the texture and flavor of meat [1]. Our previous study indicated that different cooking methods had significant effects on digestion and absorption of meat proteins. Other studies showed that collagen was degraded as well as the molecular structure of the protein was changed during meat cooking, which influenced the eating quality and nutritional value of meat [2]. Furthermore,collagen fibers are more resistant than most other protein fibers and only partly digestible. The low digestibility of proteins is also considered to be induced by naturally occurred crosslinks [3]. However, little is known on its underlying mechanisms. The objectives of this study were to investigate the changes in the protein structure and properties of collagen during heating.

II. MATERIALS AND METHODS

Collagen was dissolved in 0.1 M acetic acid solution and heated to 60,70,80 ℃ for either of 0.5,1.5,2.5 hours.After heating, the sample was ice chilled. The protein structures were tested by RF-5301 fluorescence spectrophotometer,J-1500 Circular dichromatograph and FTIR from the Nicolet company. All data were analyzed by one-way analysis of variance (ANOVA) using SPSS 18.0 statistical package (SPSS, USA).

III. RESULTS AND DISCUSSION

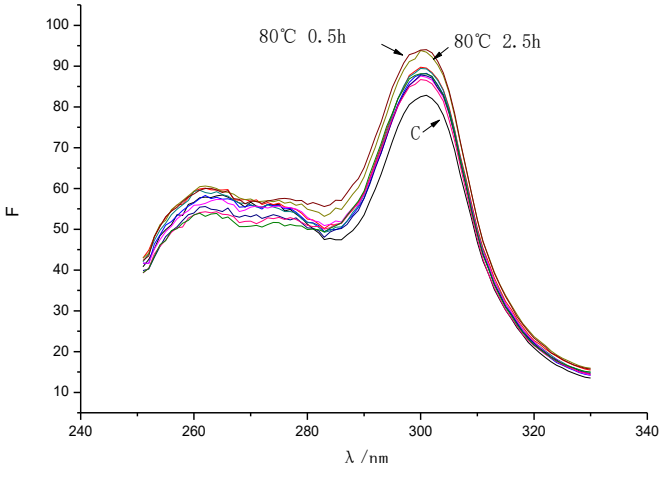

Figure 1. Tyrosine spectrum of collagen under different temperature and time conditions C is control group without heating

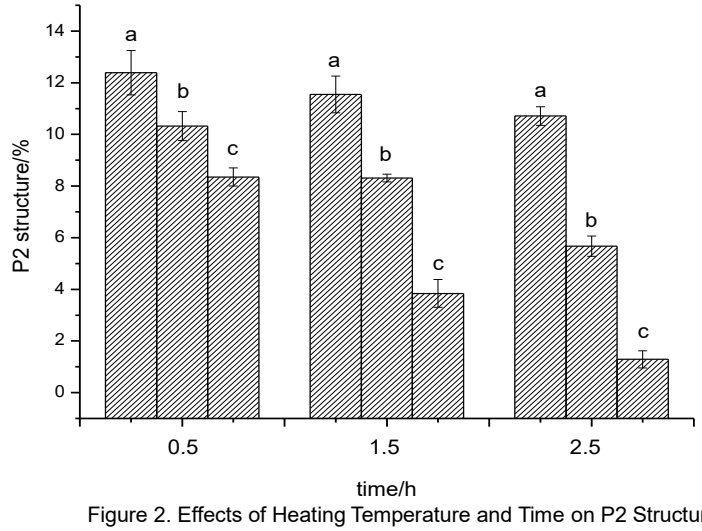

Figure 2. Effects of Heating Temperature and Time on P2 Structure of Collagen The three columns for each time, from left to right are represent heating temperature on 60°C,70°C and 80°C, respectively.

Synchronous fluorescence spectroscopy can characterize the structures of tryptophan and tyrosine in proteins. Since collagen is substantially free of tryptophan, Fig. 1 showed the spectrum of tyrosine as functions of temperature and time, one of the groups that was not heated was set as control. Below 80 ℃, temperature showed no significant effects on fluorescence intensity (FI) of Tyr and also the heating time didn't impact the FI, either.Fig.2 showed that the percentage of P2 structure had significantly decreased as the temperature increased for different heating time.

Infrared spectroscopy is an effective method to study the structures of polypeptide chains and the tertiary structure of protein. The absorbance ratio of 1240 cm^{-1} to 1450 cm^{-1} near the peak could reflect the tertiary structure characteristics of collagen. It was shown that the value of A_{1240}/A_{1450} for the complete tertiary structure of collagen was approximately 1.0 .

Table 1 The value of A_{1240}/A_{1450} on Collagen Infrared spectroscopy(means ± standard deviations)

	A_{1240}/A_{1450}			
	60℃	70℃	80℃	C
0.5 h	1.06±0.01a	1.06±0.02a	1.06±0.01a	
1.5 h	1.09±0.02a	1.06±0.01a	1.10±0.02a	1.02±0.03b
2.5 h	1.09±0.02a	1.06±0.01a	1.08±0.03a	

ab values with a different superscript across a row denotes significance (P<0.05).

C is control group without heating

Tab. 1 showed the values of A_{1240}/A_{1450}. It can be seen that the tertiary structure of collagen had a certain change after heating for a period of time compared to the control ($p<0.05$), However, there was no significant change among heating groups.

IV. CONCLUSION

In this study, we have investigated the effects of heating temperature and time on the collagen structure. P2 structure had varying degrees of decreased during heating from 60 to 80 ℃, but there was no significant change in the tertiary structure.

ACKNOWLEDGEMENTS

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