EFFECTS OF COOKING CONDITIONS ON PROTEIN DEGRADATION OF SOY-SAUCE STEWED CHICKENS

Chao-Zhi Zhu[1,2], Gai-Ming Zhao[1,2*], Miao-Yun Li[1,2] and Yan-Xia Liu [1,2]

[1]Henan Key Lab of Meat Processing and Quality Safety Control, Henan, China;

[2]College of Food Science and Technology,Henan Agricultural University, Henan, China

*Corresponding author email: zhuchaozhi66@163.com

Abstract –The objective was to investigate the effect of cooking temperatures and cooking time under two different heat power on the protein degradation of soy-sauce stewed chickens by SDS-PAGE and HPLC. The results showed that the total nitrogen and non-protein nitrogen contents were higher under strong fire than that soft fire, especially when cooking time was less than 40min. Whether under strong or soft fire, sarcoplasmic proteins were degraded and myosins were precipitated at 75℃ from 10-20mins. The content of Arg is higher under strong fire than that soft fire, while Glu is opposite. This practice attempts to provide theoretical basis for the application of cooking process to the industrialization of traditional stewed meat product.

Key Words – cooking process, heat power, protein profile

I. INTRODUCTION

Soy-sauce stewed meat products is the outcome of Chinese traditional technology. In the industrialization process of traditional products, it is the key and difficult point on how to maintain the characteristic color, texture, flavor and nutrition. Stewing is the major part of soy-sauce stewed meat products processing. As an important functional and nutritional component, study on protein properties has become the hot topic. Free amino acids were lower in the beef soup when temperature was higher than 75 ℃ and cooking time was more than 120 min.While glutamic acid, aspartic acid, lysine and methionine were increased, which were closely related with flavor [1]. Another research found when temperature was higher than 50 ℃, myosin began to gather; 60 ℃, large number of spherical aggregates formed; when temperature was higher than 60 ℃, the tail helix of myosin changed and solubility decreased [2]. Until now, there is no research on the effect of combination of cooking conditions and spicy on the protein profiles. Therefore, research on protein degradation under different cooking conditions was the basis for the verification of soy-sauce stewed meat products processing, and also provide a theoretical basis for the industrialization of traditional stewed meat products.

II. MATERIALS AND METHODS

The cooking temperature was at 75, 80, 85, 90, 95 and 100℃ and the cooking time was 10, 20, 30, 40, 50, 60, 90 and 120 min. Heat power include strong fire and soft fire. Total nitrogen, non-protein nitrogen, free amino acid and Sarcoplasmic protein and myofibrillar proteins profile were determined. Data were analyzed using SPSS version 16.0 to perform by ONEWAY ANOVA with a significance level o f $p < 0.05$. Multiple analysis was performed using Duncan's multiple range tests to compare the means. The changes of protein size on the gels were identified after staining for 90 min (Coommassie Brilliant Blue R-250, Bio-Rad, CA, USA)

III. RESULTS AND DISCUSSION

The non-protein nitrogen contents under strong fire was higher than that under soft fire at the beginning of cooking process, and with prolonging of time, the differences turned smaller. The generation of free amino acids and poly-peptides was the main reason of the increase of the non-protein nitrogen content, especially under strong fire, protein degradation is much stronger. When processing time was up to 120min, large volatile nitrogen compounds evaporated, so the non-protein nitrogen was decreased under two heat power, and no significant difference was appeared.

Table 1 Effect of heat power on the non-protein nitrogen value at 75℃ （mg/100g）

Time（min）	Strong fire	Soft fire
10	$323.96\pm6.68^{e*}$	308.00 ± 5.25^{e}
20	$406.58\pm11.25^{d*}$	389.67 ± 13.59^{d}
30	$446.25\pm13.15^{c*}$	437.50 ± 27.50^{c}
40	483.15 ± 17.76^{b}	480.08 ± 12.42^{b}
50	500.79 ± 6.80^{b}	499.33 ± 7.07^{b}
60	$551.25\pm17.50^{a*}$	561.75 ± 18.52^{a}
90	$557.58\pm11.25^{a*}$	546.08 ± 14.57^{a}
120	478.33 ± 13.37^{b}	479.50 ± 18.93^{b}

The data with different lowercase letters in the same columns are significantly different between time, The data with * in the same row are significantly different between heat power.

With the prolonging of cooking time, under two heat power conditions, the sarcoplasmic protein degraded completely when kept 10min under strong fire and 20min under soft fire at 75℃ (Figure 1). Thermal stability of myofibrillar proteins was relatively well but most of them also degraded. Myosin of 190~200kD firstly precipitated and existed only when cooking 10min at 75℃ under two heat power. There was a big difference in degradation of 24kD and 44~66kD protein components between strong fire and soft fire. The disappearance of protein lines under soft fire was later than that under strong fire. The thermal stability of connectin ranged in 34kD and 37kD were strongest, and connectin ranged in 24kD followed.

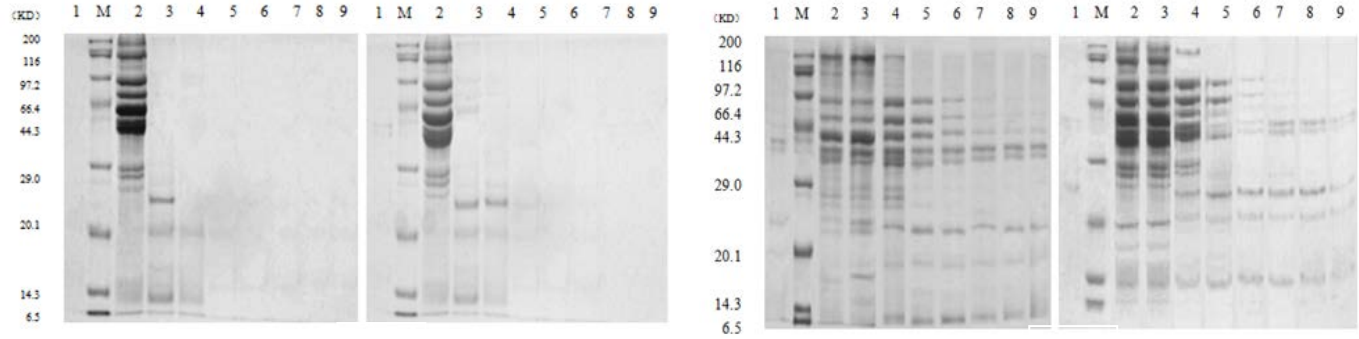

Figure 1. SDS-PAGE pattern of sarcoplasmic proteins from raw and heated chicken muscle at 75℃.

Figure 2. SDS-PAGE pattern of myofibrilla proteins from raw and heated chicken muscle at 75℃. The time of each heat power (strong and soft fire) are as follows: lane (2) raw chickens; (2) 10min; (3) 20min; (4) 30min; (5) 40min; (6) 50min; (7) 60min; (8) 90min; (9) 120min.

IV. CONCLUSION

Protein degradation is the main change during the processing of soy-sauce meat product and it plays an important part in product quality, nutrition and safety. This study has played an active role in clarifying the mechanism of protein degradation during stewing, and provide the guideline for the industrialization of traditional meat products.

ACKNOWLEDGEMENTS

The study was supported by the project of "Fire mechanism of traditional soy-sauce stewed meat products during stewing" (30972129) of National Natural Science Foundation of China.

REFERENCES

1. Claudia, I. P., Juan, A., Ordoñez, G. D., García de Fernando, M., Isabel, C. (2000). Influence of heat treatment on carnosine, anserine and free amino acid composition of beef broth and its role in flavour development. Europe Food Research Technology 210:165-172.

2. Pospiecha, E., Marion, L. G., Mikolajczaka, B., Chiangc, W., Miroslawa Krzywdzin′ska, M. (2002). Thermal properties of titin from porcine and bovine muscles. Meat Science 62: 187-192.