CHANGES IN FLAVOR COMPOUNDS OF NANJING WATER-BOILED SALTED DUCK DURING PROCESSING

Y. Liu[1,2], X. L. Xu[2], X. C. Wang[1], Y. L. Li[3], and G. H. Zhou*[2]

[1] *College of Food Science and Technology, Shanghai Fisheries University, Shanghai, 200090, P. R. China;*
[2] *Key Laboratory of Agricultural & Animal Products Processing and Quality Control, Ministry of Agriculture , Nanjing Agriculture University, Nanjing, 210095, P. R. China;*
[3]*Library of Shanghai Fisheries University, Shanghai, 200090, P. R. China*

Key Words: Duck, flavor, volatile compounds, taste compounds, processing

Introduction

Flavor is a very important component of the eating quality of meat and much research has been aimed at determining those factors during the production and processing of meat which influence flavor quality (Mottram, 1998). Wu and Liou (1992) and Lesimple and others (1995) analyzed the volatile compounds of duck meat using traditional simultaneous distillation extraction (SDE) coupled with Gas Chromatography-Mass Spectrometry (GC-MS). To our knowledge, no study has so far been reported regarding duck meat product in taste compounds.

Cooked duck products are popular items food in China and other parts of the world. Nanjing water-boiled salted Duck (NJWSD), cooked at low temperature in traditional Chinese way, is regarded as a delicacy and famous for its savory taste and tender texture. The objective of this work was to investigate the changes of flavor compounds of traditional Chinese Nanjing water-boiled salted Duck to provide theory bases for the quality improvement of duck meat products.

Materials and Methods

Thirty-six lean-type Cherry Valley ducks (about 1.5 kg each) were slaughtered and processed by dry curing, brining, roasting and boiling. Each duck was dry-cured using 100 g stir-fried purified salt with *Illicium verum* Hook. f. for 2 h. The brining process lasted for 4 hours by using the brine for Chinese traditional feature meat products and the brine contained not only excessive purified salt, but also *Allium fistulosum* L., *Illicium verum* Hook. f., and *Zingiber officinale* Roscoe.. The roasting process was 1 hour at 90 °C to dry the carcass and reduce the subcutaneous fat. At the end, ducks were boiled at a temperature of 85 °C to 90 °C for 40 minutes to achieve tender texture. Six control ducks were treated without any spices in the dry-curing and brining, but the other procedures were the same as the test ducks. At the end of each processing stage, total 72 duck breasts were trimmed of subcutaneous fat, vacuum packaged and stored at -20 °C.

Volatile compounds of traditional NJWSD during its stages of processing were analyzed by headspace solid phase microextraction (HS-SPME) coupled with gas chromatography-mass spectrometry (GC-MS). Volatiles were identified by gas chromatography-mass spectrometry, authentic compounds and Krátz retention index. Free amino acids (FAAs) were analyzed with an 835-50 amino acid auto-analyzer. Peptides and nucleotides were analyzed by HPLC following the procedure described by Martín et al. (2001).

Results and Discussion

Total 92 volatile compounds were identified, of which 57 compounds were firstly identified in duck meat. The major volatiles identified were degradation products of fatty acids, which were considered to account for the typical flavor of duck meat. The processes of dry-curing, brining, roasting and boiling all sped up lipid oxidation and degradation. Dry-curing process generated furans, the important lipid oxidation products. Brining accelerated the formation of S- and N-containing compounds. Roasting had no remarkable effect on most of volatiles. Some S- and N-containing compounds such as 2-methylthiophene, dimethyl trisulfide, 2-acetylthiazole formed during boiling combined with lipid oxidation and degradation products could constitute the principal flavor of NJWSD. The first principal component (PC1) explained 97% of the total variance of the data and was dominated by lipid oxidation and degradation products, which were pentanal, hexanal, octanal, nonanal, and 2, 3-octanedione.

Similar to the previous reports (Benito and others 2005; Chen and others 2006), in this research, we make a comparison about the quantity of compounds among different samples using peak areas directly and no further calibration method was used. Using peak area for quantify comparison does not require extensive sample preparation, but the sampling procedure and chromatographic conditions must remain constant for all samples and there should be no sample matrix effect. To obtain a more reliable result, a calibration method should be used for correcting the sample matrix effect, such as moisture, the content of fat, etc.

The change tendency between free amino acids and flavor nucleotides was inverse before boiling, which the free amino acids increased while flavor nucleotides decreased. During boiling, both free amino acids and flavor

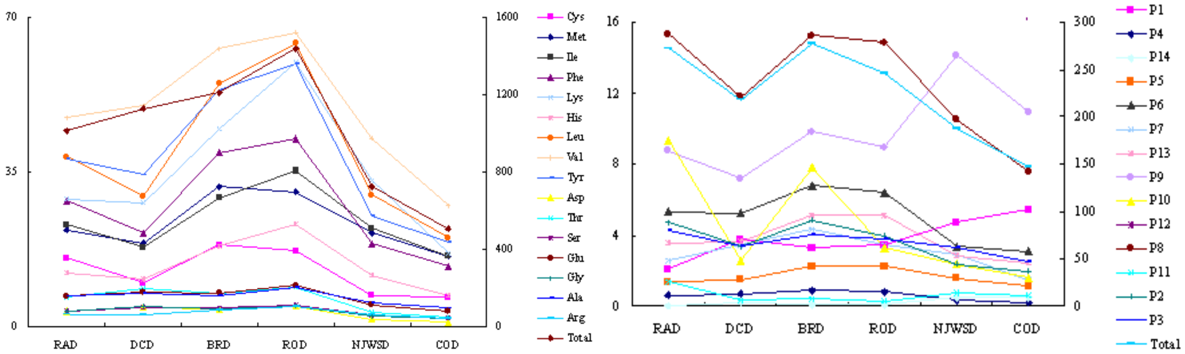

Figure 1. Changes in free amino acids and small peptides of NJWSD during the processing. Sample abbreviations were as follows: RAD, raw duck; DCD, dry-cured duck, BRD, brined duck; ROD, roasted duck; NJWSD, Nanjing water-boiled salted Duck; COD, control duck.

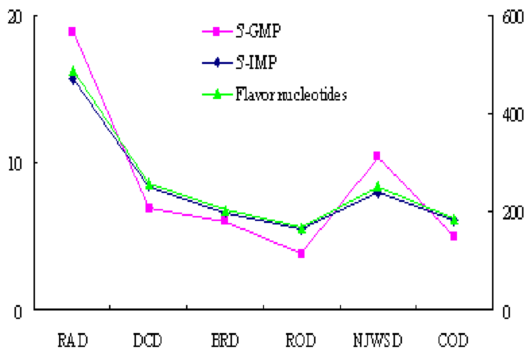

Figure 2. Changes in nucleotides of NJWSD during the processing and sample abbreviations were as Figure 1.

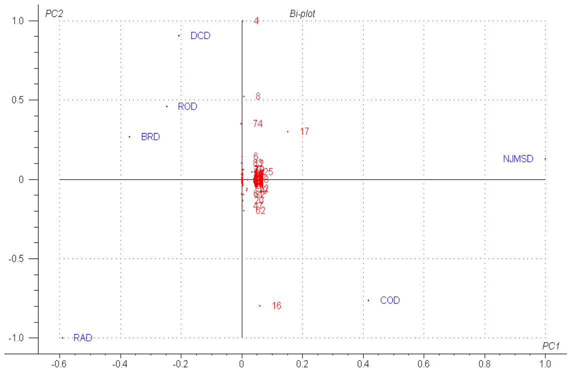

Figure 3. PCA-biplot of volatiles during the processing. Points are coded by the sequence number of volatiles and sample abbreviations were as Figure 1.

nucleotides decreased significantly. Most of peptides decreased during the processing and the changes of total peptides consistent with nucleotides. The content of desirable amino acid, flavor nucleotides and peptides in NJWSD were significantly greater ($P<0.05$) than those in control. To determine the relationship of the taste of duck meat product with their taste compounds, further sensory evaluation is needed.

Conclusions

Lipid oxidation and decomposition were the necessary condition for the formation of duck characteristic aroma, and the processing of NJWSD especially for the dry-curing sped up lipid oxidation and degradation. The delicate processing before the boiling, especially for brining, produced an increase effect on the taste compounds, which could be the reason for the savory of NJWSD.

References

1. Benito, M.J., Núñez, F., Córdoba, M.G., Martín, A., and Córdoba, J.J. (2005). Generation of non - protein nitrogen and volatile compounds by Penicillium chrysogenum Pg222 activity on pork myofibrillar proteins. *Food Microbioly*, 22, 513-519.
2. Chen, J.L., Yan, S.J., Feng, Z.S., Xiao, L.X, and Hu, X.S. (2006). Changes in the volatile compounds and chemical and physical properties of Yali pear (Pyrus bertschneideri Reld) during storage. *Food Chemistry*, 97, 248-255.
3. Lesimple, S., Torres, L., Mttjavila, S., Fernandez, Y., and Durand, L. (1995). Volatile Compunds In Processed Duck Fillet. *Journal of Food Science*, 60, 615-618.
4. Liu, Y., Xu, X. L., Zhou, G. H., Liu, Y. M., Wang, L. P., and Yuan, S. S. (2004). Flavor study on Nanjing water boiled duck by SPME. *Food Science (China)*, 25, 142-145.
5. Martín, L., Antequera, T., Ventanas, J., Benítez-Donoso, R., and Córdoba, J.J. (2001). Free amino acids and other non-volatile compounds formed during processing of Iberian ham. *Meat Science*, 59, 363–368.
6. Mottram, D.S. (1998). Flavor formation in meat and meat products: a review. *Food chemistry*, 62, 415-424.
7. Wu, C.M., and Liou, S.E. (1992). Volatile components of water-boiled duck meat and Cantonese style roasted duck. *Journal of Agricultural and Food Chemistry*, 40, 838-841.