CHANGES OF FATTY ACIDS DURING THE PROCESSING OF NANJING DRY-CURED DUCK

Weimin Xu[1,2], Xinglian Xu[1], Guanghong Zhou[1*], Yongzhi Zhu[1,2], Daoying Wang[1,2]

1. Key Laboratory of Food Processing and Quality Control, College of Food Science and Technology Nanjing Agricultural University, Nanjing, 210095, P. R. China; 2. Institute of Agricultural Products Processing, Jiangsu Academy of Agricultural Sciences, Nanjing 210014, P. R. China

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Introduction

Nanjing Dry-cured Duck is a well known local delicacy in Nanjing, China and has a history of over 300 years. The annual production of Nanjing Dry-cured Duck reaches 4 million. Similar to dry-cured Jinhua ham, dry-cured duck is produced by dry curing, marinating, piling and drying naturally but the period of its production is shorter than that of hams. Dry-cured duck is well accepted by consumers in China and Southeast Asia due to its delicate flavor and texture.

The biochemical changes that occur during the processing of dry-cured duck are directly associated with the final taste of the product. Fatty acids is one of important factors in determining the meat flavor. Flavor development in meat and meat products are reported to be associated with phospholipid composition, the extent of lipolysis and oxidation of lipids and free fatty acids during processing (1). Lipolysis and oxidation of phospholipids have been studied in dry-cured ham (1), smoked and dried reindeer meat (3), dry-cured pork loin and pickled pork loin (4) and also cooked sardine meat (5). However, such data are not available for dry-cured duck meat. Therefore, the objective of this study was to evaluate the changes of fatty acids during the processing of Nanjing Dry-cured Duck.

Materials and Methods

Forty-two Cherry Valley ducks from a commercial feedlot were slaughtered humanely in a commercial meat processing company (Jiangsu Yurun Food Ltd.). After chilling (2h), duck carcasses were dry-cured (salt content: 7% of carcass weight, 24h), marinated in brine (saturated salt solution, 20h), piled (48h) and then dried at 17-18℃ in a well-ventilated room for 5, 10 and 15 days respectively. At the end of each processing stage (including raw), six carcasses were selected for the biochemical analyses.

The fatty acids were analyzed with a gas chromatograph (GC-14B, Shimadzu, Japan) equipped with a flame ionization detector and a split injector. One point five microlitre of the sample was injected onto a capillary column (CP-Sil 88 for Fame, 50m×0.25 mm×0.20 μm, Varian, USA) containing a non-polar stationary phase (5% phenylmethyl /95% siloxane). The oven temperature increased from 160℃ to 220℃ at 6℃/min and maintained for 30 min at 220℃. The detector temperature was maintained at 280℃. The carrier gas was nitrogen and its pressure was maintained at 80KPa. The peaks were identified by comparing their retention times with those of the standards. The relative percentages of fatty acids were determined by the peak areas.

Results and Discussion

Changes of fatty acids of phospholipids In raw duck meat, arachidonic acid ($C_{20:4}$) was the most abundant and accounted for one quarter of the total fatty acids from phospholipids, which is characteristic of fatty acid composition in duck meat.Monounsaturated fatty acids had a slight ($P>0.05$) decrease.

Changes of free fatty acids Total free fatty acids, whether saturated, monounsaturated or polyunsaturated fatty acids, increased ($P<0.05$) greatly through the processing of dry-cured duck, except a decline at the marinating stage. This decline could result from the diffusion of fatty acids in the duck meat into the curing solution..

Table1 Fatty acids from phospholipids at different processing stages of Nanjing Dry-cured duck (mg/g lipids)

Fatty acids	Raw	Dry-salting	Marinating	Drying, 5d	Drying, 10d	Drying, 15d
Myristic $C_{14:0}$	3.78 ± 0.21^{a}	4.79 ± 0.25^{b}	5.37 ± 0.35^{bc}	6.54 ± 0.31^{cd}	7.79 ± 0.26^{de}	8.23 ± 0.31^{e}
Myristoleic $C_{14:1}$	4.79 ± 0.24^{a}	4.54 ± 0.17^{a}	4.32 ± 0.28^{a}	3.54 ± 0.29^{ab}	3.23 ± 0.40^{b}	3.1 ± 0.34^{b}
Palmitic $C_{16:0}$	16.41 ± 1.58^{a}	16.79 ± 1.39^{a}	17.13 ± 0.85^{ab}	18.12 ± 0.94^{bc}	19.46 ± 1.17^{cd}	19.79 ± 1.37^{d}
Stearic	18.89 ± 0.93^{a}	21.87 ± 1.52^{b}	23.8 ± 1.34^{bc}	29.76 ± 1.69^{d}	31.32 ± 1.53^{de}	33.54 ± 2.19^{e}

$C_{18:0}$ Oleic $C_{18:1}$	17.32±1.83^{a}	16.97±1.24^{ab}	16.48±0.64^{ab}	15.87±1.26^{ab}	15.43±0.76^{b}	15.26±1.11^{b}
Linoleic $C_{18:2}$	7.60±0.41^{a}	6.81±0.37^{ab}	6.27±0.42^{b}	5.12±0.47^{c}	4.54±0.72^{cd}	4.32±0.35^{d}
Arachidonic $C_{20:4}$	25.14±1.23^{a}	24.01±0.98^{a}	23.79±2.36^{ab}	20.14±2.81^{b}	17.7±1.25^{c}	15.32±1.12^{d}
Docosatetraenoic $C_{22:4}$	2.79±0.31^{a}	1.48±0.25^{b}	0.74±0.22^{c}	0.37±0.19^{d}	0.24±0.23^{d}	0.21±0.20^{d}
Docosahexaenoic $C_{22:6}$	3.28±0.36^{a}	2.74±0.19^{b}	2.1±0.32^{c}	0.54±0.21^{e}	0.29±0.17^{ef}	0.23±0.21^{f}
Σ SFA	39.08±2.72^{a}	43.45±3.16^{b}	46.3±2.54^{bc}	54.42±2.94^{d}	59.2±2.96^{e}	61.56±3.87^{e}
Σ MUFA	22.11±2.07^{a}	21.51±1.41^{a}	20.8±0.92^{ab}	19.41±1.57^{b}	18.66±1.16^{b}	18.36±1.45^{b}
Σ PUFA	38.81±2.31^{a}	35.04±1.79^{b}	32.9±3.32^{bc}	26.17±3.68^{d}	22.14±2.37^{e}	20.08±1.88^{e}

^{a,b,c,d,e} Means in the same row with different letters differ significantly ($P<0.05$)

Table 2 Free fatty acids at different processing stages of dry-cured duck (mg/g lipids)

Fatty acids	Raw	Dry-salting	Marinating	Drying, 5d	Drying, 10d	Drying,15d
Myristic $C_{14:0}$	5.81±0.41^{a}	6.01±0.34^{ab}	5.10±0.46^{c}	6.39±0.44^{b}	6.51±0.24^{b}	6.69±0.48^{b}
Myristoleic $C_{14:1}$	1.74±0.12^{a}	1.23±0.11^{b}	1.17±0.19^{b}	1.28±0.16^{b}	1.34±0.28^{b}	1.41±0.39^{ab}
Palmitic $C_{16:0}$	4.95±0.37^{a}	9.11±0.42^{b}	8.75±0.56^{b}	18.57±1.25^{d}	21.54±0.98^{e}	22.71±1.98^{e}
Stearic $C_{18:0}$	8.64±0.51^{a}	9.92±0.73^{b}	8.37±0.49^{a}	20.34±1.45^{d}	24.20±2.17^{e}	25.41±1.64^{e}
Oleic $C_{18:1}$	13.58±0.91^{a}	18.26±1.29^{b}	15.48±1.30^{c}	21.02±1.99^{bd}	22.22±1.09^{d}	23.91±2.04^{d}
Linoleic $C_{18:2}$	14.69±1.17^{a}	19.92±1.49^{b}	17.04±1.19^{c}	30.59±2.14^{e}	32.72±2.37^{ef}	33.53±1.58^{f}
Arachidonic $C_{20:4}$	8.09±0.52^{a}	15.18±1.38^{b}	10.05±0.81^{c}	21.40±1.92^{d}	23.67±0.85^{de}	25.19±1.62^{e}
Docosatetraenoic $C_{22:4}$	0.64±0.12^{a}	0.91±0.18^{b}	0.83±0.21^{ab}	1.06±0.37^{b}	0.93±0.10^{b}	0.67±0.21^{a}
Docosahexaenoic $C_{22:6}$	0.43±0.11^{a}	0.45±0.20^{a}	0.41±0.19^{a}	0.88±0.29^{b}	0.39±0.25^{a}	0.34±0.19^{a}
Σ SFA	19.4±1.14^{a}	25.04±1.84^{b}	22.22±1.17^{c}	45.3±3.41^{e}	52.25±4.16^{f}	54.81±3.42^{f}
Σ MUFA	15.32±0.94^{a}	19.49±1.13^{b}	16.65±0.99^{a}	22.3±1.43^{c}	23.56±1.94^{cd}	25.32±1.73^{d}
Σ PUFA	23.85±1.95^{a}	36.46±2.08^{b}	28.33±1.69^{c}	53.93±3.44^{e}	57.71±2.98^{ef}	59.73±4.11^{f}

^{a,b,c,d,e,f} Means in the same row with different letters differ significantly ($P<0.05$)

Conclusions

The contents of fatty acids varied greatly during the processing of Nanjing dry-cured duck. This change maybe contribute to the formation of the specific flavor of dry cured duck meat.

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