Poster exhibition parallel session 4: Process technology

PE4.01 Eeffect of added salt on TBARS and volatiles of dry-cured turkey ham 14.00

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Abstract: The effect of added salt on lipids oxidation and volatiles of dry-cured turkey hams was studied. A total of ninety green turkey hams were equally divided into 3 groups and salted with 3%, 4% or 5% salt, and then wind dried-ripened by similar process to dry-cured ham. The TBARS values significantly decreased as salt concentration increased (*p*<0.01). The total contents of volatile compounds in ripened turkey hams also significantly decreased with the increase of added salt (*p*<0.01). The amounts of total aldehydes had significant correlations with added salt (r=0.982). The amounts of simple aldehydes (e.g., hexanal) derived from fatty acids showed positive correlations with the amount of added salt, but branched aldehyses origined from amino acids (2-methyl propanal, 2-methyl butanal, 3-methyl butanal) were negatively correlated with the added salt (r=-0.953, -0.972 and -1.000, respectively). The contents of alcohols, ketones and alkanes were negatively correlated with the amount of added salt (r= -0.975, -0.649 and -0.807, respectively). The first principal component (PC1) was dominated by aldehydes, alkanes and some alcohols, and explained 68.61% total variance of volatile compounds in all ripened turkey hams. These results indicated that lower level of added salt (3%) was better than higher level of salts (5%) in ingflavor development while limiting aldehydes formation from fatty acids during processing.

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1. INTRODUCTION

Turkey is a very popular poultry in Western countries. Most of the recent studies on turkey are mainly focused on the quality characteristics of raw and cooked turkey meat, especially, the quality changes during processing using new technologies such as irradiation (Nam & Ahn, 2002) and subsequent storage (Nam & Ahn, 2003 ; Haugen, Lundby, Wold & Veberg,, 2006). Tang and Cronin (2007) studied the effects of brined onion extracts on lipid oxidation in refrigerated cooked turkey breast rolls during storage. The flavor characteristic of a meat product generally determines its overall acceptance. Kim, Nam and Ahn (2002) reported that irradiation produced off-odor volatile compounds and promoted lipids oxidation in raw and cooked turkey meat products.

Dry-curing and ripening are important processing steps for many traditional meat products such as dry-cured ham and dry-cured loin because these steps are critical for the formation of flavor compounds that determine the sensory quality of the products. Andrés, Cava, Ventanas, Muriel & Ruiz (2004) reported that the flavor characteristics of Iberian ham were significantly affected by the amount of added salt. Salt slowed down the proteolysis and lipolysis, but promoted lipid oxidation in dry-cured ham (Zhou & Zhao, 2007). Research on the process of dry-cured turkey hams, however, has not been reported yet. The objective of this study was to investigate the effect of added salt during dry-curing step on the lipid oxidation and volatiles profiles of dry-cured turkey hams.

2. MATERIAL AND METHODS

2.1. Processing of dry-cured turkey hams and sampling

A total of 90 green turkey legs were purchased from a local turkey processor (West Liberty, IA, U.S.A.) divided into three groups, salted with 3%, 4%, or 5% salt (w/w), and then dry-cured using a process used for dry-cured ham (Table 1).

Central part of muscles from ripened turkey hams were sampled and analyzed. Five turkey hams were sampled for every test group, and was packaged immediately and stored at –20 °C until analysis.

2.2. Analysis of 2-thiobarbituric acid-reactive substances (TBARS)

TBARS were measured using the method described by Nam et al. (2003). The amounts of TBARS were expressed as mg of malondialdehyde (MDA) per kg of meat.

2.3. Volatile compounds analysis

Volatiles analysis was carried out using the method described by Nam et al. (2003). The identification of volatiles was achieved by comparing mass spectral data with those of the Wiley library and authentic standards whenever available. The peak area (ion counts×10^4) was reported as the amount of volatiles released from the samples.

2.4. Statistical analysis

The analysis of variance (ANOVA) and Duncan's multiple-range test were carried out using the SAS 8.2 software (SAS Institute Inc., 2001), and the correlation analysis and principal component analysis were performed using SPSS 16.0 (SPSS Inc., 2007).

3. RESULTS AND DISCUSSIONS

3.1. Effect of salt on lipids oxidation of dry-cured turkey ham

The TBARS value of green turkey hams was 0.189±0.086 mg MDA/ kg muscle, and significantly increased during the curing and ripening processes ($p < 0.01$). TBARS in cured turkey hams salted with 3%, 4% and 5% salt were 1.082±0.090, 1.026±0.088, 1.024±0.079 mg MDA/kg muscle, respectively, and the TBARS values were negatively correlated with the amount of added salt (r= -0.935). TBARS in ripened turkey hams (Table 2) decreased significantly as the percentage of added salt increased ($p < 0.05$). This indicated that higher salt reduced TBARS values in dry-cured turkey ham.

3.2. Volatile compounds in dry-cured turkey ham

A total of 28, 25, or 23 volatiles were identified in turkey hams with 3%, 4%, or 5% salt, respectively,

and the content of volatile compounds significantly decreased with the increase of added salt ($p < 0.01$). Aldehydes are known as the major contributors to the unique flavor of dry-cured ham because of their rapid formation in lipid oxidation and their low flavor thresholds (Drinick, Opstaele, Van & Vandendriessche, 1997). Table-2 showedthat the amount of aldehydes), especially hexanal generated from the oxidative decomposition of linoleic acid, increased significantly ($p < 0.01$), but branched aldehydes such as 2-methyl propanal, 2-methyl butanal, 3-methyl butanal originated from amino acids in ripened turkey ham decreased significantly ($p < 0.01$) with the increase of salt (r=-0.953, -0.972 and -1.000, respectively). This indicated that higher level of salt retarded proteolysis and Strecker degradation reactions of amino acids, but promoted lipid oxidation in dry-cured turkey ham. This result agrees with that of dry-cured turkey ham reported by Zhou et al. (2007).

3.4. Principal component analysis

Fig. 1 shows that the first principal component (PC1) which are dominated by ethanal (1), propanal (4), 2-methyl-propanal (7), 3-methyl-butanal (16), 2-methyl-butanal (17), hexanal (24), octanal (31), ethanol (3), 1-propanol (9), 2-methyl-1-propanol (15), 1-hexanol (25), 2-heptanone (26), 2-pentanone (19), cyclohexane (14), pentane (2), hexane (8), octane (22), and tetrahydro-furan (13), and explains 68.61% of the total variance of the volatile compounds. The second principal (PC2) component is dominated by 2-propanone (5), 2,3-butanedione (11), 2-butanone (12), 1-pentanol (23), 1-butanol (18), 3-methyl-butanol (21), 2-propanol (6), 1-octen-3-ol (30) and heptanal (27), and explains 32.39% of the total variance. Different salt levels have different contribution to PC1 and PC2. The volatile compounds in 3% and 5% salting groups had greater contribution to PC1 while those in 4% salting group had greater contribution to PC2, probably due to different effects of salt content on proteolysis, lipolysis and lipids oxidation in turkey hams during the curing and ripening steps.

4. CONCLUSION

The amount of added salt significantly affected the TBARS and volatiles of dry-cured turkey ham. Higher salt content slowed down lipid oxidation, and formation of alcohols and branched aldehydes from amino acids, but promoted aldehydes formation from fatty acids. The first principal component of volatile compounds was dominated by aldehydes, alkanes and some alcohols, and explained 68.61% of the total variance of volatile compounds in ripened turkey hams. Lower amount of added salt could form more volatile flavor compounds in dry-cured turkey ham.

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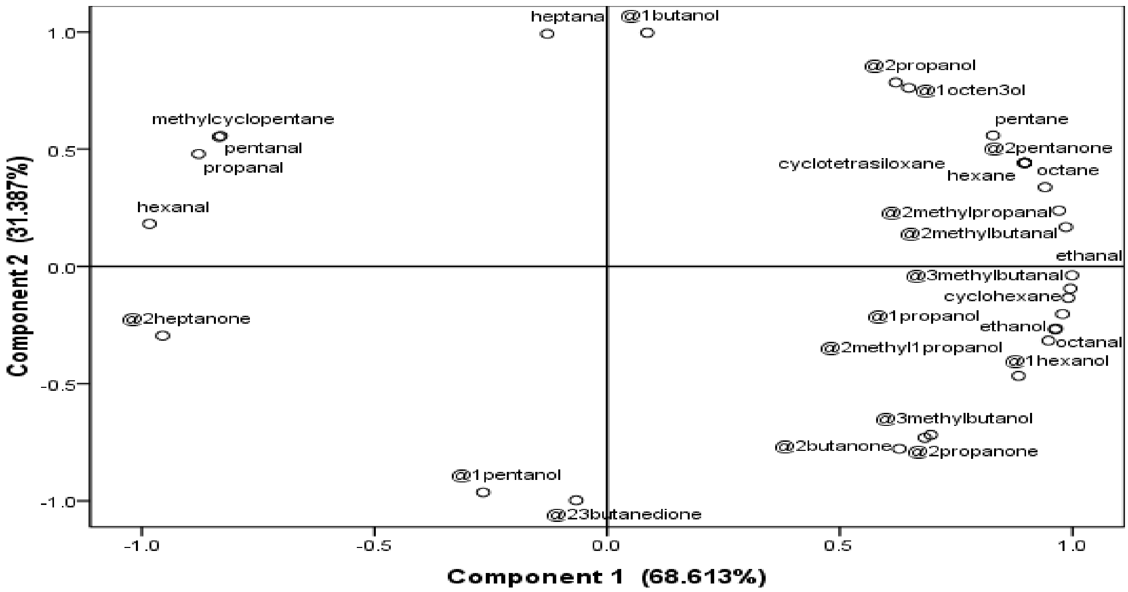

Figure 1. PC1-PC2 loading plot of principal component analysis of volatiles in all ripened turkey ham

Table 1 Design of test factors for the wind dry-ripening process of dry-cured turkey ham

Processing	Dry-curing	Low-temperature dehydrating	Wind drying-ripening 1st step	Wind drying-ripening 2ed step
Process times (day)	10	5	5	5
Temperature T1（℃）	0	15	16-20	Keep 21
Humidity（% RH）	70%	55%	50-50%	Keep 65%

Table 2. Statistical result of the TBARS and volatile compounds in dry-cured turkey ham

TBARS and Volatiles		Different salted groups		
		3% salt	4% salt	5% salt
TBARS		1.59±0.13[a]	1.53±0.15[b]	1.514±0.12[c]
The amounts of volatile compounds		28.3±1.8 [x]	25.5±1.5 [y]	23.2±1.2 [z]
Total content of volatile compounds		350571±84[x]	305895±685[y]	224477±273[z]
Aldehydes originated from amino acids	2-methyl-propanal	1228±8[a]	854±9[b]	746±0[c]
	3-methyl-butanal	4104±20[a]	3091±92[b]	1975±34[c]
	2-methyl-butanal	2736±45[a]	1573±22[b]	1092±74[c]
Aldehydes originated from Fatty acids	ethanal	18405±97[c]	22165±5[b]	26510±72[c]
	propanal	2901±7.09[c]	3158±44[b]	5476±58[a]
	pentanal	5±55.24[c]	5991±89[b]	7707±58[a]
	hexanal	56706±64[c]	63503±71[b]	73733±31[a]
	heptanal	1437±20[c]	1462±55[b]	1521±5[a]
	octanal	573.67±5.86[c]	614.33±7.09[b]	629.67±5.69[a]
Total aldehydes		93973±91[c]	102412±264[b]	119391±92[a]
Total alcohols		207596±99[a]	168701±241[b]	79927±217[c]
Total ketones		20914±33[b]	24768±34[a]	13432±39[c]
Total alkanes		24480±68[a]	10012±41[c]	11726±34[b]
Furans		3569±0	nd	nd

[x-y]Indicate the differences reached extremely significant level (α=0.01)；
[a-c] indicate the differences reached significant level (α=0.05).