Volatile Compounds and Some Properites of Chinese-Style Sausage

MING-TSAO CHEN, DENG-CHENG LIU and SHUI-LAN GUO
Department of Animal Science, National Chung-Hsing University
Kao Kung Road, Taichung, Taiwan, Republic of China

SUMMARY: Steam volatile fraction from Chinese-style sausage was prepared and analyzed by GC/MS. The pH, moisture, water activity, amino nitrogen, acid value, lactic acid, free fatty acids and ethanol of the product were also measured. Isobutyric acid, propionic acid and acetic acid were major components at the beginning, while acetic acid increased, and the other two components decreased with the storage time. Moisture content of the product was 34% at the beginning, and dropped to 15% after two week storage in the air. Water activity changed from 0.95 to 0.73. pH changed from 6.70 to 5.88, acid value increased from 2.3 to 5.6, lactic acid dropped to less than 0.2%, ethanol was slightly decreased after drying, however, amino nitrogen reminded constant.

As the results of GC/MS analysis, it could be noted that spices and wine played an important role in flavor precursors of Chinese-style sausage. Isoamyl alcohol was major component found in the volatile component. And other alcohols isolated from the products might origin from alcohol (wine) and cyclo alkanes origin from the spices. In this study, there were 48 volatile compounds being isolated and identified.

INTRODUCTION: Chinese-style sauage is one of major meat products in Taiwan market. Consumers prefer sweet but dislike salty and tangy flavor product. No much research work related to flavor components in sausage has been done in Taiwan. In order to know the characteristics of the Chinese-style sausage produced in Taiwan, microflora ecological and biochemical characteristics have been studied by our lab. This study is continuous work on the volatile compounds from the Chinese-style sausage. Volatile componds of the product were isolated and identified, pH, water activity, moisture, amino nitrogen, volatile fatty acid were also measured.

MATERIALS and METHODS: Samples were prepared according to the general commercial procedure with lean:fat ratio by 3.5:1, and added with salt, sugar, rice wine, spices, monosodium glutamate and nitrite. The samples were hanged in the air, and taken for analyzing every one week.

Chemical analysis:Amino nitrogen and free fatty acids were determined by the methods of A.O.A.C. (1984). pH value was measured with Hanna pH-meter (Italy). Lactic acid and ethanol were determined according to the method described by Nordal and Slinde (1980). Volatile fatty acids were measured by Gas chromatography, and volatile compounds were determined by the method of GC/MS described Marrse and Beiz (1981), and extracting procedure described by Likens-Nickerson. Data were analy 2ed by general linear model (SAS, 1982).

RESULTS and DISCUSSION: Table 1 showed that changes of water activity, moisture, acid value, amino nitrogen, and pH values of the sausage during processing and storage. Since the samples were hanged in the air, the moisture content of the product dropped from 34% at beginning to 15% after two week storage. The water activity dropped from 0.95 to 0.73, pH value changed from 6.70 to 5.88 after three week storage in the air. Table 2 showed that changes of ethanol and lactic acid and volatile fatty acids in sausage during processing and storage. Ethanol content of the sample after drying was 0.18g/100g at the beginning and increased to 0.22g/100g after 3 week storage. lactic acid changed from 0.08g/100g to 0.11g/100g. Isobutyric acid, acetic acid and propionic acid were the major components of the volatile fatty acids found in the sausage. Their concentrations were 86.9, 1.4 and 5.2% by area proportions for isobutyric aicd, acetic acid and propionic acid, respectively. The result revealed that acetic acid increased remarkably, and other two decreased after two week storage.

Fig. 1 showed that the gas chromatogram of volatile component from sausage. Picture A was the chromatogram for the sausage with spices and wine, B was the sausage without wine and C was no spices and wine added. The chromatograms revealed that isoamyl alcohol had higher level in the volatile components of the Chinese-style sausage prepared in our lab. This phenonmenon was wassociated with addition of wine in the product. The spices provided most volatile compounds such as trans-2-undecen-1-ol, estragole, anethole, euogenol, coumarin and cycloalkanes. However, nitrogen containing compounds such as furan, pyrzine were not detected. Fig. 2 was the GC/MS chromatogram of volatile compounds from sausage. Table 3 showed that volatile compounds were identified from the sausage product by CG/MS. There were 48 components being identified.

The difference between Chinese-style sausage and western-style sausage was noted in raw materials, processing conditions and microflora (Guo, 1989) and consumers' custom. Most consumers prefer eating sweet taste products, so sugar usage was up to 15% is very popularly found in the Chinese-style sausage. Usually the sausage

products are stored at room temperature (in the air) and cause moisture loss rapidly. And the spices used in the chinese-style sausage are also different from the western-style products. From this study we may know that spices and wine provide the precursors of the volatile compounds in the sausage.

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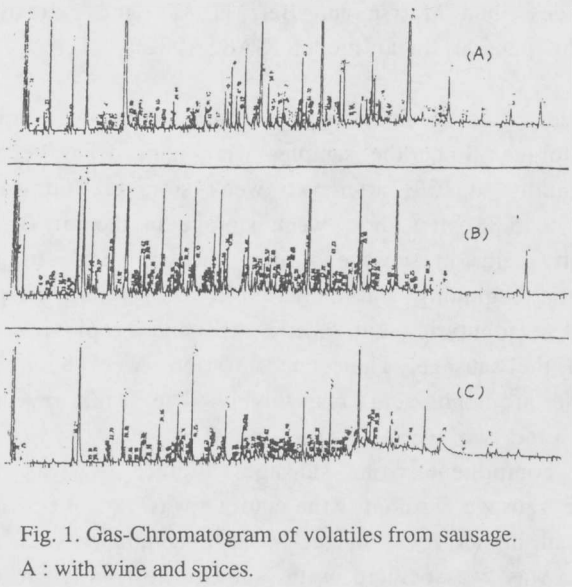

Fig. 1. Gas-Chromatogram of volatiles from sausage.
A : with wine and spices.
B : without wine.
C : without spices and wine.

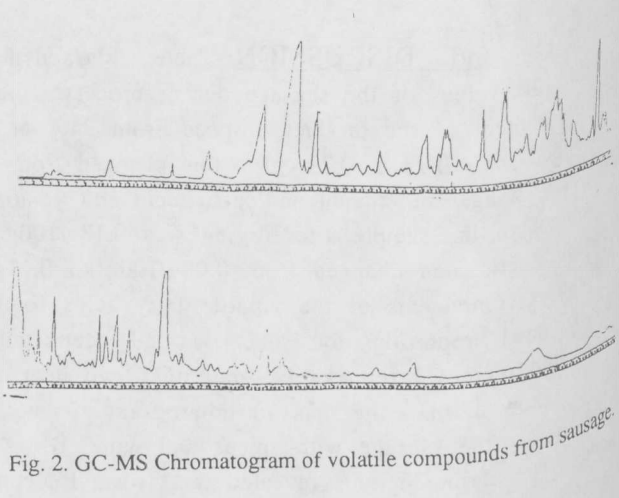

Fig. 2. GC-MS Chromatogram of volatile compounds from sausage.

Table 1 Volatile compounds identified in sausage by GC/MS.

Table 3. Volatile compounds identified in sausage by GC/MS.

No components	M. W.	CW_{20} RI*
1 ethyl alcohol	46.07	900
2 n-propanol	60.10	1002
3 isobutyl alcohol	74.12	10524
4 isoamyl alcohol	88.15	1231
5 limonene	136.24	1206
6 1,4-cineol	154	1223
7 2,n-propylthiophene	126.22	1259
8 1,2,4-trimethyl benzene	120	1248
9 2,5-dimethyl pyrazine	108.14	1306
10 n-tridecane	184.3	1300
11 2-n-butylthiophene	140.2	1353
12 diethyleneglycol dimethyl ether	134.18	1396
13 2,4,6-trimethyl pyrazine	121	1388
14 2-methyl-3-ethyl pyrazine	122.17	1381
15 D-Fenchone	152.23	1404
16 trans-2-undecen-1-ol	124	1493
17 1-heptanol	116	1465
18 coproate	172	1423
19 bezenaldehyde	106	1502
20 linalool	154.25	1506
21 n-octanol	130.23	1519
22 2-n-octyfuran	180.29	1530
23 2-n-hexylthiophene	168.3	1564
24 4-terpineol	196.29	1595
25 B-caryophylene	204	1617
26 a-acetylthiozole	127.6	1639
27 a-cubuene	204	1667
28 a-amorphene	204	1681
29 estragole	148.21	1652

Table 1. Changes of Aw, moisture, acid value, amino nitrogen (mg/g) and pH in the sausage during process and storage.

Items	Before curing	1 day after curing	After drying (day)			
			0	7	14	21
Water activity			0.95	0.81	0.73	
Moisture (%)		55.67^{a}	34.64^{b}	21.25^{c}	15.54^{c}	14.88^{d}
Acid value (g/100g)	2.3^{a}	2.5^{a}	3.6^{b}	4.5^{c}	4.7^{c}	5.6^{d}
Amino nitrogen (mg/g)	1.4^{a}	1.4^{a}	2.2^{b}	2.9^{c}	3.0^{c}	3.4^{d}
pH	6.77^{a}	6.78^{a}	6.70^{b}	6.04^{c}	6.03^{c}	5.88^{d}

*means on the same row with different superscripts differ significantly. ($p < 0.05$)

Table 2. Changes of ethanol, lactic acid and volatilic fatty acid in the sausage during process and storage. *

Items	Before curing	1 day after curing	After drying (day)			
			0	7	14	21
Ethanol (g/100g)	0.39^{a}	0.21^{b}	0.18^{c}	0.22^{d}	0.22^{d}	0.22^{d}
Lactic acid (g/100)	0.07^{a}	0.07^{a}	0.08^{b}	0.11^{c}	0.15^{d}	0.11^{d}
Acetic acid (area %)	1.5	2.1	1.4	1.4	4.1	-
Proponic acid (area %)	2.2	5.1	5.2	5.2	5.0	-
Isobutyric acid (area %)	86.9	86.6	86.9	86.2	84.0	-

*means on the row sith different supersctipts differ significantly. ($p < 0.05$)

30	a-muurolene	152	1740
31	B-bisabolene	204	1750
32	anethole	148	1809
33	n-undecanol	172.31	1822
34	ethyl-n-dodecanoate	228.38	1826
35	a-propionyl-thiophene		1821
36	BHT	220.34	
37	anis aldehyde	136.14	1982
38	veridiflorol	282.56	2071
39	n-eicosane	282.56	2000
40	ethyl-tetradecanoate	256	2029
41	euogenol	164	2103
42	iso-longifolene	204	2184
43	a-hexanoyl thiophene	182.28	2209
44	isobutyl-cinnamate	204.27	2228
45	methyl-hexadecanoate	282	2264
46	coumarin	146.5	2361
47	ethyl-9-octadecinoate	310	2429
48	ethyl-9,12-octadecadienoate	308	2466

* Retention Index for CW_{20}