CHANGES OF FREE FATTY ACIDS IN CHINESE-STYLE SAUSAGES (LA CHANG) DURING OVEN DRYING

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Background

Chinese-style sausages (La Chang) make up a distinct class of sausages both for their sensory characteristics and for their long shelf life at room temperature. Traditionally manufactured sausage using pork meat appears pink and with an alluring appearance. This sausage has a characteristic sweet taste and strong fragrance, which attracts consumers as well as the interests of many meat scientists[1]. Processing of traditional products needed at least 15d for ripening. But a few years ago, a new technology adopted to substitute ripening by oven drying under appropriate temperature and time. During the process, a series of complicated biochemical changes occurred similar to the ripening in the traditional manufacture. These changes might lead to the formation of a unique flavor[2]. It has been indicated that free fatty acids (FFA), products of lipolysis, constituted major precursors of aroma compounds in dry fermented sausages[3]. Unfortunately, till now, there is no reports about the FFA formation and their changes in the Chinese-style sausages. This study attempts to demonstrate the lipolysis during oven drying of Chinese-style sausages (La Chang).

Objectives

Because of the importance of the oven drying in the modern technology, this research has been conducted on lipid changes especially on FFA changes of Chinese-style sausages during the oven drying.

Materials and Methods

A set of batches of Chinese-style sausages named "long Chinese rose" was produced by Tang Ren Shen Group in the province of Hunan. The different batches of samples were collected respectively after 0, 9, 14, 23, 31, 36, 48, 52 hours oven drying and immediately stored at -18°C for analysis. FFAs in Chinese-style sausages were quantified according to the method described by Kenneally *et al.* (1998) [4]. Gas Chromatographic analysis was performed with a HP-6890 gas chromatograph equipped with a flame ionization detector. A capillary quartz column (30m×0.25mm i.d.) containing 0.25μm FFAP (Beijing Analytical Instrument Factory) was used. The temperatures were programmed as following: the temperature started from 50°C, then increased at a rate of 10°C /min up to 180°C and then kept for 1 min, and then continued to increase at a rate of 4°C/min up to 210°C and then kept for 12 min. Other conditions of GC were: injector temperature, 270°C; detector temperature, 270°C; Carrier gas, nitrogen; split rate, 20:1. The flow rates were: hydrogen, 30ml/min and air, 300ml/min; constant pressure mode: 17.87Psi.

Results and Discussion

The composition of FFAs in Chinese-style sausages at different drying time during the oven drying was given in Table 1. The results showed that detectable FFAs in the product were C14:0, C16:0, C16:1, C18:0, C18:1 and C18:2. The composition of FFAs had been changing in the course of oven drying, which led to an increase of unsaturated fatty acids (UFA) from about 53% (0h) to about 60% (52h), in which the mass percentage of C18:1 increased from 47.84% to 52.99%, while C18:2 largely increased from 0.32% to 2.55%. Meanwhile, the percentage of saturated fatty acids (SFA) decreased from about 47% at 0h of oven drying to about 40% at the end of oven drying, in which the mass percentage of C16:0 decreased from 29.73% to 24.49%.

At the end of the oven drying (52h), the mass percentage of C18:1 was 1.1-fold of that before oven drying and C18:2 reached 8-fold, but C16:1 decreased a bit. While the mass percentage of C16:0 declined most evidently and its mass percentage at the end of oven drying was 0.82-fold of that before oven drying, but C18:0 remained constant (fig.1).

On the other hand, the content of almost FFAs increased (table 2). The results showed that content of C12:0 in FFAs was higher in comparison with others. Content of C12:0 decreased from 8.666mg/g (dried matter, dm) before oven drying to 5.011mg/g (dm) after 52h oven drying. As only trace amount of C12:0 was detected in pork fat[5], the C12:0 in the sausages probably came from the additives. Due to decomposition and volatilization, content of C12:0 declined in the course of oven drying. Total content of FFAs (except of C12:0) increased from 7.129mg/g (dm) at 0h to 13.746mg/g (dm) after 52h oven drying, i.e. an increase of 6.617mg/g (dm).

As net content was concerned, the degree of change for C18:1 was largest, from 3.347mg/g(dm) at 0h to 7.285mg/g(dm) at 52 h of oven drying, i.e. an increase of 3.811mg/g(dm). Increases of C16:0 and C18:0 during the same conditions were 1.336mg/g(dm) and 1.039mg/g(dm) respectively. As the rate of liberation of FFAs was concerned, the rate of lipolysis of C18:2 was highest, followed by C18:1, C16:1, C18:0, C14:0 and C16:0 for which the highest values of lipolysis were respectively 22.3-fold, 2.2-fold, 2.1-fold, 2.0-fold, 1.8-fold and 1.6 fold of that at 0h oven drying (fig.2). So the conclusion was that the rate of lipolysis during oven drying of Chinese-style sausages decreased in the order linoleic>oleic>palmoleic> stearic> palmitic acid.

Table 3 summarized a research result conducted on fatty acid composition of triglycerides of pork back fat and the distribution of different fatty acids in the stereo-specific positions. It had been shown that the content of C18:1 in pork back fat was highest, followed by C16:0, C18:0, C18:2 and C16:1. While C18:1 mainly occupied positions sn-1 and sn-3, C16:0 mainly esterified on position sn-2 and C18:0 mainly on position sn-1 in triglycerides of pork fat[6]. Our experimental results confirmed that in the Chinese-style sausages C18:1 was the main FFA component before as well as during the oven drying. This is in accordance with data on dry fermented sausage[7,8], demonstrating either sn-1 or sn-3 position of glycerol molecule was preferentially attacked by lipolytic enzymes due to steric hindrance of the sn-2 position or meaning lipases presented in the adipose and/or muscle tissues were sn-1 and/or sn-3 specific. To confirm this, the component C16:0 in Chinese-style sausages was liberated slowest during the oven drying, mainly due to its occupation on position sn-2 in the triglycerides.

Conclusions

Gas Chromatographic analysis showed that FFAs in Chinese-style sausages mainly composed of a series of FFAs ranged from C14 to C18. For total FFAs, percentage of unsaturated fatty acids (UFAs) was higher than that of saturated fatty acids (SFAs). Mass percentage of UFAs increased, whereas SFAs decreased during the oven drying, meaning that UFAs in Chinese-style sausages were more prone to be released from triglycerides, in comparison with SFAs. The triglycerides were hydrolyzed gradually, which gave rise to an increase of total content of FFAs, from 7.129mg/g(dm) at 0h to 13.746mg/g(dm) after 52h oven drying. The rate of liberation of FFAs in Chinese-style sausages during the oven drying decreased in the order linoleic>oleic>palmoleic> stearic> palmitic acid.

Pertinent literature

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Table 1 Mass percentages (%) of individual FFA in total FFAs in Chinese-style sausages during the oven drying

FFA / Time(h)	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2
0	2.62	29.73	4.37	14.55	47.84	0.32
9	2.91	26.66	4.53	14.70	51.20	0.65
14	2.66	25.54	4.84	14.91	50.77	1.29
23	2.64	26.39	5.20	14.36	49.11	2.31
31	2.71	24.34	4.76	14.99	50.45	2.75
36	2.54	22.64	4.90	14.82	52.47	2.64
48	2.36	24.44	4.59	14.70	50.75	3.16
52	2.28	24.49	4.06	13.63	52.99	2.55

Table 2 Contents [mg/g(dm)] of individual and total FFA in Chinese-style sausages during the oven drying

Time (h) / FFA	0	9	14	23	31	36	48	52
C12:0	8.666	7.124	7.360	6.253	6.065	5.133	5.299	5.011
C14:0	0.188	0.272	0.284	0.296	0.342	0.311	0.334	0.313
C16:0	2.118	2.497	2.734	2.960	3.078	2.770	3.454	3.367
C16:1	0.311	0.425	0.519	0.583	0.602	0.599	0.648	0.558
C18:0	1.038	1.376	1.596	1.611	1.895	1.813	2.077	1.873
C18:1	3.474	4.794	5.435	5.509	6.393	6.421	7.171	7.285
C18:2	0.02	0.06	0.138	0.259	0.348	0.323	0.446	0.350
Total	15.795	16.488	18.066	17.471	18.723	17.37	19.429	18.757
Total - C12:0	7.129	9.364	10.706	11.218	12.658	12.237	14.130	13.746

Table 3 Composition (%) of fatty acids in triglycerides of pork back fat and their stereo-specific position (mol%)[6]

	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2
Fat	1	26~32	2~5	12~16	41~51	3~14
Sn-1	2	16	3	21	44	12
Sn-2	4	59	4	3	17	8
Sn-3	tr	2	3	10	65	24

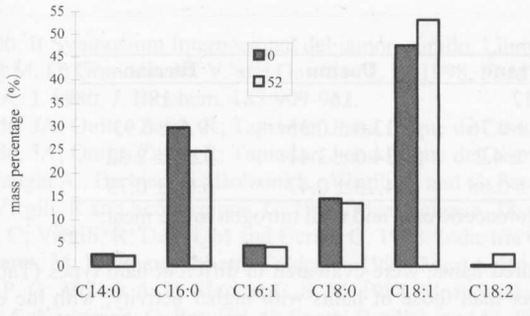

Figure 1 Comparison on mass percentage of different FFAs in Chiness-style sausages at 0h and 52h oven drying

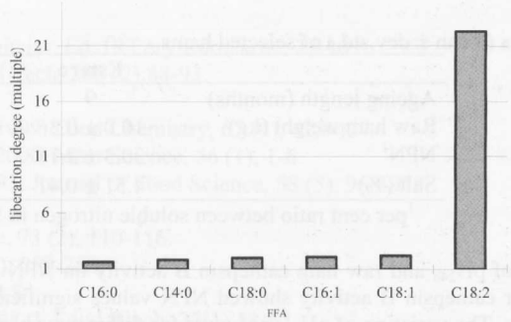

Figure 2 Rates of liberation of different FFAs in Chinese-style sausages during the oven drying