P - 127

Flavor Compounds of Low-fat Sausages Containing Various Kinds and Levels of Sugars in Combination with Lysine

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Introduction

Flavor of foods recognized as not only the sense of the smell, but also the combination of taste, and senses of tactile and sight. Flavor compounds of various foods including meat products were developed through the Maillard reactions by a reducing sugar, an amino acid and a lipid(1). Among the precursor of flavor compounds, fat serve as providing the desirable taste with proper acceptability(2) and maintaining the water holding capacity, resulting in decreases in cooking loss and increases in juiciness during cooking process(3). In addition, it plays an important role in the processing of various foods, However, excess intake of dietary fat cause diseases such as fatness, hypertension and coronary heart disease. Therefore, consumers prefer to select low-fat, low-salt foods due to their health concern. To meet this trend, food industries have tried to develop "healthier foods". However, these food products had problems related to product defects, such as texture and flavor, due to excess removal of fat in the foods. Thus, the objective of this study was performed to develop low-fat sausages with similar flavor compounds to those with regular-fat counterpart using the combination of various kinds and levels of sugars.

Materials and Methods

Three sugars(glucose, fructose, sucrose) with various levels (0.05~0.2 M) and lysine (0.1 M, fixed) were added in the sausage manufacture. Low-fat and regular-fat sausages were manufactured according to the method of Choi and Chin(4). The volatile compounds from each sausage were isolated by following the procedure of simultaneous distillation extraction method(SDE)(5). After isolation of volatile compounds, they were concentrated to the final volume of 1 mL and analyzed by a gas chromatography (HP 6890, Hewlett-Packard, Palo Alto, USA) a equipped with flame ionization detector and a fused silica capillary column of HP-5. Concentration of each peak was calculated by relative area of internal standard. The volatile compounds were identified by HP 6890 GC/MS equipped with a 5973 mass selective detector.

Statistical analyses were performed using SPSS (version 10.0) at the significant level of 0.05%.

Results and Discussion

Since no interactions were found between kind and level of sugar, data were separated out by kind and level of sugar (Table 1). Approximately 40 flavor compounds were identified and there were observed in mostly phenols, aldehydes, hetero compounds, ketones and alkans. Among them, phenols and aldehydes were the predominant flavor compounds (Table 1). Table 1 shows 28 flavor compounds as affected by various kind and level of sugars. Although the volatile compounds such as 5-Methyl furfural, 2-Methoxy phenol, 2-Methoxy-4-methyl phenol and 17-Octadecenal were not different ($P>0.05$) between the regular-fat and low-fat controls, the addition of fructose and sucrose cause to affect the composition of volatile compounds in low-fat sausages($P<0.05$). However, low-fat sausages containing glucose did not make any differences in these compounds. These results indicated that flavor compounds were significantly affected by the kind of sugar. Approximately 14 volatile compounds including 2-Chloro-2-methyl butane, Cyclopentanol, Octane and Furfural made differences between regular-fat and low-fat control, however these differences were also reduced with the addition of sugars and 0.1 M lysine as a precursor of fat. However the volatile compounds such as Nonanal, α-Terpinene, Myristicine, 2-Pentadecanone, Pentadecanal and Octadecanal was not affected by sugar and amino acid. In the effects of sugar level on the flavor compounds, the volatile compounds such as 2-Methyl-2-butanol, 5-Methyl furfural, 2-Methoxy phenol, 2-Methoxy-4-methyl phenol and 17-Octadecenal were reduced the volatility by increased level of sugar. These results indicated that the best sugar in combination of 0.1 M lysine was glucose and the optimum level was 0.05 M, since no differences in volatile compounds were observed with increased level of sugars.

Table 1. Quantitative and qualitative analysis of volatile compounds from regular-fat and low-fat sausages with various kinds and levels of sugars

				LFC + Sugar					LFC + Sugar		
CS	RT	RFC	LFC	Glucose	Fructose	Sucrose	RFC	LFC	0.05M	0.1M	0.2M
1	5.4	62^{ab}	67^{a}	59^{b}	60^{ab}	54^{b}	62^{ab}	67^{a}	59^{ab}	57^{b}	56^{b}
2	7.4	51^{b}	68^{a}	71^{a}	68^{a}	58^{b}	51^{b}	68^{a}	70^{a}	64^{a}	64^{a}
3	12.7	134^{b}	211^{a}	174^{ab}	168^{ab}	165^{ab}	134^{b}	211^{a}	178^{ab}	155^{ab}	174^{ab}
4	13.9	84^{bc}	94^{a}	88^{ab}	84^{bc}	76^{c}	84^{ab}	94^{a}	85^{ab}	82^{b}	80^{b}
5	16.0	2506^{b}	3071^{a}	2804^{ab}	2624^{b}	2497^{b}	2506^{b}	3071^{a}	2750^{ab}	2558^{b}	2617^{b}
6	17.0	608^{b}	886^{a}	762^{ab}	729^{ab}	746^{ab}	608^{b}	886^{a}	776^{ab}	694^{ab}	767^{ab}
7	19.5	232^{bc}	262^{a}	242^{ab}	227^{bc}	215^{c}	232^{b}	262^{a}	238^{ab}	224^{b}	223^{b}
8	19.7	168^{b}	198^{a}	178^{ab}	166^{b}	165^{b}	168^{b}	198^{a}	175^{ab}	164^{b}	171^{b}
9	22.0	443^{a}	456^{a}	422^{ab}	389^{bc}	376^{c}	443^{a}	456^{a}	408^{ab}	387^{b}	391^{b}
10	25.4	139^{ab}	160^{a}	145^{ab}	133^{b}	133^{b}	139^{ab}	160^{a}	141^{ab}	133^{b}	137^{ab}

Table 1. Continued.

CS	RT	RFC	LFC	LFC + Sugar			RFC	LFC	LFC + Sugar		
				Glucose	Fructose	Sucrose			0.05M	0.1M	0.2M
11	25.8	352^{ab}	367^{a}	332^{ab}	308^{b}	306^{b}	352^{ab}	367^{a}	327^{ab}	306^{b}	313^{ab}
12	27.5	1520^{a}	1543^{a}	1414^{ab}	1300^{b}	1304^{b}	1520^{a}	1543^{a}	1386^{ab}	1298^{b}	1333^{ab}
13	28.0	75^{a}	59^{b}	57^{bc}	52^{cd}	50^{d}	75^{a}	59^{b}	54^{b}	53^{b}	52^{b}
14	30.3	111^{b}	137^{a}	118^{ab}	109^{b}	111^{b}	111^{ab}	137^{a}	117^{ab}	109^{b}	112^{ab}
15	31.5	1521^{a}	1547^{a}	1423^{ab}	1322^{b}	1318^{b}	1521^{a}	1547^{a}	1398^{ab}	1324^{b}	1342^{b}
16	33.0	77^{b}	89^{a}	78^{b}	74^{b}	69^{b}	77^{b}	89^{a}	77^{b}	72^{b}	72^{b}
17	34.7	704^{ab}	781^{a}	695^{ab}	656^{b}	637^{b}	704^{ab}	781^{a}	685^{ab}	647^{b}	656^{b}
18	35.8	86^{a}	52^{b}	60^{b}	53^{b}	54^{b}	86^{a}	52^{b}	57^{b}	53^{b}	56^{b}
19	37.1	187^{b}	254^{a}	218^{b}	215^{b}	218^{b}	187^{c}	254^{a}	227^{ab}	214^{bc}	209^{bc}
20	37.3	97^{b}	136^{a}	116^{ab}	112^{b}	109^{b}	97^{b}	136^{a}	117^{ab}	109^{b}	111^{b}
21	38.3	45^{b}	77^{a}	72^{a}	65^{ab}	74^{a}	45^{b}	77^{a}	70^{ab}	68^{ab}	72^{a}
22	39.0	100^{b}	169^{a}	139^{ab}	120^{ab}	143^{ab}	100^{b}	169^{a}	135^{ab}	122^{ab}	145^{ab}
23	39.1	194^{b}	367^{a}	352^{ab}	312^{ab}	395^{a}					
24	40.5	457^{b}	929^{a}	855^{a}	828^{a}	877^{a}	457^{b}	929^{a}	892^{a}	831^{a}	837^{a}
25	42.6	8^{b}	44^{a}	37^{a}	37^{a}	40^{a}	8^{b}	44^{a}	40^{a}	36^{a}	38^{a}
26	45.0	191^{c}	1205^{a}	818^{ab}	763^{b}	913^{ab}	191^{c}	1205^{a}	796^{a}	790^{a}	907^{a}
27	48.0	17^{b}	43^{ab}	43^{ab}	43^{ab}	49^{a}	17^{b}	43^{ab}	44^{ab}	39^{ab}	52^{a}
28	49.4	12^{b}	203^{a}	138^{a}	138^{a}	162^{a}	12^{b}	203^{a}	139^{a}	139^{a}	160^{a}

[a-c] Means with same row having the same superscripts are not different (P>0.05).

CS=Compounds, RT=Retention time, RFC=Regular-fat sausage, LFC=Low-fat sausage, 1=2-Methyl-2-buranol, 2=2-Chloro-2-methyl butane, 3=Cyclopentenol, 4=Octane, 5=Furfural, 6=2-F uran methanol, 7=2-methyl-2-cyclopenten-1-one, 8=2-Acetyl furan, 9=5-Methyl furfural, 10=2,3- Dimethyl-2-cyclopenten-1-one, 11=2-Methyl phenol, 12=2-Methoxy phenol, 13=Nonanal, 14=3,4-Di methyl phenol, 15=2-Methoxy-4-methyl phenol, 16=Methoxy ehtyl phenol, 17=4-Ethyl-2-methoxy phenol, 18=α-Terpinene, 19=Eugenol, 20=α-Copane, 21=2-methylene-4, 8, 8-trimethylbiocyclonane, 22=Cis isoeugenoll, 23=4, 5-Dimethoxy-2-methyl phenol, 24=Myristicine, 25=2-pentadecanone, 26=Pentadecanal, 27=17-Octadecenal, 28=Octadecanal.

Conclusions

The volatile compounds were affected by the kind of sugar. The differences in 14 compounds between regular-fat and low-fat sausages were reduced with the addition of sugar and amino acid combination as a precursor of fat. This study suggested that the combination of glucose 0.05 M and lysine 0.1 M in the manufacture of low-fat sausages were most similar flavor profile to those with regular-fat counterpart.

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