# Supplementary Materials

## S 1.1. Preparation of flavored soy sauce

*A) Flavored soy sauce preparation at laboratory scale*

A traditional Korean soy sauce was prepared by using 32% soybeans *meju* in 18% salt solution and served as control and staring material for the preparation of flavored soy sauce. The radish, apple, and pears were washed and grinded by mechanical grinding and added separately in the basic ingredients of traditional Korean soy sauce (32% soybeans in 18% salt) at 10% (w/w), 30% (w/w), and 30% amount, respectively. The radish (10% radish+32% soybeans+18% salt), apple (30% apple+32% soybeans+18% salt), and pear (30% pear+32% soybeans+18% salt) supplemented soy sauces were further mixed in different proportions to make the four distinct flavored soy sauce. The 10% radish, 30% apple, and 30% pear supplemented soy sauces were mixed in equal amount (1:1:1) and designated as FSS-A. Further, the 10% radish, 30% apple, and 30% pear supplemented soy sauces were mixed in 1:3:2, 1:2:3, and 1:2:2 to make the three different flavored soy sauce and named as FSS-B, FSS-C, and FSS-D. Finally, all the formed FFS and traditional Korean soy sauce (control) preparations were fermented at ambient temperature for 6 months and filtered to separate solid portion to obtain liquid final product. For the laboratory scale production of flavored soy sauce was prepared at 600 mL.

*B) Flavored soy sauce preparation at plant scale*

The traditional Korean soy sauce at 100 L volume was prepared by supplementing 32% soybeans *meju* in 18% salt solution and served as control. The pulverized radish, apple, and pear were supplemented separately with the traditional Korean soy sauce at 10%, 30%, and 30% proportion (w/w), respectively. Radish (10%), pear (30%), and apple (30%)-supplemented soy sauces were finally mixed in 1: 2: 2 to make the flavored soy sauce at the plant scale (in 100 L volume) and fermented over the 6 months. This plant scale produced flavored soy sauce was named as PFSS.

## S 1.2. Commercial flavored soy sauce composition

Two commercial flavored soy sauces, CFSS-A and CFSS-B, have the following compassions, respectively.

*CFSS-A:*

Skim soybean, wheat, sea salt, refined salt, starch syrup, fructose, mixed preparations (alcohol, emulsifier sodium lauryl sulfate, and vitamin B)

*CFSS-B:*

Skim soybeans, wheat, sea salt, starch syrup, green onion, garlic, ginger, fermented alcohol, pear concentrated fruit juice, apple concentrated fruit juice.

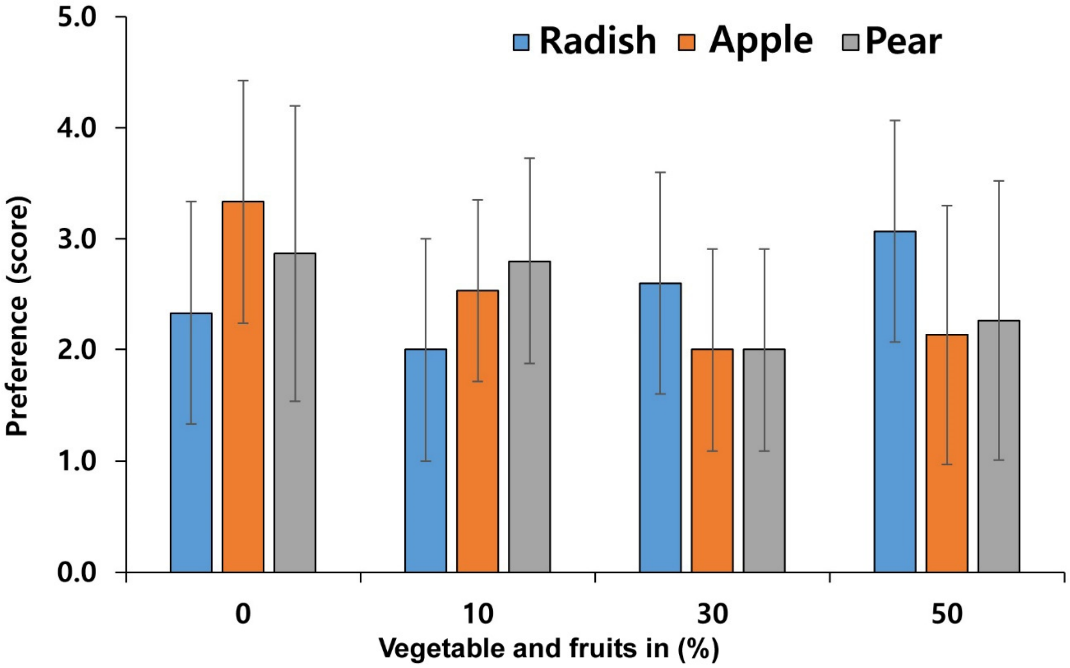

**Figure 1.** Sensory evaluation of the soy sauce supplemented with radish, apple, and pear. Sensory evaluation was conducted by 15 participants and preference for the food was given on a scale of 1-5. Numeric value 1 represents the highest preference while numerical value 5 represents the least preference towards the food.

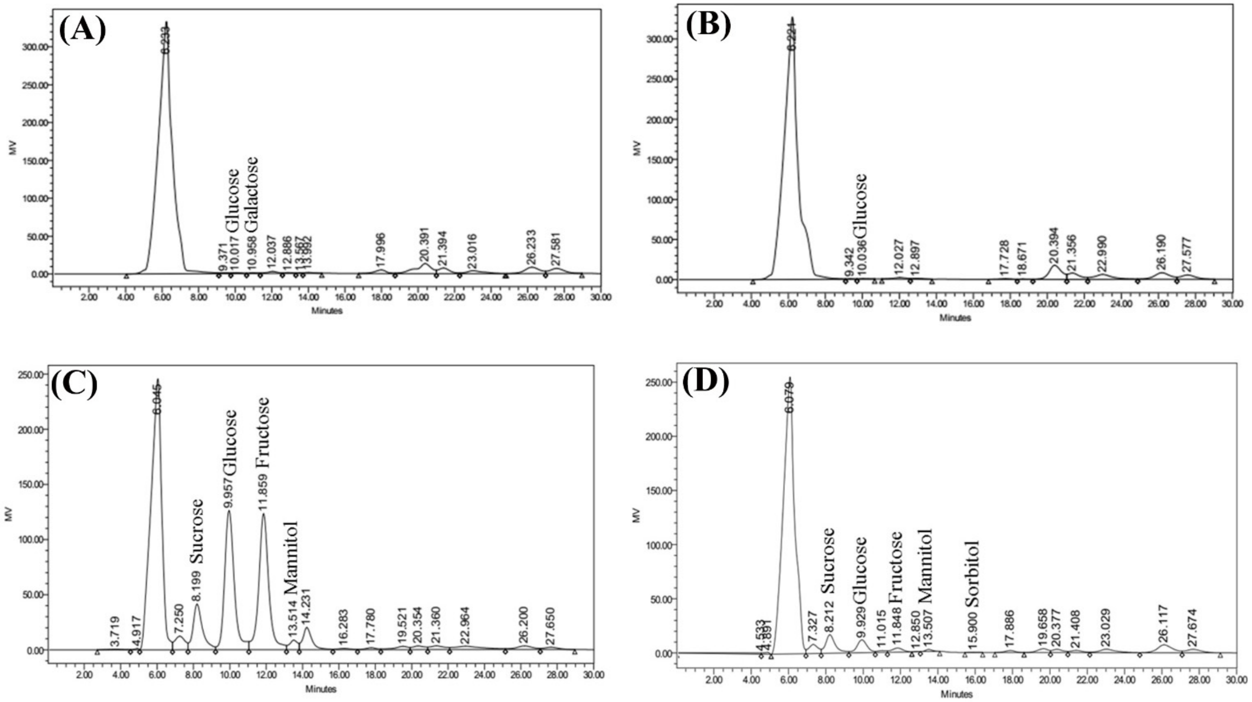

**Figure 2.** Chromatogram of free sugars detected in various soy sauce samples. **(A)** Traditional Korean soy sauce (control) **(B)** Plant scale produced flavored soy sauce (PFSS) **(C)** Commercial flavored soy sauce-A (CFSS-A) **(D)** Commercial flavored soy sauce-B (CFSS-B).

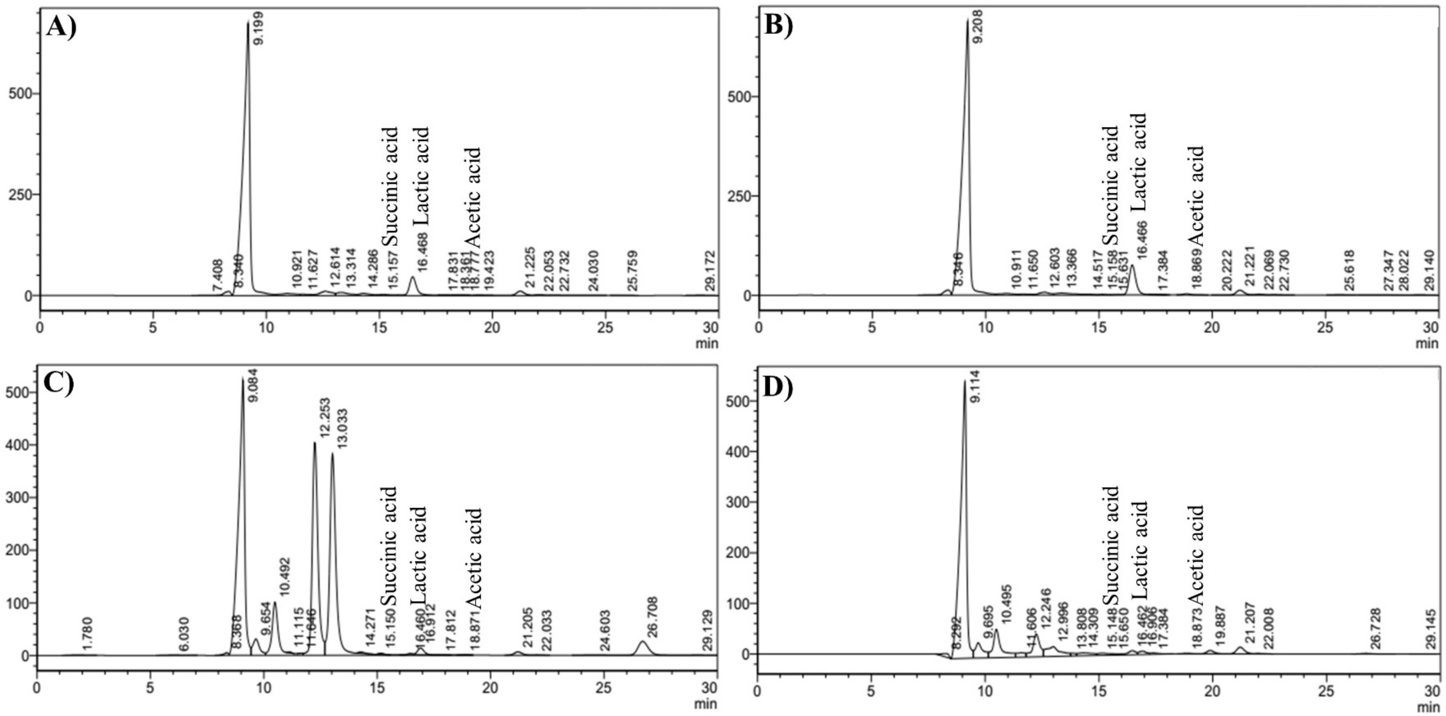

**Figure 3.** Chromatogram of organic acids detected in various soy sauce samples. **(A)** Traditional Korean soy sauce (control) **(B)** Plant scale produced flavored soy sauce (PFSS) **(C)** Commercial flavored soy sauce-A (CFSS-A) **(D)** Commercial flavored soy sauce-B (CFSS-B).

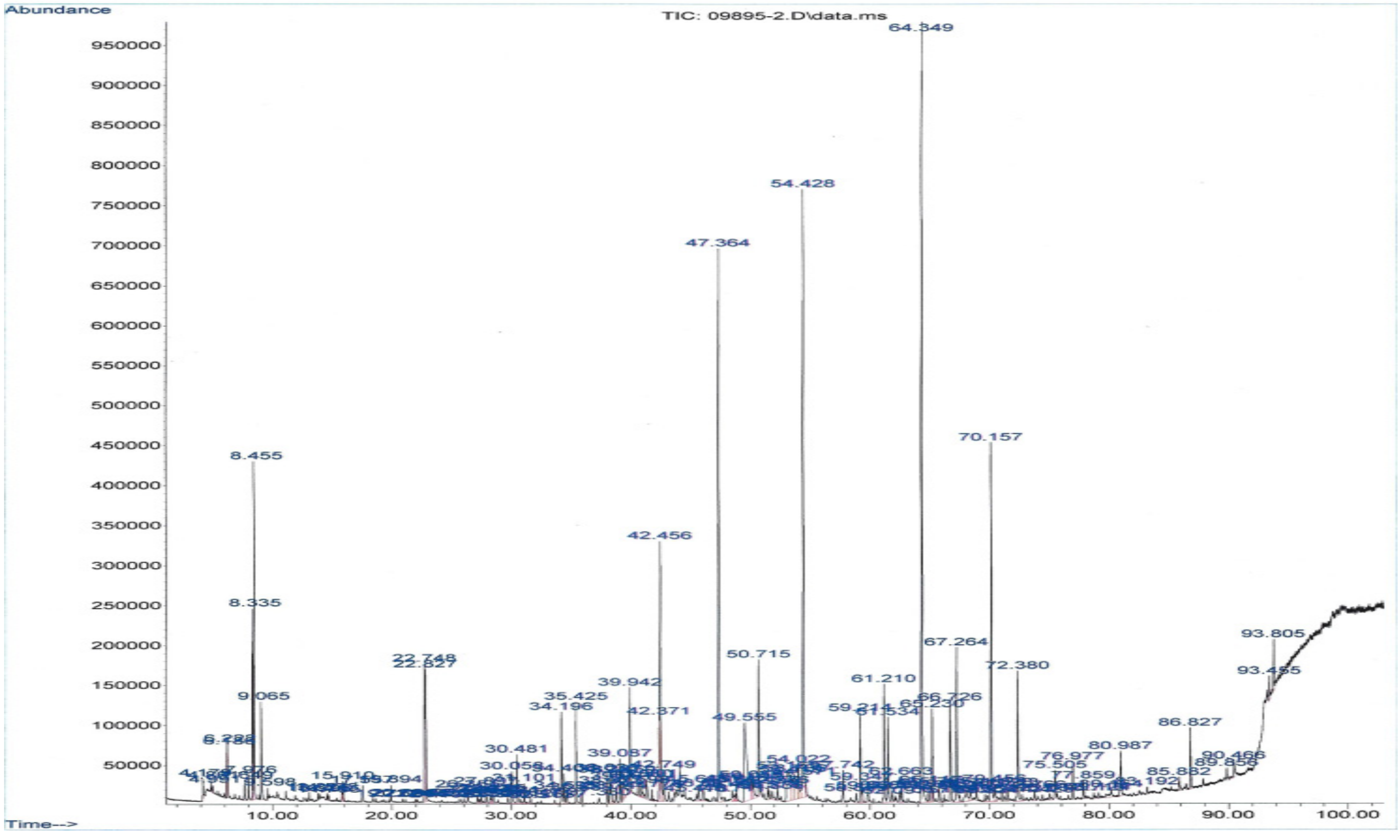

**Figure 4.** Gas chromatography-mass spectrophotometry chromatogram of traditional Korean soy sauce (control).

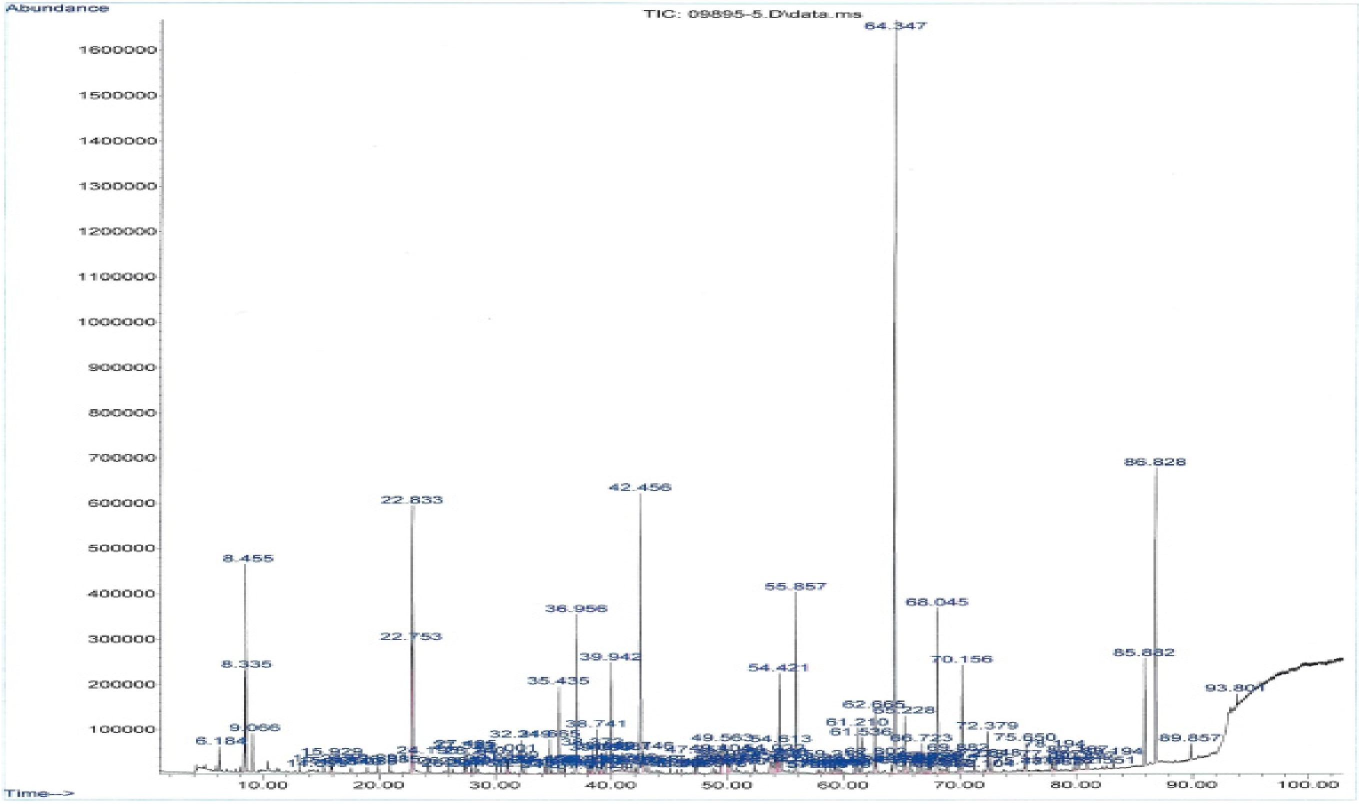

**Figure 5.** Gas chromatography-mass spectrophotometry chromatogram of plant scale prepared flavored soy sauce (PFSS).

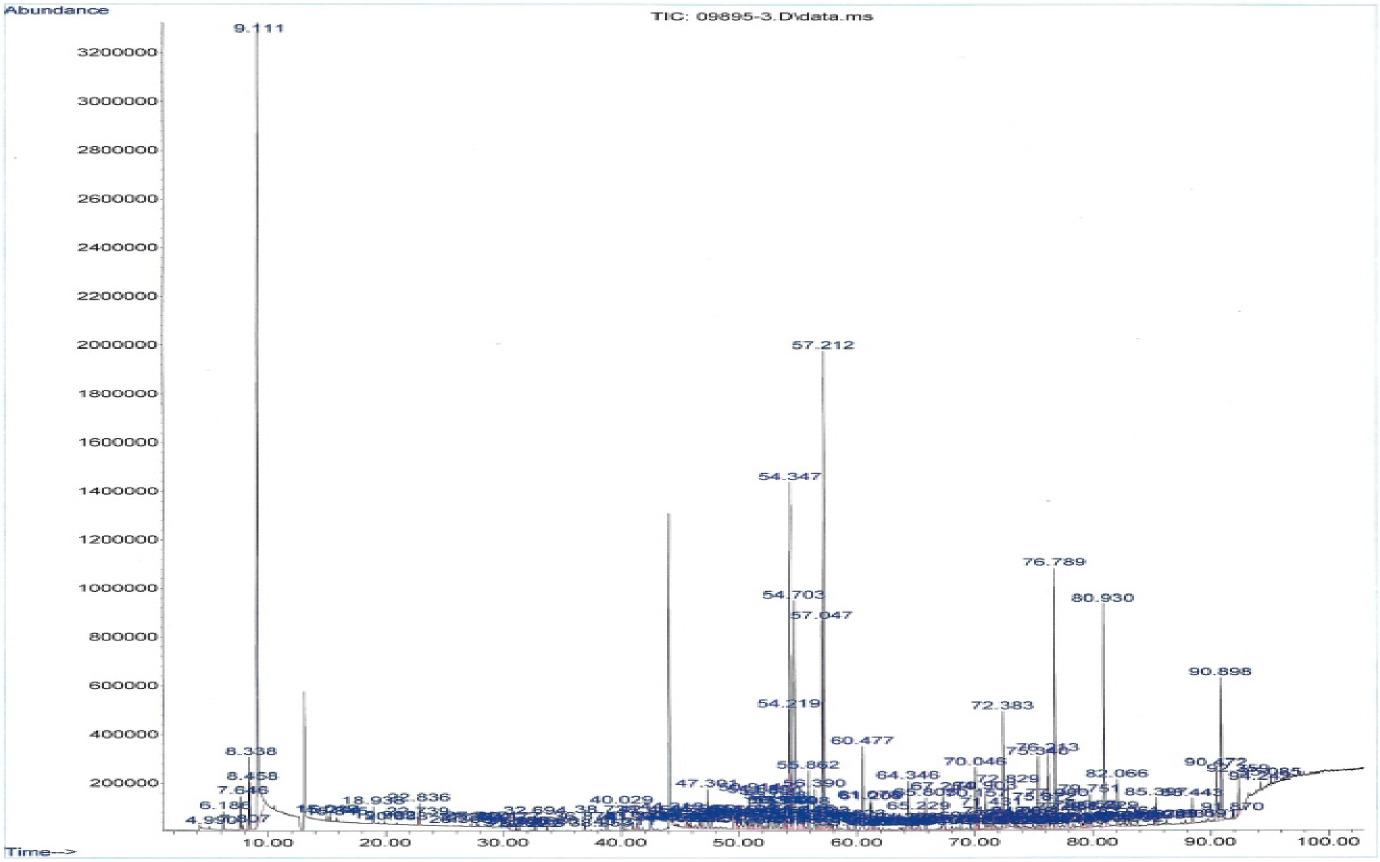

**Figure 6.** Gas chromatography-mass spectrophotometry chromatogram of commercial flavored soy sauce (CFSS-A).

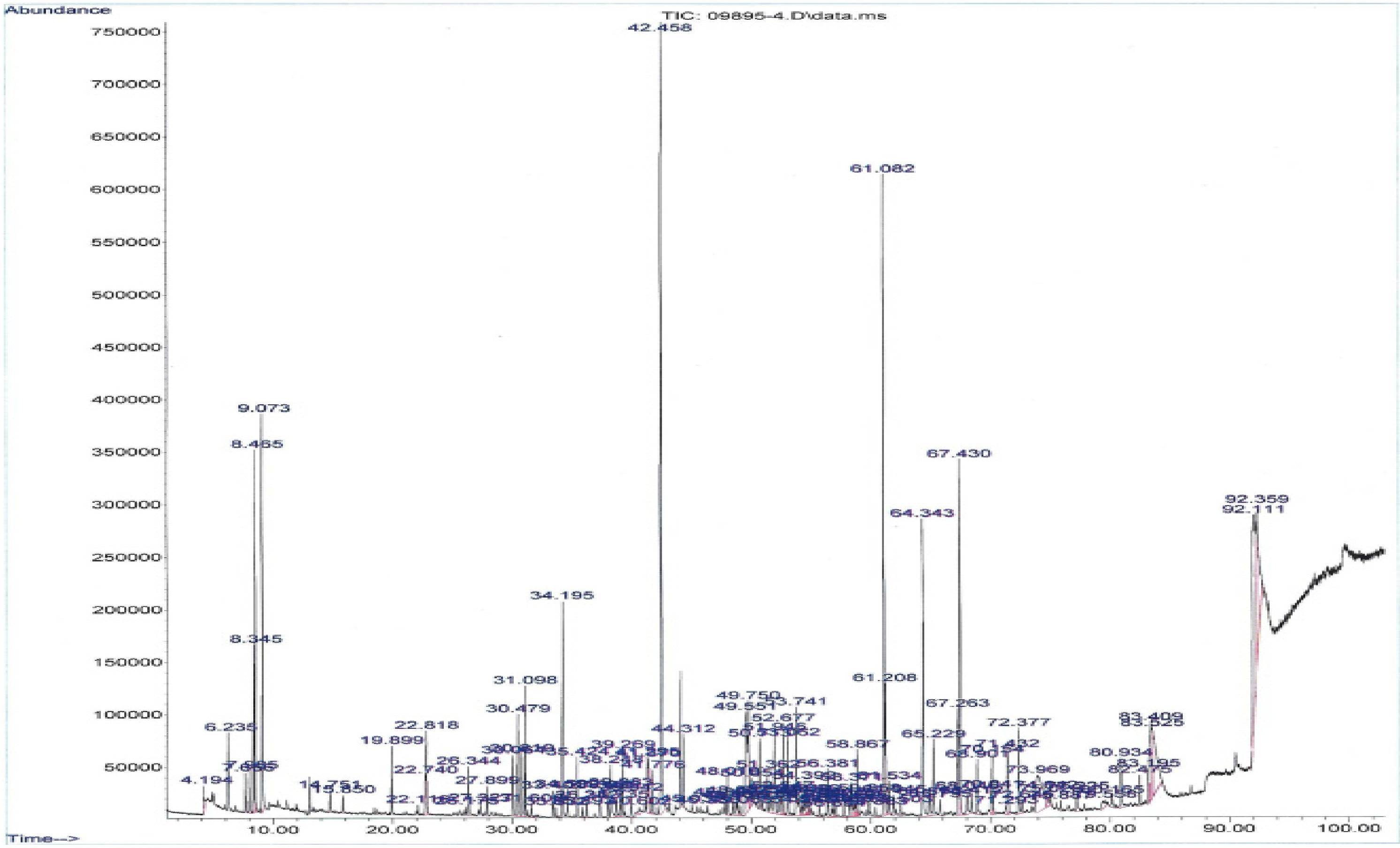

**Figure 7.** Gas chromatography-mass spectrophotometry chromatogram of commercial flavored soy sauce (CFSS-B).

**Table 1.** Gas chromatography-mass spectrophotometry profile of compounds detected in traditional Korean flavored soy sauce (control).

| Compound number | Retention time | Percentage of area | Compound name |
|---|---|---|---|
| 1 | 4.861 | 0.12 | Methanethiol |
| 2 | 4.991 | 0.10 | Cyclobutanol |
| 3 | 6.186 | 0.38 | 2-Methylpropanal |
| 4 | 6.222 | 0.53 | 2-Propanone |
| 5 | 7.649 | 0.24 | Ethyl acetate |
| 6 | 7.976 | 0.25 | 2-Butanone |
| 7 | 8.335 | 1.74 | 2-Methylbutanal |
| 8 | 8.455 | 3.22 | 3-Methylbutanal |
| 9 | 9.065 | 1.24 | Ethanol |
| 10 | 9.598 | 0.08 | 2,5-Diethylfuraan |
| 11 | 13.821 | 0.08 | 2-Methylbutanoic acid ethyl ester |
| 12 | 14.573 | 0.07 | Pentanoic acid, ethylester |
| 13 | 14.705 | 0.08 | Dimethyl disulfide |
| 14 | 15.910 | 0.23 | 2-Methyl-1-propanol |
| 15 | 17.557 | 0.26 | 3-Methyl-1-butanol acetate |
| 16 | 19.722 | 0.02 | 1-Ethyl-1-cyclopentyloxy-1-silacyclopentane |
| 17 | 19.894 | 0.16 | Decamethylcyclopentasiloxane |
| 18 | 21.098 | 0.04 | Hyrdroxymethylapyrilene |
| 19 | 22.118 | 0.05 | Heptanal |
| 20 | 22.748 | 1.71 | 2-Methyl-1-butanol |
| 21 | 22.827 | 1.66 | 3-Methyl-1-butanol |
| 22 | 25.670 | 0.09 | Ethylbenzene |
| 23 | 25.998 | 0.06 | 3-Methyl-2-hexanol |
| 24 | 26.351 | 0.18 | Methylpyrazine |
| 25 | 27.163 | 0.11 | 2,3-Octanedione |
| 26 | 27.330 | 0.06 | Butanoic acid, 2-methyl-, 3-methylbutyl ester |
| 27 | 24.475 | 0.10 | *N*-(2-Hydroxyethyl)lactamide |
| 28 | 27.897 | 0.22 | Octanal |
| 29 | 28.238 | 0.12 | 2H-Pyran, 3-4-dihydro |
| 30 | 28.326 | 0.05 | Ethylamine |
| 31 | 28.485 | 0.19 | Isopentyl 3-methylbutanoate |
| 32 | 28.878 | 0.04 | Methyl isobutyrate |
| 33 | 28.878 | 0.11 | 4-Methyl-1-pentanol |
| 34 | 30.058 | 0.57 | 2,5-Dimethylpyrazine |
| 35 | 30.481 | 0.75 | 2,6-Dimethylpyrazine |
| 36 | 30.812 | 0.07 | Ethylpyrazine |
| 37 | 31.101 | 0.22 | Dodecamethylcyclohexasiloxane |
| 38 | 31.617 | 0.08 | 2,3-Dimethylpyrazine |
| 39 | 32.511 | 0.04 | Sulfuric acid, diethyl ester- |
| 40 | 33.637 | 0.06 | Dimethyl trisulfide |
| 41 | 34.196 | 1.32 | 2-Ethyl-6-methylpyrazine |
| 42 | 34.406 | 0.40 | 2-Nonanone |
| 43 | 34.595 | 0.23 | 2,4,6-Trimethylpyridine |
| 44 | 35.425 | 1.40 | Trimethylpyrazine |
| 45 | 35.889 | 0.14 | Dimethylphenylsilane |
| 46 | 37.330 | 0.13 | 2,3-Dimethyl-5-ethylpyrazine |
| 47 | 38.036 | 0.40 | 3-Ethyl-2,5-dimethylpyrazine |
| 48 | 38.251 | 0.44 | 3-(Methylthio) propanal |
| 49 | 38.373 | 0.29 | Octen-3-ol |
| 50 | 38.74 | 0.21 | 2-Furancarboxaldehyde |
| 51 | 39.087 | 0.62 | 2,5-Dimethyl-3-ethylpyrazine |
| 52 | 39.281 | 0.27 | 2-Methyl-6-propylpyrazine |
| 53 | 39.459 | 0.68 | 2,3-Dimethyl-5-(1-methylethyl) pyrazine |
| 54 | 39.942 | 1.48 | Tetramethylpyrazine |

| | | | |
|---|---|---|---|
| 55 | 40.880 | 0.23 | 2-Ethyl-1-hexanol |
| 56 | 41.301 | 0.51 | Decanal |
| 57 | 41.778 | 0.11 | Tetradecamethyl-cyclo-hepta-siloxane |
| 58 | 42.371 | 0.76 | 2,3,5-Trimethyl-6-ethylpyrazine |
| 59 | 42.456 | 4.47 | Benzaldehyde |
| 60 | 42.749 | 0.48 | 2-Nonanol |
| 61 | 45.476 | 0.09 | 5-Methyl-2-furancarboxaldehyde |
| 62 | 45.645 | 0.26 | 6-Methyl-[1,2,4]triazolo[4,3-b]pyridazine |
| 63 | 46.061 | 0.25 | 2-Decanol |
| 64 | 47.364 | 7.58 | 2-Undecanone |
| 65 | 48.11 | 0.19 | Methyl benzoate |
| 66 | 47.711 | 0.09 | Formic acid, 3-methylbut-2-yl ester |
| 67 | 48.846 | 0.23 | 2-Isoamyl-6-methylpyrazine |
| 68 | 49.555 | 4.03 | Benzeneacetaldehyde |
| 69 | 50.056 | 0.46 | Phenyloxirane |
| 70 | 50.218 | 0.48 | Propylbenzene |
| 71 | 50.715 | 1.98 | 2-Furanmethanol |
| 72 | 51.456 | 0.18 | 2-Propyl-1-heptanol |
| 73 | 51.578 | 0.10 | Cyclododecasiloxane tertracosamethyl |
| 74 | 51.836 | 0.14 | 2-Cyano-3,4-diethylpyrrole |
| 75 | 52.26 | 0.20 | 2-Methylmerchaptomethylbut-2-enal |
| 76 | 53.169 | 1.74 | 3-Methylbutanoic acid |
| 77 | 53.419 | 1.14 | Isovaleric acid |
| 78 | 53.736 | 0.77 | D-Allose |
| 79 | 54.022 | 0.75 | 3-Methylthiopropanol |
| 80 | 54.428 | 8.31 | 2-Undecanol |
| 81 | 54.51 | 0.41 | Diethylsilanediol |
| 82 | 57.742 | 0.53 | Ethyl 2-phenylacetate |
| 83 | 58.855 | 0.18 | 6,7-Dihydro-2,3-dimethyl-5H-cyclopentapyrazine |
| 84 | 59.214 | 1.21 | 2-Tridecanone |
| 85 | 59.347 | 0.31 | 2-Phenylethyl acetate |
| 86 | 59.860 | 0.23 | 4-Propylbenzaldehyde |
| 87 | 61.210 | 1.82 | 3-Phenylfuran |
| 88 | 61.534 | 1.36 | 2-Methoxyphenol |
| 89 | 61.534 | 1.36 | 1-Cyclohexyl 1-4,5-dihydropyrazole |
| 90 | 62.07 | 0.06 | *N*-(3-Methylbutyl) acetamide |
| 91 | 62.502 | 0.19 | Benzyl alchol |
| 92 | 62.663 | 0.34 | 4-Ethyl-1,2-dimethoxybenzene |
| 93 | 64.349 | 12.03 | Benzenemethanol |
| 94 | 64.910 | 0.21 | Benzeneacetonitrile |
| 95 | 65.117 | 0.20 | 2-Heptadecanol |
| 96 | 65.795 | 0.32 | 3-Methyl-1-naphthalenol |
| 97 | 66.167 | 0.11 | 3-Phenyl-3,4,5,6-tetrahydro-2H-(1,2)-oxazine |
| 98 | 67.264 | 2.50 | 1-(1H-Pyrrol-2-yl) ethanone |
| 99 | 67.495 | 0.11 | 2,6-Pyridinedicarboxylicacid, isobutyl phenyl ester |
| 100 | 68.047 | 0.41 | 2-Phenyl-1-butanol |
| 101 | 68.283 | 0.23 | 2-O-(2-ethylhexyl) 1-O-(4-methylpentyl) oxalate |
| 102 | 68.911 | 0.21 | Phenol |
| 103 | 69.634 | 0.10 | Dehydromevalonic lactone |
| 104 | 69.824 | 0.11 | 1H-Pyrrole-2-carboxyaldehyde |
| 105 | 70.157 | 5.49 | 2-(2-methoxyphenyl) ethanol |
| 106 | 70.456 | 0.36 | 4-Hydroxy-2,5-dimethyl-3(2*H*) furanone |
| 107 | 71.028 | 0.21 | 3-Phenylpropanol |
| 108 | 71.513 | 0.23 | 3-Methyl-2(1H)-quinoxalinone |
| 109 | 72.380 | 1.95 | 5-Methyl-2-phenyl-2-hexenal |
| 110 | 72.727 | 0.11 | 1,2,4-Trimethoxybenzene |
| 111 | 73.766 | 0.18 | 3-Methylpyrrolo[1,2-a]pyrazine |
| 112 | 74.425 | 0.09 | 1,6-Dimethyl-1H-indazole |
| 113 | 75.031 | 0.13 | 2-Phenylthiophene |

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|---|---|---|---|
| 114 | 75.505 | 0.48 | Juglone |
| 115 | 76.977 | 0.59 | *p*-Ethyl-phenol |
| 116 | 77.859 | 0.27 | 2-Methoxy-4-vinylphenol |
| 117 | 78.716 | 0.08 | 12-Crown-4 |
| 118 | 79.124 | 0.08 | 15-Crown-5 |
| 119 | 80.164 | 0.31 | 4-Phenylpyridine |
| 120 | 80.987 | 0.84 | 2,6-Dimethoxyphenol |
| 121 | 83.192 | 0.10 | 1,4,7,10,13,16,19-Heptaoxacyclohenicosan-2-one |
| 122 | 85.882 | 0.22 | Ethyltrimethylsilane |
| 123 | 86.827 | 0.89 | 2(3H)-Furanone, dihydro-5-(2-octenyl), (Z)- |
| 124 | 89.856 | 0.22 | 1,4,7,10,13,16-Hexacyclooctadecane |
| 125 | 90.466 | 0.36 | Octaethylene glycol monododecyl ether |
| 126 | 93.455 | 0.29 | 3,6,9,12,15-Pentaoxanonadecan-1-ol |
| 127 | 93.805 | 0.54 | *N*-(2-Phenylethyl) acetamide |

**Table 2.** Gas chromatography-mass spectrophotometry profile of compounds detected in the plant scale prepared flavored soy sauce (PFSS).

| Compound number | Retention time | Percentage of area | Compound name |
|---|---|---|---|
| 1 | 6.184 | 0.49 | 2-Methylpropanal |
| 2 | 8.335 | 1.39 | 2-Methylbutanal |
| 3 | 8.455 | 2.91 | 3-Methylbutanal |
| 4 | 9.066 | 0.74 | Ethanol |
| 5 | 14.699 | 0.06 | Dimethyl disulfide |
| 6 | 15.215 | 0.16 | Hexanal |
| 7 | 15.827 | 0.12 | 2-Methyl-2-butenal |
| 8 | 15.929 | 0.28 | 2-Methyl-1-propanol |
| 9 | 17.549 | 0.15 | 1-Butanol, 3-methyl-, 1-acetate |
| 10 | 18.930 | 0.10 | 2,5-Dimethyltetrahydrofuran |
| 11 | 19.891 | 0.16 | Decamethylcyclopentasiloxane |
| 12 | 20.885 | 0.17 | But-1-en-3-ynyl ethyl sulfide |
| 13 | 22.753 | 2.21 | 2-Methyl-1-butanol |
| 14 | 22.833 | 5.12 | 3-Methyl-1-butanol |
| 15 | 24.195 | 0.30 | 2-Pentylfuran |
| 16 | 26.001 | 0.14 | • 2,3-Dihydrofuran |
| 17 | 26.347 | 0.09 | 2-Methyl pyrazine |
| 18 | 27.323 | 0.41 | Isopentyl-2-methylbutanoate |
| 19 | 27.485 | 0.48 | 2-Methylbutyl pentanoate |
| 20 | 27.895 | 0.14 | Octanal |
| 21 | 28.240 | 0.33 | 1,4,5,6-Tetrahydropyridazine |
| 22 | 28.452 | 0.12 | Butanoic acid, 3-methyl-, 3-methylbutyl ester |
| 23 | 30.074 | 0.25 | 2,5-Dimethylpyrazine |
| 24 | 30.483 | 0.20 | 2,6-Dimethylpyrazine |
| 25 | 31.001 | 0.39 | 6-Methyl-5-hepten-2-one |
| 26 | 31.100 | 0.20 | • Dodecamethylcyclohexasiloxane |
| 27 | 32.219 | 0.70 | 1-Hexanol |
| 28 | 34.196 | 0.20 | 2-Ethyl-6-methylpyrazine |
| 29 | 34.405 | 0.18 | 2-Nonanone |
| 30 | 34.655 | 0.72 | Nonanal |
| 31 | 34.877 | 0.07 | 3-OctanoI |
| 32 | 35.435 | 1.94 | 4,6-Dimethyl-3-pyridinamine |
| 33 | 35.890 | 0.10 | 2-Methyl-5-(1-methylethyl) pyrazine |
| 34 | 36.005 | 0.13 | 3-Methylhexanol |
| 35 | 36.956 | 3.23 | 2-Methylbutanoic acid, *n*-hexyl ester |
| 36 | 37.917 | 0.06 | 2-(5-Methyl-5-vinyletrahydro-2-furanyl)-2-propanol |
| 37 | 37.248 | 0.21 | 3-Methylthiopropanal |
| 38 | 38.372 | 0.56 | 2,4,4-Trimethylpentanal |
| 39 | 38741 | 1.13 | 2-Furan-carboxaldehyde |

|  |  |  |  |
|---|---|---|---|
| 40 | 39.085 | 0.47 | 2-Ethyl-3,5-dimethylpyrazine |
| 41 | 39.201 | 0.21 | 2-Methyl-6-hepten-1-ol |
| 42 | 39.459 | 0.48 | 2-Amino-6-(*tert*-butyl) pyridine |
| 43 | 39.942 | 2.16 | Tetramethylpyrazine |
| 44 | 40.251 | 0.06 | Acetic acid |
| 45 | 40.881 | 0.40 | 2-Ethylhexanol |
| 46 | 41.289 | 0.27 | Decanal |
| 47 | 41.780 | 0.10 | Tetradecamethyl cycloheptasiloxane |
| 48 | 42.074 | 0.13 | 4-Methoxy-2,3,4-trimethyl-2-cyclobutanone |
| 49 | 42.456 | 7.79 | Benzaldehyde |
| 50 | 42.746 | 0.47 | 2-Nonanol |
| 51 | 45.029 | 0.13 | Octyl formate |
| 52 | 45.644 | 0.12 | 1,3-Dihydrobenoimidazol-2-one |
| 53 | 46.053 | 0.17 | 3-(2-Pyridyl)-propanol |
| 54 | 47.136 | 0.17 | *p*-Fluorocarbanilonitrile |
| 55 | 47.357 | 0.38 | 2-Undecanone |
| 56 | 48.719 | 0.15 | Hexyl tiglate |
| 57 | 49.018 | 0.09 | 4,9-Decadienoic acid, 2-nitrohyl ester |
| 58 | 49.563 | 2.29 | Benzeneacetaldehyde |
| 59 | 50.057 | 0.38 | 1-Phenyl-ethanone |
| 60 | 5.214 | 0.37 | Dimethylsilanediol |
| 61 | 50.710 | 0.14 | 2-Furanmethanol |
| 62 | 52.278 | 0.14 | 2-Methylmercaptomethylbut-2-enal |
| 63 | 53.647 | 0.22 | $\beta$-Alanine, N-methoxy, methyl ester |
| 64 | 54.022 | 0.56 | 3-Methylpentanoic acid |
| 65 | 54.238 | 0.56 | 3-Methylthiopropanol |
| 66 | 54.238 | 0.36 | 1-Phenyl-1-propanon |
| 67 | 54.310 | 0.25 | 1,2-Dimethoxybenzene |
| 68 | 54.421 | 2.07 | 2-Undecanol |
| 69 | 54.613 | 0.61 | 1-Methylene-4-(1-methylethenyl) cyclohexane, |
| 70 | 57.738 | 0.09 | Ethyl 2-phenylacetate |
| 71 | 57.927 | 0.08 | 2-Methylpropyl pentyl sulfite |
| 72 | 58.373 | 0.30 | 1,3,5,7-Cyclooctatetraene-1-carboxaldehyde |
| 73 | 58.898 | 0.17 | 1-Phenyl-1,2-propanedione |
| 74 | 59.213 | 0.32 | 2-Tridecanone |
| 75 | 59.349 | 0.17 | 2-Phenylethyl acetate |
| 76 | 60.924 | 0.19 | 2,7-Octadiene-1,6-diol, 2,6-dimethyl- |
| 77 | 61.210 | 1.03 | 3-Phenylfuran |
| 78 | 62.665 | 1.25 | 4-Ethyl-1,2-dimethoxybenzene |
| 79 | 62.802 | 0.35 | 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate |
| 80 | 64.126 | 0.20 | Acetic acid 4-acetoxy-6-methoxy-2-methyl-tetrahydro-pyran-3-yl ester |
| 81 | 64.347 | 17.17 | Benzeneethanol |
| 82 | 65.228 | 1.47 | 2-Phenylbutanal |
| 83 | 65.370 | 0.14 | • 2,3-Dimethyl-3-hexanol |
| 84 | 65.782 | 0.14 | 1-Naphtha1enemethano1 |
| 85 | 66.384 | 0.21 | 1-Phenyl-1-hexanone |
| 86 | 66.723 | 0.78 | 2,6-Dimethyl-3-hdroxy-4H-pran-4-one |
| 87 | 67.146 | 0.12 | Oxan-3-ylacetic acid |
| 88 | 67.264 | 0.28 | 1-(1H-pyrrol-2-yl) ethanone |
| 89 | 67.498 | 0.34 | 2-Phenylethyl 2-phenylacetate |
| 90 | 68.045 | 3.77 | 2-Phenylbutan-1-ol |
| 91 | 68.367 | 0.19 | 2-Bromopropionic acid, 2-phenylethyl ester |
| 92 | 68.696 | 0.20 | 2-Methyl-3-phenyl-2-propenal |
| 93 | 68.915 | 0.24 | Phenol |
| 94 | 69.882 | 0.47 | Tetrahydro-2-thiopheneacetonitrile |
| 95 | 70.156 | 2.43 | 4-Ethylguaiacol |
| 96 | 71.228 | 0.31 | 3-tert-Butyl-1,2-dihydronaphthalene |
| 97 | 72.104 | 0.06 | (2-Methoxyethenyl) benzene |
| 98 | 72.379 | 0.93 | 5-Methyl-2-phenyl-2-hexenal |
| 99 | 72.648 | 0.40 | Indian-2-yl-methanol |
| 100 | 75.481 | 0.17 | 1,2,3,4-Tetramethoxybenzene |

| | | | |
|---|---|---|---|
| 101 | 75.650 | 0.63 | *γ*-Decalactone |
| 102 | 77.857 | 0.28 | 2-Methoxy-4-vinylphenol |
| 103 | 77.982 | 0.09 | 5-Methyl-1,3-thiazole |
| 104 | 78.194 | 0.47 | 6-Phenyldodecane |
| 105 | 79.781 | 0.11 | 3-(2-Methylphenyl) cyclohexene |
| 106 | 80.167 | 0.41 | 3-Phenylpyridine |
| 107 | 80.897 | 0.35 | Methyl heptanoate |
| 108 | 82.551 | 0.12 | 1,4,7,10,13,16-Hexaoxacyclooctadecane |
| 109 | 83.194 | 0.24 | 2,4-Di-*tert*-butylphenol |
| 110 | 85.882 | 2.38 | 4-Octylbutan-4-olide |
| 111 | 93.801 | 0.19 | 1,4,7,10,13,16-Hexathiacyclooctadecane |

**Table 3.** Gas chromatography-mass spectrophotometry profile of compounds detected in the commercial flavored soy sauce (CFSS-A).

| Compound number | Retention time | Percentage of area | Compound name |
|---|---|---|---|
| 1 | 4.990 | 0.03 | 2-Propanamine |
| 2 | 6.186 | 0.22 | 2-Methylpropanal |
| 3 | 7.646 | 0.39 | Ethyl acetate |
| 4 | 7.807 | 0.06 | 1,1-Diethoxyethane |
| 5 | 8.338 | 0.83 | 2-Methylbutanal |
| 6 | 8.458 | 0.58 | 3-Methylbutanal |
| 7 | 9.111 | 17.36 | Ethanol |
| 8 | 15.244 | 0.08 | Methoxymethyl isothiocyanate |
| 9 | 15.845 | 0.07 | 2,2-Dihydroxypropanedioic acid |
| 10 | 15.938 | 0.26 | 3-Prop-2-enylsulfanylprop-1-ene |
| 11 | 22.836 | 0.43 | Eucalyptol |
| 12 | 27.717 | 0.09 | 3-Cyclohexene-1-carboxylicacid |
| 13 | 27.889 | 0.05 | 3-Methyl-2-heptanol |
| 14 | 30.477 | 0.11 | 2,5-Dimethylpyrazine |
| 15 | 31.000 | 0.03 | 6-Methyl-5-heptene-2-one |
| 16 | 31.100 | 0.05 | Dodecamethylcyclohexasiloxane |
| 17 | 21.320 | 0.06 | Ethyl 2-hydroxypropanoate |
| 18 | 32.222 | 0.02 | 1-Hexanol |
| 19 | 32.694 | 0.22 | • 2-[2-(Methoxy)ethyl]-4(5)-methylimidazole |
| 20 | 36.876 | 0.15 | 1-Allyl-2-isopropyldisulfane |
| 21 | 38.253 | 0.03 | 3-(Methylthio) propanal |
| 22 | 38.738 | 0.30 | 2-Furan-carboxaldehyde |
| 23 | 40.029 | 0.43 | 3-(Prop-2-enyldisulfanyl) prop-1-ene |
| 24 | 40.311 | 0.05 | 1,2,4-Metheno-1H-indene |
| 25 | 40.999 | 0.11 | Copaene |
| 26 | 41.290 | 0.10 | Decanal |
| 27 | 42.459 | 0.33 | Benzaldehyde |
| 28 | 44.310 | 0.09 | L-Linalool |
| 29 | 44.690 | 0.05 | Dimethylamine-D1 |
| 30 | 44.826 | 0.05 | 2-Hydroxyethyl propanoate |
| 31 | 45.489 | 0.08 | 5-Methyl-2-furancarboxaldehyde |
| 32 | 45.896 | 0.05 | Benzoyl bromide |
| 33 | 46.855 | 0.23 | *β*-Elemene |
| 34 | 47.301 | 0.73 | Caryophyllene |
| 35 | 47.614 | 0.29 | 1,3-Dithiolane |
| 36 | 49.543 | 0.41 | Benzeneacetaldehyde |
| 37 | 49.667 | 0.06 | Phenyloxirane |
| 38 | 49.750 | 0.33 | Ethyl decanoate |
| 39 | 50.495 | 0.44 | *γ*-Curcumene |
| 40 | 50.713 | 0.19 | 2-Furanmethanol |
| 41 | 51.402 | 0.36 | 1-(Propyltrisulfanyl) propane |
| 42 | 51.689 | 0.63 | Isoledene |
| 43 | 52.389 | 0.15 | Thujopsene-(I2) |
| 44 | 52.650 | 0.82 | 1-Methyl-4-(-methylhept-5-en-2-yl)cyclohexa-1,3-diene |
| 45 | 53.058 | 0.61 | 2-(4-Methyl-3-cyclohexen-1-yl)-2-propanol |

|  |  |  |  |
|---|---|---|---|
| 46 | 53.340 | 0.44 | 1,7,7-Trimethylbicyclo[2.2.1]heptan-2-ol |
| 47 | 53.744 | 0.44 | Dodecanal |
| 48 | 54.026 | 0.05 | 3-Methylthiopropanol |
| 49 | 54.347 | 6.09 | 2-Methyl-5-(6-methylhept-5-en-2-yl) cyclohexa-1,3-diene |
| 50 | 54.703 | 5.21 | *β*-Bisabolene |
| 51 | 55.008 | 0.64 | 3-Methyl-1,2,4-trithiolane |
| 52 | 55.862 | 0.97 | *α*-Farnesene |
| 53 | 56.390 | 0.84 | *δ*-Cadinene |
| 54 | 56.723 | 0.25 | (-)-*α*-Panasinse |
| 55 | 56.896 | 0.21 | Citronellol |
| 56 | 57.047 | 3.49 | *β*-Sesquiphellandrene |
| 57 | 57.212 | 8.16 | Benzene, 1-(1,5-dimethyl-4-hexenyl)-4-methyl- |
| 58 | 57.594 | 0.15 | Silana-3,7(11)-diene |
| 59 | 57.746 | 0.18 | Ethyl 2-phenylacetate |
| 60 | 59.246 | 0.14 | Ethanone, 1-(2-furanyl)- |
| 61 | 59.402 | 0.04 | Ethyl nicotinate |
| 62 | 59.823 | 0.23 | Benzenepropanoic acid, 2-ethenyl-4-methoxy-, methyl ester |
| 63 | 61.078 | 0.54 | Ethyl decanoate |
| 64 | 61.209 | 0.51 | Geraniol |
| 65 | 61.540 | 0.08 | 2,5-Dimethyl-3-ethylfuran |
| 66 | 61.836 | 0.04 | 3,5,11-Eudesmatriene |
| 67 | 62.198 | 0.05 | • Isothiocyanatoethane |
| 68 | 62.742 | 0.04 | *α*-Bromomesitylen |
| 69 | 63.735 | 0.03 | Dibutyl 3,6,9,12,15,18,21-heptaoxa tricosane-1,23-dioate |
| 70 | 63.866 | 0.05 | 3,3-Diethoxy-1-propanol |
| 71 | 64.346 | 0.93 | Benzeneethanol |
| 72 | 64.698 | 0.12 | *α*-Calacorene |
| 73 | 62.084 | 0.05 | 2,4-Dimethyl-2,4-pentadien-1-ol |
| 74 | 65.229 | 0.36 | 2-Phenylbutanal |
| 75 | 67.100 | 0.07 | 5-Methoxymethyl-[1,3,4]thiadiazol-2-ylamine |
| 76 | 67.264 | 0.69 | Ethanone, 1-(1H-pyrrol-2-yl)- |
| 77 | 67.412 | 0.11 | 1-Pentamethyldisilyloxycyclopentan |
| 78 | 67.984 | 0.09 | Glutaric acid, dodec-2-en-1-yl 3-hexyl ester |
| 79 | 98.451 | 0.08 | Diglycolic acid, 2-chloro-6-fluorophenyl propyl ester |
| 80 | 68.799 | 0.10 | Trans-*β*-ionone |
| 81 | 70.046 | 1.10 | 8-Amino-6-methoxy-2-methylquinolin |
| 82 | 70.457 | 0.53 | 4-Ethylguaiacol |
| 83 | 70.298 | 0.11 | 4-Aminopyridine-2-carboxylic acid |
| 84 | 70.903 | 0.65 | 1,6,10-Dodecatrien-3-ol,3,7,11-trimethyl- |
| 85 | 71.139 | 0.17 | 2-(2-Chloroethyl)-*m*-dithiane |
| 86 | 72.207 | 0.04 | Di-epi-1,10-cubenol |
| 87 | 72.383 | 2.02 | 5-Methyl-2-phenyl-2-hexenal |
| 88 | 72.602 | 0.20 | 3,5-Diethyl-1,2,4-trithiolane |
| 89 | 72.829 | 0.74 | Cyclohexanemethanol, 4-ethenyl-*α*,*α*,4-trimethyl-3-(1-methylethenyl)-, [1*R*-(1*α*,3*α*,4*β*)]- |
| 90 | 73.356 | 0.17 | Octaethylene glycol monododecyl ether |
| 91 | 74.438 | 0.04 | TMS derivative of hemiacetal oligomer of formaldehyde and methanol |
| 92 | 74.912 | 0.09 | 2H-Thiopyran, 3,4-dihydro-2-[(2-propenylthio)methyl]- |
| 93 | 75.044 | 0.06 | 1-Methylisophosphinoline |
| 94 | 75.340 | 1.27 | (+)-Calarene or (+)-β-Gurjune |
| 95 | 76.459 | 0.36 | Mintsulfide |
| 96 | 76.789 | 4.56 | 6-Ethyl-4,5,7-trithia-2,8-decadien |
| 97 | 77.836 | 0.49 | (3-tert-Butylphenyl) carbamate |
| 98 | 78.463 | 0.02 | 12-Crown-4 |
| 99 | 79.065 | 0.08 | *β*-Himachalene |
| 100 | 79.188 | 0.09 | *α*-Bisabolol |
| 101 | 79.848 | 0.32 | *α*-Cadinol |
| 102 | 80.660 | 0.09 | 1,4,7,10,13,16-Hexaoxacyclooctadecane |

| | | | |
|---|---|---|---|
| 103 | 80.930 | 4.21 | Ethyl hexadecanoate |
| 104 | 81.229 | 0.42 | 3,4-Pyridinediamine |
| 105 | 82.066 | 0.86 | Ethyl 9-hexadecenoate |
| 106 | 82.542 | 0.14 | (E1)-1-(6,10-Dimethylundeca-5,9-dien-2-yl)-4-methylbenzebne |
| 107 | 83.061 | 0.23 | Methoxyacetic acid, TMS derivative |
| 108 | 83.198 | 0.07 | Phenol, 2,4-bis (1,1-dimethyl) |
| 109 | 85.198 | 0.09 | 2-(bromomethyl)-2-hexyl-15-crown-5 |
| 110 | 85.397 | 0.51 | Farnesol 1 |
| 111 | 86.248 | 0.09 | 1,4,7,10,13-Pentaoxacyclopentadecane |
| 112 | 88.443 | 0.53 | Ethanedioic acid, bis (trimethylsilyl) ester |
| 113 | 90.472 | 1.21 | Ethyl oleate |
| 114 | 90.898 | 2.78 | 1-Allyl-3-(2-(allylthio)propyl) tri sulfane |
| 115 | 91.870 | 0.12 | 21-Krone-7 |
| 116 | 92.359 | 0.64 | Linoleic acid ethyl ester |
| 117 | 97.406 | 0.13 | 15-Crown-5 |

**Table 4.** Gas chromatography-mass spectrophotometry profile of compounds detected in the commercial flavored soy sauce (CFSS-B).

| Compound number | Retention time | Percentage of area | Compound name |
|---|---|---|---|
| 1 | 4.194 | 0.15 | Acetonitrile-d3 |
| 2 | 6.235 | 0.83 | 2-Propanone |
| 3 | 7.656 | 0.32 | Ethyl acetate |
| 4 | 7.985 | 0.35 | 2-Butanone |
| 5 | 8.345 | 1.18 | 2-Methylbutanal |
| 6 | 8.465 | 2.69 | 3-Methylbutanal |
| 7 | 9.073 | 3.58 | Ethanol |
| 8 | 14.751 | 0.23 | Dimethyl disulfide |
| 9 | 15.850 | 0.19 | 2-Methyl-1-propanol |
| 10 | 19.899 | 0.49 | Decamethylcyclopentasiloxane |
| 11 | 22.116 | 0.09 | Trimethyloxazole |
| 12 | 22.740 | 0.36 | 2-Methyl-1-butanol |
| 13 | 22.818 | 0.85 | 3-Methyl-1-butanol |
| 14 | 26.175 | 0.09 | 2-Ethyl-3,4-dimethyl oxazole |
| 15 | 26.34 | 0.59 | 2-Methyl pyrazine |
| 16 | 27.327 | 0.11 | 4-Methylthiazole |
| 17 | 27.899 | 0.29 | Octanal |
| 18 | 30.064 | 0.76 | 2,5-Dimethylpyrazine |
| 19 | 30.479 | 1.14 | 2,6-Dimethylpyrazine |
| 20 | 30.810 | 0.72 | Ethylpyrazine |
| 21 | 31.098 | 0.96 | Dodecamethylcyclohexasiloxane |
| 22 | 31.608 | 0.15 | 2,3-Dimethylpyrazine |
| 23 | 33.401 | 0.28 | 4,5-Dimethylthiazole |
| 24 | 33.632 | 0.11 | Dimethyl trisulfide |
| 25 | 34.195 | 2.23 | 2-Ethyl-6-methylpyrazine |
| 26 | 35.424 | 0.68 | Trimethylpyrazine |
| 27 | 35.893 | 0.12 | 2-Methyl-5-isopropyl pyrazine |
| 28 | 36.242 | 0.19 | • 2-Propylpyrazine |
| 29 | 37.340 | 0.40 | 2,6-Diethylpyrazine |
| 30 | 38.032 | 0.28 | 2,5-Dimethyl-3-ethylpyrazine |
| 31 | 38.248 | 0.77 | 3-Methylthiopropanol |
| 32 | 38.735 | 0.23 | 2-Furancarboxaldehyde |
| 33 | 39.083 | 0.30 | 5-Ethyl-2,3-dimethylpyrazine |
| 34 | 39.269 | 0.68 | 2-Methyl-5-propylpyrazine |
| 35 | 39.942 | 0.28 | Tetramethylpyrazine |
| 36 | 40.602 | 0.10 | Acetic acid |
| 37 | 41.295 | 0.55 | Decanal |
| 38 | 41.370 | 0.72 | 1-(2-Furanyl) ethanone |
| 39 | 41.776 | 0.32 | Tetradecamethylcycloheptasiloxane |
| 40 | 42.458 | 9.94 | Benzaldehyde |

|  |  |  |  |
|---|---|---|---|
| 41 | 44.312 | 0.70 | L-Linalool |
| 42 | 45.031 | 0.08 | 3,5,5-Trimethylhexylamine |
| 43 | 47.823 | 0.17 | 4-Oxopentanoic acid ethyl ester |
| 44 | 48.019 | 0.48 | 2-Acetyl-5-methylfuran |
| 45 | 48.466 | 0.15 | Methyl benzoate |
| 46 | 48.710 | 0.20 | 1-(2-Pyrazinyl) ethanone |
| 47 | 48.837 | 0.24 | 2-Isoamyl-6-methylpyrazine |
| 48 | 49.068 | 0.14 | *Cis*-3-Methyl-2-*n*-propylthiophane |
| 49 | 49.551 | 2.48 | Benzeneacetaldehyde |
| 50 | 49.750 | 1.85 | Ethyl decanoate |
| 51 | 50.054 | 0.30 | 1-Phenyl-ethanone |
| 52 | 50.713 | 0.75 | 2-Furanmethanol |
| 53 | 50.911 | 0.11 | 2,5-Dimethyl-3-(3-methylbutyl)pyrazine |
| 54 | 51.362 | 0.53 | 1-Chlorododecane |
| 55 | 51.580 | 0.26 | Hexadecamethylcyclooctasiloxane |
| 56 | 51.946 | 1.19 | 4,5,6,7-Tetrahydro-2-benzofuran-1(3H)-one |
| 57 | 52.274 | 0.26 | 2-Methylmercaptomethylbut-2-enal |
| 58 | 52.547 | 0.25 | l-(6-Methyl-2-pyrazinyl)-1-ethanon |
| 59 | 52.677 | 1.04 | 2-Acetyl-4-methy1thiazole |
| 60 | 53.062 | 0.88 | 2-(4-Methyl-3-cyclohexen-1-yl)-2-propanol |
| 61 | 53.741 | 1.51 | Dodecanal |
| 62 | 54.019 | 0.32 | 3-Methylthiopropanol |
| 63 | 54.243 | 0.10 | 1(3H)-Isobenzofuranone |
| 64 | 54.392 | 0.39 | 1-Phenylpropan-2-one |
| 65 | 5.696 | 0.26 | 1-Methyl-2-fluoro-4,5-dicyanoimidazole |
| 66 | 54.792 | 0.18 | 1-Amido-1-cyano-3-methylbut-1-ene |
| 67 | 55.663 | 0.16 | 2-Amino-4,6-dimethoxypyrimidine |
| 68 | 56.381 | 0.57 | 1-(4-Methyl-2-thienyl) ethanone |
| 69 | 56.705 | 0.14 | 1-(3-Thienyl) ethanone |
| 70 | 56.854 | 0.09 | 4-Ethyl-5-methylthiazole |
| 71 | 57.013 | 0.22 | 4-Methoxy-5-ethylimidazole |
| 72 | 57.745 | 0.22 | 5-Methyl-5-hydroxy-1,2-octadien-7-yn-4-one |
| 73 | 58.234 | 0.18 | 2-Chlorobenzaldehyde |
| 74 | 58.371 | 0.51 | 2-Phenylpropenal |
| 75 | 58.593 | 0.16 | 1-Phenyl-2-butanone |
| 76 | 58.87 | 0.88 | 5-Acetyl-2,4-dimethylthiazole |
| 77 | 59.858 | 0.24 | 4-Propylbenzaldehyde |
| 78 | 60.383 | 0.16 | 2-Methyl-5-propylthiophene |
| 79 | 61.082 | 6.43 | Ethyl dodecanoate |
| 80 | 61.208 | 1.46 | 3-Methylcinnoline |
| 81 | 61.534 | 0.42 | 2-Methoxyphenol |
| 82 | 61.945 | 0.24 | 4-Methoxybenzenethiol |
| 83 | 62.503 | 0.11 | Benzenemethanol |
| 84 | 64.343 | 3.49 | Benzeneethanol |
| 85 | 64.874 | 0.29 | 1,2-Dithian-4-one |
| 86 | 67.263 | 1.26 | Acetylpyrrole |
| 87 | 67.430 | 3.87 | 1-Decene |
| 88 | 68.046 | 0.68 | 2-Phenylbutan-1-ol |
| 89 | 68.412 | 0.21 | 4(1H)-Quinazolinone |
| 90 | 68.901 | 0.68 | Phenol |
| 91 | 70.041 | 0.25 | 1,3-Cyclopentanedione, 2-(2,4,6-cycloheptatrien-1-yl) |
| 92 | 70.154 | 0.74 | 4-Ethylguaiacol |
| 93 | 71.432 | 0.94 | Ethyl tetradecanoate |
| 94 | 72.377 | 0.94 | 5-Methyl -2-phenyl -2-hexenal |
| 95 | 73.969 | 1.51 | Octanoic acid |
| 96 | 77.225 | 0.27 | Methyl 4,6-decadieny1 ether |
| 97 | 80.165 | 0.19 | 3-Phenylpyridine |
| 98 | 80.934 | 0.77 | Ethyl hexadecanoate |
| 99 | 82.475 | 0.34 | Dimethyl phthalate |
| 100 | 83.195 | 0.31 | 2,4-Di-tert-butylphenol |
| 101 | 83.409 | 2.26 | *n*-Decanoic acid |

|  |  |  |  |
|---|---|---|---|
| 102 | 83.523 | 3.81 | Decanoic acid |
| 103 | 92.111 | 9.61 | Dodecanoic acid |