**Table S1. Amino acid nitrogen content, production technology, and raw materials of soy sauce.**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Amino acid nitrogen content (g/100 mL) | Production technology | Raw materials |
| SS1 | 1.25 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Sugar, Monosodium glutamate, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Sucralose, High fructose syrup |
| SS2 | 1.2 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Monosodium glutamate, Sugar, Disodium 5’-inosinate, Disodium 5’-ribonucleotide, Yeast extract, Sucralose |
| SS3 | 1.2 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Sugar, Yeast extract, Monosodium glutamate, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Sucralose |
| SS4 | 1 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Sugar, Yeast extract |
| SS5 | 1 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Sugar, Rice, Yeast extract, Monosodium glutamate, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Potassium sorbate, Sucralose |
| SS6 | 1 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Monosodium glutamate, Sugar, Rice, Yeast extract, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Potassium sorbate, Sucralose |
| SS7 | 0.8 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Monosodium glutamate, Sugar, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Scallop, Sucralose |
| SS8 | 0.7 | High salt dilute fermentation | Water, Soya beans, Salt, Sugar, Wheat, Straw mushroom |
| SS9 | 0.7 | High salt dilute fermentation | Water, Soya beans, Caramel color, Sugar, Salt, Wheat, Wheat flour, Monosodium glutamate, Disodium 5’-ribonucleotide, Disodium 5’-inosinate |

**Continued Table S1.**

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Amino acid nitrogen content(g/100mL) | Production technology | Raw materials |
| SS10 | 0.5 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Monosodium glutamate, Wheat flour, High fructose syrup, Rice, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Caramel color, Potassium sorbate, Sucralose |
| SS11 | 0.4 | High salt dilute fermentation | Water, Soya beans, Salt, Wheat, Monosodium glutamate, Wheat flour, High fructose syrup, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Caramel color, Potassium sorbate, Sucralose |
| SS12 | 0.4 | High salt dilute fermentation | Water, Soya beans, Salt, Caramel color, Wheat, Monosodium glutamate, Wheat flour, Disodium 5’-ribonucleotide, Disodium 5’-inosinate, Potassium sorbate, Sucralose |

**Table S2.** **Free amino acid (FAA) contents of soy sauce peptide fractions eluted by 60% ethanol (mg/100 mg).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Amino acid | SS1 | SS2 | SS3 | SS4 | SS5 | SS6 | SS7 | SS8 | SS9 | SS10 | SS11 | SS12 |
| Glu | 1.063 | 1.334 | 1.515 | 0.255 | 0.717 | 1.860 | 0.616 | 0.034 | 0.934 | 0.908 | 0.257 | 0.033 |
| Asp | 0.121 | 0.170 | 0.194 | 0.084 | 0.078 | 0.262 | 0.118 | 0.038 | 0.112 | 0.231 | 0.031 | 0.014 |
| Val | 0.107 | 0.157 | 0.160 | 0.072 | 0.063 | 0.174 | 0.092 | 0.017 | 0.056 | 0.139 | 0.027 | 0.008 |
| Met | 0.020 | 0.046 | 0.022 | 0.027 | 0.018 | 0.036 | 0.030 | 0.024 | nd | 0.025 | 0.007 | nd |
| Ile | 0.163 | 0.252 | 0.207 | 0.104 | 0.114 | 0.256 | 0.160 | 0.053 | 0.062 | 0.136 | 0.040 | 0.017 |
| Leu | 0.282 | 0.426 | 0.335 | 0.168 | 0.186 | 0.427 | 0.259 | 0.079 | 0.101 | 0.209 | 0.067 | 0.028 |
| Phe | 0.683 | 1.116 | 0.735 | 0.371 | 0.447 | 0.963 | 0.647 | 0.125 | 0.096 | 0.195 | 0.131 | 0.028 |
| His | 0.288 | 0.468 | 0.334 | 0.480 | 0.299 | 0.407 | 0.303 | 0.165 | 0.103 | 0.077 | 0.150 | 0.068 |
| Tyr | 0.047 | 0.064 | 0.059 | 0.030 | 0.040 | 0.080 | 0.054 | 0.027 | 0.031 | 0.042 | 0.015 | nd |
| Arg | 0.052 | 0.076 | 0.067 | 0.009 | 0.010 | 0.071 | 0.014 | 0.029 | 0.020 | 0.014 | nd | nd |
| Lys | 0.150 | 0.316 | 0.232 | 0.135 | 0.111 | 0.271 | 0.173 | 0.045 | 0.073 | 0.161 | 0.050 | 0.019 |
| Pro | 0.124 | 0.181 | 0.142 | 0.035 | 0.099 | 0.227 | 0.157 | 0.118 | 0.095 | 0.129 | 0.040 | 0.021 |
| Thr | 0.066 | 0.095 | 0.089 | 0.061 | 0.042 | 0.113 | 0.061 | 0.018 | 0.042 | 0.091 | 0.016 | 0.007 |
| Ser | 0.091 | 0.121 | 0.124 | 0.248 | 0.058 | 0.160 | 0.080 | 0.029 | 0.063 | 0.133 | 0.022 | 0.011 |
| Gly | 0.057 | 0.072 | 0.069 | 0.038 | 0.037 | 0.093 | 0.050 | 0.014 | 0.038 | 0.076 | 0.014 | 0.007 |
| Ala | 0.084 | 0.117 | 0.116 | 0.053 | 0.053 | 0.146 | 0.072 | 0.027 | 0.057 | 0.124 | 0.018 | 0.009 |
| UAA | 2.056 | 2.872 | 2.690 | 0.830 | 1.371 | 3.403 | 1.556 | 0.266 | 1.268 | 1.575 | 0.466 | 0.091 |
| Total FAA | 3.398 | 5.010 | 4.403 | 2.169 | 2.372 | 5.544 | 2.887 | 0.843 | 1.884 | 2.690 | 0.885 | 0.270 |

UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly).

nd: not detected.

**Table S3.** **Hydrolyzed amino acid (HAA) contents of soy sauce peptide fractions eluted by 60% ethanol (mg/100 mg).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Amino acid | SS1 | SS2 | SS3 | SS4 | SS5 | SS6 | SS7 | SS8 | SS9 | SS10 | SS11 | SS12 |
| Glu | 1.758 | 1.744 | 1.659 | 0.996 | 0.755 | 2.552 | 1.237 | 0.307 | 1.131 | 1.137 | 0.675 | 0.272 |
| Asp | 0.543 | 0.768 | 0.521 | 1.034 | 0.347 | 0.696 | 0.291 | 0.229 | 0.153 | 0.420 | 0.260 | 0.114 |
| Val | 0.385 | 0.504 | 0.323 | 0.530 | 0.240 | 0.469 | 0.413 | 0.134 | 0.116 | 0.229 | 0.188 | 0.143 |
| Met | 0.095 | 0.132 | 0.095 | 0.153 | 0.054 | 0.122 | nd | 0.030 | nd | 0.051 | 0.054 | nd |
| Ile | 0.418 | 0.574 | 0.358 | 0.630 | 0.244 | 0.568 | 0.579 | 0.216 | 0.102 | 0.189 | 0.159 | 0.180 |
| Leu | 0.608 | 0.832 | 0.526 | 0.898 | 0.379 | 0.841 | 0.794 | 0.287 | 0.147 | 0.303 | 0.233 | 0.246 |
| Phe | 0.959 | 1.289 | 0.771 | 1.216 | 0.506 | 1.420 | 1.258 | 0.357 | 0.172 | 0.401 | 0.065 | 0.315 |
| His | 0.527 | 0.670 | 0.530 | 0.600 | 0.374 | 0.613 | 0.482 | 0.060 | 0.079 | 0.084 | 0.077 | 0.112 |
| Tyr | 0.201 | 0.372 | 0.216 | 0.412 | 0.157 | 0.246 | 0.180 | 0.077 | 0.059 | 0.105 | nd | 0.046 |
| Arg | 0.147 | 0.198 | 0.094 | 0.358 | 0.037 | 0.236 | 0.169 | 0.935 | 0.039 | 0.065 | 0.041 | 0.066 |
| Lys | 0.442 | 0.581 | 0.403 | 0.705 | 0.264 | 0.506 | 0.505 | 0.058 | 0.071 | 0.193 | 0.141 | 0.151 |
| Pro | 0.533 | 1.045 | 0.609 | 1.228 | 0.439 | 0.685 | 0.891 | 0.120 | 0.120 | 0.378 | 0.296 | 0.286 |
| Thr | 0.348 | 0.392 | 0.239 | 0.418 | 0.162 | 0.316 | 0.152 | 0.100 | 0.052 | 0.176 | 0.118 | 0.049 |
| Ser | 0.278 | 0.401 | 0.268 | 0.414 | 0.173 | 0.353 | 0.307 | 0.110 | 0.096 | 0.206 | 0.123 | 0.047 |
| Gly | 0.387 | 0.459 | 0.302 | 0.743 | 0.214 | 0.395 | 0.508 | 0.149 | 0.067 | 0.183 | 0.148 | 0.173 |
| Ala | 0.186 | 0.235 | 0.175 | 0.463 | 0.105 | 0.252 | 0.281 | 0.068 | 0.058 | 0.142 | 0.157 | 0.097 |
| UAA | 4.034 | 4.867 | 3.643 | 4.864 | 2.086 | 5.561 | 3.753 | 1.188 | 1.640 | 2.388 | 1.306 | 1.018 |
| Total HAA | 7.814 | 10.196 | 7.089 | 10.799 | 4.452 | 10.270 | 8.045 | 3.237 | 2.460 | 4.261 | 2.735 | 2.299 |

UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly).

nd: not detected.

**Table S4. Percentage of the contents of free amino acids (FAA) of total amino acids (%).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Amino acid | SS1 | SS2 | SS3 | SS4 | SS5 | SS6 | SS7 | SS8 | SS9 | SS10 | SS11 | SS12 |
| Glu | 31.28 | 26.62 | 34.42 | 11.75 | 30.22 | 33.54 | 21.32 | 4.06 | 49.58 | 33.74 | 29.10 | 12.16 |
| Asp | 3.55 | 3.40 | 4.41 | 3.85 | 3.28 | 4.73 | 4.09 | 4.53 | 5.92 | 8.61 | 3.48 | 5.23 |
| Val | 3.15 | 3.13 | 3.63 | 3.32 | 2.67 | 3.13 | 3.20 | 2.02 | 3.00 | 5.17 | 3.05 | 2.91 |
| Met | 0.58 | 0.92 | 0.50 | 1.23 | 0.77 | 0.66 | 1.04 | 2.84 | 0.00 | 0.92 | 0.81 | 0.00 |
| Ile | 4.80 | 5.03 | 4.70 | 4.80 | 4.79 | 4.61 | 5.53 | 6.29 | 3.32 | 5.07 | 4.49 | 6.19 |
| Leu | 8.30 | 8.51 | 7.61 | 7.76 | 7.85 | 7.71 | 8.99 | 9.37 | 5.34 | 7.76 | 7.60 | 10.47 |
| Phe | 20.11 | 22.27 | 16.70 | 17.09 | 18.86 | 17.38 | 22.41 | 14.82 | 5.12 | 7.23 | 14.78 | 10.29 |
| His | 8.47 | 9.33 | 7.59 | 22.12 | 12.60 | 7.34 | 10.51 | 19.55 | 5.48 | 2.85 | 16.91 | 25.06 |
| Tyr | 1.40 | 1.27 | 1.35 | 1.40 | 1.67 | 1.44 | 1.87 | 3.19 | 1.63 | 1.57 | 1.65 | 0.00 |
| Arg | 1.52 | 1.51 | 1.53 | 0.42 | 0.44 | 1.29 | 0.50 | 3.45 | 1.07 | 0.53 | 0.00 | 0.00 |
| Lys | 4.42 | 6.31 | 5.27 | 6.21 | 4.67 | 4.88 | 6.01 | 5.30 | 3.89 | 5.99 | 5.64 | 7.07 |
| Pro | 3.66 | 3.61 | 3.23 | 1.59 | 4.19 | 4.09 | 5.44 | 13.98 | 5.03 | 4.81 | 4.53 | 7.91 |
| Thr | 1.93 | 1.90 | 2.03 | 2.81 | 1.75 | 2.03 | 2.11 | 2.19 | 2.25 | 3.39 | 1.79 | 2.72 |
| Ser | 2.69 | 2.41 | 2.81 | 11.43 | 2.46 | 2.88 | 2.77 | 3.48 | 3.34 | 4.94 | 2.52 | 3.94 |
| Gly | 1.69 | 1.44 | 1.57 | 1.76 | 1.54 | 1.67 | 1.73 | 1.71 | 2.02 | 2.82 | 1.57 | 2.62 |
| Ala | 2.47 | 2.33 | 2.64 | 2.45 | 2.24 | 2.63 | 2.50 | 3.21 | 3.02 | 4.59 | 2.07 | 3.42 |
| UAA | 60.50 | 57.33 | 61.09 | 38.29 | 57.82 | 61.39 | 53.92 | 31.52 | 67.29 | 58.56 | 52.66 | 33.73 |

UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly).

**Table S5. Percentage of the contents of hydrolyzed amino acids (HAA) of total amino acids (%).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Amino acid | SS1 | SS2 | SS3 | SS4 | SS5 | SS6 | SS7 | SS8 | SS9 | SS10 | SS11 | SS12 |
| Glu | 22.50 | 17.10 | 23.40 | 9.22 | 16.96 | 24.85 | 15.37 | 9.49 | 45.96 | 26.68 | 24.67 | 11.85 |
| Asp | 6.95 | 7.53 | 7.35 | 9.58 | 7.79 | 6.78 | 3.61 | 7.06 | 6.21 | 9.86 | 9.51 | 4.97 |
| Val | 4.92 | 4.95 | 4.56 | 4.91 | 5.38 | 4.56 | 5.14 | 4.13 | 4.70 | 5.37 | 6.86 | 6.21 |
| Met | 1.21 | 1.29 | 1.34 | 1.42 | 1.22 | 1.19 | 0.00 | 0.93 | 0.00 | 1.19 | 1.98 | 0.00 |
| Ile | 5.36 | 5.63 | 5.06 | 5.83 | 5.49 | 5.53 | 7.19 | 6.68 | 4.14 | 4.44 | 5.80 | 7.81 |
| Leu | 7.78 | 8.16 | 7.42 | 8.32 | 8.52 | 8.19 | 9.87 | 8.87 | 5.96 | 7.11 | 8.54 | 10.71 |
| Phe | 12.27 | 12.64 | 10.88 | 11.26 | 11.38 | 13.82 | 15.63 | 11.03 | 6.97 | 9.41 | 2.39 | 13.71 |
| His | 6.74 | 6.58 | 7.48 | 5.56 | 8.40 | 5.97 | 6.00 | 1.84 | 3.20 | 1.97 | 2.81 | 4.87 |
| Tyr | 2.57 | 3.65 | 3.05 | 3.81 | 3.53 | 2.40 | 2.24 | 2.39 | 2.42 | 2.46 | 0.00 | 2.01 |
| Arg | 1.88 | 1.94 | 1.32 | 3.32 | 0.84 | 2.29 | 2.10 | 28.89 | 1.57 | 1.53 | 1.49 | 2.88 |
| Lys | 5.65 | 5.70 | 5.69 | 6.53 | 5.94 | 4.93 | 6.28 | 1.79 | 2.89 | 4.53 | 5.14 | 6.57 |
| Pro | 6.82 | 10.25 | 8.59 | 11.37 | 9.85 | 6.67 | 11.08 | 3.70 | 4.86 | 8.86 | 10.83 | 12.45 |
| Thr | 4.46 | 3.84 | 3.38 | 3.87 | 3.63 | 3.08 | 1.88 | 3.08 | 2.12 | 4.12 | 4.33 | 2.15 |
| Ser | 3.55 | 3.93 | 3.78 | 3.83 | 3.88 | 3.44 | 3.82 | 3.41 | 3.90 | 4.83 | 4.49 | 2.06 |
| Gly | 4.95 | 4.50 | 4.26 | 6.88 | 4.82 | 3.85 | 6.32 | 4.61 | 2.74 | 4.30 | 5.41 | 7.54 |
| Ala | 2.38 | 2.31 | 2.47 | 4.29 | 2.37 | 2.46 | 3.49 | 2.10 | 2.36 | 3.34 | 5.76 | 4.20 |
| UAA | 51.62 | 47.73 | 51.40 | 45.04 | 46.84 | 54.14 | 46.66 | 36.69 | 66.66 | 56.04 | 47.73 | 44.28 |

UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly).



**Figure S1.** Taste characteristics of soy sauce peptide fractions eluted by ethanol with different concentrations. A: SS1; B: SS2; C: SS3; D: SS4; E: SS5; F: SS6; G: SS7; H: SS8; I: SS9; J: SS10; K: SS11; L: SS12



**Figure S2.** Umami scores of soy sauce peptide fractions eluted by ethanol with different concentrations. A: SS1; B: SS2; C: SS3; D: SS4; E: SS5; F: SS6; G: SS7; H: SS8; I: SS9; J: SS10; K: SS11; L: SS12. Different letters indicated significant differences (*P* < 0.05).

**Figure S3.** Pearson correlation analysis between the umami scores and hydrolyzed amino acid (HAA) contents of soy sauce peptide fraction SS-60%. UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly). ∗∗∗ P < 0.001; ∗∗ P < 0.01; ∗ P < 0.05.



**Figure S4.** Pearson correlation analysis between the umami scores and hydrolyzed amino acid (HAA) contents of soy sauce peptide fraction SS-60%. A: Ten soy sauces added sodium glutamate; B: Six soy sauces added sodium glutamate but not yeast extract. C: Five soy sauces added yeast extract; D: Seven soy sauces without yeast extract. UAA: umami amino acids (Glu, Asp, Phe, Tyr, Ala, Gly). ∗∗∗ *P* < 0.001; ∗∗ *P* < 0.01; ∗ *P* < 0.05



**Figure S5.** Mass spectra of soy sauce peptide fraction SS-60% with m/z 400-5000. A: SS1; B: SS2; C: SS3; D: SS5; E: SS9; F: SS10.