**Table S1.** Metabolomic identification of secondary metabolites (Rt, retention time) detected in the two honey samples analyzed (2021 and 2022); values are in ppm.

| Compounds | Formula | m/z | RT | 2021 | 2022 | p-value | Sign. Code |
|---|---|---|---|---|---|---|---|
| *Carboxylic acids* | | | | | | | |
| 1-(Carboxymethyl)cyclohexanecarboxylic acid | $C_9H_{14}O_4$ | 185.08 | 10.44 | 0.70 ± 0.04 | 0.80 ± 0.06 | 0.0977 | ns |
| 1,2,3-cyclopropanetricarboxylic acid | $C_6H_6O_6$ | 173.01 | 2.75 | 1.87 ± 0.16 | 2.08 ± 0.06 | 0.0978 | ns |
| 1,2,4-Benzenetricarboxylic acid | $C_9H_6O_6$ | 209.01 | 6.39 | 2.21 ± 0.21 | 1.02 ± 0.06 | 0.0007 | ** |
| 10-HDA | $C_{10}H_{18}O_3$ | 185.12 | 11.53 | 0.89 ± 0.04 | 0.83 ± 0.05 | 0.1588 | ns |
| 12-Hydroxydodecanoic acid | $C_{12}H_{24}O_3$ | 199.17 | 13.7 | 3.46 ± 0.28 | 3.30 ± 0.18 | 0.4653 | ns |
| 13-HODE | $C_{18}H_{32}O_3$ | 295.23 | 15.68 | 3.77 ± 0.46 | 2.62 ± 0.36 | 0.0269 | * |
| 13-Isogrindelic acid | $C_{20}H_{32}O_3$ | 319.23 | 15.44 | 7.01 ± 1.67 | 6.06 ± 0.86 | 0.4268 | ns |
| 14(Z)-Eicosenoic acid | $C_{20}H_{38}O_2$ | 309.28 | 18.15 | 9.11 ± 0.74 | 3.60 ± 0.25 | 0.0003 | ** |
| 16-Hydroxyhexadecanoic acid | $C_{16}H_{32}O_3$ | 271.23 | 15.66 | 13.69 ± 2.31 | 8.81 ± 0.31 | 0.0222 | * |
| 2,2-Dimethylsuccinic acid | $C_6H_{10}O_4$ | 145.05 | 7.84 | 0.57 ± 0.03 | 0.63 ± 0.04 | 0.0739 | ns |
| 2,3,4,9-Tetrahydro-1H-β-carboline-3-carboxylic acid | $C_{12}H_{12}N_2O_2$ | 215.08 | 7.47 | 0.57 ± 0.02 | 0.49 ±0.02 | 0.0109 | * |
| 2-[(2S,4aR,8aS)-2-Hydroxy-4a-methyl-8-methylenedecahydro-2-naphthalenyl]acrylic acid | $C_{15}H_{22}O_3$ | 249.15 | 16.23 | 5.34 ± 4.08 | 2.31 ± 0.26 | 0.2690 | ns |
| 2-Furoic acid | $C_5H_4O_3$ | 113.02 | 12.18 | 9.31 ± 1.30 | 7.68 ± 0.22 | 0.0991 | ns |
| 2-Hydroxynicotinic acid | $C_6H_5NO_3$ | 138.02 | 7.37 | 3.14 ± 0.10 | 2.88 ± 0.14 | 0.0579 | ns |
| 2-Hydroxyvaleric acid | $C_5H_{10}O_3$ | 101.06 | 5.95 | 3.99 ± 0.09 | 4.95 ± 0.09 | 0.0002 | ** |
| 2-Isopropylmalic acid | $C_7H_{12}O_5$ | 175.06 | 7.8 | 18.83 ± 0.89 | 18.89 ± 0.10 | 0.9037 | ns |
| 2-Methyl-3-hydroxybutyric acid | $C_5H_{10}O_3$ | 117.06 | 5.77 | 7.01 ± 0.75 | 7.78 ± 0.25 | 0.1660 | ns |
| 2-Methylhippuric acid | $C_{10}H_{11}NO_3$ | 192.07 | 9.22 | 0.89 ± 0.03 | 1.36 ± 0.05 | 0.0002 | ** |
| 2-Norbornaneacetic acid | $C_9H_{14}O_2$ | 153.09 | 11.43 | 1.29 ± 0.06 | 1.31 ± 0.02 | 0.7166 | ns |
| 3-(2-Hydroxy-3-methoxyphenyl)acrylic acid | $C_{10}H_{10}O_4$ | 195.07 | 9.6 | 3.34 ± 0.44 | 4.09 ± 0.37 | 0.0865 | ns |
| 3-(3,4-dimethoxyphenyl)prop-2-enoic acid | $C_{11}H_{12}O_4$ | 209.08 | 10.85 | 13.33 ± 1.17 | 15.80 ± 0.44 | 0.0269 | * |
| 3,3-Dimethylglutaric acid | $C_7H_{12}O_4$ | 159.07 | 9.15 | 0.66 ± 0.13 | 0.73 ± 0.05 | 0.4198 | ns |
| 3,5-Dihydroxybenzoic acid | $C_7H_6O_4$ | 153.02 | 7.3 | 0.48 ± 0.02 | 0.44 ± 0.04 | 0.2330 | ns |
| 3-Hydroxy myristic acid | $C_{14}H_{28}O_3$ | 243.2 | 15.81 | 0.57 ± 0.24 | 0.30 ± 0.06 | 0.1428 | ns |
| 3-Methylglutaric acid | $C_6H_{10}O_4$ | 145.05 | 7.62 | 0.78 ± 0.06 | 1.06 ± 0.07 | 0.0073 | ** |
| 3-Methylpimelic acid | $C_8H_{14}O_4$ | 173.08 | 5.81 | 0.65 ± 0.04 | 0.71 ± 0.02 | 0.0816 | ns |
| 4-{[-3-(3,4-dihydroxyphenyl)prop-2-enoyl]oxy}-1,3,5-trihydroxycyclohexane-1-carboxylic acid | $C_{16}H_{18}O_9$ | 355.1 | 7.83 | 1.30 ± 0.02 | 1.61 ± 0.05 | 0.0005 | ** |
| 4-Hydroxy-4-{4-hydroxy-2-[(1E)-6-hydroxy-1-hepten-1-yl]cyclopentyl}-2-butenoic acid | $C_{16}H_{26}O_5$ | 297.17 | 13.5 | 3.45 ± 0.06 | 4.26 ± 0.08 | 0.0002 | ** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4-Hydroxybenzoic acid | $C_7H_6O_3$ | 137.02 | 10.55 | 13.79 ± 0.55 | 13.38 ± 0.25 | 0.3106 | ns |
| 4-Phenylbutyric acid | $C_{10}H_{12}O_2$ | 165.09 | 11.64 | 24.04 ± 0.80 | 20.93 ± 0.18 | 0.0028 | ** |
| 4-Toluic acid | $C_8H_8O_2$ | 135.04 | 8.18 | 2.15 ± 0.06 | 2.44 ± 0.07 | 0.0053 | ** |
| 5-Hydroxyindole-3-acetic acid | $C_{10}H_9NO_3$ | 190.05 | 8.95 | 11.51 ± 0.67 | 11.57 ± 0.26 | 0.8859 | ns |
| 6-Quinolinecarboxylic acid | $C_{10}H_7NO_2$ | 174.05 | 4.34 | 2.42 ± 0.11 | 1.64 ± 0.08 | 0.0006 | ** |
| 9-HpODE | $C_{18}H_{32}O_4$ | 311.22 | 14.75 | 1.04 ± 0.01 | 1.25 ± 0.16 | 0.0787 | ns |
| Abscisic acid | $C_{15}H_{20}O_4$ | 247.13 | 11.43 | 23.08 ± 0.72 | 24.11 ± 0.34 | 0.0884 | ns |
| Arachidic acid | $C_{20}H_{40}O_2$ | 311.3 | 18.9 | 1.77 ± 1.02 | 0.54 ± 0.08 | 0.1037 | ns |
| Caffeic acid | $C_9H_8O_4$ | 179.03 | 8.18 | 68.61 ± 1.26 | 80.72 ± 1.09 | 0.0002 | ** |
| Camphanic acid | $C_{10}H_{14}O_4$ | 197.08 | 10.92 | 3.11 ± 0.13 | 3.60 ± 0.18 | 0.0191 | * |
| Citric acid | $C_6H_8O_7$ | 191.02 | 2.21 | 227.78 ± 4.86 | 213.84 ± 3.98 | 0.0184 | * |
| Crotonic acid | $C_4H_6O_2$ | 87.04 | 0.63 | 2.95 ± 0.31 | 2.86 ± 0.41 | 0.7827 | ns |
| Cyclohexanecarboxylic acid | $C_7H_{12}O_2$ | 127.08 | 9.17 | 0.94 ± 0.05 | 1.06 ± 0.05 | 0.0346 | * |
| D-(-)-Quinic acid | $C_7H_{12}O_6$ | 193.07 | 1.48 | 2.32 ± 0.10 | 0.43 ± 0.03 | < 0,0001 | *** |
| Docosanoic Acid | $C_{22}H_{44}O_2$ | 339.33 | 20.07 | 1.29 ± 0.06 | 0.66 ± 0.02 | < 0,0001 | *** |
| Dodecanedioic acid | $C_{12}H_{22}O_4$ | 229.14 | 13.57 | 6.46 ± 0.39 | 7.21 ± 0.42 | 0.0860 | ns |
| Ethylmalonic acid | $C_5H_8O_4$ | 131.03 | 5.65 | 5.68 ± 0.19 | 6.81 ± 0.35 | 0.0080 | ** |
| Fumaric acid | $C_4H_4O_4$ | 115 | 2.56 | 2.78 ± 0.49 | 2.52 ± 0.05 | 0.4154 | ns |
| Gallic acid | $C_7H_6O_5$ | 169.01 | 3.88 | 2.81 ± 0.15 | 1.29 ± 0.06 | < 0,0001 | *** |
| germacra-1(10),4,11(13)-trien-12-oic acid | $C_{15}H_{22}O_2$ | 233.15 | 14.98 | 13.87 ± 1.58 | 12.16 ± 0.30 | 0.1391 | ns |
| Indole-3-acrylic acid | $C_{11}H_9NO_2$ | 188.07 | 7.8 | 0.53 ± 0.03 | 0.25 ± 0.02 | 0.0002 | ** |
| Lactic Acid | $C_3H_6O_3$ | 89.02 | 1.89 | 195.23 ± 30.70 | 180.29 ± 1.78 | 0.4474 | ns |
| Levulinic acid | $C_5H_8O_3$ | 115.04 | 9.27 | 1.43 ± 0.05 | 1.76 ± 0.01 | 0.0003 | ** |
| Maleic acid | $C_4H_4O_4$ | 117.02 | 14.46 | 5.31 ± 0.47 | 5.04 ± 0.11 | 0.3935 | ns |
| Mesaconic acid | $C_5H_6O_4$ | 129.02 | 4.18 | 4.09 ± 0.57 | 4.61 ± 0.04 | 0.1923 | ns |
| Methylmalonic acid | $C_4H_6O_4$ | 117.02 | 2.67 | 45.59 ± 1.78 | 41.00 ± 1.24 | 0.0213 | * |
| Mevalonic acid | $C_6H_{12}O_4$ | 147.07 | 6 | 19.68 ± 1.32 | 24.90 ± 0.21 | 0.0025 | ** |
| Myristic acid | $C_{14}H_{28}O_2$ | 227.2 | 16.8 | 2.85 ± 0.74 | 2.22 ± 0.06 | 0.2125 | ns |
| Nicotinic acid | $C_6H_5NO_2$ | 124.04 | 2.21 | 5.68 ± 0.38 | 9.43 ± 0.32 | 0.0002 | ** |
| Oleanolic acid | $C_{30}H_{48}O_3$ | 455.35 | 17.04 | 0.93 ± 0.01 | 0.25 ± 0.02 | < 0,0001 | *** |
| Palmitic Acid | $C_{16}H_{32}O_2$ | 255.23 | 17.39 | 41.83 ± 2.59 | 44.24 ± 2.29 | 0.2941 | ns |
| Palmitoleic acid | $C_{16}H_{30}O_2$ | 253.22 | 16.98 | 3.67 ± 0.46 | 2.90 ± 0.05 | 0.0454 | * |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pentadecanoic acid | $C_{15}H_{30}O_2$ | 241.22 | 17.1 | 1.54 ± 0.33 | 1.33 ± 0.09 | 0.3310 | ns |
| Protocatechuic acid | $C_7H_6O_4$ | 153.02 | 6.04 | 7.61 ± 0.15 | 5.04 ± 0.21 | < 0,0001 | *** |
| Ricinoleic Acid | $C_{18}H_{34}O_3$ | 297.24 | 16.31 | 2.24 ± 0.83 | 1.21 ± 0.06 | 0.0997 | ns |
| Salicylic acid | $C_7H_6O_3$ | 137.02 | 7.44 | 6.21 ± 0.64 | 5.74 ± 0.29 | 0.3101 | ns |
| Suberic acid | $C_8H_{14}O_4$ | 173.08 | 9.82 | 40.46 ± 1.32 | 43.53 ± 1.00 | 0.0326 | * |
| *Flavonoids* | | | | | | | |
| 3-Methoxy-5,7,3',4'-tetrahydroxy-flavone | $C_{16}H_{12}O_7$ | 315.05 | 12.42 | 11.01 ± 0.75 | 9.58 ± 0.24 | 0.0349 | * |
| Apigenin | $C_{15}H_{10}O_5$ | 269.04 | 13.78 | 51.41 ± 4.08 | 49.54 ± 1.59 | 0.5010 | ns |
| Chrysin | $C_{15}H_{10}O_4$ | 253.05 | 15.39 | 7.00 ± 0.45 | 7.74 ± 1.44 | 0.4404 | ns |
| Daidzein | $C_{15}H_{10}O_4$ | 253.05 | 13.75 | 56.84 ± 3.87 | 50.82 ± 1.09 | 0.0606 | ns |
| Diosmetin | $C_{16}H_{12}O_6$ | 299.06 | 12.25 | 1.73 ± 0.14 | 0.82 ± 0.05 | 0.0004 | ** |
| Fisetin | $C_{15}H_{10}O_6$ | 285.04 | 11.86 | 1.97 ± 0.17 | 1.27 ± 0.05 | 0.0025 | ** |
| Formononetin | $C_{16}H_{12}O_4$ | 269.08 | 13.14 | 4.49 ± 0.06 | 3.96 ± 0.07 | 0.0005 | ** |
| Genistein | $C_{15}H_{10}O_5$ | 269.05 | 12.5 | 6.71 ± 0.66 | 6.11 ± 0.33 | 0.2307 | ns |
| Glycitein | $C_{16}H_{12}O_5$ | 283.06 | 14.07 | 13.52 ± 1.28 | 12.41 ± 0.53 | 0.2383 | ns |
| Hispidulin | $C_{16}H_{12}O_6$ | 299.06 | 12.71 | 7.01 ± 0.64 | 6.53 ± 0.34 | 0.3111 | ns |
| Isorhamnetin | $C_{16}H_{12}O_7$ | 315.05 | 13.03 | 7.89 ± 1.28 | 7.04 ± 0.45 | 0.3381 | ns |
| Kaempferol | $C_{15}H_{10}O_6$ | 285.04 | 11.29 | 0.08 ± 0.02 | 0.10 ± 0.01 | 0.1645 | ns |
| licoricidin | $C_{26}H_{32}O_5$ | 423.22 | 16.93 | 1.02 ± 0.30 | 1.27 ± 0.33 | 0.3702 | ns |
| Luteolin | $C_{15}H_{10}O_6$ | 285.04 | 12.24 | 7.85 ± 0.53 | 9.98 ± 0.39 | 0.0048 | ** |
| Naringenin | $C_{15}H_{12}O_5$ | 271.06 | 11.77 | 160.56 ± 6.87 | 190.61 ± 4.39 | 0.0031 | ** |
| olmelin | $C_{16}H_{12}O_5$ | 285.08 | 13.5 | 5.49 ± 0.36 | 5.50 ± 0.21 | 0.9542 | ns |
| pinostrobin | $C_{16}H_{14}O_4$ | 271.1 | 14.72 | 2.68 ± 0.12 | 2.09 ± 0.07 | 0.0016 | ** |
| Quercetin | $C_{15}H_{10}O_7$ | 301.03 | 11.46 | 3.58 ± 0.30 | 3.29 ± 0.19 | 0.2157 | ns |
| Strobopinin | $C_{16}H_{14}O_4$ | 269.08 | 13.24 | 0.45 ± 0.10 | 2.19 ± 0.22 | 0.0002 | ** |
| Tricin | $C_{17}H_{14}O_7$ | 329.07 | 13.44 | 19.67 ± 1.85 | 18.12 ± 0.80 | 0.2534 | ns |
| *Nitrogen compounds* | | | | | | | |
| 1,3-Dimethylpteridine-2,4-dione | $C_8H_8N_4O_2$ | 193.07 | 7.18 | 1.69 ± 0.06 | 0.67 ± 0.01 | < 0,0001 | *** |
| 1-Tetradecylamine | $C_{14}H_{31}N$ | 214.25 | 13.42 | 6.85 ± 0.44 | 6.15 ± 0.17 | 0.0635 | ns |
| 2-Hydroxyquinoline | $C_9H_7NO$ | 146.06 | 9.93 | 1.36 ± 0.06 | 1.40 ± 0.07 | 0.5046 | ns |
| 3-Methylquinolin-2-one | $C_{10}H_9NO$ | 160.08 | 5.38 | 1.74 ± 0.03 | 1.11 ± 0.13 | 0.0012 | ** |
| 5-Methoxyindole | $C_9H_9NO$ | 148.08 | 7.06 | 0.39 ± 0.29 | 0.65 ± 0.03 | 0.1947 | ns |
| 6-Methoxyquinoline | $C_{10}H_9NO$ | 160.08 | 8.81 | 1.35 ± 0.04 | 1.47 ± 0.06 | 0.0537 | ns |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Betaine | $C_5H_{11}NO_2$ | 118.09 | 1.37 | 16.17 ± 0.26 | 16.44 ± 0.12 | 0.1757 | ns |
| Caprolactam | $C_6H_{11}NO$ | 114.09 | 7.97 | 7.56 ± 2.59 | 5.49 ± 0.45 | 0.2445 | ns |
| Choline | $C_5H_{13}NO$ | 104.11 | 1.28 | 17.02 ± 0.28 | 15.59 ± 0.31 | 0.0040 | ** |
| Di-4-coumaroylputrescine | $C_{22}H_{24}N_2O_4$ | 381.18 | 10.22 | 0.72 ± 0.06 | 0.30 ± 0.01 | 0.0002 | ** |
| Isoleucine | $C_6H_{13}NO_2$ | 132.1 | 2.63 | 19.33 ± 1.42 | 17.07 ± 0.25 | 0.0528 | ns |
| Leucine | $C_6H_{13}NO_2$ | 132.1 | 2.8 | 16.94 ± 0.64 | 16.46 ± 0.09 | 0.2639 | ns |
| Methyl indole-3-acetate | $C_{11}H_{11}NO_2$ | 190.09 | 6.95 | 10.31 ± 0.48 | 5.70 ± 0.08 | < 0,0001 | *** |
| N-Acetyldopamine | $C_{10}H_{13}NO_3$ | 196.1 | 6.94 | 2.78 ± 0.19 | 2.27 ± 0.06 | 0.0121 | * |
| N-Acetylglutamic acid | $C_7H_{11}NO_5$ | 188.06 | 2.64 | 1.01 ± 0.07 | 0.86 ± 0.02 | 0.0272 | * |
| N-Acetylleucine | $C_8H_{15}NO_3$ | 172.1 | 8.96 | 3.40 ± 0.16 | 4.06 ± 0.15 | 0.0070 | ** |
| N-Acetylphenylalanine | $C_{11}H_{13}NO_3$ | 206.08 | 9.56 | 3.76 ± 0.18 | 4.87 ± 0.21 | 0.0022 | ** |
| N-Acetyltyramine | $C_{10}H_{13}NO_2$ | 180.1 | 7.91 | 0.74 ± 0.02 | 0.99 ± 0.05 | 0.0011 | ** |
| N-Acetyltyrosine | $C_{11}H_{13}NO_4$ | 222.08 | 7.23 | 1.82 ± 0.08 | 2.20 ± 0.14 | 0.0148 | * |
| N-Acetylvaline | $C_7H_{13}NO_3$ | 160.1 | 7.18 | 1.72 ± 0.05 | 1.92 ± 0.07 | 0.0174 | * |
| Phenylalanine | $C_9H_{11}NO_2$ | 166.09 | 5.21 | 175.27 ± 6.38 | 138.35 ± 2.99 | 0.0008 | ** |
| Prolylleucine | $C_{11}H_{20}N_2O_3$ | 229.15 | 1.94 | 10.07 ± 0.46 | 9.49 ± 0.35 | 0.1599 | ns |
| Pyridoxine | $C_8H_{11}NO_3$ | 170.08 | 2.24 | 2.42 ± 0.05 | 2.21 ± 0.03 | 0.0032 | ** |
| Stachydrine | $C_7H_{13}NO_2$ | 144.1 | 1.5 | 20.33 ± 0.06 | 20.48 ± 2.07 | 0.9076 | ns |
| Uracil | $C_4H_4N_2O_2$ | 113.03 | 2.91 | 5.22 ± 0.07 | 5.25 ± 0.06 | 0.5844 | ns |
| Uridine | $C_9H_{12}N_2O_6$ | 243.06 | 2.92 | 5.55 ± 0.32 | 5.20 ± 0.15 | 0.1607 | ns |
| Valine | $C_5H_{11}NO_2$ | 118.09 | 1.65 | 20.18 ± 1.67 | 19.33 ± 1.24 | 0.5160 | ns |
| δ-Valerolactam | $C_5H_9NO$ | 100.08 | 6.39 | 2.61 ± 0.14 | 2.65 ± 0.08 | 0.6646 | ns |
| *Glycosides* | | | | | | | |
| 2-Methylbutyl beta-D-glucopyranoside | $C_{11}H_{22}O_6$ | 268.18 | 9.32 | 1.89 ± 0.12 | 1.55 ± 0.05 | 0.0128 | * |
| 2-Phenylethyl-glucopyranoside | $C_{14}H_{20}O_6$ | 307.12 | 9.31 | 0.36 ± 0.01 | 0.36 ± 0.03 | 0.7090 | ns |
| *Carbonyl compounds* | | | | | | | |
| 2,4,5-Trimethoxybenzaldehyde | $C_{10}H_{12}O_4$ | 197.08 | 10.69 | 0.99 ± 0.25 | 6.62 ± 0.08 | < 0,0001 | *** |
| 2,4,6-Trihydroxy-2-(4-hydroxybenzyl)-1-benzofuran-3(2H)-one | $C_{15}H_{12}O_6$ | 287.06 | 10.1 | 0.88 ± 0.03 | 1.15 ± 0.07 | 0.0031 | ** |
| 3',11'-dihydroxy-1',2',5'-trimethyl-8'-oxaspiro[oxirane-2,12'-tricyclo[7.2.1.0]dodecan]-5'-en-4'-one | $C_{15}H_{20}O_5$ | 279.12 | 9.27 | 0.73 ± 0.06 | 0.77 ± 0.02 | 0.3270 | ns |
| Benzophenone | $C_{13}H_{10}O$ | 183.08 | 13.65 | 617.25 ± 40.88 | 585.58 ± 2.82 | 0.2517 | ns |
| Citral | $C_{10}H_{16}O$ | 153.13 | 12.4 | 4.61 ± 0.19 | 5.99 ± 0.03 | 0.0002 | ** |
| Coenzyme Q0 | $C_9H_{10}O_4$ | 183.07 | 7.1 | 1.42 ± 0.05 | 1.90 ± 0.04 | 0.0002 | ** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| curcumenone | $C_{15}H_{22}O_2$ | 233.15 | 0.56 | 0.29 ± 0.01 | 0.51 ± 0.57 | 0.5469 | ns |
| gentisaldehyde | $C_7H_6O_3$ | 137.02 | 7.07 | 2.13 ± 0.07 | 2.50 ± 0.09 | 0.0055 | ** |
| Isobutyraldehyde | $C_4H_8O$ | 73.06 | 3.21 | 14.62 ± 1.29 | 15.53 ± 0.05 | 0.2880 | ns |
| Kojic acid | $C_6H_6O_4$ | 143.03 | 5.65 | 2.33 ± 0.76 | 2.32 ± 0.10 | 0.9845 | ns |
| *Esters and lactones* | | | | | | | |
| 3,8,9-trihydroxy-10-propyl-3,4,5,8,9,10-hexahydro-2H-oxecin-2-one | $C_{12}H_{20}O_5$ | 243.12 | 10.53 | 1.98 ± 0.04 | 2.42 ± 0.11 | 0.0029 | ** |
| 4-Hydroxycoumarin | $C_9H_6O_3$ | 163.04 | 13.8 | 214.25 ± 11.34 | 199.65 ± 2.13 | 0.0936 | ns |
| 6-Pentyl-2H-pyran-2-one | $C_{10}H_{14}O_2$ | 167.11 | 13.8 | 3.80 ± 0.50 | 3.53 ± 0.06 | 0.4130 | ns |
| 7-Hydroxycoumarine | $C_9H_6O_3$ | 163.04 | 15.39 | 507.08 ± 39.97 | 526.55 ± 22.96 | 0.5050 | ns |
| Ascorbic acid | $C_6H_8O_6$ | 175.02 | 2.04 | 9.92 ± 0.98 | 9.52 ± 1.59 | 0.7279 | ns |
| Mevalonolactone | $C_6H_{10}O_3$ | 131.07 | 4.27 | 3.48 ± 0.15 | 3.61 ± 0.07 | 0.2168 | ns |
| Propyl gallate | $C_{10}H_{12}O_5$ | 211.06 | 6.36 | 31.21 ± 1.18 | 9.01 ± 0.35 | < 0,0001 | *** |
| δ-Ribono-1,4-lactone | $C_5H_8O_5$ | 147.03 | 2.79 | 52.67 ± 2.04 | 63.29 ± 1.52 | 0.0019 | ** |
| *Others* | | | | | | | |
| 1,2,3,4-Tetramethyl-1,3-cyclopentadiene | $C_9H_{14}$ | 123.12 | 11.95 | 1.06 ± 0.06 | 1.79 ± 0.01 | < 0,0001 | *** |
| Galactal | $C_6H_{10}O_4$ | 145.05 | 6.96 | 0.97 ± 0.09 | 1.19 ± 0.05 | 0.0168 | * |
| Pyrogallol | $C_6H_6O_3$ | 125.02 | 6.15 | 0.62 ± 0.01 | 0.87 ± 0.02 | < 0,0001 | *** |
| Rishitin | $C_{14}H_{22}O_2$ | 221.15 | 15.47 | 6.80 ± 0.08 | 5.47 ± 2.78 | 0.4523 | ns |
| Tetrahydrofuran | $C_4H_8O$ | 73.06 | 7.37 | 0.97 ± 0.05 | 0.80 ± 0.09 | 0.0504 | ns |
| α-Pinene-2-oxide | $C_{10}H_{16}O$ | 153.13 | 7.79 | 0.85 ± 0.24 | 3.14 ± 0.41 | 0.0011 | ** |

**Table S2**. Identification of volatile organic compounds (VOCs) detected in in the two honey samples analyzed (2021 and 2022). Rt=retention time; values are in ppm.

| Compounds | CAS | RT | 2021 | 2022 | p-value | Signific. Code |
|---|---|---|---|---|---|---|
| *Alcohols* | | | | | | |
| Ethanol | 64-17-5 | 3.77 | 4.01 ± 0.14 | 1.57 ± 0.06 | <0.0001 | *** |
| 2-butanol | 78-92-2 | 6.5 | 1.55 ± 0.15 | 0.75 ± 0.02 | 0.0008 | ** |
| 1-propanol | 71-23-8 | 7.05 | 5.39 ± 1.45 | 3.27 ± 0.06 | 0.0646 | ns |
| 2-methylbut-3-en-2-ol | 115-18-4 | 7.25 | 4.40 ± 1.22 | 2.35 ± 0.22 | 0.0457 | * |
| Isobutanol | 78-83-1 | 10.14 | 0.55 ± 0.02 | 0.42 ± 0.03 | 0.0032 | ** |
| 2-pentanol | 6032-29-7 | 11.51 | 0.13 ± 0.01 | 0.11 ± 0.01 | 0.0818 | ns |
| 1-butanol | 71-36-3 | 12.57 | 0.92 ± 0.06 | 0.70 ± 0.01 | 0.0030 | ** |
| 2-hexanol | 626-93-7 | 13.72 | 0.06 ± 0.01 | 0.07 ± 0.01 | 0.2197 | ns |
| 3-methyl-1-butanol | 123-51-3 | 15.34 | 12.83 ± 1.06 | 8.62 ± 0.36 | 0.0029 | ** |
| 3-methyl-3-buten-1-ol | 763-32-6 | 16.71 | 4.73 ± 0.04 | 4.54 ± 0.26 | 0.2825 | ns |
| 2-methyl-but-2-ene-1-ol | 4675-87-0 | 19.21 | 2.10 ± 0.22 | 0.68 ± 0.22 | 0.0014 | ** |
| 3-pentanol | 584-02-1 | 19.36 | 0.39 ± 0.02 | 0.71 ± 0.07 | 0.0013 | ** |
| 1-hexanol | 111-27-3 | 20.34 | 5.20 ± 1.00 | 4.31 ± 0.54 | 0.2455 | ns |
| 3-hexen-1-ol | 544-12-7 | 21.07 | 10.41 ± 2.32 | 5.57 ± 0.63 | 0.0251 | * |
| *p*-cymen-7-ol | 536-60-7 | 30.41 | 0.80 ± 0.02 | 0.48 ± 0.03 | <0.0001 | *** |
| 2-phenylethanol | 60-12-8 | 31.6 | 9.70 ± 2.11 | 3.58 ± 0.26 | 0.0075 | ** |
| *Aldehydes* | | | | | | |
| 2-methylbutanal | 96-17-3 | 3.33 | 2.13 ± 0.48 | 1.74 ± 0.17 | 0.2629 | ns |
| 3-methylbutanal | 590-86-3 | 3.4 | 0.96 ± 0.06 | 1.05 ± 0.11 | 0.2782 | ns |
| Hexanal | 66-25-1 | 8.94 | 1.00 ± 0.08 | 0.55 ± 0.11 | 0.0048 | ** |
| 2-methyl-2-butenal | 1115-11-3 | 9.26 | 4.49 ± 0.19 | 3.71 ± 0.02 | 0.0020 | ** |
| Heptanal | 111-71-7 | 14.02 | 0.08 ± 0.01 | 0.06 ± 0.02 | 0.0894 | ns |
| 3-methyl-2-butenal | 107-86-8 | 14.45 | 1.97 ± 0.57 | 1.84 ± 0.28 | 0.7419 | ns |
| 2-hexenal | 645-62-5 | 15.19 | 0.93 ± 0.13 | 0.90 ± 0.19 | 0.8301 | ns |
| Octanal | 124-13-0 | 17.95 | 0.22 ± 0.02 | 1.00 ± 0.07 | <0.0001 | *** |
| Furfural | 98-01-1 | 22.57 | 8.16 ± 1.00 | 4.45 ± 0.27 | 0.0035 | ** |
| Benzaldehyde | 100-52-7 | 23.84 | 10.84 ± 0.40 | 11.71 ± 0.17 | 0.0250 | * |
| 2-furanacetaldehyde | 15022-16-9 | 25.27 | 0.59 ± 0.05 | 1.76 ± 0.07 | <0.0001 | *** |
| Phenylacetaldehyde | 122-78-1 | 26.37 | 1.09 ± 0.32 | 0.76 ± 0.01 | 0.1509 | ns |
| 4,5-dimethylfurfural | 52480-43-0 | 32.16 | 2.67 ± 0.61 | 3.12 ± 0.23 | 0.2970 | ns |
| Cinnamaldehyde | 14371-10-9 | 32.81 | 0.71 ± 0.17 | 0.57 ± 0.04 | 0.2483 | ns |
| 3,4-dimethoxy-benzaldehyde | 120-14-9 | 37.07 | 0.10 ± 0.03 | 0.70 ± 0.02 | <0.0001 | *** |
| *Ketones* | | | | | | |
| Acetone | 67-64-1 | 2.25 | 2.84 ± 0.35 | 1.38 ± 0.15 | 0.0026 | ** |
| 2-butanone | 78-93-3 | 3.13 | 13.78 ± 0.48 | 11.05 ± 0.86 | 0.0087 | ** |
| 2,3-butanedione | 431-03-8 | 4.82 | 1.08 ± 0.14 | 0.92 ± 0.05 | 0.1352 | ns |
| 3-penten-2-one | 3102-33-8 | 5.04 | 0.77 ± 0.11 | 0.80 ± 0.02 | 0.7421 | ns |
| 2,3-pentanedione | 600-14-6 | 8.14 | 0.14 ± 0.01 | 0.19 ± 0.01 | 0.0032 | ** |
| 2-heptanone | 110-43-0 | 13.86 | 0.10 ± 0.03 | 0.36 ± 0.46 | 0.3868 | ns |

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|---|---|---|---|---|---|---|
| cyclohexanone | 108-94-1 | 17.46 | 0.26 ± 0.05 | 0.09 ± 0.03 | 0.0074 | ** |
| 3-hydroxy-2-butanone | 51555-24-9 | 17.6 | 1.07 ± 0.01 | 0.95 ± 0.24 | 0.4411 | ns |
| Hydroxyacetone | 116-09-6 | 18.05 | 2.28 ± 0.21 | 2.30 ± 0.38 | 0.9555 | ns |
| 2-furyl methyl ketone | 1192-62-7 | 23.48 | 0.56 ± 0.05 | 0.64 ± 0.08 | 0.2049 | ns |
| Ketoisophorone | 1125-21-9 | 27.38 | 1.65 ± 0.24 | 1.45 ± 0.03 | 0.2298 | ns |
| *Carboxylic acids* | | | | | | |
| Acetic acid | 64-19-7 | 21.73 | 333.11 ± 14.10 | 292.41 ± 4.58 | 0.0089 | ** |
| Formic acid | 64-18-6 | 23.29 | 3.04 ± 0.12 | 2.19 ± 0.08 | 0.0006 | ** |
| Propanoic acid | 79-09-4 | 24.13 | 26.06 ± 1.60 | 26.08 ± 0.47 | 0.9855 | ns |
| Isobutyric acid | 79-31-2 | 24.88 | 9.76 ± 1.37 | 9.95 ± 0.22 | 0.8214 | ns |
| Butyric acid | 107-92-6 | 26.13 | 4.95 ± 0.82 | 4.86 ± 0.42 | 0.8772 | ns |
| 2-methylbutanoic acid | 116-53-0 | 26.99 | 32.33 ± 2.09 | 28.41 ± 0.52 | 0.0346 | * |
| Pentanoic acid | 109-52-4 | 28.3 | 0.60 ± 0.01 | 0.55 ± 0.08 | 0.3083 | ns |
| 3-methyl-2-butenoic acid | 541-47-9 | 29.36 | 1.92 ± 0.28 | 1.47 ± 0.09 | 0.0576 | ns |
| 4-methylpentanoic acid | 646-07-1 | 29.53 | 0.30 ± 0.03 | 0.11 ± 0.01 | 0.0004 | ** |
| Caproic acid | 142-62-1 | 30.3 | 6.53 ± 0.04 | 5.90 ± 0.44 | 0.0691 | ns |
| Heptanoic acid | 111-14-8 | 31.94 | 2.56 ± 0.28 | 1.87 ± 0.44 | 0.0835 | ns |
| 3-hexenoic acid | 1577-18-0 | 31.97 | 2.25 ± 0.35 | 2.09 ± 0.31 | 0.5958 | ns |
| 2-hexenoic acid | 1191-04-4 | 32.06 | 2.41 ± 0.30 | 1.27 ± 0.05 | 0.0029 | ** |
| Octanoic acid | 124-07-2 | 33.03 | 3.68 ± 1.46 | 1.02 ± 0.69 | 0.0461 | * |
| Nonanoic acid | 112-05-0 | 34.1 | 5.37 ± 2.30 | 3.14 ± 0.83 | 0.1894 | ns |
| Benzoic acid | 65-85-0 | 37.79 | 2.08 ± 0.39 | 1.97 ± 0.06 | 0.6523 | ns |
| *Esters* | | | | | | |
| Methyl acetate | 79-20-9 | 2.37 | 0.41 ± 0.05 | 0.59 ± 0.07 | 0.0240 | * |
| Ethyl acetate | 141-78-6 | 3 | 1.45 ± 0.03 | 0.43 ± 0.05 | <0.0001 | *** |
| Propyl acetate | 109-60-4 | 4.73 | 0.88 ± 0.05 | 0.47 ± 0.05 | 0.0005 | ** |
| 2-methylbutyl acetate | 624-41-9 | 11.19 | 0.19 ± 0.02 | 0.10 ± 0.01 | 0.0020 | ** |
| Isoamyl acetate | 123-92-2 | 11.27 | 0.36 ± 0.06 | 0.16 ± 0.02 | 0.0040 | ** |
| 4-pentenyl acetate | 1576-85-8 | 14.72 | 0.11 ± 0.02 | 0.13 ± 0.02 | 0.3512 | ns |
| *cis*-3-hexenyl acetate | 3681-71-8 | 18.93 | 0.06 ± 0.01 | 0.10 ± 0.01 | 0.0060 | ** |
| Ethyl lactate | 97-64-3 | 19.65 | 0.13 ± 0.01 | 0.07 ± 0.01 | 0.0062 | ** |
| γ-valerolactone | 108-29-2 | 25.58 | 2.94 ± 0.59 | 2.18 ± 0.05 | 0.0896 | ns |
| 4-methyl-4-vinylbutyrolactone | 1073-11-6 | 26.83 | 1.27 ± 0.32 | 0.85 ± 0.09 | 0.0924 | ns |
| (*D*)-pantolactone | 599-04-2 | 32.7 | 1.30 ± 0.33 | 1.59 ± 0.09 | 0.2142 | ns |
| (*R*)-(-)-massoilactone | 51154-96-2 | 34.84 | 0.34 ± 0.06 | 1.25 ± 0.10 | 0.0002 | *** |
| *Terpenes* | | | | | | |
| Citral | 5392-40-5 | 15.47 | 2.89 ± 0.33 | 3.24 ± 0.46 | 0.3311 | ns |
| Herboxide | 13679-86-2 | 16.4 | 0.12 ± 0.02 | 0.21 ± 0.01 | 0.0049 | ** |
| *trans*-linalool oxide | 34995-77-2 | 22.83 | 1.35 ± 0.20 | 0.96 ± 0.03 | 0.0296 | * |
| Linalool | 78-70-6 | 24.67 | 3.36 ± 0.95 | 4.71 ± 0.15 | 0.0714 | ns |
| Hotrienol | 20053-88-7 | 25.94 | 7.73 ± 1.12 | 6.74 ± 0.18 | 0.2019 | ns |
| α-terpineol | 98-55-5 | 27.61 | 0.84 ± 0.13 | 0.64 ± 0.06 | 0.0817 | ns |
| Nerolic acid | 4613-38-1 | 35.97 | 0.64 ± 0.11 | 0.32 ± 0.02 | 0.0076 | ** |
| *Others* | | | | | | |
| Octane | 111-65-9 | 2.18 | 0.65 ± 0.10 | 0.70 ± 0.12 | 0.6492 | ns |
| 2-methoxy-2-methylpropane | 1634-04-4 | 1.7 | 1.42 ± 0.03 | 1.68 ± 0.04 | 0.0011 | ** |
| Dimethyl sulfide | 75-18-3 | 1.9 | 5.43 ± 0.56 | 2.68 ± 0.16 | 0.0012 | ** |
| Dimethyldisulfide | 624-92-0 | 8.28 | 0.67 ± 0.02 | 0.19 ± 0.04 | <0.0001 | *** |

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|---|---|---|---|---|---|---|
| 2,5-dimethylpyrazine | 123-32-0 | 18.81 | 0.07 ± 0.01 | 0.33 ± 0.06 | 0.0021 | ** |
| 2,6-dimethylpyrazine | 108-50-9 | 19.02 | 0.09 ± 0.02 | 0.15 ± 0.02 | 0.0215 | * |
| 2-ethyl-3-methylmaleic anhydride | 3552-33-8 | 28.2 | 1.30 ± 0.57 | 1.05 ± 0.19 | 0.5131 | ns |
| 2-methoxy-4-vinylphenol | 7786-61-0 | 34.41 | 0.82 ± 0.13 | 0.59 ± 0.06 | 0.0489 | * |