Table S1. Tentative LC-ESI-QTOF-MS metabolite screening of S. sparsipilosa extracts

	Molecules	R.T.	Chemical Formula	Mass	MES	EAS	DES
	Flavonoid glycosides						
1	3,4',6'-Trihydroxy-4,2'-dimethoxychalcone 4'-O-rutinoside	8.716	$C_{29}H_{36}O_{15}$	624.205	-	+	+
2	8-C-Galactosylluteolin	8.913	$C_{21}H_{20}O_{11}$	448.1004	+	-	+
3	8-Hydroxyluteolin 4'-methyl ether 7-(6'''- acetylallosyl-(1->2)-glucoside	11.699	$C_{30}H_{34}O_{18}$	682.1738	-	+	-
4	8-Hydroxyluteolin 7-[6''' acethylallosyl-(1->2)-3''-acetylglucoside]	11.924	$C_{31}H_{34}O_{19}$	710.169	-	+	-
5	8-Prenylquercetin 7,4'-dimethyl ether 3-rhamnosyl-(1->4) rhamnoside	14.496	$C_{34}H_{42}O_{15}$	690.2512	+	-	-
6	Apigenin 7-glucoside	10.028	$C_{21}H_{20}O_{10}$	432.1055	+	-	-
7	Dillenetin 5-glucoside-7 glucuronide	9.354	$C_{29}H_{32}O_{18}$	668.1581	+	+	-
8	Hesperetin 7-(2,6-dirhamnosylglucoside)	8.624	$C_{34}H_{44}O_{19}$	756.2469	+	-	-
9	Kaempferol 3-(4'',6''-diacetylglucoside)-7-rhamnoside	12.541	$C_{31}H_{34}O_{17}$	678.1794	-	+	-
10	Kaempferol 3-O-β-Dglucosyl-(1->2)-β-Dglucoside	9.194	$C_{27}H_{30}O_{16}$	610.1525	-	-	+
11	Luteolin 7-(6'''-acetylallosyl-(1->2)-glucoside)	9.343	$C_{29}H_{32}O_{17}$	652.1636	+	-	-
12	Luteolin 7-neohesperidoside	6.828	$C_{27}H_{30}O_{15}$	594.1575	+	-	-
13	Patuletin 3-(4''-acetylrhamnoside)-7-(3''',4'''- diacetylrhamnoside)	11.476	$C_{34}H_{38}O_{19}$	750.2002	+	-	-
14	Patuletin 3-rhamnoside- 7-(3''',4'''-diacetylrhamnoside)	5.705	$C_{32}H_{36}O_{18}$	708.1895	+	-	-
15	Quercetin 3-(2''',3''',4'''- triacetyl-alpha-Larabinopyranosyl)(1->6)-glucoside	10.128	$C_{32}H_{34}O_{19}$	722.1723	-	+	-
16	Quercetin 3-(3'',4'' diacetylrhamnosyl)-(1>6)glucoside	11.868	$C_{31}H_{34}O_{18}$	694.1739	+	+	-
17	Kaempferol 3-(6'' sulfatogetiobioside)	9.511	$C_{27}H_{30}O_{19}S$	690.1102	+	-	-
18	Kaempferol 7-methyl ether 3-[3-hydroxy-3- methylglutaryl-(1->6)]-[apiosyl-(1->2)- galactoside]	8.905	$C_{33}H_{38}O_{19}$	738.1978	+	-	-
19	Butyl 4'-O hexadecanoylneohesperidoside	32.515	$C_{32}H_{60}O_{11}$	620.4165	+	-	-
20	Quercetin 3-O-glucoside	8.557	$C_{21}H_{20}O_{12}$	464.095	+	-	-
21	Isorhamnetin 3-(4''',6'''-diacetylglucosyl) (1->3)- galactoside	11.419	$C_{32}H_{36}O_{19}$	724.1844	+	+	-
22	Rhamnetin 3-sophoroside	9.747	$C_{28}H_{32}O_{17}$	640.1635	+	-	-
23	(-)-Matairesinol 4'- [apiosyl-(1->2)-glucoside]	11.823	$C_{31}H_{40}O_{15}$	652.2361	-	+	-
24	1-Octen-3-yl primeveroside	11.026	$C_{19}H_{34}O_{10}$	422.2149	-	+	-
25	2'',3''-Di-O-pcoumaroylafzelin	16.82	$C_{39}H_{32}O_{14}$	724.1781	+	-	-
26	4',6'-Dihydroxy-2'-methoxyacetophenone 6'-glucoside	6.379	$C_{15}H_{20}O_{9}$	344.1108	+	-	-
27	Platycarpanetin 7-Olaminaribioside	10.678	$C_{30}H_{34}O_{17}$	666.1791	+	+	+
28	6,8-Di-C-glucopyranosyltricetin	8.434	$C_{27}H_{30}O_{17}$	626.1477	+	-	-
	Flavonoids & Polyphenols						

29	Myricetin 3,7,3',4'-tetramethyl ether	17.593	$C_{19}H_{18}O_8$	374.0998	+	+	+
30	Rutin	8.464	$C_{27}H_{30}O_{16}$	610.1525	-	-	+
31	Procyanidin B1	13.227	$C_{30}H_{26}O_{12}$	578.1418	+	-	-
32	Prosogerin E	16.862	$C_{18}H_{16}O_7$	344.0897	-	-	+
33	Tecostanine	13.168	$C_{11}H_{21}NO$	183.1627	-	-	+
34	Tephcalostan	15.537	$C_{21}H_{14}O_6$	362.0789	-	-	+
	Phenylpropanoid Glycosides						
35	Verbasoside	3.728	$C_{20}H_{30}O_{12}$	462.1732	+	+	-
36	Verbaspinoside	9.78	$C_{30}H_{38}O_{15}$	638.2206	+	+	+
37	Isoacteoside	8.826	$C_{29}H_{36}O_{15}$	624.2064	-	+	-
38	Miconioside A	9.633	$C_{29}H_{36}O_{14}$	608.2099	-	+	-
	Phenolic Acids & Derivatives						
39	Chlorogenic acid	4.357	$C_{16}H_{18}O_9$	354.0947	+	+	+
40	5Z-Caffeoylquinic acid	5.264	$C_{16}H_{18}O_9$	354.0951	+	-	+
	Terpenoids & Derivatives						
41	(10S)-Juvenile hormone	19.298	$C_{16}H_{28}O_4$	284.1985	-	-	+
42	(3S,5R,6R,7E)-3,5,6-Trihydroxy-7-megastigmen-9-one	15.225	$C_{13}H_{22}O_4$	242.1521	+	+	+
43	1,2-Epoxy-1,2,7,7',8,8',11,12-octahydro-psicarotene	27.305	$C_{40}H_{62}O$	558.4816	-	+	+
44	2'-Dehydroplectaniaxanthin	26.528	$C_{40}H_{54}O_2$	566.4097	-	-	+
45	5a,6a-Epoxy-7Emegastigmene 3b,9ediol-9-glucoside	6.716	$C_{19}H_{32}O_8$	388.2097	+	-	-
46	9-Hydroxy-7- megastigmen-3-one glucoside	8.961	$C_{19}H_{32}O_7$	372.2146	+	-	-
47	Arjunolic acid	18.368	$C_{30}H_{48}O_5$	488.3494	+	+	+
48	Chukrasin methyl ether	26.979	$C_{43}H_{58}O_{16}$	830.3705	-	+	-
49	Ginsenoside Rh4	34.097	$C_{36}H_{60}O_8$	620.4268	+	+	+
50	Juvabione	17.21	$C_{16}H_{26}O_3$	266.1883	-	-	+
51	Kurilensoside F	24.284	$C_{33}H_{58}O_{11}$	630.3964	-	+	+
52	Marasmene	22.217	$C_{15}H_{22}O_2$	234.1622	-	-	+
53	Notoginsenoside R10	26.09	$C_{30}H_{50}O_9$	554.3447	-	+	+
54	Perilloside A	17.526	$C_{16}H_{26}O_6$	314.1728	-	+	+
55	Perilloside C	17.985	$C_{16}H_{28}O_6$	316.1885	+	+	+
56	Theasapogenol A	23.095	$C_{30}H_{50}O_6$	506.36	-	+	+
57	3-trans-p-Coumaroylrotundic acid	21.936	$C_{39}H_{54}O_7$	634.3861	-	-	+
58	Germanaism E	10.373	$C_{29}H_{32}O_{16}$	636.1689	+	-	+
59	Katonic acid	27.044	$C_{30}H_{48}O_3$	456.3595	-	-	+
60	S-Farnesyl Thioacetic Acid	19.795	$C_{17}H_{28}O_2S$	296.1805	+	-	+
	Iridoids & Derivatives						
61	Sarmentosin epoxide	1.316	$C_{11}H_{17}NO_8$	291.0954	+	-	-
62	Undulatoside A	6.817	$C_{16}H_{18}O_9$	354.0951	+	-	-
63	10-Hydroxymorroniside	4.583	$C_{17}H_{26}O_{12}$	422.1419	+	-	-
	Lactones & Derivatives						
64	2-Carboxy-4-dodecanolide	16.705	$C_{13}H_{22}O_4$	242.1522	-	+	+
65	11-Dodecanolide	16.695	$C_{12}H_{22}O_2$	198.1622	-	+	+
66	3-Hydroxy-4-butanolide	3.122	$C_{10}H_{16}O_8$	264.0844	-	+	-
	Alkaloids & Organic Nitrogen Compounds						
67	8-Methyl-5-propyloctahydroindolizin-8-ol	14.629	$C_{12}H_{23}NO$	197.1778	+	+	+
68	Dipiperamide D	16.694	$C_{36}H_{40}N_2O_6$	596.2868	-	-	+
69	Glutathionylspermine	22.273	$C_{20}H_{41}N_7O_5S$	491.2905	-	-	+
70	N1,N5,N10-Tricoumaroyl spermidine	13.508	$C_{34}H_{37}N_3O_6$	583.2672	+	-	-

71	Lisuride	23.163	$C_{20}H_{26}N_4O$	338.212	+	-	-
72	Psilocybin	12.44	$C_{12}H_{17}N_2O_4P$	284.0936	-	+	+
73	Sunitinib	30.606	$C_{22}H_{27}FN_4O_2$	398.2114	+	+	+
74	Termitomycamide B	23.227	$C_{28}H_{40}N_2O_2$	436.3077	-	-	+
75	Lactapiperanol C	18.873	$C_{16}H_{26}O_4$	282.1828	-	+	+
76	Nisoldipine	25.161	$C_{20}H_{24}N_2O_6$	388.1626	+	+	+
	Fatty Acids & Derivatives						
77	(E)-octadec-9-en-12-ynoic acid	26.452	$C_{18}H_{30}O_2$	278.2242	+	+	+
78	(Z)-5-Hexadecenoic acid	29.29	$C_{16}H_{30}O_2$	254.2245	-	-	+
79	11,12,13-trihydroxy-9-octadecenoic acid	14.609	$C_{18}H_{34}O_5$	330.2406	+	-	-
80	11-chloro-12-hydroxyoctadecanoic acid	28.045	$C_{18}H_{35}ClO_3$	334.2261	-	+	-
81	14,17-Octadecadiynoic acid	20.735	$C_{18}H_{28}O_2$	276.2091	-	+	+
82	2-Hydroxyhexadecanoic acid	26.742	$C_{16}H_{32}O_3$	272.235	+	-	+
83	3R-hydroxy-eicosanoic acid	33.379	$C_{20}H_{40}O_3$	328.2969	+	-	-
84	9(E),11(E)-Conjugated Linoleic Acid	27.988	$C_{18}H_{32}O_2$	280.2401	+	+	+
85	9,10-dichlorooctadecanoic acid	20.14	$C_{18}H_{34}Cl_2O_2$	352.193	-	-	+
86	9,12,13-trihydroxy- 10,15-octadecadienoic acid	13.776	$C_{18}H_{32}O_5$	328.2249	-	+	-
87	9-Hexadecenoic acid, 10- methyl-alpha-kamlolenic acid	20.567	$C_{17}H_{32}O_2$	268.2402	-	-	+
88	9-hydroperoxy-10E,12,15Zoctadecatrienoic acid	15.649	$C_{18}H_{30}O_4$	310.2144	-	-	+
89	9S-hydroxy-octadecanoic acid	29.605	$C_{18}H_{36}O_3$	300.2662	+	+	+
90	DL-2-hydroxy stearic acid	30.225	$C_{18}H_{36}O_3$	300.2662	+	-	-
91	Octadecanedioic acid	19.457	$C_{18}H_{34}O_4$	314.245	+	+	+
92	Stearidonic Acid	20.681	$C_{18}H_{28}O_2$	276.2089	-	+	-
93	Undecanoic acid	15.986	$C_{11}H_{22}O_2$	186.1619	-	-	+
94	alpha-licanic acid	21.319	$C_{18}H_{28}O_3$	292.2039	-	+	+
95	cis-9,10-Epoxystearic acid	25.753	$C_{18}H_{34}O_3$	298.2505	+	+	+
96	10-hydroxy-2E-decenoic acid	13.945	$C_{10}H_{18}O_3$	186.1258	-	+	-
97	7-hydroxy-10-heptadecen-8-ynoic acid	22.554	$C_{17}H_{30}O_3$	282.2193	-	+	+
98	9-Keto heptadecylic acid	21.644	$C_{17}H_{32}O_3$	284.235	-	+	+
99	9S,10R-Epoxy-3Z,6Zoctadecadiene	23.654	$C_{17}H_{30}O$	250.2298	-	+	+
100	Ambrettolic acid	24.462	$C_{16}H_{30}O_3$	270.2193	-	+	+
101	2-hydroxy behenic acid	30.749	$C_{22}H_{44}O_3$	356.3282	+	+	+
102	Butyl dodecanoate	29.439	$C_{16}H_{32}O_2$	256.2399	+	-	-
103	3R-hydroxy-5Z-dodecenoic acid	13.898	$C_{12}H_{22}O_3$	214.1572	+	-	+
104	Lesquerolic acid	25.697	$C_{20}H_{38}O_3$	326.2816	+	+	+
105	Eicosanedioic acid	31.457	$C_{20}H_{38}O_4$	342.2766	-	+	+
106	Docosanedioic acid	26.517	$C_{22}H_{42}O_4$	370.3083	-	+	+
107	Undecanedioic acid	13.797	$C_{11}H_{20}O_4$	216.1362	-	-	+
108	alpha-kamlolenic acid	20.848	$C_{18}H_{30}O_3$	294.2196	+	+	+
109	cis-6,7-epoxy-9Z-heptadecene	27.269	$C_{17}H_{32}O$	252.245	+	-	+
110	α-Linolenic Acid	26.405	$C_{18}H_{30}O_2$	278.2246	-	-	+
	Lipids & Derivatives						
111	C16 Sphinganine-1-phosphate	16.034	$C_{16}H_{36}NO_5P$	353.2326	+	-	-

112	Ganglioside GM3 (d18:1/23:0)	27.653	$C_{64}H_{118}N_2O_{21}$	1250.8245	-	+	-
113	Gingerglycolipid A	19.279	$C_{33}H_{56}O_{14}$	676.3659	+	-	-
114	Glycerol tripropanoate	12.317	$C_{12}H_{20}O_6$	260.1259	-	+	+
115	1,2-Dioctanoyl-snglycerol	20.188	$C_{19}H_{36}O_5$	344.2561	+	-	-
	Carbohydrate Derivatives						
116	2(α-D-Mannosyl)-Dglycerate	1.606	$C_9H_{16}O_9$	268.0795	-	+	-
117	2,3-Dioxogulonic acid	1.81	$C_6H_8O_7$	192.0271	+	-	-
118	D-Fructosyl-Dfructofuranose	1.204	$C_{12}H_{22}O_{11}$	342.1166	+	-	-
119	D-Gal α 1->6D-Gal α 1- >6D-Glucose	1.159	$C_{18}H_{32}O_{16}$	504.1686	+	-	-
120	2D-5-O-Methyl-2,3,5/4,6-pentahydroxycyclohexanone	4.467	$C_7H_{12}O_6$	192.0633	-	-	+
121	Hydroxypropyl methyl cellulose	16.751	$C_{25}H_{44}O_{21}$	680.2386	-	+	-
122	2D-5-O-Methyl-pentahydroxycyclohexan	4.121	$C_7H_{12}O_6$	192.0633	-	+	-
123	Acetyl-maltose	1.137	$C_{14}H_{24}O_{12}$	384.1268	+	-	+
124	Sucrose	1.215	$C_{12}H_{22}O_{11}$	342.1163	+	-	-
125	Fagopyritol A3	1.148	$C_{24}H_{42}O_{21}$	666.2216	+	-	+
126	Isomaltulose	1.191	$C_{12}H_{22}O_{11}$	342.116	+	+	+
	Organic Acids						
127	3-Hydroxytetradecanedioic acid	16.143	$C_{14}H_{26}O_5$	274.1778	-	-	+
128	3-Methylsuberic acid	10.241	$C_9H_{16}O_4$	188.1051	+	+	+
129	5-Heptyltetrahydro-2-oxo-3 furancarboxylic acid	13.935	$C_{12}H_{20}O_4$	228.1364	+	-	-
130	Azelaic acid	10.081	$C_9H_{16}O_4$	188.1053	-	-	+
131	Malic acid	1.305	$C_4H_6O_5$	134.0216	+	+	+
132	N-Undecylbenzenesulfonic acid	25.912	$C_{17}H_{28}O_3S$	312.1759	-	+	+
133	Pyroglutamic acid	1.709	$C_5H_7NO_3$	129.0425	+	-	-
134	Quinic acid	4.759	$C_7H_{12}O_6$	192.063	+	-	+
135	Sebacic acid	12.113	$C_{10}H_{18}O_4$	202.1204	-	-	+
136	Traumatic Acid	15.303	$C_{12}H_{20}O_4$	228.1364	-	+	+
137	(R)-(+)-2-Pyrrolidone-5- carboxylic acid	2.102	$C_5H_7NO_3$	129.0423	+	-	-
	Other Organic Compounds						
138	2,2-Dichloro-1,1-ethanediol	22.082	$C_2H_4Cl_2O_2$	129.9582	-	-	+
139	2-chloro-3-Deazaadenosine	3.178	$C_{11}H_{13}ClN_4O_4$	300.0613	-	+	-
140	Dinitrochlorobenzene	1.773	$C_6H_3ClN_2O_4$	201.979	-	-	+
141	Avocadene acetate	19.435	$C_{19}H_{36}O_4$	328.2607	+	+	+
142	Avocadyne 1-acetate	28.438	$C_{19}H_{34}O_4$	326.2454	-	+	-
143	(2E)-4-hydroxy-3-methylbut-2-en-1-yl trihydrogen diphosphate	3.403	$C_5H_{12}O_8P_2$	261.9998	-	+	-
144	3,8-Dimethyldec-7-en-1-yl trihydrogen diphosphate	13.946	$C_{12}H_{26}O_7P_2$	344.1146	+	-	-
145	N1-(5-Phospho-a-Dribosyl)-5,6-dimethylbenzimidazole	13.878	$C_{14}H_{19}N_2O_7P$	358.0941	-	+	-
	Eicosanoids						
146	(±)5,6-DHET	27.932	$C_{20}H_{34}O_4$	338.2449	+	-	+
147	(±)9-HpODE	17.771	$C_{18}H_{32}O_4$	312.2299	+	+	+
148	10S-HODE	21.914	$C_{18}H_{32}O_3$	296.235	+	+	+
149	11β-13,14-dihydro-15-keto PGF2α	21.981	$C_{20}H_{34}O_5$	354.24	+	-	+
150	11β-Prostaglandin F1β	23.149	$C_{20}H_{36}O_5$	356.2575	-	-	+
151	12R-HOME(13Z)	27.696	$C_{18}H_{34}O_3$	298.2519	-	-	+
152	15(S)-HpEDE	29.436	$C_{20}H_{36}O_4$	340.2611	+	+	+

153	15-deoxy-Δ12,14-Prostaglandin J2-biotin	20.813	$C_{35}H_{54}N_4O_4S$	626.3855	-	-	+
154	17,20-dimethyl Prostaglandin F1α	25.125	$C_{22}H_{40}O_5$	384.287	-	+	+
155	5S-HETE diendoperoxide	19.175	$C_{20}H_{34}O_8$	402.225	-	+	+
156	9,11-methane-epoxy PGF1α	26.294	$C_{21}H_{36}O_4$	352.261	-	+	-
157	9-HOME(10E)	27.977	$C_{18}H_{34}O_3$	298.2507	+	+	+
158	9-OxoODE	23.16	$C_{18}H_{30}O_3$	294.2194	-	-	+
159	9-OxoOTrE	21.88	$C_{18}H_{28}O_3$	292.204	-	-	+
160	19(R)-hydroxy-PGF1α	17.109	$C_{20}H_{36}O_6$	372.2507	+	+	+
161	Misoprostol	26.18	$C_{22}H_{38}O_5$	382.2715	-	+	+
162	Prostaglandin D2-d9	19.009	$C_{20}H_{23}D_9O_5$	361.2819	+	-	-
163	PGF1α	22.307	$C_{20}H_{36}O_5$	356.256	+	+	+
	Macrolide / Antibiotic						
164	6-Deoxyerythronolide B	22.927	$C_{21}H_{38}O_6$	386.2662	+	-	-
165	Antimycin A1	19.402	$C_{28}H_{40}N_2O_9$	548.2736	+	-	-
166	Mupirocin	21.085	$C_{26}H_{44}O_9$	500.2977	-	+	+

Annotations are database-based tentative matches and do not imply confirmed presence

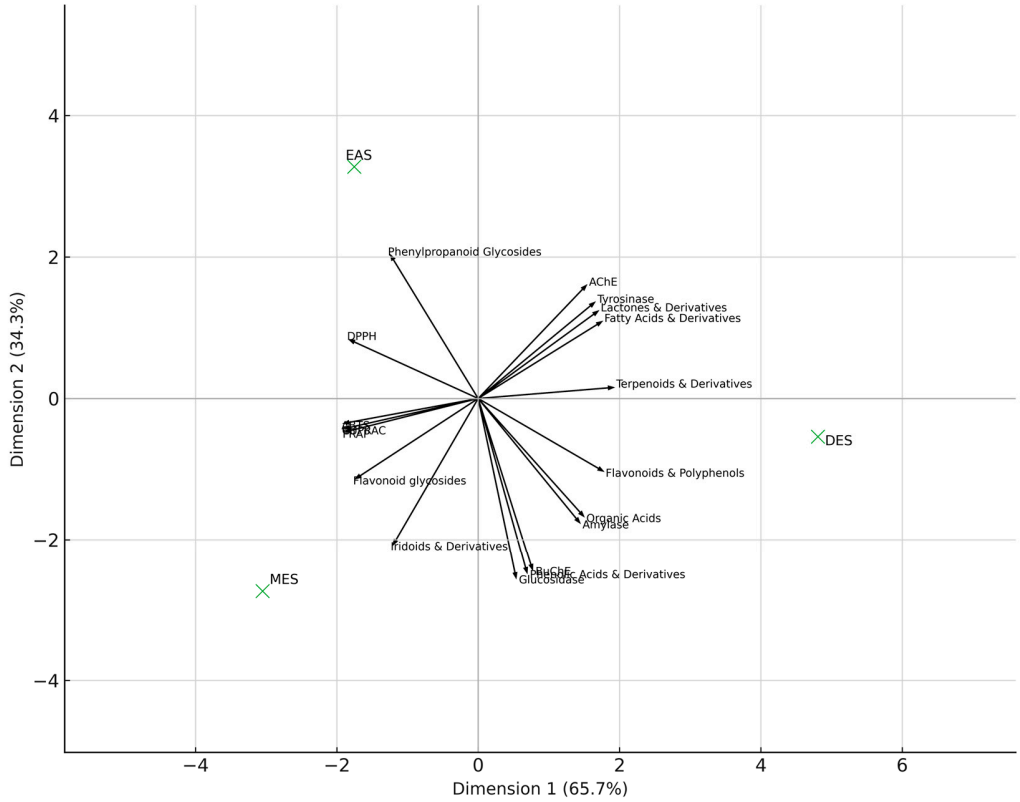


Figure S1. Exploratory Principal Component Analysis (PCA) based on metabolite-class distribution derived from the untargeted LC–MS annotations of MES, EAS, and DES. The analysis was performed using the number of annotated metabolites per chemical class rather than quantitative feature-intensity values. The plot illustrates compositional trends among the extracts and does not represent intensity-based metabolomic profiling.

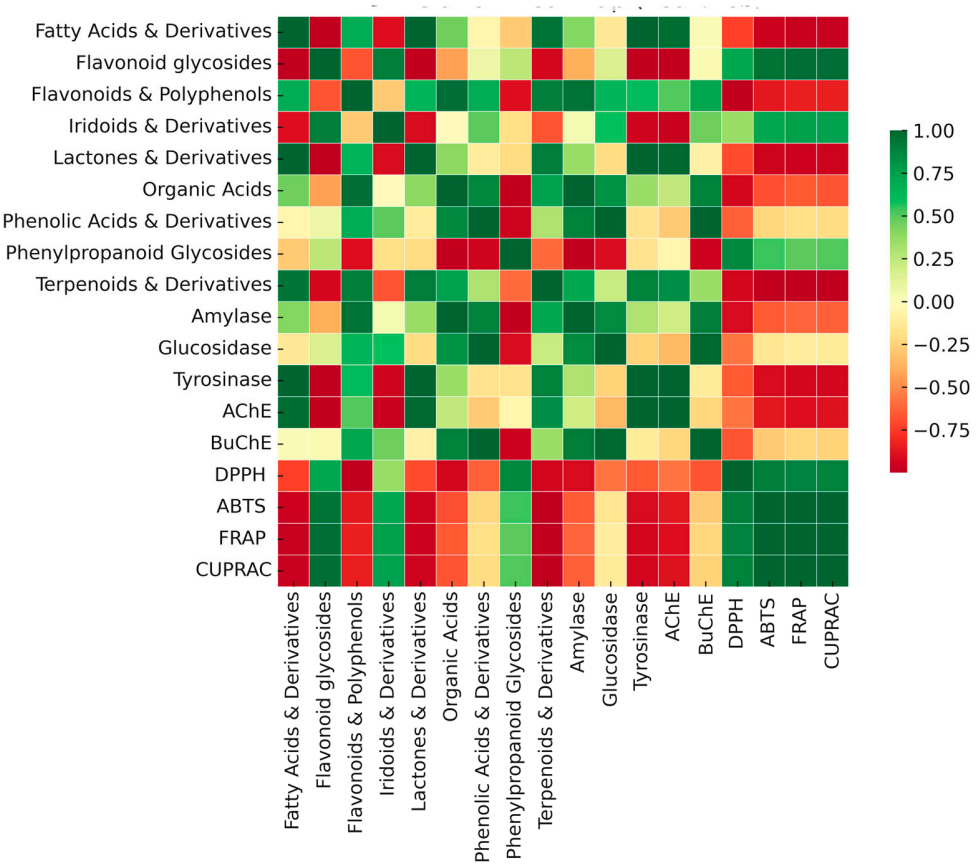


Figure S2. Exploratory heatmap illustrating associations between metabolite-class distribution (number of annotated metabolites per class) and measured biological activities. The visualization is based on occurrence data from the untargeted LC–MS annotations and is intended to provide an overview of compositional trends rather than quantitative correlation analysis.