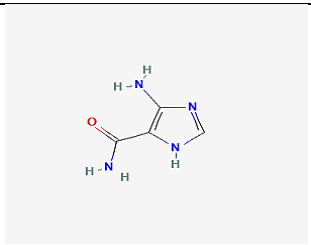
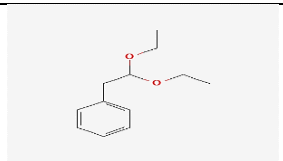
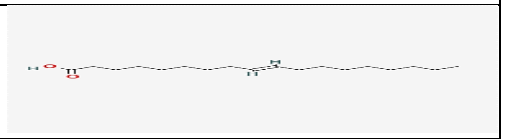
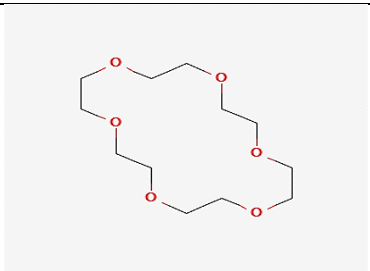
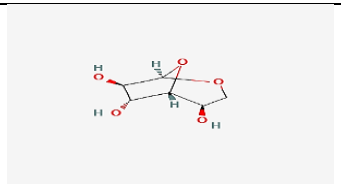
Supplementary Materials

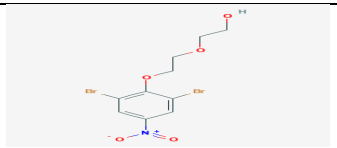
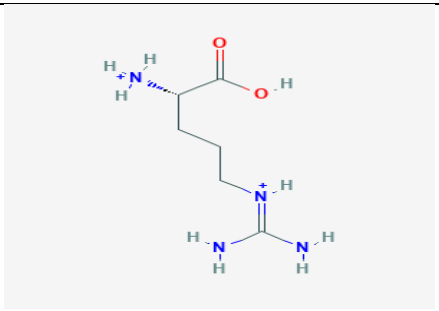
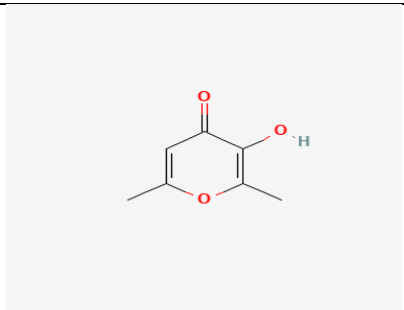
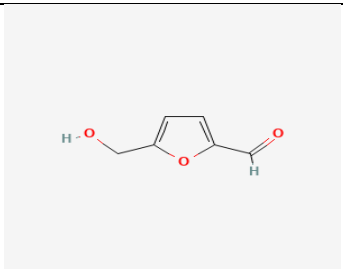
GC-MS, antibacterial, antibiofilm, and anticancer properties against MCF–7 and HEPG2 cell lines of *Aspergillus terreus* AUMC 15762 crude extract

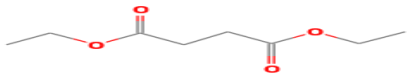
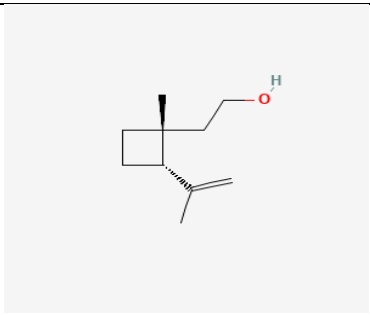
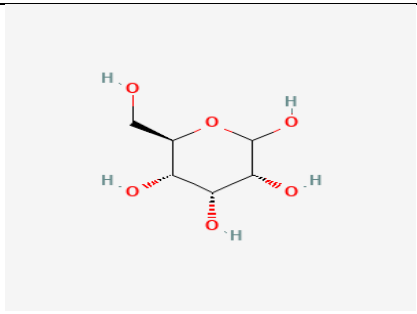
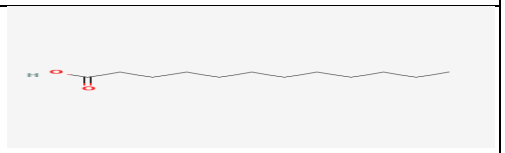
Ahmed M. A. A. Ramadan[1], Hussein H. EL–Sheikh[1], Reda M. Shehata[1] Osama . M. Al-Bedak[2,3,*]

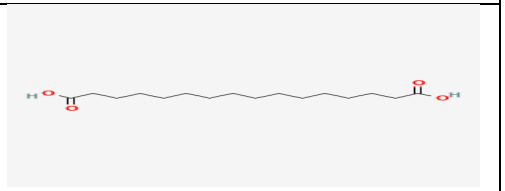
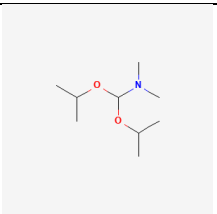
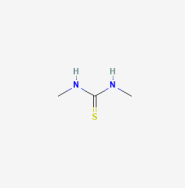
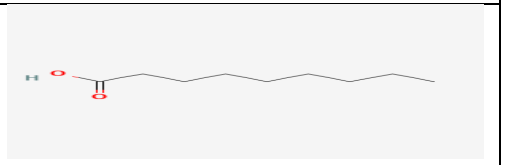
[1]*Department of Botany & Microbiology, Faculty of Science, Al Azhar University, Cairo, 11511, Egypt.*
[2]*Assiut University Mycological Centre, Assiut 71511, Egypt.*
[3]*ERU Science & Innovation Center of Excellence, Egyptian Russian University, Badr city 11829, Cairo, Egypt.*

Table S1. GC–MS spectral analysis of the chemical compounds detected in the *A. terreus* AUMC 15762 crude extract

RT (min)	Compound name	Compound group	Biological activity	Molecular weight	Chemical formula	Chemical structures
11.478	4-Amino-1h-Imidazole-5-Carboxamide	Alkaloids	Potent inhibitors (Antimetabolites), anti-inflammatory agent (Sung et al., 2015) (Łabuzek, Liber, Gabryel, & Okopień, 2010), Cytotoxic activity	126.12	$C_4H_6N_4O$	
11.976	(2,2-diethoxyethyl)-Benzene	Ethylbenzenes	Cytotoxic activity	194.27	$C_{12}H_{18}O_2$	
26.233	Elaidic acid	Fatty acid	Antibacterial activity (Pu et al., 2010)	282.5	$C_{18}H_{34}O_2$	
34.144	1,4,7,10,13,16-Hexaoxacyclooctadecane	Polyethylene Oxides	ND.	264.31	$C_{12}H_{24}O_6$	
18.871	1,6-Anhydro-.beta.-D-glucofuranose	Monosaccharide derivatives	Antibacterial activity against Gram-positive bacteria, but not against Gram-negative bacteria or fungi. antitumor and ant oxidative properties	162.14	$C_6H_{10}O_5$	

RT (min)	Compound name	Compound group	Biological activity	Molecular weight	Chemical formula	Chemical structures
			(Madouh & Davidson, 2024)			
25.547	2-[2-(4-Nitrophenoxy) ethoxy]ethanol	Phenolic derivatives	ND.	385.01	$C_{10}H_{11}Br_2NO_5$	
18.994	2-Amino-5-Guanidino-Pentanoic Acid	Fatty acid	ND.	176.22	$C_6H_{16}N_4O_2$	
23.781	3-Hydroxy-2,6-Dimethyl- 4h-Pyran-4-One	Pyranones derivatives	antimicrobial activity (Us et al., 2010)	140.14	$C_7H_8O_3$	
11.128	Hydroxymethylfurfural	Furan derivatives	applications like making inks, plastics, antacids, adhesives, nematicides, fungicides, fertilizers, and flavouring compounds (Raman & Gnansounou, 2015)	126.11	$C_6H_6O_3$	

RT (min)	Compound name	Compound group	Biological activity	Molecular weight	Chemical formula	Chemical structures
10.391	Succinic acid	Fatty acid	ND.	174.1944	$C_8H_{14}O_4$	
25.463	Grandisol	Oxygenated Hydrocarbons	ND.	154.25	$C_{10}H_{18}O$	
15.76	D-Allose	Monosaccharide	ND.	180.16	$C_6H_{12}O_6$	
16.588	Lauric Acid	Fatty acid	antibacterial, antioxidant and anti-apoptotic activity (Renugadevi, Nachiyar, & Zaveri, 2021)	200.3178	$C_{12}H_{24}O_2$	
29.318	Glycol bromohydrin	Halogenated alcohol	potent immunostimulation of human γδ T lymphocytes (Espinosa et al., 2001).	124.96	C_2H_5BrO	

RT (min)	Compound name	Compound group	Biological activity	Molecular weight	Chemical formula	Chemical structures
23.833	Thapsic acid	Fatty acid	antioxidant, antimicrobial, anti-inflammatory(Siswadi & Saragih, 2021) Antibacterial activity (Pu et al., 2010)	286.41	$C_{16}H_{30}O_4$	
29.215	Methyl 7,10-hexadecadienoate	Fatty acid	ND.	266.4	$C_{17}H_{30}O_2$	
12.027	N,N-Dimethylformamide diisopropyl acetal	Tertiary amines	ND.	175.27	$(CH_3)_2NCH[OCH(CH_3)_2]_2$	
22.047	N,N-Dimethylthiourea	Tertiary amines	It is used in photography, pharmaceutical and pesticide manufacture, and textile chemicals.	104.18	$C_3H_8N_2S$	
12.461	n-Decanoic acid	Fatty acid	ND.	172.26	$C_{10}H_{20}O_2$	
11.335	Nonanoic acid	Fatty acid	ND.	158.24	$C_9H_{18}O_2$	

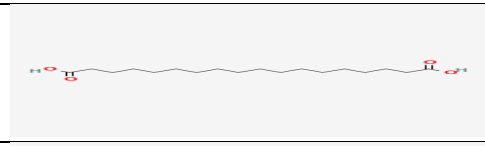
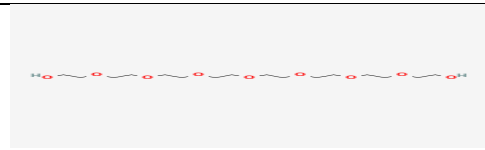
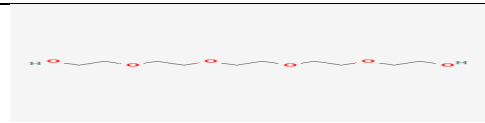
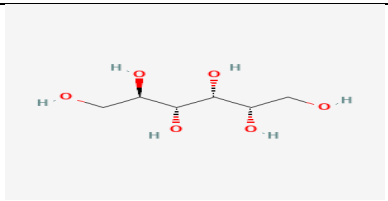
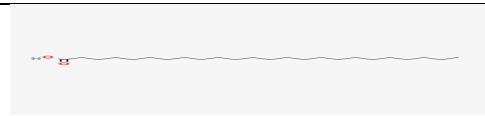
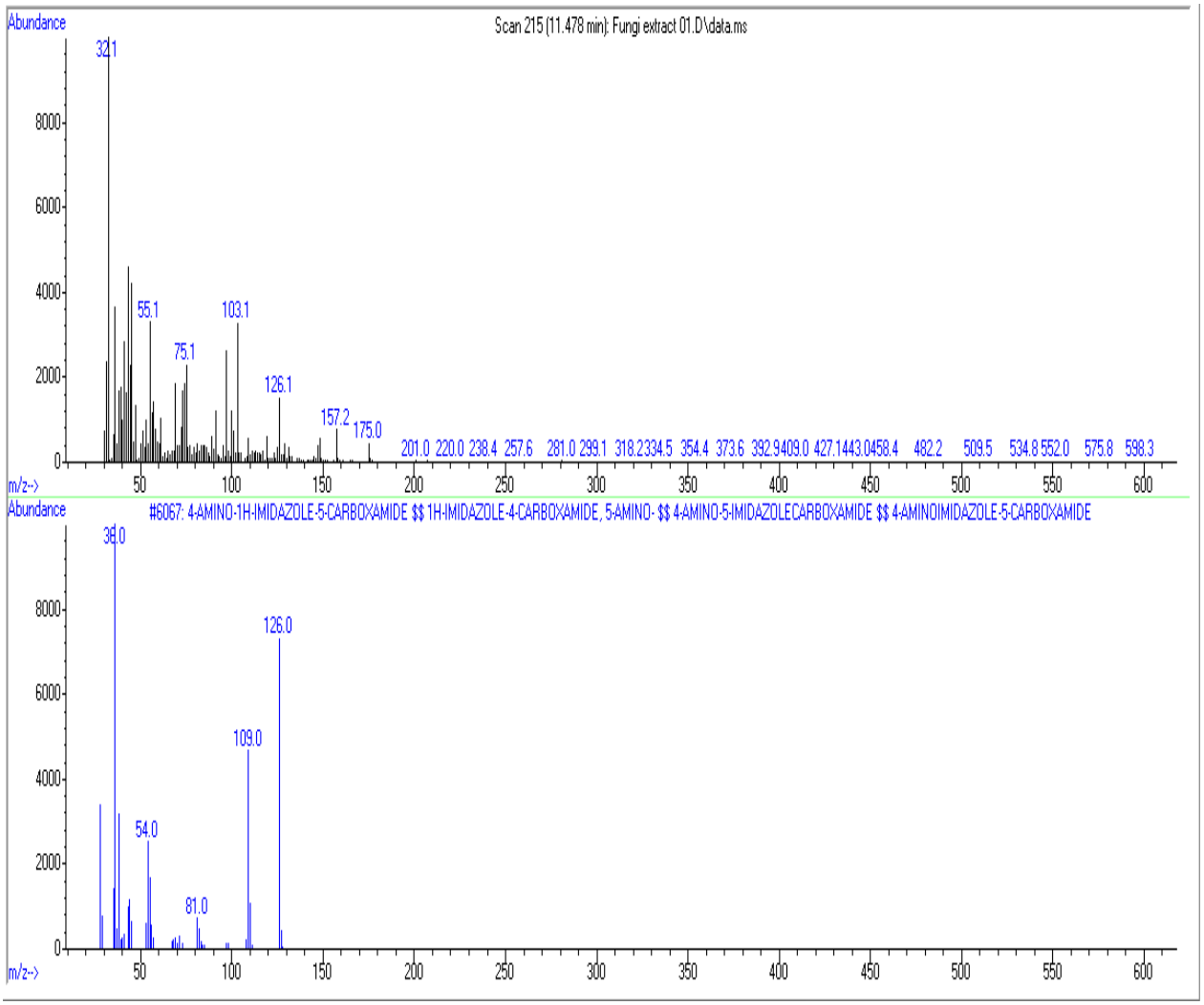
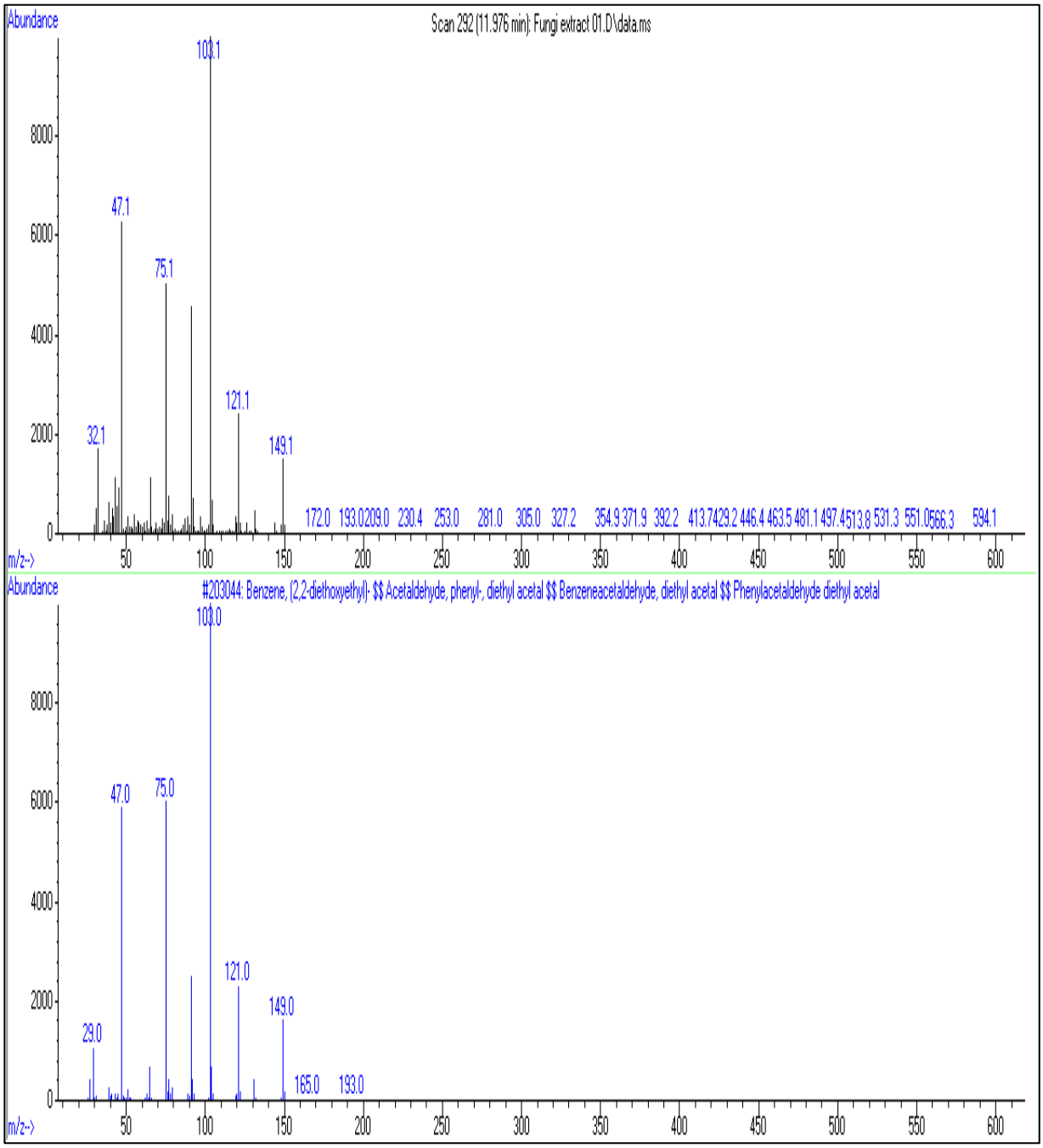
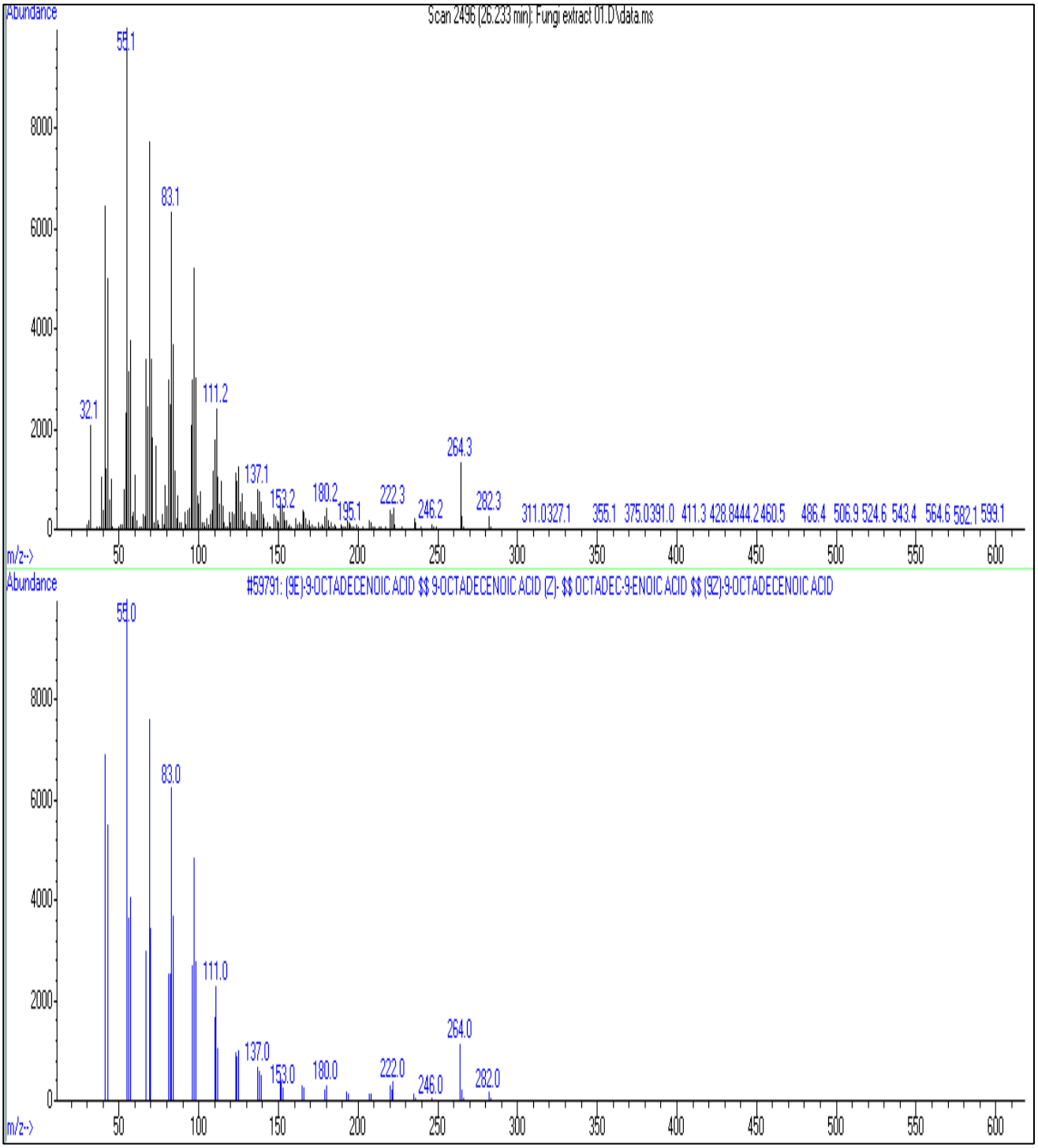
RT (min)	Compound name	Compound group	Biological activity	Molecular weight	Chemical formula	Chemical structures
26.549	Octadecanedioic acid	Fatty acid	Antibacterial activity (Pu et al., 2010)	314.5	$C_{18}H_{34}O_4$	
25.230	Octaethylene glycol	Polyethylene Oxides	ND.	370.44	$C_{16}H_{34}O_9$	
21.394	Pentaethylene glycol	Polyethylene Oxides	ND.	238.3	$C_{10}H_{22}O_6$	
18.658	Sorbitol	Monosaccharide derivatives	Preserve moisture, add sweetness, and provide texture to products, as well as potentially support digestive and oral health.	182.17	$C_6H_{14}O_6$	
21.045	Lignoceric acid	Fatty acid	ND.	368.6	$C_{24}H_{48}O_2$	

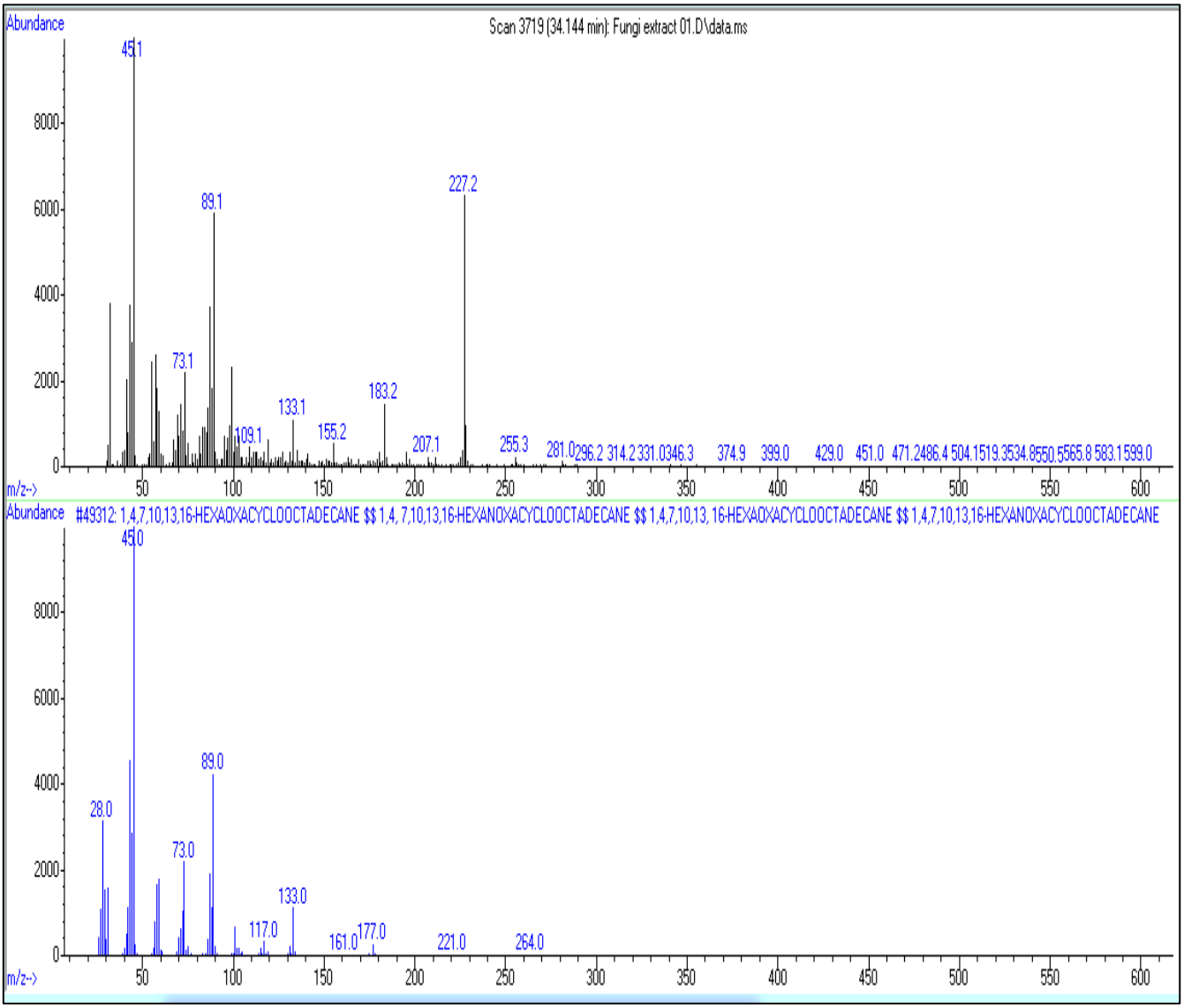
Table S2. Effect of *A. terreus* AUMC 15762 crude extract on biofilm formation by *E. coli*, *S. marcescens*, *S. aureus*, and *S. epidermidis*.

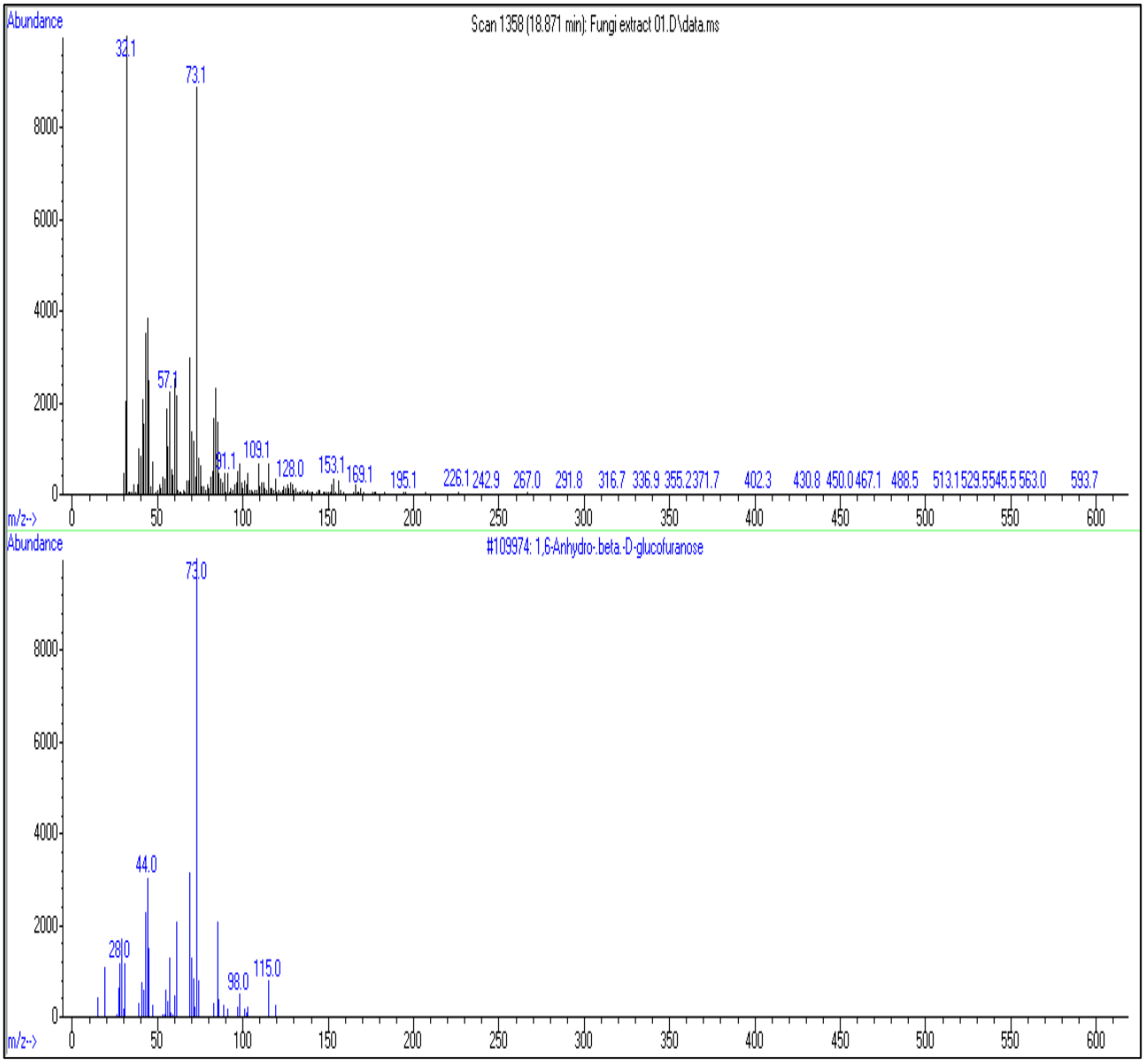
Antibiofilm	**SBF (Mean ± SD)**		**Control**	**75% of MBC**	**50% of MBC**	**25% of MBC**
E. coli	SBF (Mean ± SD)	0.002±0.002	1.957±0.005	0.145±0.002	0.193±0.004	0.301±0.003
	Anti–biofilm activity (%)			92.69	90.23	84.69
S. marcescens	SBF (Mean ± SD)	0.002±0.002	1.9±0.004	0.140±0.002	0.135±0.004	0.300± 0.003
	Anti–biofilm activity (%)			92.0	91.1	84.60
S. aureus	SBF (Mean ± SD)	0.002±0.002	1.338±0.003	0.147±0.003	0.197±0.002	0.310±0.006
	Anti–biofilm activity (%)			89.17	85.40	76.95
S. epidermidis	SBF (Mean ± SD)	0.002±0.002	1.430±0.006	0.095±0.003	0.160±0.003	0.278±0.003
	Anti–biofilm activity (%)			93.46	88.96	80.70

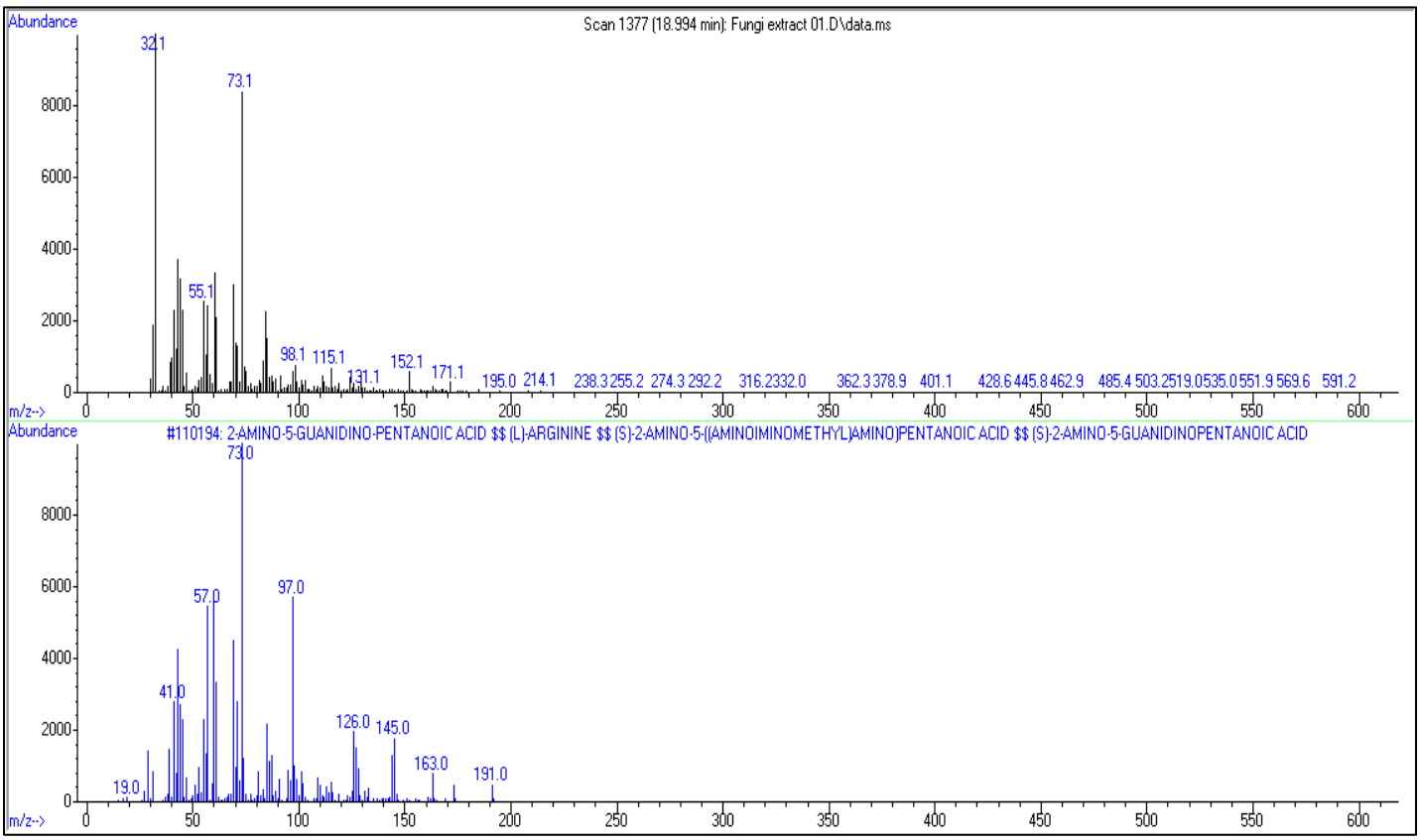

Abundance
Scan 215 (11.478 min): Fungi extract 01.D\data.ms
32.1
55.1
103.1
75.1
126.1
157.2
175.0
201.0 220.0 238.4 257.6 281.0 299.1 318.2334.5 354.4 373.6 392.9409.0 427.1443.0458.4 482.2 509.5 534.8 552.0 575.8 598.3
m/z-->
Abundance
#6067: 4-AMINO-1H-IMIDAZOLE-5-CARBOXAMIDE $$ 1H-IMIDAZOLE-4-CARBOXAMIDE, 5-AMINO- $$ 4-AMINO-5-IMIDAZOLECARBOXAMIDE $$ 4-AMINOIMIDAZOLE-5-CARBOXAMIDE
38.0
126.0
109.0
54.0
81.0
m/z-->

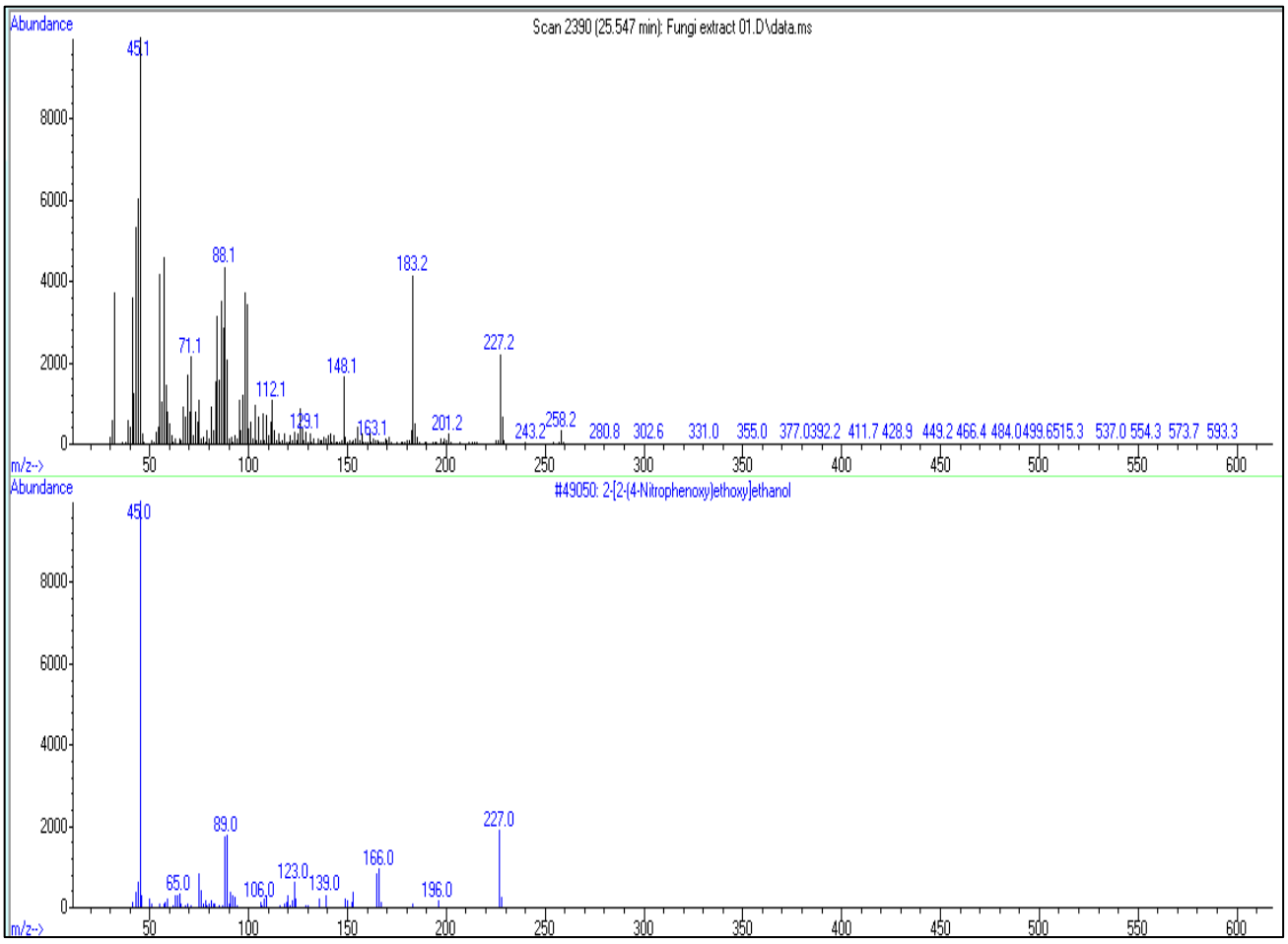

Abundance
Scan 292 (11.976 min): Fungi extract 01.D\data.ms
103.1
47.1
75.1
121.1
32.1
149.1
m/z-->
Abundance
#203044: Benzene, (2,2-diethoxyethyl)- $$ Acetaldehyde, phenyl-, diethyl acetal $$ Benzeneacetaldehyde, diethyl acetal $$ Phenylacetaldehyde diethyl acetal
103.0
47.0
75.0
121.0
149.0
29.0
165.0
193.0
m/z-->

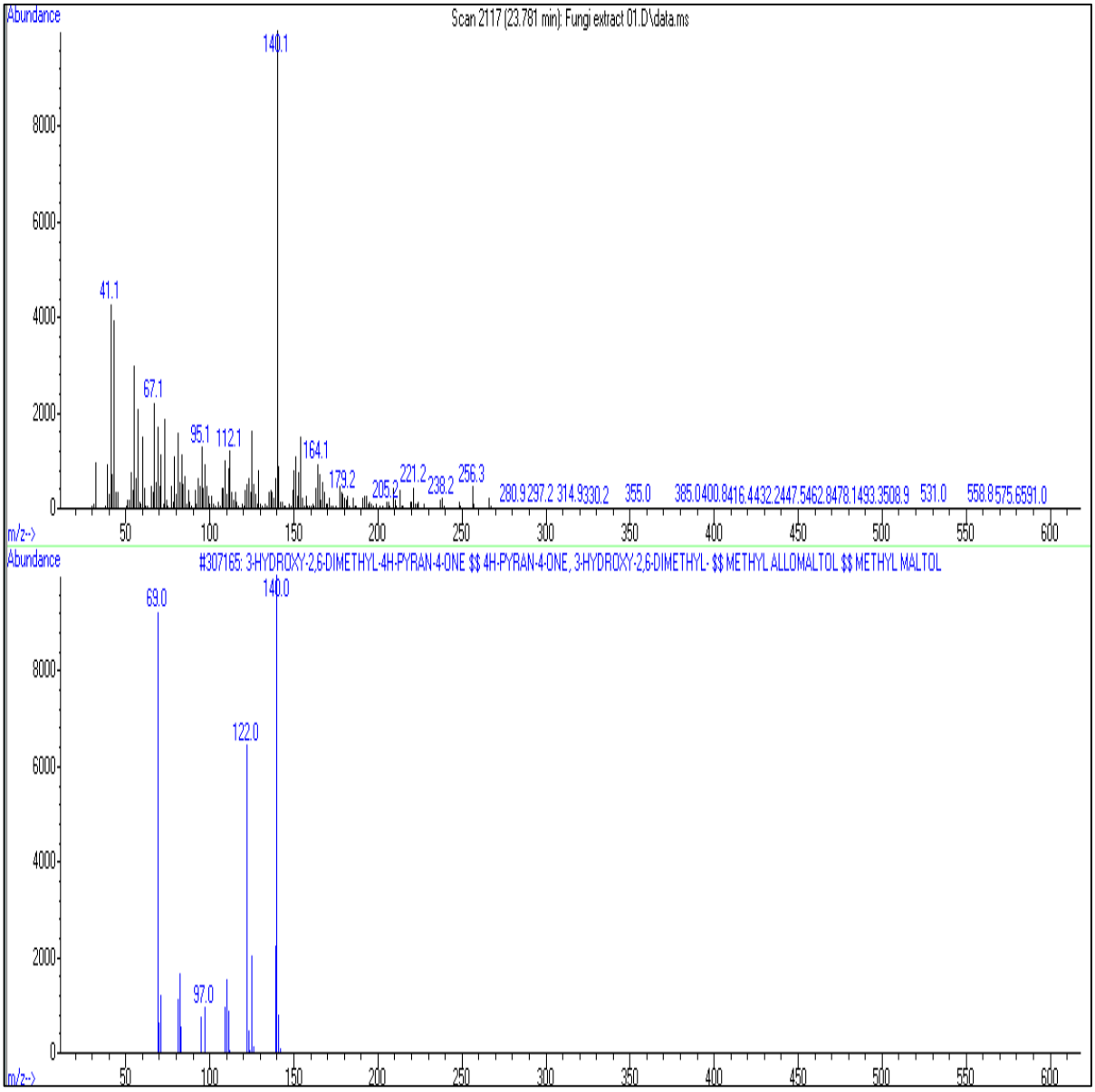

Abundance
Scan 2496 (26.233 min): Fungi extract 01.D\data.ms
55.1
83.1
111.2
32.1
264.3
137.1
153.2
180.2
195.1
222.3
246.2
282.3
311.0327.1
355.1
375.0391.0
411.3
428.8444.2460.5
486.4
506.9
524.6
543.4
564.6
582.1
599.1
m/z-->
Abundance
#59791: (9E)-9-OCTADECENOIC ACID $$ 9-OCTADECENOIC ACID (Z)- $$ OCTADEC-9-ENOIC ACID $$ (9Z)-9-OCTADECENOIC ACID
55.0
83.0
111.0
264.0
137.0
153.0
180.0
222.0
246.0
282.0
m/z-->

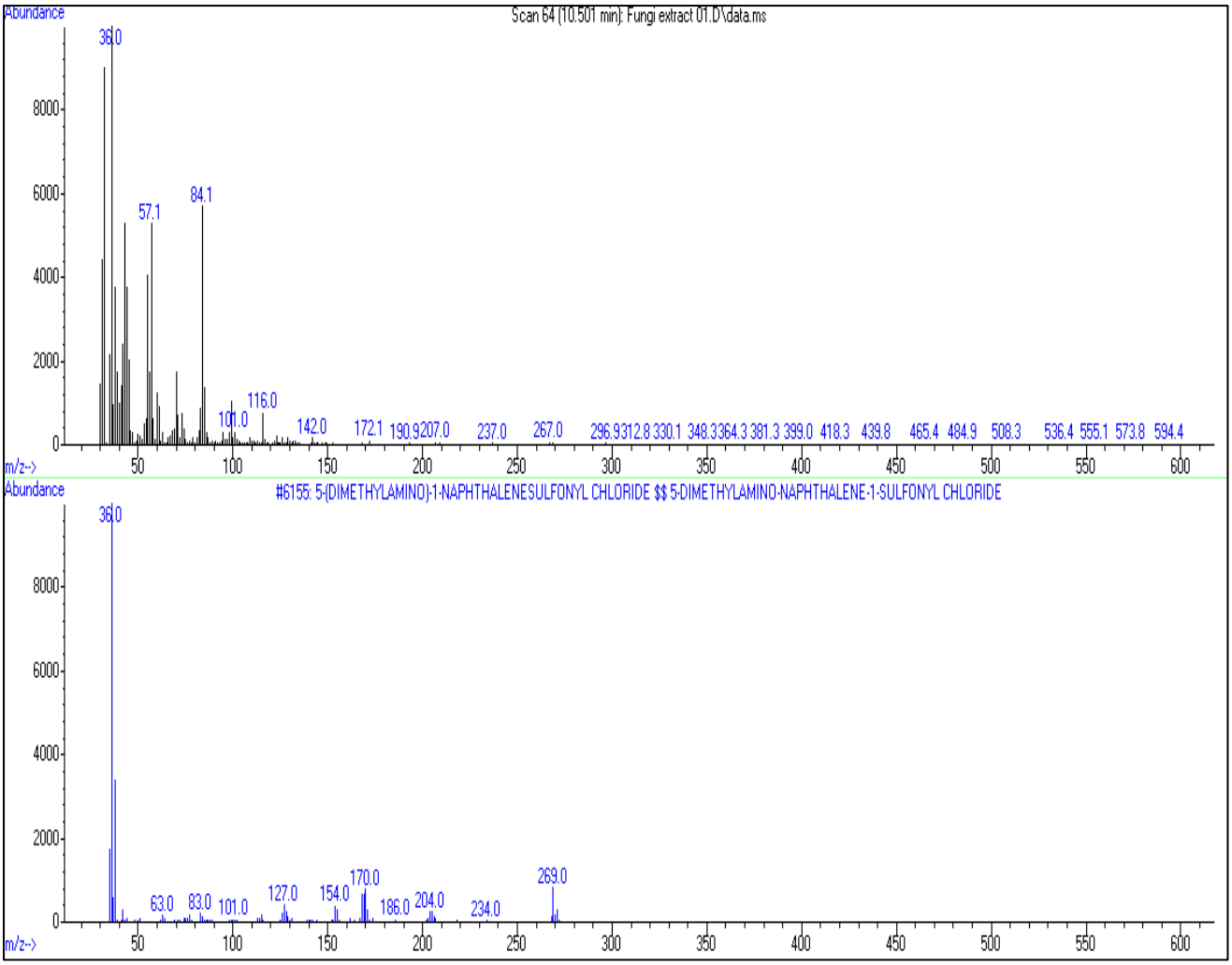

Abundance
Scan 3719 (34.144 min): Fungi extract 01.D\data.ms
45.1
89.1
227.2
73.1
183.2
133.1
155.2
109.1
207.1
255.3
281.0
296.2
314.2
331.0
346.3
374.9
399.0
429.0
451.0
471.2
486.4
504.1
519.3
534.8
550.5
565.8
583.1
599.0
m/z-->
Abundance
#49312: 1,4,7,10,13,16-HEXAOXACYCLOOCTADECANE $$ 1,4, 7,10,13,16-HEXANOXACYCLOOCTADECANE $$ 1,4,7,10,13, 16-HEXAOXACYCLOOCTADECANE $$ 1,4,7,10,13,16-HEXANOXACYCLOOCTADECANE
45.0
89.0
28.0
73.0
133.0
117.0
161.0
177.0
221.0
264.0
m/z-->

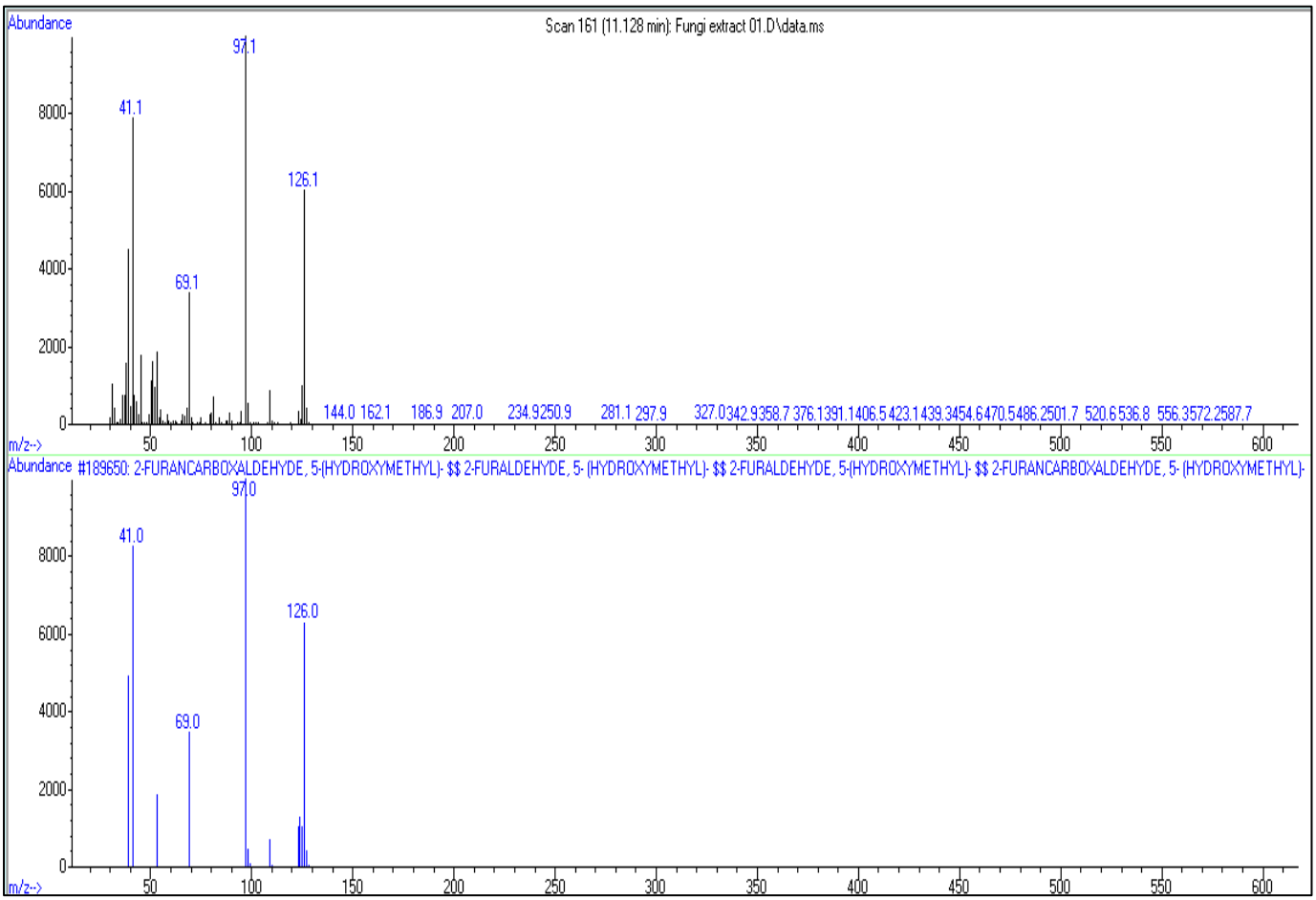

Abundance
Scan 1358 (18.871 min): Fungi extract 01.D\data.ms
32.1
73.1
57.1
81.1
109.1
128.0
153.1
169.1
195.1
226.1
242.9
267.0
291.8
316.7
336.9
355.2
371.7
402.3
430.8
450.0
467.1
488.5
513.1
529.5
545.5
563.0
593.7
m/z-->
Abundance
#109974: 1,6-Anhydro-beta-D-glucofuranose
73.0
44.0
28.0
98.0
115.0
m/z-->

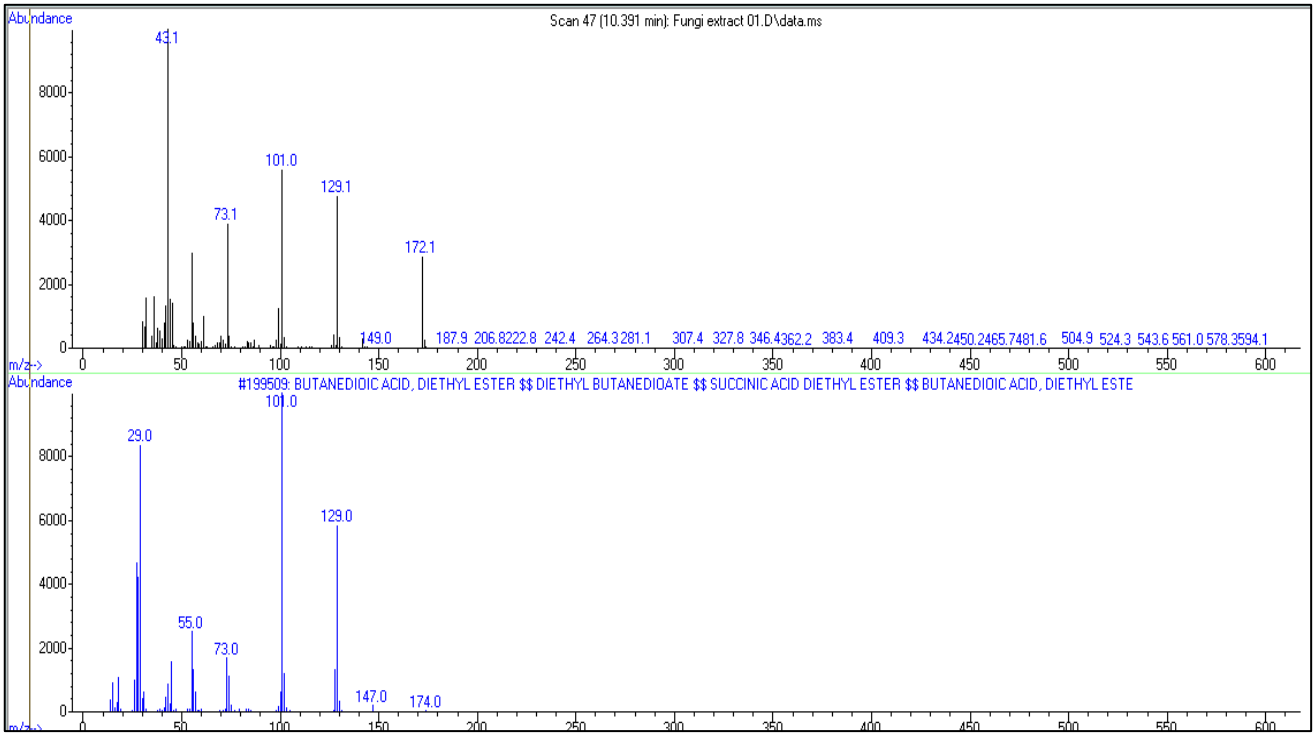

Abundance
Scan 1377 (18.994 min): Fungi extract 01.D\data.ms
32.1
73.1
55.1
98.1
115.1
131.1
152.1
171.1
195.0
214.1
238.3
255.2
274.3
292.2
316.2
332.0
362.3
378.9
401.1
428.6
445.8
462.9
485.4
503.2
519.0
535.0
551.9
569.6
591.2
m/z-->
Abundance
#110194: 2-AMINO-5-GUANIDINO-PENTANOIC ACID $$ (L)-ARGININE $$ (S)-2-AMINO-5-[(AMINOIMINOMETHYL)AMINO]PENTANOIC ACID $$ (S)-2-AMINO-5-GUANIDINOPENTANOIC ACID
73.0
57.0
97.0
41.0
126.0
145.0
163.0
191.0
19.0
m/z-->

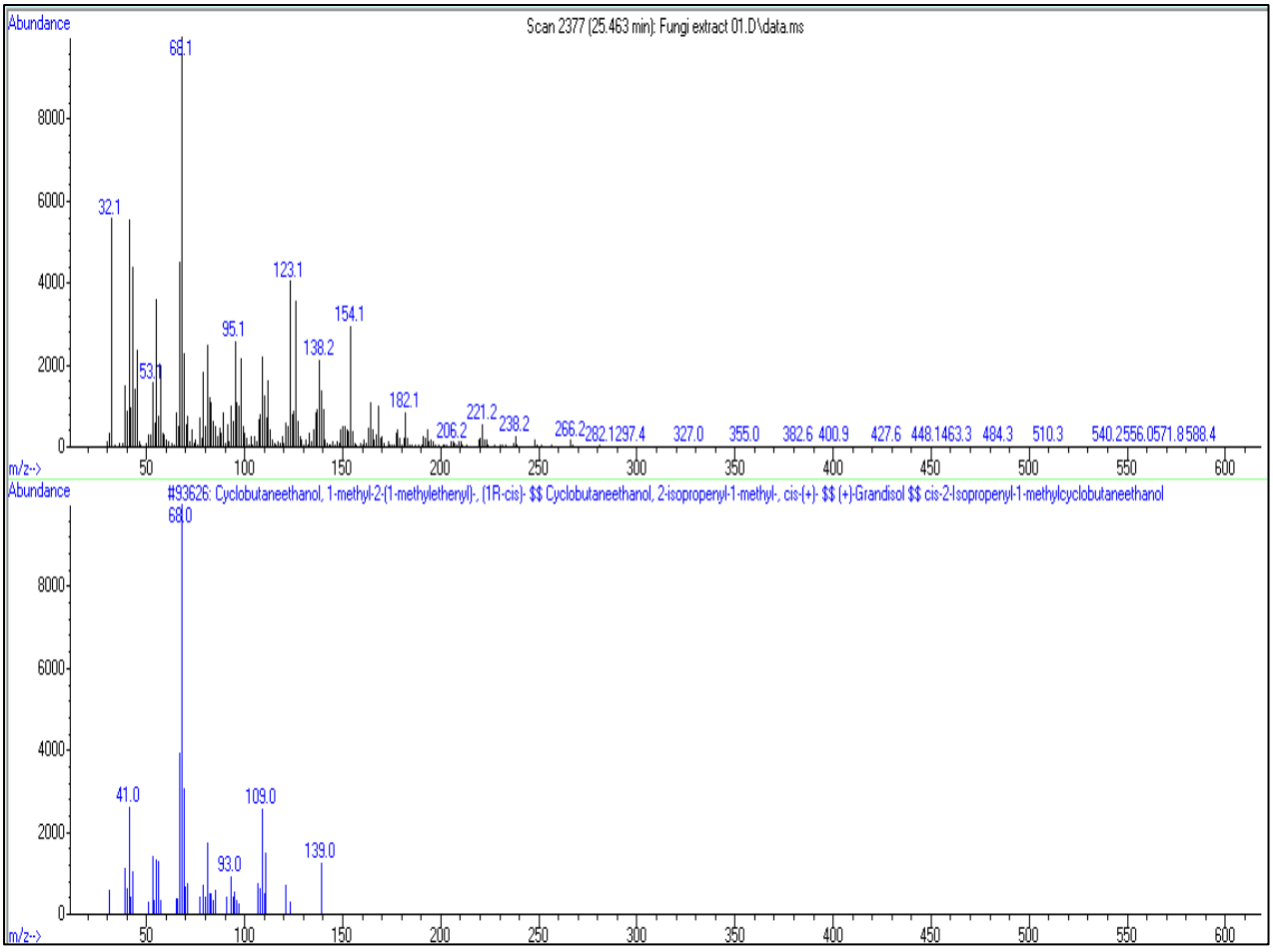

Abundance
Scan 2390 (25.547 min): Fungi extract 01.D\data.ms
45.1
88.1
183.2
71.1
227.2
148.1
112.1
129.1
163.1
201.2
258.2
m/z-->
Abundance
#49050: 2-[2-(4-Nitrophenoxy)ethoxy]ethanol
45.0
89.0
227.0
166.0
123.0
65.0
139.0
106.0
196.0
m/z-->

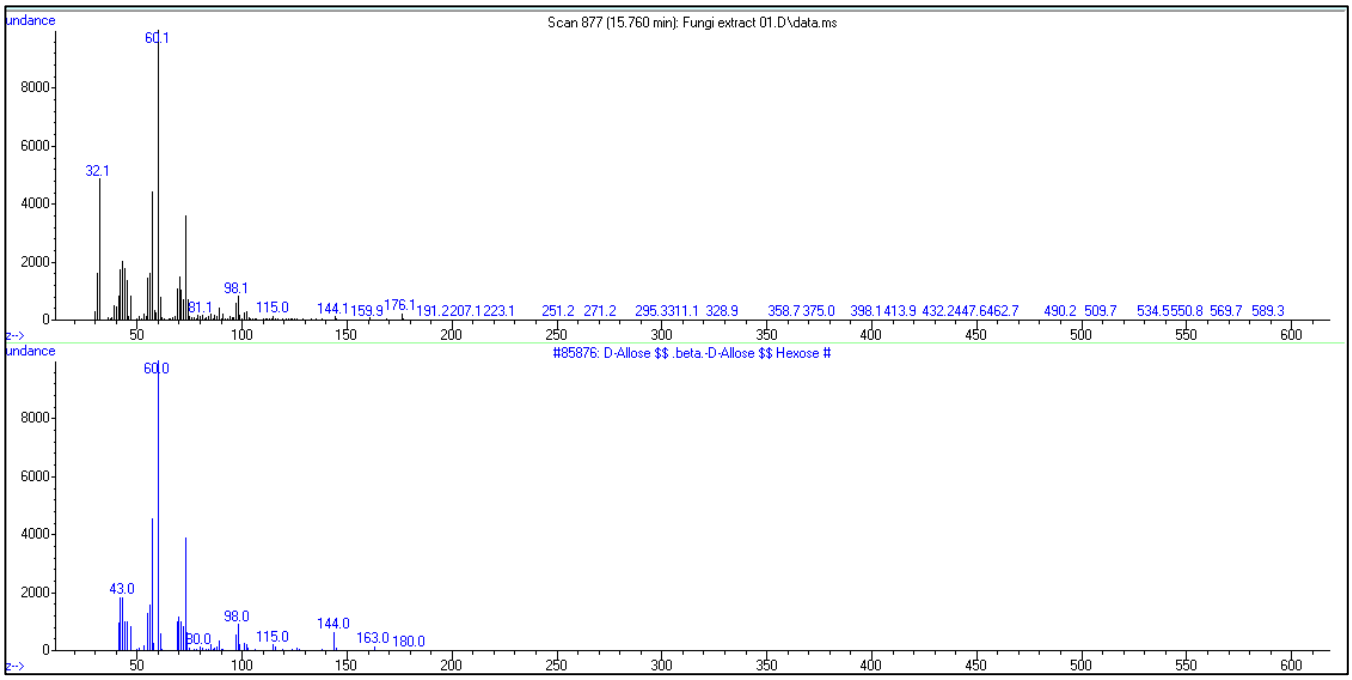

Abundance
Scan 2117 (23.781 min): Fungi extract 01.D\data.ms
140.1
41.1
67.1
95.1
112.1
164.1
179.2
205.2
221.2
238.2
256.3
280.9 297.2 314.9 330.2
355.0
385.0 400.8 416.4 432.2 447.5 462.8 478.1 493.3 508.9
531.0
558.8 575.6 591.0
m/z-->
Abundance
#307165: 3-HYDROXY-2,6-DIMETHYL-4H-PYRAN-4-ONE $$ 4H-PYRAN-4-ONE, 3-HYDROXY-2,6-DIMETHYL- $$ METHYL ALLOMALTOL $$ METHYL MALTOL
69.0
140.0
122.0
97.0
m/z-->

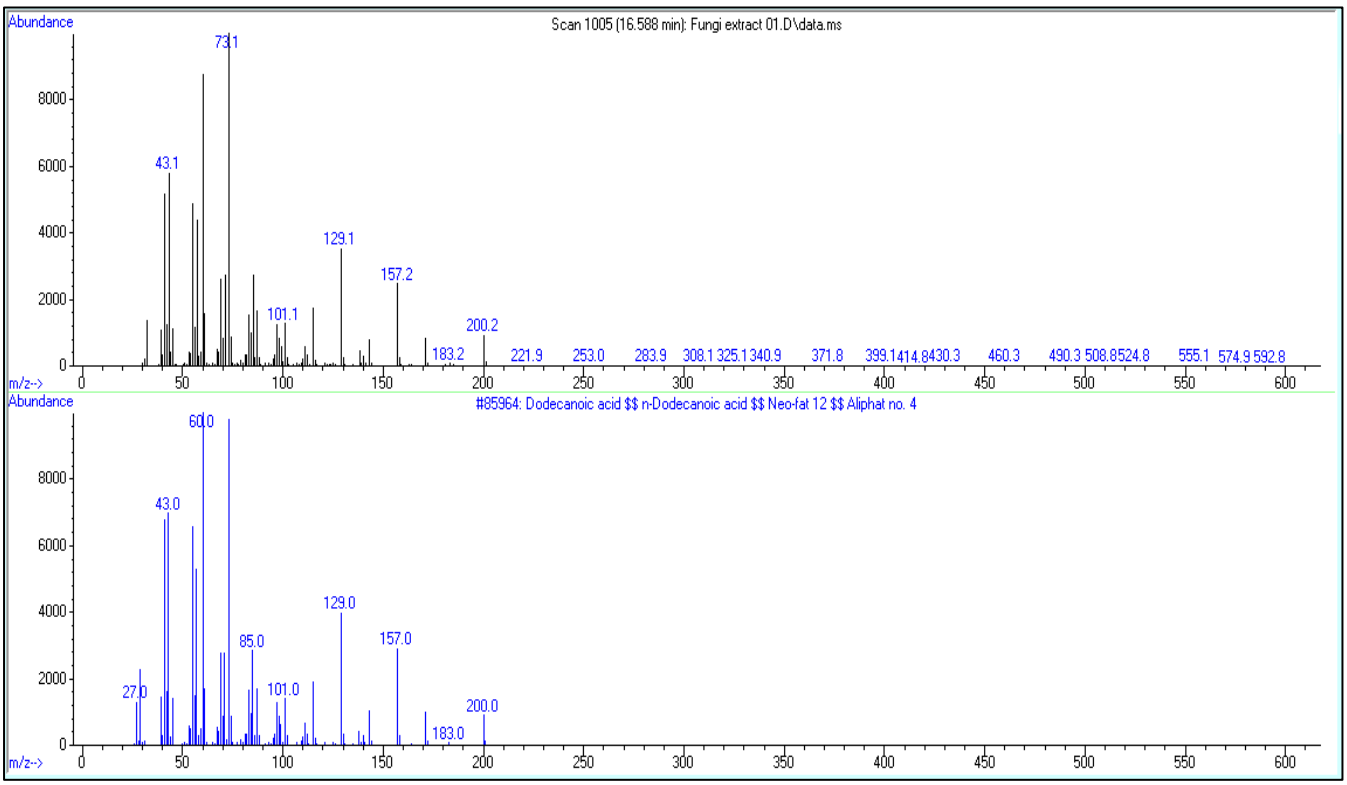

Abundance
Scan 64 (10.501 min): Fungi extract 01.D\data.ms
36.0
84.1
57.1
116.0
101.0
142.0
172.1
190.9
207.0
237.0
267.0
296.9
312.8
330.1
348.3
364.3
381.3
399.0
418.3
439.8
465.4
484.9
508.3
536.4
555.1
573.8
594.4
m/z-->
Abundance
#6155: 5-(DIMETHYLAMINO)-1-NAPHTHALENESULFONYL CHLORIDE $$ 5-DIMETHYLAMINO-NAPHTHALENE-1-SULFONYL CHLORIDE
36.0
63.0
83.0
101.0
127.0
154.0
170.0
186.0
204.0
234.0
269.0
m/z-->

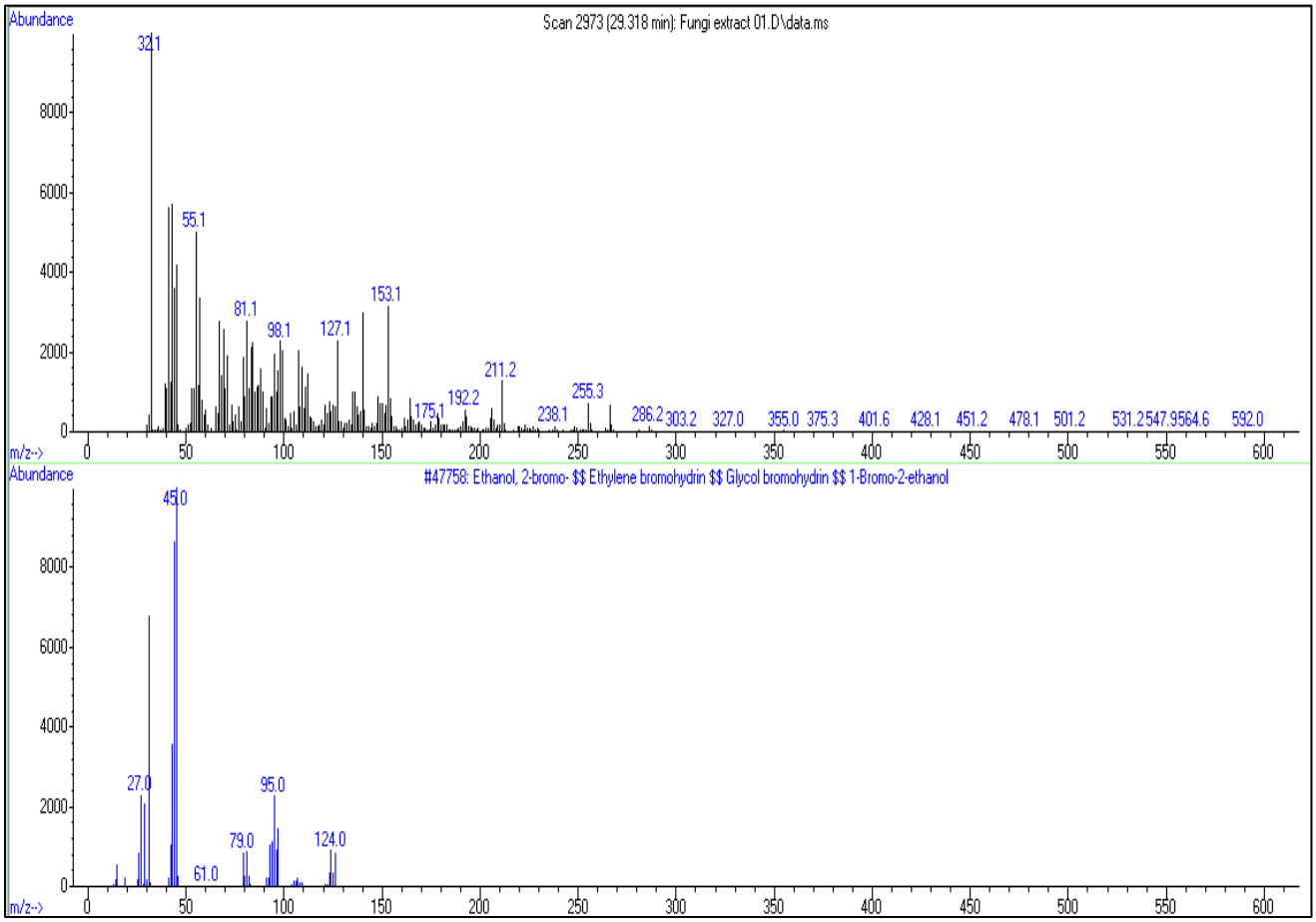

Abundance
Scan 161 (11.128 min): Fungi extract 01.D\data.ms
97.1
41.1
126.1
69.1
144.0 162.1 186.9 207.0 234.9250.9 281.1 297.9 327.0342.9358.7 376.1391.1406.5423.1439.3454.6470.5486.2501.7 520.6536.8 556.3572.2587.7
m/z-->
Abundance
#189650: 2-FURANCARBOXALDEHYDE, 5-(HYDROXYMETHYL)- $$ 2-FURALDEHYDE, 5- (HYDROXYMETHYL)- $$ 2-FURALDEHYDE, 5-(HYDROXYMETHYL)- $$ 2-FURANCARBOXALDEHYDE, 5- (HYDROXYMETHYL)-
97.0
41.0
126.0
69.0
m/z-->

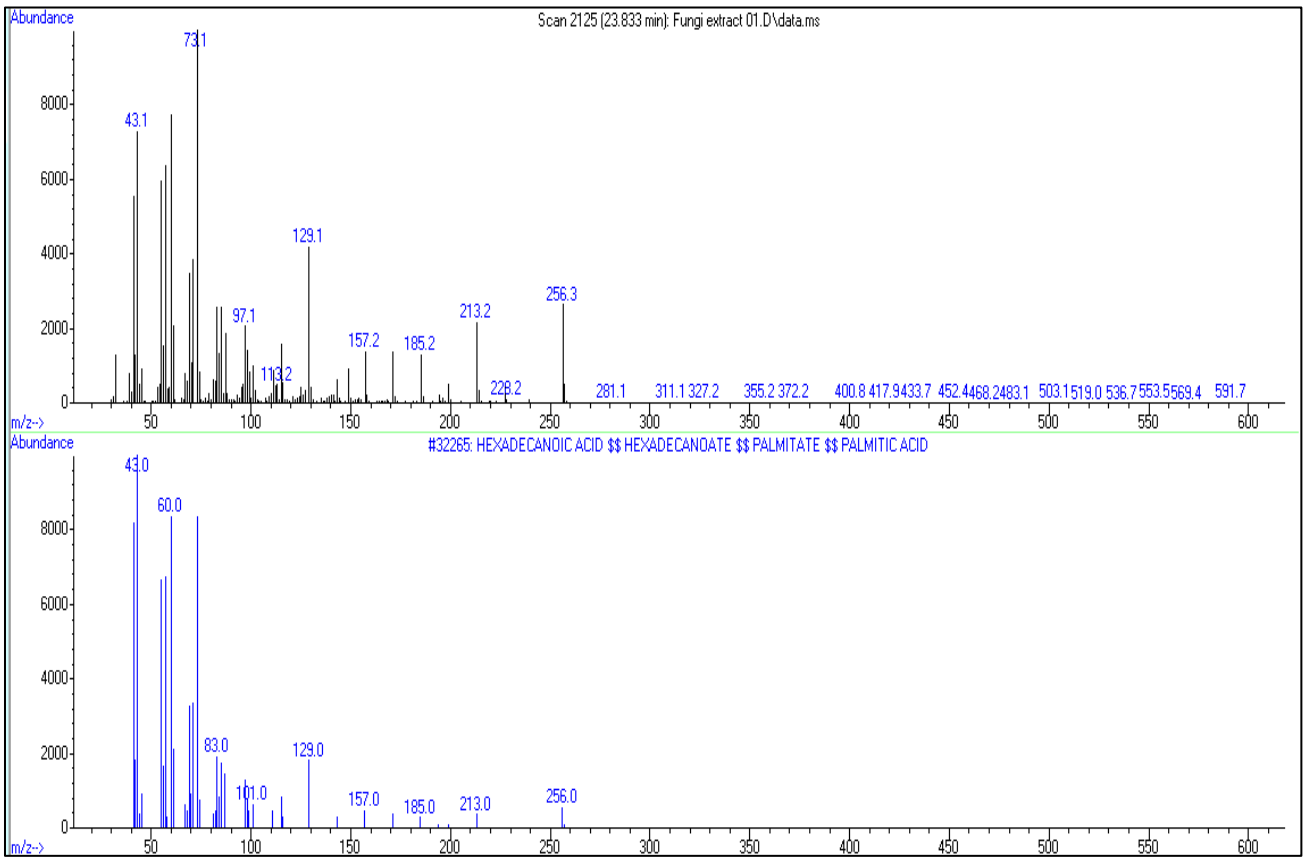

Abundance
Scan 47 (10.391 min): Fungi extract 01.D\data.ms
43.1
101.0
129.1
73.1
172.1
149.0
187.9 206.8222.8 242.4 264.3 281.1 307.4 327.8 346.4362.2 383.4 409.3 434.2450.2465.7481.6 504.9 524.3 543.6 561.0 578.3594.1
m/z-->
Abundance
#199509: BUTANEDIOIC ACID, DIETHYL ESTER $$ DIETHYL BUTANEDIOATE $$ SUCCINIC ACID DIETHYL ESTER $$ BUTANEDIOIC ACID, DIETHYL ESTE
101.0
29.0
129.0
55.0
73.0
147.0
174.0
m/z-->

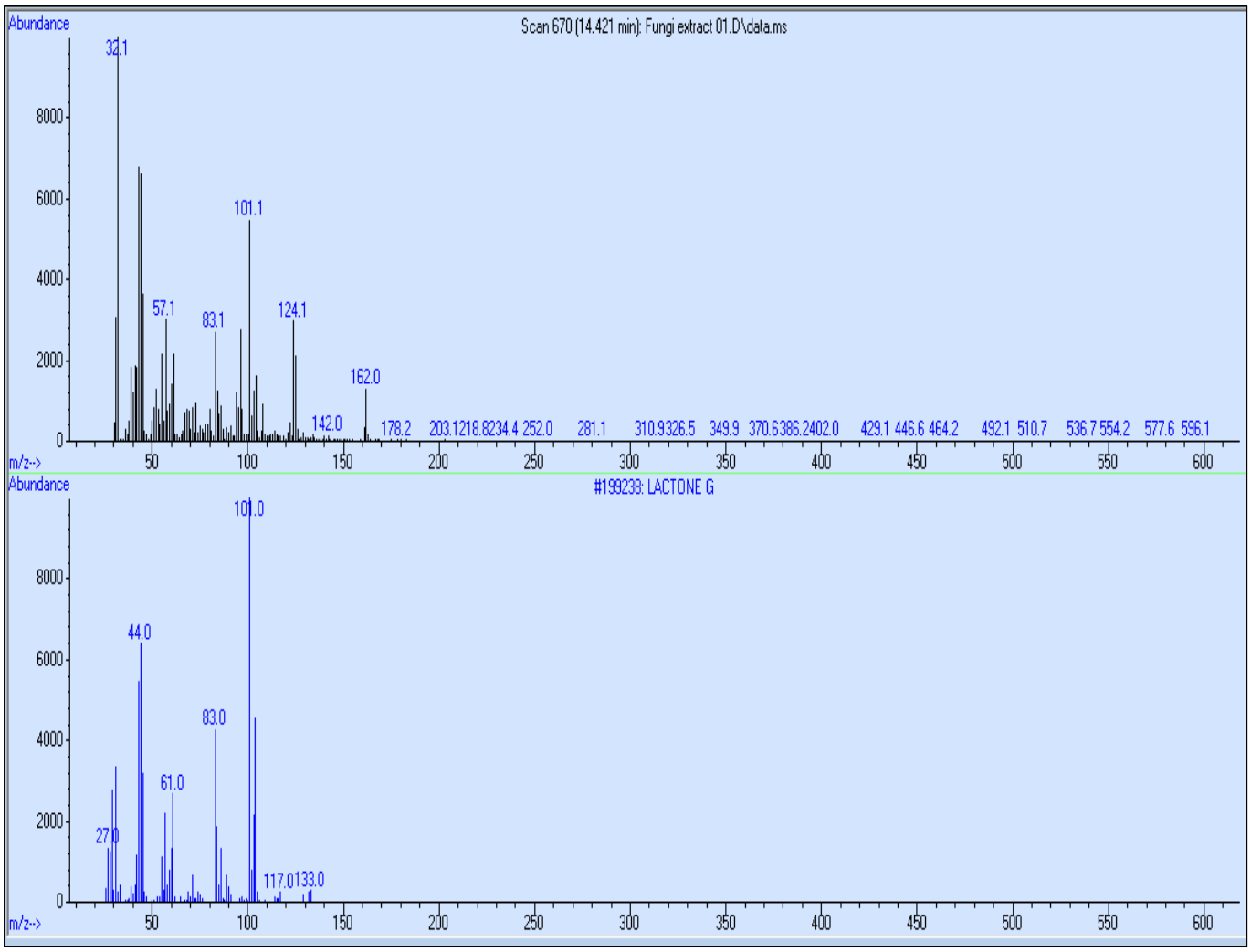

Abundance
Scan 2377 (25.463 min): Fungi extract 01.D\data.ms
68.1
32.1
123.1
154.1
95.1
138.2
53.1
182.1
221.2
206.2
238.2
266.2
282.1
297.4
327.0
355.0
382.6
400.9
427.6
448.1
463.3
484.3
510.3
540.2
556.0
571.8
588.4
m/z-->
Abundance
#93626: Cyclobutaneethanol, 1-methyl-2-(1-methylethenyl)-, (1R-cis)- $$ Cyclobutaneethanol, 2-isopropenyl-1-methyl-, cis-(+)- $$ (+)-Grandisol $$ cis-2-Isopropenyl-1-methylcyclobutaneethanol
68.0
41.0
109.0
139.0
93.0
m/z-->

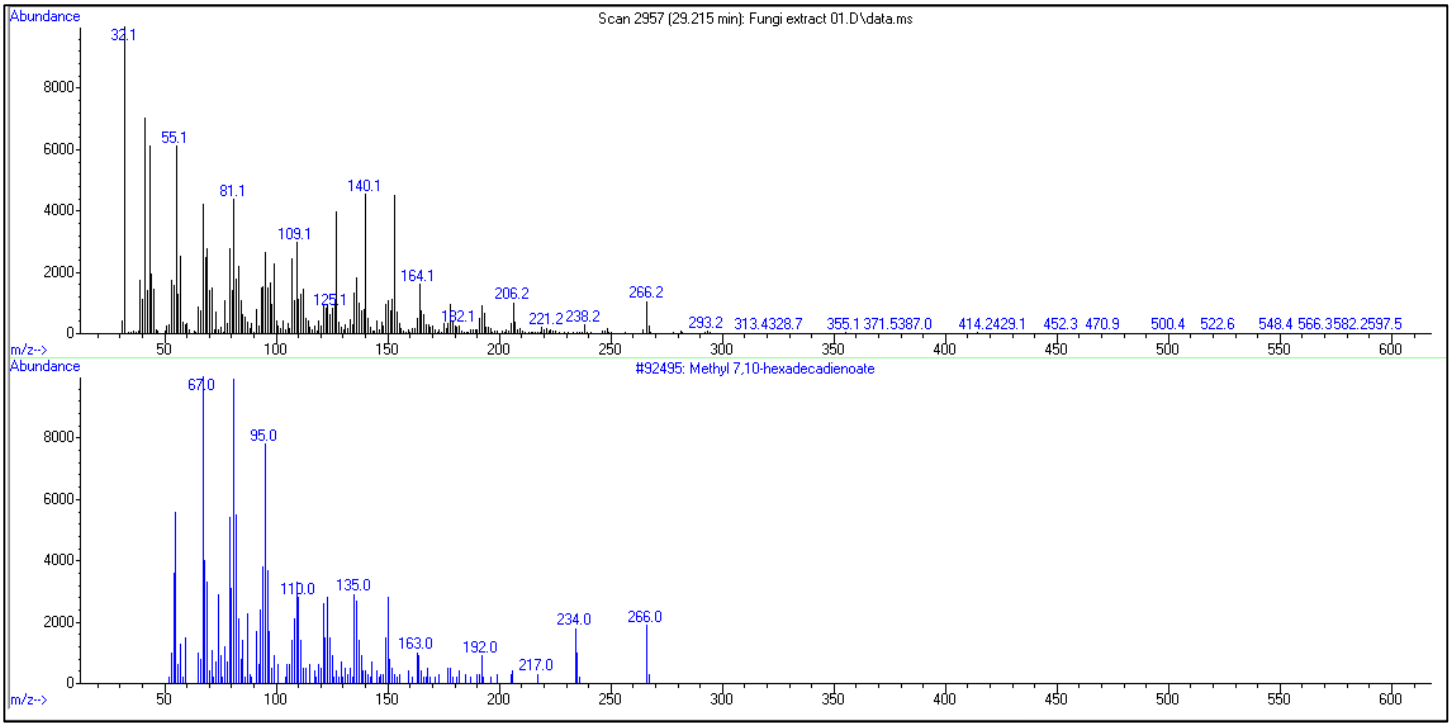

undance
Scan 877 (15.760 min): Fungi extract 01.D\data.ms
60.1
32.1
98.1
81.1
115.0
144.1
159.9
176.1
191.2
207.1
223.1
251.2
271.2
295.3
311.1
328.9
358.7
375.0
398.1
413.9
432.2
447.6
462.7
490.2
509.7
534.5
550.8
569.7
589.3
z-->
undance
#85876: D-Allose $$ .beta.-D-Allose $$ Hexose #
60.0
43.0
98.0
80.0
115.0
144.0
163.0
180.0
z-->

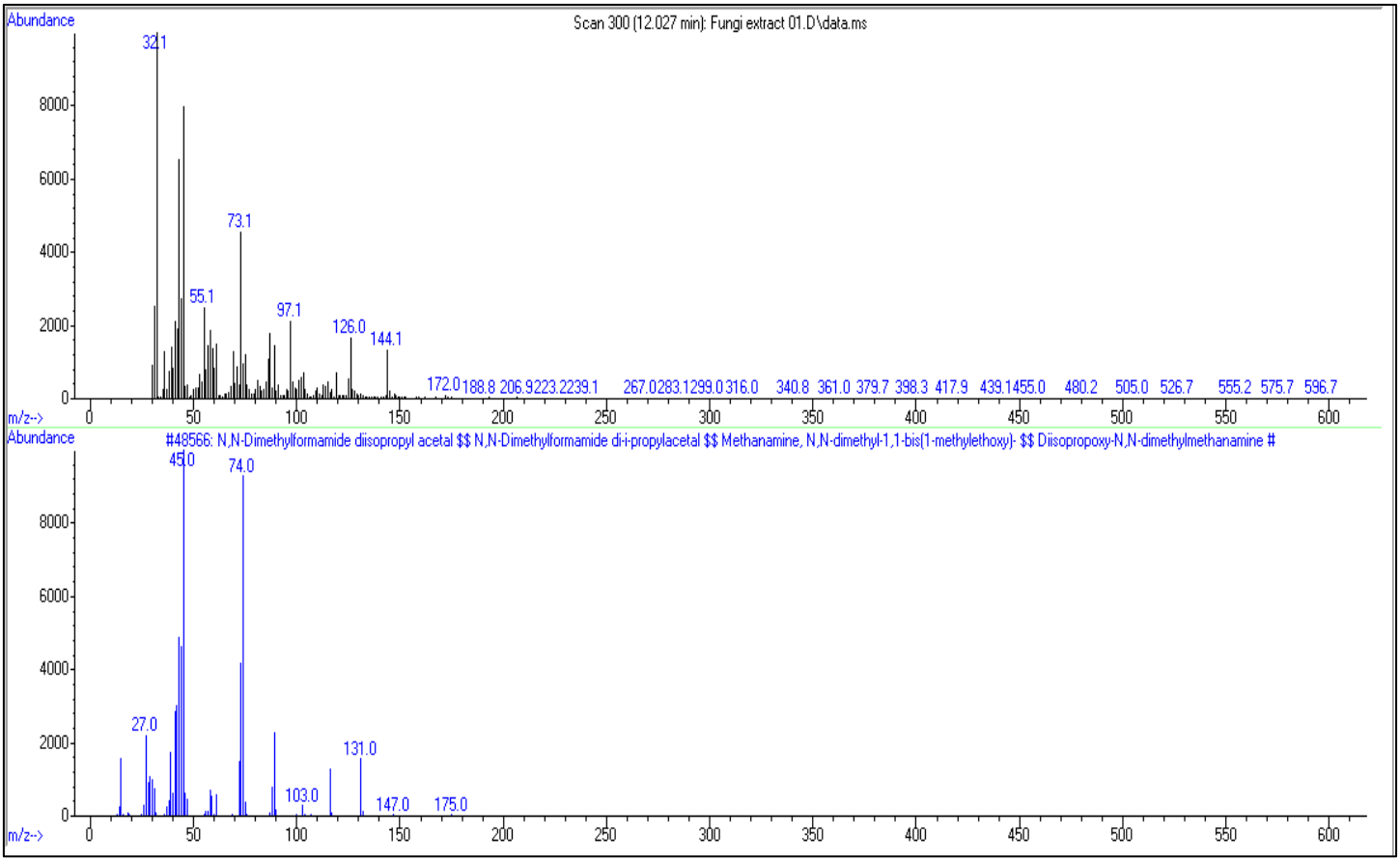

Abundance
Scan 1005 (16.588 min): Fungi extract 01.D\data.ms
73.1
43.1
129.1
157.2
101.1
200.2
183.2
221.9
253.0
283.9
308.1 325.1 340.9
371.8
399.1 414.8 430.3
460.3
490.3 508.8 524.8
555.1
574.9 592.8
m/z-->
Abundance
#85964: Dodecanoic acid $$ n-Dodecanoic acid $$ Neo-fat 12 $$ Aliphat no. 4
60.0
43.0
129.0
157.0
85.0
27.0
101.0
200.0
183.0
m/z-->

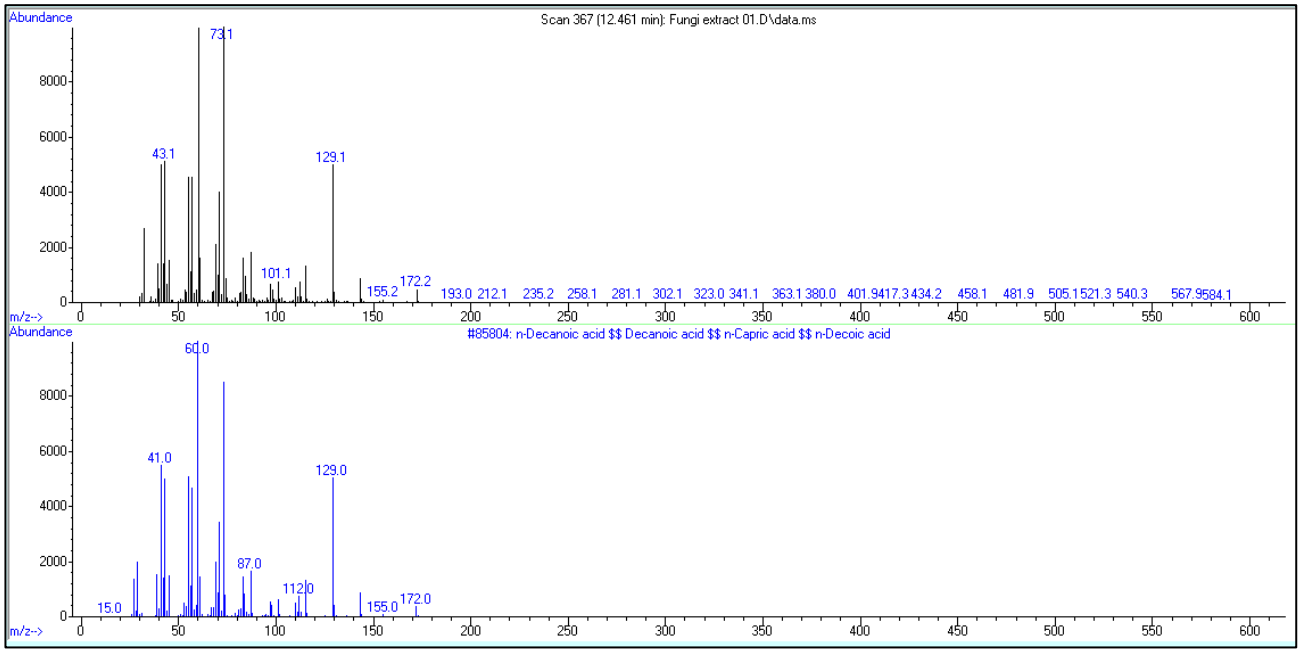

Abundance
Scan 2973 (29.318 min): Fungi extract 01.D\data.ms
321
55.1
81.1
98.1
127.1
153.1
175.1
192.2
211.2
238.1
255.3
286.2
303.2
327.0
355.0
375.3
401.6
428.1
451.2
478.1
501.2
531.2
547.9
564.6
592.0
m/z-->
Abundance
#47758: Ethanol, 2-bromo- $$ Ethylene bromohydrin $$ Glycol bromohydrin $$ 1-Bromo-2-ethanol
45.0
27.0
95.0
79.0
124.0
61.0
m/z-->

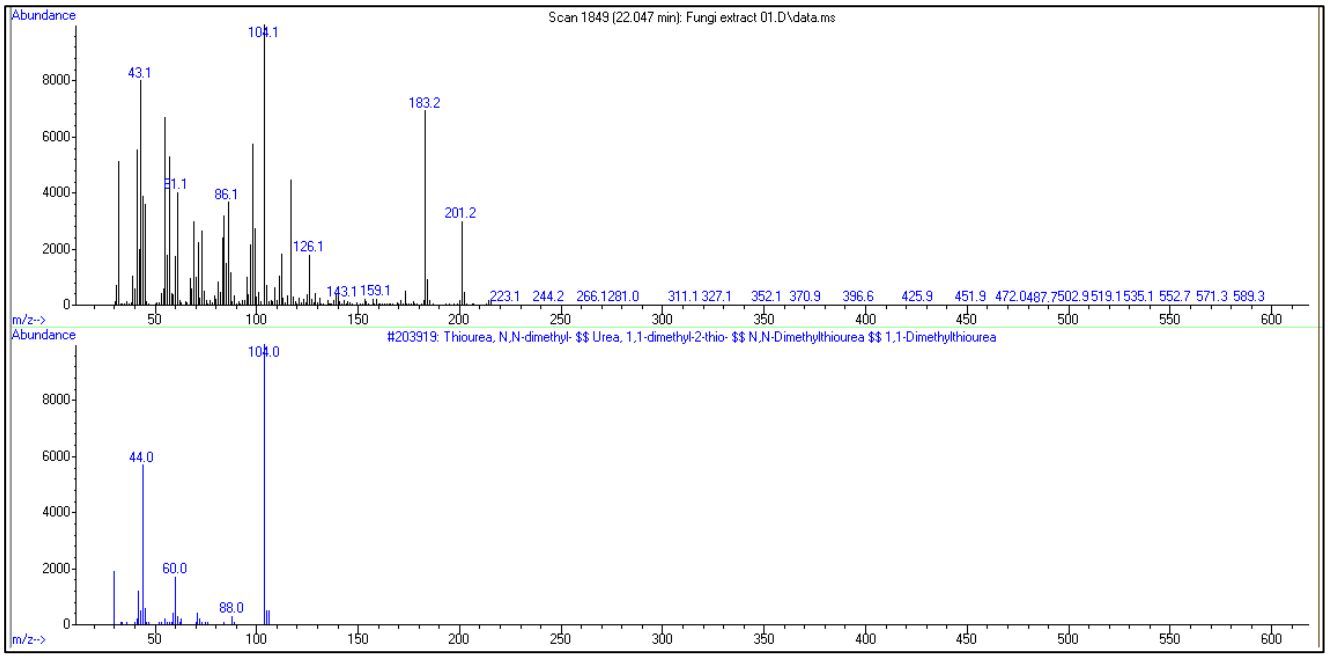

Abundance
Scan 2125 (23.833 min): Fungi extract 01.D\data.ms
73.1
43.1
129.1
97.1
256.3
213.2
157.2
185.2
113.2
228.2
281.1
311.1 327.2
355.2 372.2
400.8 417.9 433.7
452.4 468.2 483.1
503.1 519.0 536.7 553.5 569.4
591.7
m/z-->
Abundance
#32265: HEXADECANOIC ACID $$ HEXADECANOATE $$ PALMITATE $$ PALMITIC ACID
43.0
60.0
83.0
129.0
101.0
157.0
185.0
213.0
256.0
m/z-->

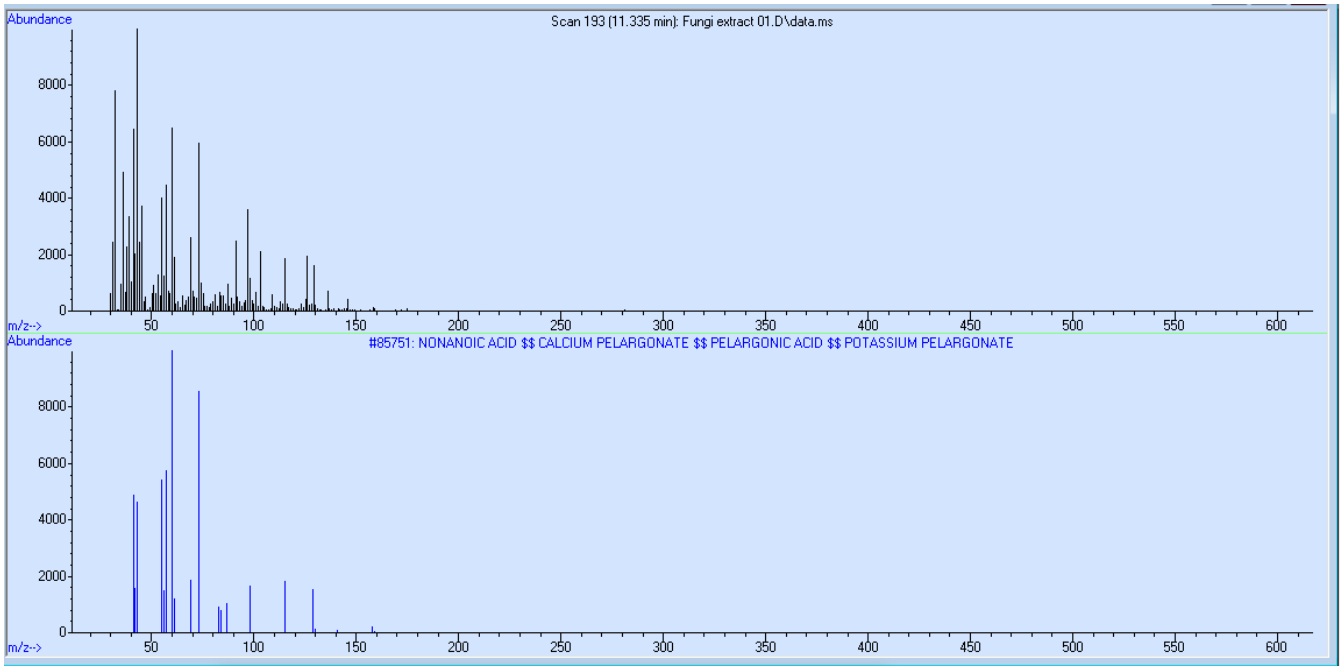

Abundance
Scan 670 (14.421 min): Fungi extract 01.D\data.ms
32.1
101.1
57.1
83.1
124.1
162.0
142.0
178.2
203.1218.8234.4
252.0
281.1
310.9326.5
349.9
370.6386.2402.0
429.1
446.6
464.2
492.1
510.7
536.7
554.2
577.6
596.1
m/z-->
Abundance
#199238: LACTONE G
101.0
44.0
83.0
61.0
27.0
117.0133.0
m/z-->

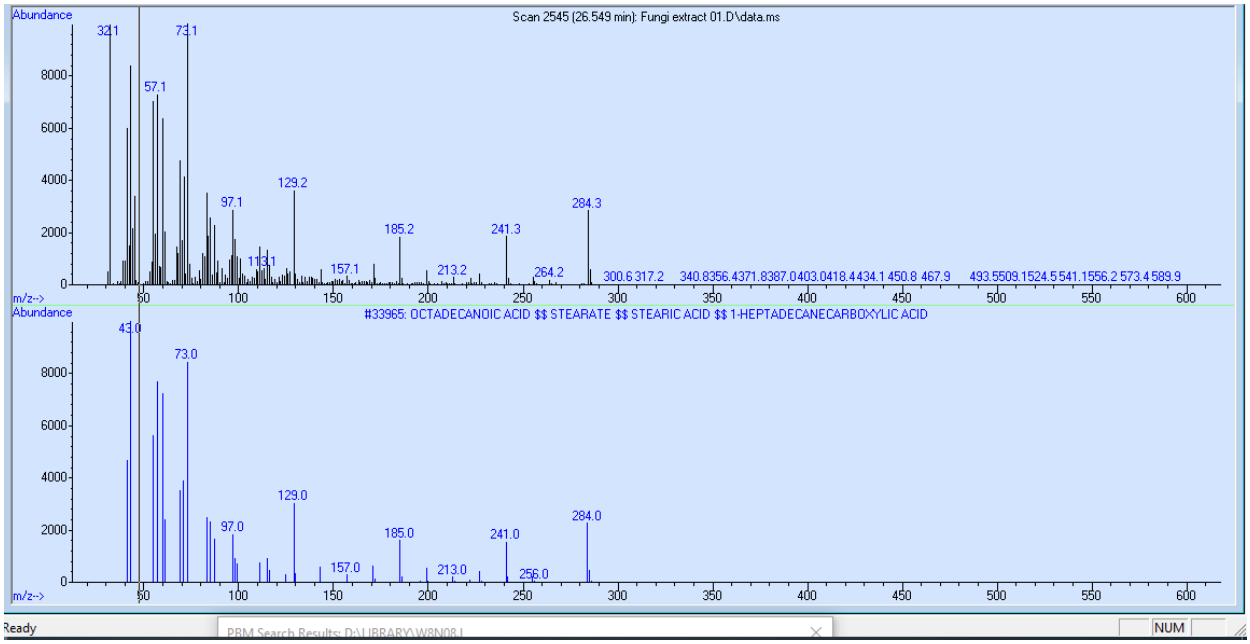

Abundance
Scan 2957 (29.215 min): Fungi extract 01.D\data.ms
32.1
55.1
81.1
109.1
125.1
140.1
164.1
182.1
206.2
221.2
238.2
266.2
293.2
313.4328.7
355.1 371.5387.0
414.2429.1
452.3
470.9
500.4
522.6
548.4
566.3582.2597.5
m/z-->
Abundance
#92495: Methyl 7,10-hexadecadienoate
67.0
95.0
110.0
135.0
163.0
192.0
217.0
234.0
266.0
m/z-->

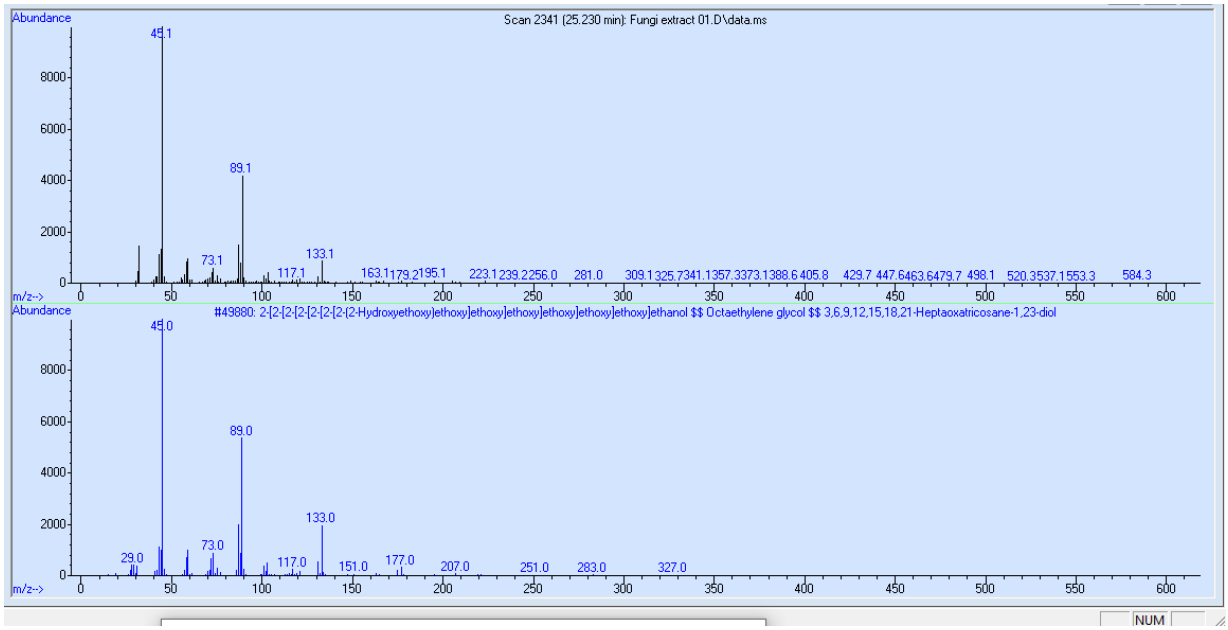

Abundance
Scan 300 (12.027 min): Fungi extract 01.D\data.ms
32.1
73.1
55.1
97.1
126.0
144.1
172.0
188.8
206.9
223.2
239.1
267.0
283.1
299.0
316.0
340.8
361.0
379.7
398.3
417.9
439.1
455.0
480.2
505.0
526.7
555.2
575.7
596.7
m/z-->
Abundance
#48566: N,N-Dimethylformamide diisopropyl acetal $$ N,N-Dimethylformamide di-i-propylacetal $$ Methanamine, N,N-dimethyl-1,1-bis(1-methylethoxy)- $$ Diisopropoxy-N,N-dimethylmethanamine #
45.0
74.0
27.0
131.0
103.0
147.0
175.0
m/z-->

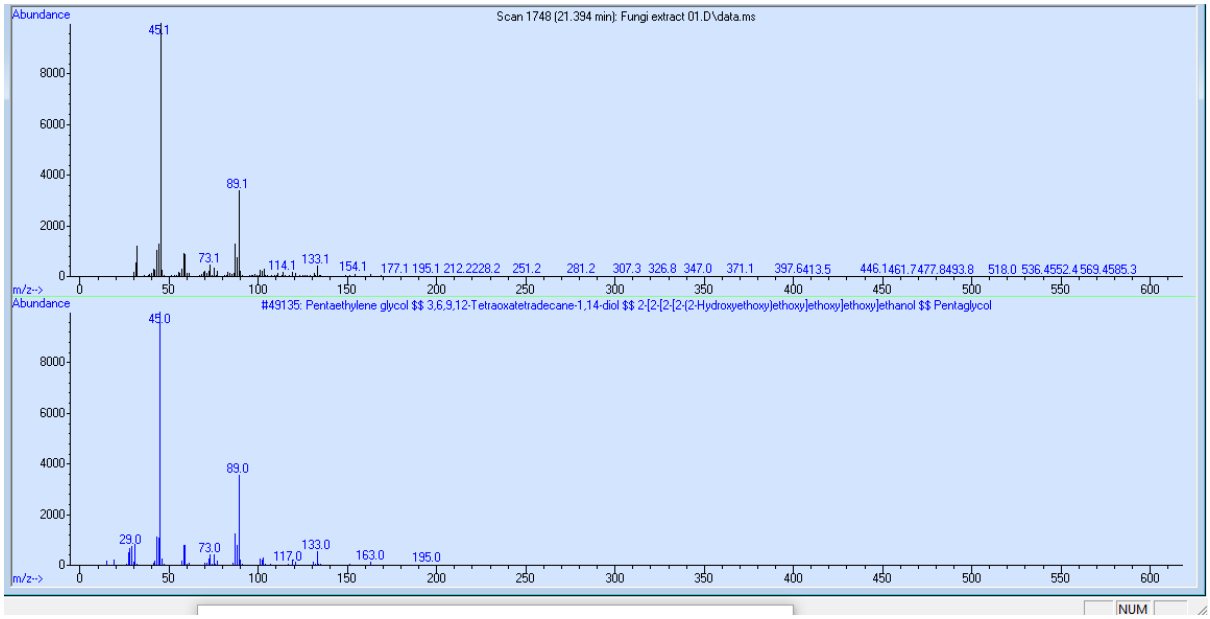

Abundance
Scan 367 (12.461 min): Fungi extract 01.D\data.ms
73.1
43.1
129.1
101.1
155.2
172.2
193.0 212.1 235.2 258.1 281.1 302.1 323.0 341.1 363.1 380.0 401.9 417.3 434.2 458.1 481.9 505.1 521.3 540.3 567.9 584.1
m/z-->
Abundance
#85804: n-Decanoic acid $$ Decanoic acid $$ n-Capric acid $$ n-Decoic acid
60.0
41.0
129.0
87.0
112.0
15.0
155.0
172.0
m/z-->

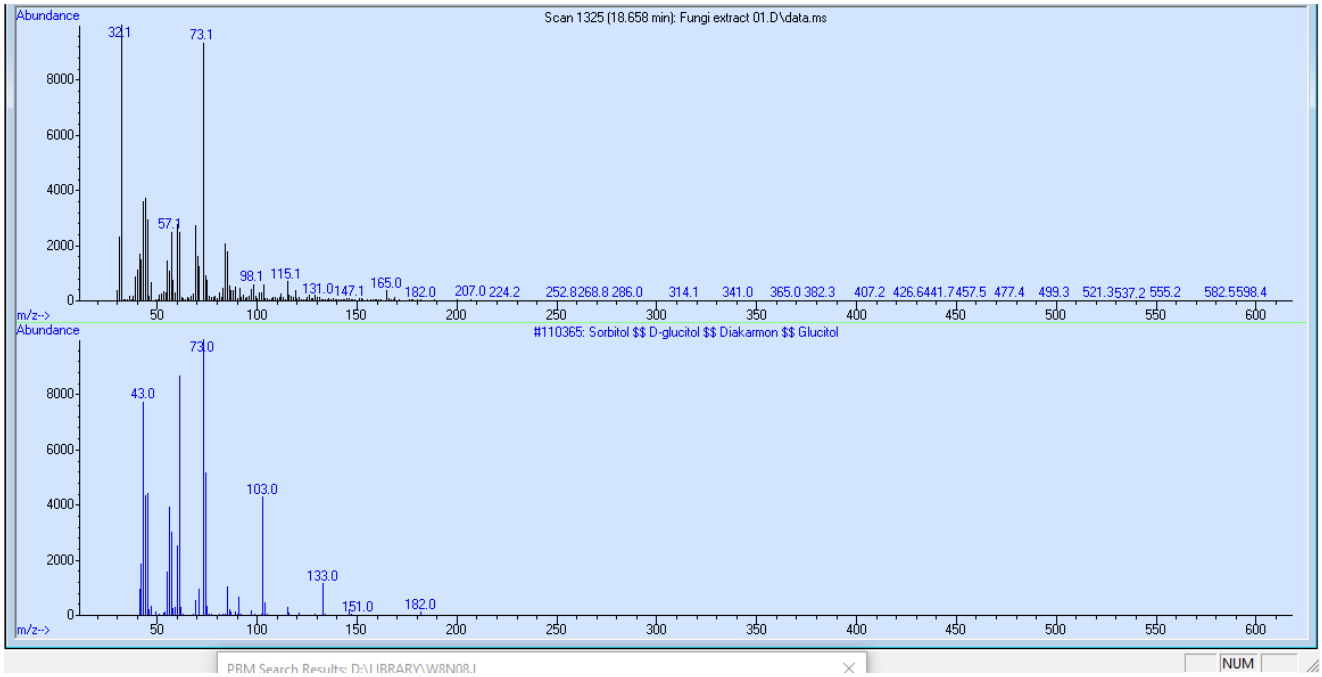

Abundance
Scan 1849 (22.047 min): Fungi extract 01.D\data.ms
104.1
43.1
183.2
81.1
86.1
201.2
126.1
143.1 159.1
223.1 244.2 266.1281.0 311.1 327.1 352.1 370.9 396.6 425.9 451.9 472.0487.7502.9 519.1 535.1 552.7 571.3 589.3
m/z-->
Abundance
#203919: Thiourea, N,N-dimethyl- $$ Urea, 1,1-dimethyl-2-thio- $$ N,N-Dimethylthiourea $$ 1,1-Dimethylthiourea
104.0
44.0
60.0
88.0
m/z-->

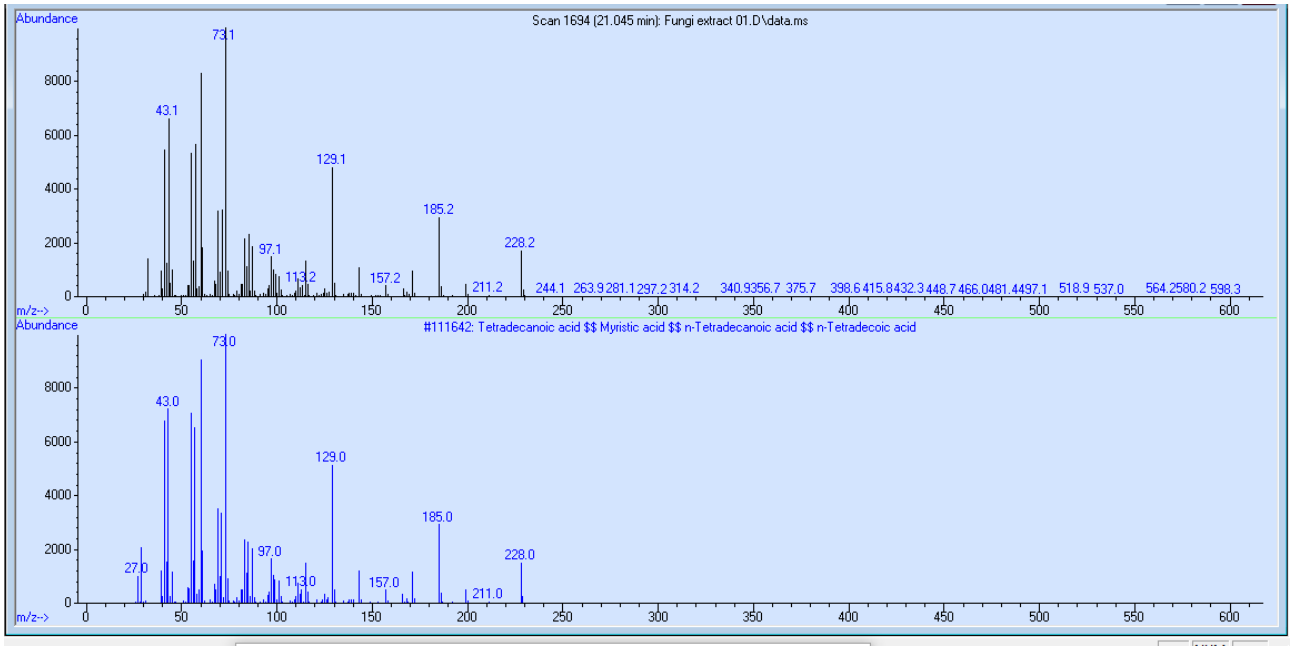

Abundance
Scan 193 (11.335 min): Fungi extract 01.D\data.ms
8000
6000
4000
2000
0
m/z-->
50
100
150
200
250
300
350
400
450
500
550
600
Abundance
#85751: NONANOIC ACID $$ CALCIUM PELARGONATE $$ PELARGONIC ACID $$ POTASSIUM PELARGONATE
8000
6000
4000
2000
0
m/z-->
50
100
150
200
250
300
350
400
450
500
550
600


Abundance
Scan 2545 (26.549 min): Fungi extract 01.D\data.ms
32.1
73.1
57.1
129.2
97.1
284.3
185.2
241.3
113.1
157.1
213.2
264.2
300.6 317.2 340.8356.4371.8387.0403.0418.4434.1 450.8 467.9 493.5509.1524.5541.1556.2 573.4 589.9
m/z-->
Abundance
#33965: OCTADECANOIC ACID $$ STEARATE $$ STEARIC ACID $$ 1-HEPTADECANECARBOXYLIC ACID
43.0
73.0
129.0
97.0
284.0
185.0
241.0
157.0
213.0
256.0
m/z-->
Ready
PBM Search Results: D:\LIBRARY\W8N08.L
NUM


Abundance
Scan 2341 (25.230 min): Fungi extract 01.D\data.ms
45.1
89.1
73.1
133.1
117.1
163.1 179.2 195.1 223.1 239.2 256.0 281.0 309.1 325.7 341.1 357.3 373.1 388.6 405.8 429.7 447.6 463.6 479.7 498.1 520.3 537.1 553.3 584.3
m/z-->
Abundance
#49880: 2-[2-[2-[2-[2-[2-[2-[2-(2-Hydroxyethoxy)ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethoxy]ethanol $$ Octaethylene glycol $$ 3,6,9,12,15,18,21-Heptaoxatricosane-1,23-diol
45.0
89.0
133.0
29.0
73.0
117.0
151.0
177.0
207.0
251.0
283.0
327.0
m/z-->


Abundance
Scan 1748 (21.394 min): Fungi extract 01.D\data.ms
45.1
89.1
73.1
114.1
133.1
154.1
177.1 195.1 212.2228.2 251.2 281.2 307.3 326.8 347.0 371.1 397.6413.5 446.1461.7477.8493.8 518.0 536.4552.4 569.4585.3
m/z-->
Abundance
#49135: Pentaethylene glycol $$ 3,6,9,12-Tetraoxatetradecane-1,14-diol $$ 2-[2-[2-[2-[2-Hydroxyethoxy]ethoxy]ethoxy]ethoxy]ethanol $$ Pentaglycol
45.0
89.0
29.0
73.0
117.0
133.0
163.0
195.0
m/z-->


Abundance
Scan 1325 (18.658 min): Fungi extract 01.D\data.ms
32.1
73.1
57.1
98.1
115.1
131.0
147.1
165.0
182.0
207.0
224.2
252.8
268.8
286.0
314.1
341.0
365.0
382.3
407.2
426.6
441.7
457.5
477.4
499.3
521.3
537.2
555.2
582.5
598.4
m/z-->
Abundance
#110365: Sorbitol $$ D-glucitol $$ Diakarmon $$ Glucitol
73.0
43.0
103.0
133.0
151.0
182.0
m/z-->


Abundance
Scan 1694 (21.045 min): Fungi extract 01.D\data.ms
73.1
43.1
129.1
185.2
228.2
97.1
113.2
157.2
211.2
m/z-->
Abundance
#111642: Tetradecanoic acid $$ Myristic acid $$ n-Tetradecanoic acid $$ n-Tetradecoic acid
73.0
43.0
129.0
185.0
228.0
97.0
27.0
113.0
157.0
211.0
m/z-->

Espinosa, E., Belmant, C., Pont, F., Luciani, B., Poupot, R., Romagné, F., . . . Fournié, J.-J. (2001). Chemical synthesis and biological activity of bromohydrin pyrophosphate, a potent stimulator of human γδ T cells. *Journal of Biological Chemistry, 276*(21), 18337-18344.

Łabuzek, K., Liber, S., Gabryel, B., & Okopień, B. (2010). AICAR (5-aminoimidazole-4-carboxamide-1-β-4-ribofuranoside) increases the production of toxic molecules and affects the profile of cytokines release in LPS-stimulated rat primary microglial cultures. *Neurotoxicology, 31*(1), 134-146.

Madouh, T. A., & Davidson, M. K. (2024). Phytochemical screening and potential effects of Farsetia aegyptia turra seeds: A native desert herb, from Kuwait. *Journal of Tropical Agriculture, 62*(1), 81-96.

Pu, Z.-H., Zhang, Y.-q., Yin, Z.-q., Jiao, X., Jia, R.-y., Yang, L., & Fan, Y. (2010). Antibacterial activity of 9-octadecanoic acid-hexadecanoic acid-tetrahydrofuran-3, 4-diyl ester from neem oil. *Agricultural Sciences in China, 9*(8), 1236-1240.

Raman, J. K., & Gnansounou, E. (2015). Furfural production from empty fruit bunch–A biorefinery approach. *Industrial crops and products, 69*, 371-377.

Renugadevi, K., Nachiyar, V. C., & Zaveri, M. (2021). Bioactivity of dodecanoic acid extracted from Geitlerinema sp. TRV57. *Indian J Pharm Educ Res, 55*(1), 224-231.

Siswadi, S., & Saragih, G. S. (2021). *Phytochemical analysis of bioactive compounds in ethanolic extract of Sterculia quadrifida R. Br.* Paper presented at the AIP Conference Proceedings.

Sung, M. S., Li, Z., Cui, L., Choi, J. S., Choi, W., Park, M. J., . . . Yoon, K. C. (2015). Effect of topical 5-aminoimidazole-4-carboxamide-1-β-d-ribofuranoside in a mouse model of experimental dry eye. *Investigative Ophthalmology & Visual Science, 56*(5), 3149-3158.

Us, D., Berk, B., GÜRDAL, E. E., Aytekin, N., KOCAGÖZ, Z. T., Çağlayan, B., . . . Erol, D. D. (2010). Mannich base derivatives of 3-hydroxy-6-methyl-4H-pyran-4-one with antimicrobial activity. *Turkish Journal of Chemistry, 34*(3), 447-456.