

Catalytic Effect of Ultrananocrystalline Fe₃O₄ on Algal Bio-Crude Production via HTL Process

Arnulfo Rojas-Pérez^a, Daysi Diaz-Diestra^{a,b}, Cecilia B. Frias-Flores^a, Juan Beltran-Huarcac^{a,b}, K. C. Das^c, Brad R. Weiner^{a,b}, Gerardo Morell^{a,b} and Liz M. Díaz-Vázquez^{*a}

Table 1-S: Profile of volatile and semivolatile compounds of the bio-crudes obtained from raw *Ulva fasciata* in absence of UNCFO (only compounds with quality identification factor higher that 70 were considered through NIST library)

Library/ID	Area
1H-Pyrrole	0.0114
2,3,4-Trimethylpyrrole	0.0231
1H-Pyrrole	0.0493
Pyridine	0.084
2-Pyridinamine, 4,6-dimethyl-	0.0094
2-Acetoncyclopentanone	0.0097
Phenol	0.0503
Benzoic acid	0.09
Benzenamine	0.0154
2-Cyclopenten-1-one	0.147
2,4-Heptadiene	0.1024
Nonanoic acid	0.0385
7-Methylindan-1-one	0.0168
3-Methylcatechol	0.1156
Acetophenone	0.1829

Benzenepropanoic acid	0.1005
Anthracene	0.0409
2,5-di-tert-Butyl-1,4-benzoquinone	0.0565
Methylhydroquinon	0.1455
Acetophenone	0.0671
Acetamide	0.08
1H-Indole, 2,6-dimethyl-	0.2334
1,2-Benzenediol	0.1657
Butylated Hydroxytoluene	0.2888
2-Isopropyl-10-methylphenanthrene	0.1123
5-Chloro-3-phenyl-1H-indazole	0.0976
1-Isopropyl-1H-indole	0.1426
Anthracene	0.067
2,5-Diphenyl-2,4-hexadiene	0.0685
2,3,7-Trimethylindole	0.2276
2-Methyl-5-(hexyn-1-yl)pyridine	0.0527

1H-Indole	0.1785
Acetamide,	0.1709
2,4-Diamino-N,N,5-trimethyl-6-quinolinesulfonamide	0.2219
5-Octadecene	0.2917
4-Nitro-4'-chlorodiphenylsulfoxide	0.3376
1,4-Naphthoquinone	0.0926
Benzene	0.0812
5-Amino-6-methoxy-4-methyl-8-nitroquinoline	0.1121
Benzenesulfonamide	0.3824
L-Proline	0.3457
Tetradecanoic acid	0.6458
2,4-Dimethyl-5,8-dimethoxy-6-nitroquinoline	0.2155
n-Pentadecanoic acid	0.3955
6-n-Heptylamino-5,8-quinolinedione	0.1764
cis-9-Hexadecenoic acid	0.5224
Hexadecanoic acid	10.3992
Benzenamine	0.2343

1-Nonadecene	0.2075
Heptadecanoic acid	0.2635
9-Octadecenoic acid	1.6244
n-Hexadecanoic acid	0.3779
Octadecanamide	0.3834
Pyrimidine-5-carbonitrile	0.2562
9,12-Octadecadienoic acid	0.2475
Oleic acid	0.4083
11-trans-Octadecenoic acid	0.8196
Octadecanoic acid	0.6567
Pyrrolo[1,2-a]pyrazine-1,4-dione	0.6425
9-Amino-10,10-dimethyl-9,10-dihydro-10-sila-2-azanthracene	0.1709
n-Propyl 11-octadecenoate	0.1616
i-Propyl 11-octadecenoate	0.1865
Tetracosane	0.2152
1-Hexacosene	0.0512
E-8-Methyl-9-tetradecen-1-ol acetate	0.193
Methoxyacetic acid	0.0697

Table 2-S: Profile of volatile and semivolatile compounds of the bio-crudes obtained from raw *Ulva fasciata* with a UNCFO loading of 0.63 wt.% (only compounds with quality identification factor higher than 70 were considered through NIST library)

Library/ID	Area
Bensulide	1E+06
Acetamide	3E+06
4-Decyne	1E+07
2,4-Hexadiene	1E+07
3-Ethylphenol	3E+07
Cyclopropane	2E+07
2-Cyclopenten-1-one	86034956
Pyridine	2E+08
Propan-2-one	2E+07
Methyl ethyl cyclopentene	5E+07
3-Trimethylsilyloxy-6-methylpyridine	1E+08
Propanoic acid	6E+06
4-Pyridinamine	1E+07
Benzeneacetic acid	2E+07
2-Cyclopenten-1-one	1E+08
4-Quinolinol	2E+07
2-Cyclohexen-1-one	1E+07
2-Methoxy-5-methylphenol	1E+07
Benzene	2E+06
2-Acetyl cyclopentanone	2E+07
Benzenepropanoic acid	5E+07

2,5-Pyrrolidinedione	2E+07
Isoquinoline	5E+06
2-Propynamide	7E+06
n-Butanoic acid	1E+07
1,2,4-Benzenetricarboxylic acid	3E+06
Quinolin-2-ol	2E+07
Ethane	2E+07
2-Ethyl-1-butanol	6E+06
Tetradecanoic acid	2E+06
1H-Indole	2E+07
1H-Indole-3-acetic acid	2E+07
Quinoline	1E+07
3-Cyclohexen-1-one	2E+07
1-Heptene	1E+07
2,5-Dihydroxyacetophenone	3E+06
Indole-5-carboxylic acid	1E+07
2-Octanol	8E+06
Hexadecanoic acid	1E+08
2-Ethyl-3-hydroxyhexanoic acid	1E+06
1,2-Longidione	793756
Benzene	1E+06
10-Undecynoic acid	2E+06

2-Hexanol	5E+07
dl-2-Pentanol	1E+08
Butanoic acid	2E+08
Diethylene glycol	1E+08
2-Methylbutanoic acid	9E+07
Ethanol	4E+08
Propanoic acid	3E+08
Propane	2E+08
1-Butanol	6E+08

Neopentyl alcohol	5E+08
2-Methyl-1-butanol	5E+08
Methyl 3,3-dimethoxypropionate	5E+08
.beta.-Alanine	3E+08
dl-3-Methyl-2-butanol	3E+08
Butanedioic acid	9E+08
2-Propenoic acid	6E+08
Arachidonic acid	1E+09

Table 3-S: Profile of volatile and semivolatile compounds of the bio-crudes obtained from raw *Ulva fasciata* with a UNCFO loading of 1.25 wt.% (only compounds with quality identification factor higher than 70 were considered through NIST library)

Library/ID	Area
Acetamide	68551
2-Cyclopenten-1-one	2E+08
2,4-Hexadiene	3776446
4-(Diethoxyphosphinoyl)-N-methylbutanamide	4E+08
N-Trimethylsilyl-2-pyrrolidinone	3E+08
Pyridine	2E+08
Naphthalene	5E+07
1H-Purine	2E+07
1H-Purine	5E+06
Acridine	5E+07
2-Methyl-5-hydroxybenzofuran	1E+07

2-Methyl-1-ethylpyrrolidine	3E+07
Propanoic acid, pentamethyldisilanyl ester	2E+07
2-Methyl-Z-7-hexadecene	4E+06
Benzoic acid	1E+07
Benzene	2E+07
Benzenepropanoic acid	8E+07
2,5-Pyrrolidinedione	4E+07
9-Methyl-tetradecanoic acid, pyrrolidide	5E+06
(2-Diisopropylaminoethyl) methylphosphonite	1E+07
1-Butanol	1E+07
Hexanoic acid	3E+07
Benzene, (2,2-dimethoxyethyl)-	6E+06

Acetophenone	6E+07
4-Propylacridine	2E+07
1-Dodecanamine	3E+06
1H-Indole	3E+07
Benzenamine	1E+07
2-Methyl-1-butanol	5E+06
n-Pentanoic acid	6E+06
Quinoline	2E+07
1H-Pyrazole	3E+07
Tetradecanoic acid, pyrrolidide	3E+07
1,2-Diethoxybenzene	1E+07
Pentalene-1,5-dione	4E+06
Propanoic acid	2E+06
Hexadecanoic acid	1E+08

Tridecanoic acid	8E+06
Ethanol	92138
Farnesol	1E+06
1,2-Longidione	2E+06
Diethylene glycol	5E+06
2-Hexanol	2E+06
Cyclohexanol	725612
10-Undecen-1-ol	57888
Neopentyl alcohol	19150
Butanedioic acid	574331
n-Butanoic acid	2E+06
Arachidonic acid	1E+06
Erucic acid	1E+07
6-Hydroxy-heptanoic acid	4E+06

Table 4-S: Profile of volatile and semivolatile compounds of the bio-crudes obtained from raw *Ulva fasciata* with a UNCFO loading of 2.50 wt.% (only compounds with quality identification factor higher than 70 were considered through NIST library)

Library/ID	Area
Benzoic acid	1E+07
4-Hydroxy-3-methylbenzaldehyde	945116
3-Ethylphenol	4E+07
Pyridine	3E+08
2-Cyclopenten-1-one	2E+08
Naphthalene	3E+06

3-Trimethylsilyloxy-6-methylpyridine	3E+08
2-Anilino-2-phenylpropionitrile	7E+07
2-Acetyl-5-methylfuran	3E+07
4,7-Phenanthroline	3E+07
Benzenepropanoic acid	4E+06
o-Fluoroacetophenone	1E+07
9,10-Anthracenedione	7E+06

1-(3-Methylbutyl)-2,3,4,5-tetramethylbenzene	2E+07
cis-1,4-Bis(aminomethyl)cyclohexane	4E+07
Propanoic acid	3E+07
3-Ethylcarbazole	2E+07
2-Methoxy-5-methylphenol	5E+07
dl-3-Methyl-2-butanol	2E+06
2-Pyridinecarboxaldehyde	3E+07
2,5-Dimethoxy-4-ethylbenzaldehyde	4E+07
2-Ethyl-5-undecyl-5-pyrroline	2E+07
9H-Carbazole	2E+07
Benzoic acid	8E+06
Butanenitrile	4E+07
3-Methylenecycloheptene	2E+07
Phenol	5E+07
Benzeneacetic acid	3E+06
5-Methyl-5-formylamino-6-imino-hexahydro-2-thioxopyrimidin-4-one	2E+07
(2-Diisopropylaminoethyl)methylphosphonite	1E+07
2,5-Pyrrolidinedione	5E+07
Cyclohexanol	3E+07
5-Acetoacenaphthylene	3E+07
Acetophenone	6E+07
2H-Thiopyrano[4,3-b]pyridine-3-carbonitrile	3E+07
1H-Inden-1-one	2E+07
Thiazolo[4,5-f]quinoline	2E+07
.beta.-Alanine	4E+06

Geraniol	7E+06
1,2-Benzisothiazol-3-amine tms	3E+07
2,5-Diphenyl-2,4-hexadiene	1E+07
1H-Indole	3E+07
2-Ethyl-1-butanol	1E+06
P-Menthane	2E+07
Quinoline	3E+07
1H-Pyrazole	3E+07
Thiazole	2E+07
2-Fluorobenzoic acid	1E+07
Benzenebutanoic acid	2E+06
Geranylgeraniol	2E+07
Tetranoic acid	2E+06
2-heptanol	7E+06
Pentanoic acid	98921
Farnesol	4E+06
1-Butanol	1E+06
Hexadecanoic acid	1E+08
Methyl ethyl cyclopentene	7E+07
2,4(1H,3H)-Pyrimidinedione	84330
2-Butene-1,4-diol	1E+08
.alpha.-Linolenic acid	2E+08
2-Octanol	3E+08
2-Hexanol	3E+08
Allyl(2-pentyloxy)dimethylsilane	4E+08
Androstan-17-one	7E+07
2-Methyl-3-pentanol	4E+08
Diethylene glycol	2E+08

Heptadecanoic acid	2E+08
Butanedioic acid	7E+08

9,12-Octadecadiynoic acid	4E+08
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Table 5-S: Profile of volatile and semivolatile compounds of the bio-crudes obtained from raw *Ulva fasciata* with a UNCFO loading of 3.75 wt.% (only compounds with quality identification factor higher than 70 were considered through NIST library)

Library/ID	Area
Acetamide	1E+07
Phenol	1E+07
1-Propene	1E+07
2,6-Octadiene	128153
6-Isopropylquinoline	5E+07
3-Butanone	3E+07
Isoborneol	1E+07
Pyridine	3E+08
N-Trimethylsilyl-2-pyrrolidinone	3E+08
2-Anilino-2-phenylpropionitrile	7E+07
2,3-Dimethoxyphenylacetic acid	6E+07
Methyl ethyl cyclopentene	7E+07
3-Trimethylsilyloxy-6-methylpyridine	2E+08
4H-1,2,4-Triazole-4-butanoic acid	3E+07
4-Trimethylsilyloxyaniline	3E+07
Carbonochloridothioic acid	2E+07
1,3-Benzenediol	4E+07
2,4(1H,3H)-Pyrimidinedione	3E+06
1-(3,4-Dimethoxy-benzylidene)-6-methyl-	2E+07

1H,5H-furo[3,4-c]pyridine-3,4-dione	
Propanoic acid	8E+06
3-Ethylcarbazole	2E+07
Benzaldehyde,	1E+08
2-Cyclopenten-1-one	2E+08
Z-10-Pentadecenol	7E+06
dl-3-Methyl-2-butanol	3E+07
2-(2-Hydroxyethylamino)-4,6-dimethylbenzothiazole	3E+07
2(3H)-Furanone	2E+06
Benzoic acid	1E+07
Fumaric acid	3E+07
Phenol, 3-phenoxy-	3E+07
Thiazolo[5,4-f]quinoline	2E+07
Pyridine-2,6-dicarboxylic acid	2E+07
2-Amino-4-trimethylsilylbenzoic acid	2E+07
9H-Carbazole	1E+07
2,3(2H)-Imidazole-2-one[b]quinoxaline	4E+07
Benzenepropanoic acid	5E+07
2,5-Pyrrolidinedione	3E+07

9-Methyl-tetradecanoic acid	9E+06
4,4-Dimethyl-2-cyclopenten-1-one	4E+07
3-Amino-2-[2,2-bis(methyloxy)ethyl]benzonitrile	2E+07
Quinazolin-4-yl-O-tolyl-amine	6E+06
1,2,5,6-Tetramethylacenaphthylene	7E+07
Thiophene	7E+06
4-Propylacridine	1E+07
5-(4-Chlorobutyl)hydantoin	3E+07
1,2-Benzisothiazol-3-amine tms	3E+07
Phenanthrene	2E+07
6-Hydroxy-7-nitrotetralin	1E+07
1H-Indole	3E+07
Quinoline	2E+07
Ethanethioic acid	3E+07
1,3,2-Dioxaborinane	3E+07
7-Methylindan-1-one	1E+07
2H-1-Benzopyran-2-one	2E+07
N-(3-Amino-2-hydroxy-phenyl)-acetamide	1E+07
1,2-Diethoxybenzene	1E+07
Geranylgeraniol	9E+06
1-Butanol	2E+06
2-Methyl-3-pentanol	9E+06
Neopentyl alcohol	3E+06
1-Pyrrol[tert-butyl(dimethyl)silyl]oxymorphopropan-2-ol	5E+06
2-Methyl-1-butanol	7E+06
2,3,3-Trimethyl-2-(4-methylpentanoyl)-	2E+07

cyclopentanone	
Diethylene glycol,	2E+06
2-Methylbutanoic acid	2E+06
dl-2-Pentanol	3E+06
.beta.-Alanine	885977
.alpha.-Linolenic acid	629876
Cyclohexanol	105825
Methyl 3,3-dimethoxypropionate	339962
Butanedioic acid	2E+06
9,12-Octadecadiynoic acid	2E+06
Arachidonic acid	3E+06