Supplementary Data

This supplementary data is a part of paper entitled "Catalytic and Thermal Cracking of Bio-Oil from Oil-Palm Empty Fruit Bunches, in Batch Reactor".

Appendix 1. Compounds in the upgrading bio-oil as identified through GC-MS analysis

Name of compound	% Area							
	Treatments							
	A_1B_1	A_1B_2	A_2B_1	A_2B_2	A_3B_1	A_3B_2	A_4B_1	A_4B_2
Aromatic								
Hexane	-	-	-	-	6.62	-	-	5.85
1-Methyl-Indan-2-one	-	-	-	2.05	-	-	-	-
1H-Indene, 2,3-dihydro-4,7-dimethyl-	-	-	-	-	0.53	-	-	-
Benzene, methoxy-	0.71	-	1.34	-	0.40	-	-	0.65
3,4-Dimethoxytoluene	-	0.14	-	-	0.22	-	0.21	0.31
Benzene, 1,2-dimethoxy	0.46	--	-	-	0.21	0.4	-	0.30
Benzeneethanol, 2-methoxy-.alpha.-methyl-	-	-	0.26	-	-	-	-	-
Benzene, 1-ethyl-4-methoxy-	-	-	-	-	-	-	-	0.32
Benzene, 1,4-dimethoxy-	-	-	-	-	-	-	-	0.36
2,3-Dimethoxytoluene	-	-	-	0.67	-	0.54	-	-
Benzaldehyde, 2-hydroxy-	-	-	-	-	-	0.31	-	-
Naphthalene, 2-methyl	-	-	-	-	-	0.34	-	-
Methyl-4-methoxybenzoate	-	1.05	-	1.71	0.32	1.12	0.56	0.53
	1.17	**1.19**	**1.60**	**4.43**	**8.3**	**2.71**	**0.77**	**8.32**
Phenols								
Phenol	38.8	23.0	62.59	33.06	55.62	30.48	34.16	29.26
Phenol, 2-methyl	2.44	-	-	-	-	-	-	-
Phenol, 4-methyl	1.26	-	-	-	-	-	-	-
Phenol, 2-methoxy	2.59	2.51	2.53	4.92	2.64	-	-	-
Phenol, 3-ethyl	0.61	-	-	-	-	-	-	-
Phenol, 4-methoxy-3-methyl	1.03	-	-	-	-	-	-	-
2-Methoxy-4-methylphenol	4.41	2.08	-	-	0.62	-	-	0.9
Phenol, 4-ethyl-2-methoxy-	-	1.40	-	-	-	-	-	-
2-methoxy-4-ethyl-6-methylphenol	-	-	-	-	-	0.24	-	-
	51.14	**28.99**	**65.12**	**37.98**	**58.88**	**30.72**	**34.16**	**30.16**
Aliphatic and Alicyclic								
Tridecane (CAS) n-Tridecane	-	0.17	0.62	0.68	0.37	-	1.45	-
Octadecane (CAS) n-Octadecane	-	0.98	-	-	-	-	2.4	-
Hexadecane (CAS) n-Hexadecane	-	1.78	0.21	1.08	-	2.28	0.76	0.26
Tetradecane (CAS) n-Tetradecane	-	-	0.133	-	0.29	0.92	0.71	2.54
Eicosane (CAS) n-Eicosane	-	-	1.22	-	-	-	-	-
Nonadecane (CAS) n-Nonadecane	-	-	-	-	1.09	-	-	2.06
Dodecane (CAS) n-Dodecane	-	-	-	-	-	3.09	4.07	2.74
Heptadecane, 2,6,10,15-tetramethyl-	-	-	-	-	-	2.59	-	-
Octane (CAS) n-Octane	-	-	-	-	-	-	0.28	-
Nonane (CAS) n-Nonane	-	-	-	-	-	-	0.61	-
Cyclododecane	-	-	-	-	-	-	0.51	-`
Pentacosane (CAS) n-Pentacosane	-	-	-	-	-	-	1.61	
Octacosane	-	-	-	-	-	-	-	0.86
Pentatriacontane	-	1.20	-	-	-	-	-	-
Cyclopentane, methyl	-	-	-	-	-	-	-	0.4

Appendix 1. Compounds in the upgrading bio-oil as identified through GC-MS analysis (*Continued*)

Name of compound	% Area							
	Treatments							
	A_1B_1	A_1B_2	A_2B_1	A_2B_2	A_3B_1	A_3B_2	A_4B_1	A_4B_2
9-Eicosene, (E)	-	-	-	-	0.27	-	-	-
1-Octene (CAS) Caprylene	-	-	-	-	-	-	0.21	-
3-Methylpentane	-	-	-	-	-	-	-	0.60
2-methylpentane	-	-	-	-	-	-	-	0.08
1-Hexadecene (CAS) Cetene	-	-	-	0.45	-	0.31	0.23	0.27
1-Octadecene	-	-	-	2.27	-	0.79	0.77	0.49
1-Nonadecene	0.59	-	-	1.72	-	1.08	1.03	-
	0.59	**4.13**	**2.18**	**6.2**	**2.01**	**11.06**	**14.64**	**10.3**
Ketone								
acetone-oxime	-	-	0.62	-	-	0.19	-	0.10
Ethanone, 1-(2-furanyl)	0.69	-	-	-	0.41	-	-	-
2-Cyclopenten-1-one, 2-methyl-	0.37	-	0.44	-	0.59	-	-	-
2,3-Dimethyl-2-cyclopenten-1-one	1.96	0.27	2.5	2.23	0.82	1.34	1.46	0.93
2-Undecanone	-	-	-	0.33	0.17	0.23	-	0.2
3-isopropylcyclopentyl-2-enone	-	-	-	-	0.21	-	-	-
	0.23	**0.27**	**3.56**	**2.56**	**2.2**	**1.76**	**1.46**	**1.23**
Ester								
Acetic acid, methyl ester	1.16	-	0.93	-	-	0.19	0.18	0.10
Butanoic acid, anhydride	1.97	-	-	-	-	0.69	-	-
Acetic acid, phenyl ester	1.06	-	0.4	0.25	1.75	0.66	0.30	1.06
Octanoic acid, methyl ester	1.45	0.23	2.29	-	0.42	3.13	2.49	5.64
Benzoic acid, methyl ester	-	-	2.75	-	3.06	-	2.64	7.4
Tetradecanoic acid, methyl ester	-	3.11	-	-	-	-	-	-
Dodecanoic acid, methyl ester	6.90	6.41	4.96	12.88	5.36	9.58	10.91	8.71
Decanoic acid, methyl ester	-	0.45	1.01	2.86	1.19	2.43	1.91	2.12
Dodecanoic acid, phenyl ester	-	0.72	-	1.18	-	0.8	0.78	2.63
9-Octadecenoic acid (Z)-, methyl ester	-	2.67	-	0.36	-	-	2.77	0.25
Heptadecanoic acid, 16-methyl- ester	-	0.74	-	-	-	-	-	-
Methyl propanoate	-	-	0.2	-	-	-	-	-
Hexanoic acid, methyl ester	-	-	0.74	-	0.29	-	-	2.08
Octadecoic acid methyl ester	-	-	-	1.84	-	-	-	-
octanoic acid, phenyl ester	-	-	-	0.4	-	0.31	-	0.15
Propanoic acid, phenyl ester	-	-	-	-	0.23	-	-	-
Methyl palmitate	-	-	-	1.7	0.42	1.07	3.00	1.13
Octadecanoic acid, 2-propenyl ester	-	1.88	-	-	-	-	-	-
Heptadecanoic acid, 16-methyl-, methyl ester	-	-	-	-	-	-	0.89	
Pentanoic acid, 4-methyl-, methyl ester	-	-	-	-	-	-	-	0.13
Heptanoic acid, methyl ester	-	-	-	-	-	-	-	0.67
	12.54	**16.21**	**13.28**	**21.47**	**12.72**	**18.86**	**25.87**	**31.94**
Acid								
Acetic acid	5.40	-	10.87	1.91	9.71	-	3.32	4.53
Octanoic acid	4.87	2.04	-	0.75	-	4.28	-	1.28
Hexadecanoic acid	-	0.98	-	-	-	-	-	-
Decanoic acid (CAS) Capric acid	-	0.49	-	-	-	-	-	-
Tetradecanoic acid (CAS) Myristic acid	-	6.60	-	-	-	-	-	-
Dodecanoic acid, 1-(hydroxymethyl)-1,2-ethanediyl	-	0.25	-	-	-	-	-	-
Dodecanoic acid (CAS) Lauric acid	20.10	34.23	-	5.15	-	1.54	8.47	-

Appendix 1. Compounds in the upgrading bio-oil as identified through GC-MS analysis (*Continued*)

Name of compound	% Area							
	Treatments							
	A_1B_1	A_1B_2	A_2B_1	A_2B_2	A_3B_1	A_3B_2	A_4B_1	A_4B_2
Nonanoic acid (CAS) Nonoic acid	-	-	-	-	-	-	0.88	
Propanoic acid (CAS) Propionic acid	-	-	-	-	1.62	-	-	-
Butanoic acid (CAS) n-Butyric acid	-	-	-	-	0.61	-	-	0.65
	30.37	**44.59**	**10.87**	**7.81**	**11.94**	**5.82**	**12.67**	**6.46**
Furan								
2-Furancarboxaldehyde (CAS) Furfural	-	-	-	-	-	-	-	0.34
2,3-Dimethylbenzofuran	-	-	0.59	0.32	0.19	0.29	-	0.82
2-Furanmethanol, tetrahydro-	-	-	-	0.70	-	-	1.00	-
Benzofuran, 2-methyl	0.81	-	0.62	-	0.34	1.12	-	1.36
2-Ethylbenzofuran	0.21	-	-	-	-	-	-	-
2,4-Dimethylfuran	-	-	-	-	-	0.26	-	-
	1.02		**1.21**	**1.02**	**0.53**	**1.67**	**1.00**	**2.52**
Alcohol								
1-Heptadecanol (CAS) n-Heptadecanol	-	0.48	-	-	-	-	-	-
1-Tridecanol (CAS) n-Tridecanol	-	-	-	0.65	-	-	-	-
1-Tetradecanol (CAS) Alfol 14	-	-	-	1.23	0.26	0.51	0.55	1.35
1-Nonanol (CAS) n-Nonyl alcohol	-	-	-	-	-	-	0.25	
1-Dodecanol (CAS) n-Dodecanol	-	-	-	-	-	-	0.23	
1-Undecanol (CAS) n-Undecanol	-	-	-	-	-	0.32	0.39	1.15
7-Dodecenol	-	-	-	-	-	-	-	0.49
	-	**0.48**		**1.88**	**0.26**	**0.83**	**1.42**	**2.99**
Other Compounds		**3.84**	**0.31**	**3.49**	**0.41**	**23.49**	**3.95**	**2.08**
Total	**97.06**	**99.7**	**98.13**	**86.84**	**97.25**	**96.92**	**95.94**	**96**