





Cite this: *Green Chem.*, 2025, **27**, 12483

## Correction: Hydrothermal liquefaction vs. fast/flash pyrolysis for biomass-to-biofuel conversion: new insights and comparative review of liquid biofuel yield, composition, and properties

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DOI: 10.1039/d5gc90176f  
[rs.c.li/greenchem](https://doi.org/10.1039/d5gc90176f)

Correction for 'Hydrothermal liquefaction vs. fast/flash pyrolysis for biomass-to-biofuel conversion: new insights and comparative review of liquid biofuel yield, composition, and properties' by Farid Alizad Oghyanous, *et al.*, *Green Chem.*, 2025, **27**, 7009–7041, <https://doi.org/10.1039/D5GC01314C>.

Authors have made three modifications to the published review article to provide better clarity to the discussion.

1. The beginning of the second paragraph in section 2.2.2 Hydrothermal liquefaction, has been modified to clarify the mention of organic solvent, whereby:

“Instead of utilizing the moisture of biomass as the solvent, organic solvents are also investigated in HTL as they play a key role in bio-crude oil yield. The selection of solvent affects both the temperature needed to achieve the maximum bio-crude yield in the HTL process and the overall yield of bio-crude oil.” has been modified to “While HTL is conventionally defined as a TP occurring in water or aqueous media, some studies have also explored the use of organic solvents or co-solvents to enhance bio-crude oil yield and alter reaction severity. Reaction media play a critical role in determining product yield and composition; the choice of solvent can influence both the optimal reaction temperature and the resulting bio-crude oil yield.”

2. Tables 1 and 2 have been modified by reporting the maximum liquid biofuel yields on a dry basis (db) whenever both the product and feedstock weights were clearly defined on a dry basis to enable more meaningful comparisons. If a different yield basis was used in the original reference, it is now explicitly indicated in parentheses in the table. Sources where the yield basis was not specified are indicated with footnote *b*.

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**Table 1** Biomass elemental composition, ash content, and operational conditions for fast/flash pyrolysis of various biomass for maximizing pyrolysis oil production

Biomass		C (wt%)	H (wt%)	N (wt%)	O (wt%)	Ash (wt%)	T (°C)	Residence time (s)	Particle size (mm)	Reactor type	Max. pyrolysis oil yield <sup>a</sup> (wt%, (db))	Ref.
<b>Lignocellulosic biomass</b>												
Kraft lignin		—	—	—	—	—	399.85	—	—	Fixed bed	24.30	55 <sup>b</sup>
							499.85				30.20	
Wood chips		—	—	—	—	—	599.85	—	—		26.00	56 <sup>b</sup>
							399.85				57.40	
Oat straw		44.11	5.98	0.62	43.65	5.64	599.85	0.75–2.50	0.25–0.75	Drop tube	65.40	56 <sup>b</sup>
							600				71.10	
Corn straw		43.12	6.19	1.44	35.68	13.57	700	0.75–2.75	—		28.51	6
							500				8.47	
Palm kernel shell		48.82	5.68	0.42	45.08	3.87	700	5.00–6.00	0.075–0.125	Entrained flow	52.09	6
							600				9.41	
<b>Microalgae</b>	<i>Chlorella vulgaris</i>	43.75	6.07	7.86	41.61	5.54	600	5.00–6.00	<0.105	Entrained flow	42.24	6
							700				43.63	
							800				45.37	57
		32.10	4.80	5.30	22.10	35.20	480	2.00	2.00	Fluidized bed	55.00 (dry ash-free)	
		45.04	6.88	6.64	29.42	8.34	500	—	0.42–0.70	Fluidized bed	28.20	41
<b>Macroalgae</b>												
<i>Saccharina japonica</i>		32.89	6.17	0.93	60.01	20.21	350	<3.00	0.30–0.50	Bubbling fluidized-bed	44.99 (including water)	58
							375				40.21 (including water)	
							400				37.41 (including water)	59
							425				30.75 (including water)	
							450				28.40 (including water)	60
							500				26.67 (including water)	
<i>Ulva lactuca</i>		33.60	5.10	3.30	28.20	29.10	550	0.50–2.00	<1.00	Centrifugal	65.00 (dry ash-free)	59
Seaweed powder		36.44	5.14	3.72	39.36	14.71	400	60.00	—	Thermogravimetric analyzer	23.57	
							500				31.87	61
							600				36.87	
							700				37.99	61
							400				48.00	
<b>Municipal sludge</b>												
Mixed activated and primary sludge		38.30	5.00	3.40	37.30	16.00	400	1.70	1	Fluidized bubbling bed	53.00	43
Digested sewage sludge		25.50	4.50	4.90	25.80	37.20	450	<1.00	0.50–3.00	Conical spouted bed	70.00 (dry ash-free)	
							500				77.00 (dry ash-free)	62
							600				70.50 (dry ash-free)	
Sewage sludge		40.60	7.10	7.70	41.20	37.20	450	<100.00 ms	0.50–3.00	Conical spouted bed reactor	71.30 (dry ash-free)	62
							500				77.00 (dry ash-free)	
							600				72.30 (dry ash-free)	63
							525				72.83 (including water)	
<b>Food waste</b>												
Waste fish oil		—	—	—	—	—	450	8.00	1	Laboratory auger	22.70	64 <sup>b</sup>
Potato peel waste		43.80	6.00	4.10	46.20	9.30	450				25.60	
Potato peel waste residue		47.80	6.40	4.00	41.80	6.50	—				28.92	65 <sup>b</sup>
Grape seeds powder		50.90	5.40	2.50	36.90	4.10	750	600.00	—	Oven	32.56	
							850					

<sup>a</sup> Maximum pyrolysis oil yield is reported on a dry basis (db). If the dry basis was not specified in the original reference, the reported yield basis (wt%) is indicated in parentheses. <sup>b</sup> References where the yield basis was not specified in the source.



Table 2 Biomass elemental analysis, ash content, and operational conditions for HTL of various feedstocks for bio-crude oil production

Biomass	Name	C (wt%)	H (wt%)	N (wt%)	O (wt%)	Ash (wt%)	Solvent	T (°C)	Residence time (min)	Pressure (bar)	Max. bio-crude oil yield <sup>a</sup> (wt%, (db))	Ref.
<b>Lignocellulosic biomass</b>	Corn stover	43.57	5.84	0.56	49.98	6.96	Water	250 300 350	0.00–60.00	75.84–234.42	22.20 at 15 min and 110.31 bar 29.25 at 0 min and pressure of 151.68 17.70 at 15 min and 179.26 and 217.18 bar 14.25 at 15 min and pressure of 196.5 and 241.31 bar	97 <sup>b</sup>
	Wheat straw	42.15	6.21	0.82	50.82	6.92	K <sub>2</sub> CO <sub>3</sub>	375	15.00	320.00	22.00 (dry ash-free)	98
	Eucalyptus	47.85	5.81	0.10	46.23	1.15		400			28.00 (dry ash-free)	
	Pinewood	49.90	6.30	0.30	42.80	0.59		350			27.00 (dry ash-free)	
	Rice straw	36.20	5.20	0.70	40.30	—	Milli-Q water, tap water, seawater, recycled wastewater, industrial wastewater	350	30.00	180.00	36.40 in industrial wastewater	99 <sup>b</sup>
<b>Microalgae</b>	<i>Chlorella vulgaris</i>	52.60	7.10	8.20	32.20	7.00	Water, Na <sub>2</sub> CO <sub>3</sub> , HCOOH	350	60.00	—	38.00 in water (dry ash-free) 37.50 in water (dry ash-free) 31.00 in water (dry ash-free)	100
	<i>Nannochloropsis occulta</i>	57.80	8.60	25.70	26.40	26.40					22.00 in water (dry ash-free)	101
	<i>Spirulina</i>	55.70	6.80	11.20	26.40	7.60					21.50 (dry ash-free)	
	<i>Porphyridium creatum</i>	51.30	7.60	8.00	33.10	24.40	Water	250 300 350	7.00–30.00	175–225 225–270 260–280	31.00 (dry ash-free) 35.05 (dry ash-free)	
	<i>Scenedesmus obliquus</i>	33.40	4.70	4.40	16.50	40.80		350	1.40 5.80	180.00	39.70 (dry ash-free) 36.80 (dry ash-free)	102
<i>Chlorella</i> sp.	56.20	6.90	7.70	28.70	11.70	Water		15.00		45.00–120.00	18.50 in C <sub>2</sub> H <sub>5</sub> OH 25.20 in C <sub>3</sub> H <sub>5</sub> OH 20.00 in C <sub>2</sub> H <sub>5</sub> OH	103 <sup>b</sup>
<b>Macroalgae</b>	<i>Sargassum tenerrimum</i>	32.10	4.70	0.93	60.72	26.50	Water, C <sub>2</sub> H <sub>5</sub> OH	260 280	15.00		12.00 7.00	104
	<i>Ulva fasciata</i>	—	—	—	—	25.40	Water	280	15.00		9.00	
	<i>Enteromorpha</i> sp.	—	—	—	—	23.20		280			12.50 at 30 min in water	
	<i>Sargassum tenerrimum</i>	—	—	—	—	32.00		280			18.24 in 5% Na <sub>2</sub> CO <sub>3</sub> at 30 min 19.80 in 5% Na <sub>2</sub> CO <sub>3</sub> at 30 min 23 in 5% Na <sub>2</sub> CO <sub>3</sub> at 30 min	105 <sup>b</sup>
	<i>Enteromorpha prolifera</i>	28.75	5.22	3.65	32.28	30.10	Water, 5% Na <sub>2</sub> CO <sub>3</sub>	220 240 260 280 300 320	5.00–60.00		17.65 at 30 min in water	
<b>Municipal sludge</b>	Swine manure	46.02	6.10	2.57	45.31	11.45	Water	350	15.00	—	33.00 (dry ash-free)	106
	Sewage sludge	51.94	7.28	8.33	32.44	25.10					37.00 (dry ash-free)	
	Mixed primary and secondary sludge	47.90	5.70	3.70	32.30	9.80	Water	350	15.00	170.00	38.50 34.70	107
	Primary sludge	47.80	6.50	3.60	34.10	7.50					20.00	
	Secondary sludge	43.60	6.60	7.90	25.00	16.20					30.50 in cycle 2 in water and aqueous phase (dry ash-free)	108
Dehydrated sewage sludge	15.60	2.30	1.00	13.70	67.40	Water, 2.28 aqueous phase: 1 water	330	30.00	250.00			
<b>Food waste</b>	Food waste	48.18	7.3	4.52	39.73	5.40	Water	280 310 340	30.00	—	29.00 30.00 30.00	109
	Food waste	47.80	5.11	4.78	42.10	3.30	Water	200 300 350 400 500 600	30.00 30.00 30.00 1.00 and 30.00 1.00 and 30.00	353 353 138–357 353 353	11.80 28.80 37.4 at 169 bar 30 23 at 1 min 30.5 at 1 min	110
	Food waste	56.16	8.05	2.61	33.19	4.68	Water	280–360	10.00–60.00	12–110	46.9 at 360 °C and 40 min (dry ash-free)	111
	Mixed synthetic food waste											
	Mixed synthetic food waste											

<sup>a</sup> Maximum bio-crude oil yield is reported on a dry basis (db). If the dry basis was not specified in the original reference, the reported yield basis (wt%) is indicated in parentheses. <sup>b</sup> References where the yield basis was not specified in the source.

3. Fig. 6 has been modified to reflect levoglucosan as the major product.

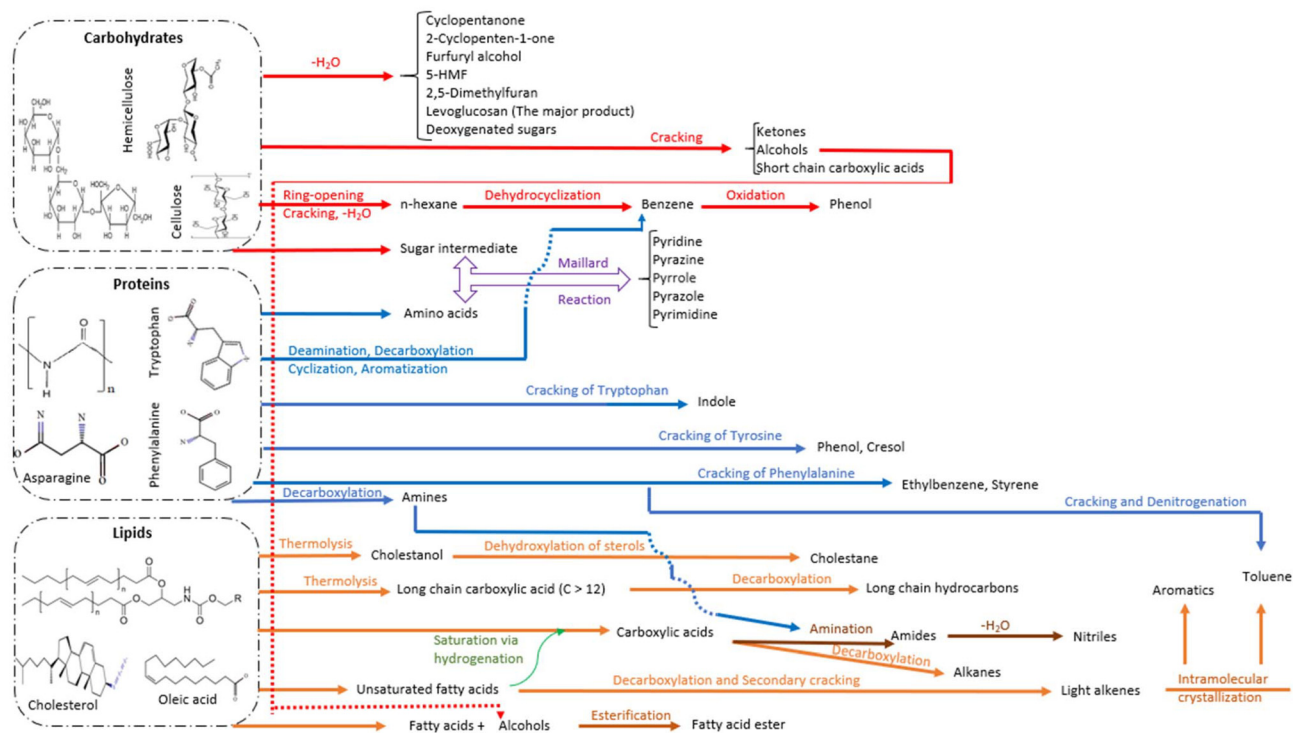


Fig. 6 Plausible reaction pathways of pyrolysis of carbohydrates, proteins, lipids, and lignin.<sup>138,340–344</sup>

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