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Microwave assisted extraction as an important technology for valorising orange waste.

Thomas M. Attard, Baillie Watterson, Vitaliy L. Budarin, James H. Clark and Andrew J. Hunt*

Supplementary information

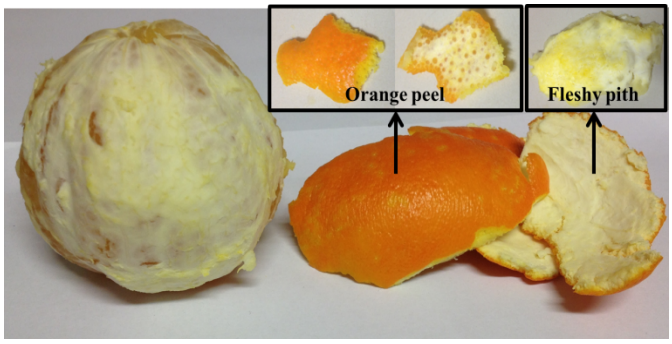

Fig. S1 Illustration of the separation of the peel from the fleshy pith.

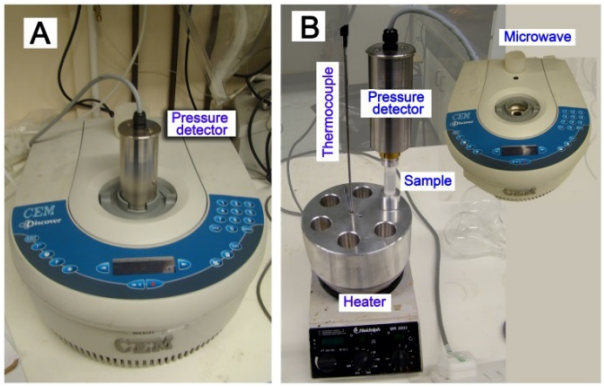

Fig. S2 A) Microwave-assisted extraction set-up B) Conventional heating extraction set-up.

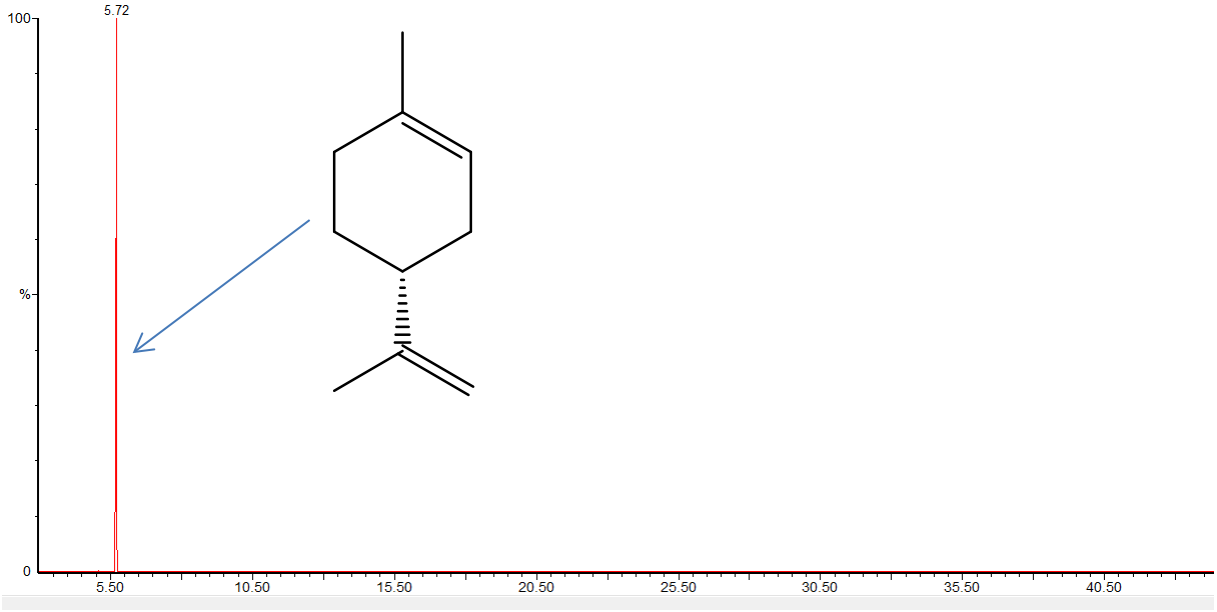

Fig. S3 GC-chromatogram of extract from orange peel prior to addition of external standard (MAE at 110 °C)

Table S1.1 – Raw Data from microwave experiments

Temperature / ° C	Extraction Time / minutes	Raw Material (RM) /g	Extract Yield (E) / g	w/w / g/g	Percentage Yield / %
70	2	0.9967	0.0025	0.002508	0.2508
70	2	1.0176	0.0030	0.002948	0.2948
70	5	0.9974	0.0046	0.004612	0.4612
70	5	1.0112	0.0051	0.005044	0.5044
70	10	1.0058	0.0082	0.008153	0.8153
70	10	1.0032	0.0071	0.007077	0.7077
70	15	1.0083	0.0103	0.010215	1.0215
70	15	0.9990	0.0086	0.008609	0.8609
70	20	1.0482	0.0117	0.011162	1.1162
70	30	1.0058	0.0112	0.011135	1.1135
90	2	0.9984	0.0064	0.006410	0.6410
90	2	0.9997	0.0030	0.003001	0.3001
90	5	0.9926	0.0062	0.006246	0.6246
90	5	0.9960	0.0273	0.027410	2.7410
90	10	0.9939	0.0306	0.030788	3.0788
90	15	0.9927	0.0409	0.041201	4.1201
90	20	1.0081	0.0488	0.048408	4.8408
90	20	1.0019	0.0411	0.041022	4.1022
90	30	1.0164	0.0449	0.044176	4.4176
110	2	1.0186	0.0130	0.012763	1.2763
110	5	0.9957	0.0186	0.018680	1.8680
110	5	1.0016	0.0203	0.020268	2.0268
110	10	1.0057	0.0523	0.052004	5.2004
110	10	0.9944	0.0409	0.041130	4.1130
110	15	1.0166	0.0610	0.060004	6.0004

110	15	1.0037	0.0731	0.072831	7.2831
110	20	0.9939	0.0755	0.075963	7.5963
110	20	1.0135	0.0901	0.088900	8.8900
110	30	0.9992	0.1062	0.106285	10.6285
110	30	1.0160	0.1173	0.115453	11.5453

Table S1.2 - Raw Data from conventional heating experiments

Temperature / ° C	**Extraction Time / minutes**	**Raw Material (RM) /g**	**Extract Yield (E) / g**	**w/w / g/g**	**Percentage Yield / %**
70	2	0.2205	0.0011	0.004989	0.4989
70	2	0.2098	0.0008	0.003813	0.3813
70	5	0.2144	0.0012	0.005597	0.5597
70	5	0.2201	0.0009	0.004089	0.4089
70	10	0.2433	0.0019	0.007809	0.7809
70	10	0.2186	0.0021	0.009607	0.9607
70	15	0.2188	0.0015	0.006856	0.6856
70	15	0.2215	0.0028	0.012641	1.2641
70	20	0.2194	0.0021	0.009572	0.9572
70	30	0.2654	0.0028	0.010550	1.0550
70	30	0.2418	0.0022	0.009098	0.9098
90	2	0.2024	0.0011	0.005435	0.5435
90	2	0.2147	0.0014	0.006521	0.6521
90	5	0.2091	0.0035	0.016738	1.6738
90	5	0.2056	0.0042	0.020428	2.0428
90	10	0.2241	0.0077	0.034360	3.4360
90	10	0.2108	0.0051	0.024194	2.4194
90	15	0.2010	0.0045	0.022388	2.2388
90	15	0.2114	0.0053	0.025071	2.5071
90	20	0.2195	0.0056	0.025513	2.5513
90	20	0.2092	0.0062	0.029637	2.9637
90	30	0.2137	0.0059	0.027609	2.7609
90	30	0.2004	0.0067	0.033433	3.3433
110	2	0.2269	0.0012	0.005289	0.528867
110	2	0.2189	0.0016	0.007309	0.730927
110	5	0.2021	0.0069	0.034142	3.414151
110	5	0.2182	0.0047	0.02154	2.153987
110	10	0.2206	0.0106	0.048051	4.805077
110	10	0.2101	0.0082	0.039029	3.902903
110	15	0.2319	0.0091	0.039241	3.924105
110	15	0.2178	0.0101	0.046373	4.637282
110	20	0.2241	0.0098	0.04373	4.373048
110	20	0.2098	0.0079	0.037655	3.765491
110	30	0.2204	0.0103	0.046733	4.673321

Table S3 - % yield of *D*-Limonene obtained for different extraction techniques.

Extraction technique	Time (mins)	Average D-limonene Yield (%)
Soxhlet (hexane)	420	5.47
MAE (110 °C)	30	11.55
CH (110 °C)	30	4.67

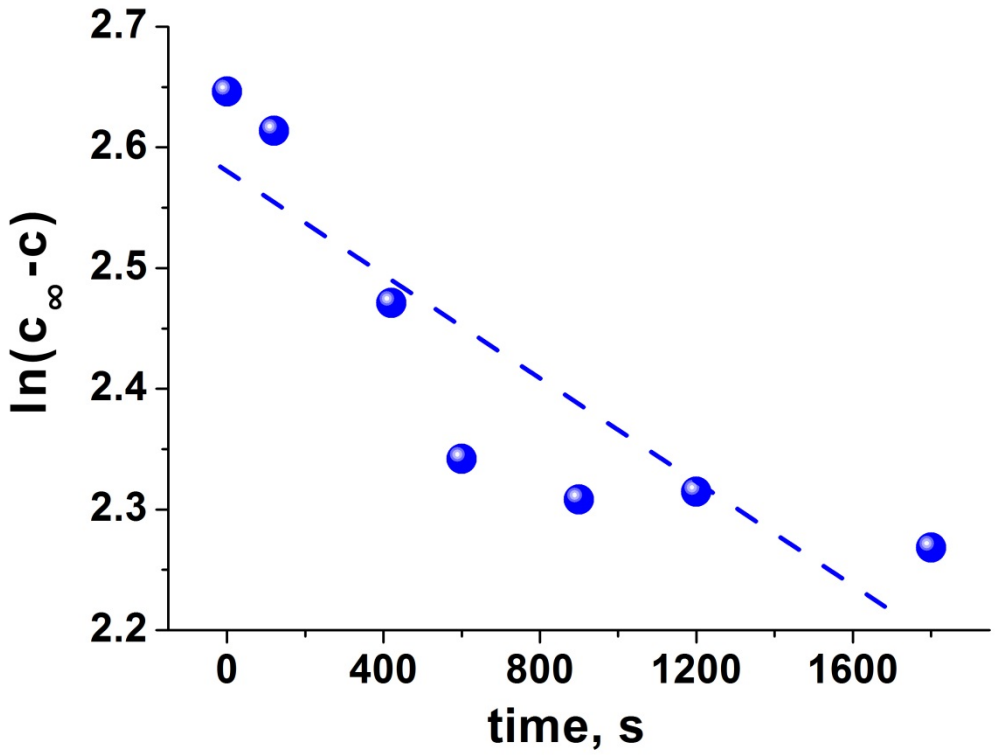

Fig. S4 Graph showing the linear fitting of the data to a one stage extraction model.

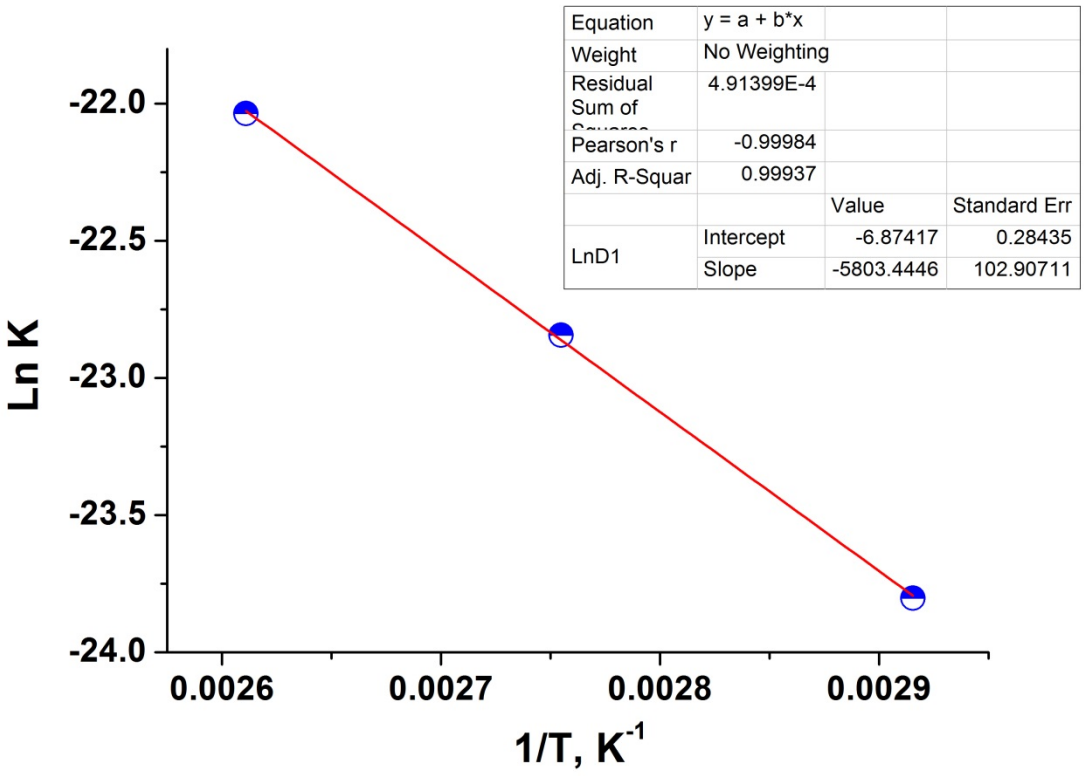

Fig S5 Arrhenius plot for MAE data for first stage of the extraction process

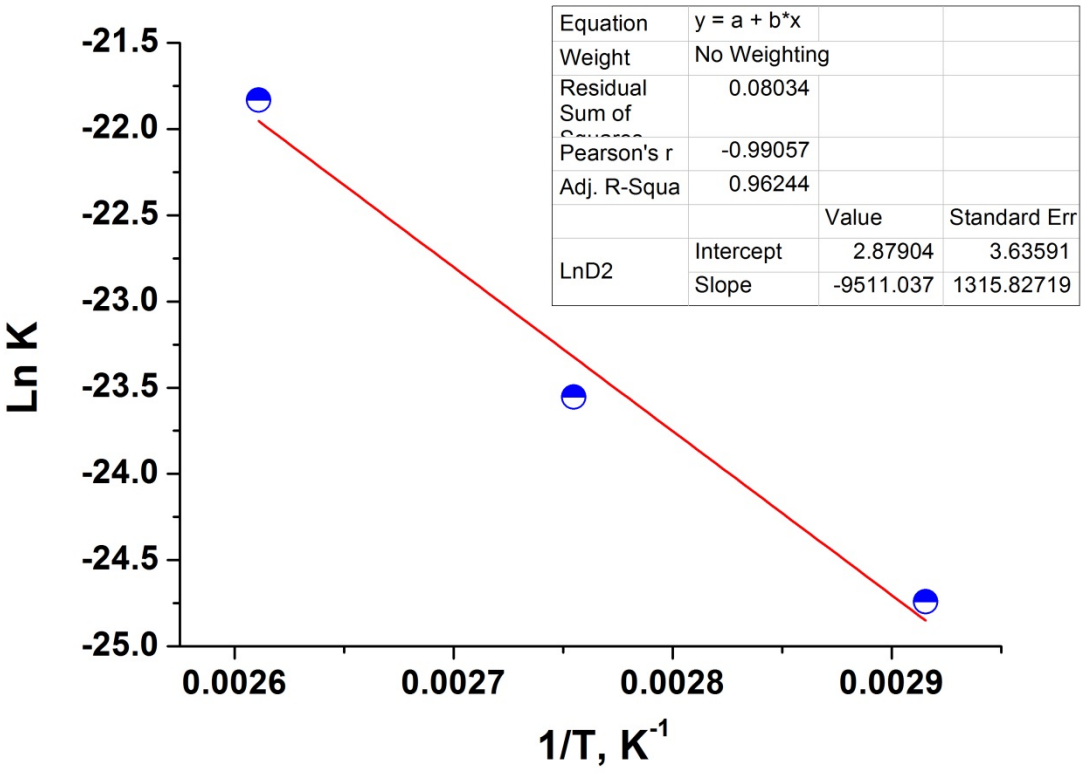

Fig. S6 Arrhenius plot for MAE data for second stage of the extraction process