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## **APPENDICES**



### Table 1

Preliminary results of appropriate nonionic surfactants selection

Code of nonionic surfactant	Concentration	Triplicate	J. kernels (g)	Microemulsion Layer (mm)	Oil (mm)	Oil (g)	Remark
LS1	1%	1	1.0055	2.82		N/A	Monolayer separation, the excess oil phase cannot be measured.
		2	1.0098	2.77		N/A	
		3	1.0062	2.68		N/A	
	3%	1	1.0133	4.25		N/A	
		2	1.0123	4.18		N/A	
		3	1.0017	4.29		N/A	
	5%	1	1.0123	3.85		N/A	
		2	1.0138	5.51		N/A	
		3	1.0053	5.58		N/A	
LS2	1%	1	1.0117	0.69	2.13	0.1127	Microemulsion system is formed. The oil was measurable.
		2	1.0052	0.83	2.26	0.1137	
		3	1.0125	0.99	2.35	0.1183	
	Average		1.0098	0.84	2.25	0.1149	
	3%	1	1.0076	2.93	2.57	0.1603	
		2	1.0094	3.09	2.55	0.1463	
		3	1.0022	2.91	2.42	0.1772	
	Average		1.0064	2.98	2.51	0.1613	
	5%	1	1.0001	5.33	2.61	0.1844	
		2	1.0032	4.92	2.79	0.1844	
3		1.0001	4.10	2.66	0.1800		
Average		1.0011	4.78	2.69	0.1829		

**Table 1 (cont'd)**

Code of nonionic surfactant	Concentration	Triplicate	J. kernels (g)	Microemulsion Layer (mm)	Oil (mm)	Oil (g)	Remark
LS3	1%	1	1.0140	2.75		N/A	Monolayer separation. Cloud is formed in aqueous phase, oil can't be measured.
		2	1.0128	2.58		N/A	
		3	1.0130	2.32		N/A	
	3%	1	1.0010	4.44	1.34	N/A	
		2	1.0101	4.05	1.67	N/A	
		3	1.0047	3.32	1.23	N/A	
	5%	1	1.0059	6.09	1.45	N/A	
		2	1.0097	6.76	1.14	N/A	
		3	1.0055	6.12	1.76	N/A	
LS7	1%	1	1.0095	2.57		N/A	Monolayer separation. Very turbid. Surfactant mixed with oil.
		2	1.0089	3.07		N/A	
		3	1.0242	3.17		N/A	
	3%	1	1.0156	3.20		N/A	
		2	1.0124	3.18		N/A	
		3	1.0077	3.21		N/A	
	5%	1	1.0064	3.01		N/A	
		2	1.0029	3.04		N/A	
		3	1.0032	3.11		N/A	

**Table 1 (cont'd)**

<b>Code of nonionic surfactant</b>	<b>Concentration</b>	<b>Triplicate</b>	<b>J. kernels (g)</b>	<b>Microemulsion Layer (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>Remark</b>
LS9	1%	1	1.0047	3.21		N/A	Monolayer separation. The system was very turbid.
		2	1.0024	3.42		N/A	
		3	1.0184	3.25		N/A	
	3%	1	1.0019	3.36		N/A	
		2	1.0136	3.25		N/A	
		3	1.0109	3.77		N/A	
	5%	1	1.0138	2.90		N/A	
		2	1.0113	2.94		N/A	
		3	1.0192	3.48		N/A	

**Table 2****Appropriate concentration of LS2 nonionic surfactants selection**

Concentration	Triplicate	J. kernels (g)	Microemulsion Layer (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Rematk
1%	1	1.0141	0.58	2.44	0.0751	7.41	13.25	
	2	1.0120	0.63	2.24	0.0792	7.83	14.01	
	3	1.0031	0.63	2.25	0.0827	8.24	14.76	
Average		1.0097	0.61	2.31	0.0790	7.82	14.01	
SD		0.0058	0.0289	0.11	0.0038	0.42	0.75	
1.5%	1	1.0083	0.76	2.51	0.1093	10.84	19.40	
	2	1.0117	0.90	2.39	0.1120	11.07	19.81	
	3	1.0192	0.71	2.11	0.1101	10.80	19.33	
Average		1.0131	0.79	2.34	0.1105	10.90	19.52	
SD		0.0056	0.0985	0.21	0.0014	0.15	0.26	
2%	1	1.0104	1.89	2.11	0.1764	17.46	31.25	
	2	1.0167	1.85	2.22	0.1729	17.01	30.44	
	3	1.0005	1.60	2.43	0.1727	17.26	30.89	
Average		1.0092	1.78	2.25	0.1740	17.24	30.86	
SD		0.0082	0.1572	0.16	0.0021	0.23	0.41	
2.5%	1	1.0068	2.85	2.57	0.2215	22.00	39.37	
	2	1.0053	2.67	2.27	0.2191	21.79	39.01	
	3	1.0003	2.37	2.39	0.2258	22.57	40.40	
Average		1.0041	2.63	2.41	0.2221	22.12	39.59	
SD		0.0034	0.2425	0.15	0.0034	0.40	0.72	

**Table 2 (cont'd)**

Concentration	TriPLICATE	J. kernels (g)	Microemulsion Layer (mm)		Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
3%	1	1.0087	1.31	1.29	2.33	0.1722	17.07	30.55	*** Trilayer separation***
	2	1.0085	1.39	1.23	2.34	0.2039	20.22	36.18	
	3	1.0099	1.17	0.55	2.17	0.1720	17.03	30.48	
Average		1.0090	1.29	1.023	2.28	0.1827	18.11	32.41	
SD		0.0008	N/A		0.10	0.0184	1.83	3.27	
3.5%	1	1.0006	2.14	1.63	2.55	0.2105	21.04	37.65	
	2	1.0176	1.35	0.65	2.50	0.1661	16.32	29.21	
	3	1.0004	1.69	1.73	2.33	0.1721	17.20	30.79	
Average		1.0062	1.73	1.34	2.46	0.1829	18.18	32.55	
SD		0.0099	N/A		0.12	0.0241	2.51	4.49	
4%	1	1.0032	1.56	1.23	2.29	0.1792	17.86	31.97	*** Trilayer separation***
	2	1.0119	1.68	0.76	2.42	0.1595	15.76	28.21	
	3	1.0198	1.65	0.89	2.21	0.1777	17.42	31.19	
Average		1.0116	1.63	0.96	2.31	0.1721	17.02	30.46	
SD		0.0083	N/A		0.11	0.0110	1.11	1.98	
4.5%	1	1.0052	3.19	2.01	2.38	0.1946	19.36	34.65	
	2	1.0127	1.42	1.05	2.4	0.1687	16.66	29.81	
	3	1.0048	3.21	1.93	2.62	0.1980	19.71	35.27	
Average		1.0076	2.61	1.66	2.47	0.1871	18.57	33.24	
SD		0.0045	N/A		0.13	0.0160	1.67	2.99	

**Table 2 (cont'd)**

Concentration	Triplicate	J. kernels (g)	Microemulsion Layer (mm)		Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
5%	1	1.0046	1.35		2.39	0.1621	16.14	28.88	*** Trilayer separation***
	2	1.0060	0.84	0.92	2.69	0.1935	19.23	34.42	
	3	1.0025	1.96	1.93	2.82	0.2601	25.95	46.43	
Average		1.0044	N/A		2.63	0.2052	20.43	36.58	
SD		0.0018	N/A		0.22	0.0500	5.01	8.97	

**Table 3****Extraction efficiency of mixed surfactants aqueous-based solution systems (0.6% NaCl)**

System No.	Triplicate	J. kernels (g)	Microemulsion Layer (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
1	1	1.0033	2.45	2.00	0.1634	16.29	29.15	
	2	1.0030	2.37	1.77	0.1612	16.07	28.76	
	3	1.0034	2.40	1.87	0.1727	17.21	30.80	
	Average	1.0032	2.41	1.88	0.1658	16.52	29.57	
	SD	0.0002	0.04	0.12	0.0061	0.61	1.08	
2	1	1.0000	2.2	2.33	0.1342	13.42	24.02	
	2	1.0002	2.48	2.45	0.1576	15.76	28.20	
	3	1.0001	2.68	2.38	0.1447	14.47	25.89	
	Average	1.0001	2.45	2.39	0.1455	14.55	26.04	
	SD	0.0001	0.24	0.06	0.0117	1.17	2.09	
3	1	1.0034	2.77	2.45	0.1456	14.51	25.97	
	2	1.0033	2.65	2.53	0.1135	11.31	20.24	
	3	1.0030	2.13	2.44	0.1553	15.48	27.71	
	Average	1.0032	2.52	2.47	0.1381	13.77	24.64	
	SD	0.0002	0.34	0.05	0.0219	2.18	3.91	
4	1	1.0049	4.01	2.67	0.2764	27.51	49.23	
	2	1.0049	4.10	2.31	0.2859	28.45	50.92	
	3	1.0049	3.59	2.55	0.2941	29.27	52.38	
	Average	1.0049	3.90	2.51	0.2855	28.41	50.84	
	SD	0.0000	0.27	0.18	0.0089	0.88	1.58	

**Table 3 (cont'd)**

<b>System No.</b>	<b>Triplicate</b>	<b>J. kernels (g)</b>	<b>Microemulsion Layer (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
5	1	1.0030	3.08	2.50	0.2627	26.19	46.88	
	2	1.0029	3.37	2.37	0.2773	27.65	49.49	
	3	1.0026	3.20	2.21	0.2340	23.34	41.77	
	Average	1.0028	3.22	2.36	0.2580	25.73	46.04	
	SD	0.0002	0.15	0.15	0.0220	2.19	3.92	
6	1	1.0083	3.45	2.39	0.2496	24.75	44.30	
	2	1.0083	3.70	2.49	0.2580	25.59	45.79	
	3	1.0082	3.80	2.16	0.2616	25.95	46.44	
	Average	1.0083	3.65	2.35	0.2564	25.43	45.51	
	SD	0.0001	0.18	0.17	0.0062	0.61	1.09	
7	1	1.0038	4.11	2.54	0.3844	38.29	68.54	
	2	1.0037	4.02	2.23	0.3836	38.22	68.40	
	3	1.0038	4.34	2.23	0.3490	34.77	62.22	
	Average	1.0038	4.16	2.33	0.3723	37.09	66.39	
	SD	0.0001	0.17	0.18	0.0202	2.01	3.61	
8	1	1.0023	3.36	2.63	0.3029	30.22	54.09	
	2	1.0021	3.31	2.35	0.3112	31.05	55.58	
	3	1.0024	3.33	2.38	0.3225	32.17	57.58	
	Average	1.0023	3.33	2.45	0.3122	31.15	55.75	
	SD	0.0002	0.03	0.15	0.010	0.98	1.75	



**Table 3 (cont'd)**

System No.	Triplicate	J. kernels (g)	Microemulsion Layer (mm)		Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
9	1	1.0005	3.95		2.39	0.2603	26.02	46.56	
	2	1.0004	3.83		2.59	0.2052	20.51	36.71	
	3	1.0008	3.82		2.49	0.2281	22.79	40.79	
	Average	1.0006	3.87		2.49	0.2312	23.11	41.35	
	SD	0.0002	0.07		0.10	0.0277	2.77	4.95	
10	1	1.0072	3.68		3.06	0.2885	28.64	51.26	
	2	1.0072	3.86		3.12	0.2936	29.15	52.17	
	3	1.0073	4.02		2.73	0.2733	27.13	48.56	
	Average	1.0072	3.85		2.97	0.2851	28.31	50.66	
	SD	0.0001	0.17		0.21	0.0106	1.05	1.88	
11	1	1.0042	3.96		2.80	0.2761	27.49	49.21	
	2	1.0042	3.82		2.78	0.2769	27.57	49.35	
	3	1.0043	4.05		2.59	0.2668	26.57	47.55	
	Average	1.0042	3.94		2.72	0.2733	27.21	48.70	
	SD	0.0001	0.12		0.12	0.0056	0.56	1.00	
12	1	1.0019	2.10	1.76	2.64	0.1552	15.49	27.72	Trilayer separation
	2	1.0017	2.03	1.66	2.99	0.1513	15.10	27.03	
	3	1.0015	2.12	1.51	2.67	0.1275	12.73	22.78	
	Average	1.0017	2.08	1.64	2.77	0.1447	14.44	25.85	
	SD	0.0002	0.05	0.13	0.19	0.0150	1.49	2.67	

**Table 3 (cont'd)**

System No.	Triplicate	J. kernels (g)	Microemulsion Layer (mm)		Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
13	1	1.0090	3.08	1.72	2.94	0.2149	21.30	38.12	Trilayer separation
	2	1.0092	2.26	1.70	2.93	0.2177	21.57	38.61	
	3	1.0096	2.81	1.67	2.66	0.2274	22.52	40.31	
	Average	1.0093	2.72	1.70	2.84	0.2200	21.80	39.01	
	SD	0.0003	0.42	0.03	0.16	0.0066	0.64	1.15	
14	1	1.0003	2.56	1.68	2.58	0.2099	20.98	37.55	Trilayer separation
	2	1.0004	2.38	1.76	2.55	0.2305	23.04	41.24	
	3	1.0002	2.12	1.79	2.66	0.2805	28.04	50.19	
	Average	1.0003	2.35	1.74	2.60	0.2403	24.02	42.99	
	SD	0.0001	0.22	0.06	0.06	0.0363	3.63	6.50	
15	1	1.0066	1.58	2.23	2.49	0.1962	19.49	34.88	Trilayer separation
	2	1.0066	1.72	2.34	2.65	0.2161	21.47	38.42	
	3	1.0062	1.73	2.05	2.75	0.2192	21.78	38.99	
	Average	1.0065	1.68	2.21	2.63	0.2105	20.91	37.43	
	SD	0.0002	0.08	0.15	0.13	0.0125	1.24	2.22	
16	1	1.0072	2.08	2.06	3.14	0.3232	32.09	57.43	Trilayer separation
	2	1.0070	2.14	2.59	2.81	0.3318	32.95	58.97	
	3	1.0072	2.41	2.24	3.16	0.3195	31.72	56.77	
	Average	1.0071	2.21	2.30	3.04	0.3248	32.25	57.72	
	SD	0.0001	0.18	0.27	0.20	0.0063	0.63	1.13	

**Table 3 (cont'd)**

System No.	Triplicate	J. kernels (g)	Microemulsion Layer (mm)		Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
17	1	1.0021	1.88	2.55	3.07	0.3132	31.25	55.94	Trilayer separation
	2	1.0020	1.55	2.77	2.71	0.2632	26.27	47.01	
	3	1.0019	1.54	2.24	3.16	0.2376	23.71	42.44	
	Average	1.0020	1.66	2.52	2.98	0.2713	27.08	48.46	
	SD	0.0001	0.19	0.27	0.24	0.0385	3.83	6.86	
18	1	1.0092	1.93	2.86	2.84	0.2644	26.20	46.89	Trilayer separation
	2	1.0095	1.44	2.46	3.26	0.2701	26.76	47.89	
	3	1.0092	1.63	2.53	3.18	0.2301	22.80	40.81	
	Average	1.0093	1.67	2.62	3.09	0.2549	25.25	45.19	
	SD	0.0002	0.25	0.21	0.22	0.0216	2.14	3.83	
19	1	1.0054	2.02	3.24	2.66	0.3565	35.46	63.46	Trilayer separation
	2	1.0055	1.96	2.68	3.47	0.3888	38.67	69.20	
	3	1.0059	2.32	2.71	2.44	0.3271	32.52	58.20	
	Average	1.0056	2.10	2.88	2.86	0.3575	35.55	63.62	
	SD	0.0003	0.19	0.32	0.54	0.0309	3.08	5.50	
20	1	1.0035	1.84	3.31	2.88	0.2831	28.21	50.49	Trilayer separation
	2	1.0031	1.86	2.74	3.04	0.2994	29.85	53.42	
	3	1.0039	1.84	3.27	2.89	0.3148	31.36	56.12	
	Average	1.0035	1.85	3.11	2.94	0.2991	29.81	53.34	
	SD	0.0004	0.01	0.32	0.09	0.0159	1.57	2.82	

**Table 3 (cont'd)**

<b>System No.</b>	<b>Triplicate</b>	<b>J. kernels (g)</b>	<b>Microemulsion Layer (mm)</b>		<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
21	1	1.0010	1.96	3.42	2.84	0.2940	29.37	52.57	Trilayer separation
	2	1.0007	2.16	2.83	3.01	0.3151	31.49	56.35	
	3	1.0006	2.03	3.37	2.80	0.2704	27.02	48.36	
	Average	1.0008	2.05	3.21	2.88	0.2932	29.29	52.43	
	SD	0.0002	0.10	0.33	0.11	0.0224	2.23	4.00	

**Table 4****Extraction efficiency of system 10 (3% LS2 + 0.02% Alfoterra 145-4PO) with salinity scan**

<b>% NaCl</b>		<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
0.2	1	1.0057	4.55	2.99	0.2559	25.44	45.54	Clear
	2	1.0057	4.68	2.38	0.2632	26.17	46.84	Clear
	3	1.0057	4.54	2.36	0.2573	25.58	45.79	Clear
Average		1.0057	4.59	2.58	0.2588	25.73	46.06	
SD		0	0.08	0.36	0.0039	0.39	0.69	
0.4	1	1.0044	4.79	2.28	0.3262	32.48	58.12	Clear
	2	1.0043	4.30	2.42	0.3390	33.75	60.41	Clear
	3	1.0043	4.24	2.38	0.3050	30.37	54.35	Clear
Average		1.0043	4.44	2.36	0.3234	32.20	57.63	
SD		0.0001	0.30	0.07	0.0172	1.71	3.06	
0.6	1	1.0052	3.49	2.59	0.3598	35.79	64.06	Clear
	2	1.0052	3.47	2.66	0.3436	34.18	61.18	Clear
	3	1.0052	3.54	2.76	0.3699	36.80	65.86	Clear
Average		1.0052	3.50	2.67	0.3578	35.59	63.70	
SD		0.0000	0.04	0.09	0.0133	1.32	2.36	
0.8	1	1.0093	3.97	2.66	0.3065	30.37	54.35	Clear
	2	1.0091	4.06	2.45	0.3012	29.85	53.42	Clear
	3	1.0093	3.61	2.61	0.3247	32.17	57.58	Clear
Average		1.0092	3.88	2.57	0.3108	30.80	55.12	
SD		0.0001	0.24	0.11	0.0123	1.22	2.18	
1	1	1.0072	3.15	2.7	0.3018	29.96	53.63	Clear
	2	1.0075	2.61	2.82	0.2954	29.32	52.47	Clear
	3	1.0072	2.98	2.48	0.3009	29.87	53.47	Clear
Average		1.0073	2.91	2.67	0.2994	29.72	53.19	
SD		0.0002	0.28	0.17	0.0035	0.35	0.62	

**Table 4 (cont'd)**

**Extraction efficiency of system 11 (3% LS2 + 0.04% Alfoterra 145-4PO) with salinity scan**

% NaCl		J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
0.2	1	1.0014	4.05	2.39	0.2521	25.17	45.06	Clear
	2	1.0013	4.10	2.44	0.2605	26.02	46.56	Clear
	3	1.0014	3.82	2.64	0.2447	24.44	43.73	Clear
Average		1.0014	3.99	2.49	0.2524	25.21	45.12	
SD		0.0001	0.15	0.13	0.0079	0.79	1.42	
0.4	1	1.002	3.16	2.72	0.3364	33.57	60.09	Clear
	2	1.0018	2.76	2.97	0.3317	33.11	59.26	Clear
	3	1.0020	3.31	2.56	0.3361	33.54	60.03	Clear
Average		1.0019	3.08	2.75	0.3347	33.41	59.79	
SD		0.0001	0.28	0.21	0.0026	0.26	0.46	
0.6	1	1.004	3.19	2.79	0.3472	34.58	61.89	Clear
	2	1.004	3.39	2.70	0.3403	33.89	60.66	Clear
	3	1.0039	3.16	2.62	0.3313	33.00	59.06	Clear
Average		1.0040	3.25	2.70	0.3396	33.83	60.54	
SD		0.0001	0.13	0.09	0.0080	0.79	1.42	
0.8	1	1.0019	2.8	2.89	0.2928	29.22	52.30	Clear
	2	1.0019	2.72	2.62	0.3016	30.10	53.88	Clear
	3	1.0019	2.54	2.9	0.2882	28.77	51.48	Clear
Average		1.0019	2.69	2.80	0.2942	29.36	52.55	
SD		0.0000	0.13	0.16	0.0068	0.68	1.22	
1	1	1.0001	3.29	3.08	0.2811	28.11	50.30	Clear
	2	1.0000	2.87	2.58	0.2919	29.19	52.24	Clear
	3	1.0000	3.21	2.94	0.2796	27.96	50.04	Clear
Average		1.0000	3.12	2.87	0.2842	28.42	50.86	
SD		0.0001	0.22	0.26	0.0067	0.67	1.20	

**Table 5****Extraction efficiency of system 10 (3% LS2 + 0.02% Alfoterra 145-4PO) with salinity scan and ultrasonication**

% NaCl		J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Remark
0.2	1	1.0082	3.94	2.20	0.2447	24.27	43.44	Very turbid
	2	1.0087	2.95	1.70	0.1054	10.45	18.70	Very turbid
	3	1.0085	4.26	2.38	0.2417	23.97	42.89	Very turbid
Average		1.0085	3.72	2.09	0.1973	19.56	35.01	
SD		0.0003	0.68	0.35	0.0796	7.89	14.13	
0.4	1	1.006	3.87	2.36	0.1828	18.17	32.52	Very turbid
	2	1.0062	3.76	2.5	0.1696	16.86	30.17	Very turbid
	3	1.0061	4.42	2.22	0.1868	18.57	33.23	Very turbid
Average		1.0061	4.02	2.36	0.1797	17.86	31.97	
SD		0.0001	0.35	0.14	0.0090	0.90	1.60	
0.6	1	1.0045	3.63	2.38	0.216	21.50	38.48	Very turbid
	2	1.0043	3.78	2.21	0.1686	16.79	30.05	Very turbid
	3	1.0043	3.77	2.60	0.1985	19.77	35.37	Very turbid
Average		1.0044	3.73	2.40	0.1944	19.35	34.63	
SD		0.0001	0.08	0.20	0.0240	2.38	4.27	
0.8	1	1.0065	3.47	2.69	0.172	17.09	30.58	Very turbid
	2	1.0068	3.00	2.53	0.1705	16.93	30.31	Very turbid
	3	1.0063	3.44	2.42	0.1721	17.10	30.61	Very turbid
Average		1.0065	3.30	2.55	0.1715	17.04	30.50	
SD		0.0003	0.26	0.14	0.0009	0.09	0.17	
1	1	1.0092	3.37	2.82	0.2067	20.48	36.66	Very turbid
	2	1.0097	2.95	2.64	0.219	21.69	38.82	Very turbid
	3	1.0096	3.03	2.83	0.2048	20.29	36.30	Very turbid
Average		1.0095	3.12	2.76	0.2102	20.82	37.26	
SD		0.0003	0.22	0.11	0.0077	0.76	1.36	

**Table 5 (cont'd)****Extraction efficiency of system 11 (3% LS2 + 0.04% Alfoterra 145-4PO) with salinity scan and ultrasonication**

<b>% NaCl</b>		<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
0.2	1	1.0054	3.61	2.62	0.2058	20.47	36.63	Very turbid
	2	1.0053	3.00	2.98	0.2015	20.04	35.87	Very turbid
	3	1.0054	3.44	2.72	0.2139	21.28	38.08	Very turbid
Average		1.0054	3.35	2.77	0.2071	20.60	36.86	
SD		0.0001	0.31	0.19	0.0063	0.63	1.12	
0.4	1	1.0060	3.19	2.79	0.1985	19.73	35.31	Very turbid
	2	1.0061	2.91	2.99	0.1890	18.79	33.62	Very turbid
	3	1.0060	3.40	2.63	0.1870	18.59	33.27	Very turbid
Average		1.0060	3.17	2.80	0.1915	19.04	34.07	
SD		0.0001	0.25	0.18	0.0061	0.61	1.09	
0.6	1	1.0018	3.00	2.82	0.1785	17.82	31.89	Very turbid
	2	1.0019	2.71	2.82	0.2186	21.82	39.05	Very turbid
	3	1.0018	3.12	2.65	0.2048	20.44	36.59	Very turbid
Average		1.0018	2.94	2.76	0.2006	20.03	35.84	
SD		0.0001	0.21	0.10	0.0204	2.03	3.64	
0.8	1	1.0034	2.69	2.76	0.1548	15.43	27.61	Very turbid
	2	1.0033	3.57	2.45	0.1519	15.14	27.10	Very turbid
	3	1.0034	2.41	2.62	0.1655	16.49	29.52	Very turbid
Average		1.0034	2.89	2.61	0.1574	15.69	28.08	
SD		0.0001	0.61	0.16	0.0072	0.71	1.28	
1	1	1.0012	2.76	2.53	0.1607	16.05	28.73	Very turbid
	2	1.0011	2.55	2.59	0.1553	15.51	27.76	Very turbid
	3	1.0011	2.27	2.66	0.1524	15.22	27.25	Very turbid
Average		1.0011	2.53	2.59	0.1561	15.60	27.91	
SD		0.0001	0.25	0.07	0.0042	0.42	0.75	



**Table 6****Extraction efficiency at various contact time****0 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0029	3.57	2.14	0.2023	20.17	36.10	
1/(2)	1.0029	3.86	2.25	0.2059	20.53	36.74	
1/(3)	1.0025	3.77	1.96	0.2082	20.77	37.17	
Average	1.0028	3.73	2.12	0.2055	20.49	36.67	
SD	0.0002	0.15	0.15	0.0030	0.30	0.54	
2/(1)	1.0073	4.01	2.45	0.3053	30.31	54.24	
2/(2)	1.0072	4.20	2.35	0.3016	29.94	53.59	
2/(3)	1.0084	3.79	2.23	0.3251	32.24	57.70	
Average	1.0076	4.00	2.34	0.3107	30.83	55.18	
SD	0.0007	0.21	0.11	0.0126	1.23	2.21	
3/(1)	1.0043	4.20	2.15	0.2719	27.07	48.45	
3/(2)	1.0044	4.22	2.15	0.2758	27.46	49.14	
3/(3)	1.0036	4.19	2.14	0.2974	29.63	53.04	
Average	1.0041	4.20	2.15	0.2817	28.05	50.21	
SD	0.0004	0.02	0.01	0.0137	1.38	2.47	
4/(1)	1.0065	4.25	2.25	0.2583	25.66	45.93	
4/(2)	1.0073	4.26	2.42	0.2482	24.64	44.10	
4/(3)	1.0090	4.09	2.35	0.2598	25.75	46.08	
Average	1.0076	4.20	2.34	0.2554	25.35	45.37	
SD	0.0013	0.10	0.09	0.0063	0.62	1.10	

**Table 6 (cont'd)****1 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0001	3.18	2.63	0.3296	32.96	58.98	
1/(2)	1.0001	3.49	2.47	0.2952	29.52	52.83	
1/(3)	1.0001	3.50	2.29	0.3167	31.67	56.67	
Average	1.0001	3.39	2.46	0.3138	31.38	56.16	
SD	0.0000	0.18	0.17	0.0174	1.74	3.11	
2/(1)	1.0022	3.61	2.57	0.4085	40.76	72.95	
2/(2)	1.0020	3.52	2.50	0.3783	37.75	67.57	
2/(3)	1.0021	3.46	2.46	0.3815	38.07	68.13	
Average	1.0021	3.53	2.51	0.3894	38.86	69.55	
SD	0.0001	0.08	0.06	0.0166	1.65	2.96	
3/(1)	1.0071	3.82	2.41	0.3301	32.78	58.66	
3/(2)	1.0071	4.36	2.44	0.3338	33.14	59.32	
3/(3)	1.0071	3.52	2.79	0.3464	34.40	61.56	
Average	1.0071	3.90	2.55	0.3368	33.44	59.85	
SD	0.0000	0.43	0.21	0.0085	0.85	1.52	
4/(1)	1.0012	3.86	2.28	0.3176	31.72	56.77	
4/(2)	1.0012	3.70	2.56	0.3097	30.93	55.36	
4/(3)	1.0012	3.71	2.39	0.3331	33.27	59.54	
Average	1.0012	3.76	2.41	0.3201	31.97	57.23	
SD	0.0000	0.09	0.14	0.0119	1.19	2.13	

**Table 6 (cont'd)**

**3 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0045	3.15	2.45	0.2509	24.98	44.70	
1/(2)	1.0045	3.13	1.90	0.2208	21.98	39.34	
1/(3)	1.0047	2.83	2.57	0.2514	25.02	44.78	
Average	1.0046	3.04	2.31	0.2410	23.99	42.94	
SD	0.0001	0.18	0.36	0.0175	1.74	3.12	
2/(1)	1.0030	3.37	2.43	0.3218	32.08	57.42	
2/(2)	1.0033	3.88	2.41	0.3432	34.21	61.22	
2/(3)	1.0032	3.15	2.53	0.3307	32.96	59.00	
Average	1.0032	3.47	2.46	0.3319	33.09	59.21	
SD	0.0002	0.37	0.06	0.0108	1.07	1.91	
3/(1)	1.0010	3.83	2.56	0.3139	31.36	56.12	
3/(2)	1.0009	3.84	1.85	0.3288	32.85	58.79	
3/(3)	1.0009	4.05	2.22	0.3410	34.07	60.97	
Average	1.0009	3.91	2.21	0.3279	32.76	58.63	
SD	0.0001	0.12	0.36	0.0136	1.36	2.43	
4/(1)	1.0025	3.71	2.54	0.3010	30.02	53.74	
4/(2)	1.0025	3.93	2.15	0.3289	32.81	58.72	
4/(3)	1.0026	3.62	2.55	0.3075	30.67	54.89	
Average	1.0025	3.75	2.41	0.3125	31.17	55.78	
SD	0.0001	0.16	0.23	0.0146	1.46	2.61	

**Table 6 (cont'd)**

**5 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0012	3.24	2.11	0.2836	28.33	50.70	
1/(2)	1.0013	3.19	2.19	0.2475	24.72	44.24	
1/(3)	1.0013	3.09	2.38	0.2848	28.44	50.90	
Average	1.0013	3.17	2.23	0.2720	27.16	48.61	
SD	0.0001	0.08	0.14	0.0212	2.12	3.79	
2/(1)	1.0015	3.69	2.21	0.3586	35.81	64.08	
2/(2)	1.0015	3.45	2.37	0.3284	32.79	58.69	
2/(3)	1.0015	3.03	2.81	0.3434	34.29	61.37	
Average	1.0015	3.39	2.46	0.3435	34.30	61.38	
SD	0.0000	0.33	0.31	0.0151	1.51	2.70	
3/(1)	1.0016	3.31	2.22	0.3514	35.08	62.79	
3/(2)	1.0015	3.84	2.39	0.3207	32.02	57.31	
3/(3)	1.0015	3.55	2.11	0.3102	30.97	55.43	
Average	1.0015	3.57	2.24	0.327433	32.69	58.51	
SD	0.0001	0.27	0.14	0.0214	2.14	3.82	
4/(1)	1.0082	2.47	2.45	0.3066	30.41	54.43	
4/(2)	1.0083	3.62	2.51	0.2952	29.28	52.40	
4/(3)	1.0083	3.50	2.44	0.3249	32.22	57.67	
Average	1.0083	3.20	2.47	0.3089	30.64	54.83	
SD	0.0001	0.63	0.04	0.0150	1.49	2.66	

**Table 6 (cont'd)**

**7 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0028	3.36	2.41	0.1892	18.87	33.77	
1/(2)	1.0029	3.60	2.39	0.2207	22.01	39.38	
1/(3)	1.0027	3.75	2.57	0.2264	22.58	40.41	
Average	1.0028	3.57	2.46	0.2121	21.15	37.85	
SD	0.0001	0.20	0.10	0.0200	2.00	3.58	
2/(1)	1.0073	4.25	2.19	0.3603	35.77	64.02	
2/(2)	1.0072	4.02	2.58	0.3648	36.22	64.82	
2/(3)	1.0070	4.31	2.23	0.3218	31.96	57.19	
Average	1.0072	4.19	2.33	0.3490	34.65	62.01	
SD	0.0002	0.15	0.21	0.0236	2.34	4.19	
3/(1)	1.0004	4.27	2.33	0.2530	25.29	45.26	
3/(2)	1.0005	4.30	2.50	0.2787	27.86	49.85	
3/(3)	1.0003	4.37	2.45	0.2147	21.46	38.41	
Average	1.0004	4.31	2.43	0.2488	24.87	44.51	
SD	0.0001	0.05	0.09	0.0322	3.22	5.76	
4/(1)	1.0034	4.28	2.28	0.2031	20.24	36.23	
4/(2)	1.0034	4.05	2.44	0.2331	23.23	41.58	
4/(3)	1.0033	4.12	2.62	0.2134	21.27	38.07	
Average	1.0034	4.15	2.45	0.2165	21.58	38.62	
SD	0.0001	0.12	0.17	0.0152	1.52	2.72	

**Table 6 (cont'd)**

**9 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.001	3.23	2.51	0.1534	15.32	27.43	
1/(2)	1.001	3.15	2.42	0.1698	16.96	30.36	
1/(3)	1.001	3.28	2.32	0.1744	17.42	31.18	
Average	1.001	3.22	2.42	0.1659	16.57	29.66	
SD	0.0000	0.07	0.10	0.0110	1.10	1.97	
2/(1)	1.0008	3.22	2.64	0.2198	21.96	39.31	
2/(2)	1.0008	3.45	2.70	0.2193	21.91	39.22	
2/(3)	1.0008	3.55	2.40	0.2160	21.58	38.63	
Average	1.0008	3.41	2.58	0.2184	21.82	39.05	
SD	0.0000	0.17	0.16	0.0021	0.21	0.37	
3/(1)	1.0055	3.46	2.13	0.1730	17.21	30.79	
3/(2)	1.0054	3.43	2.40	0.2068	20.57	36.81	
3/(3)	1.0053	3.76	2.30	0.1811	18.01	32.24	
Average	1.0054	3.55	2.28	0.1870	18.60	33.28	
SD	0.0001	0.18	0.14	0.0176	1.76	3.14	
4/(1)	1.0020	3.34	2.54	0.1775	17.71	31.70	
4/(2)	1.0020	3.26	2.73	0.1823	18.19	32.56	
4/(3)	1.0019	3.22	2.74	0.1643	16.40	29.35	
Average	1.0020	3.27	2.67	0.1747	9.36	31.20	
SD	0.0001	0.06	0.11	0.0093	0.93	1.66	

**Table 6 (cont'd)**

**11 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0063	2.49	2.63	0.1756	17.45	31.23	
1/(2)	1.0062	2.57	2.56	0.1656	16.46	29.46	
1/(3)	1.0061	2.98	2.22	0.1768	17.57	31.45	
Average	1.0062	2.68	2.47	0.1727	17.16	30.71	
SD	0.0001	0.26	0.22	0.0061	0.61	1.09	
2/(1)	1.0019	2.93	3.00	0.2391	23.86	42.71	
2/(2)	1.0017	2.95	2.78	0.2253	22.49	40.25	
2/(3)	1.0017	3.17	2.82	0.2188	21.84	39.09	
Average	1.0018	3.02	2.87	0.2277	22.73	40.69	
SD	0.0001	0.13	0.12	0.0104	1.03	1.85	
3/(1)	1.0024	3.24	2.53	0.1639	16.35	29.26	
3/(2)	1.0024	3.18	2.77	0.1804	18.00	32.21	
3/(3)	1.0024	3.31	2.84	0.1574	15.70	28.10	
Average	1.0024	3.24	2.71	0.1672	16.68	29.86	
SD	0.0000	0.07	0.16	0.0119	1.18	2.12	
4/(1)	1.0014	3.18	2.50	0.1435	14.33	25.65	
4/(2)	1.0014	2.86	2.90	0.1523	15.21	27.22	
4/(3)	1.0012	3.00	2.84	0.1715	17.13	30.66	
Average	1.0013	3.01	2.75	0.155767	15.56	27.84	
SD	0.0001	0.16	0.22	0.0143	1.43	2.56	

**Table 6 (cont'd)**

**13 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0003	2.59	2.55	0.1740	17.39	31.13	
1/(2)	1.0002	2.44	2.42	0.1888	18.88	33.78	
1/(3)	1.0001	2.32	2.53	0.1644	16.44	29.42	
Average	1.0002	2.45	2.50	0.1757	17.57	31.44	
SD	0.0001	0.14	0.07	0.0123	1.23	2.20	
2/(1)	1.0069	2.18	2.91	0.2055	20.41	36.53	
2/(2)	1.0068	2.80	2.26	0.2209	21.94	39.27	
2/(3)	1.0066	2.65	2.39	0.2566	25.49	45.62	
Average	1.0068	2.54	2.52	0.2277	22.61	40.47	
SD	0.0002	0.32	0.34	0.0262	2.61	4.67	
3/(1)	1.0064	2.44	2.25	0.1832	18.20	32.58	
3/(2)	1.0063	2.07	2.46	0.2256	22.42	40.12	
3/(3)	1.0058	2.45	2.38	0.1973	19.62	35.11	
Average	1.0062	2.32	2.36	0.2020	20.08	35.94	
SD	0.0003	0.22	0.11	0.0216	2.15	3.84	
4/(1)	1.0050	2.25	2.28	0.1986	19.76	35.37	
4/(2)	1.0048	1.90	2.73	0.1745	17.37	31.08	
4/(3)	1.0048	2.49	2.61	0.1899	18.90	33.82	
Average	1.0049	2.21	2.54	0.1877	18.68	33.42	
SD	0.0001	0.30	0.23	0.0122	1.21	2.17	



**Table 6 (cont'd)**

**15 min**

<b>System</b>	<b>J. (g)</b>	<b>ME (mm)</b>		<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>	<b>Remark</b>
1/(1)	1.0022	2.53		2.39	0.1650	16.46	29.47	
1/(2)	1.0023	2.48		2.62	0.1964	19.59	35.07	
1/(3)	1.0023	2.89		2.82	0.2016	20.11	36.00	
Average	1.0023	2.63		2.61	0.1877	18.72	33.51	
SD	0.0001	0.22		0.22	0.0198	1.97	3.53	
2/(1)	1.0040	3.42		2.28	0.2538	25.28	45.24	
2/(2)	1.0041	3.27		2.66	0.2618	26.07	46.66	
2/(3)	1.0041	3.69		2.66	0.2380	23.70	42.42	
Average	1.0041	3.46		2.53	0.2512	25.02	44.78	
SD	0.0001	0.21		0.22	0.0121	1.21	2.16	
3/(1)	1.0075	0.53	1.98	2.47	0.1994	19.79	35.42	Trilayer separation
3/(2)	1.0078	1.73	2.89	2.75	0.2323	23.05	41.25	
3/(3)	1.0078	0.58	3.89	2.72	0.2366	23.48	42.02	
Average	1.0077	0.95	2.92	2.65	0.2228	22.11	39.56	
SD	0.0002	0.68	0.96	0.15	0.0204	2.02	3.61	
4/(1)	1.0082	1.10	2.65	2.60	0.2243	22.25	39.82	Trilayer separation
4/(2)	1.0082	1.18	2.71	2.53	0.1849	18.34	32.82	
4/(3)	1.0083	1.24	2.84	2.58	0.2092	20.75	37.13	
Average	1.0082	1.17	2.73	2.57	0.2061	20.45	36.59	
SD	0.0001	0.07	0.10	0.04	0.0199	1.97	3.53	

### Table 7

#### Extraction efficiency at various solid liquid ratios

4 ml							6 ml								
	J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Note		J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Note
1/(1)	1.0033	1.99	2.21	0.0942	9.39	16.80	Incomplete separation	1/(1)	1.0025	2.57	2.10	0.1504	15.00	26.85	Incomplete separation
1/(2)	1.0031	2.15	1.96	0.1066	10.63	19.02		1/(2)	1.0026	2.29	2.08	0.1626	16.22	29.03	
1/(3)	1.0031	1.79	2.23	0.1048	10.45	18.70		1/(3)	1.0026	2.65	2.12	0.1682	16.78	30.02	
Ave	1.0032	1.98	2.13	0.1019	10.15	18.17		Ave	1.0026	2.50	2.10	0.1604	16.00	28.63	
SD	0.0001	0.18	0.15	0.0067	0.67	1.20		SD	0.0001	0.19	0.02	0.0091	0.91	1.62	
2/(1)	1.0044	1.95	2.26	0.1333	13.27	23.75		2/(1)	1.0081	2.24	2.44	0.1852	18.37	32.88	
2/(2)	1.0043	1.85	2.08	0.1432	14.26	25.52		2/(2)	1.0082	2.36	2.28	0.1442	14.30	25.60	
2/(3)	1.0044	1.75	2.11	0.1513	15.06	26.96		2/(3)	1.0080	1.98	2.51	0.1744	17.30	30.96	
Ave	1.0044	1.85	2.15	0.1426	14.20	25.41		Ave	1.0081	2.19	2.41	0.1679	16.66	29.81	
SD	0.0001	0.10	0.10	0.0090	0.90	1.61		SD	0.0001	0.19	0.12	0.0213	2.11	3.77	
3/(1)	1.0055	1.88	2.27	0.1206	11.99	21.47		3/(1)	1.0087	2.47	2.03	0.1877	18.61	33.30	
3/(2)	1.0052	1.99	2.64	0.1865	18.55	33.21		3/(2)	1.0088	2.18	2.19	0.1581	15.67	28.05	
3/(3)	1.0053	2.06	2.04	0.1602	15.94	28.52		3/(3)	1.0087	2.54	1.94	0.1397	13.85	24.79	
Ave	1.0053	1.98	2.32	0.1558	15.49	27.73		Ave	1.0087	2.40	2.05	0.1618	16.04	28.71	
SD	0.0002	0.09	0.30	0.0332	3.30	5.91		SD	0.0001	0.19	0.13	0.0242	2.40	4.30	
4/(1)	1.0090	2.79	1.40	0.1818	18.02	32.25		4/(1)	1.0072	1.98	2.10	0.1812	17.99	32.20	
4/(2)	1.0091	2.16	1.99	0.1813	17.97	32.15		4/(2)	1.0072	2.39	2.22	0.1771	17.58	31.47	
4/(3)	1.0093	1.06	2.07	0.1875	18.58	33.25		4/(3)	1.0072	2.26	2.04	0.1832	18.19	32.55	
Ave	1.0091	2.00	1.82	0.1835	18.19	32.55		Ave	1.0072	2.21	2.12	0.1805	17.92	32.07	
SD	0.0002	0.88	0.37	0.0034	0.34	0.61		SD	0.0000	0.21	0.09	0.0031	0.31	0.55	

**Table 7 (cont'd)**

8 ml							10 ml								
	J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Note		J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Extraction	% Efficiency	Note
1/(1)	1.0045	2.23	2.64	0.2501	24.90	44.56		1/(1)	1.0061	2.58	2.87	0.2755	27.38	49.01	
1/(2)	1.0045	2.33	2.50	0.2356	23.45	41.98		1/(2)	1.0062	2.77	2.77	0.2980	29.62	53.00	
1/(3)	1.0045	2.29	2.50	0.2583	25.71	46.02		1/(3)	1.0067	2.78	2.78	0.3155	31.34	56.09	
Ave	1.0045	2.28	2.55	0.2480	24.69	44.19		Ave	1.0063	2.71	2.81	0.296333	29.45	52.70	
SD	0.0000	0.05	0.08	0.0115	1.14	2.05		SD	0.0003	0.11	0.06	0.0201	1.98	3.55	
2/(1)	1.0016	2.11	2.66	0.2346	23.42	41.92		2/(1)	1.0032	2.68	2.93	0.3914	39.02	69.83	
2/(2)	1.0016	2.18	2.36	0.2489	24.85	44.47		2/(2)	1.0034	2.39	2.74	0.3805	37.92	67.87	
2/(3)	1.0016	2.22	2.69	0.2256	22.52	40.31		2/(3)	1.0037	2.69	2.69	0.4118	41.03	73.43	
Ave	1.0016	2.17	2.57	0.2364	23.60	42.24		Ave	1.0034	2.59	2.79	0.3946	39.32	70.37	
SD	0.0000	0.06	0.18	0.0118	1.17	2.10		SD	0.0003	0.17	0.13	0.0159	1.58	2.82	
3/(1)	1.0057	2.68	2.59	0.1736	17.26	30.89		3/(1)	1.0025	2.86	2.64	0.3282	32.74	58.59	
3/(2)	1.0053	2.95	2.54	0.2555	25.42	45.49		3/(2)	1.0023	2.89	2.61	0.3398	33.90	60.67	
3/(3)	1.0057	2.95	2.03	0.2463	24.49	43.83		3/(3)	1.0028	2.73	2.87	0.3496	34.86	62.39	
Ave	1.0056	2.86	2.39	0.2251	22.39	40.07		Ave	1.0025	2.83	2.71	0.3392	33.83	60.55	
SD	0.0002	0.16	0.31	0.0449	4.46	7.99		SD	0.0003	0.09	0.14	0.0107	1.06	1.90	
4/(1)	1.0013	2.81	2.41	0.2424	24.21	43.33		4/(1)	1.0097	2.77	2.82	0.3105	30.75	55.04	
4/(2)	1.0016	2.70	2.25	0.2376	23.72	42.46		4/(2)	1.0099	3.64	2.25	0.3267	32.35	57.90	
4/(3)	1.0014	2.44	2.56	0.2432	24.29	43.47		4/(3)	1.0094	3.54	2.92	0.3498	34.65	62.02	
Ave	1.0014	2.65	2.41	0.2411	24.07	43.08		Ave	1.0097	3.32	2.66	0.3290	32.59	58.32	
SD	0.0002	0.19	0.16	0.0030	0.31	0.55		SD	0.0003	0.48	0.36	0.0198	1.96	3.51	

**Table 7 (cont'd)****12 ml**

	<b>J. (g)</b>	<b>ME (mm)</b>	<b>Oil (mm)</b>	<b>Oil (g)</b>	<b>% Extraction</b>	<b>% Efficiency</b>
1/(1)	1.0008	3.37	2.38	0.3334	33.31	59.62
1/(2)	1.0007	2.75	3.16	0.3235	32.33	57.86
1/(3)	1.0010	3.00	2.97	0.2923	29.20	52.26
Ave	1.0008	3.04	2.84	0.3164	31.61	56.58
SD	0.0002	0.31	0.41	0.0215	2.15	3.84
2/(1)	1.0005	2.06	2.51	0.2181	21.80	39.01
2/(2)	1.0002	2.24	2.43	0.2491	24.91	44.57
2/(3)	1.0005	2.51	2.41	0.2254	22.53	40.32
Ave	1.0004	2.27	2.45	0.2309	23.08	41.30
SD	0.0002	0.23	0.05	0.0162	1.62	2.91
3/(1)	1.0073	3.23	2.93	0.2636	26.17	46.84
3/(2)	1.0076	3.55	2.35	0.2503	24.84	44.46
3/(3)	1.0078	3.42	2.93	0.2602	25.82	46.21
Ave	1.0076	3.40	2.74	0.2580	25.61	45.83
SD	0.0003	0.16	0.33	0.0069	0.69	1.23
4/(1)	1.0081	3.34	2.98	0.2355	23.36	41.81
4/(2)	1.0086	3.40	3.00	0.2585	25.63	45.87
4/(3)	1.0084	3.51	2.69	0.2356	23.36	41.81
Ave	1.0084	3.42	2.89	0.2432	24.12	43.16
SD	0.0003	0.09	0.17	0.0133	1.31	2.34

**Table 8**  
**Extraction efficiency of re-extraction**

System	# 1						# 2						Remark
	J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Ext	%Eff	ME (mm)	Oil (mm)	Oil (g)	% Ext	%Eff		
1(1)	1.0008	2.42	4.04	0.2939	29.37	52.56	2.54	2.12	0.1436	14.35	25.68	Turbid aqueous, float small particulate attach with microemulsion layer.  Free oil is not so clear compared with #1.	
1(2)	1.0002	2.19	4.08	0.2946	29.45	52.71	2.05	2.15	0.1274	12.74	22.80		
1(3)	1.0002	2.23	4.17	0.2831	28.30	50.66	1.94	1.78	0.1504	15.04	26.91		
Ave	1.0004	2.28	4.10	0.2905	29.04	51.98	2.18	2.02	0.1405	14.04	25.13		
SD	0.0003	0.12	0.07	0.0064	0.64	1.15	0.32	0.21	0.0118	1.18	2.11		
2(1)	1.0015	2.12	3.76	0.3918	39.12	70.02	2.31	2.77	0.1044	10.42	18.66		
2(2)	1.0012	2.19	3.92	0.3839	38.34	68.62	1.51	2.40	0.1543	15.41	27.58		
2(3)	1.0013	2.21	3.85	0.4070	40.65	72.75	1.65	2.18	0.1258	12.56	22.49		
Ave	1.0013	2.17	3.84	0.3942	39.37	70.46	1.82	2.45	0.1282	12.80	22.91		
SD	0.0002	0.05	0.08	0.0117	1.17	2.10	0.43	0.30	0.0250	2.50	4.48		
3(1)	1.0029	2.05	3.83	0.3822	38.11	68.21	2.62	2.42	0.1367	13.63	24.39		
3(2)	1.0023	2.27	4.16	0.3592	35.84	64.14	2.24	2.52	0.1156	11.53	20.64		
3(3)	1.0026	2.33	3.84	0.3623	36.14	64.67	2.10	2.27	0.1203	12.00	21.47		
Ave	1.0026	2.22	3.94	0.3679	36.69	65.67	2.32	2.40	0.1242	12.39	22.17		
SD	0.0003	0.15	0.19	0.0125	1.23	2.21	0.27	0.13	0.0111	1.10	1.97		
4(1)	1.0055	2.66	3.86	0.3302	32.84	58.77	2.12	2.26	0.1274	12.67	22.68		
4(2)	1.0051	2.29	3.79	0.3138	31.22	55.88	1.86	2.30	0.1136	11.30	20.23		
4(3)	1.0050	2.74	3.39	0.3380	33.63	60.19	1.95	1.86	0.1015	10.10	18.08		
Ave	1.0052	2.56	3.68	0.3273	32.56	58.28	1.98	2.14	0.1142	11.36	20.33		
SD	0.0003	0.24	0.25	0.0124	1.23	2.20	0.13	0.24	0.0130	1.29	2.30		

## Table 9

**Extraction efficiency of reuse of mixed surfactants aqueous-based solution**

System	# 1						# 2				Remark
	J. (g)	ME (mm)	Oil (mm)	Oil (g)	% Ext	%Eff	J. (g)	Oil (g)	% Ext	%Eff	
1(1)	1.0002	2.96	3.02	0.3145	31.44	56.28	1.0090	0.1747	17.31	30.99	Turbid aqueous, float small particulate attach with microemulsion layer
1(2)	1.0000	2.86	3.09	0.3304	33.04	59.13	1.0094	0.1438	14.25	25.50	
1(3)	1.0000	3.23	2.99	0.2952	29.52	52.83	1.0091	0.1451	14.38	25.73	
Average	1.0001	3.016667	3.03	0.3134	31.33	56.08	1.0092	0.1545	15.31	27.41	
SD	0.0001	0.1914	0.0513	0.0176	1.7625	3.1544	0.0002	0.0175	1.7342	3.1038	
2(1)	1.0004	2.54	3.13	0.3734	37.33	66.80	1.0060	0.2562	25.47	45.58	
2(2)	1.0008	2.27	3.19	0.3807	38.04	68.08	1.0063	0.2446	24.31	43.50	
2(3)	1.0009	2.08	3.71	0.3916	39.12	70.02	1.0065	0.2788	27.70	49.58	
Average	1.0007	2.30	3.34	0.3819	38.16	68.30	1.01	0.2599	25.82	46.22	
SD	0.0003	0.2312	0.3190	0.0092	0.9062	1.6218	0.0003	0.0174	1.7246	3.0865	
3(1)	1.0012	3.24	2.97	0.3602	35.98	64.39	1.0054	0.1556	15.48	27.70	
3(2)	1.0013	3.07	2.89	0.3588	35.83	64.13	1.0058	0.1796	17.86	31.96	
3(3)	1.0014	3.02	2.99	0.3348	33.43	59.84	1.0055	0.1883	18.73	33.52	
Average	1.0013	3.11	2.95	0.3513	35.08	62.79	1.0056	0.1745	17.35	31.06	
SD	0.0001	0.1153	0.0529	0.0143	1.4290	2.5574	0.0002	0.0169	1.6827	3.0115	
4(1)	1.0024	3.27	2.85	0.2979	29.72	53.19	1.0027	0.1521	15.17	27.15	
4(2)	1.0022	3.22	3.1	0.346	34.52	61.79	1.0030	0.1441	14.37	25.71	
4(3)	1.0027	2.84	3.1	0.3346	33.37	59.72	1.0027	0.1402	13.98	25.02	
Average	1.0024	3.11	3.01667	0.3262	32.54	58.23	1.0028	0.1455	14.51	25.96	
SD	0.0003	0.2352	0.1443	0.0251	2.5085	4.4895	0.0002	0.0061	0.6055	1.0837	

**Table 12****Percentage of Jatropha oil contained by hexane extraction**

<b>Samples</b>	<b>Kernels (g)</b>	<b>Weight of extracted Jatropha oil (g)</b>	<b>% Oil Contained</b>
A	5.0118	2.92	58.26
B	5.0125	2.81	56.06
C	5.0092	2.67	53.30
Average	5.0112	2.80	55.87

## Table 13

### The Fatty acid composition of Jatropha oil from hexane extraction

Food Research and Testing Laboratory  
Faculty of Science  
Chulalongkorn University  
Bangkok 10330, Thailand



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Date of Report : 5 February 2009

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**Test Report**

**Report No.** C 005/09

**Client Name/ Address:** Interpostgraduate Program in Environmental Management  
(Graduate school) Institute Building , 2<sup>nd</sup> Floor, Phayathai Rd., Wangmai,  
Pathumwan, Bangkok 10330

**Sampler:** S2- FA

**The below sample(s) submitted by client as :**

**Sample Description:** The liquid sample was contained in glass bottle, kept at room temperature

Quantity : one bottle , volume 50 ml

**Laboratory Code/Number :** C 005/09

**Client Reference Number :**

**Date of Sample Reception:** 15 January 2009

**Date of Commenced:** 5 February 2009

#### Test Result

State of Detection	Peak area	Result (Norm %)	Test Method
Methyl Dodecanoate	Not Detected	Not Detected	GC-FID
Methyl Myristate	Not Detected	Not Detected	
Methyl Palmitate	1741.76	0.49	
Methyl Stearate	863.22	0.26	
Methyl Oleate	5398.46	1.54	
Methyl Linoleate	4284.84	1.13	
Methyl Linolenate	Not Detected	Not Detected	

Norm % = Normalize percent

end report

*Kuliat Am*  
.....  
(Attawiriyasak, Kuliat)  
Chief of Chemistry Unit

*T. Sihrai*  
.....  
(Tatiya Sihrai)  
Quality Manager

Scaled and signed for and on behalf of  
Food Research and Testing Laboratory  
Faculty of Science, Chulalongkorn University

*Sirirat Korp*  
.....  
(Kckpol, Sirirat, Assoc.Prof.Dr.)  
Laboratory Director

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## Table 14

### The Fatty acid composition of Jatropha oil from compress extraction

Food Research and Testing Laboratory  
Faculty of Science  
Chulalongkorn University  
Bangkok 10330, Thailand



Page 1 of a total of 1 pages  
Date of Report : 5 February 2009

begin report

#### Test Report

Report No. C 004/09

Client Name/ Address: Interpostgraduate Program in Environmental Management  
(Graduate school) Institute Building, 2<sup>nd</sup> Floor, PhayWangmai,  
Pathumwan, Bangkok 10330

Sampler: C2-FA

The below sample(s) submitted by client as :

Sample Description: The liquid sample was contained in glass bottle, kept at room temperature

Quantity : one bottle , volume 50 ml

Laboratory Code/Number : C 004/09

Client Reference Number :

Date of Sample Reception: 15 January 2009

Date of Commenced: 5 February 2009

#### Test Result

State of Detection	Peak area	Result (Norm %)	Test Method
Methyl Dodecanoate	Not Detected	Not Detected	GC-FID
Methyl Myristate	Not Detected	Not Detected	
Methyl Palmitate	794.84	0.24	
Methyl Stearate	399.58	0.13	
Methyl Oleate	2583.37	0.79	
Methyl Linoleate	2133.39	0.61	
Methyl Linolenate	Not Detected	Not Detected	

Norm % = Normalize percent

end report

*Kukiat Ann*

(Attawiriyasak, Kukiat)  
Chief of Chemistry Unit

*T. Sili*

(Tatiya Siharai)  
Quality Manager

Scaled and signed for and on behalf of  
Food Research and Testing Laboratory  
Faculty of Science, Chulalongkorn University

*Sirint Kiatphak*

(Kokpol, Sirint, Assoc. Prof. Dr.)  
Laboratory Director

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## Table 15

### The Fatty acid composition of Jatropha oil from mixed surfactant aqueous-based solution

Food Research and Testing Laboratory  
Faculty of Science  
Chulalongkorn University  
Bangkok 10330, Thailand



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Date of Report : 5 February 2009

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begin report  
**Test Report**

**Report No.** C 006/09

**Client Name/ Address:** Interpostgraduate Program in Environmental Management (Graduate school) Institute Building , 2<sup>nd</sup> Floor, PhayWangmai, Pathumwan, Bangkok 10330

**Sampler:** suf 2-FA

**The below sample(s) submitted by client as :**

**Sample Description:** The liquid sample was contained in glass bottle, kept at room temperature

Quantity : one bottle , volume 50 ml

**Laboratory Code/Number :** C 006/09

**Client Reference Number :**

**Date of Sample Reception:** 15 January 2009

**Date of Commenced:** 5 February 2009

#### Test Result

State of Detection	Peak area	Result (Norm %)	Test Method
Methyl Dodecanoate	Not Detected	Not Detected	GC-FID
Methyl Myristate	Not Detected	Not Detected	
Methyl Palmitate	1918.55	0.53	
Methyl Stearate	901.89	0.27	
Methyl Oleate	5677.64	1.62	
Methyl Linoleate	4586.37	1.20	
Methyl Linolenate	Not Detected	Not Detected	

Norm % = Normalize percent

-----  
end report  
-----

*Kuki-at An*

(Attawiriyasuk, Kuki-at)  
Chief of Chemistry Unit

*T. Siharai*

(Tatiya Siharai)  
Quality Manager

Sealed and signed for and on behalf of  
Food Research and Testing Laboratory  
Faculty of Science, Chulalongkorn University

*Sirirat Kokpol*  
(Kokpol, Sirirat, Assoc. Prof. Dr.)  
Laboratory Director

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## Table 16

### The amount of water in extracted oil from various extraction methods



THE PETROLEUM AND PETROCHEMICAL COLLEGE  
**CHULALONGKORN UNIVERSITY**  
 SOI CHULALONGKORN 12, PHAYA THAI ROAD, BANGKOK 10330, THAILAND  
 THE RESEARCH AFFAIRS

PPCSDWI-06-203/001.4

#### ANALYTICAL / TESTING REPORT

Report no. 070/52

Sample owner : Chulalongkorn University  
 Sample type : oil  
 Number of sample : 3  
 Instrument used : KF Titrator  
 Date of receiving : February 25, 2009  
 Date of analysis : March 3, 2009  
 Result :

Sample Name	Water Content (%)	Average (%)
Suf 1-w	0.0012 0.0011 0.0010	0.011
S1-w	0.0901 0.0964 0.0930	0.0932
C1-w	0.1837 0.1821 0.1830	0.1829

Analyzed by :

*Ms. Pastra Somboonthanate*

(Ms. Pastra Somboonthanate)

Researcher

Approved by :

*Hathaikarn M.*

(Asst. Prof. Dr. Hathaikarn Manuspiya)

Acting Deputy Director for Research Affairs

N.B. The result is valid for sample analyzed only.

## BIOGRAPHY

Miss Pilada Pookboonmee was born on 03<sup>rd</sup> October, 1984 in General Police Hospital, Bangkok, Thailand. She is the second child of Mr.Amnaj Pookboonmee and Pol.Col.(Lady) Wiladda Pookboonmee and her big sister is a conceirge at the Mandarin Oriental Hotel. In 2005, she graduated her Bachelor of Science in Environmental Resources Chemistry from King Mongkut's Institute of Technology Ladkrabang. During her undergraduate program, she got a scholarship to join an international junior internship from Department of Chemistry, Faculty of Science, Harbin Institute of Technology, China. After her graduation, she spent a full year of career as an environmental scientist at SECOT Co., Ltd. responsible for EIA and CDM project coordinator for petroleum and petrochemical industries. Then she persued her Master's degree studies at the International Postgraduated Program in Environmental Management (Hazardous Waste Management), Graduate School, Chulalongkorn University, Thailand. During her postgraduate education, she received the award of "Outstanding Presentation" from the Pure and Applied Chemistry International Conference (PACCON) 2009 and this thesis of her has been registered for patent with registration number 0901000104. She finished her Master's of Science Degree in Environmental Management in May 2009.

