REFERENCES

[1] Z. Fang, B. Bhandari, 4 - Spray drying, freeze drying and related processes for food ingredient and nutraceutical encapsulation, in: N. Garti, D.J. McClements (Eds.) Encapsulation Technologies and Delivery Systems for Food Ingredients and Nutraceuticals, Woodhead Publishing, 2012, pp. 73-109.

[2] M. I Ré, Microencapsulation by Spray Drying, Drying Technology, 16 (1998) 1195-1236.

[3] P.L. Lam, R. Gambari, Advanced progress of microencapsulation technologies: In vivo and in vitro models for studying oral and transdermal drug deliveries, Journal of Controlled Release, 178 (2014) 25-45.

[4] S. Hokputsa, W. Gerddit, S. Pongsamart, K. Inngjerdingen, T. Heinze, A. Koschella, S.E. Harding, B.S. Paulsen, Water-soluble polysaccharides with pharmaceutical importance from Durian rinds (Durio zibethinus Murr.): isolation, fractionation, characterisation and bioactivity, Carbohydrate Polymers, 56 (2004) 471-481.

[5] S. Pongsamart, S. Sukrong, A. Tawatsin, The Determination of toxic effects at a high oral dose of polysaccharide gel extracts from fruit-hulls of durian (*Duriozibethinus* L.) in mice and rats, Songklanakarin J. Sci. Technol., 23 (2001) 55-62.

[6] S. Pongsamart, A. Tawatsin, S. Sukrong, Long-term consumption of polysaccharide gel from durian fruit-hulls in mice Songklanakarin J. Sci. Technol., 24 (2002) 649-661.

[7] V. Lipipun, N. Nantawanit, S. Pongsamart, Antimicrobial activity (in vitro) of polysaccharide gel from durian fruit-hulls, Songklanakarin J. Sci. Technol. , 24 (2002) 31-38.

[8] P. Eakwaropas, Development of hydrogel wound dressing using mixtures of polyvinyl alcohol and polysaccharide extract from durian fruit-hulls, in: Department of Industrial Pharmacy, Chulalongkorn University, Faculty of Pharmaceutical Sciences, 2009.

[9] R. Siripokasupkul, Property of polysaccharide gel from durian as dressing preparations and its effect on wound healing in dog skin in: Department of Biochemistry, Chulalongkorn University, Faculty of Pharmaceutical Sciences, 2004.

[10] O. Nakchat, Preparation and evaluation of dressing film of polysaccharide gel from fruit-hulls of durian on wound healing in pig skin in vivo, in: Department of Biochemistry, Chulalongkorn University, Faculty of Pharmaceutical Sciences, 2002.

[11] C.H. Goh, P.W.S. Heng, L.W. Chan, Alginates as a useful natural polymer for microencapsulation and therapeutic applications, Carbohydrate Polymers, 88 (2012) 1-12.

[12] M.J.M. Smulders, G.J. Klerk, Epigenetics in plant tissue culture, Plant Growth Regulation, 63 (2010) 137-146.

[13] C. Miguel, L. Marum, An epigenetic view of plant cells cultured in vitro: somaclonal variation and beyond, Journal of experimental botany, 62 (2011) 3713-3725.

[14] E.W.C. Chan, S.Y. Eng, Y.P. Tan, Z.C. Wong, Phytochemistry and pharmacological properties of Thunbergia laurifolia: A review, Pharmacognosy Journal, 3 (2011) 1-6.

[15] P. Suwanchaikasem, C. Chaichantipyuth, S. Sukrong, Antioxidant-guided isolation of rosmarinic acid, a major constituent from Thunbergia laurifolia, and its use as a bioactive marker for standardization, Chiang Mai Journal of Science, 41 (2014) 117-127.

[16] M. Schafer, S. Werner, Oxidative stress in normal and impaired wound repair, Pharmacological research : the official journal of the Italian Pharmacological Society, 58 (2008) 165-171.

[17] A. Gharsallaoui, G. Roudaut, O. Chambin, A. Voilley, R. Saurel, Applications of spray-drying in microencapsulation of food ingredients: An overview, Food Research International, 40 (2007) 1107-1121.

[18] S. Ersus, U. Yurdagel, Microencapsulation of anthocyanin pigments of black carrot (Daucus carota L.) by spray drier, Journal of Food Engineering, 80 (2007) 805-812.

[19] R.S. Pentewar, S.V. Somwanshi, B.K. Sugave, Spray drying: A review on single step rapid drying technique, Research Journal of Pharmaceutical, Biological and Chemical Sciences, 5 (2014) 1502-1514.

[20] G.A. Rocha, C.S. Fávaro-Trindade, C.R.F. Grosso, Microencapsulation of lycopene by spray drying: Characterization, stability and application of microcapsules, Food and Bioproducts Processing, 90 (2012) 37-42.

[21] W. Abdelwahed, G. Degobert, S. Stainmesse, H. Fessi, Freeze-drying of nanoparticles: Formulation, process and storage considerations, Advanced Drug Delivery Reviews, 58 (2006) 1688-1713.

[22] C. Ratti, 3 - Freeze drying for food powder production, in: B. Bhandari, N. Bansal, M. Zhang, P. Schuck (Eds.) Handbook of Food Powders, Woodhead Publishing, 2013, pp. 57-84.

[23] P.N. Ezhilarasi, D. Indrani, B.S. Jena, C. Anandharamakrishnan, Freeze drying technique for microencapsulation of Garcinia fruit extract and its effect on bread quality, Journal of Food Engineering, 117 (2013) 513-520.

[24] T.-C. Hua, B.-L. Liu, H. Zhang, 4 - Equipment for Freeze-drying, in: T.-C. Hua, B.-L. Liu, H. Zhang (Eds.) Freeze-Drying of Pharmaceutical and Food Products, Woodhead Publishing, 2010, pp. 111-140.

[25] P. Karthik, C. Anandharamakrishnan, Microencapsulation of Docosahexaenoic Acid by Spray-Freeze-Drying Method and Comparison of its Stability with Spray-Drying and Freeze-Drying Methods, Food and Bioprocess Technology, 6 (2012) 2780-2790.

[26] H. Dörnenburg, D. Knorr, Strategies for the improvement of secondary metabolite production in plant cell cultures, Enzyme and Microbial Technology, 17 (1995) 674-684.

[27] S. Ramachandra Rao, G.A. Ravishankar, Plant cell cultures: Chemical factories of secondary metabolites, Biotechnology Advances, 20 (2002) 101-153.

[28] J.J. Zhong, 3.27 - Plant Secondary Metabolites, in: M. Moo-Young (Ed.) Comprehensive Biotechnology (Second Edition), Academic Press, Burlington, 2011, pp. 299-308.

[29] F. DiCosmo, M. Misawa, Plant cell and tissue culture: Alternatives for metabolite production, Biotechnology Advances, 13 (1995) 425-453.

[30] M. Ikeuchi, K. Sugimoto, A. Iwase, Plant callus: mechanisms of induction and repression, The Plant cell, 25 (2013) 3159-3173.

[31] T. Muranaka, K. Saito, 3.17 - Production of Pharmaceuticals by Plant Tissue Cultures, in: H.-W. Liu, L. Mander (Eds.) Comprehensive Natural Products II, Elsevier, Oxford, 2010, pp. 615-628.

[32] O. Wonkchalee, T. Boonmars, C. Aromdee, P. Laummaunwai, W. Khunkitti, K. Vaeteewoottacharn, P. Sriraj, R. Aukkanimart, W. Loilome, Y. Chamgramol, C. Pairojkul, Z. Wu, A. Juasook, P. Sudsarn, Anti-inflammatory, antioxidant and hepatoprotective effects of Thunbergia laurifolia Linn. on experimental opisthorchiasis, Parasitology Research, 111 (2012) 353-359.

[33] P. Suwanchaikasem, T. Phadungcharoen, S. Sukrong, Authentication of the Thai medicinal plants sharing the same common name 'Rang Chuet': Thunbergia laurifolia, Crotalaria spectabilis, and Curcuma aff. amada by combined techniques of TLC, PCR-RFLP fingerprints, and antioxidant activities, ScienceAsia, 39 (2013) 124-133.

[34] A. Iwase, H. Aoyagi, M. Ohme-Takagi, H. Tanaka, Development of a novel system for producing ajmalicine and serpentine using direct culture of leaves in Catharanthus roseus intact plant, Journal of bioscience and bioengineering, 99 (2005) 208-215.

[35] N. Erkan, G. Ayranci, E. Ayranci, Antioxidant activities of rosemary (Rosmarinus Officinalis L.) extract, blackseed (Nigella sativa L.) essential oil, carnosic acid, rosmarinic acid and sesamol, Food Chemistry, 110 (2008) 76-82.

[36] T. Iuvone, D. De Filippis, G. Esposito, A. D'Amico, A.A. Izzo, The spice sage and its active ingredient rosmarinic acid protect PC12 cells from amyloid-beta peptide-induced neurotoxicity, The Journal of pharmacology and experimental therapeutics, 317 (2006) 1143-1149.

[37] J. Reichling, S. Nolkemper, F.C. Stintzing, P. Schnitzler, Impact of ethanolic lamiaceae extracts on herpesvirus infectivity in cell culture, Forschende Komplementarmedizin, 15 (2008) 313-320.

[38] V. Swarup, J. Ghosh, S. Ghosh, A. Saxena, A. Basu, Antiviral and anti-inflammatory effects of rosmarinic acid in an experimental murine model of Japanese encephalitis, Antimicrobial agents and chemotherapy, 51 (2007) 3367-3370.

[39] N. Nantawanit. Antimicrobial property of polysaccharide gel from durian fruit-hulls. , in: Department of Biochemistry, Chulalongkorn University., Faculty of Pharmaceutical Sciences, , 2001.

[40] P. Wattanaarsakit, E. Joyce, P. Eakwaropas, N. Sutanthavibul, S. Pongsamart, W. Kao, Processing parameters and incorporation of durian polysaccharide into poly (vinyl alcohol) improve hydrogel physicochemical properties and a commentary on translational research in academia, in: International Conference on Biological, Medical and Chemical Engineering (BMCE 2013), 2013, pp. 285-291.

[41] P. Liu, T.R. Krishnan, Alginate-pectin-poly-L-lysine particulate as a potential controlled release formulation, Journal of Pharmacy and Pharmacology, 51 (1999) 141-149.

[42] H. Madziva, K. Kailasapathy, M. Phillips, Alginate-pectin microcapsules as a potential for folic acid delivery in foods, Journal of microencapsulation, 22 (2005) 343-351.

[43] K. Moebus, J. Siepmann, R. Bodmeier, Novel preparation techniques for alginate-poloxamer microparticles controlling protein release on mucosal surfaces, European journal of pharmaceutical sciences : official journal of the European Federation for Pharmaceutical Sciences, 45 (2012) 358-366.

[44] J. Hanna, J. Giacopelli, A review of wound healing and wound dressing products The Journal of foot and ankle surjery, 36 (1997) 1-13.

[45] J.S. Boateng, K.H. Matthews, H.N. Stevens, G.M. Eccleston, Wound healing dressings and drug delivery systems: a review, Journal of pharmaceutical sciences, 97 (2008) 2892-2923.

[46] A. Sezer, E. Cevhe, Biopolymers as wound healing materials: Challenge and new strategies, Biomaterial Apllications for Nanomedicine, (2011) 383-414.

APPENDICES

APPENDIX A

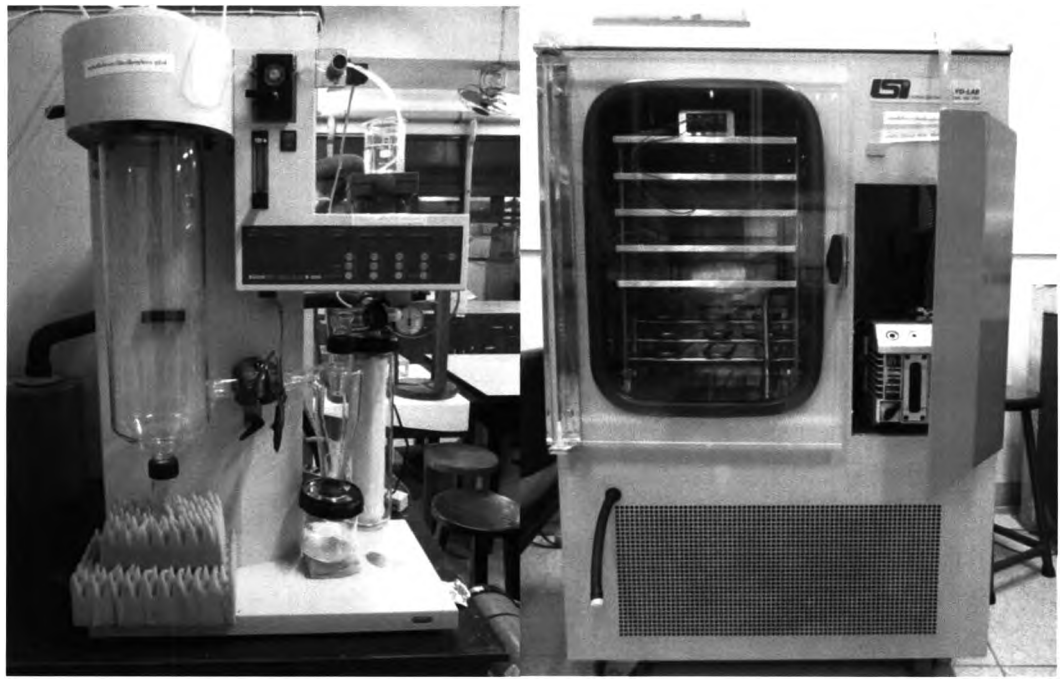

Figure 62 BUCHI mini spray dryer (left) and Freeze dryer (LYOLAB) (right)

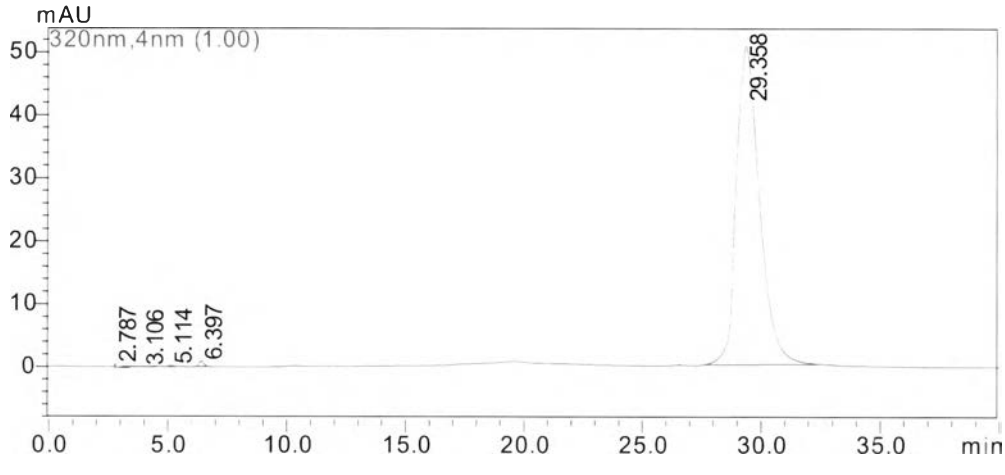

Figure 63 HPLC chromatogram of standard rosmarinic acid 200 µg/ml

Peak#	Ret. Time	Conc.	Area	Height	Area%	Tailing F.	Resolution
1	2.787	0.03440	1193	585	0.0344	1.284	--
2	3.106	0.06920	2400	144	0.0692	--	1.470
3	5.114	0.06217	2156	183	0.0622	1.162	5.698

4	6.397	0.37528	13014	872	0.3753	1.295	3.482
5	29.358	99.45895	3448995	50584	99.4590	1.367	21.395

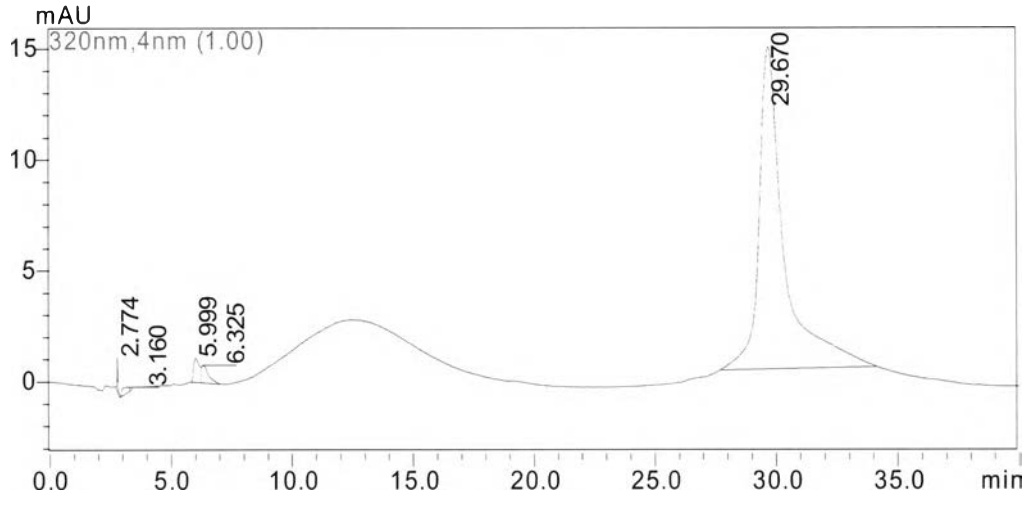

Figure 64 HPLC chromatogram of entrapment of SN-1DGAG2:1

Peak#	Ret. Time	Conc.	Area	Height	Area%	Tailing F.	Resolution
1	2.774	0.36667	3994	1515	0.3667	1.231	--
2	3.160	0.55008	5992	276	0.5501	0.780	1.547
3	5.999	1.63109	17769	1058	1.6311	--	5.411
4	6.325	1.44884	15783	775	1.4488	--	0.363
5	29.670	96.00332	1045830	14494	96.0033	1.890	17.978

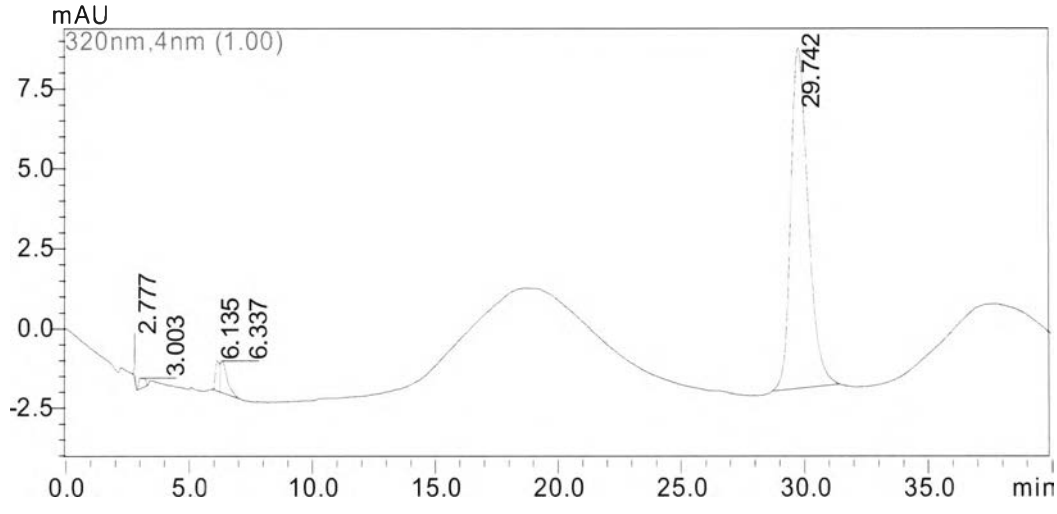

Figure 65 HPLC chromatogram of entrapment of FC-1DGAG2:1

Peak#	Ret. Time	Conc.	Area	Height	Area%	Tailing F.	Resolution
1	2.777	0.62506	3520	1502	0.6251	1.448	--
2	3.003	1.03497	5829	346	1.0350	1.968	0.911
3	6.135	2.00954	11318	947	2.0095	--	3.790
4	6.337	3.36150	18932	996	3.3615	--	0.182
5	29.742	92.96892	523612	10662	92.9689	1.314	20.820

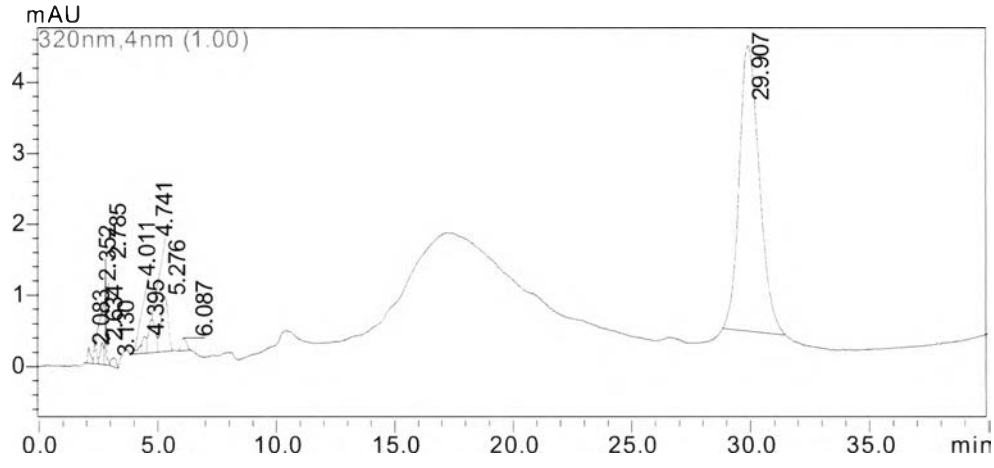

Figure 66 HPLC chromatogram of ethanol TL callus extract

Peak#	Ret. Time	Conc.	Area	Height	Area%	Tailing F.	Resolution
1	2.083	0.73662	2093	229	0.7366	--	--
2	2.352	0.79918	2271	337	0.7992	--	1.207
3	2.634	1.11429	3166	310	1.1143	--	0.921
4	2.785	1.70953	4857	1506	1.7095	--	0.598
5	3.130	0.67346	1913	123	0.6735	1.054	1.511
6	4.011	0.55170	1568	50	0.5517	--	1.234
7	4.395	1.00136	2845	225	1.0014	--	0.399
8	4.741	3.24854	9230	461	3.2485	--	0.479
9	5.276	5.49937	15625	762	5.4994	--	0.972
10	6.087	0.95213	2705	178	0.9521	1.060	1.750
11	29.907	83.71383	237854	4017	83.7138	1.164	24.601

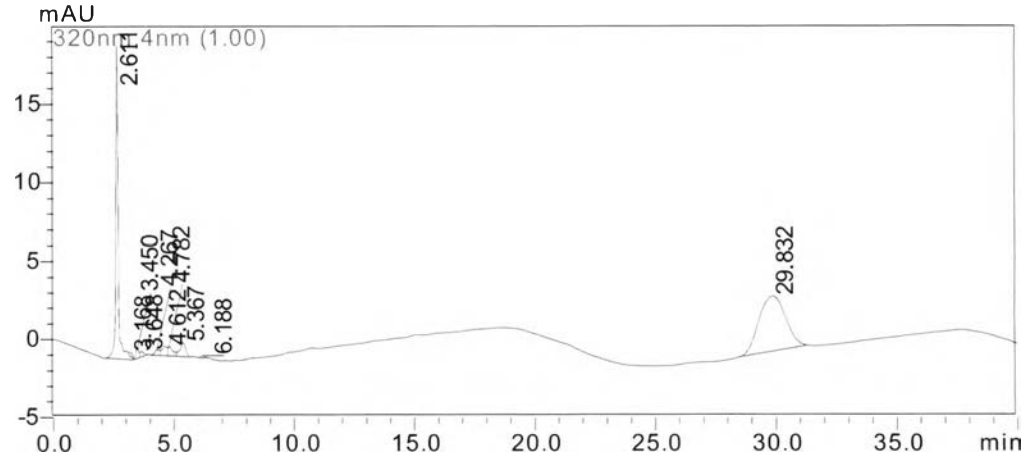

Figure 67 HPLC chromatogram of rosmarinic acid from PTC-FC-2DGAG1:1

Peak#	Ret. Time	Conc.	Area	Height	Area%	Tailing F.	Resolution
1	2.611	30.66851	142179	20058	30.6685	1.316	--
2	3.168	0.51173	2372	215	0.5117	--	2.072
3	3.450	1.22510	5680	636	1.2251	--	0.871
4	3.648	0.76626	3552	328	0.7663	--	0.442
5	4.267	1.06715	4947	321	1.0672	--	0.763
6	4.612	1.88528	8740	604	1.8853	--	0.383
7	4.782	1.80345	8361	559	1.8034	--	0.216
8	5.367	3.08039	14281	876	3.0804	--	0.978
9	6.188	0.38193	1771	140	0.3819	1.182	2.138
10	29.832	58.61020	271716	3551	58.6102	1.065	19.584

Table 10 Raw data of 1st validation of HPLC analysis

Sample (%)	Grand wt (mg)	Conc. (mg/mL) (C added)	Peak area	Conc. (mg/mL) (C found)	% Recovery	%RSD	Peak purity index
5	0.610	0.006	71884	0.006			0.999903
5	0.590	0.006	62132	0.005	-	-	0.999792
5	0.460	0.004	48466	0.005			0.999952
25	1.150	0.022	360988	0.022	98.7		0.999994
25	1.260	0.024	389360	0.024	96.5	1.2	1.000000
25	1.230	0.024	380951	0.023	96.9		0.999995
50	2.480	0.048	812523	0.047	97.9		0.999993
50	2.580	0.050	838319	0.049	97.0	0.9	0.999993
50	2.620	0.051	843921	0.049	96.1		0.999992
100	0.910	0.088	1539747	0.088	99.2		0.998343
100	1.120	0.109	1899780	0.108	99.0	1.2	0.998012
100	1.100	0.107	1905793	0.108	101.1		0.998144
150	1.600	0.155	2762022	0.155			0.997017
150	1.640	0.159	2810971	0.158	-	-	0.996863
150	1.420	0.138	2409448	0.136			0.997363
200	2.220	0.215	3812124	0.214			0.996385
200	1.960	0.190	3424036	0.192	-	-	0.996334
200	1.940	0.188	3409731	0.191			0.996314

Table 11 Raw data of 2nd validation of HPLC analysis

Sample (%)	Grand wt (mg)	Conc. (mg/mL) (C added)	Peak area	Conc. (mg/mL) (C found)	% Recovery	%RSD	Peak purity index
5	0.520	0.005	29568	0.004			0.999939
5	0.540	0.005	45243	0.005			0.999939
5	0.570	0.006	76537	0.007			0.999916
25	1.230	0.024	390685	0.023	97.7	1.1	0.999994
25	1.260	0.024	393542	0.023	96.0		0.999997
25	1.360	0.026	427692	0.025	95.8		0.999999
50	2.450	0.048	840436	0.047	98.9	1.4	0.999992
50	2.510	0.049	845050	0.047	97.0		0.999995
50	2.590	0.050	865812	0.048	96.2		0.999984
100	0.990	0.096	1699583	0.092	96.0	1.3	0.998127
100	0.940	0.091	1653642	0.090	98.5		0.998438
100	0.970	0.094	1697508	0.092	97.9		0.998061
150	1.550	0.150	2793643	0.150			0.996758
150	1.480	0.144	2696122	0.145			0.996762
150	1.490	0.145	2692565	0.144			0.996817
200	2.080	0.202	3788832	0.202			0.996143
200	1.970	0.191	3603864	0.192			0.996066
200	1.960	0.190	3611648	0.193			0.996062

Table 12 Raw data of 3rd validation of HPLC analysis

Sample (%)	Grand wt (mg)	Conc. (mg/mL) (C added)	Peak area	Conc. (mg/mL) (C found)	% Recovery	%RSD	Peak purity index
5	0.580	0.006	32564	0.006			0.999998
5	0.600	0.006	34018	0.006			0.999973
5	0.630	0.006	33879	0.006			0.999976
25	1.240	0.024	337727	0.023	95.2		0.999999
25	1.170	0.023	324336	0.022	97.5	1.2	1.000000
25	1.160	0.023	317370	0.022	96.6		0.999998
50	2.550	0.049	780275	0.048	97.2		0.999969
50	2.430	0.047	748259	0.046	98.1	0.9	0.999988
50	2.560	0.050	777235	0.048	96.5		0.999970
100	1.030	0.100	1629559	0.096	96.5		0.998239
100	1.000	0.097	1596361	0.095	97.5	0.5	0.998004
100	1.040	0.101	1647394	0.097	96.6		0.998071
150	1.590	0.154	2616115	0.153			0.996248
150	1.420	0.138	2353627	0.138			0.997074
150	1.790	0.174	3005934	0.175			0.995907
200	2.060	0.200	3478264	0.202			0.995974
200	2.090	0.203	3531928	0.205			0.996168
200	2.100	0.204	3554844	0.206			0.996003

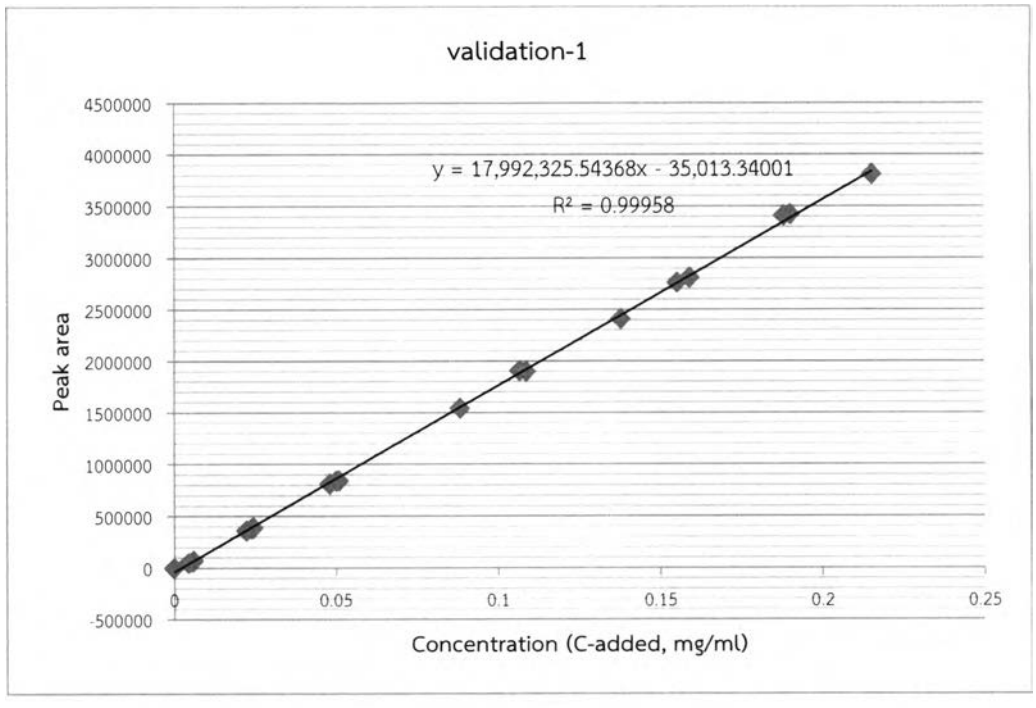

Figure 68 Calibration curve of 1st validation

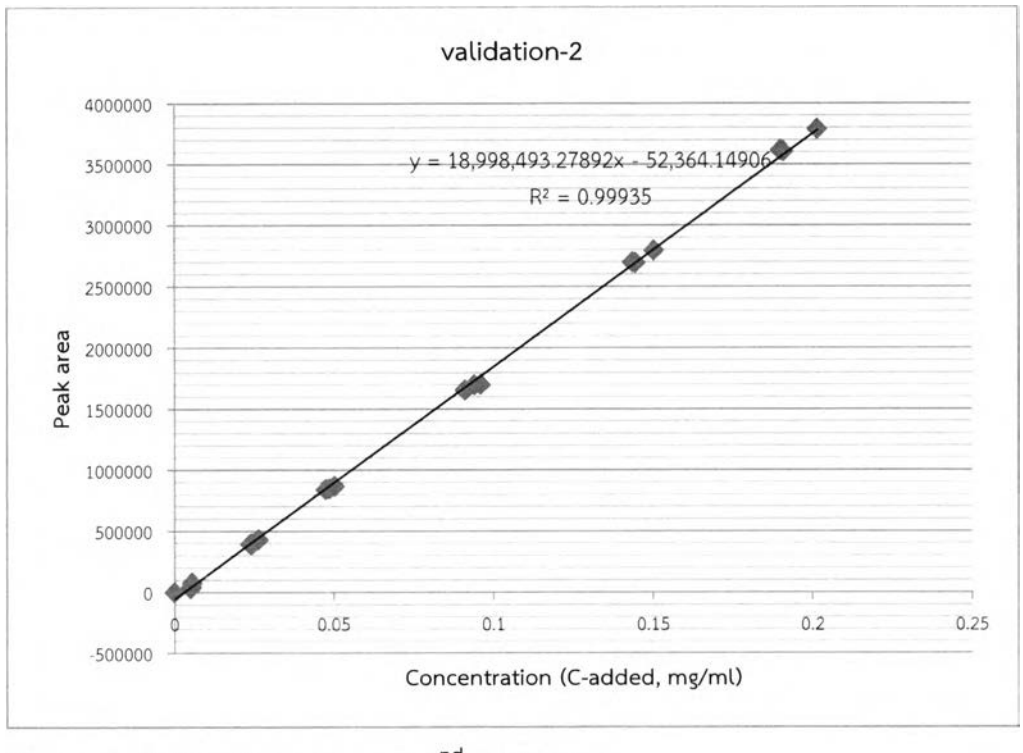

Figure 69 Calibration curve of 2nd validation

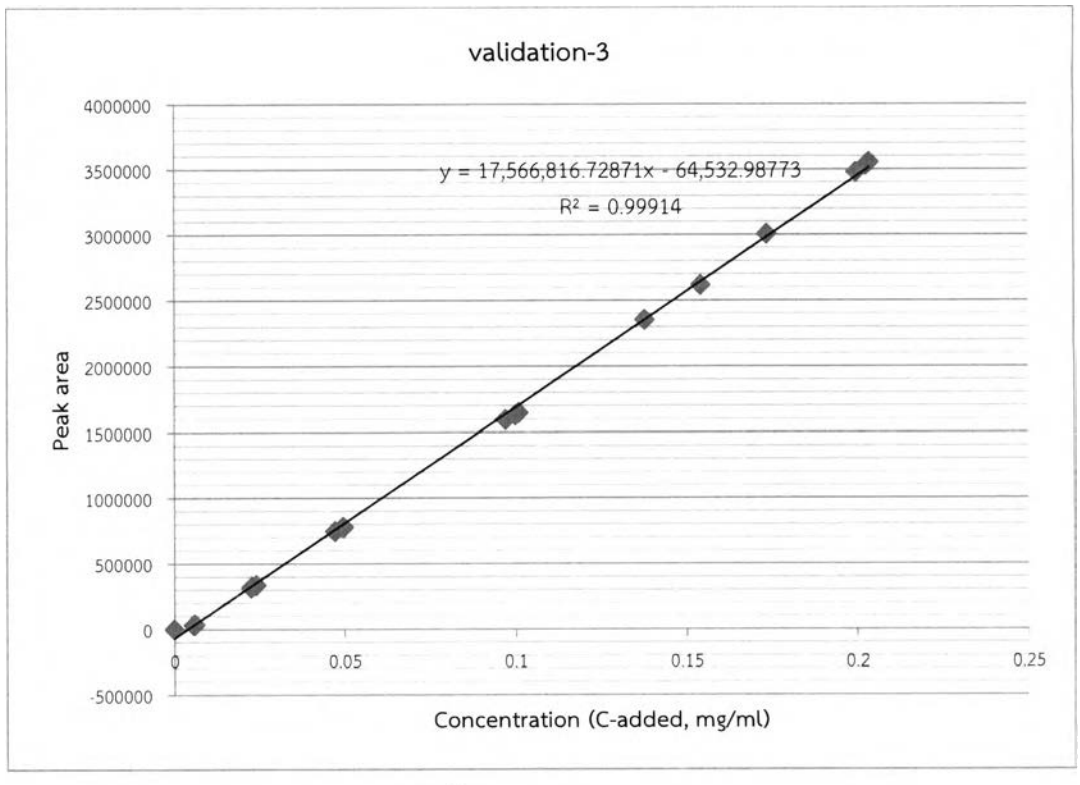

Figure 70 Calibration curve of 3rd validation

Table 13 Statistical data of calibration curves of rosmarinic acid analysis

Parameter	Rosmarinic acid
Linearity and range	5-200 µg/mL
Regression equation (1st validation) Correlation coefficient (R^2)	y = 17,992,325.54x - 35,013.34 0.99958
Regression equation (2nd validation) Correlation coefficient (R^2)	y = 18,998,493.27892x - 52,364.14906 0.99935
Regression equation (3rd validation) Correlation coefficient (R^2)	y = 17,566,816.72871x - 64,532.98773 0.99914

Table 14 Precision and accuracy of method for determination of rosmarinic acid

(n = 9; three sets for 3 days)

Concentration (µg/mL)	Concentration added (mean±SD) (µg/mL)	Concentration found (mean±SD) (µg/mL)	% Recovery	CV (%)
Within-day (n = 3)				
25	0.024±0.0011	0.023± 0.0008	97.13±1.15	1.2
50	0.050±0.0014	0.048±0.0009	97.00±0.90	0.9
100	0.101±0.0112	0.101±0.0116	99.70±1.17	1.2
Between-day (n = 9)				
25	0.024±0.0016	0.023± 0.0012	96.22±0.78	1.2
50	0.049±0.0014	0.048±0.0011	97.43±0.97	1.1
100	0.99±0.0116	0.98±0.0116	96.89±1.73	1.0

Table 15 Stress testing data of rosmarinic acid

Stress test/Time	% Standard rosmarinic acid remaining (mean)											
	1	3	6	9	18	24	48	72	96	120	144	168
Photostability	98.26	96.11	95.71	92.76	93.88	91.04	89.91	88.42	85.49	83.67	76.15	-
Temperature	97.46	94.11	92.70	90.03	88.19	89.45	84.22	81.17	78.31	-	-	-
Humidity	98.62	95.44	96.73	93.21	91.24	90.86	85.23	83.74	84.49	81.05	75.44	-
Oxidation	92.83	81.39	70.55	53.12	-	-	-	-	-	-	-	-

Figure 71 Spray dried RA microparticles (left), freeze dried cake (right)

Table 16 Particle size of spray dried RA microparticles and freeze dried RA particles

Polymer	Formulation	Particle size mean±SD (μm)
AG 1%	SNB-1AG	52.47±3.29
	SN-1AG	26.75±4.18
	SC-1AG	71.57±5.67
	FC-1AG	154.87±8.34
DG 1%	SNB-1DG	60.18±3.62
	SN-1DG	37.68±3.51
	SC-1DG	100.81±4.49
	FC-1DG	338.19±15.03
DG+AG 1% 1:1	SNB-1DGAG 1:1	25.21±2.09
	SN-1DGAG 1:1	11.81±1.98
	SC-1DGAG 1:1	61.57±5.67
	FC-1DGAG 1:1	224.92±9.53
DG+AG 1% 2:1	SNB-1DGAG 2:1	30.06±2.18
	SN-1DGAG 2:1	15.39±1.62

	SC-1DGAG 2:1	85.93±4.22
	FC-1DGAG 2:1	318.71±13.25
AG 2%	SNB-2AG	14.92±2.03
	SN-2AG	15.93±2.9
	SC-2AG	50.26±3.91
	FC-2AG	248.44±11.67
DG 2%	SNB-2DG	52.14±8.22
	SN-2DG	48.31±5.07
	SC-2DG	141.15±9.01
	FC-2DG	422.12±14.81
DG+AG 2% 1:1	SNB-2DGAG 1:1	29.03±2.45
	SN-2DGAG 1:1	18.83±2.31
	SC-2DGAG 1:1	121.57±4.73
	FC-2DGAG 1:1	237.27±9.06
DG+AG 2% 2:1	SNB-2DGAG 2:1	30.77±2.18
	SN-2DGAG 2:1	23.15±3.01
	SC-2DGAG 2:1	152.44±7.82
	FC-2DGAG 2:1	356.31±10.81

Table 17 Entrapment efficiency of encapsulated RA microparticles

Formulations	Entrapment efficiency (mean±SD)
SN-1AG	71.97±2.17
SC-1AG	1.71±0.08
FC-1AG	103.90±2.76
SN-1DG	96.39±3.02
SC-1DG	8.26±1.02
FC-1DG	104.11±0.87
SN-1DGAG1:1	96.79±1.65
SC-1DGAG1:1	1.69±0.23
FC-1DGAG1:1	102.05±3.22
SN-1DGAG2:1	97.51±3.03
SC-1DGAG2:1	1.83±0.41
FC-1DGAG2:1	99.20±3.31
SN-2AG	75.59±2.49
SC-2AG	2.13±0.14
FC-2AG	90.71±2.67
SN-2DG	96.33±2.18
SC-2DG	7.07±0.89
FC-2DG	103.37±1.91
SN-2DGAG1:1	87.92±2.14
SC-2DGAG1:1	1.71±0.17
FC-2DGAG1:1	96.81±2.97
SN-2DGAG2:1	91.33±1.98
SC-2DGAG2:1	1.68±0.04
FC-2DGAG2:1	100.27±1.20

Table 18 Stability data of encapsulated RA microparticles storage at 40°C/75%RH

Formulations/Months	%Rosmarinic acid remaining of encapsulated RA microparticles stability at 40°C/75%RH		
	0	1	3
Spray dried RA MPs			
SN-1AG	100.00	89.34±2.93	84.05±2.69
SN-1DG	100.00	87.59±3.57	53.95±4.08
SN-1DGAG1:1	100.00	82.65±3.34	67.41±4.54
SN-1DGAG2:1	100.00	84.75±2.59	68.12±3.12
SN-2AG	100.00	79.67±4.01	45.73±3.79
SN-2DG	100.00	89.18±2.94	34.25±3.05
SN-2DGAG1:1	100.00	92.96±3.92	48.23±2.83
SN-2DGAG2:1	100.00	92.59±3.19	48.84±2.84
Freeze dried RA MPs			
FC-1AG	100.00	74.52±2.91	71.35±2.46
FC-1DG	100.00	81.66±4.92	85.36±1.95
FC-1DGAG1:1	100.00	81.04±3.58	72.86±3.31
FC-1DGAG2:1	100.00	88.52±2.91	76.16±2.22
FC-2AG	100.00	91.55±3.38	85.70±2.89
FC-2DG	100.00	98.93±2.44	85.43±3.47
FC-2DGAG1:1	100.00	93.37±1.38	91.67±3.22
FC-2DGAG2:1	100.00	88.95±2.43	81.90±3.19

Figure 72 TL callus(left-top row), TL callus before harvested (right-top row), TL callus before freeze drying process (left-bottom row) and freeze dried TL callus (right-bottom row)

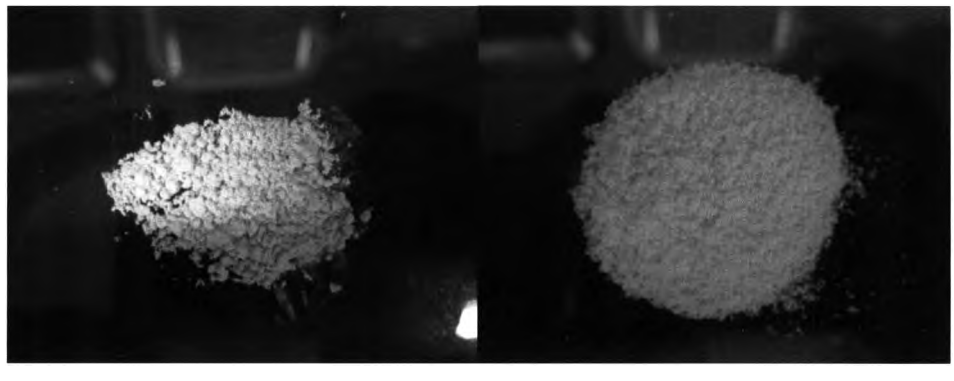

Figure 73 Encapsulated TC microparticles: TC-SN-1AG (left), TC-FC-2DGAG1:1 (right)

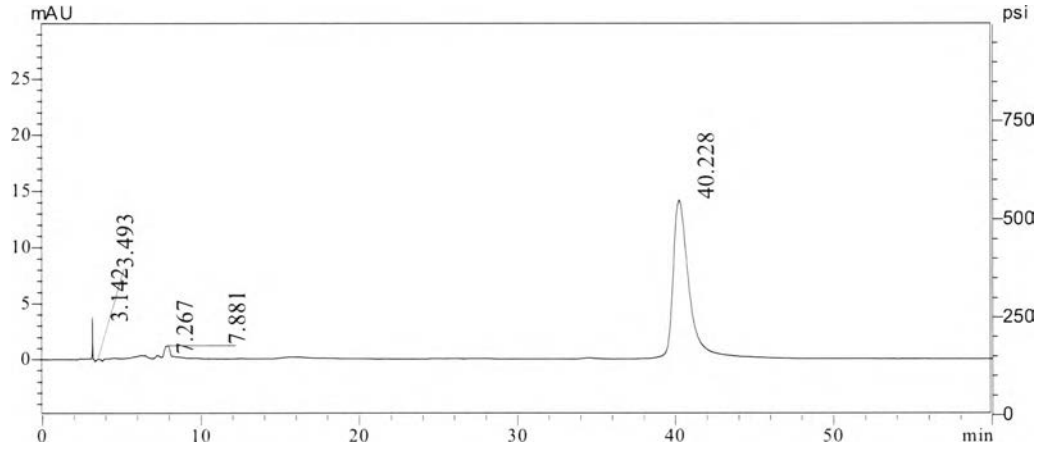

Figure 74 HPLC chromatogram of TL callus ethanol extract

(NAA1, BA2 media) (HPLC : Run at 0.9 ml/min)

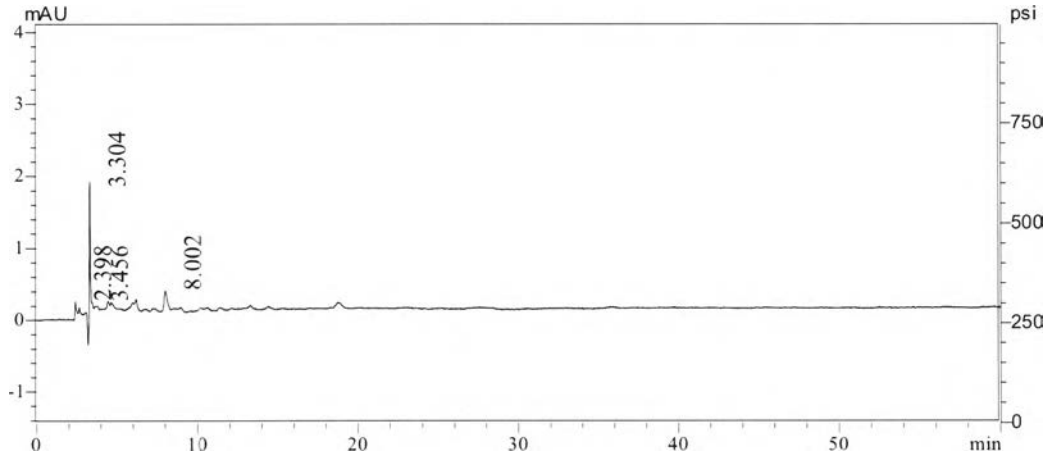

Figure 75 HPLC chromatogram of TL callus water extract

(NAA1, BA2 media) (HPLC : Run at 0.9 ml/min)

Table 19 Encapsulated TC particle size

Formulations	Particle size mean±SD (μm)
TC-SN-1AG	16.51±0.75
TC-FC-1DG	153.39±3.61
TC-FC-2AG	230.71±5.52
TC-FC-2DG	351.93±5.23
TC-FC-2DGAG1:1	256.42±4.97

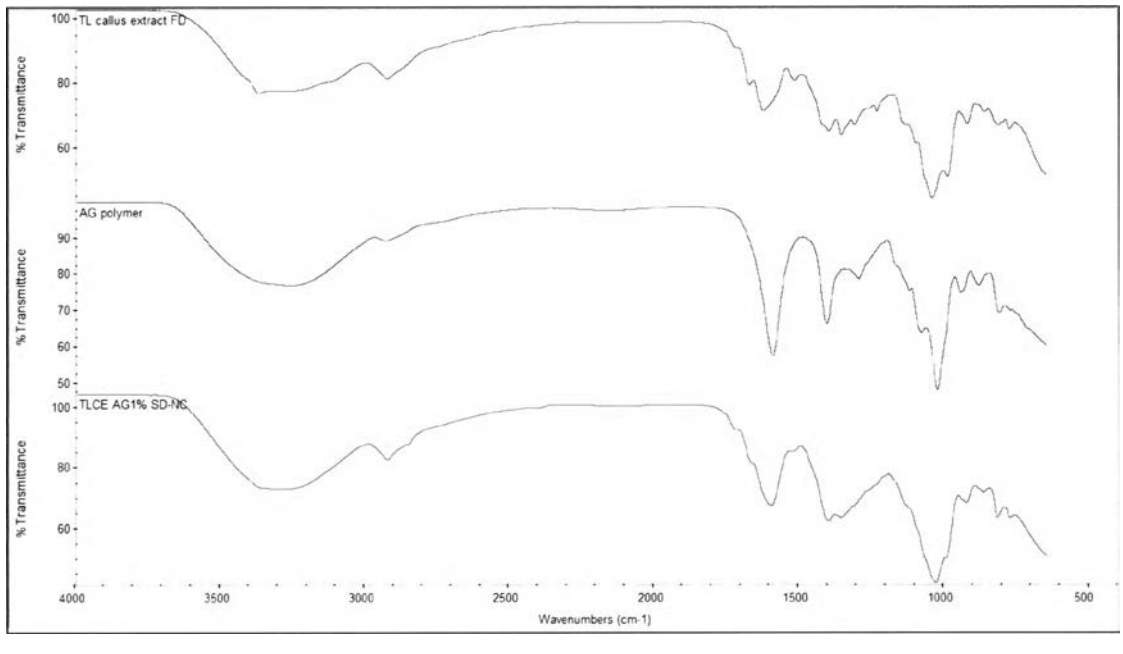

Figure 76 FTIR spectra of TL callus extract, sodium alginate and TC-SN-1AG

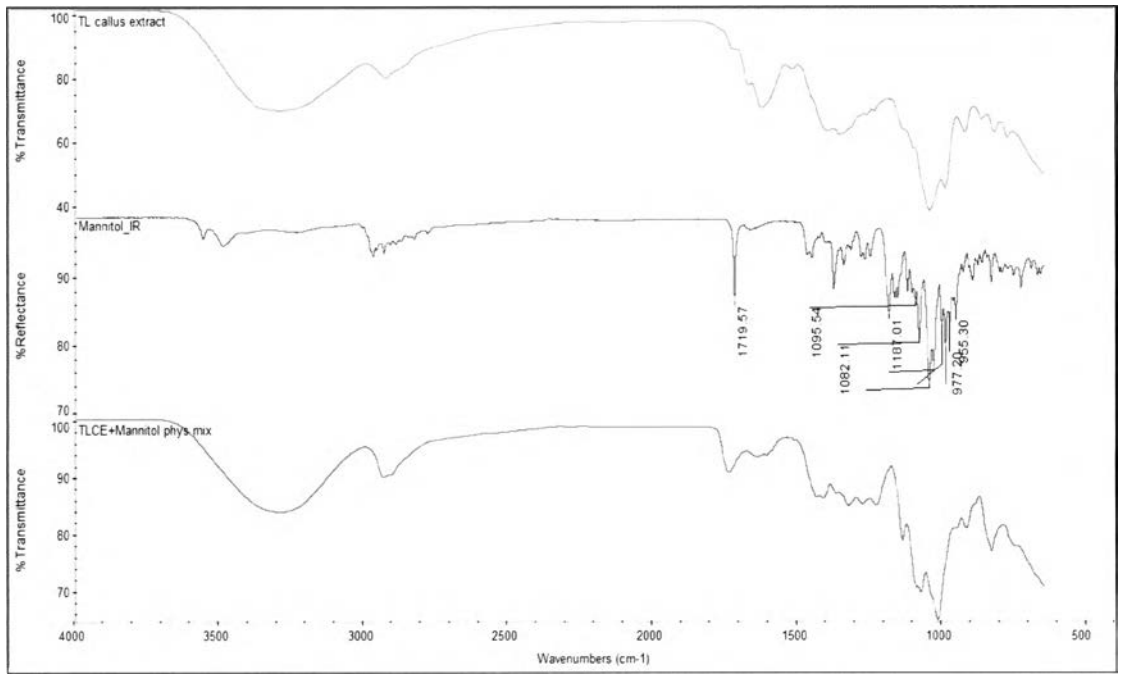

Figure 77 FTIR spectra of TL callus extract, mannitol and physical mixture of TL callus extract with mannitol

Table 20 Entrapment efficiency of encapsulated TC microparticles

Formulations	Entrapment efficiency (mean±SD)
TC-SN-1AG	79.97±3.04
TC-FC-1DG	97.90±3.76
TC-FC-2AG	102.11±5.87
TC-FC-2DG	100.05±4.92
TC-FC-2DGAG1:1	96.20±3.36

Table 21 *In vitro* release data of encapsulated TC microparticles

Formulation/Hours	% Rosmarinic acid cumulative release from TC MPs					
	0	1	3	6	9	12
TC-SN-1AG	0.00	41.84±2.31	60.74±2.19	74.35±3.03	87.41±3.42	94.18±4.81
TC-FC-1DG	0.00	63.35±1.46	74.04±2.03	79.35±2.87	88.23±3.05	95.07±2.98
TC-FC-2AG	0.00	48.39±2.51	62.04±2.72	76.25±3.05	87.67±3.01	92.12±2.98
TC-FC-2DG	0.00	54.29±1.95	68.35±2.48	80.67±3.54	93.56±3.70	97.03±2.97
TC-FC-2DGAG1:1	0.00	49.41±1.88	71.19±2.24	89.06±2.31	98.81±3.55	101.43±3.81

Table 22 Stability data of encapsulated TC microparticles storage at 4°C

Formulation/Months	% Rosmarinic acid remaining from encapsulated TC microparticles stability at 4°C			
	0	1	2	3
TC	100.00	94.39±2.05	88.04±2.71	83.49±1.84
TC-SN-1AG	100.00	95.24±2.18	93.87±2.76	87.31±3.09
TC-FC-1DG	100.00	94.25±3.78	90.41±2.06	86.02±2.86
TC-FC-2AG	100.00	94.04±1.76	92.88±2.98	90.29±1.45
TC-FC-2DG	100.00	97.44±2.85	92.21±3.19	89.95±2.78
TC-FC-2DGAG1:1	100.00	98.23±1.05	97.41±2.11	93.28±2.56

Table 23 Stability data of encapsulated TC microparticles storage at 30°C/75%RH

Formulation/Months	% Rosmarinic acid remaining from encapsulated TC microparticles stability at 30°C/75%RH			
	0	1	2	3
TC	100.00	92.71±1.71	84.02±2.03	72.23±2.32
TC-SN-1AG	100.00	92.24±1.46	89.87±2.74	83.31±1.89
TC-FC-1DG	100.00	90.25±2,57	86.41±2.83	85.98±1.96
TC-FC-2AG	100.00	89.32±2.01	88.21±2.22	84.98±3.14
TC-FC-2DG	100.00	94.62±1.94	87.46±2.07	85.21±2.33
TC-FC-2DGAG1:1	100.00	95.39±2.83	90.07±1.94	88.28±3.03

Table 24 Stability data of encapsulated TC microparticles storage at 40°C/75%RH

Formulation/Months	% Rosmarinic acid remaining from encapsulated TC microparticles stability at 40°C/75%RH			
	0	1	2	3
TC	100.00	83.75±1.09	73.48±0.86	69.83±2.73
TC-SN-1AG	100.00	90.47±3.46	88.32±2.01	80.83±2.79
TC-FC-1DG	100.00	89.08±2.04	81.63±1.96	74.21±1.95
TC-FC-2AG	100.00	88.13±2.03	85.37±2.14	84.21±3.01
TC-FC-2DG	100.00	92.49±3.21	88.43±1.94	85.81±1.97
TC-FC-2DGAG1:1	100.00	94.23±2.05	90.42±3.02	88.24±2.96

Figure 78 PTC-FC-2DGAG1:1 and packaging

Figure 79 Franz diffusion cell (left), TC MPs-loaded patch release study using Franz diffusion cell (right)

Table 25 In vitro release data of TC MPs-loaded freeze dried patch

Formulation/Hours	% Rosmarinic acid cumulative release from TC MPs-loaded freeze dried patch					
	0	1	3	6	9	12
PTC	0.00	69.74±2.08	78.02±3.09	85.89±2.23	92.44.54	96.22±3.45
PTC-SN-1AG	0.00	32.14±2.45	49.34±2.87	65.41±3.09	74.834.01	84.72±3.15
PTC-FC-1DG	0.00	47.11±2.09	60.03±1.98	77.81±2.87	85.913.40	90.82±4.08
PTC-FC-2AG	0.00	40.33±3.60	56.41±4.58	70.80±464	78.41±3.82	85.45±2.98
PTC-FC-2DG	0.00	42.27±3.03	60.44±2.58	74.29±2.97	81.45±3.07	89.82±4.13
PTC-FC-2DGAG1:1	0.00	40.09±2.75	55.76±4.09	78.03±5.06	85.42±3.78	91.04±4.57

Table 26 Stability data of TC MPs-loaded freeze dried patch storage at 4°C

Formulation/Months	% Rosmarinic acid remaining from TC MPs-loaded freeze-dried patch stability at 4°C			
	0	1	2	3
PTC	100.00	96.44±2.14	93.31±1.96	88.39±2.98
PTCexc	100.00	97.89±2.13	95.03±2.16	89.44±2.09
PTC-SN-1AG	100.00	96.41±1.09	92.23±2.93	90.74±1.39
PTC-FC-1DG	100.00	97.25±1.98	93.22±2.17	92.21±2.13
PTC-FC-2AG	100.00	95.55±2.07	94.67±2.10	90.78±1.76
PTC-FC-2DG	100.00	93.21±1.67	92.05±2.8	88.04±2.98
PTC-FC-2DGAG1:1	100.00	95.34±1.08	92.89±1.45	89.65±3.01

Table 27 Stability data of TC MPs-loaded freeze dried patch storage at 30°C/75%RH

Formulation/Months	% Rosmarinic acid remaining from TC MPs-loaded freeze-dried patch stability at 30°C/75%RH			
	0	1	2	3
PTC	100.00	93.40±1.34	83.23±1.06	75.83±2.02
PTCexc	100.00	91.82±2.64	85.61±1.22	78.04±1.65
PTC-SN-1AG	100.00	94.72±1.05	88.45±1.54	85.73±1.94
PTC-FC-1DG	100.00	92.01±1.51	87.80±2.05	83.75±2.34
PTC-FC-2AG	100.00	95.77±1.04	93.21±1.87	89.04±2.51
PTC-FC-2DG	100.00	94.73±1.68	90.82±1.31	88.21±2.54
PTC-FC-2DGAG1:1	100.00	93.22±1.20	90.74±2.07	87.45±3.31

Table 28 Stability data of TC MPs-loaded freeze dried patch storage at 40°C/75%RH

Formulation/Months	% Rosmarinic acid remaining from TC MPs-loaded freeze-dried patch stability at 40°C/75%RH			
	0	1	2	3
PTC	100.00	88.05±1.21	80.76±2.04	71.42±1.63
PTCexc	100.00	90.21±1.93	87.34±1.59	79.41±2.83
PTC-SN-1AG	100.00	94.71±2.01	86.74±2.54	82.90±2.95
PTC-FC-1DG	100.00	90.75±1.34	86.76±1.69	81.44±3.03
PTC-FC-2AG	100.00	93.90±1.56	90.82±2.94	84.03±2.05
PTC-FC-2DG	100.00	91.52±1.91	87.48±2.14	84.08±2.16
PTC-FC-2DGAG1:1	100.00	94.61±2.42	89.77±1.95	87.01±3.93

APPENDIX B

STATISTICAL ANALYSIS

Table 29 One-Way ANOVA of **Particle size of encapsulated spray dried RA microparticles**

29.1 Test of Homogeneity of Variances

Particle size

Levene Statistic	df1	df2	Sig.
.417	7	16	.878

29.2 Hypothesis test

ANOVA

Particle size

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3169.857	7	452.837	72.264	.000
Within Groups	100.263	16	6.266		
Total	3270.119	23			

Multiple Comparisons

Dependent Variable: spraydriedRAmicroparticle

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
SN-1AG	SN-1DG	-10.95667*	2.04392	.001	-18.0330	-3.8803
	SN-1DGAG1:1	14.61333*	2.04392	.000	7.5370	21.6897
	SN-1DGAG2:1	10.78333*	2.04392	.002	3.7070	17.8597
	SN-2AG	10.39000*	2.04392	.002	3.3136	17.4664
	SN-2DG	-21.30333*	2.04392	.000	-28.3797	-14.2270
	SN-2DGAG1:1	7.88667*	2.04392	.024	.8103	14.9630
	SN-2DGAG2:1	2.88000	2.04392	.841	-4.1964	9.9564
SN-1DG	SN-1AG	10.95667*	2.04392	.001	3.8803	18.0330
	SN-1DGAG1:1	25.57000*	2.04392	.000	18.4936	32.6464
	SN-1DGAG2:1	21.74000*	2.04392	.000	14.6636	28.8164
	SN-2AG	21.34667*	2.04392	.000	14.2703	28.4230
	SN-2DG	-10.34667*	2.04392	.002	-17.4230	-3.2703
	SN-2DGAG1:1	18.84333*	2.04392	.000	11.7670	25.9197
	SN-2DGAG2:1	13.83667*	2.04392	.000	6.7603	20.9130
SN-1DGAG1:1	SN-1AG	-14.61333*	2.04392	.000	-21.6897	-7.5370
	SN-1DG	-25.57000*	2.04392	.000	-32.6464	-18.4936
	SN-1DGAG2:1	-3.83000	2.04392	.585	-10.9064	3.2464
	SN-2AG	-4.22333	2.04392	.473	-11.2997	2.8530
	SN-2DG	-35.91667*	2.04392	.000	-42.9930	-28.8403
	SN-2DGAG1:1	-6.72667	2.04392	.069	-13.8030	.3497
	SN-2DGAG2:1	-11.73333*	2.04392	.001	-18.8097	-4.6570
SN-1DGAG2:1	SN-1AG	-10.78333*	2.04392	.002	-17.8597	-3.7070
	SN-1DG	-21.74000*	2.04392	.000	-28.8164	-14.6636
	SN-1DGAG1:1	3.83000	2.04392	.585	-3.2464	10.9064
	SN-2AG	-.39333	2.04392	1.000	-7.4697	6.6830
	SN-2DG	-32.08667*	2.04392	.000	-39.1630	-25.0103
	SN-2DGAG1:1	-2.89667	2.04392	.837	-9.9730	4.1797
	SN-2DGAG2:1	-7.90333*	2.04392	.023	-14.9797	-.8270
SN-2AG	SN-1AG	-10.39000*	2.04392	.002	-17.4664	-3.3136
	SN-1DG	-21.34667*	2.04392	.000	-28.4230	-14.2703
	SN-1DGAG1:1	4.22333	2.04392	.473	-2.8530	11.2997
	SN-1DGAG2:1	.39333	2.04392	1.000	-6.6830	7.4697
	SN-2DG	-31.69333*	2.04392	.000	-38.7697	-24.6170
	SN-2DGAG1:1	-2.50333	2.04392	.913	-9.5797	4.5730
	SN-2DGAG2:1	-7.51000*	2.04392	.033	-14.5864	-.4336
SN-2DG	SN-1AG	21.30333*	2.04392	.000	14.2270	28.3797
	SN-1DG	10.34667*	2.04392	.002	3.2703	17.4230
	SN-1DGAG1:1	35.91667*	2.04392	.000	28.8403	42.9930
	SN-1DGAG2:1	32.08667*	2.04392	.000	25.0103	39.1630
	SN-2AG	31.69333*	2.04392	.000	24.6170	38.7697
	SN-2DGAG1:1	29.19000*	2.04392	.000	22.1136	36.2664
	SN-2DGAG2:1	24.18333*	2.04392	.000	17.1070	31.2597
SN-2DGAG1:1	SN-1AG	-7.88667*	2.04392	.024	-14.9630	-.8103
	SN-1DG	-18.84333*	2.04392	.000	-25.9197	-11.7670
	SN-1DGAG1:1	6.72667	2.04392	.069	-.3497	13.8030
	SN-1DGAG2:1	2.89667	2.04392	.837	-4.1797	9.9730
	SN-2AG	2.50333	2.04392	.913	-4.5730	9.5797
	SN-2DG	-29.19000*	2.04392	.000	-36.2664	-22.1136
	SN-2DGAG2:1	-5.00667	2.04392	.283	-12.0830	2.0697
SN-2DGAG2:1	SN-1AG	-2.88000	2.04392	.841	-9.9564	4.1964
	SN-1DG	-13.83667*	2.04392	.000	-20.9130	-6.7603
	SN-1DGAG1:1	11.73333*	2.04392	.001	4.6570	18.8097
	SN-1DGAG2:1	7.90333*	2.04392	.023	.8270	14.9797
	SN-2AG	7.51000*	2.04392	.033	.4336	14.5864
	SN-2DG	-24.18333*	2.04392	.000	-31.2597	-17.1070
	SN-2DGAG1:1	5.00667	2.04392	.283	-2.0697	12.0830

*. The mean difference is significant at the .05 level.

Table 30 One-Way ANOVA of **Particle size of encapsulated freeze dried RA microparticles**

30.1 Test of Homogeneity of Variances

Particle size

Levene Statistic	df1	df2	Sig.
.546	7	16	.788

30.2 Hypothesis test

ANOVA

Particle size

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	156364.016	7	22337.717	169.979	.000
Within Groups	2102.635	16	131.415		
Total	158466.652	23			

Multiple Comparisons

Dependent Variable: freezedriedRAmicropartcles

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
FC-1AG	FC-1DG	-181.75000*	9.36001	.000	-214.1558	-149.3442
	Fc-1DGAG1:1	-69.52667*	9.36001	.000	-101.9324	-37.1209
	FC-1DGAG2:1	-164.04333*	9.36001	.000	-196.4491	-131.6376
	FC-2AG	-92.87333*	9.36001	.000	-125.2791	-60.4676
	FC-2DG	-267.51667*	9.36001	.000	-299.9224	-235.1109
	FC-2DGAG1:1	-81.28000*	9.36001	.000	-113.6858	-48.8742
	FC-2DGAG2:1	-201.46333*	9.36001	.000	-233.8691	-169.0576
FC-1DG	FC-1AG	181.75000*	9.36001	.000	149.3442	214.1558
	Fc-1DGAG1:1	112.22333*	9.36001	.000	79.8176	144.6291
	FC-1DGAG2:1	17.70667	9.36001	.574	-14.6991	50.1124
	FC-2AG	88.87667*	9.36001	.000	56.4709	121.2824
	FC-2DG	-85.76667*	9.36001	.000	-118.1724	-53.3609
	FC-2DGAG1:1	100.47000*	9.36001	.000	68.0642	132.8758
	FC-2DGAG2:1	-19.71333	9.36001	.451	-52.1191	12.6924
Fc-1DGAG1:1	FC-1AG	69.52667*	9.36001	.000	37.1209	101.9324
	FC-1DG	-112.22333*	9.36001	.000	-144.6291	-79.8176
	FC-1DGAG2:1	-94.51667*	9.36001	.000	-126.9224	-62.1109
	FC-2AG	-23.34667	9.36001	.265	-55.7524	9.0591
	FC-2DG	-197.99000*	9.36001	.000	-230.3958	-165.5842
	FC-2DGAG1:1	-11.75333	9.36001	.902	-44.1591	20.6524
	FC-2DGAG2:1	-131.93667*	9.36001	.000	-164.3424	-99.5309
FC-1DGAG2:1	FC-1AG	164.04333*	9.36001	.000	131.6376	196.4491
	FC-1DG	-17.70667	9.36001	.574	-50.1124	14.6991
	Fc-1DGAG1:1	94.51667*	9.36001	.000	62.1109	126.9224
	FC-2AG	71.17000*	9.36001	.000	38.7642	103.5758
	FC-2DG	-103.47333*	9.36001	.000	-135.8791	-71.0676
	FC-2DGAG1:1	82.76333*	9.36001	.000	50.3576	115.1691
	FC-2DGAG2:1	-37.42000*	9.36001	.018	-69.8258	-5.0142
FC-2AG	FC-1AG	92.87333*	9.36001	.000	60.4676	125.2791
	FC-1DG	-88.87667*	9.36001	.000	-121.2824	-56.4709
	Fc-1DGAG1:1	23.34667	9.36001	.265	-9.0591	55.7524
	FC-1DGAG2:1	-71.17000*	9.36001	.000	-103.5758	-38.7642
	FC-2DG	-174.64333*	9.36001	.000	-207.0491	-142.2376
	FC-2DGAG1:1	11.59333	9.36001	.908	-20.8124	43.9991
	FC-2DGAG2:1	-108.59000*	9.36001	.000	-140.9958	-76.1842
FC-2DG	FC-1AG	267.51667*	9.36001	.000	235.1109	299.9224
	FC-1DG	85.76667*	9.36001	.000	53.3609	118.1724
	Fc-1DGAG1:1	197.99000*	9.36001	.000	165.5842	230.3958
	FC-1DGAG2:1	103.47333*	9.36001	.000	71.0676	135.8791
	FC-2AG	174.64333*	9.36001	.000	142.2376	207.0491
	FC-2DGAG1:1	186.23667*	9.36001	.000	153.8309	218.6424
	FC-2DGAG2:1	66.05333*	9.36001	.000	33.6476	98.4591
FC-2DGAG1:1	FC-1AG	81.28000*	9.36001	.000	48.8742	113.6858
	FC-1DG	-100.47000*	9.36001	.000	-132.8758	-68.0642
	Fc-1DGAG1:1	11.75333	9.36001	.902	-20.6524	44.1591
	FC-1DGAG2:1	-82.76333*	9.36001	.000	-115.1691	-50.3576
	FC-2AG	-11.59333	9.36001	.908	-43.9991	20.8124
	FC-2DG	-186.23667*	9.36001	.000	-218.6424	-153.8309
	FC-2DGAG2:1	-120.18333*	9.36001	.000	-152.5891	-87.7776
FC-2DGAG2:1	FC-1AG	201.46333*	9.36001	.000	169.0576	233.8691
	FC-1DG	19.71333	9.36001	.451	-12.6924	52.1191
	Fc-1DGAG1:1	131.93667*	9.36001	.000	99.5309	164.3424
	FC-1DGAG2:1	37.42000*	9.36001	.018	5.0142	69.8258
	FC-2AG	108.59000*	9.36001	.000	76.1842	140.9958
	FC-2DG	-66.05333*	9.36001	.000	-98.4591	-33.6476
	FC-2DGAG1:1	120.18333*	9.36001	.000	87.7776	152.5891

*. The mean difference is significant at the .05 level.

Table 31 One-Way ANOVA of **Entrapment efficiency of spray dried RA microparticles**

31.1 Test of Homogeneity of Variances

Entrapment efficiency

Levene Statistic	df1	df2	Sig.
5.265	7	16	.003

31.2 Hypothesis test

ANOVA

Entrapment efficiency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1921.194	7	274.456	19.423	.000
Within Groups	226.091	16	14.131		
Total	2147.285	23			

Multiple Comparisons

Dependent Variable: spraydriedRAentrapment

Dunnett T3

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
SN-1AG	SN-1DG	-24.45333*	1.94447	.006	-36.7454	-12.1613
	SN-1DGAG1:1	-24.76667*	1.42088	.001	-32.8742	-16.6591
	SN-1DGAG2:1	-19.01000	5.45173	.339	-70.6423	32.6223
	SN-2AG	-4.00000	1.52126	.448	-12.6683	4.6683
	SN-2DG	-24.50333*	1.62793	.002	-33.9360	-15.0707
	SN-2DGAG1:1	-15.94333*	1.45882	.005	-24.2406	-7.6461
	SN-2DGAG2:1	-19.60667*	1.26220	.002	-27.3682	-11.8452
SN-1DG	SN-1AG	24.45333*	1.94447	.006	12.1613	36.7454
	SN-1DGAG1:1	-.31333	1.90389	1.000	-12.7517	12.1250
	SN-1DGAG2:1	5.44333	5.59708	.989	-42.3135	53.2001
	SN-2AG	20.45333*	1.97994	.009	8.2311	32.6756
	SN-2DG	-.05000	2.06302	1.000	-12.2765	12.1765
	SN-2DGAG1:1	8.51000	1.93237	.144	-3.8177	20.8377
	SN-2DGAG2:1	4.84667	1.78860	.467	-8.5528	18.2462
SN-1DGAG1:1	SN-1AG	24.76667*	1.42088	.001	16.6591	32.8742
	SN-1DG	.31333	1.90389	1.000	-12.1250	12.7517
	SN-1DGAG2:1	5.75667	5.43739	.978	-46.3336	57.8470
	SN-2AG	20.76667*	1.46904	.002	12.3214	29.2120
	SN-2DG	.26333	1.57924	1.000	-9.0602	9.5869
	SN-2DGAG1:1	8.82333*	1.40428	.036	.8241	16.8225
	SN-2DGAG2:1	5.16000	1.19876	.137	-2.0164	12.3364
SN-1DGAG2:1	SN-1AG	19.01000	5.45173	.339	-32.6223	70.6423
	SN-1DG	-5.44333	5.59708	.989	-53.2001	42.3135
	SN-1DGAG1:1	-5.75667	5.43739	.978	-57.8470	46.3336
	SN-2AG	15.01000	5.46448	.486	-36.2276	66.2476
	SN-2DG	-5.49333	5.49514	.986	-55.8290	44.8424
	SN-2DGAG1:1	3.06667	5.44743	1.000	-48.7014	54.8347
	SN-2DGAG2:1	-.59667	5.39810	1.000	-54.0242	52.8309
SN-2AG	SN-1AG	4.00000	1.52126	.448	-4.6683	12.6683
	SN-1DG	-20.45333*	1.97994	.009	-32.6756	-8.2311
	SN-1DGAG1:1	-20.76667*	1.46904	.002	-29.2120	-12.3214
	SN-1DGAG2:1	-15.01000	5.46448	.486	-66.2476	36.2276
	SN-2DG	-20.50333*	1.67013	.003	-30.0809	-10.9257
	SN-2DGAG1:1	-11.94333*	1.50577	.016	-20.5391	-3.3476
	SN-2DGAG2:1	-15.60667*	1.31619	.007	-23.8921	-7.3212
SN-2DG	SN-1AG	24.50333*	1.62793	.002	15.0707	33.9360
	SN-1DG	.05000	2.06302	1.000	-12.1765	12.2765
	SN-1DGAG1:1	-.26333	1.57924	1.000	-9.5869	9.0602
	SN-1DGAG2:1	5.49333	5.49514	.986	-44.8424	55.8290
	SN-2AG	20.50333*	1.67013	.003	10.9257	30.0809
	SN-2DGAG1:1	8.56000	1.61346	.068	-.8332	17.9532
	SN-2DGAG2:1	4.89667	1.43815	.283	-4.6377	14.4310
SN-2DGAG1:1	SN-1AG	15.94333*	1.45882	.005	7.6461	24.2406
	SN-1DG	-8.51000	1.93237	.144	-20.8377	3.8177
	SN-1DGAG1:1	-8.82333*	1.40428	.036	-16.8225	-.8241
	SN-1DGAG2:1	-3.06667	5.44743	1.000	-54.8347	48.7014
	SN-2AG	11.94333*	1.50577	.016	3.3476	20.5391
	SN-2DG	-8.56000	1.61346	.068	-17.9532	.8332
	SN-2DGAG2:1	-3.66333	1.24349	.366	-11.2485	3.9219
SN-2DGAG2:1	SN-1AG	19.60667*	1.26220	.002	11.8452	27.3682
	SN-1DG	-4.84667	1.78860	.467	-18.2462	8.5528
	SN-1DGAG1:1	-5.16000	1.19876	.137	-12.3364	2.0164
	SN-1DGAG2:1	59667	5.39810	1.000	-52.8309	54.0242
	SN-2AG	15.60667*	1.31619	.007	7.3212	23.8921
	SN-2DG	-4.89667	1.43815	.283	-14.4310	4.6377
	SN-2DGAG1:1	3.66333	1.24349	.366	-3.9219	11.2485

*. The mean difference is significant at the .05 level.

Table 32 One-Way ANOVA of **Entrapment efficiency of freeze dried RA microparticles**

32.1 Test of Homogeneity of Variances

Entrapment efficiency

Levene Statistic	df1	df2	Sig.
.736	7	16	.646

32.2 Hypothesis test

ANOVA

Entrapment efficiency

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	450.475	7	64.354	19.557	.000
Within Groups	52.650	16	3.291		
Total	503.126	23			

Multiple Comparisons

Dependent Variable: freezedriedRAmicroparticles

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
FC-1AG	FC-1DG	-.64333	1.48113	1.000	-5.7712	4.4846
	FC-1DGAG1:1	1.33667	1.48113	.981	-3.7912	6.4646
	FC-1DGAG2:1	4.43000	1.48113	.118	-.6979	9.5579
	FC-2AG	13.18000*	1.48113	.000	8.0521	18.3079
	FC-2DG	.26000	1.48113	1.000	-4.8679	5.3879
	FC-2DGAG1:1	6.79000*	1.48113	.006	1.6621	11.9179
	FC-2DGAG2:1	3.06000	1.48113	.473	-2.0679	8.1879
FC-1DG	FC-1AG	.64333	1.48113	1.000	-4.4846	5.7712
	FC-1DGAG1:1	1.98000	1.48113	.872	-3.1479	7.1079
	FC-1DGAG2:1	5.07333	1.48113	.054	-.0546	10.2012
	FC-2AG	13.82333*	1.48113	.000	8.6954	18.9512
	FC-2DG	.90333	1.48113	.998	-4.2246	6.0312
	FC-2DGAG1:1	7.43333*	1.48113	.002	2.3054	12.5612
	FC-2DGAG2:1	3.70333	1.48113	.262	-1.4246	8.8312
FC-1DGAG1:1	FC-1AG	-1.33667	1.48113	.981	-6.4646	3.7912
	FC-1DG	-1.98000	1.48113	.872	-7.1079	3.1479
	FC-1DGAG2:1	3.09333	1.48113	.460	-2.0346	8.2212
	FC-2AG	11.84333*	1.48113	.000	6.7154	16.9712
	FC-2DG	-1.07667	1.48113	.995	-6.2046	4.0512
	FC-2DGAG1:1	5.45333*	1.48113	.033	.3254	10.5812
	FC-2DGAG2:1	1.72333	1.48113	.931	-3.4046	6.8512
FC-1DGAG2:1	FC-1AG	-4.43000	1.48113	.118	-9.5579	.6979
	FC-1DG	-5.07333	1.48113	.054	-10.2012	.0546
	FC-1DGAG1:1	-3.09333	1.48113	.460	-8.2212	2.0346
	FC-2AG	8.75000*	1.48113	.000	3.6221	13.8779
	FC-2DG	-4.17000	1.48113	.159	-9.2979	.9579
	FC-2DGAG1:1	2.36000	1.48113	.748	-2.7679	7.4879
	FC-2DGAG2:1	-1.37000	1.48113	.979	-6.4979	3.7579
FC-2AG	FC-1AG	-13.18000*	1.48113	.000	-18.3079	-8.0521
	FC-1DG	-13.82333*	1.48113	.000	-18.9512	-8.6954
	FC-1DGAG1:1	-11.84333*	1.48113	.000	-16.9712	-6.7154
	FC-1DGAG2:1	-8.75000*	1.48113	.000	-13.8779	-3.6221
	FC-2DG	-12.92000*	1.48113	.000	-18.0479	-7.7921
	FC-2DGAG1:1	-6.39000*	1.48113	.010	-11.5179	-1.2621
	FC-2DGAG2:1	-10.12000*	1.48113	.000	-15.2479	-4.9921
FC-2DG	FC-1AG	-.26000	1.48113	1.000	-5.3879	4.8679
	FC-1DG	-.90333	1.48113	.998	-6.0312	4.2246
	FC-1DGAG1:1	1.07667	1.48113	.995	-4.0512	6.2046
	FC-1DGAG2:1	4.17000	1.48113	.159	-.9579	9.2979
	FC-2AG	12.92000*	1.48113	.000	7.7921	18.0479
	FC-2DGAG1:1	6.53000*	1.48113	.008	1.4021	11.6579
	FC-2DGAG2:1	2.80000	1.48113	.575	-2.3279	7.9279
FC-2DGAG1:1	FC-1AG	-6.79000*	1.48113	.006	-11.9179	-1.6621
	FC-1DG	-7.43333*	1.48113	.002	-12.5612	-2.3054
	FC-1DGAG1:1	-5.45333*	1.48113	.033	-10.5812	-.3254
	FC-1DGAG2:1	-2.36000	1.48113	.748	-7.4879	2.7679
	FC-2AG	6.39000*	1.48113	.010	1.2621	11.5179
	FC-2DG	-6.53000*	1.48113	.008	-11.6579	-1.4021
	FC-2DGAG2:1	-3.73000	1.48113	.255	-8.8579	1.3979
FC-2DGAG2:1	FC-1AG	-3.06000	1.48113	.473	-8.1879	2.0679
	FC-1DG	-3.70333	1.48113	.262	-8.8312	1.4246
	FC-1DGAG1:1	-1.72333	1.48113	.931	-6.8512	3.4046
	FC-1DGAG2:1	1.37000	1.48113	.979	-3.7579	6.4979
	FC-2AG	10.12000*	1.48113	.000	4.9921	15.2479
	FC-2DG	-2.80000	1.48113	.575	-7.9279	2.3279
	FC-2DGAG1:1	3.73000	1.48113	.255	-1.3979	8.8579

*. The mean difference is significant at the .05 level.

Table 33 One-Way ANOVA of Stability of encapsulated RA spray dried microparticles at accelerated condition

33.1 Test of Homogeneity of Variances

Stability

Levene Statistic	df1	df2	Sig.
.202	7	16	.980

33.2 Hypothesis test

ANOVA

Stability

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5262.697	7	751.814	91.602	.000
Within Groups	131.318	16	8.207		
Total	5394.016	23			

Multiple Comparisons

Dependent Variable: spraydriedRAstability

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
SN-1AG	SN-1DG	30.34333*	2.33914	.000	22.2449	38.4418
	SN-1DGAG1:1	16.83000*	2.33914	.000	8.7315	24.9285
	SN-1DGAG2:1	15.93333*	2.33914	.000	7.8349	24.0318
	SN-2AG	38.22667*	2.33914	.000	30.1282	46.3251
	SN-2DG	49.73333*	2.33914	.000	41.6349	57.8318
	SN-2DGAG1:1	35.67333*	2.33914	.000	27.5749	43.7718
	SN-2DGAG2:1	35.67333*	2.33914	.000	27.5749	43.7718
SN-1DG	SN-1AG	-30.34333*	2.33914	.000	-38.4418	-22.2449
	SN-1DGAG1:1	-13.51333*	2.33914	.001	-21.6118	-5.4149
	SN-1DGAG2:1	-14.41000*	2.33914	.000	-22.5085	-6.3115
	SN-2AG	7.88333	2.33914	.059	-.2151	15.9818
	SN-2DG	19.39000*	2.33914	.000	11.2915	27.4885
	SN-2DGAG1:1	5.33000	2.33914	.361	-2.7685	13.4285
	SN-2DGAG2:1	5.33000	2.33914	.361	-2.7685	13.4285
SN-1DGAG1:1	SN-1AG	-16.83000*	2.33914	.000	-24.9285	-8.7315
	SN-1DG	13.51333*	2.33914	.001	5.4149	21.6118
	SN-1DGAG2:1	-.89667	2.33914	1.000	-8.9951	7.2018
	SN-2AG	21.39667*	2.33914	.000	13.2982	29.4951
	SN-2DG	32.90333*	2.33914	.000	24.8049	41.0018
	SN-2DGAG1:1	18.84333*	2.33914	.000	10.7449	26.9418
	SN-2DGAG2:1	18.84333*	2.33914	.000	10.7449	26.9418
SN-1DGAG2:1	SN-1AG	-15.93333*	2.33914	.000	-24.0318	-7.8349
	SN-1DG	14.41000*	2.33914	.000	6.3115	22.5085
	SN-1DGAG1:1	.89667	2.33914	1.000	-7.2018	8.9951
	SN-2AG	22.29333*	2.33914	.000	14.1949	30.3918
	SN-2DG	33.80000*	2.33914	.000	25.7015	41.8985
	SN-2DGAG1:1	19.74000*	2.33914	.000	11.6415	27.8385
	SN-2DGAG2:1	19.74000*	2.33914	.000	11.6415	27.8385
SN-2AG	SN-1AG	-38.22667*	2.33914	.000	-46.3251	-30.1282
	SN-1DG	-7.88333	2.33914	.059	-15.9818	.2151
	SN-1DGAG1:1	-21.39667*	2.33914	.000	-29.4951	-13.2982
	SN-1DGAG2:1	-22.29333*	2.33914	.000	-30.3918	-14.1949
	SN-2DG	11.50667*	2.33914	.003	3.4082	19.6051
	SN-2DGAG1:1	-2.55333	2.33914	.950	-10.6518	5.5451
	SN-2DGAG2:1	-2.55333	2.33914	.950	-10.6518	5.5451
SN-2DG	SN-1AG	-49.73333*	2.33914	.000	-57.8318	-41.6349
	SN-1DG	-19.39000*	2.33914	.000	-27.4885	-11.2915
	SN-1DGAG1:1	-32.90333*	2.33914	.000	-41.0018	-24.8049
	SN-1DGAG2:1	-33.80000*	2.33914	.000	-41.8985	-25.7015
	SN-2AG	-11.50667*	2.33914	.003	-19.6051	-3.4082
	SN-2DGAG1:1	-14.06000*	2.33914	.000	-22.1585	-5.9615
	SN-2DGAG2:1	-14.06000*	2.33914	.000	-22.1585	-5.9615
SN-2DGAG1:1	SN-1AG	-35.67333*	2.33914	.000	-43.7718	-27.5749
	SN-1DG	-5.33000	2.33914	.361	-13.4285	2.7685
	SN-1DGAG1:1	-18.84333*	2.33914	.000	-26.9418	-10.7449
	SN-1DGAG2:1	-19.74000*	2.33914	.000	-27.8385	-11.6415
	SN-2AG	2.55333	2.33914	.950	-5.5451	10.6518
	SN-2DG	14.06000*	2.33914	.000	5.9615	22.1585
	SN-2DGAG2:1	.00000	2.33914	1.000	-8.0985	8.0985
SN-2DGAG2:1	SN-1AG	-35.67333*	2.33914	.000	-43.7718	-27.5749
	SN-1DG	-5.33000	2.33914	.361	-13.4285	2.7685
	SN-1DGAG1:1	-18.84333*	2.33914	.000	-26.9418	-10.7449
	SN-1DGAG2:1	-19.74000*	2.33914	.000	-27.8385	-11.6415
	SN-2AG	2.55333	2.33914	.950	-5.5451	10.6518
	SN-2DG	14.06000*	2.33914	.000	5.9615	22.1585
	SN-2DGAG1:1	.00000	2.33914	1.000	-8.0985	8.0985

*. The mean difference is significant at the .05 level.

Table 34 One-Way ANOVA of Stability of encapsulated RA freeze dried microparticles at accelerated condition

34.1 Test of Homogeneity of Variances

Stability

Levene Statistic	df1	df2	Sig.
.161	7	16	.990

34.2 Hypothesis test

ANOVA

Stability

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1120.725	7	160.104	26.923	.000
Within Groups	95.148	16	5.947		
Total	1215.874	23			

Multiple Comparisons

Dependent Variable: freezedriedRAstability

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
FC-1AG	FC-1DG	-14.09000*	1.99111	.000	-20.9835	-7.1965
	FC-1DGAG1:1	-1.30667	1.99111	.997	-8.2002	5.5869
	FC-1DGAG2:1	-4.78000	1.99111	.304	-11.6735	2.1135
	FC-2AG	-14.01333*	1.99111	.000	-20.9069	-7.1198
	FC-2DG	-14.11000*	1.99111	.000	-21.0035	-7.2165
	FC-2DGAG1:1	-21.00333*	1.99111	.000	-27.8969	-14.1098
	FC-2DGAG2:1	-9.74333*	1.99111	.003	-16.6369	-2.8498
FC-1DG	FC-1AG	14.09000*	1.99111	.000	7.1965	20.9835
	FC-1DGAG1:1	12.78333*	1.99111	.000	5.8898	19.6769
	FC-1DGAG2:1	9.31000*	1.99111	.005	2.4165	16.2035
	FC-2AG	.07667	1.99111	1.000	-6.8169	6.9702
	FC-2DG	-.02000	1.99111	1.000	-6.9135	6.8735
	FC-2DGAG1:1	-6.91333*	1.99111	.049	-13.8069	-.0198
	FC-2DGAG2:1	4.34667	1.99111	.409	-2.5469	11.2402
FC-1DGAG1:1	FC-1AG	1.30667	1.99111	.997	-5.5869	8.2002
	FC-1DG	-12.78333*	1.99111	.000	-19.6769	-5.8898
	FC-1DGAG2:1	-3.47333	1.99111	.662	-10.3669	3.4202
	FC-2AG	-12.70667*	1.99111	.000	-19.6002	-5.8131
	FC-2DG	-12.80333*	1.99111	.000	-19.6969	-5.9098
	FC-2DGAG1:1	-19.69667*	1.99111	.000	-26.5902	-12.8031
	FC-2DGAG2:1	-8.43667*	1.99111	.011	-15.3302	-1.5431
FC-1DGAG2:1	FC-1AG	4.78000	1.99111	.304	-2.1135	11.6735
	FC-1DG	-9.31000*	1.99111	.005	-16.2035	-2.4165
	FC-1DGAG1:1	3.47333	1.99111	.662	-3.4202	10.3669
	FC-2AG	-9.23333*	1.99111	.005	-16.1269	-2.3398
	FC-2DG	-9.33000*	1.99111	.005	-16.2235	-2.4365
	FC-2DGAG1:1	-16.22333*	1.99111	.000	-23.1169	-9.3298
	FC-2DGAG2:1	-4.96333	1.99111	.265	-11.8569	1.9302
FC-2AG	FC-1AG	14.01333*	1.99111	.000	7.1198	20.9069
	FC-1DG	-.07667	1.99111	1.000	-6.9702	6.8169
	FC-1DGAG1:1	12.70667*	1.99111	.000	5.8131	19.6002
	FC-1DGAG2:1	9.23333*	1.99111	.005	2.3398	16.1269
	FC-2DG	-.09667	1.99111	1.000	-6.9902	6.7969
	FC-2DGAG1:1	-6.99000*	1.99111	.046	-13.8835	-.0965
	FC-2DGAG2:1	4.27000	1.99111	.430	-2.6235	11.1635
FC-2DG	FC-1AG	14.11000*	1.99111	.000	7.2165	21.0035
	FC-1DG	.02000	1.99111	1.000	-6.8735	6.9135
	FC-1DGAG1:1	12.80333*	1.99111	.000	5.9098	19.6969
	FC-1DGAG2:1	9.33000*	1.99111	.005	2.4365	16.2235
	FC-2AG	.09667	1.99111	1.000	-6.7969	6.9902
	FC-2DGAG1:1	-6.89333	1.99111	.050	-13.7869	.0002
	FC-2DGAG2:1	4.36667	1.99111	.404	-2.5269	11.2602
FC-2DGAG1:1	FC-1AG	21.00333*	1.99111	.000	14.1098	27.8969
	FC-1DG	6.91333*	1.99111	.049	.0198	13.8069
	FC-1DGAG1:1	19.69667*	1.99111	.000	12.8031	26.5902
	FC-1DGAG2:1	16.22333*	1.99111	.000	9.3298	23.1169
	FC-2AG	6.99000*	1.99111	.046	.0965	13.8835
	FC-2DG	6.89333	1.99111	.050	-.0002	13.7869
	FC-2DGAG2:1	11.26000*	1.99111	.001	4.3665	18.1535
FC-2DGAG2:1	FC-1AG	9.74333*	1.99111	.003	2.8498	16.6369
	FC-1DG	-4.34667	1.99111	.409	-11.2402	2.5469
	FC-1DGAG1:1	8.43667*	1.99111	.011	1.5431	15.3302
	FC-1DGAG2:1	4.96333	1.99111	.265	-1.9302	11.8569
	FC-2AG	-4.27000	1.99111	.430	-11.1635	2.6235
	FC-2DG	-4.36667	1.99111	.404	-11.2602	2.5269
	FC-2DGAG1:1	-11.26000*	1.99111	.001	-18.1535	-4.3665

*. The mean difference is significant at the .05 level.

Table 35 One-Way ANOVA of **Particle size of encapsulated TC microparticles**

35.1 Test of Homogeneity of Variances

Particle size

Levene Statistic	df1	df2	Sig.
.845	4	10	.528

35.2 Hypothesis test

ANOVA

Particle size

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	189187.452	4	47296.863	2825.444	.000
Within Groups	167.396	10	16.740		
Total	189354.848	14			

Multiple Comparisons

Dependent Variable: particlesize

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TC-SN-1AG	TC-FC-1DG	-137.18667*	3.34062	.000	-148.1809	-126.1924
	TC-FC-2AG	-213.91000*	3.34062	.000	-224.9043	-202.9157
	TC-FC-2DG	-335.50333*	3.34062	.000	-346.4976	-324.5091
	TC-FC-2DGAG1:1	-240.36333*	3.34062	.000	-251.3576	-229.3691
TC-FC-1DG	TC-SN-1AG	137.18667*	3.34062	.000	126.1924	148.1809
	TC-FC-2AG	-76.72333*	3.34062	.000	-87.7176	-65.7291
	TC-FC-2DG	-198.31667*	3.34062	.000	-209.3109	-187.3224
	TC-FC-2DGAG1:1	-103.17667*	3.34062	.000	-114.1709	-92.1824
TC-FC-2AG	TC-SN-1AG	213.91000*	3.34062	.000	202.9157	224.9043
	TC-FC-1DG	76.72333*	3.34062	.000	65.7291	87.7176
	TC-FC-2DG	-121.59333*	3.34062	.000	-132.5876	-110.5991
	TC-FC-2DGAG1:1	-26.45333*	3.34062	.000	-37.4476	-15.4591
TC-FC-2DG	TC-SN-1AG	335.50333*	3.34062	.000	324.5091	346.4976
	TC-FC-1DG	198.31667*	3.34062	.000	187.3224	209.3109
	TC-FC-2AG	121.59333*	3.34062	.000	110.5991	132.5876
	TC-FC-2DGAG1:1	95.14000*	3.34062	.000	84.1457	106.1343
TC-FC-2DGAG1:1	TC-SN-1AG	240.36333*	3.34062	.000	229.3691	251.3576
	TC-FC-1DG	103.17667*	3.34062	.000	92.1824	114.1709
	TC-FC-2AG	26.45333*	3.34062	.000	15.4591	37.4476
	TC-FC-2DG	-95.14000*	3.34062	.000	-106.1343	-84.1457

*. The mean difference is significant at the .05 level.

Table 36 One-Way ANOVA of Entrapment of encapsulated TC microparticles

36.1 Test of Homogeneity of Variances

Entrapment

Levene Statistic	df1	df2	Sig.
.244	4	10	.907

36.2 Hypothesis test

ANOVA

Entrapment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	987.149	4	246.787	49.037	.000
Within Groups	50.326	10	5.033		
Total	1037.475	14			

Multiple Comparisons

Dependent Variable: entrapment

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TC-SN-1AG	TC-FC-1DG	-17.99667*	1.83169	.000	-24.0249	-11.9684
	TC-FC-2AG	-23.22667*	1.83169	.000	-29.2549	-17.1984
	TC-FC-2DG	-20.09333*	1.83169	.000	-26.1216	-14.0651
	TC-FC-2DGAG1:1	-16.86333*	1.83169	.000	-22.8916	-10.8351
TC-FC-1DG	TC-SN-1AG	17.99667*	1.83169	.000	11.9684	24.0249
	TC-FC-2AG	-5.23000	1.83169	.098	-11.2582	.7982
	TC-FC-2DG	-2.09667	1.83169	.781	-8.1249	3.9316
	TC-FC-2DGAG1:1	1.13333	1.83169	.969	-4.8949	7.1616
TC-FC-2AG	TC-SN-1AG	23.22667*	1.83169	.000	17.1984	29.2549
	TC-FC-1DG	5.23000	1.83169	.098	-.7982	11.2582
	TC-FC-2DG	3.13333	1.83169	.469	-2.8949	9.1616
	TC-FC-2DGAG1:1	6.36333*	1.83169	.038	.3351	12.3916
TC-FC-2DG	TC-SN-1AG	20.09333*	1.83169	.000	14.0651	26.1216
	TC-FC-1DG	2.09667	1.83169	.781	-3.9316	8.1249
	TC-FC-2AG	-3.13333	1.83169	.469	-9.1616	2.8949
	TC-FC-2DGAG1:1	3.23000	1.83169	.442	-2.7982	9.2582
TC-FC-2DGAG1:1	TC-SN-1AG	16.86333*	1.83169	.000	10.8351	22.8916
	TC-FC-1DG	-1.13333	1.83169	.969	-7.1616	4.8949
	TC-FC-2AG	-6.36333*	1.83169	.038	-12.3916	-.3351
	TC-FC-2DG	-3.23000	1.83169	.442	-9.2582	2.7982

*. The mean difference is significant at the .05 level.

Table 37 One-Way ANOVA of Stability encapsulated TC microparticles 40°C/75%RH 3 months

37.1 Test of Homogeneity of Variances

Stability

Levene Statistic	df1	df2	Sig.
.484	5	12	.782

37.2 Hypothesis test

ANOVA

Stability

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	778.729	5	155.746	39.040	.000
Within Groups	47.872	12	3.989		
Total	826.602	17			

Multiple Comparisons

Dependent Variable: stability40C75RH

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TC	TC-SN-1AG	-10.87667*	1.63082	.000	-16.3545	-5.3989
	TC-FC-1DG	-4.61667	1.63082	.119	-10.0945	.8611
	TC-FC-2AG	-14.94667*	1.63082	.000	-20.4245	-9.4689
	TC-FC-2DG	-16.08333*	1.63082	.000	-21.5611	-10.6055
	TC-FC-2DGAG1:1	-18.52000*	1.63082	.000	-23.9978	-13.0422
TC-SN-1AG	TC	10.87667*	1.63082	.000	5.3989	16.3545
	TC-FC-1DG	6.26000*	1.63082	.022	.7822	11.7378
	TC-FC-2AG	-4.07000	1.63082	.200	-9.5478	1.4078
	TC-FC-2DG	-5.20667	1.63082	.066	-10.6845	.2711
	TC-FC-2DGAG1:1	-7.64333*	1.63082	.005	-13.1211	-2.1655
TC-FC-1DG	TC	4.61667	1.63082	.119	-.8611	10.0945
	TC-SN-1AG	-6.26000*	1.63082	.022	-11.7378	-.7822
	TC-FC-2AG	-10.33000*	1.63082	.000	-15.8078	-4.8522
	TC-FC-2DG	-11.46667*	1.63082	.000	-16.9445	-5.9889
	TC-FC-2DGAG1:1	-13.90333*	1.63082	.000	-19.3811	-8.4255
TC-FC-2AG	TC	14.94667*	1.63082	.000	9.4689	20.4245
	TC-SN-1AG	4.07000	1.63082	.200	-1.4078	9.5478
	TC-FC-1DG	10.33000*	1.63082	.000	4.8522	15.8078
	TC-FC-2DG	-1.13667	1.63082	.979	-6.6145	4.3411
	TC-FC-2DGAG1:1	-3.57333	1.63082	.308	-9.0511	1.9045
TC-FC-2DG	TC	16.08333*	1.63082	.000	10.6055	21.5611
	TC-SN-1AG	5.20667	1.63082	.066	-.2711	10.6845
	TC-FC-1DG	11.46667*	1.63082	.000	5.9889	16.9445
	TC-FC-2AG	1.13667	1.63082	.979	-4.3411	6.6145
	TC-FC-2DGAG1:1	-2.43667	1.63082	.674	-7.9145	3.0411
TC-FC-2DGAG1:1	TC	18.52000*	1.63082	.000	13.0422	23.9978
	TC-SN-1AG	7.64333*	1.63082	.005	2.1655	13.1211
	TC-FC-1DG	13.90333*	1.63082	.000	8.4255	19.3811
	TC-FC-2AG	3.57333	1.63082	.308	-1.9045	9.0511
	TC-FC-2DG	2.43667	1.63082	.674	-3.0411	7.9145

*. The mean difference is significant at the .05 level.

Table 38 One-Way ANOVA of Stability of TC MPs-loaded freeze dried patch at 40°C/75%RH 3 months

38.1 Test of Homogeneity of Variances

Stability

Levene Statistic	df1	df2	Sig.
.319	6	14	.916

38.2 Hypothesis test

ANOVA

Stability

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	482.450	6	80.408	14.893	.000
Within Groups	75.586	14	5.399		
Total	558.037	20			

Multiple Comparisons

Dependent Variable: stability patch40C75RH

Tukey HSD

(I) formulation	(J) formulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
PTC	PTCexc	-8.04333*	1.89719	.011	-14.5215	-1.5652
	PTC-SN-1AG	-11.05000*	1.89719	.001	-17.5281	-4.5719
	PTC-FC-1DG	-10.00667*	1.89719	.002	-16.4848	-3.5285
	PTC-FC-2AG	-12.90667*	1.89719	.000	-19.3848	-6.4285
	PTC-FC-2DG	-12.80000*	1.89719	.000	-19.2781	-6.3219
	PTC-FC-2DGAG1:1	-16.30667*	1.89719	.000	-22.7848	-9.8285
PTCexc	PTC	8.04333*	1.89719	.011	1.5652	14.5215
	PTC-SN-1AG	-3.00667	1.89719	.693	-9.4848	3.4715
	PTC-FC-1DG	-1.96333	1.89719	.937	-8.4415	4.5148
	PTC-FC-2AG	-4.86333	1.89719	.209	-11.3415	1.6148
	PTC-FC-2DG	-4.75667	1.89719	.228	-11.2348	1.7215
	PTC-FC-2DGAG1:1	-8.26333*	1.89719	.009	-14.7415	-1.7852
PTC-SN-1AG	PTC	11.05000*	1.89719	.001	4.5719	17.5281
	PTCexc	3.00667	1.89719	.693	-3.4715	9.4848
	PTC-FC-1DG	1.04333	1.89719	.997	-5.4348	7.5215
	PTC-FC-2AG	-1.85667	1.89719	.951	-8.3348	4.6215
	PTC-FC-2DG	-1.75000	1.89719	.962	-8.2281	4.7281
	PTC-FC-2DGAG1:1	-5.25667	1.89719	.151	-11.7348	1.2215
PTC-FC-1DG	PTC	10.00667*	1.89719	.002	3.5285	16.4848
	PTCexc	1.96333	1.89719	.937	-4.5148	8.4415
	PTC-SN-1AG	-1.04333	1.89719	.997	-7.5215	5.4348
	PTC-FC-2AG	-2.90000	1.89719	.725	-9.3781	3.5781
	PTC-FC-2DG	-2.79333	1.89719	.756	-9.2715	3.6848
	PTC-FC-2DGAG1:1	-6.30000	1.89719	.059	-12.7781	.1781
PTC-FC-2AG	PTC	12.90667*	1.89719	.000	6.4285	19.3848
	PTCexc	4.86333	1.89719	.209	-1.6148	11.3415
	PTC-SN-1AG	1.85667	1.89719	.951	-4.6215	8.3348
	PTC-FC-1DG	2.90000	1.89719	.725	-3.5781	9.3781
	PTC-FC-2DG	.10667	1.89719	1.000	-6.3715	6.5848
	PTC-FC-2DGAG1:1	-3.40000	1.89719	.573	-9.8781	3.0781
PTC-FC-2DG	PTC	12.80000*	1.89719	.000	6.3219	19.2781
	PTCexc	4.75667	1.89719	.228	-1.7215	11.2348
	PTC-SN-1AG	1.75000	1.89719	.962	-4.7281	8.2281
	PTC-FC-1DG	2.79333	1.89719	.756	-3.6848	9.2715
	PTC-FC-2AG	-.10667	1.89719	1.000	-6.5848	6.3715
	PTC-FC-2DGAG1:1	-3.50667	1.89719	.540	-9.9848	2.9715
PTC-FC-2DGAG1:1	PTC	16.30667*	1.89719	.000	9.8285	22.7848
	PTCexc	8.26333*	1.89719	.009	1.7852	14.7415
	PTC-SN-1AG	5.25667	1.89719	.151	-1.2215	11.7348
	PTC-FC-1DG	6.30000	1.89719	.059	-.1781	12.7781
	PTC-FC-2AG	3.40000	1.89719	.573	-3.0781	9.8781
	PTC-FC-2DG	3.50667	1.89719	.540	-2.9715	9.9848

*. The mean difference is significant at the .05 level.

VITA

Miss Supaporn Ketpitthaya was born in Lopburi, Thailand, on November 5th, 1985. She received her Bachelor's degree of pharmacy in 2009 from Department of Pharmaceutical Sciences, Faculty of Pharmacy, Chiang Mai University, Thailand. After graduation, she had worked at Department of pharmaceutical product development as Project leader pharmacist at Medica Innova Co, Ltd., Bangkok, Thailand in 2009-2010. She entered the Master's Program at Department of Pharmaceutics and Industrial Pharmacy, Chulalongkorn University in 2010.