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## **APPENDICES**

## APPENDIX A

### Preparation of tamarind pulp extract

Table 23 Density of tamarind pulp extract lot no. R001

	No.	Weight (g)		Density of tamarind extract (g/mL)
		pycnometer and sample	Pycnometer sample	
water	1	25.67031	15.76017	9.91014
	2	25.67362	15.76302	9.91060
	3	25.68007	15.76612	9.91395
	mean		9.91156	
				1.0255
tamarind extract	1	25.92554	15.76076	10.16478
	2	25.92321	15.75970	10.16351
	3	25.92448	15.75990	10.16458
	mean		10.16429	

Table 24 Density of tamarind pulp extract lot no. R002

	No.	Weight (g)		Density of tamarind extract (g/mL)
		pycnometer and sample	Pycnometer sample	
water	1	25.66786	15.76030	9.90756
	2	25.66779	15.76045	9.90734
	3	25.66693	15.76026	9.90667
	mean		9.90719	
				1.0254
tamarind extract	1	25.92066	15.76022	10.16044
	2	25.91686	15.76015	10.15671
	3	25.91956	15.76003	10.15953
	mean		10.15889	

Table 25 Density of tamarind pulp extract lot no. R003

	No.	Weight (g)			Density of tamarind extract (g/mL)
		pycnometer and sample	Pycnometer	sample	
water	1	25.66976	15.76021	9.90955	1.0255
	2	25.67198	15.76033	9.91165	
	3	25.67156	15.76031	9.91125	
	mean			9.91081667	
tamarind extract	1	25.92460	15.76023	10.16437	
	2	25.92311	15.75994	10.16317	
	3	25.92430	15.76017	10.16413	
	mean			10.16389	

Table 26 Viscosity of tamarind pulp extract

No.	Viscosity (mPas)		
	R001	R002	R003
1	4.44	4.62	3.78
2	4.38	4.68	3.60
3	4.56	4.74	3.54
Mean $\pm$ SD	4.46 $\pm$ 0.09	4.68 $\pm$ 0.06	3.64 $\pm$ 0.12

Table 27 pH of tamarind extract

No.	pH		
	R001	R002	R003
1	2.68	2.62	2.84
2	2.65	2.61	2.84
3	2.63	2.61	2.84
Mean $\pm$ SD	2.65 $\pm$ 0.03	2.61 $\pm$ 0.01	2.84 $\pm$ 0.00

Table 28 Data titratable acidity of tamarind extract Lot no.R001

	Blank					tamarind pulp extract				
	1	2	3	4	5	1	2	3	4	5
weight of tamarind extract (g)	0	0	0	0	0	10.009	10.001	10.003	10.026	10.015
Phenolphthalien TS (mL)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
carbon dioxide free water (mL)	250	250	250	250	250	250	250	250	250	250
volumn of 0.1020 N NaOH to titrate solution (mL)	0.08	0.06	0.03	0.05	0.07	17.58	17.75	17.93	17.94	17.98
mean of 0.1020 N NaOH to titrate phenolphlein (mLL)			0.058			0.058	0.058	0.058	0.058	0.058
volumn of 0.1020 N NaOH to titrate tamarind pulp extract (mL)						17.52	17.69	17.87	17.88	17.92

Table 29 Data titratable acidity of tamarind extract Lot R002

	Blank					tamarind pulp extract				
	1	2	3	4	5	1	2	3	4	5
weight of tamarind extract (g)	0	0	0	0	0	10.009	10.009	10.01	10.036	10.013
Phenolphthalien TS (mL)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
carbon dioxide free water (mL)	250	250	250	250	250	250	250	250	250	250
volumn of 0.10125 N NaOH to titrate solution (mL)	0.05	0.09	0.08	0.05	0.08	21.2	21.58	21.78	21.85	21.69
mean of 0.10125 N NaOH to titrate phenolphlein (mL)			0.07			0.07	0.07	0.07	0.07	0.07
volumn of 0.10125 N NaOH to titrate tamarind pulp extract (mL)						21.13	21.51	21.71	21.78	21.62



Table 30 Data titratable acidity of tamarind extract Lot R003

	Blank					tamarind pulp extract				
	1	2	3	4	5	1	2	3	4	5
weight of tamarind extract (g)	0	0	0	0	0	10.003	10.002	10.004	10.038	10.002
Phenolphthalien TS (mL)	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
carbon dioxide free water (mL)	250	250	250	250	250	250	250	250	250	250
volumn of 0.1035 N NaOH to titrate solution (mL)	0.08	0.07	0.09	0.07	0.07	16.1	15.82	15.95	16.1	16.01
mean of 0.1035 N NaOH to titrate phenolphlein (mL)			0.076			0.076	0.076	0.076	0.076	0.076
volumn of 0.1035 N NaOH to titrate tamarind pulp extract (mL)						16.02	15.74	15.87	16.02	15.93

Table 31 Soluble solid in tamarind pulp extract

No.	degree Brix		
	R001	R002	ROO3
1	5.2	5.2	5.2
2	5.2	5.2	5.2
3	5.2	5.2	5.2
Mean $\pm$ SD	5.2 $\pm$ 0.0	5.2 $\pm$ 0.0	5.2 $\pm$ 0.0

Table 32 Data of tartaric acid in tamarind pulp extract

No.	Tartaric acid (% w/w)		
	R001	R002	R003
1	1.17	1.34	1.00
2	1.18	1.36	0.99
3	1.20	1.32	0.98
Mean $\pm$ SD	1.19 $\pm$ 0.02	1.34 $\pm$ 0.02	0.99 $\pm$ 0.01

Table 33 Data of tartaric acid in tamarind pulp

Lot	Tamarind pulp	Tamarind extract	Weigh of extract	Tartaric acid	Tartaric in extract	Tartaric acid in pulp	Percent tartaric in pulp
	(g)	(mL)	(g)	(%w/w)	(g)	(g)	(%w/w)
R001	100.33	853.33	875.09	1.19	10.41	10.41	10.38
R002	100.04	899.17	922.01	1.34	12.36	12.36	12.35
R003	100.69	825.00	846.04	0.99	8.38	8.38	8.32
Mean	100.35	859.17	881.05	1.17	10.38	10.38	10.38
SD	0.33	37.43	38.33	0.18	1.99	1.99	1.99

## APPENDIX B

### Preparation of spray-dried tamarind pulp extract

Table 34 Data for percent yield of 32 experimental spray-dried tamarind pulp extract

Ex	Type of carrier	Conc. of carrier (%w/w)	Conc. of silicon dioxide (% w/w)	Inlet temp. (°C)	Fan	% Yield		
						Cyclone (%w/w)	Collector (%w/w)	total (%w/w)
1	Maltodextrin	10%	1%	130	50	13.01	40.65	53.66
2	Maltodextrin	10%	1%	130	30	34.92	1.73	36.65
3	Maltodextrin	10%	1%	110	50	11.01	36.09	47.11
4	Maltodextrin	10%	1%	110	30	45.88	2.98	48.86
5	Maltodextrin	10%	0%	130	50	51.81	5.72	57.53
6	Maltodextrin	10%	0%	130	30	47.13	1.76	48.89
7	Maltodextrin	10%	0%	110	50	45.58	2.12	47.70
8	Maltodextrin	10%	0%	110	30	45.29	1.30	46.59
9	Maltodextrin	5%	1%	130	50	47.07	0.23	47.30
10	Maltodextrin	5%	1%	130	30	36.26	0.07	36.33
11	Maltodextrin	5%	1%	110	50	41.47	0.50	41.97
12	Maltodextrin	5%	1%	110	30	37.70	0.14	37.84
13	Maltodextrin	5%	0%	130	50	41.86	0.45	42.31
14	Maltodextrin	5%	0%	130	30	34.41	n/a	34.41
15	Maltodextrin	5%	0%	110	50	39.91	0.51	40.43
16	Maltodextrin	5%	0%	110	30	43.57	n/a	43.57
17	Acacia	10%	1%	130	50	10.63	37.75	48.38
18	Acacia	10%	1%	130	30	32.72	4.87	37.58
19	Acacia	10%	1%	110	50	9.48	32.67	42.15
20	Acacia	10%	1%	110	30	31.87	12.54	44.42
21	Acacia	10%	0%	130	50	1.50	54.14	55.64
22	Acacia	10%	0%	130	30	4.59	38.47	43.06
23	Acacia	10%	0%	110	50	1.15	49.10	50.25
24	Acacia	10%	0%	110	30	8.07	42.92	50.99

Table 34 Data for percent yield of 32 experimental spray-dried tamarind pulp extract (continue)

Ex	Type of carrier	Conc. of carrier (%w/w)	Conc. of silicon dioxide (% w/w)	Inlet temp. (°C)	Fan	% Yield		
						Cyclone (% w/w)	Collector (% w/w)	Total (% w/w)
25	Acacia	5%	1%	130	50	26.96	17.25	44.21
26	Acacia	5%	1%	130	30	22.18	26.28	48.46
27	Acacia	5%	1%	110	50	9.08	35.83	44.91
28	Acacia	5%	1%	110	30	41.94	2.10	44.03
29	Acacia	5%	0%	130	50	0.33	55.52	55.86
30	Acacia	5%	0%	130	30	3.86	46.98	50.84
31	Acacia	5%	0%	110	50	0.14	59.56	59.70
32	Acacia	5%	0%	110	30	5.79	39.37	45.17

Table 35 Data percentage moisture content of 32 experiment spray-dried

Ex	Type of carrier	Conc. of carrier (% w/w)	Conc. of silicon dioxide (% w/w)	Inlet temperature (°C)	Fan setting	Moisture content	
						Cyclone (%)	Collector (%)
1	Maltodextrin	10%	1%	130	50	4.25	4.96
2	Maltodextrin	10%	1%	130	30	3.53	5.36
3	Maltodextrin	10%	1%	110	50	4.25	5.11
4	Maltodextrin	10%	1%	110	30	3.78	5.74
5	Maltodextrin	10%	0%	130	50	4.15	4.24
6	Maltodextrin	10%	0%	130	30	4.38	-
7	Maltodextrin	10%	0%	110	50	4.33	5.12
8	Maltodextrin	10%	0%	110	30	3.82	-
9	Maltodextrin	5%	1%	130	50	4.08	-
10	Maltodextrin	5%	1%	130	30	3.74	-
11	Maltodextrin	5%	1%	110	50	5.16	-
12	Maltodextrin	5%	1%	110	30	5.3	-
13	Maltodextrin	5%	0%	130	50	3.71	-
14	Maltodextrin	5%	0%	130	30	3.78	-
15	Maltodextrin	5%	0%	110	50	6.07	-
16	Maltodextrin	5%	0%	110	30	5.88	-
17	Acacia	10%	1%	130	50	3.45	6.36
18	Acacia	10%	1%	130	30	3.5	5.69
19	Acacia	10%	1%	110	50	3.5	6.88
20	Acacia	10%	1%	110	30	4.38	7.69
21	Acacia	10%	0%	130	50	-	6.85
22	Acacia	10%	0%	130	30	8.81	8.7
23	Acacia	10%	0%	110	50	-	5.69
24	Acacia	10%	0%	110	30	4.13	7.18
25	Acacia	5%	1%	130	50	3.68	5.5
26	Acacia	5%	1%	130	30	4.66	5.77
27	Acacia	5%	1%	110	50	4.24	5.79
28	Acacia	5%	1%	110	30	6.5	-
29	Acacia	5%	0%	130	50	-	6.11
30	Acacia	5%	0%	130	30	-	6.93
31	Acacia	5%	0%	110	50	-	7.50
32	Acacia	5%	0%	110	30	-	7.20

Table 36 Data repeated condition for spray-dried tamarind pulp extract

Ex	% Yield (w/w)			% Moisture content	
	Cyclone	Collector	total	Cyclone	Collector
1	13.01	40.65	53.66	4.25	4.96
	3.73	42.415	46.14	2.00	4.13
	23.51	26.56	50.06	2.33	4.5
Mean	13.42	36.54	49.95	2.86	4.53
SD	9.90	8.69	3.76	1.22	0.42
3	11.01	36.09	47.11	4.25	5.11
	21.82	28.21	50.04	3.50	5.14
	33.54	11.52	45.06	3.94	5.23
Mean	22.12	25.28	47.40	3.90	5.16
SD	9.06	12.03	15.19	1.10	1.52
17	10.63	37.75	48.38	3.45	6.36
	3.53	46.06	49.59	2.4	4.74
	2.14	39.98	42.12	4.26	5.17
Mean	5.43	41.26	46.70	3.37	5.42
SD	4.56	4.30	4.01	0.93	0.84
18	32.72	4.87	37.58	3.50	5.69
	41.66	5.92	47.58	3.73	7.72
	29.446	6.10	35.54	5.57	6.08
Mean	34.61	5.63	40.24	4.27	6.50
SD	6.32	0.67	6.44	1.13	1.08
19	9.48	32.67	42.15	3.50	6.88
	0.32	57.47	57.79	n/a	6.18
	7.30	28.54	35.83	3.22	5.23
Mean	5.70	39.56	45.26	3.36	6.10
SD	4.79	15.65	11.30	0.20	0.83

Table 36 Data repeated condition for spray-dried tamarind pulp extract (continue).

Ex	% Yield (w/w)			% Moisture content	
	Cyclone	Collector	total	Cyclone	Collector
20	31.879	12.54	44.42	4.38	7.69
	36.80	4.21	41.01	6.41	8.06
	29.10	2.87	31.97	7.50	8.29
Mean	32.59	6.54	39.13	6.10	8.01
SD	3.90	5.24	6.43	1.58	0.30
23	1.15	49.10	50.25	n/a	5.69
	0.28	58.17	58.44	n/a	6.90
	1.00	57.50	58.49	n/a	6.64
Mean	0.81	54.92	55.73	n/a	6.41
SD	0.47	5.05	4.75	n/a	0.64
24	8.077	42.92	50.99	4.13	7.18
	28.947	12.48	41.42	4.82	6.40
	20.957	22.21	43.17	8.73	9.36
Mean	19.327	25.87	45.20	5.89	7.65
SD	10.53	15.55	5.10	2.48	1.53
25	26.96	17.25	44.21	3.68	5.50
	7.65	38.79	46.44	3.32	6.61
	22.81	16.92	39.73	6.99	7.39
Mean	19.14	24.32	43.46	4.66	6.50
SD	10.16	12.54	3.42	2.02	0.95

Table 37 Displayed size of spray-dried tamarind pulp extract

Experiment	mean diameter ( $\mu\text{m}$ )					Span				
	1	2	3	mean	SD	1	2	3	mean	SD
1	36.87	36.83	36.30	36.67	0.32	2.300	2.277	2.257	2.278	0.022
3	93.60	83.42	97.34	91.45	7.20	4.431	3.864	4.947	4.414	0.542
17	23.01	23.10	23.90	23.34	0.49	2.348	2.390	2.337	2.358	0.028
23	16.14	16.15	16.30	16.20	0.09	2.892	2.889	2.880	2.887	0.006
24	37.33	37.33	35.14	36.60	1.26	2.430	2.396	2.374	2.400	0.028

Table 38 Tartaric acid in spray-dried tamarind pulp extract.

No.	percent tartaric acid (% w/w)
1	7.68
2	7.91
3	7.89
Mean $\pm$ SD	7.83 $\pm$ 0.13

Table 39 Stability data of percent remaining of tartaric acid of spray-dried tamarind pulp extract in clear vial

clear vial glass N	percent of tartaric acid in spray-fried tamarind pulp extract				
	day 0	day 30	day 60	day 90	day 180
1	7.72	7.86	8.42	7.52	7.17
2	7.79	7.73	7.32	7.42	7.35
3	7.76	7.68	7.38	7.43	7.16
Mean	7.76	7.76	7.71	7.46	7.23
SD	0.04	0.09	0.61	0.06	0.11
% Remaining	100.00	100.02	99.37	96.14	93.16



Table 40 Stability data of percent remaining of tartaric acid of spray-dried tamarind pulp extract in light protected vial

light protect vial N	percent of tartaric acid in spray-fried tamarind pulp extract				
	day 0	day 30	day 60	day 90	day 180
1	7.68	8.30	7.59	7.43	7.23
2	7.91	7.53	7.41	7.31	7.35
3	7.89	7.51	7.46	7.37	7.30
Mean	7.83	7.78	7.49	7.37	7.29
SD	0.13	0.45	0.09	0.06	0.06
% Remaining	100.00	99.41	95.66	94.15	93.16

Table 41 Stability data of percent moisture content of spray-dried tamarind pulp extract in clear vial

clear vial N	Moisture content of spray-dried tamarind pulp extract				
	day 0	day 30	day 60	day 90	day 180
1	5.45	5.45	5.51	5.51	5.6
2	5.54	5.73	5.59	5.69	5.69
3	5.62	5.44	5.51	5.53	5.47
Mean	5.54	5.54	5.54	5.58	5.59
SD	0.09	0.16	0.05	0.10	0.11

Table 42 Stability data of percent moisture content of spray-dried tamarind pulp extract in light protected vial

light protect vial N	Moisture content of spray-dried tamarind pulp extract				
	day 0	day 30	day 60	day 90	day 180
1	5.5	5.47	5.47	5.5	5.61
2	5.44	5.45	5.62	5.4	5.57
3	5.6	5.48	5.62	5.46	5.7
Mean	5.51	5.47	5.57	5.45	5.63
SD	0.08	0.02	0.09	0.05	0.07

## APPENDIX C

### Formulations of oil-in-water emulsions containing spray-dried tamarind pulp extract

Table 43 pH of oil-in-water emulsion base

Formulation	pH before heating cooling cycle				pH after heating cooling cycle			
	1	2	3	Mean $\pm$ SD	1	2	3	Mean $\pm$ SD
1	3.68	3.65	3.56	3.63 $\pm$ 0.06	3.66	3.58	3.55	3.36 $\pm$ 0.01
2	3.68	3.68	3.56	3.61 $\pm$ 0.06	Phase separation			
3	3.42	3.44	3.49	3.45 $\pm$ 0.04	3.02	3.04	3.02	3.03 $\pm$ 0.01
4	3.46	3.52	3.53	3.50 $\pm$ 0.04	3.15	3.18	3.17	3.17 $\pm$ 0.02
5	4.3	4.33	4.34	4.32 $\pm$ 0.02	4.2	4.21	4.2	4.20 $\pm$ 0.01
6	3.55	3.52	3.54	3.54 $\pm$ 0.02	3.25	3.27	3.27	3.26 $\pm$ 0.01
7	4.61	4.63	4.62	4.62 $\pm$ 0.01	4.25	4.26	4.26	4.26 $\pm$ 0.01
8	4.43	4.44	4.45	4.44 $\pm$ 0.01	4.13	4.15	4.14	4.14 $\pm$ 0.01
9	4.57	4.59	4.57	4.58 $\pm$ 0.01	Phase separation			
10	3.93	3.83	3.95	3.90 $\pm$ 0.06	3.82	3.85	3.81	3.83 $\pm$ 0.02
11	3.87	3.83	3.83	3.84 $\pm$ 0.02	4	3.9	3.85	3.92 $\pm$ 0.08
12	3.67	3.72	3.6	3.66 $\pm$ 0.06	3.27	3.43	3.46	3.39 $\pm$ 0.10
13	3.98	3.93	3.95	3.95 $\pm$ 0.03	4.02	3.99	3.9	3.97 $\pm$ 0.06
14	3.86	3.89	3.83	3.86 $\pm$ 0.03	3.78	3.8	3.82	3.80 $\pm$ 0.02
15	3.47	3.34	3.3	3.37 $\pm$ 0.09	3.88	3.83	3.86	3.86 $\pm$ 0.03
16	3.99	3.95	3.5	3.81 $\pm$ 0.27	4.02	3.91	3.88	3.94 $\pm$ 0.07
17	4.23	4.29	4.28	4.27 $\pm$ 0.03	3.92	3.87	3.86	3.88 $\pm$ 0.03
18	3.8	3.65	3.71	3.72 $\pm$ 0.08	4.18	4.17	4.12	4.16 $\pm$ 0.03
19	4.11	4.12	4.06	4.10 $\pm$ 0.03	4.23	4.18	4.12	4.18 $\pm$ 0.06
20	4.01	3.99	3.98	3.99 $\pm$ 0.02	4.15	4.08	4.02	4.08 $\pm$ 0.07

Table 44 pH of oil-in-water emulsion containing 8 % w/w spray-dried tamarind pulp extract

Formulation	pH before heating cooling cycle				pH after heating cooling cycle			
	1	2	3	Mean $\pm$ SD	1	2	3	Mean $\pm$ SD
1T	3.39	3.3	3.36	3.35 $\pm$ 0.05	3.31	3.26	3.21	3.26 $\pm$ 0.05
2T	3.45	3.5	3.52	3.49 $\pm$ 0.04	Phase separation			
3T	3.31	3.39	3.35	3.35 $\pm$ 0.04	3.31	3.34	3.39	3.35 $\pm$ 0.04
4T	3.34	3.39	3.37	3.37 $\pm$ 0.03	3.35	3.32	3.37	3.35 $\pm$ 0.03
5T	3.54	3.52	3.51	3.52 $\pm$ 0.02	3.35	3.39	3.38	3.37 $\pm$ 0.02
6T	3.23	3.23	3.23	3.23 $\pm$ 0.00	3.21	3.23	3.34	3.26 $\pm$ 0.04
7T	3.41	3.43	3.44	3.43 $\pm$ 0.02	Phase separation			
8T	3.34	3.36	3.35	3.35 $\pm$ 0.01	Phase separation			
9T	3.43	3.43	3.42	3.43 $\pm$ 0.01	Phase separation			
10T	3.77	3.67	3.77	3.74 $\pm$ 0.06	3.41	3.42	3.34	3.39 $\pm$ 0.04
11T	3.5	3.5	3.53	3.51 $\pm$ 0.02	3.42	3.4	3.31	3.38 $\pm$ 0.06
12T	3.6	3.57	3.55	3.57 $\pm$ 0.03	3.27	3.31	3.32	3.30 $\pm$ 0.03
13T	3.54	3.47	3.43	3.48 $\pm$ 0.06	3.32	3.29	3.28	3.30 $\pm$ 0.02
14T	3.31	3.23	3.26	3.27 $\pm$ 0.04	3.25	3.21	3.25	3.24 $\pm$ 0.02
15T	3.32	3.35	3.27	3.31 $\pm$ 0.04	3.27	3.28	3.3	3.28 $\pm$ 0.02
16T	3.64	3.59	3.42	3.55 $\pm$ 0.12	3.3	3.37	3.35	3.34 $\pm$ 0.04
17T	3.35	3.37	3.34	3.35 $\pm$ 0.02	3.39	3.39	3.36	3.38 $\pm$ 0.02
18T	3.37	3.37	3.36	3.37 $\pm$ 0.01	Phase separation			
19T	3.38	3.33	3.34	3.35 $\pm$ 0.03	Phase separation			
20T	3.15	3.16	3.18	3.16 $\pm$ 0.02	3.39	3.35	3.32	3.35 $\pm$ 0.04

Table 45 Stability data of percent remaining of tartaric acid of oil-in-water emulsion containing 8 % w/w spray-dried tamarind pulp extract at ambient temperature

N	percent of tartaric acid in emulsion			
	Day 0	Day 14	Day 28	Day 42
1	0.6680	0.6552	0.7144	0.6631
2	0.6848	0.6629	0.6446	0.6935
3	0.6525	0.6841	0.6430	0.6436
Mean $\pm$ SD	0.6684 $\pm$ 0.02	0.6674 $\pm$ 0.01	0.6673 $\pm$ 0.04	0.6668 $\pm$ 0.03
% Remaining	100.00	99.84	99.83	99.75

## APPENDIX D

### Whitening and moisturizing efficacy test in volunteers

Table 46 Mean melanin value at forehead of oil-in-water emulsion base group

code	Mean melanin value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
1	236.67	219.33	224.67	201.00	228.00	226.67	223.33
2	290.00	255.33	272.00	260.67	252.00	254.67	254.33
3	183.67	173.33	179.67	172.00	141.00	164.67	174.67
4	240.00	284.33	251.67	236.33	239.33	248.33	221.00
5	285.67	300.00	270.67	306.33	308.33	286.00	342.33
6	257.67	258.67	253.33	251.67	243.33	227.33	233.00
7	296.00	289.33	293.67	290.33	309.33	270.00	277.00
8	207.00	189.00	205.67	196.67	194.00	215.33	200.67
9	312.33	288.67	290.33	285.33	266.00	265.67	267.00
10	245.33	248.67	255.67	234.00	238.67	226.33	231.33
11	381.00	341.67	343.67	330.33	337.00	302.33	319.33
12	310.33	308.67	300.00	256.67	293.67	270.00	282.67
13	242.33	266.67	319.33	284.33	261.00	248.00	262.33
14	397.67	426.33	414.67	409.33	450.67	398.00	432.33
15	315.67	275.00	314.33	291.00	269.00	292.67	284.33
16	165.00	171.00	165.00	143.67	162.67	140.00	156.33
17	184.33	220.33	227.00	215.67	199.33	192.33	217.33
18	330.33	328.00	337.00	333.67	317.00	314.67	318.00
19	188.00	165.67	192.00	178.00	180.67	172.33	173.33
20	220.00	195.00	237.33	201.00	205.33	201.33	198.00
21	247.33	258.67	229.00	233.67	243.00	236.33	231.67
22	253.33	259.00	237.00	231.00	232.33	225.67	228.67
23	237.67	208.67	202.33	190.00	203.33	207.00	195.67
24	177.67	152.00	167.67	148.33	153.67	132.33	130.67
25	501.67	524.67	496.00	493.00	505.00	473.33	471.67

Table 46 Mean melanin value at forehead of oil-in-water emulsion base group  
(continue)

code	Mean melanin value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
26	248.00	263.00	254.00	242.67	253.00	255.00	213.33
27	338.33	336.67	335.00	341.67	317.67	314.33	294.67
28	287.33	294.33	265.33	269.33	269.00	242.00	272.00
29	226.00	218.00	218.00	241.00	218.67	230.00	228.00
30	185.00	166.33	167.67	160.67	173.33	161.67	177.33
31	338.00	332.33	328.00	310.33	313.67	305.33	312.67
32	264.67	225.00	250.33	225.67	246.00	243.33	226.67
33	286.00	282.33	273.00	259.67	266.33	251.33	244.67
34	340.00	332.00	340.67	319.00	313.67	295.67	308.00
35	326.33	290.33	302.33	255.67	281.00	286.33	272.67
Mean	272.75	267.10	268.97	257.13	259.60	250.75	253.63
SD	71.33	75.87	70.43	72.27	74.65	66.91	70.29

Table 47 Mean melanin value at forehead of oil-in-water emulsion containing 8 % w/w tamarind pulp extract.

code	Mean melanin value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
1	252.33	216.67	205.67	208.67	212.67	214.67	209.33
2	281.67	268.67	311.00	261.00	260.00	275.00	265.33
3	210.67	201.33	195.67	190.33	163.33	164.67	172.00
4	247.33	253.33	221.33	232.67	216.33	223.33	207.33
5	310.00	311.33	310.67	301.33	314.00	300.00	299.67
6	255.00	254.67	243.00	241.00	223.00	229.00	236.33
7	316.67	301.33	309.00	311.67	298.00	302.00	319.33
8	197.67	197.00	199.33	191.67	187.00	189.67	194.00
9	315.67	292.67	292.00	282.00	280.67	284.00	265.67
10	245.33	235.33	250.00	223.67	221.67	227.33	211.00
11	376.00	344.67	336.00	300.67	317.00	342.00	322.33
12	306.67	303.67	283.33	273.33	285.00	278.00	278.33
13	298.00	338.00	274.00	285.33	261.00	309.33	310.00
14	370.67	388.33	370.00	342.67	404.00	355.33	354.00
15	295.33	321.67	281.00	251.00	254.00	257.33	266.67
16	161.33	155.33	155.67	141.67	137.33	124.00	123.67
17	194.00	220.00	242.00	184.00	218.67	206.00	199.00
18	306.00	293.67	300.33	283.67	289.67	271.67	291.67
19	205.33	206.67	212.00	198.33	201.33	181.67	176.67
20	213.67	194.67	208.67	192.67	198.00	185.33	210.33
21	243.33	230.67	221.00	213.67	227.67	224.00	225.00
22	252.67	262.33	244.00	229.67	225.67	209.67	236.67
23	257.00	218.67	227.67	215.33	219.67	217.67	208.67
24	151.00	142.00	144.00	129.00	136.00	135.33	115.67
25	519.33	521.00	494.00	489.00	478.00	482.67	448.00
26	255.33	284.00	230.00	238.67	225.67	221.67	236.67
27	332.00	312.67	317.33	348.00	337.00	297.67	327.33
28	293.67	301.67	267.00	262.00	266.67	246.67	274.67

Table 47 Mean melanin value at forehead of oil-in-water emulsion containing 8 % w/w tamarind pulp extract (continue).

code	Mean melanin value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
29	253.33	260.67	255.00	243.33	250.00	238.67	221.67
30	185.00	176.67	176.67	174.00	177.67	167.33	177.67
31	376.00	382.33	383.33	374.00	375.33	314.67	377.33
32	236.67	236.67	229.67	242.00	236.00	240.67	219.33
33	319.67	318.67	299.67	278.33	265.33	272.67	256.00
34	328.67	313.33	307.33	301.67	293.00	302.00	304.67
35	306.00	316.67	293.00	293.67	289.67	284.33	260.67
mean	276.26	273.63	265.44	255.13	255.60	250.74	251.50
SD	71.66	74.13	68.67	69.40	71.12	68.86	69.22



Table 48 Mean moisture value at forehead of oil-in-water emulsion base.

code	Mean moisture value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
1	68.27	85.43	82.60	76.50	82.93	67.03	73.43
2	63.33	73.47	73.63	74.13	71.10	82.70	64.63
3	58.13	84.60	80.47	86.30	100.63	81.07	73.60
4	69.83	74.03	81.87	72.47	77.57	66.17	67.47
5	74.53	80.90	84.77	72.13	83.60	80.43	81.77
6	69.00	62.90	83.60	67.83	66.10	63.67	67.53
7	90.17	102.97	74.97	68.83	78.53	66.97	66.53
8	92.37	73.53	76.13	100.43	82.93	58.25	72.17
9	70.60	80.17	69.67	73.33	90.00	71.67	75.90
10	83.47	76.90	78.30	72.80	81.83	74.67	60.77
11	62.73	82.53	85.13	77.67	60.83	70.50	72.67
12	63.27	71.60	74.03	75.60	78.37	68.00	72.20
13	55.37	73.60	70.60	48.13	75.23	61.60	67.83
14	58.40	77.07	68.43	76.23	70.57	78.50	65.47
15	54.77	55.57	72.93	72.03	83.60	69.30	65.07
16	50.63	55.57	62.33	64.17	45.67	55.17	67.43
17	76.37	81.00	81.37	82.70	80.70	73.87	77.63
18	64.87	68.63	64.93	65.70	71.70	63.60	61.20
19	68.23	72.17	70.27	64.07	64.63	68.17	62.07
20	57.73	65.87	63.20	58.77	71.97	54.33	80.40
21	65.63	59.83	85.60	73.77	73.57	66.43	66.50
22	62.53	52.47	89.13	84.77	88.93	59.63	81.70
23	56.63	65.20	75.30	76.17	76.23	74.13	71.40
24	36.20	71.40	74.80	69.83	66.37	62.43	64.20
25	82.33	75.77	72.47	64.57	75.33	54.03	88.90
26	65.33	71.47	75.90	74.97	71.37	57.03	62.37
27	78.73	75.23	82.73	75.83	76.53	75.10	76.73
28	59.30	49.53	58.03	59.83	66.10	66.77	51.93
29	63.50	83.37	89.30	77.30	86.73	77.87	62.97

Table 48 Mean moisture value at forehead of oil-in-water emulsion base (continue)

code	Mean moisture value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
30	65.40	68.07	75.90	51.43	57.13	56.30	59.57
31	64.97	74.87	76.27	69.27	73.10	69.53	76.40
32	72.83	60.43	78.23	69.60	85.67	78.70	83.27
33	73.30	66.27	72.47	58.23	85.00	73.17	69.20
34	50.83	82.83	90.60	84.97	87.43	79.77	68.07
35	58.53	64.67	75.13	86.37	87.37	66.97	78.73
Mean	65.95	72.00	76.32	72.19	76.44	68.39	70.22
SD	11.33	10.80	7.77	10.28	10.63	8.23	7.94

Table 49 Mean moisture value at forehead of oil-in-water emulsion containing 8 % w/w spray-dried tamarind pulp extract.

code	Mean moisture value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
1	60.00	76.40	76.37	74.53	79.73	63.83	64.00
2	60.97	74.07	77.97	77.60	85.00	67.07	76.03
3	54.60	80.80	82.07	74.63	96.10	87.53	72.23
4	71.23	45.87	85.90	73.97	81.73	63.53	67.87
5	76.53	69.50	80.83	71.03	81.47	72.77	77.00
6	67.63	71.30	86.37	76.97	75.63	67.77	75.10
7	99.57	97.77	79.97	69.87	73.07	70.07	62.63
8	85.63	75.83	78.00	99.27	83.17	57.63	76.90
9	75.53	74.67	71.47	75.93	81.60	57.57	67.30
10	83.67	78.07	83.77	77.80	74.40	70.90	88.47
11	51.50	76.23	75.00	75.03	66.13	53.17	59.40
12	72.13	67.20	74.07	78.97	82.90	74.93	71.63
13	44.13	68.67	56.37	46.87	75.27	61.03	57.97
14	75.57	73.47	74.80	87.63	78.73	81.20	72.87
15	57.70	69.17	74.77	63.60	74.70	64.93	63.50
16	42.20	65.90	75.30	77.23	46.20	69.27	54.23
17	79.93	75.97	79.37	82.93	86.43	75.13	72.93
18	74.23	75.13	73.87	63.20	81.83	61.53	65.83
19	61.90	63.23	61.97	53.87	63.47	61.10	53.97
20	54.93	68.97	59.33	64.83	75.17	62.13	82.43
21	61.10	72.80	74.60	73.00	68.23	76.10	70.83
22	62.30	60.83	91.17	91.93	87.13	83.83	86.03
23	58.03	66.33	67.90	61.83	73.53	68.77	66.63
24	59.60	70.67	74.53	64.30	67.50	57.67	49.17
25	74.47	74.47	68.93	67.47	68.00	58.37	81.87
26	72.17	71.33	79.67	82.90	78.70	74.40	72.97
27	73.33	71.33	73.67	70.27	70.03	73.67	65.30
28	52.37	51.87	62.90	65.27	73.27	64.83	53.90

Table 49 Mean moisture value at forehead of oil-in-water emulsion containing 8 % w/w spray-dried tamarind pulp extract (continue).

code	Mean moisture value						
	0 week	1 week	2 week	3 week	4 week	5 week	6 week
29	62.23	76.23	84.37	73.33	89.60	77.17	73.90
30	62.73	73.47	78.73	60.90	65.27	70.70	79.37
31	72.33	76.90	77.20	68.43	69.20	58.93	64.20
32	68.33	63.97	79.23	70.23	84.53	64.83	81.53
33	62.10	53.80	68.57	58.07	69.33	56.57	57.77
34	64.93	64.63	84.03	77.23	86.33	58.07	74.60
35	55.97	63.07	73.23	86.50	86.33	65.10	77.50
Mean	66.05	70.28	75.61	72.50	76.56	67.20	69.65
SD	11.86	9.02	7.68	10.56	9.46	8.31	9.75

Table 50 Pair t-test of difference mean melanin value and difference mean moisture value.

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	dif melanin base C 0-1 wk - dif melanin tam C 0- 1 wk	3.02857	20.82896	3.52074	-4.126	10.18357	.860	34	.396
Pair 2	dif melanin base C 0-2 wk - dif melanin tam C 0- 2 wk	-7.038	23.02354	3.89169	14.946	.87077	-1.808	34	.079
Pair 3	dif melanin base C 0-3 wk - dif melanin tam C 0- 3 wk	-5.504	22.42976	3.79132	13.209	2.20013	-1.452	34	.156
Pair 4	dif melanin base C 0-4 wk - dif melanin tam C 0- 4 wk	-7.504	20.21055	3.41621	14.447	-5.6219	-2.197	34	.035
Pair 5	dif melanin base C 0-5 wk - dif melanin tam C 0- 5 wk	-3.514	19.34285	3.26954	10.158	3.13022	-1.075	34	.290
Pair 6	dif melanin base C 0-6 wk - dif melanin tam C 0- 6 wk	-5.628	23.33162	3.94376	13.643	2.38612	-1.427	34	.163
Pair 7	dif moisture base C 1-0 wk - dif moisture tam C 1-0 wk	3.42190	19.95225	3.37255	-3.431	10.27574	1.015	34	.317
Pair 8	dif moisture base C 2-0 wk - dif moisture tam C 2-0 wk	-4.4857	20.00740	3.38187	-7.321	6.42421	-.133	34	.895
Pair 9	dif moisture base C 3-0 wk - dif moisture tam C 3-0 wk	-14.878	18.73569	3.16691	-21.3	-8.44216	-4.698	34	.000
Pair 10	dif moisture base C 4-0 wk - dif moisture tam C 4-0 wk	-10.164	21.82558	3.68920	-17.66	-2.66741	-2.755	34	.009
Pair 11	dif moisture base C 5-0 wk - dif moisture tam C 5-0 wk	-23.074	20.86869	3.52745	-30.24	-15.906	-6.541	34	.000
Pair 12	dif moisture base C 6-0 wk - dif moisture tam C 6-0 wk	-20.479	21.19821	3.58315	-27.76	-13.197	-5.715	34	.000

## VITA

Miss Rattana Songmek was born on September 25, 1979 in Tak, Thailand. She received her Bachelor's degree in Pharmacy from the Faculty of Pharmaceutical sciences, Naresuan University, Phitsanulok, Thailand in 2003. She has worked for Food and Drug Administration, Ministry of Public Health, Thailand.