

References

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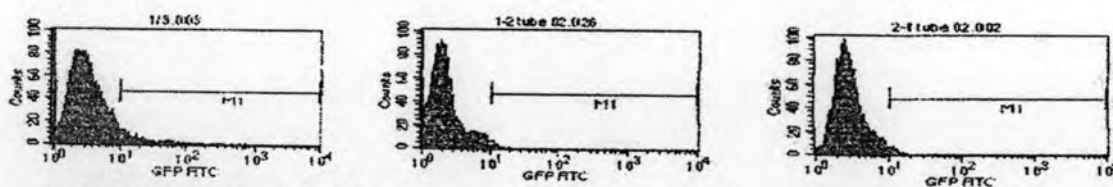
APPENDICES

APPENDIX A

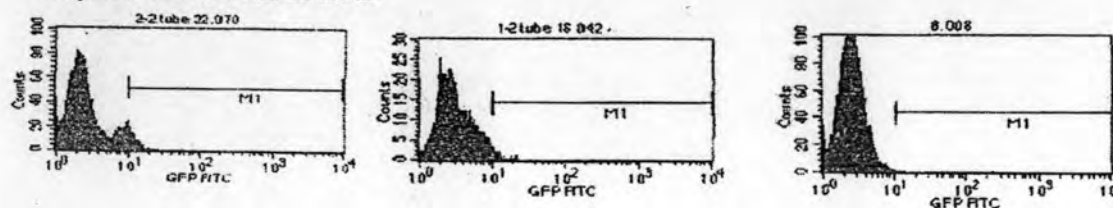
In vitro transfection in HeLa cells

	Sample	Percentage of positive cells
1	pDNA in sodium sulfate	0.88±2.27
2	pDNA in sodium chloride	0.60±1.66
3	pDNA in water	0.65±2.20
4	2:1 CSA/DNA S nanoparticles	5.29±3.53
5	2:1 CSA/DNA C nanoparticles	5.96±2.94
6	2:1 CSA/DNA W nanoparticles	10.45±6.77
7	2:1 CSL/DNA S nanoparticles	5.06±1.80
8	2:1 CSL/DNA C nanoparticles	6.84±3.64
9	2:1 CSL/DNA W nanoparticles	9.47±5.53
10	2:1 CSG/DNA S nanoparticles	9.17±5.97
11	2:1 CSG/DNA C nanoparticles	6.34±6.80
12	2:1 CSG/DNA W nanoparticles	10.82±7.61
13	3:1 CSA/DNA S nanoparticles	8.69±4.80
14	5:1 CSA/DNA S nanoparticles	13.07±7.12
15	7:1 CSA/DNA S nanoparticles	8.90±5.36
16	Lipofectamine TM -pDNA complexes	14.60±5.95

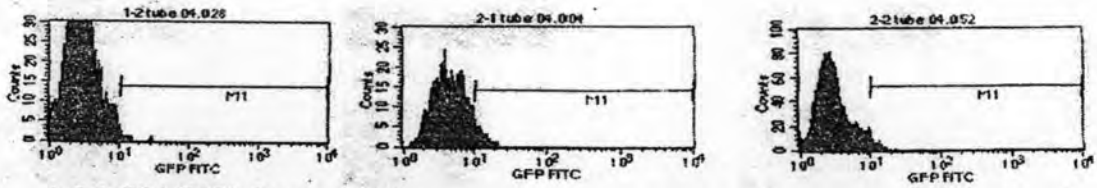
1. pDNA in sodium sulfate



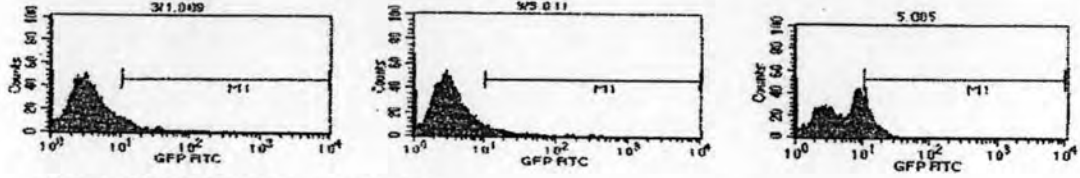
2. pDNA in sodium chloride



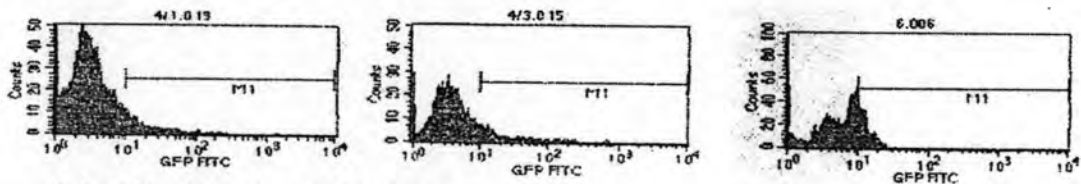
3. pDNA in water



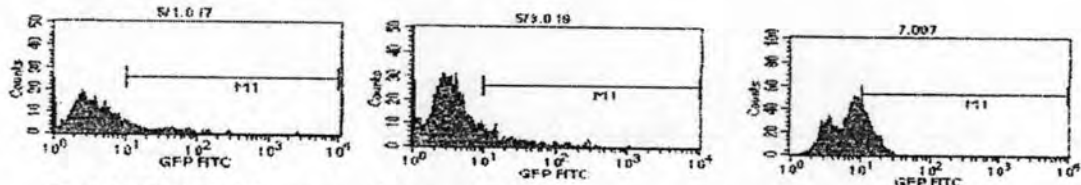
4. 2:1 CSA/DNA S nanoparticles



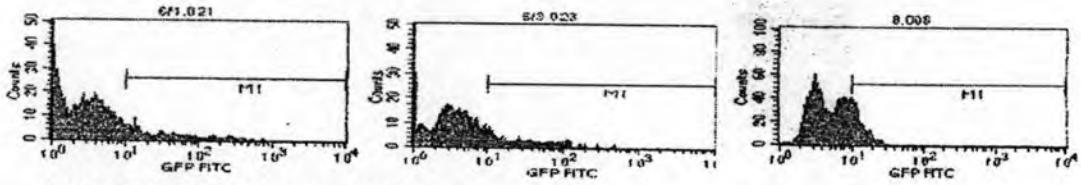
5. 2:1 CSA/DNA C nanoparticles



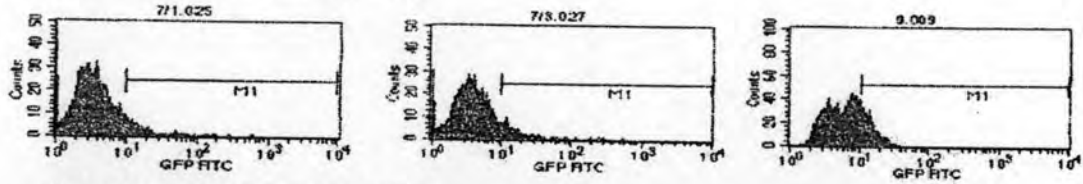
6. 2:1 CSA/DNA W nanoparticles



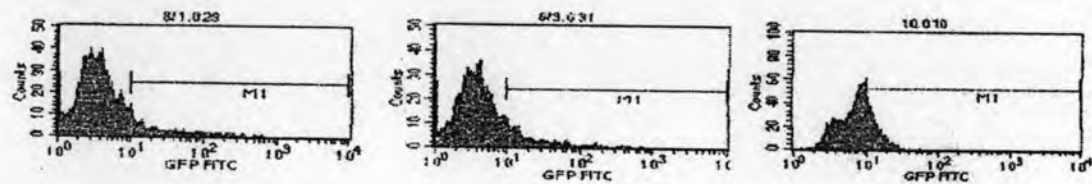
7. 2:1 CSL/DNA S nanoparticles



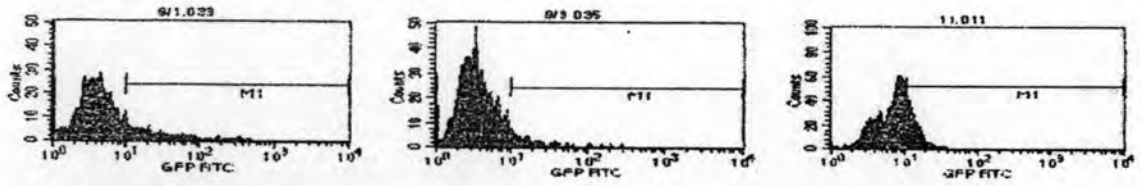
8. 2:1 CSL/DNA C nanoparticles



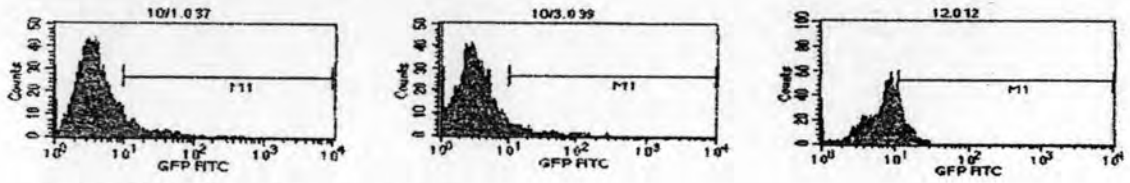
9. 2:1 CSA/DNA W nanoparticles



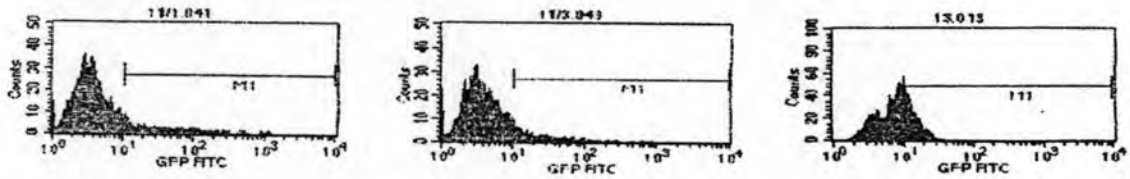
10. 2:1 CSG/DNA S nanoparticles



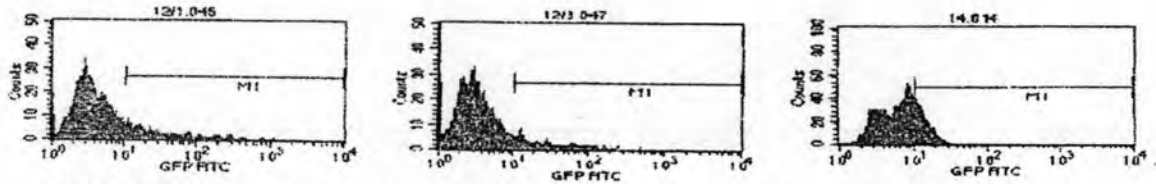
11. 2:1 CSG/DNA C nanoparticles



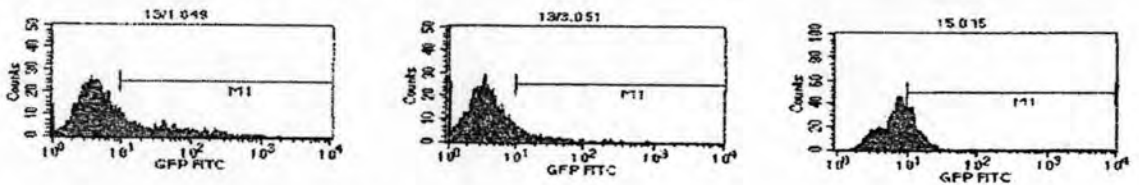
12. 2:1 CSG/DNA W nanoparticles



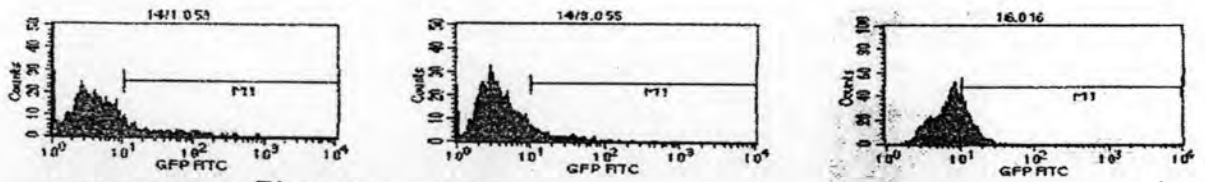
13. 3:1 CSA/DNA S nanoparticles



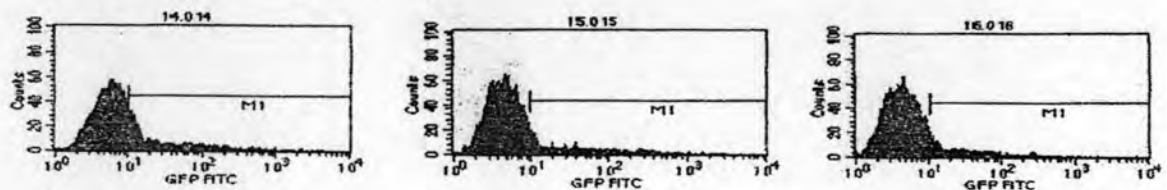
14. 5:1 CSA/DNA S nanoparticles



15. 7:1 CSA/DNA S nanoparticles



16. LipofectamineTM-pDNA complexes



Descriptives

percentage

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	3	.8800	2.27007	1.31062	-4.7592	6.5192	-.50	3.50
2	3	.6033	1.66100	.95898	-3.5228	4.7295	-.53	2.51
3	3	.6500	2.20027	1.27033	-4.8158	6.1158	-.89	3.17
4	3	5.2900	3.53106	2.03866	-3.4816	14.0616	2.11	9.09
5	3	5.9633	2.93517	1.69462	-1.3280	13.2547	2.85	8.68
6	3	10.4467	6.77329	3.91056	-6.3791	27.2724	5.89	18.23
7	3	5.0567	1.79879	1.03853	.5882	9.5251	3.40	6.97
8	3	6.8433	3.64452	2.10417	-2.2102	15.8968	3.93	10.93
9	3	9.4700	5.53387	3.19498	-4.2769	23.2169	5.35	15.76
10	3	9.1667	5.97004	3.44681	-5.6637	23.9971	3.06	14.99
11	3	6.3367	6.79799	3.92482	-10.5505	23.2238	1.35	14.08
12	3	10.8200	7.61236	4.39500	-8.0902	29.7302	6.42	19.61
13	3	8.6867	4.80072	2.77170	-3.2390	20.6123	4.82	14.06
14	3	13.0700	7.12154	4.11162	-4.6209	30.7609	4.85	17.38
15	3	8.9033	5.35961	3.09437	-4.4107	22.2173	4.98	15.01
16	3	14.6000	5.95097	3.43580	-.1830	29.3830	10.61	21.44
Total	48	7.2992	5.83578	.84232	5.6046	8.9937	-.89	21.44

Test of Homogeneity of Variances

percentage

Levene Statistic	df1	df2	Sig.
1.978	15	32	.052

ANOVA

percentage	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	791.525	15	52.768	2.087	.040
Within Groups	809.122	32	25.285		
Total	1600.648	47			

Multiple Comparisons

percentage

LSD

(I) formulat ion	(J) formulat ion	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.27667	4.10569	.947	-8.0864	8.6397
	3	.23000	4.10569	.956	-8.1330	8.5930
	4	-4.41000	4.10569	.291	-12.7730	3.9530
	5	-5.08333	4.10569	.225	-13.4464	3.2797
	6	-9.56667*	4.10569	*.026	-17.9297	-1.2036
	7	-4.17667	4.10569	.317	-12.5397	4.1864
	8	-5.96333	4.10569	.156	-14.3264	2.3997
	9	-8.59000*	4.10569	*.044	-16.9530	-.2270
	10	-8.28667	4.10569	.052	-16.6497	.0764
	11	-5.45667	4.10569	.193	-13.8197	2.9064
	12	-9.94000*	4.10569	*.021	-18.3030	-1.5770
	13	-7.80667	4.10569	.066	-16.1697	.5564
	14	-12.19000*	4.10569	*.006	-20.5530	-3.8270
	15	-8.02333	4.10569	.059	-16.3864	.3397
	16	-13.72000*	4.10569	*.002	-22.0830	-5.3570
	2	3	-.04667	4.10569	.991	-8.4097
4		-4.68667	4.10569	.262	-13.0497	3.6764
5		-5.36000	4.10569	.201	-13.7230	3.0030
6		-9.84333*	4.10569	*.023	-18.2064	-1.4803
7		-4.45333	4.10569	.286	-12.8164	3.9097
8		-6.24000	4.10569	.138	-14.6030	2.1230
9		-8.86667*	4.10569	*.038	-17.2297	-.5036
10		-8.56333*	4.10569	.045	-16.9264	-.2003
11		-5.73333	4.10569	.172	-14.0964	2.6297
12		-10.21667*	4.10569	*.018	-18.5797	-1.8536
13		-8.08333	4.10569	.058	-16.4464	.2797
14	-12.46667*	4.10569	*.005	-20.8297	-4.1036	
15	-8.30000	4.10569	.052	-16.6630	.0630	

	16	-13.99667*	4.10569	*.002	-22.3597	-5.6336
3	4	-4.64000	4.10569	.267	-13.0030	3.7230
	5	-5.31333	4.10569	.205	-13.6764	3.0497
	6	-9.79667*	4.10569	*.023	-18.1597	-1.4336
	7	-4.40667	4.10569	.291	-12.7697	3.9564
	8	-6.19333	4.10569	.141	-14.5564	2.1697
	9	-8.82000*	4.10569	*.039	-17.1830	-.4570
	10	-8.51667*	4.10569	.046	-16.8797	-.1536
	11	-5.68667	4.10569	.176	-14.0497	2.6764
	12	-10.17000*	4.10569	*.019	-18.5330	-1.8070
	13	-8.03667	4.10569	.059	-16.3997	.3264
	14	-12.42000*	4.10569	*.005	-20.7830	-4.0570
	15	-8.25333	4.10569	.053	-16.6164	.1097
	16	-13.95000*	4.10569	*.002	-22.3130	-5.5870
4	5	-.67333	4.10569	.871	-9.0364	7.6897
	6	-5.15667	4.10569	.218	-13.5197	3.2064
	7	.23333	4.10569	.955	-8.1297	8.5964
	8	-1.55333	4.10569	.708	-9.9164	6.8097
	9	-4.18000	4.10569	.316	-12.5430	4.1830
	10	-3.87667	4.10569	.352	-12.2397	4.4864
	11	-1.04667	4.10569	.800	-9.4097	7.3164
	12	-5.53000	4.10569	.187	-13.8930	2.8330
	13	-3.39667	4.10569	.414	-11.7597	4.9664
	14	-7.78000	4.10569	.067	-16.1430	.5830
	15	-3.61333	4.10569	.385	-11.9764	4.7497
	16	-9.31000*	4.10569	*.030	-17.6730	-.9470
5	6	-4.48333	4.10569	.283	-12.8464	3.8797
	7	.90667	4.10569	.827	-7.4564	9.2697
	8	-.88000	4.10569	.832	-9.2430	7.4830
	9	-3.50667	4.10569	.399	-11.8697	4.8564
	10	-3.20333	4.10569	.441	-11.5664	5.1597
	11	-.37333	4.10569	.928	-8.7364	7.9897
	12	-4.85667	4.10569	.246	-13.2197	3.5064
	13	-2.72333	4.10569	.512	-11.0864	5.6397

	14	-7.10667	4.10569	.093	-15.4697	1.2564
	15	-2.94000	4.10569	.479	-11.3030	5.4230
	16	-8.63667	4.10569	*.043	-16.9997	-.2736
6	7	5.39000	4.10569	.199	-2.9730	13.7530
	8	3.60333	4.10569	.387	-4.7597	11.9664
	9	.97667	4.10569	.813	-7.3864	9.3397
	10	1.28000	4.10569	.757	-7.0830	9.6430
	11	4.11000	4.10569	.324	-4.2530	12.4730
	12	-.37333	4.10569	.928	-8.7364	7.9897
	13	1.76000	4.10569	.671	-6.6030	10.1230
	14	-2.62333	4.10569	.527	-10.9864	5.7397
	15	1.54333	4.10569	.709	-6.8197	9.9064
	16	-4.15333	4.10569	.319	-12.5164	4.2097
7	8	-1.78667	4.10569	.666	-10.1497	6.5764
	9	-4.41333	4.10569	.290	-12.7764	3.9497
	10	-4.11000	4.10569	.324	-12.4730	4.2530
	11	-1.28000	4.10569	.757	-9.6430	7.0830
	12	-5.76333	4.10569	.170	-14.1264	2.5997
	13	-3.63000	4.10569	.383	-11.9930	4.7330
	14	-8.01333	4.10569	.060	-16.3764	.3497
	15	-3.84667	4.10569	.356	-12.2097	4.5164
	16	-9.54333	4.10569	*.027	-17.9064	-1.1803
8	9	-2.62667	4.10569	.527	-10.9897	5.7364
	10	-2.32333	4.10569	.575	-10.6864	6.0397
	11	.50667	4.10569	.903	-7.8564	8.8697
	12	-3.97667	4.10569	.340	-12.3397	4.3864
	13	-1.84333	4.10569	.656	-10.2064	6.5197
	14	-6.22667	4.10569	.139	-14.5897	2.1364
	15	-2.06000	4.10569	.619	-10.4230	6.3030
	16	-7.75667	4.10569	.068	-16.1197	.6064
9	10	.30333	4.10569	.942	-8.0597	8.6664
	11	3.13333	4.10569	.451	-5.2297	11.4964
	12	-1.35000	4.10569	.744	-9.7130	7.0130
	13	.78333	4.10569	.850	-7.5797	9.1464

	14	-3.60000	4.10569	.387	-11.9630	4.7630
	15	.56667	4.10569	.891	-7.7964	8.9297
	16	-5.13000	4.10569	.221	-13.4930	3.2330
10	11	2.83000	4.10569	.496	-5.5330	11.1930
	12	-1.65333	4.10569	.690	-10.0164	6.7097
	13	.48000	4.10569	.908	-7.8830	8.8430
	14	-3.90333	4.10569	.349	-12.2664	4.4597
	15	.26333	4.10569	.949	-8.0997	8.6264
	16	-5.43333	4.10569	.195	-13.7964	2.9297
11	12	-4.48333	4.10569	.283	-12.8464	3.8797
	13	-2.35000	4.10569	.571	-10.7130	6.0130
	14	-6.73333	4.10569	.111	-15.0964	1.6297
	15	-2.56667	4.10569	.536	-10.9297	5.7964
	16	-8.26333	4.10569	.053	-16.6264	.0997
12	13	2.13333	4.10569	.607	-6.2297	10.4964
	14	-2.25000	4.10569	.587	-10.6130	6.1130
	15	1.91667	4.10569	.644	-6.4464	10.2797
	16	-3.78000	4.10569	.364	-12.1430	4.5830
13	14	-4.38333	4.10569	.294	-12.7464	3.9797
	15	-.21667	4.10569	.958	-8.5797	8.1464
	16	-5.91333	4.10569	.160	-14.2764	2.4497
14	15	4.16667	4.10569	.318	-4.1964	12.5297
	16	-1.53000	4.10569	.712	-9.8930	6.8330
15	16	-5.69667	4.10569	.175	-14.0597	2.6664

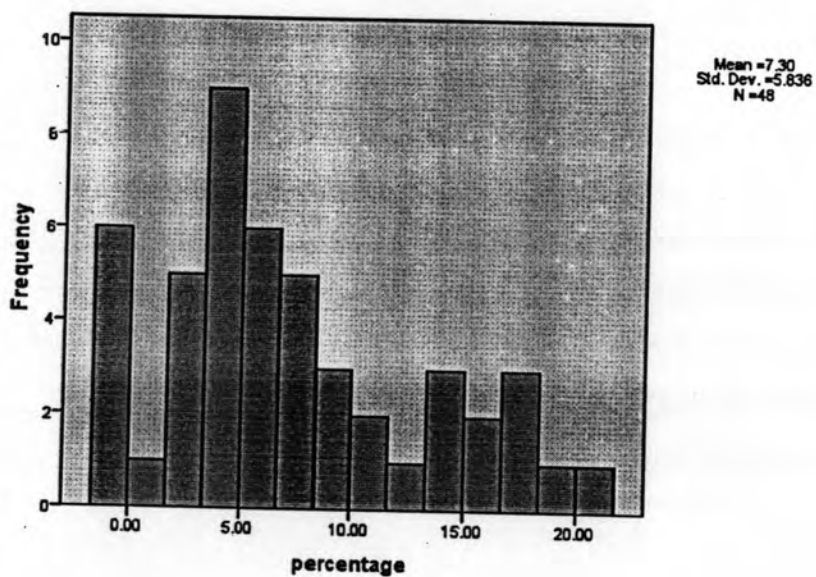
*. The mean difference is significant at the 0.05 level.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
percentage	.167	48	.002	.930	48	.007

a. Lilliefors Significance Correction

Histogram



APPENDIX B

Cell viability of HeLa cells incubated with various concentration of chitosan and LipofectamineTM Reagent

	Polymer	cell viability (%)
1	2 µg/ml chitosan in acetic acid	107.40±4.48
2	4 µg/ml chitosan in acetic acid	104.62±3.65
3	6 µg/ml chitosan in acetic acid	104.94±5.97
4	8 µg/ml chitosan in acetic acid	108.05±4.61
5	10 µg/ml chitosan in acetic acid	108.61±3.93
6	25 µg/ml chitosan in acetic acid	103.32±3.94
7	2 µg/ml chitosan in lactic acid	101.91±5.70
8	4 µg/ml chitosan in lactic acid	102.22±5.24
9	6 µg/ml chitosan in lactic acid	103.40±7.14
10	8 µg/ml chitosan in lactic acid	103.61±4.25
11	10 µg/ml chitosan in lactic acid	102.72±3.98
12	25 µg/ml chitosan in lactic acid	105.15±5.94
13	2 µg/ml chitosan in glycolic acid	104.96±4.65
14	4 µg/ml chitosan in glycolic acid	103.78±5.91
15	6 µg/ml chitosan in glycolic acid	102.02±4.13
16	8 µg/ml chitosan in glycolic acid	100.39±6.76
17	10 µg/ml chitosan in glycolic acid	107.05±5.70
18	25 µg/ml chitosan in glycolic acid	106.96±3.63
19	4 µl/ml Lipofectamine TM Reagent	70.12±6.41

Descriptives

viability

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	3	1.0740E2	4.48411	2.58890	96.2608	118.5392	102.47	111.24
2	3	1.0462E2	3.65040	2.10756	95.5552	113.6914	101.85	108.76
3	3	1.0494E2	5.97276	3.44837	90.1035	119.7778	98.08	108.99
4	3	1.0805E2	4.61074	2.66201	96.5989	119.5064	102.95	111.91
5	3	1.0861E2	3.93167	2.26995	98.8449	118.3785	106.07	113.14
6	3	1.0332E2	3.94423	2.27720	93.5260	113.1220	99.50	107.38
7	3	1.0191E2	5.69890	3.29026	87.7498	116.0635	98.03	108.45
8	3	1.0221E2	5.23612	3.02307	89.2061	115.2206	98.78	108.24
9	3	1.0340E2	7.13838	4.12134	85.6640	121.1294	98.94	111.63
10	3	1.0361E2	4.24625	2.45157	93.0584	114.1549	99.55	108.02
11	3	1.0273E2	3.98421	2.30028	92.8277	112.6223	98.14	105.34
12	3	1.0515E2	5.93903	3.42890	90.3933	119.9000	100.12	111.70
13	3	1.0496E2	4.65142	2.68550	93.4096	116.5191	101.97	110.32
14	3	1.0378E2	5.90801	3.41099	89.1057	118.4583	100.00	110.59
15	3	1.0201E2	4.13204	2.38563	91.7488	112.2779	97.28	104.90
16	3	1.0039E2	6.76209	3.90410	83.5967	117.1926	93.97	107.45
17	3	1.0705E2	5.69990	3.29084	92.8920	121.2107	100.47	110.40
18	3	1.0696E2	3.63379	2.09797	97.9342	115.9878	102.84	109.69
19	3	70.1247	6.40489	3.69786	54.2140	86.0353	62.82	74.77
Total	57	1.0270E2	9.11708	1.20759	100.2777	105.1159	62.82	113.14

Test of Homogeneity of Variances

viability

Levene Statistic	df1	df2	Sig.
.528	18	38	.926

ANOVA

viability					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3639.854	18	202.214	7.571	.000
Within Groups	1014.927	38	26.709		
Total	4654.782	56			

Multiple Comparisons

viability

LSD

(I) polymer	(J) polymer	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	2.77667	4.21969	.514	-5.7656	11.3190
	3	2.45933	4.21969	.563	-6.0830	11.0016
	4	-.65267	4.21969	.878	-9.1950	7.8896
	5	-1.21167	4.21969	.776	-9.7540	7.3306
	6	4.07600	4.21969	.340	-4.4663	12.6183
	7	5.49333	4.21969	.201	-3.0490	14.0356
	8	5.18667	4.21969	.227	-3.3556	13.7290
	9	4.00333	4.21969	.349	-4.5390	12.5456
	10	3.79333	4.21969	.374	-4.7490	12.3356
	11	4.67500	4.21969	.275	-3.8673	13.2173
	12	2.25333	4.21969	.596	-6.2890	10.7956
	13	2.43567	4.21969	.567	-6.1066	10.9780
	14	3.61800	4.21969	.397	-4.9243	12.1603
	15	5.38667	4.21969	.210	-3.1556	13.9290
	16	7.00533	4.21969	.105	-1.5370	15.5476
	17	.34867	4.21969	.935	-8.1936	8.8910
	18	.43900	4.21969	.918	-8.1033	8.9813
	19	37.27533	4.21969	.000	28.7330	45.8176

2	3	-3.1733	4.21969	.940	-8.8596	8.2250	
	4	-3.42933	4.21969	.421	-11.9716	5.1130	
	5	-3.98833	4.21969	.351	-12.5306	4.5540	
	6	1.29933	4.21969	.760	-7.2430	9.8416	
	7	2.71667	4.21969	.524	-5.8256	11.2590	
	8	2.41000	4.21969	.571	-6.1323	10.9523	
	9	1.22667	4.21969	.773	-7.3156	9.7690	
	10	1.01667	4.21969	.811	-7.5256	9.5590	
	11	1.89833	4.21969	.655	-6.6440	10.4406	
	12	-.52333	4.21969	.902	-9.0656	8.0190	
	13	-.34100	4.21969	.936	-8.8833	8.2013	
	14	.84133	4.21969	.843	-7.7010	9.3836	
	15	2.61000	4.21969	.540	-5.9323	11.1523	
	16	4.22867	4.21969	.323	-4.3136	12.7710	
	17	-2.42800	4.21969	.568	-10.9703	6.1143	
	18	-2.33767	4.21969	.583	-10.8800	6.2046	
	19	34.49867*	4.21969	.000	25.9564	43.0410	
	3	4	-3.11200	4.21969	.465	-11.6543	5.4303
		5	-3.67100	4.21969	.390	-12.2133	4.8713
6		1.61667	4.21969	.704	-6.9256	10.1590	
7		3.03400	4.21969	.477	-5.5083	11.5763	
8		2.72733	4.21969	.522	-5.8150	11.2696	
9		1.54400	4.21969	.716	-6.9983	10.0863	
10		1.33400	4.21969	.754	-7.2083	9.8763	
11		2.21567	4.21969	.603	-6.3266	10.7580	
12		-.20600	4.21969	.961	-8.7483	8.3363	
13		-.02367	4.21969	.996	-8.5660	8.5186	
14		1.15867	4.21969	.785	-7.3836	9.7010	
15		2.92733	4.21969	.492	-5.6150	11.4696	
16		4.54600	4.21969	.288	-3.9963	13.0883	
17		-2.11067	4.21969	.620	-10.6530	6.4316	
18		-2.02033	4.21969	.635	-10.5626	6.5220	
19		34.81600*	4.21969	.000	26.2737	43.3583	
4		5	-.55900	4.21969	.895	-9.1013	7.9833

	6	4.72867	4.21969	.269	-3.8136	13.2710
	7	6.14600	4.21969	.153	-2.3963	14.6883
	8	5.83933	4.21969	.174	-2.7030	14.3816
	9	4.65600	4.21969	.277	-3.8863	13.1983
	10	4.44600	4.21969	.299	-4.0963	12.9883
	11	5.32767	4.21969	.214	-3.2146	13.8700
	12	2.90600	4.21969	.495	-5.6363	11.4483
	13	3.08833	4.21969	.469	-5.4540	11.6306
	14	4.27067	4.21969	.318	-4.2716	12.8130
	15	6.03933	4.21969	.161	-2.5030	14.5816
	16	7.65800	4.21969	.077	-.8843	16.2003
	17	1.00133	4.21969	.814	-7.5410	9.5436
	18	1.09167	4.21969	.797	-7.4506	9.6340
	19	37.92800*	4.21969	.000	29.3857	46.4703
5	6	5.28767	4.21969	.218	-3.2546	13.8300
	7	6.70500	4.21969	.120	-1.8373	15.2473
	8	6.39833	4.21969	.138	-2.1440	14.9406
	9	5.21500	4.21969	.224	-3.3273	13.7573
	10	5.00500	4.21969	.243	-3.5373	13.5473
	11	5.88667	4.21969	.171	-2.6556	14.4290
	12	3.46500	4.21969	.417	-5.0773	12.0073
	13	3.64733	4.21969	.393	-4.8950	12.1896
	14	4.82967	4.21969	.260	-3.7126	13.3720
	15	6.59833	4.21969	.126	-1.9440	15.1406
	16	8.21700	4.21969	.059	-.3253	16.7593
	17	1.56033	4.21969	.714	-6.9820	10.1026
	18	1.65067	4.21969	.698	-6.8916	10.1930
	19	38.48700*	4.21969	.000	29.9447	47.0293
6	7	1.41733	4.21969	.739	-7.1250	9.9596
	8	1.11067	4.21969	.794	-7.4316	9.6530
	9	-.07267	4.21969	.986	-8.6150	8.4696
	10	-.28267	4.21969	.947	-8.8250	8.2596
	11	.59900	4.21969	.888	-7.9433	9.1413
	12	-1.82267	4.21969	.668	-10.3650	6.7196

	13	-1.64033	4.21969	.700	-10.1826	6.9020
	14	-.45800	4.21969	.914	-9.0003	8.0843
	15	1.31067	4.21969	.758	-7.2316	9.8530
	16	2.92933	4.21969	.492	-5.6130	11.4716
	17	-3.72733	4.21969	.383	-12.2696	4.8150
	18	-3.63700	4.21969	.394	-12.1793	4.9053
	19	33.19933	4.21969	.000	24.6570	41.7416
7	8	-.30667	4.21969	.942	-8.8490	8.2356
	9	-1.49000	4.21969	.726	-10.0323	7.0523
	10	-1.70000	4.21969	.689	-10.2423	6.8423
	11	-.81833	4.21969	.847	-9.3606	7.7240
	12	-3.24000	4.21969	.447	-11.7823	5.3023
	13	-3.05767	4.21969	.473	-11.6000	5.4846
	14	-1.87533	4.21969	.659	-10.4176	6.6670
	15	-.10667	4.21969	.980	-8.6490	8.4356
	16	1.51200	4.21969	.722	-7.0303	10.0543
	17	-5.14467	4.21969	.230	-13.6870	3.3976
	18	-5.05433	4.21969	.238	-13.5966	3.4880
	19	31.78200	4.21969	.000	23.2397	40.3243
8	9	-1.18333	4.21969	.781	-9.7256	7.3590
	10	-1.39333	4.21969	.743	-9.9356	7.1490
	11	-.51167	4.21969	.904	-9.0540	8.0306
	12	-2.93333	4.21969	.491	-11.4756	5.6090
	13	-2.75100	4.21969	.518	-11.2933	5.7913
	14	-1.56867	4.21969	.712	-10.1110	6.9736
	15	.20000	4.21969	.962	-8.3423	8.7423
	16	1.81867	4.21969	.669	-6.7236	10.3610
	17	-4.83800	4.21969	.259	-13.3803	3.7043
	18	-4.74767	4.21969	.268	-13.2900	3.7946
	19	32.08867	4.21969	.000	23.5464	40.6310
9	10	-.21000	4.21969	.961	-8.7523	8.3323
	11	.67167	4.21969	.874	-7.8706	9.2140
	12	-1.75000	4.21969	.681	-10.2923	6.7923
	13	-1.56767	4.21969	.712	-10.1100	6.9746

	14	-38533	4.21969	.928	-8.9276	8.1570
	15	1.38333	4.21969	.745	-7.1590	9.9256
	16	3.00200	4.21969	.481	-5.5403	11.5443
	17	-3.65467	4.21969	.392	-12.1970	4.8876
	18	-3.56433	4.21969	.404	-12.1066	4.9780
	19	33.27200	4.21969	.000	24.7297	41.8143
10	11	.88167	4.21969	.836	-7.6606	9.4240
	12	-1.54000	4.21969	.717	-10.0823	7.0023
	13	-1.35767	4.21969	.749	-9.9000	7.1846
	14	-.17533	4.21969	.967	-8.7176	8.3670
	15	1.59333	4.21969	.708	-6.9490	10.1356
	16	3.21200	4.21969	.451	-5.3303	11.7543
	17	-3.44467	4.21969	.419	-11.9870	5.0976
	18	-3.35433	4.21969	.432	-11.8966	5.1880
	19	33.48200	4.21969	.000	24.9397	42.0243
11	12	-2.42167	4.21969	.569	-10.9640	6.1206
	13	-2.23933	4.21969	.599	-10.7816	6.3030
	14	-1.05700	4.21969	.804	-9.5993	7.4853
	15	.71167	4.21969	.867	-7.8306	9.2540
	16	2.33033	4.21969	.584	-6.2120	10.8726
	17	-4.32633	4.21969	.312	-12.8686	4.2160
	18	-4.23600	4.21969	.322	-12.7783	4.3063
	19	32.60033	4.21969	.000	24.0580	41.1426
12	13	.18233	4.21969	.966	-8.3600	8.7246
	14	1.36467	4.21969	.748	-7.1776	9.9070
	15	3.13333	4.21969	.462	-5.4090	11.6756
	16	4.75200	4.21969	.267	-3.7903	13.2943
	17	-1.90467	4.21969	.654	-10.4470	6.6376
	18	-1.81433	4.21969	.670	-10.3566	6.7280
	19	35.02200	4.21969	.000	26.4797	43.5643
13	14	1.18233	4.21969	.781	-7.3600	9.7246
	15	2.95100	4.21969	.489	-5.5913	11.4933
	16	4.56967	4.21969	.286	-3.9726	13.1120
	17	-2.08700	4.21969	.624	-10.6293	6.4553

	18	-1.99667	4.21969	.639	-10.5390	6.5456
	19	34.83967*	4.21969	.000	26.2974	43.3820
14	15	1.76867	4.21969	.677	-6.7736	10.3110
	16	3.38733	4.21969	.427	-5.1550	11.9296
	17	-3.26933	4.21969	.443	-11.8116	5.2730
	18	-3.17900	4.21969	.456	-11.7213	5.3633
	19	33.65733*	4.21969	.000	25.1150	42.1996
15	16	1.61867	4.21969	.703	-6.9236	10.1610
	17	-5.03800	4.21969	.240	-13.5803	3.5043
	18	-4.94767	4.21969	.248	-13.4900	3.5946
	19	31.88867*	4.21969	.000	23.3464	40.4310
16	17	-6.65667	4.21969	.123	-15.1990	1.8856
	18	-6.56633	4.21969	.128	-15.1086	1.9760
	19	30.27000*	4.21969	.000	21.7277	38.8123
17	18	.09033	4.21969	.983	-8.4520	8.6326
	19	36.92667*	4.21969	.000	28.3844	45.4690
18	19	36.83633*	4.21969	.000	28.2940	45.3786

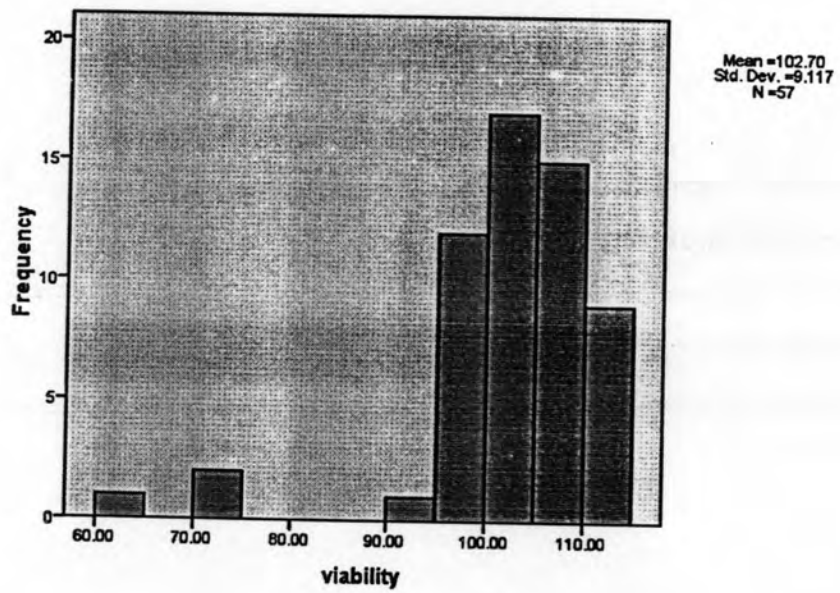
*. The mean difference is significant at the 0.05 level.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
viability	.217	57	.000	.734	57	.000

a. Lilliefors Significance Correction

Histogram



APPENDIX C

Cell viability of HeLa cells incubated with the medium of selected formulations

	Sample	cell viability (%)
1	naked pDNA	106.63±4.45
2	A/S medium	104.68±5.61
3	A/C medium	109.08±2.25
4	A/W medium	104.13±2.94
5	L/S medium	101.73±5.19
6	L/C medium	106.37±5.72
7	L/W medium	105.57±5.17
8	G/S medium	106.51±5.76
9	G/C medium	106.86±4.40
10	G/W medium	101.12±3.99

Descriptives

viability

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	3	1.0663E2	4.44929	2.56880	95.5817	117.6870	101.53	109.70
2	3	1.0468E2	5.61342	3.24091	90.7321	118.6212	99.15	110.37
3	3	1.0908E2	2.24656	1.29705	103.4979	114.6594	106.74	111.22
4	3	1.0413E2	2.93587	1.69503	96.8322	111.4184	100.74	105.91
5	3	1.0173E2	5.18546	2.99383	88.8456	114.6084	96.40	106.76
6	3	1.0637E2	5.72471	3.30516	92.1477	120.5896	102.14	112.88
7	3	1.0557E2	5.17380	2.98709	92.7172	118.4221	100.97	111.17
8	3	1.0651E2	5.75829	3.32455	92.2039	120.8127	102.60	113.12
9	3	1.0686E2	4.40189	2.54143	95.9251	117.7949	104.15	111.94
10	3	1.0112E2	3.98524	2.30088	91.2161	111.0159	98.03	105.62
Total	30	1.0527E2	4.54566	.82992	103.5691	106.9638	96.40	113.12

Test of Homogeneity of Variances

viability

Levene Statistic	df1	df2	Sig.
.563	9	20	.811

ANOVA

viability	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	159.590	9	17.732	.807	.616
Within Groups	439.638	20	21.982		
Total	599.228	29			

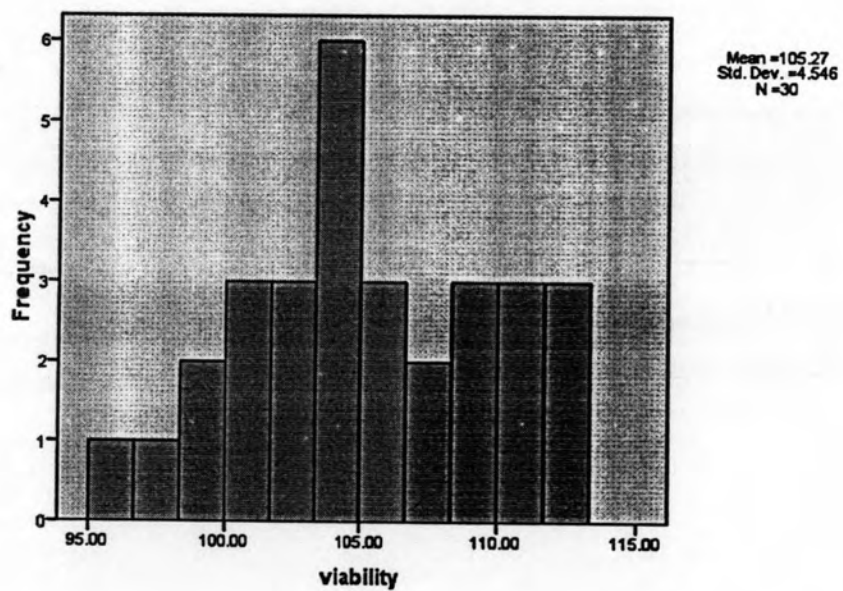
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
viability	.094	30	.200*	.972	30	.597

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Histogram



APPENDIX D

Cell viability of HeLa cells incubated with the nanoparticles of the selected formulations and LipofectamineTM-pDNA complexes

	Sample	cell viability (%)
1	naked pDNA	106.63±4.45
2	2:1 CSA/DNA S nanoparticles	102.50±5.09
3	2:1 CSA/DNA C nanoparticles	109.51±8.13
4	2:1 CSA/DNA W nanoparticles	103.72±6.77
5	2:1 CSL/DNA S nanoparticles	109.15±3.37
6	2:1 CSL/DNA C nanoparticles	104.71±5.21
7	2:1 CSL/DNA W nanoparticles	108.37±5.24
8	2:1 CSG/DNA S nanoparticles	101.07±4.36
9	2:1 CSG/DNA C nanoparticles	107.67±3.04
10	2:1 CSG/DNA W nanoparticles	102.90±3.73
11	3:1 CSA/DNA S nanoparticles	103.20±3.91
12	5:1 CSA/DNA S nanoparticles	102.32±5.60
13	7:1 CSA/DNA S nanoparticles	106.00±7.62
14	Lipofectamine TM -DNA complexes	73.92±3.40

Descriptives

viability

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	3	1.0663E2	4.44929	2.56880	95.5817	117.6870	101.53	109.70
2	3	1.0250E2	5.09230	2.94004	89.8487	115.1486	98.13	108.09
3	3	1.0903E2	8.81978	5.09210	87.1211	130.9402	100.42	118.05
4	3	1.0373E2	6.76559	3.90611	86.9183	120.5317	99.32	111.52
5	3	1.0915E2	3.36537	1.94300	100.7896	117.5097	105.46	112.06
6	3	1.0471E2	5.20653	3.00599	91.7759	117.6434	101.24	110.70
7	3	1.0837E2	5.23828	3.02432	95.3581	121.3833	103.01	113.48
8	3	1.0107E2	4.35725	2.51566	90.2507	111.8987	97.43	105.90
9	3	1.0767E2	3.03919	1.75468	100.1179	115.2174	104.56	110.64
10	3	1.0290E2	3.72984	2.15342	93.6379	112.1688	99.29	106.74
11	3	1.0320E2	3.90812	2.25635	93.4870	112.9036	99.27	107.09
12	3	1.0232E2	5.60062	3.23352	88.4073	116.2327	96.20	107.19
13	3	1.0600E2	7.61841	4.39849	87.0748	124.9252	97.51	112.24
14	3	73.9173	3.40150	1.96386	65.4675	82.3671	71.49	77.80
Total	42	1.0294E2	9.61350	1.48339	99.9469	105.9384	71.49	118.05

Test of Homogeneity of Variances

viability

Levene Statistic	df1	df2	Sig.
.770	13	28	.683

ANOVA

viability					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3002.097	13	230.931	8.215	.000
Within Groups	787.095	28	28.111		
Total	3789.192	41			

Multiple Comparisons

viability

LSD

(I) formulat ion	(J) formulat ion	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	4.13567	4.32901	.348	-4.7319	13.0032
	3	-2.39633	4.32901	.584	-11.2639	6.4712
	4	2.90933	4.32901	.507	-5.9582	11.7769
	5	-2.51533	4.32901	.566	-11.3829	6.3522
	6	1.92467	4.32901	.660	-6.9429	10.7922
	7	-1.73633	4.32901	.691	-10.6039	7.1312
	8	5.55967	4.32901	.210	-3.3079	14.4272
	9	-1.03333	4.32901	.813	-9.9009	7.8342
	10	3.73100	4.32901	.396	-5.1366	12.5986
	11	3.43900	4.32901	.434	-5.4286	12.3066
	12	4.31433	4.32901	.327	-4.5532	13.1819
	13	.63433	4.32901	.885	-8.2332	9.5019
	14	32.71700	4.32901	.000	23.8494	41.5846
	2	3	-6.53200	4.32901	.143	-15.3996
4		-1.22633	4.32901	.779	-10.0939	7.6412
5		-6.65100	4.32901	.136	-15.5186	2.2166
6		-2.21100	4.32901	.614	-11.0786	6.6566
7		-5.87200	4.32901	.186	-14.7396	2.9956

	8	1.42400	4.32901	.745	-7.4436	10.2916
	9	-5.16900	4.32901	.242	-14.0366	3.6986
	10	-.40467	4.32901	.926	-9.2722	8.4629
	11	-.69667	4.32901	.873	-9.5642	8.1709
	12	.17867	4.32901	.967	-8.6889	9.0462
	13	-3.50133	4.32901	.425	-12.3689	5.3662
	14	28.58133*	4.32901	.000	19.7138	37.4489
3	4	5.30567	4.32901	.231	-3.5619	14.1732
	5	-.11900	4.32901	.978	-8.9866	8.7486
	6	4.32100	4.32901	.327	-4.5466	13.1886
	7	.66000	4.32901	.880	-8.2076	9.5276
	8	7.95600	4.32901	.077	-.9116	16.8236
	9	1.36300	4.32901	.755	-7.5046	10.2306
	10	6.12733	4.32901	.168	-2.7402	14.9949
	11	5.83533	4.32901	.188	-3.0322	14.7029
	12	6.71067	4.32901	.132	-2.1569	15.5782
	13	3.03067	4.32901	.490	-5.8369	11.8982
	14	35.11333*	4.32901	.000	26.2458	43.9809
4	5	-5.42467	4.32901	.221	-14.2922	3.4429
	6	-.98467	4.32901	.822	-9.8522	7.8829
	7	-4.64567	4.32901	.292	-13.5132	4.2219
	8	2.65033	4.32901	.545	-6.2172	11.5179
	9	-3.94267	4.32901	.370	-12.8102	4.9249
	10	.82167	4.32901	.851	-8.0459	9.6892
	11	.52967	4.32901	.903	-8.3379	9.3972
	12	1.40500	4.32901	.748	-7.4626	10.2726
	13	-2.27500	4.32901	.603	-11.1426	6.5926
	14	29.80767*	4.32901	.000	20.9401	38.6752
5	6	4.44000	4.32901	.314	-4.4276	13.3076
	7	.77900	4.32901	.858	-8.0886	9.6466
	8	8.07500	4.32901	.073	-.7926	16.9426
	9	1.48200	4.32901	.735	-7.3856	10.3496
	10	6.24633	4.32901	.160	-2.6212	15.1139
	11	5.95433	4.32901	.180	-2.9132	14.8219

	12	6.82967	4.32901	.126	-2.0379	15.6972
	13	3.14967	4.32901	.473	-5.7179	12.0172
	14	35.23233*	4.32901	.000	26.3648	44.0999
6	7	-3.66100	4.32901	.405	-12.5286	5.2066
	8	3.63500	4.32901	.408	-5.2326	12.5026
	9	-2.95800	4.32901	.500	-11.8256	5.9096
	10	1.80633	4.32901	.680	-7.0612	10.6739
	11	1.51433	4.32901	.729	-7.3532	10.3819
	12	2.38967	4.32901	.585	-6.4779	11.2572
	13	-1.29033	4.32901	.768	-10.1579	7.5772
	14	30.79233*	4.32901	.000	21.9248	39.6599
7	8	7.29600	4.32901	.103	-1.5716	16.1636
	9	.70300	4.32901	.872	-8.1646	9.5706
	10	5.46733	4.32901	.217	-3.4002	14.3349
	11	5.17533	4.32901	.242	-3.6922	14.0429
	12	6.05067	4.32901	.173	-2.8169	14.9182
	13	2.37067	4.32901	.588	-6.4969	11.2382
	14	34.45333*	4.32901	.000	25.5858	43.3209
8	9	-6.59300	4.32901	.139	-15.4606	2.2746
	10	-1.82867	4.32901	.676	-10.6962	7.0389
	11	-2.12067	4.32901	.628	-10.9882	6.7469
	12	-1.24533	4.32901	.776	-10.1129	7.6222
	13	-4.92533	4.32901	.265	-13.7929	3.9422
	14	27.15733*	4.32901	.000	18.2898	36.0249
9	10	4.76433	4.32901	.280	-4.1032	13.6319
	11	4.47233	4.32901	.310	-4.3952	13.3399
	12	5.34767	4.32901	.227	-3.5199	14.2152
	13	1.66767	4.32901	.703	-7.1999	10.5352
	14	33.75033*	4.32901	.000	24.8828	42.6179
10	11	-.29200	4.32901	.947	-9.1596	8.5756
	12	.58333	4.32901	.894	-8.2842	9.4509
	13	-3.09667	4.32901	.480	-11.9642	5.7709
	14	28.98600*	4.32901	.000	20.1184	37.8536
11	12	.87533	4.32901	.841	-7.9922	9.7429

	13	-2.80467	4.32901	.522	-11.6722	6.0629
	14	29.27800*	4.32901	.000	20.4104	38.1456
12	13	-3.68000	4.32901	.402	-12.5476	5.1876
	14	28.40267*	4.32901	.000	19.5351	37.2702
13	14	32.08267*	4.32901	.000	23.2151	40.9502

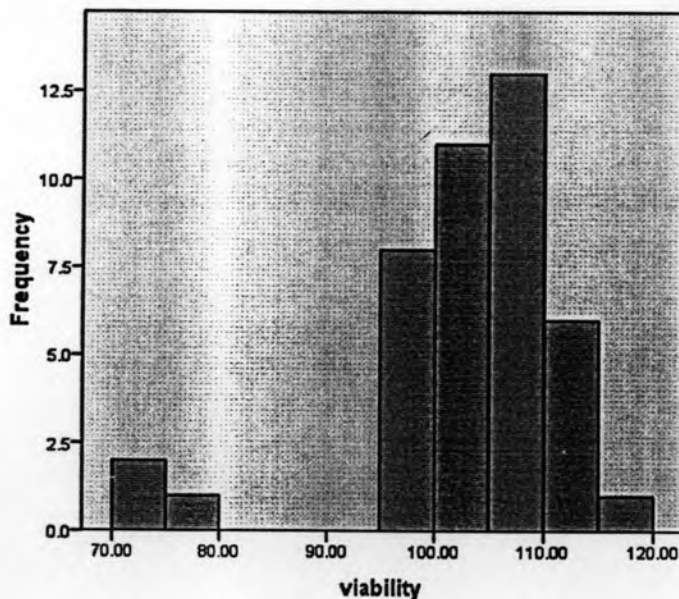
*. The mean difference is significant at the 0.05 level.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
viability	.188	42	.001	.802	42	.000

a. Lilliefors Significance Correction

Histogram



BIOGRAPHY

Miss Ornsita Siribunchong was born on May 16, 1982 in Bangkok, Thailand. She received her Bachelor Degree of Science in Pharmacy (2nd Class Honours) in 2003 from the Faculty of Pharmaceutical Sciences, Chulalongkorn University, Thailand.