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APPENDICES

APPENDIX A

Validation of HPLC Method

A. High performance liquid chromatograph (HPLC) method

1. Validation of HPLC method

The validation of analytical method is the process by which it is established that the performance characteristics of the method meet the requirements for the intended analytical applications. The performance characteristics are expressed in term of analytical parameters. For HPLC assay validation, these include specificity, linearity, accuracy and precision.

1.1 Specificity

The specificity of an analytical method is the ability to measure the analyte accurately and with specificity in the presence of other components in the sample.

Figures 54-57 are shown typical chromatogram of standard solution, internal standard solution, centella total triterpenes extract solution, mobile phase, 50% ethanol, blank sample solution (blank microspheres in each suppository preparations), respectively. The chromatograms demonstrated that the HPLC condition used in the study had a suitable specificity.

1.2 Linearity

The linearity of an analytical method is a directly mathematical transformation, proportional to the concentration of the analyte in samples within a given range. The linearity is usually expressed in terms of the variance around the slope of the regression line calculated according to an established mathematical relationship from test results obtained by the analysis of samples with varying concentrations of analyte. The calibration curve data of asiaticoside and madecassoside standard solutions in mobile phase and 50% ethanol are shown in Table 28 and Table 29. The plot of standard concentrations versus the mean peak area ratios of asiaticoside and madecassoside in mobile phase and 50% ethanol are shown in Figure 58 and Figure 59. The coefficients of determination (R^2) were 0.9998, 0.9999, 0.9998 and 0.9998, respectively. These results indicated that HPLC method was acceptable for quantitative analysis of asiaticoside and madecassoside in the range studied.

Table 28 Data for calibration curve of asiaticoside and madecassoside in mobile phase

Concentration (µg/ml)	Peak area ratio			Mean	SD	%CV
	Set1	Set2	Set3			
asiaticoside						
10	0.1717	0.1747	0.1716	0.1726	0.0017	1.01
20	0.3632	0.3551	0.3638	0.3607	0.0048	1.34
40	0.6962	0.6894	0.6788	0.6882	0.0088	1.27
60	1.0310	1.0216	1.0432	1.0319	0.0108	1.05
80	1.3527	1.3784	1.3426	1.3579	0.0185	1.36
100	1.7735	1.7549	1.7640	1.7641	0.0093	0.53
madecassoside						
10	0.1963	0.1951	0.1959	0.1957	0.0006	0.32
40	0.7201	0.7228	0.7375	0.7268	0.0094	1.29
80	1.5228	1.5137	1.5044	1.5136	0.0092	0.61
120	2.2355	2.2417	2.2395	2.2389	0.0031	0.14
160	2.9233	2.9216	3.0032	2.9494	0.0467	1.58
200	3.7250	3.7013	3.7081	3.7115	0.0122	0.33

Table 29 Data for calibration curve of asiaticoside and madecassoside in 50% ethanol

Concentration (µg/ml)	Peak area ratio			Mean	SD	%CV
	Set1	Set2	Set3			
asiaticoside						
10	0.1648	0.1682	0.1659	0.1663	0.0017	1.04
20	0.3657	0.3597	0.3606	0.3620	0.0032	0.89
40	0.7024	0.7035	0.7059	0.7039	0.0018	0.25
60	1.0589	1.0776	1.0612	1.0659	0.0102	0.96
80	1.4256	1.4473	1.4360	1.4363	0.0108	0.75
100	1.7933	1.7875	1.7910	1.7906	0.0029	0.16
madecassoside						
10	0.1878	0.1884	0.1881	0.1881	0.0003	0.16
40	0.8019	0.7982	0.7917	0.7973	0.0052	0.65
80	1.5674	1.5746	1.5656	1.5692	0.0048	0.30
120	2.2797	2.2945	2.2643	2.2795	0.0151	0.66
160	3.0267	3.0575	3.0494	3.0445	0.0160	0.52
200	3.7720	3.8274	3.8306	3.8100	0.0329	0.86

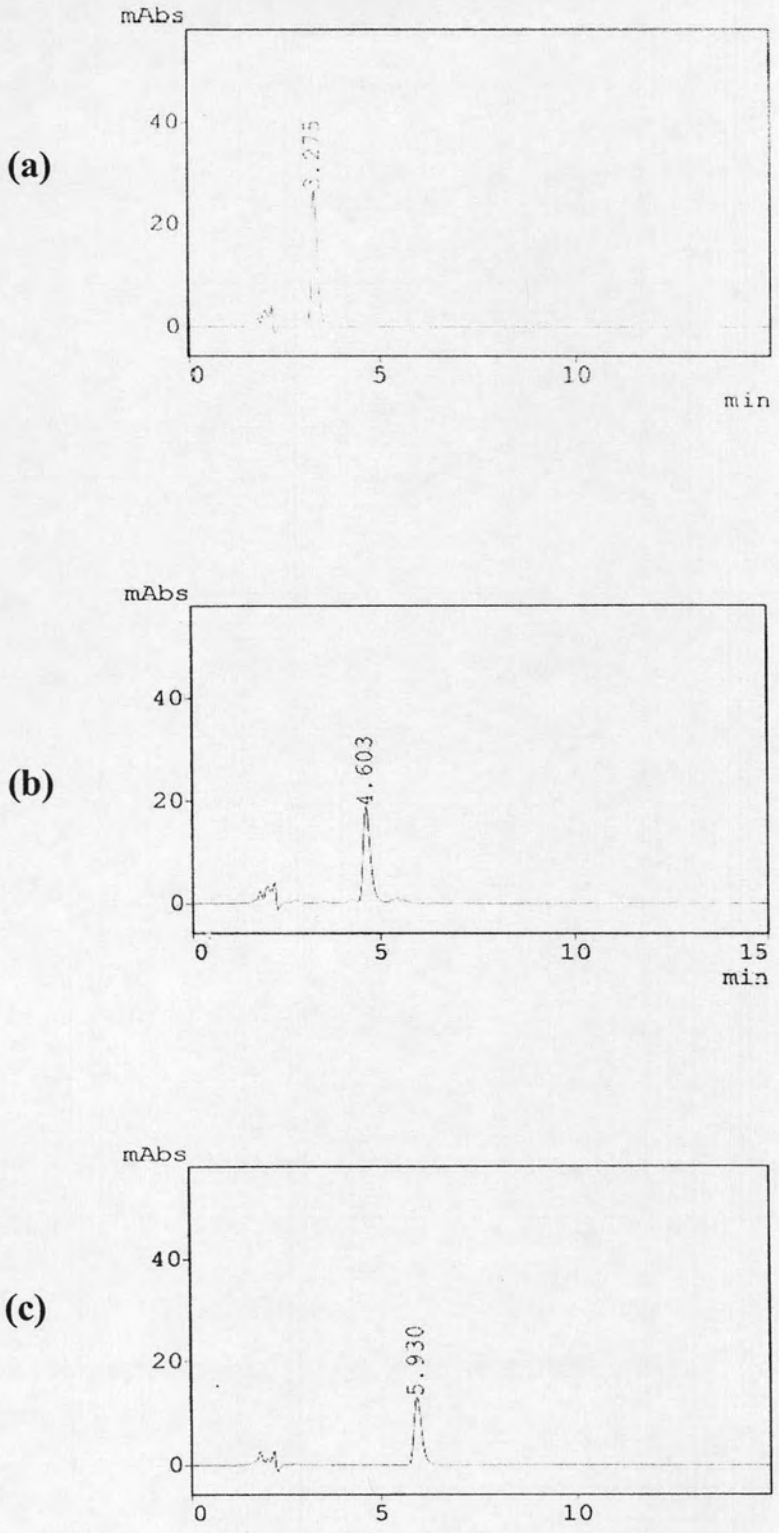


Figure 54 HPLC chromatograms of standard stock solution;

(a) madecassoside standard solution 120 µg/ml

(b) asiaticoside standard solution 60 µg/ml

(c) prednisolone standard solution 10 µg/ml

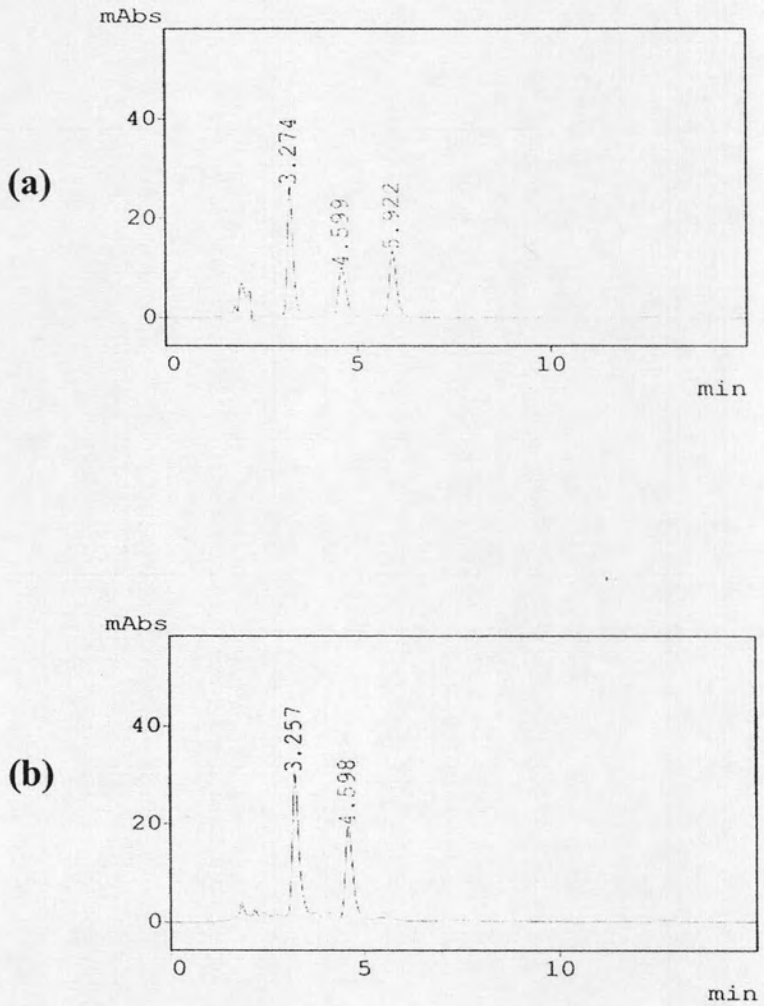


Figure 55 HPLC chromatograms of mixtures standard stock solution and centella extract;

(a) HPLC chromatogram of mixtures of 120 µg/ml, madecassoside, 60 µg/ml asiaticoside, 10 µg/ml prednisolone

(b) HPLC chromatogram of centella total triterpenes extract

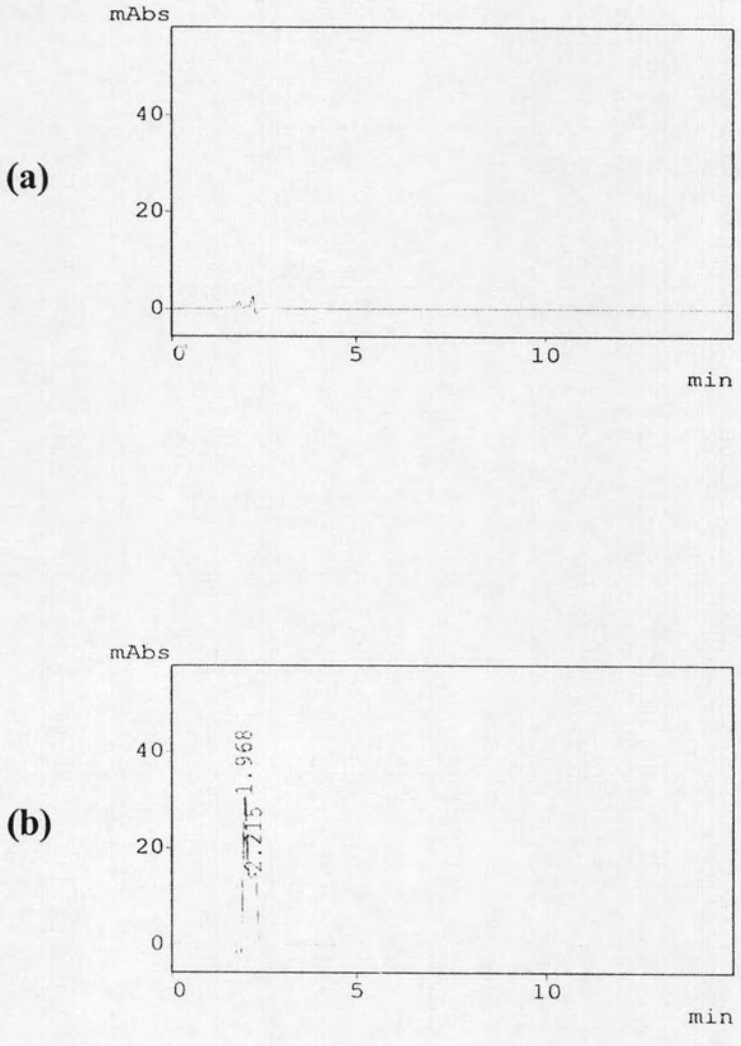


Figure 56 HPLC chromatograms of mobile phase and 50% ethanol;

(a) HPLC chromatogram of mobile phase

(b) HPLC chromatogram of 50% ethanol

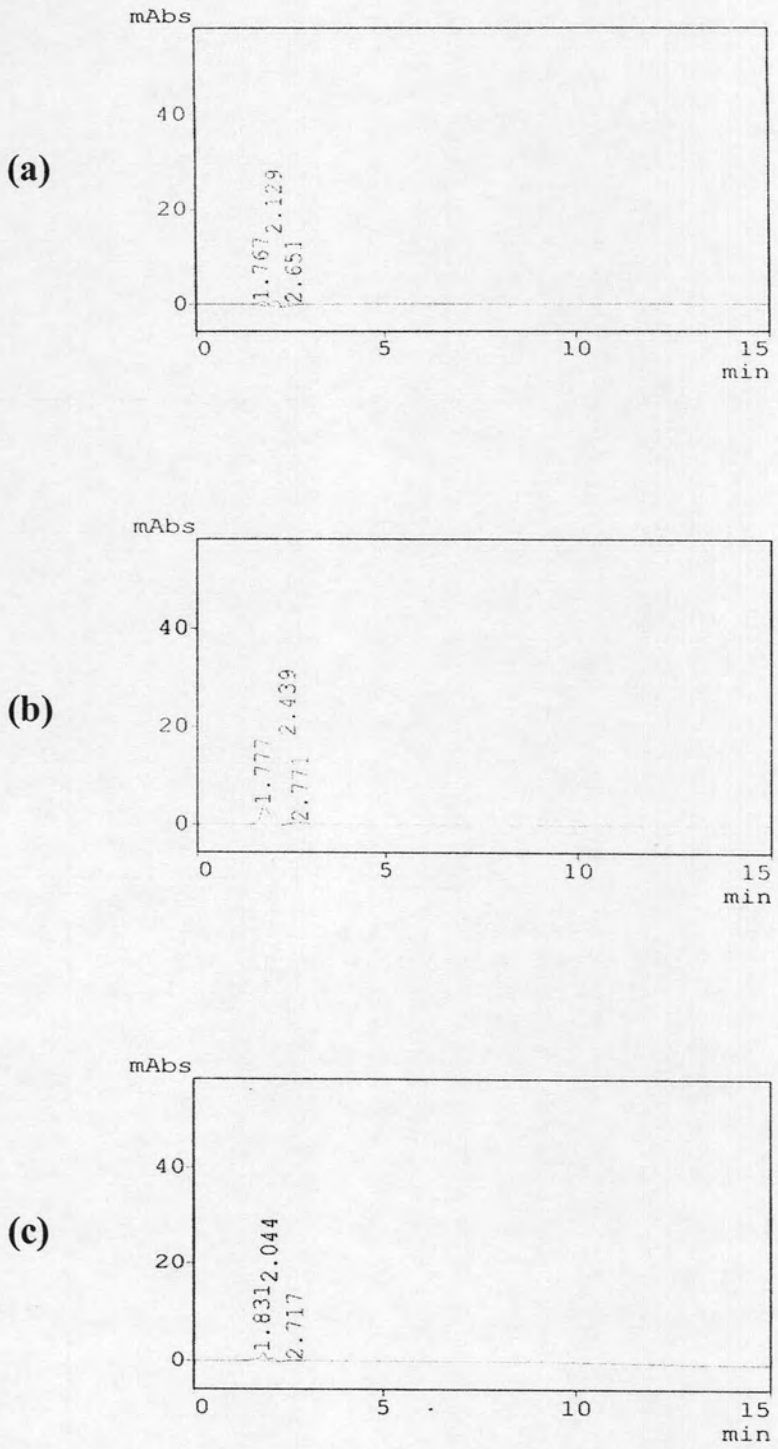
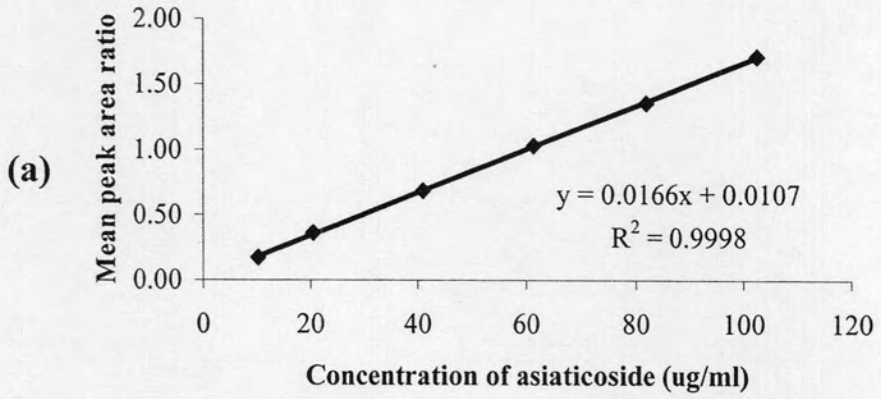


Figure 57 HPLC chromatograms of blank microspheres in suppositories;

(a) HPLC chromatogram of blank microspheres in poloxamer suppository

(b) HPLC chromatogram of blank microspheres in PEG suppository

(c) HPLC chromatogram of blank microspheres in Suppocire® AM suppository



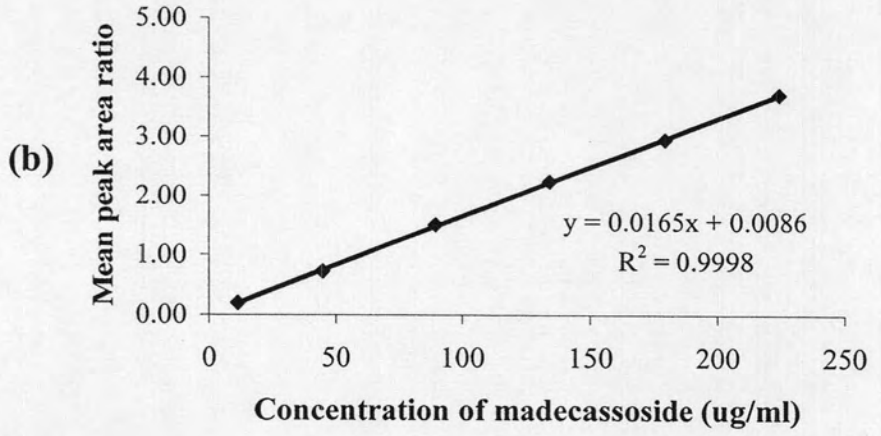


Figure 58 Standard curves of asiaticoside and madecassoside in mobile phase by HPLC method;

(a) asiaticoside

(b) madecassoside

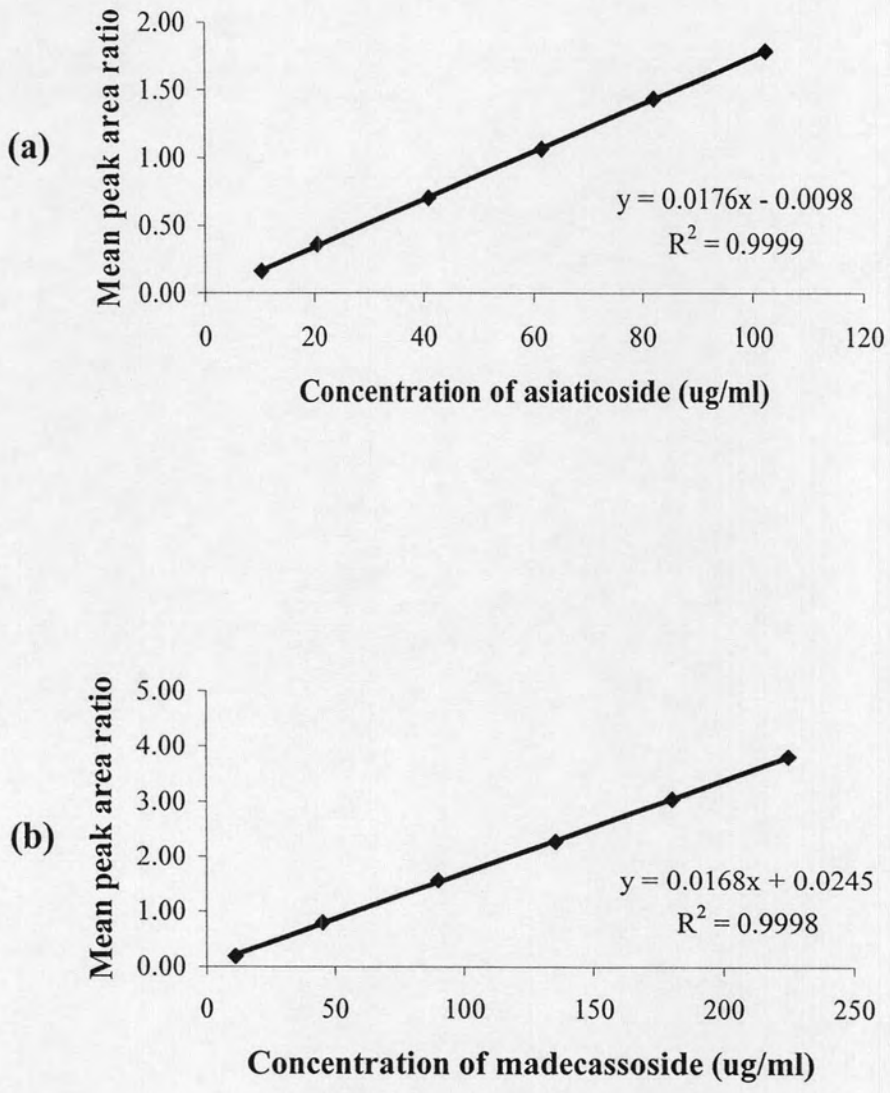


Figure 59 Standard curves of asiaticoside and madecassoside in 50% ethanol by HPLC method;

(a) asiaticoside

(b) madecassoside

1.3 Accuracy

The accuracy of an analytical method is the closeness of test results obtained by the method to the true value. Accuracy is calculated as percent recovery by the assay of known added amount of analyte. The percentage of analytical recovery of asiaticoside and madecassoside in mobile phase and 50% ethanol are shown in Table 30 and Table 31. The percentages analytical recovery of asiaticoside and madecassoside were in the range of 100.17-101.11%, 100.81-101.32% in mobile phase and 99.55-100.56%, 99.49-100.41% in 50% ethanol, respectively, which indicated that this method could be used for analysis in all concentrations studied with a high accuracy.

Table 30 The percentages of analytical recovery of asiaticoside and madecassoside in mobile phase

Concentration (µg/ml)	**%Analytical recovery**					**Mean ± SD**
	1	**2**	**3**	**4**	**5**	
asiaticoside						
15	101.11	101.52	100.94	100.54	101.41	101.11 ± 0.39
50	101.41	101.44	99.69	101.28	99.60	100.68 ± 0.95
90	99.99	99.75	100.10	100.93	100.09	100.17 ± 0.45
madecassoside						
20	99.90	101.76	100.60	100.95	101.92	101.03 ± 0.90
100	100.30	100.80	100.82	101.30	100.84	100.81 ± 0.36
180	101.29	101.36	101.54	101.11	101.31	101.32 ± 0.15

Table 31 The percentages of analytical recovery of asiaticoside and madecassoside in 50% ethanol

Concentration (µg/ml)	**%Analytical recovery**					**Mean ± SD**
	1	**2**	**3**	**4**	**5**	
asiaticoside						
15	100.55	100.04	100.53	101.62	100.56	100.56 ± 0.66
50	99.85	99.39	99.31	99.85	99.35	99.55 ± 0.28
90	99.41	99.25	101.40	99.22	99.24	99.71 ± 0.96
madecassoside						
20	99.11	99.17	99.48	100.32	99.35	99.49 ± 0.46
100	100.01	100.40	100.54	100.55	99.98	100.30 ± 0.28
180	100.78	100.89	100.06	100.09	100.21	100.41 ± 0.39

1.4 Precision

The precision of an analytical method is the degree of agreement among individual test results when the method is applied repeatedly to multiple samplings of a homogeneous sample. The precision of an analytical was usually expressed as the standard deviation or relative standard deviation (coefficient of variation) of a series of measurement. In this context, within run precision refers to the use of the analytical procedure with the same equipment in the same day. Table 32 and Table 33 display the data of the analyses of asiaticoside and madecassoside in mobile phase and 50% ethanol in the same day, respectively. Between run precision expresses within laboratory variation as on different days. As given Table 34 and Table 35, there were the data of between run precision in mobile phase and 50% ethanol, respectively. All coefficient of variation values were small as shown to be in the range of 0.24-1.39%. The coefficient of variation of an analytical method should generally be less than 2%. Therefore, The HPLC method could be used precisely for quantitative analysis in the range studied.

In conclusion, the analysis of asiaticoside and madecassoside in mobile phase or 50% ethanol by HPLC method developed in this study showed good specificity, linearity, accuracy and precision. Thus this method was used for the determination of the content of asiaticoside and madecassoside in this study.

Table 32 Data of within run precision of asiaticoside and madecassoside in mobile phase

Concentration (µg/ml)	**Peak area ratio**					**Mean**	**SD**	**%CV**
	Set1	**Set2**	**Set3**	**Set4**	**Set5**			
asiaticoside								
15	0.2465	0.2439	0.2461	0.2447	0.2457	0.2454	0.0011	0.43
50	0.8402	0.8470	0.8487	0.8445	0.8430	0.8447	0.0033	0.40
90	1.5032	1.5043	1.5035	1.5206	1.5054	1.5074	0.0074	0.49
madecassoside								
20	0.3559	0.3554	0.3550	0.3540	0.3579	0.3556	0.0015	0.41
100	1.7636	1.7673	1.7792	1.7647	1.7652	1.7680	0.0064	0.36
180	3.1673	3.1757	3.1939	3.2056	3.2130	3.1911	0.0193	0.61

Table 33 Data of within run precision of asiaticoside and madecassoside in 50% ethanol

Concentration (µg/ml)	Peak area ratio					Mean	SD	%CV
	Set1	Set2	Set3	Set4	Set5			
asiaticoside								
15	0.2509	0.2620	0.2628	0.2630	0.2654	0.2628	0.0017	0.63
50	0.8767	0.8747	0.8798	0.8809	0.8889	0.8802	0.0054	0.62
90	1.5815	1.6028	1.5858	1.5760	1.5844	1.5861	0.0101	0.63
madecassoside								
20	0.3957	0.3961	0.3974	0.3972	0.3936	0.3960	0.0015	0.38
100	1.8804	1.8761	1.8850	1.8862	1.8963	1.8848	0.0076	0.40
180	3.4062	3.4064	3.4150	3.4212	3.4240	3.4146	0.0082	0.24

Table 34 Data of between run precision of asiaticoside and madecassoside in mobile phase

Concentration (µg/ml)	Peak area ratio					Mean	SD	%CV
	Set1	Set2	Set3	Set4	Set5			
asiaticoside								
15	0.2525	0.2505	0.2492	0.2463	0.2438	0.2485	0.0035	1.39
50	0.8468	0.8524	0.8554	0.8465	0.8372	0.8477	0.0070	0.82
90	1.5242	1.5285	1.5048	1.5124	1.5233	1.5186	0.0098	0.64
Madecassoside								
20	0.3582	0.3580	0.3557	0.3623	0.3607	0.3590	0.0026	0.72
100	1.7596	1.7692	1.7736	1.7697	1.7808	1.7705	0.0077	0.43
180	3.2048	3.1931	3.2181	3.2203	3.2338	3.2140	0.0156	0.48

Table 35 Data of between run precision of asiaticoside and madecassoside in 50% ethanol

Concentration (µg/ml)	Peak area ratio					Mean	SD	%CV
	Set1	Set2	Set3	Set4	Set5			
asiaticoside								
15	0.2593	0.2620	0.2628	0.2622	0.2614	0.2606	0.0019	0.73
50	0.8809	0.8893	0.8889	0.8833	0.8948	0.8874	0.0054	0.61
90	1.6028	1.5858	1.5908	1.5844	1.5883	1.5904	0.0073	0.46
madecassoside								
20	0.3917	0.3961	0.3974	0.3977	0.3988	0.3939	0.0031	0.79
100	1.8862	1.8972	1.8963	1.9059	1.9155	1.9002	0.0111	0.58
180	3.4064	3.4150	3.4235	3.4240	3.4271	3.4192	0.0084	0.25

APPENDIX B

Experimental data

Table 36 Fractional factorial design matrix of five parameters and the viscosity and outlet temperature

Rx	Inlet temp (°C)	Feed rate (ml/min)	%solid content	Aerosil (%w/v)	Polymer /extract ratio	viscosity (m Pas)	outlet temp (° C)
F1	(-) 140	(-) 5	(-) 2%	(-) 0%	(+)1.5/1	80.3	88
F2	(+) 160	(-) 5	(-) 2%	(-) 0%	(-)1/1	46.2	97
F3	(-) 140	(+) 7	(-) 2%	(-) 0%	(-)1/1	59.1	76
F4	(+) 160	(+) 7	(-) 2%	(-) 0%	(+)1.5/1	81.2	84
F5	(-) 140	(-) 5	(+) 4%	(-) 0%	(-)1/1	119.1	91
F6	(+) 160	(-) 5	(+) 4%	(-) 0%	(+)1.5/1	199.8	94
F7	(-) 140	(+) 7	(+) 4%	(-) 0%	(+)1.5/1	201.9	76
F8	(+) 160	(+) 7	(+) 4%	(-) 0%	(-)1/1	118.5	98
F9	(-) 140	(-) 5	(-) 2%	(+) 0.5%	(-)1/1	95.3	83
F10	(+) 160	(-) 5	(-) 2%	(+) 0.5%	(+)1.5/1	156.8	88
F11	(-) 140	(+) 7	(-) 2%	(+) 0.5%	(+)1.5/1	153.2	76
F12	(+) 160	(+) 7	(-) 2%	(+) 0.5%	(-)1/1	94.5	89
F13	(-) 140	(-) 5	(+) 4%	(+) 0.5%	(+)1.5/1	284.6	79
F14	(+) 160	(-) 5	(+) 4%	(+) 0.5%	(-)1/1	139.2	96
F15	(-) 140	(+) 7	(+) 4%	(+) 0.5%	(-)1/1	146.7	78
F16	(+) 160	(+) 7	(+) 4%	(+) 0.5%	(+)1.5/1	285.2	92
F17	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	182.6	84
F18	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	185.1	84
F19	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	180.9	84

Table 37 Fractional factorial design matrix of five parameters and the moisture content (n=3)

Rx	Parameters					Responses				
	Inlet temp	Feed rate	Solid content	Aerosil	Polymer	%Moisture content				
	(°C)	(ml/min)	(%)	(%w/v)	/extract ratio	1	2	3	mean	SD
F1	(-) 140	(-) 5	(-) 2%	(-) 0%	(+)1.5/1	6.91	6.26	6.56	6.58	0.33
F2	(+) 160	(-) 5	(-) 2%	(-) 0%	(-)1/1	4.14	4.11	4.29	4.18	0.10
F3	(-) 140	(+) 7	(-) 2%	(-) 0%	(-)1/1	10.51	11.54	10.15	10.73	0.72
F4	(+) 160	(+) 7	(-) 2%	(-) 0%	(+)1.5/1	6.16	6.12	6.88	6.39	0.43
F5	(-) 140	(-) 5	(+) 4%	(-) 0%	(-)1/1	5.78	5.86	5.94	5.86	0.08
F6	(+) 160	(-) 5	(+) 4%	(-) 0%	(+)1.5/1	6.93	6.84	6.93	6.90	0.05
F7	(-) 140	(+) 7	(+) 4%	(-) 0%	(+)1.5/1	13.67	13.99	14.10	13.92	0.22
F8	(+) 160	(+) 7	(+) 4%	(-) 0%	(-)1/1	6.44	6.47	6.45	6.45	0.02
F9	(-) 140	(-) 5	(-) 2%	(+) 0.5%	(-)1/1	8.87	9.39	9.46	9.24	0.32
F10	(+) 160	(-) 5	(-) 2%	(+) 0.5%	(+)1.5/1	11.32	11.17	10.94	11.14	0.19
F11	(-) 140	(+) 7	(-) 2%	(+) 0.5%	(+)1.5/1	11.67	12.94	11.38	12.00	0.83
F12	(+) 160	(+) 7	(-) 2%	(+) 0.5%	(-)1/1	9.81	10.33	9.93	10.02	0.27
F13	(-) 140	(-) 5	(+) 4%	(+) 0.5%	(+)1.5/1	10.38	10.24	10.62	10.41	0.19
F14	(+) 160	(-) 5	(+) 4%	(+) 0.5%	(-)1/1	6.39	6.11	6.27	6.26	0.14
F15	(-) 140	(+) 7	(+) 4%	(+) 0.5%	(-)1/1	10.92	11.97	11.94	11.61	0.60
F16	(+) 160	(+) 7	(+) 4%	(+) 0.5%	(+)1.5/1	8.51	8.30	8.16	8.32	0.18
F17	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	12.92	12.89	12.82	12.88	0.05
F18	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	13.72	13.90	13.98	13.87	0.13
F19	(0) 150	(0) 6	(0) 3%	(0) 0.25%	(0)1.25/1	13.67	13.44	13.52	13.54	0.12

Table 38 Fractional factorial design matrix of five parameters and the size of microspheres (n=3)

Rx	Parameters					Responses				
	Inlet	Feed rate	Solid content	Aerosil	Polymer	Size (μm)				
	(°C)	(ml/min)	(%)	(%w/v)	/extract ratio	1	2	3	mean	SD
F1	(-) 140	(-) 5	(-) 2%	(-) 0%	(+)1.5/1	10.71	10.68	10.20	10.53	0.29
F2	(+) 160	(-) 5	(-) 2%	(-) 0%	(-)1/1	11.99	11.21	11.27	11.22	0.04
F3	(-) 140	(+) 7	(-) 2%	(-) 0%	(-)1/1	41.81	42.09	41.75	41.88	0.18
F4	(+) 160	(+) 7	(-) 2%	(-) 0%	(+)1.5/1	14.02	14.14	13.96	14.04	0.09
F5	(-) 140	(-) 5	(+) 4%	(-) 0%	(-)1/1	15.42	15.56	15.70	15.56	0.14
F6	(+) 160	(-) 5	(+) 4%	(-) 0%	(+)1.5/1	16.17	16.48	16.22	16.29	0.17
F7	(-) 140	(+) 7	(+) 4%	(-) 0%	(+)1.5/1	125.16	126.90	127.67	126.58	1.29
F8	(+) 160	(+) 7	(+) 4%	(-) 0%	(-)1/1	22.91	23.05	22.67	22.88	0.19
F9	(-) 140	(-) 5	(-) 2%	(+) 0.5%	(-)1/1	16.49	16.39	16.46	16.45	0.05
F10	(+) 160	(-) 5	(-) 2%	(+) 0.5%	(+)1.5/1	63.34	63.67	68.28	65.10	2.76
F11	(-) 140	(+) 7	(-) 2%	(+) 0.5%	(+)1.5/1	75.15	77.16	76.92	76.41	1.10
F12	(+) 160	(+) 7	(-) 2%	(+) 0.5%	(-)1/1	39.89	39.54	39.66	39.70	0.18
F13	(-) 140	(-) 5	(+) 4%	(+) 0.5%	(+)1.5/1	166.52	163.84	167.93	166.10	2.08
F14	(+) 160	(-) 5	(+) 4%	(+) 0.5%	(-)1/1	9.43	9.49	9.50	9.47	0.04
F15	(-) 140	(+) 7	(+) 4%	(+) 0.5%	(-)1/1	49.43	49.34	49.35	49.37	0.05
F16	(+) 160	(+) 7	(+) 4%	(+) 0.5%	(+)1.5/1	20.74	21.52	20.76	21.01	0.44
Optimum	160	5	3.4%	0.5%	1/1	5.18	5.19	5.21	5.19	0.02

Table 39 Central composite design matrix of two parameters and the viscosity and outlet temperature

Rx	Parameters		Responses	
	Inlet tem (°C)	Solid (%)	Viscosity (m Pas)	Outlet temp (° C)
C1	(-) 140	(-) 2	94.9	71
C2	(+) 160	(-) 2	95.4	82
C3	(-) 140	(+) 4	275.6	79
C4	(+) 160	(+) 4	278.2	89
C5	(-α) 136	(0) 3	160.8	78
C6	(α) 164	(0) 3	161.2	96
C7	(0) 150	(-α) 1.6	70.8	79
C8	(0) 150	(α) 4.4	262.7	80
C9	(0) 150	(0) 3	130.3	86
C10	(0) 150	(0) 3	131.1	85
C11	(0) 150	(0) 3	133.6	85
C12	(0) 150	(0) 3	132.2	86
C13	(0) 150	(0) 3	131.9	85

Table 40 Central composite design matrix of two parameters and the moisture content (n=3)

Rx	Parameters		%Moisture content				
	Inlet temp (°C)	Solid (%)	1	2	3	mean	SD
C1	(-) 140	(-) 2	10.87	11.39	10.71	10.99	0.36
C2	(+) 160	(-) 2	8.91	8.82	8.93	8.89	0.06
C3	(-) 140	(+) 4	9.92	9.67	10.09	9.89	0.21
C4	(+) 160	(+) 4	7.88	7.73	7.89	7.83	0.09
C5	(-α) 136	(0) 3	11.42	11.57	11.61	11.31	0.10
C6	(α) 164	(0) 3	7.69	7.41	7.75	7.62	0.18
C7	(0) 150	(-α) 1.6	7.75	7.56	8.47	7.93	0.48
C8	(0) 150	(α) 4.4	8.37	7.90	8.25	8.17	0.24
C9	(0) 150	(0) 3	8.51	8.13	8.31	8.32	0.19
C10	(0) 150	(0) 3	8.47	8.65	8.72	8.61	0.13
C11	(0) 150	(0) 3	8.75	9.36	9.15	9.09	0.31
C12	(0) 150	(0) 3	7.78	7.92	8.01	7.90	0.12
C13	(0) 150	(0) 3	8.21	8.98	9.24	8.81	0.54

Table 41 The optimum region by overlay plot of two parameters and the viscosity and outlet temperature

Rx	Parameters		Responses	
	Inlet tem (°C)	Solid (%)	Viscosity (m Pas)	Outlet temp (° C)
O1	160	3.4	120.7	89
O2	160	3.4	121.3	89
O3	160	3.4	123.8	89

Table 42 Zeta potential of spray-dried microspheres (n=3)

Formulation code	Zeta potential (mV)				
	1	2	3	mean	SD
F1	30.38	29.57	30.98	30.31	0.71
F2	33.65	33.54	33.33	33.51	0.16
F3	30.23	31.85	28.90	30.33	1.48
F4	28.28	28.70	29.20	28.73	0.46
F5	30.39	29.77	30.64	30.27	0.45
F6	29.18	29.39	31.56	30.04	1.32
F7	32.14	31.07	30.32	31.18	0.91
F8	30.95	32.18	33.84	32.32	1.45
F9	29.68	31.62	28.36	29.89	1.64
F10	21.53	20.38	20.91	20.94	0.58
F11	26.86	26.00	26.40	26.42	0.43
F12	31.40	33.05	33.13	32.53	0.98
F13	25.69	29.56	25.76	27.00	2.21
F14	34.69	36.24	35.59	35.51	0.78
F15	26.82	25.25	24.48	25.52	1.19
F16	32.38	32.39	33.87	32.88	0.86
Optimal microspheres	31.90	32.24	34.46	32.87	1.39
Chitosan microspheres	43.30	41.34	42.37	42.34	0.98
Ethylcellulose microspheres	-72.80	-73.67	-71.62	-72.68	1.03
Aerosil®	-31.90	-32.02	-31.86	-31.94	0.08

Table 43 Gelation temperatures of poloxamer solutions (n=5)

Rx	Concentration (%w/w)	Gelation temperature (° C)					Mean ± SD
		1	2	3	4	5	
	P407						
1	10%			>50			
2	15%			>50			
3	17%	26.7	26.4	26.2	26.5	26.3	26.4 ± 0.19
4	20%	22.5	22.2	22.3	22.5	22.2	22.3 ± 0.15
5	23%	19.8	19.5	19.6	19.8	19.6	19.7 ± 0.13
6	25%	17.9	17.9	18.1	18.3	18.3	18.1 ± 0.20
7	27%	16.5	16.7	16.5	16.8	16.8	16.7 ± 0.15
8	30%	14.4	14.4	14.6	14.5	14.5	14.5 ± 0.08
	P188						
9	20%			>50			
10	25%			>50			
11	30%			>50			
		52.9	52.7	52.7	52.5	53.1	52.8 ± 0.23
	P407/188						
12	15/10	44.5	44	44.4	44.1	44.2	44.2 ± 0.21
13	15/15	40.7	40.7	40.2	40.2	40.5	40.5 ± 0.25
14	17/5	39.5	39.9	39.8	39.7	39.3	39.6 ± 0.24
15	17/10	41.9	42.0	41.7	41.7	41.5	41.8 ± 0.19
16	16/4	39.5	39.4	40.8	40.0	39.9	39.9 ± 0.55
17	16/8	40.7	41.1	40.8	40.3	40.2	40.6 ± 0.33
18	18/4	33.5	33.6	33.8	33.5	33.4	33.6 ± 0.15
19	20/5	32.1	31.8	32.3	32.1	32.3	32.1 ± 0.20
20	20/10	33.7	33.4	33.7	33.8	33.6	33.6 ± 0.15
21	25/5	21.3	21.4	21.3	21.2	21.1	21.3 ± 0.11
22	25/10	27.8	27.4	27.5	27.1	27.6	27.5 ± 0.26

Table 44 Gel strengths of poloxamer solutions (n=5)

P407/P188 (% w/w)	Gel strength (s)					Mean ± SD
	1	2	3	4	5	
20/5			> 50			
20/10			> 50			
18/4	48	45	48	47	46	46.8 ±1.30

Table 45 Effect of centella microspheres on the physical properties of poloxamer base (n=3)

Physical properties of P407/P188 (18/4% w/w) + microspheres	**set**			
	1	**2**	**3**	**Mean ± SD**
Gelation temperature (° C)	32.5	32.6	32.3	32.5 ±0.15
Gel strength (s)	50	51	48	49.7 ±1.53
Setting time (s)	30	30	30	30 ±0.00

Figure 60 Zeta potential of chitosan

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	43.3	**Peak 1:**	43.46	99.34	3.815
Zeta Deviation (mV):	4.266	**Peak 2:**	19.47	0.6552	0.005524
Conductivity (mS/cm):	0.4502	**Peak 3:**	0	0	0

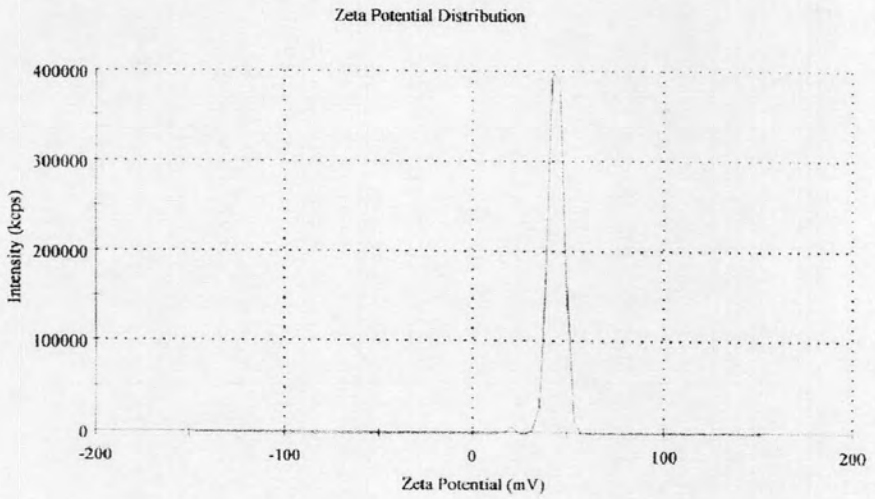


Figure 61 Zeta potential of ethylcellulose

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	-73.67	**Peak 1:**	-74	99.57	10.85
Zeta Deviation (mV):	11.31	**Peak 2:**	-36.77	0.428	2.016
Conductivity (mS/cm):	0.04831	**Peak 3:**	0	0	0

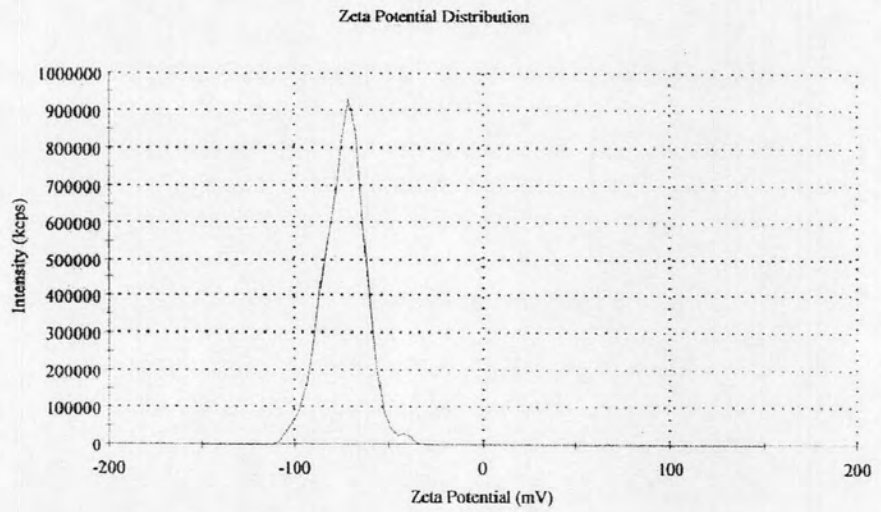


Figure 62 Zeta potential of Aerosil®

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	-32.02	**Peak 1:**	-32.17	99.61	7.188
Zeta Deviation (mV):	7.468	**Peak 2:**	-2.049	0.3897	0
Conductivity (mS/cm):	0.03088	**Peak 3:**	0	0	0

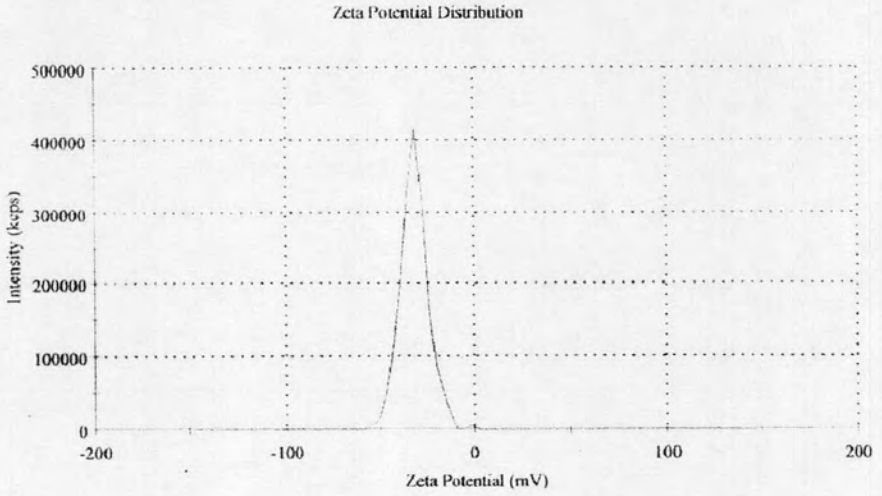


Figure 63 Zeta potential of F1

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	30.98	**Peak 1:**	30.98	100	9.424
Zeta Deviation (mV):	9.424	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.07791	**Peak 3:**	0	0	0

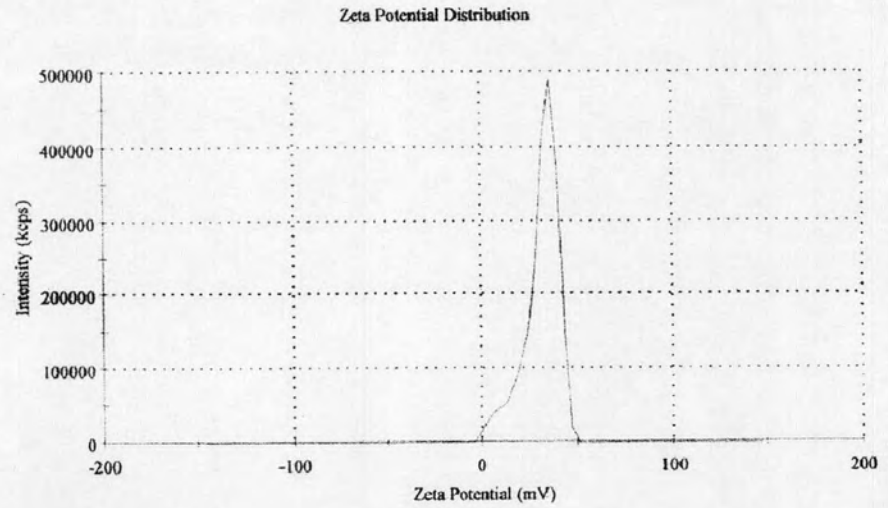


Figure 64 Zeta potential of F2

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	33.33	Peak 1:	33.33	100	8.191
Zeta Deviation (mV):	8.191	Peak 2:	0	0	0
Conductivity (mS/cm):	0.06727	Peak 3:	0	0	0

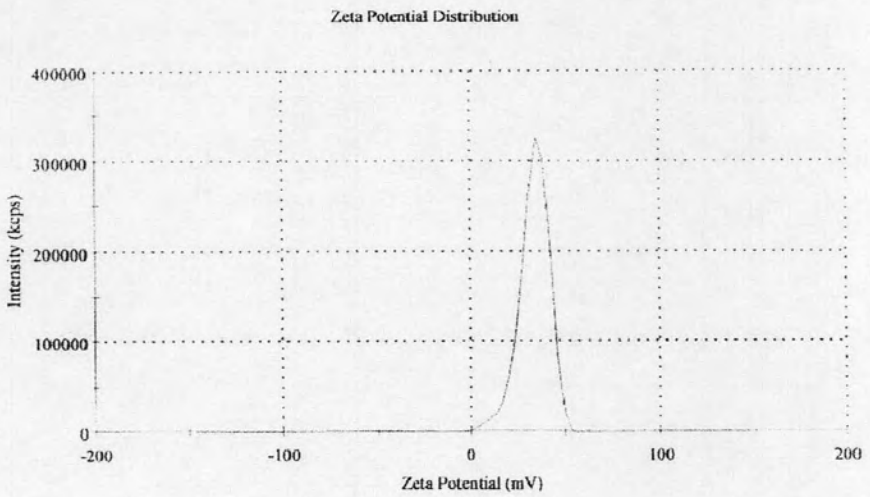


Figure 65 Zeta potential of F3

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	28.9	Peak 1:	28.9	100	6.697
Zeta Deviation (mV):	6.697	Peak 2:	0	0	0
Conductivity (mS/cm):	0.06123	Peak 3:	0	0	0

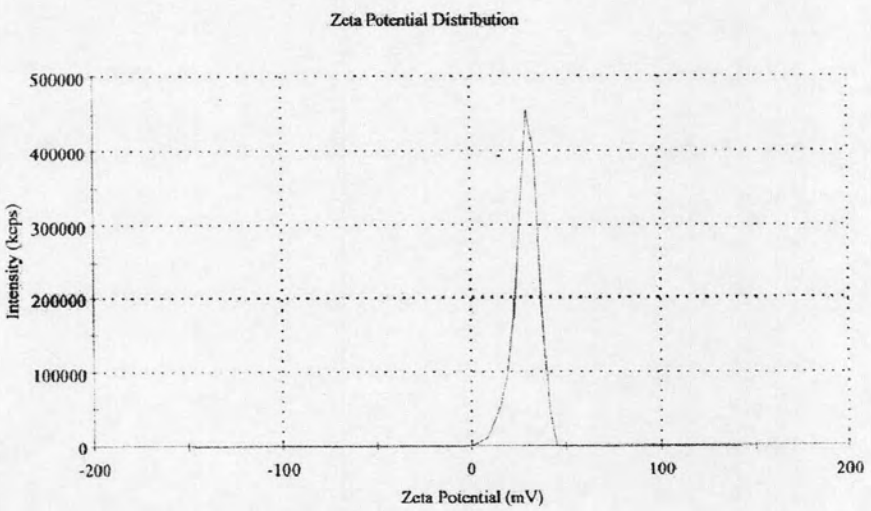


Figure 66 Zeta potential of F4

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	29.2	Peak 1:	29.2	100	7.629
Zeta Deviation (mV):	7.629	Peak 2:	0	0	0
Conductivity (mS/cm):	0.0684	Peak 3:	0	0	0

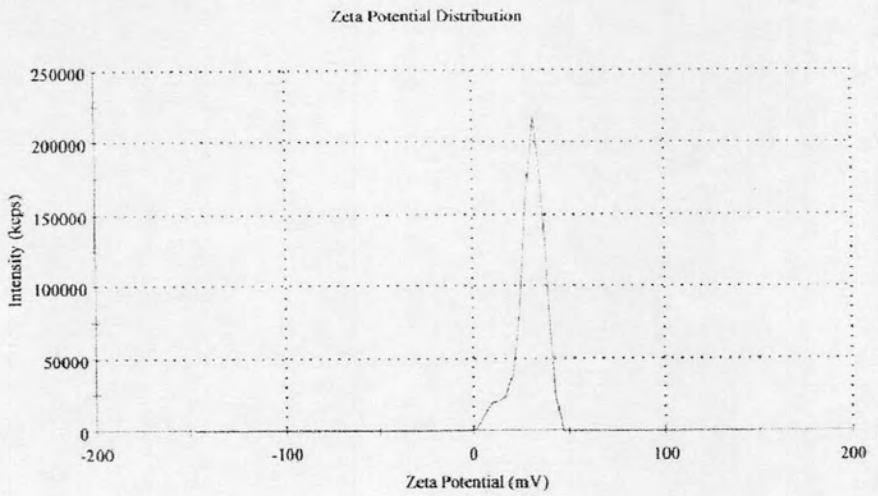


Figure 67 Zeta potential of F5

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	30.64	Peak 1:	30.64	100	5.876
Zeta Deviation (mV):	5.876	Peak 2:	0	0	0
Conductivity (mS/cm):	0.04694	Peak 3:	0	0	0

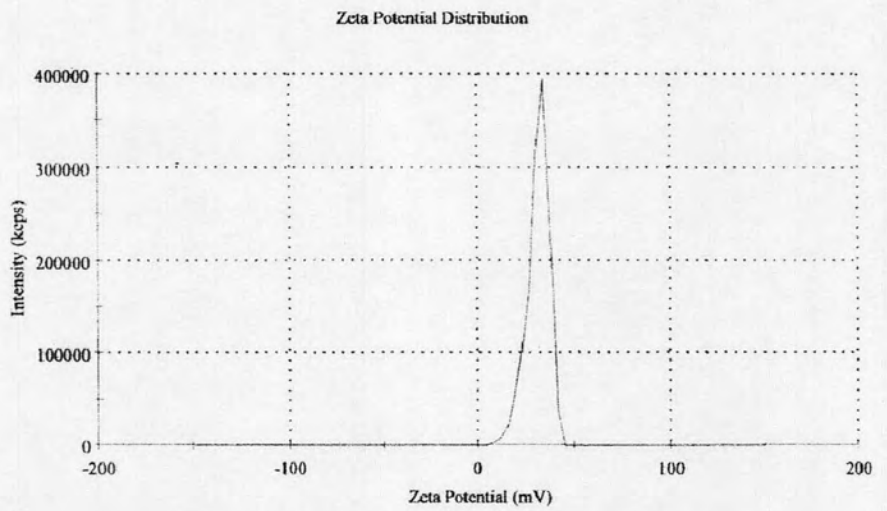


Figure 68 Zeta potential of F6

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	31.56	**Peak 1:**	31.56	100	7.931
Zeta Deviation (mV):	7.931	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.1693	**Peak 3:**	0	0	0

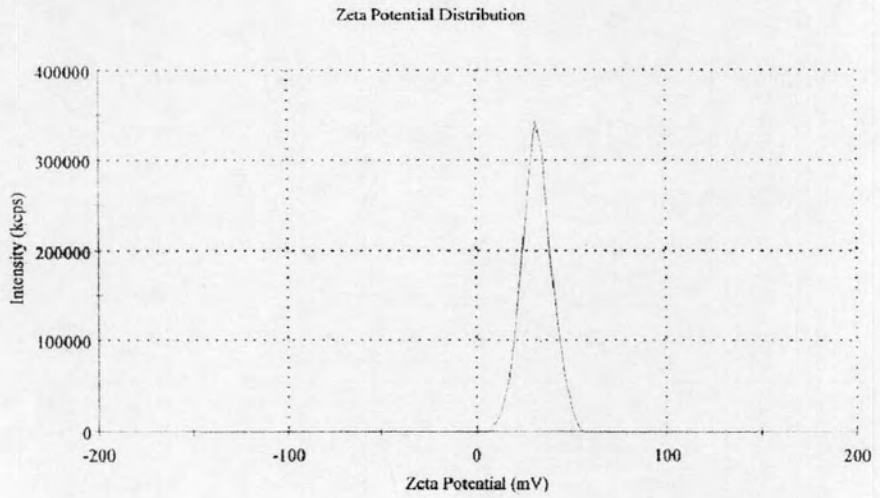


Figure 69 Zeta potential of F7

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	31.07	**Peak 1:**	31.07	100	7.647
Zeta Deviation (mV):	7.647	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.06909	**Peak 3:**	0	0	0

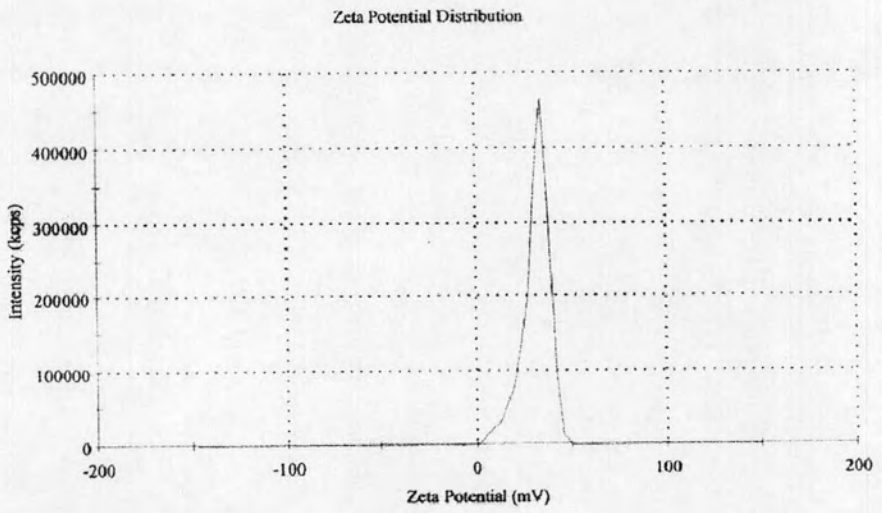


Figure 70 Zeta potential of F8

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	33.84	**Peak 1:**	33.84	100	5.695
Zeta Deviation (mV):	5.695	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.1254	**Peak 3:**	0	0	0

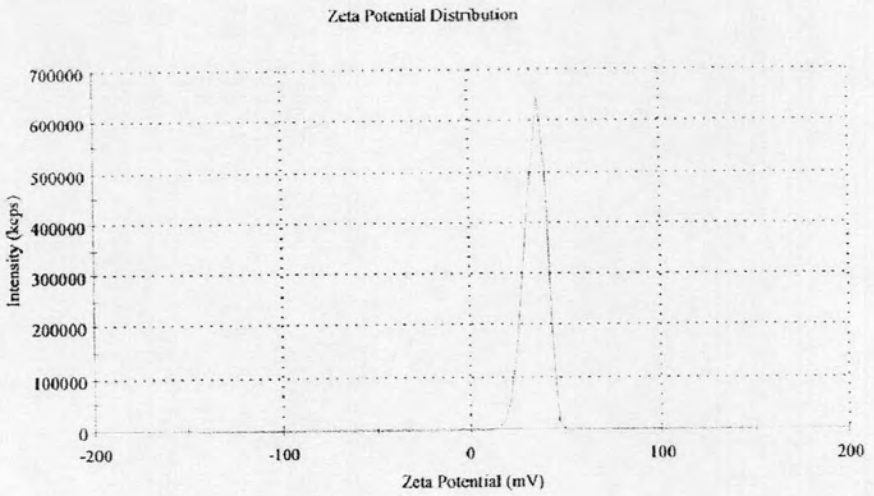


Figure 71 Zeta potential of F9

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	31.62	**Peak 1:**	31.62	100	4.333
Zeta Deviation (mV):	4.333	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.05338	**Peak 3:**	0	0	0

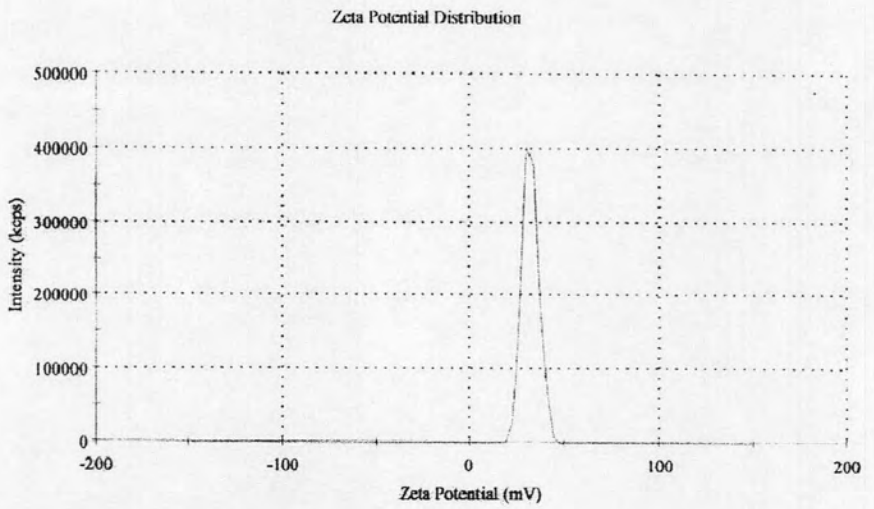


Figure 72 Zeta potential of F10

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	20.91	Peak 1:	20.91	100	7.104
Zeta Deviation (mV):	7.104	Peak 2:	0	0	0
Conductivity (mS/cm):	0.0438	Peak 3:	0	0	0

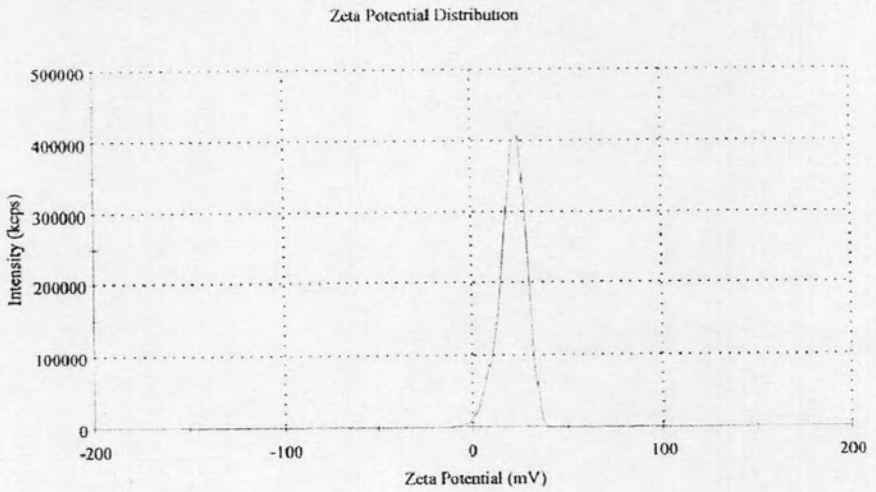


Figure 73 Zeta potential of F11

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	26	Peak 1:	26	100	7.348
Zeta Deviation (mV):	7.348	Peak 2:	0	0	0
Conductivity (mS/cm):	0.04956	Peak 3:	0	0	0

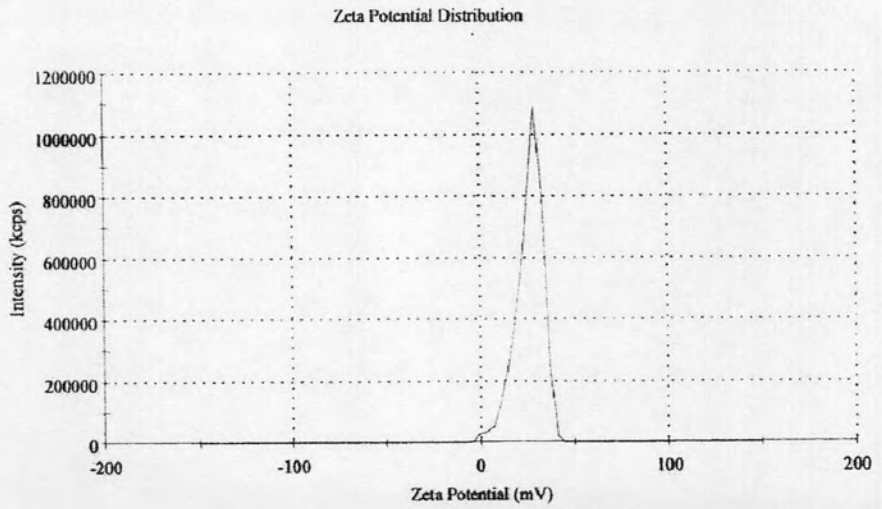


Figure 74 Zeta potential of F12

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	31.4	Peak 1:	31.68	99.6	5.685
Zeta Deviation (mV):	6.215	Peak 2:	2.074	0.3997	2.884
Conductivity (mS/cm):	0.05654	Peak 3:	0	0	0

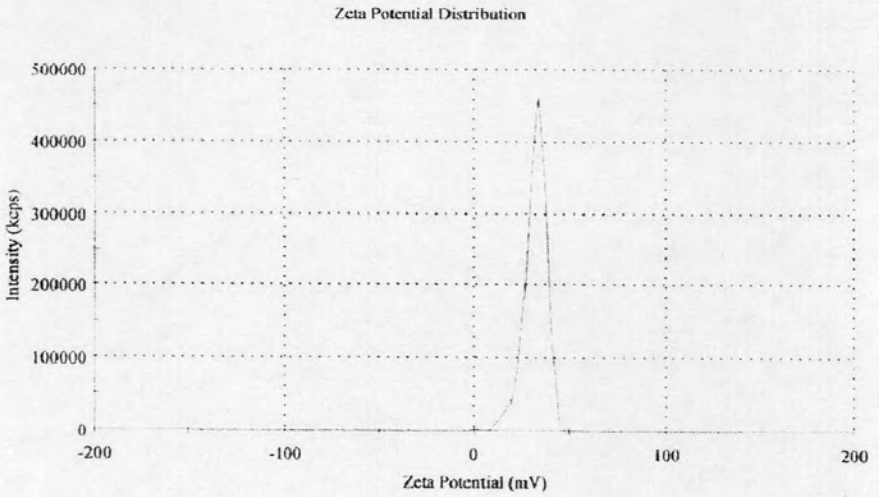


Figure 75 Zeta potential of F13

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	29.56	Peak 1:	29.56	100	4.742
Zeta Deviation (mV):	4.742	Peak 2:	0	0	0
Conductivity (mS/cm):	0.06844	Peak 3:	0	0	0

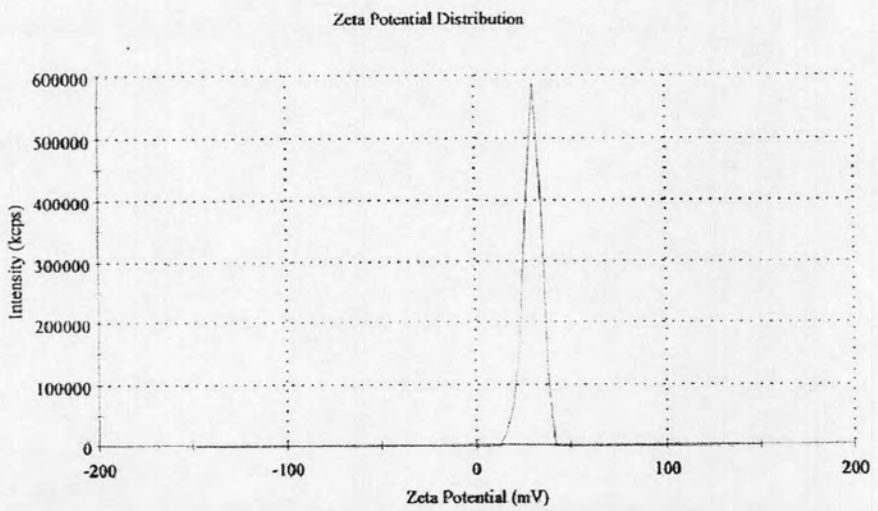


Figure 76 Zeta potential of F14

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	36.24	**Peak 1:**	37.01	97.68	4.669
Zeta Deviation (mV):	5.853	**Peak 2:**	16.21	2.318	3.631
Conductivity (mS/cm):	0.1003	**Peak 3:**	0	0	0

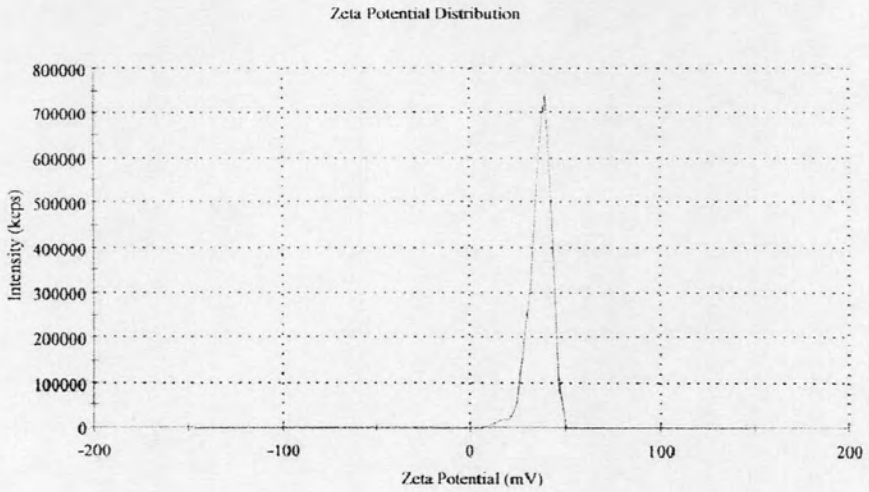


Figure 77 Zeta potential of F15

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	24.48	**Peak 1:**	24.48	100	9.836
Zeta Deviation (mV):	9.836	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.1059	**Peak 3:**	0	0	0

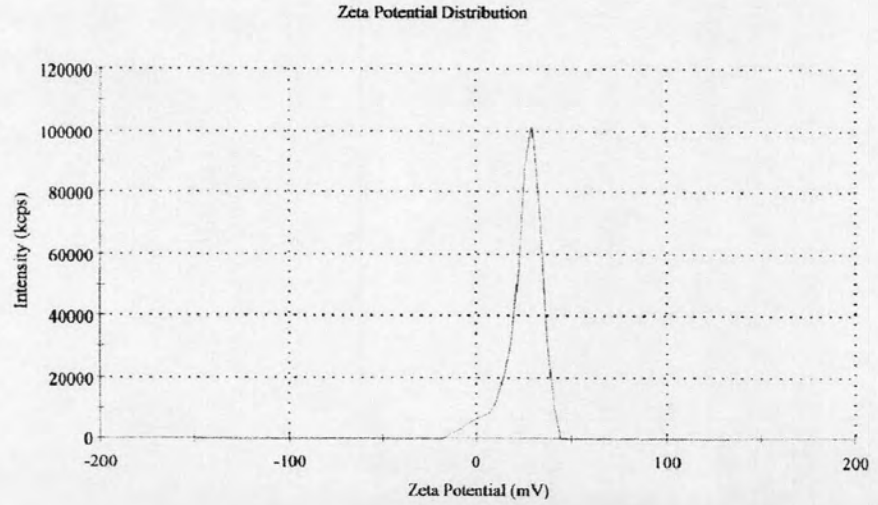


Figure 78 Zeta potential of F16

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	33.87	**Peak 1:**	33.87	100	4.656
Zeta Deviation (mV):	4.656	**Peak 2:**	0	0	0
Conductivity (mS/cm):	0.09143	**Peak 3:**	0	0	0

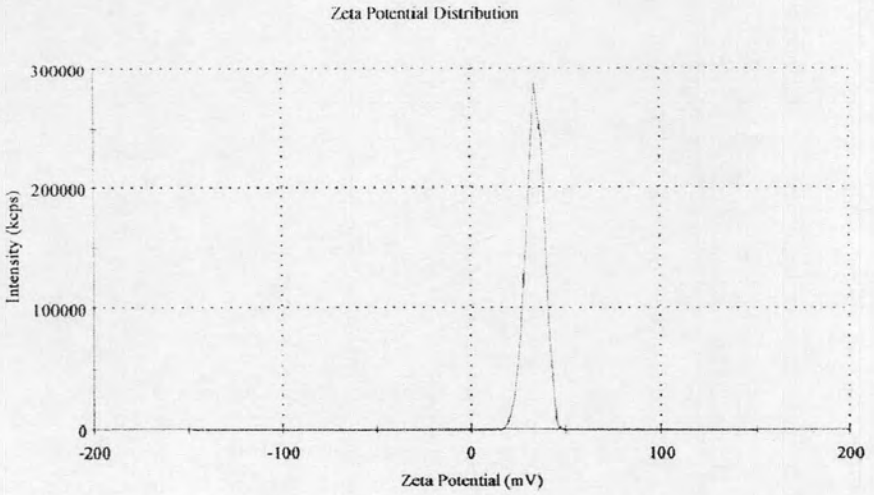


Figure 79 Zeta potential of optimal formulation

			Mean (mV)	Area (%)	Width (mV)
Zeta Potential (mV):	31.9	**Peak 1:**	34.1	91.49	4.424
Zeta Deviation (mV):	7.903	**Peak 2:**	10.79	8.511	4.24
Conductivity (mS/cm):	0.05151	**Peak 3:**	0	0	0

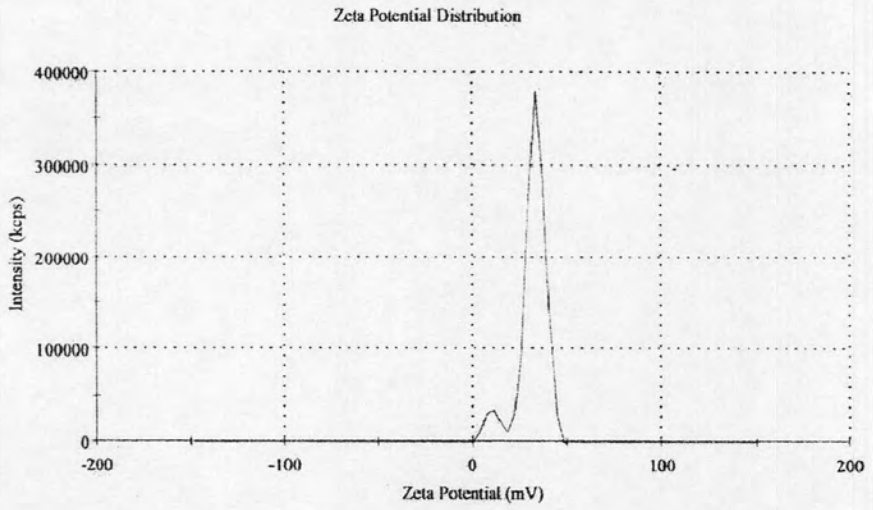


Figure 80 Size and size distribution of F1

Result Statistics

Distribution Type: Volume
Mean Diameters:
D [4, 3] = 10.68 um

Concentration = 0.0059 %Vol
D (v, 0.1) = 0.07 um
D [3, 2] = 0.19 um

Density = 1.000 g / cub. cm
D (v, 0.5) = 0.24 um
Span = 1.502E+02

Specific S.A. = 32.2120 sq. m / g
D (v, 0.9) = 35.72 um
Uniformity = 4.452E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	2.50	0.06	2.50
0.06	4.64	0.07	7.14
0.07	6.23	0.08	13.38
0.08	7.10	0.09	20.48
0.09	7.18	0.11	27.66
0.11	6.56	0.13	34.22
0.13	5.50	0.15	39.71
0.15	4.31	0.17	44.02
0.17	3.23	0.20	47.26
0.20	2.36	0.23	49.62
0.23	1.71	0.27	51.33
0.27	1.24	0.31	52.58
0.31	0.91	0.36	53.49
0.36	0.67	0.42	54.16
0.42	0.49	0.49	54.66
0.49	0.35	0.58	55.00
0.58	0.23	0.67	55.23
0.67	0.14	0.78	55.37
0.78	0.14	0.91	55.51
0.91	0.15	1.06	55.66
1.06	0.19	1.24	55.85
1.24	0.26	1.44	56.11
1.44	0.34	1.68	56.46
1.68	0.44	1.95	56.90
1.95	0.54	2.28	57.44
2.28	0.64	2.65	58.08
2.65	0.74	3.09	58.82
3.09	0.84	3.60	59.66
3.60	0.93	4.19	60.59
4.19	1.01	4.88	61.60
4.88	1.05	5.69	62.65
5.69	1.07	6.63	63.72

Size Low (um)	In %	Size High (um)	Under%
6.63	1.07	7.72	64.79
7.72	1.11	9.00	65.90
9.00	1.21	10.48	67.12
10.48	1.41	12.21	68.53
12.21	1.73	14.22	70.26
14.22	2.15	16.57	72.40
16.57	2.64	19.31	75.05
19.31	3.16	22.49	78.21
22.49	3.65	26.20	81.85
26.20	4.08	30.53	85.93
30.53	3.97	35.56	89.89
35.56	3.50	41.43	93.40
41.43	2.79	48.27	96.18
48.27	1.96	56.23	98.15
56.23	1.18	65.51	99.33
65.51	0.54	76.32	99.87
76.32	0.13	88.91	100.00
88.91	0.00	103.58	100.00
103.58	0.00	120.67	100.00
120.67	0.00	140.58	100.00
140.58	0.00	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.28	100.00
222.28	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

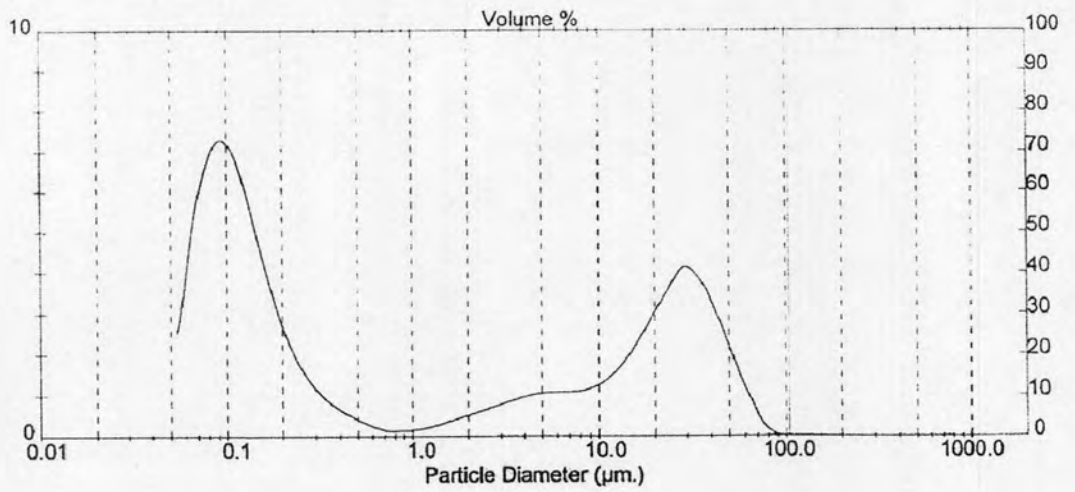


Figure 81 Size and size distribution of F2

Result Statistics

Distribution Type: Volume	Concentration = 0.0056 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 33.0752 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.07 um	D (v, 0.5) = 0.23 um	D (v, 0.9) = 37.54 um
D [4, 3] = 11.21 um	D [3, 2] = 0.18 um	Span = 1.614E+02	Uniformity = 4.782E+01

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	2.80	0.06	2.80	6.63	1.02	7.72	64.87
0.06	5.12	0.07	7.92	7.72	1.10	9.00	65.97
0.07	6.71	0.08	14.62	9.00	1.25	10.48	67.22
0.08	7.40	0.09	22.03	10.48	1.48	12.21	68.70
0.09	7.21	0.11	29.24	12.21	1.79	14.22	70.49
0.11	6.33	0.13	35.56	14.22	2.16	16.57	72.65
0.13	5.13	0.15	40.69	16.57	2.57	19.31	75.23
0.15	3.96	0.17	44.65	19.31	2.98	22.49	78.20
0.17	2.99	0.20	47.65	22.49	3.34	26.20	81.54
0.20	2.25	0.23	49.90	26.20	3.66	30.53	85.20
0.23	1.67	0.27	51.57	30.53	3.59	35.56	88.79
0.27	1.22	0.31	52.79	35.56	3.26	41.43	92.06
0.31	0.89	0.36	53.68	41.43	2.74	48.27	94.80
0.36	0.65	0.42	54.33	48.27	2.11	56.23	96.92
0.42	0.48	0.49	54.81	56.23	1.48	65.51	98.39
0.49	0.35	0.58	55.16	65.51	0.91	76.32	99.31
0.58	0.24	0.67	55.39	76.32	0.48	88.91	99.79
0.67	0.16	0.78	55.55	88.91	0.21	103.58	100.00
0.78	0.16	0.91	55.72	103.58	0.00	120.67	100.00
0.91	0.19	1.06	55.90	120.67	0.00	140.58	100.00
1.06	0.24	1.24	56.14	140.58	0.00	163.77	100.00
1.24	0.32	1.44	56.46	163.77	0.00	190.80	100.00
1.44	0.41	1.68	56.87	190.80	0.00	222.28	100.00
1.68	0.50	1.95	57.37	222.28	0.00	258.95	100.00
1.95	0.60	2.28	57.97	258.95	0.00	301.68	100.00
2.28	0.67	2.65	58.64	301.68	0.00	351.46	100.00
2.65	0.74	3.09	59.39	351.46	0.00	409.45	100.00
3.09	0.81	3.60	60.19	409.45	0.00	477.01	100.00
3.60	0.86	4.19	61.05	477.01	0.00	555.71	100.00
4.19	0.90	4.88	61.95	555.71	0.00	647.41	100.00
4.88	0.93	5.69	62.88	647.41	0.00	754.23	100.00
5.69	0.97	6.63	63.85	754.23	0.00	878.67	100.00

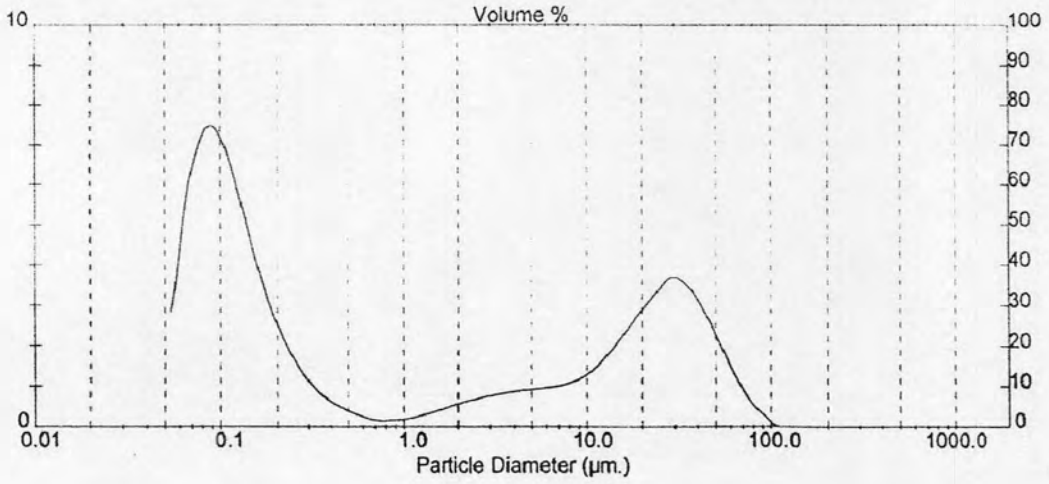


Figure 82 Size and size distribution of F3

Result Statistics

Distribution Type: Volume	Concentration = 0.0092 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 18.5816 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.09 um	D (v, 0.5) = 33.71 um	D (v, 0.9) = 95.25 um
D [4, 3] = 41.81 um	D [3, 2] = 0.32 um	Span = 2.823E+00	Uniformity = 1.063E+00

Size Low (um)	In %	Size High (um)	Under%
0.05	1.23	0.06	1.23
0.06	2.34	0.07	3.57
0.07	3.24	0.08	6.81
0.08	3.85	0.09	10.66
0.09	4.11	0.11	14.77
0.11	4.01	0.13	18.78
0.13	3.59	0.15	22.37
0.15	3.00	0.17	25.37
0.17	2.35	0.20	27.72
0.20	1.78	0.23	29.50
0.23	1.32	0.27	30.82
0.27	1.00	0.31	31.82
0.31	0.77	0.36	32.59
0.36	0.58	0.42	33.17
0.42	0.43	0.49	33.60
0.49	0.30	0.58	33.90
0.58	0.20	0.67	34.10
0.67	0.12	0.78	34.22
0.78	0.11	0.91	34.33
0.91	0.11	1.06	34.45
1.06	0.13	1.24	34.58
1.24	0.16	1.44	34.74
1.44	0.20	1.68	34.94
1.68	0.23	1.95	35.18
1.95	0.26	2.28	35.44
2.28	0.29	2.65	35.73
2.65	0.32	3.09	36.05
3.09	0.36	3.60	36.40
3.60	0.40	4.19	36.81
4.19	0.45	4.88	37.26
4.88	0.49	5.69	37.74
5.69	0.50	6.63	38.24

Size Low (um)	In %	Size High (um)	Under%
6.63	0.47	7.72	38.71
7.72	0.43	9.00	39.14
9.00	0.38	10.48	39.52
10.48	0.23	12.21	39.74
12.21	0.27	14.22	40.01
14.22	0.41	16.57	40.42
16.57	0.71	19.31	41.14
19.31	1.23	22.49	42.37
22.49	2.00	26.20	44.37
26.20	3.03	30.53	47.40
30.53	4.21	35.56	51.60
35.56	5.36	41.43	56.97
41.43	6.29	48.27	63.26
48.27	6.88	56.23	70.14
56.23	7.20	65.51	77.34
65.51	6.17	76.32	83.51
76.32	4.79	88.91	88.30
88.91	3.41	103.58	91.72
103.58	2.28	120.67	94.00
120.67	1.53	140.58	95.53
140.58	1.12	163.77	96.64
163.77	0.94	190.80	97.58
190.80	0.86	222.28	98.44
222.28	0.74	258.95	99.18
258.95	0.52	301.68	99.69
301.68	0.31	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

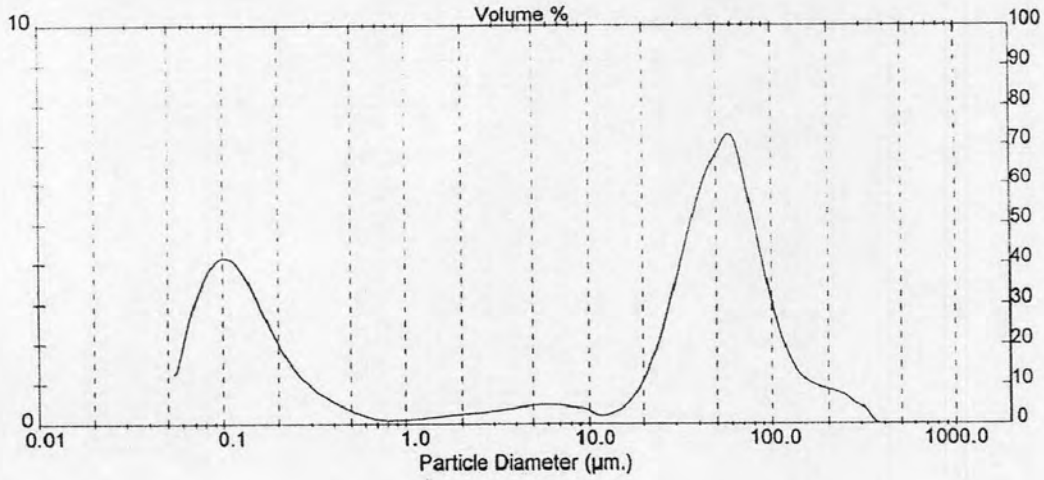


Figure 83 Size and size distribution of F4

Result Statistics

Distribution Type: Volume	Concentration = 0.0067 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 30.6520 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.07 um	D (v, 0.5) = 0.33 um	D (v, 0.9) = 43.96 um
D [4, 3] = 14.14 um	D [3, 2] = 0.20 um	Span = 1.336E+02	Uniformity = 4.267E+01

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	2.47	0.06	2.47	6.63	0.81	7.72	59.58
0.06	4.56	0.07	7.03	7.72	0.84	9.00	60.42
0.07	6.05	0.08	13.08	9.00	0.93	10.48	61.35
0.08	6.79	0.09	19.87	10.48	1.11	12.21	62.46
0.09	6.75	0.11	26.62	12.21	1.42	14.22	63.88
0.11	6.06	0.13	32.68	14.22	1.86	16.57	65.75
0.13	5.02	0.15	37.70	16.57	2.43	19.31	68.17
0.15	3.93	0.17	41.63	19.31	3.06	22.49	71.23
0.17	2.98	0.20	44.61	22.49	3.68	26.20	74.91
0.20	2.23	0.23	46.84	26.20	4.25	30.53	79.16
0.23	1.64	0.27	48.48	30.53	4.72	35.56	83.88
0.27	1.20	0.31	49.68	35.56	4.51	41.43	88.39
0.31	0.88	0.36	50.56	41.43	3.92	48.27	92.31
0.36	0.65	0.42	51.21	48.27	3.08	56.23	95.39
0.42	0.47	0.49	51.68	56.23	2.17	65.51	97.56
0.49	0.33	0.58	52.01	65.51	1.36	76.32	98.92
0.58	0.22	0.67	52.23	76.32	0.74	88.91	99.66
0.67	0.14	0.78	52.37	88.91	0.34	103.58	100.00
0.78	0.13	0.91	52.50	103.58	0.00	120.67	100.00
0.91	0.14	1.06	52.64	120.67	0.00	140.58	100.00
1.06	0.17	1.24	52.81	140.58	0.00	163.77	100.00
1.24	0.23	1.44	53.04	163.77	0.00	190.80	100.00
1.44	0.30	1.68	53.34	190.80	0.00	222.28	100.00
1.68	0.36	1.95	53.70	222.28	0.00	258.95	100.00
1.95	0.43	2.28	54.13	258.95	0.00	301.68	100.00
2.28	0.48	2.65	54.61	301.68	0.00	351.46	100.00
2.65	0.55	3.09	55.16	351.46	0.00	409.45	100.00
3.09	0.62	3.60	55.77	409.45	0.00	477.01	100.00
3.60	0.68	4.19	56.46	477.01	0.00	555.71	100.00
4.19	0.74	4.88	57.20	555.71	0.00	647.41	100.00
4.88	0.78	5.69	57.98	647.41	0.00	754.23	100.00
5.69	0.80	6.63	58.78	754.23	0.00	878.67	100.00

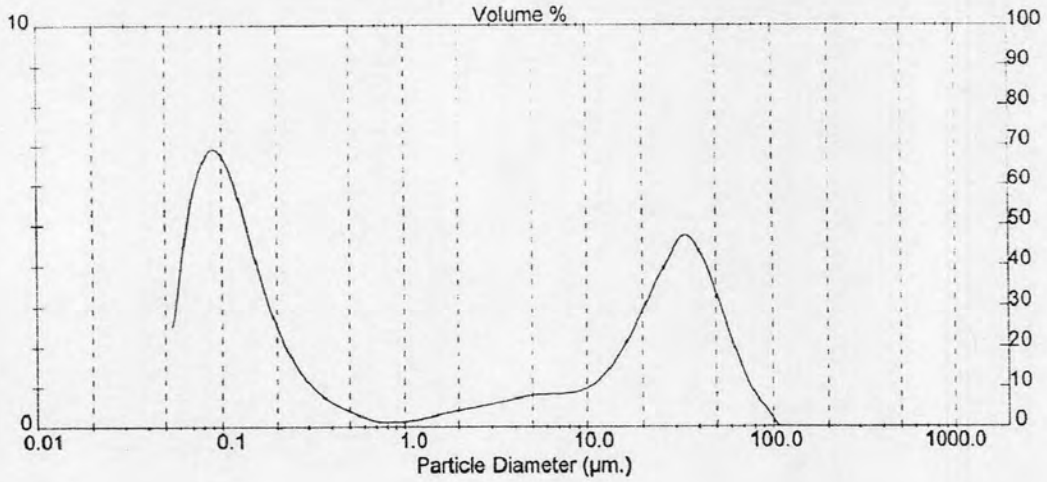


Figure 84 Size and size distribution of F5

Result Statistics

Distribution Type: Volume	Concentration = 0.0066 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 28.9577 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.08 um	D (v, 0.5) = 0.65 um	D (v, 0.9) = 47.00 um
D [4, 3] = 15.42 um	D [3, 2] = 0.21 um	Span = 7.165E+01	Uniformity = 2.334E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	2.18	0.06	2.18
0.06	4.07	0.07	6.25
0.07	5.51	0.08	11.76
0.08	6.35	0.09	18.10
0.09	6.50	0.11	24.61
0.11	6.02	0.13	30.63
0.13	5.11	0.15	35.74
0.15	4.02	0.17	39.76
0.17	3.00	0.20	42.76
0.20	2.17	0.23	44.93
0.23	1.55	0.27	46.48
0.27	1.12	0.31	47.61
0.31	0.83	0.36	48.44
0.36	0.62	0.42	49.05
0.42	0.45	0.49	49.50
0.49	0.32	0.58	49.82
0.58	0.21	0.67	50.03
0.67	0.14	0.78	50.16
0.78	0.14	0.91	50.30
0.91	0.16	1.06	50.46
1.06	0.20	1.24	50.66
1.24	0.27	1.44	50.93
1.44	0.34	1.68	51.27
1.68	0.40	1.95	51.67
1.95	0.46	2.28	52.13
2.28	0.51	2.65	52.64
2.65	0.56	3.09	53.20
3.09	0.61	3.60	53.82
3.60	0.68	4.19	54.49
4.19	0.74	4.88	55.24
4.88	0.80	5.69	56.04
5.69	0.84	6.63	56.87
6.63	0.86	7.72	57.73
7.72	0.89	9.00	58.62
9.00	0.96	10.48	59.58
10.48	1.12	12.21	60.70
12.21	1.38	14.22	62.08
14.22	1.78	16.57	63.86
16.57	2.30	19.31	66.16
19.31	2.92	22.49	69.07
22.49	3.57	26.20	72.64
26.20	4.21	30.53	76.86
30.53	4.80	35.56	81.66
35.56	4.76	41.43	86.41
41.43	4.29	48.27	90.70
48.27	3.51	56.23	94.21
56.23	2.59	65.51	96.80
65.51	1.71	76.32	98.50
76.32	0.99	88.91	99.50
88.91	0.50	103.58	100.00
103.58	0.00	120.67	100.00
120.67	0.00	140.58	100.00
140.58	0.00	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.28	100.00
222.28	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

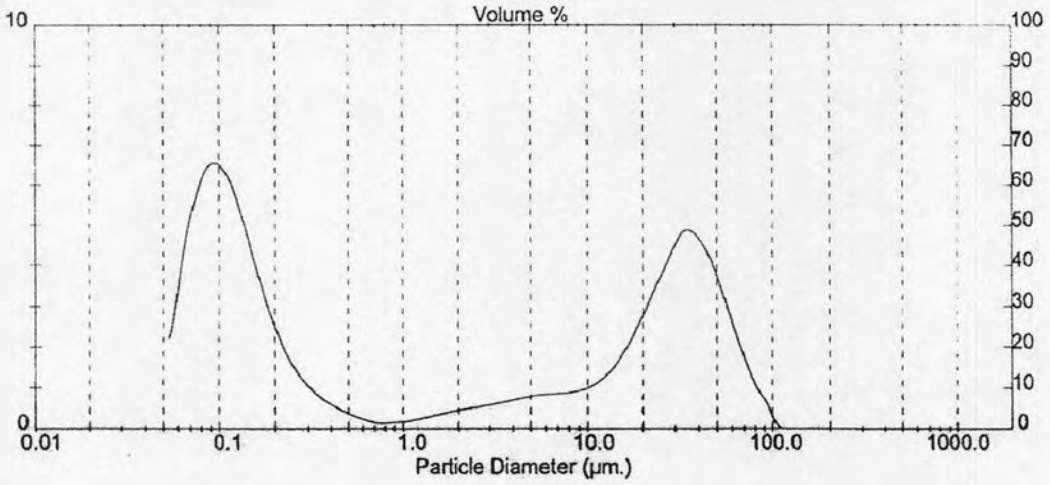


Figure 85 Size and size distribution of F6

Result Statistics

Distribution Type: Volume
Mean Diameters:
D [4, 3] = 16.22 um

Concentration = 0.0066 %Vol
D (v, 0.1) = 0.08 um
D [3, 2] = 0.21 um

Density = 1.000 g / cub. cm
D (v, 0.5) = 0.62 um
Span = 7.958E+01

Specific S.A. = 28.4656 sq. m / g
D (v, 0.9) = 49.33 um
Uniformity = 2.598E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	2.14	0.06	2.14
0.06	3.98	0.07	6.12
0.07	5.36	0.08	11.49
0.08	6.14	0.09	17.63
0.09	6.26	0.11	23.88
0.11	5.79	0.13	29.67
0.13	4.95	0.15	34.62
0.15	3.99	0.17	38.61
0.17	3.10	0.20	41.71
0.20	2.36	0.23	44.07
0.23	1.78	0.27	45.86
0.27	1.33	0.31	47.19
0.31	1.00	0.36	48.19
0.36	0.75	0.42	48.93
0.42	0.55	0.49	49.48
0.49	0.38	0.58	49.87
0.58	0.25	0.67	50.12
0.67	0.15	0.78	50.27
0.78	0.14	0.91	50.41
0.91	0.15	1.06	50.56
1.06	0.18	1.24	50.74
1.24	0.24	1.44	50.98
1.44	0.31	1.68	51.29
1.68	0.37	1.95	51.66
1.95	0.43	2.28	52.09
2.28	0.47	2.65	52.56
2.65	0.52	3.09	53.09
3.09	0.57	3.60	53.66
3.60	0.63	4.19	54.28
4.19	0.68	4.88	54.97
4.88	0.74	5.69	55.71
5.69	0.79	6.63	56.50

Size Low (um)	In %	Size High (um)	Under%
6.63	0.83	7.72	57.33
7.72	0.90	9.00	58.23
9.00	1.00	10.48	59.23
10.48	1.18	12.21	60.41
12.21	1.45	14.22	61.86
14.22	1.82	16.57	63.68
16.57	2.29	19.31	65.97
19.31	2.84	22.49	68.81
22.49	3.41	26.20	72.22
26.20	3.98	30.53	76.19
30.53	4.51	35.56	80.71
35.56	4.54	41.43	85.25
41.43	4.20	48.27	89.45
48.27	3.56	56.23	93.01
56.23	2.74	65.51	95.75
65.51	1.91	76.32	97.66
76.32	1.20	88.91	98.87
88.91	0.69	103.58	99.55
103.58	0.38	120.67	99.93
120.67	0.07	140.58	100.00
140.58	0.00	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.28	100.00
222.28	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

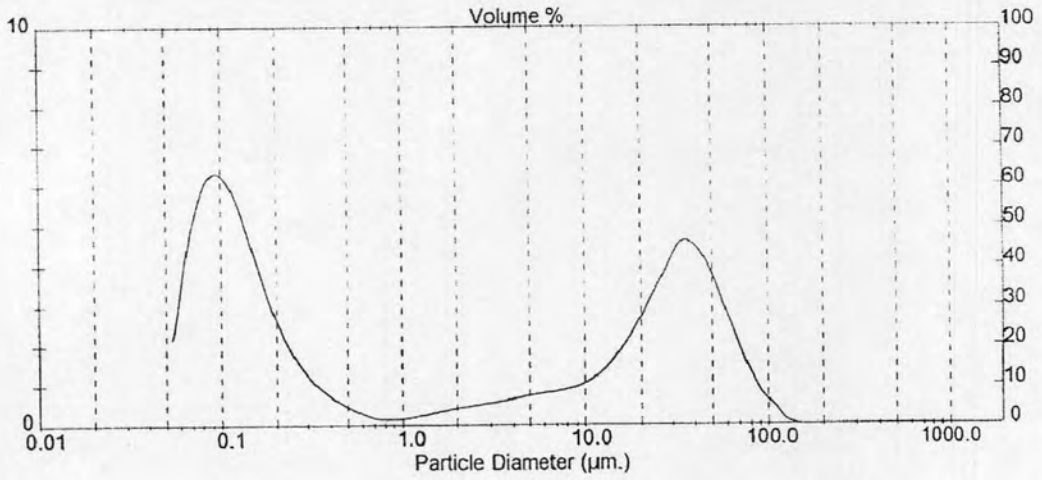


Figure 86 Size and size distribution of F7

Result Statistics

Distribution Type: Volume	Concentration = 0.0185 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 9.1747 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.13 um	D (v, 0.5) = 119.95 um	D (v, 0.9) = 253.88 um
D [4, 3] = 127.67 um	D [3, 2] = 0.65 um	Span = 2.115E+00	Uniformity = 6.169E-01

Size Low (um)	In %	Size High (um)	Under%
0.05	0.55	0.06	0.56
0.06	1.07	0.07	1.63
0.07	1.52	0.08	3.15
0.08	1.86	0.09	5.01
0.09	2.06	0.11	7.06
0.11	2.07	0.13	9.14
0.13	1.91	0.15	11.05
0.15	1.62	0.17	12.67
0.17	1.26	0.20	13.93
0.20	0.93	0.23	14.86
0.23	0.68	0.27	15.54
0.27	0.52	0.31	16.07
0.31	0.41	0.36	16.47
0.36	0.32	0.42	16.79
0.42	0.23	0.49	17.02
0.49	0.16	0.58	17.18
0.58	0.10	0.67	17.28
0.67	0.06	0.78	17.34
0.78	0.05	0.91	17.39
0.91	0.04	1.06	17.43
1.06	0.05	1.24	17.48
1.24	0.06	1.44	17.54
1.44	0.07	1.68	17.61
1.68	0.08	1.95	17.68
1.95	0.07	2.28	17.76
2.28	0.07	2.65	17.82
2.65	0.06	3.09	17.88
3.09	0.05	3.60	17.93
3.60	0.04	4.19	17.98
4.19	0.03	4.88	18.01
4.88	0.02	5.69	18.03
5.69	0.02	6.63	18.05
6.63	0.03	7.72	18.08
7.72	0.04	9.00	18.12
9.00	0.06	10.48	18.18
10.48	0.08	12.21	18.25
12.21	0.09	14.22	18.35
14.22	0.11	16.57	18.45
16.57	0.11	19.31	18.56
19.31	0.11	22.49	18.67
22.49	0.11	26.20	18.78
26.20	0.17	30.53	18.95
30.53	0.30	35.56	19.25
35.56	0.57	41.43	19.82
41.43	1.00	48.27	20.82
48.27	1.67	56.23	22.49
56.23	2.63	65.51	25.12
65.51	3.94	76.32	29.06
76.32	5.54	88.91	34.60
88.91	7.20	103.58	41.80
103.58	8.55	120.67	50.35
120.67	9.39	140.58	59.74
140.58	9.69	163.77	69.43
163.77	8.58	190.80	78.01
190.80	7.09	222.28	85.10
222.28	5.53	258.95	90.63
258.95	4.06	301.68	94.69
301.68	2.79	351.46	97.49
351.46	1.77	409.45	99.26
409.45	0.74	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

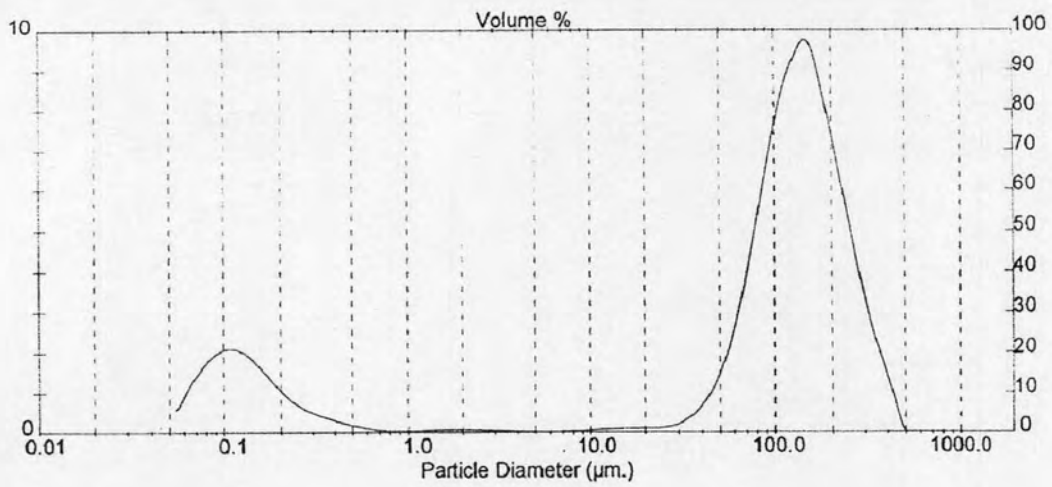


Figure 87 Size and size distribution of F8

Result Statistics

Distribution Type: Volume	Concentration = 0.0070 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 26.0399 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.08 um	D (v, 0.5) = 3.78 um	D (v, 0.9) = 59.04 um
D [4, 3] = 23.05 um	D [3, 2] = 0.23 um	Span = 1.558E+01	Uniformity = 6.020E+00

Size Low (um)	In %	Size High (um)	Under%
0.05	1.83	0.06	1.83
0.06	3.45	0.07	5.29
0.07	4.73	0.08	10.01
0.08	5.53	0.09	15.54
0.09	5.78	0.11	21.32
0.11	5.49	0.13	26.81
0.13	4.81	0.15	31.62
0.15	3.93	0.17	35.55
0.17	3.05	0.20	38.60
0.20	2.29	0.23	40.90
0.23	1.70	0.27	42.60
0.27	1.28	0.31	43.88
0.31	0.97	0.36	44.84
0.36	0.73	0.42	45.57
0.42	0.53	0.49	46.10
0.49	0.37	0.58	46.48
0.58	0.24	0.67	46.72
0.67	0.15	0.78	46.87
0.78	0.14	0.91	47.01
0.91	0.14	1.06	47.15
1.06	0.17	1.24	47.33
1.24	0.23	1.44	47.55
1.44	0.28	1.68	47.83
1.68	0.33	1.95	48.16
1.95	0.37	2.28	48.53
2.28	0.40	2.65	48.94
2.65	0.43	3.09	49.37
3.09	0.47	3.60	49.84
3.60	0.51	4.19	50.34
4.19	0.55	4.88	50.89
4.88	0.58	5.69	51.47
5.69	0.62	6.63	52.09

Size Low (um)	In %	Size High (um)	Under%
6.63	0.65	7.72	52.74
7.72	0.72	9.00	53.46
9.00	0.83	10.48	54.28
10.48	1.01	12.21	55.30
12.21	1.30	14.22	56.60
14.22	1.71	16.57	58.31
16.57	2.22	19.31	60.53
19.31	2.82	22.49	63.35
22.49	3.44	26.20	66.79
26.20	4.01	30.53	70.80
30.53	4.48	35.56	75.28
35.56	4.87	41.43	80.15
41.43	4.63	48.27	84.78
48.27	4.08	56.23	88.85
56.23	3.32	65.51	92.17
65.51	2.48	76.32	94.65
76.32	1.69	88.91	96.34
88.91	1.02	103.58	97.36
103.58	0.54	120.67	97.90
120.67	0.26	140.58	98.16
140.58	0.17	163.77	98.33
163.77	0.22	190.80	98.56
190.80	0.33	222.28	98.89
222.28	0.40	258.95	99.29
258.95	0.37	301.68	99.66
301.68	0.24	351.46	99.90
351.46	0.10	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

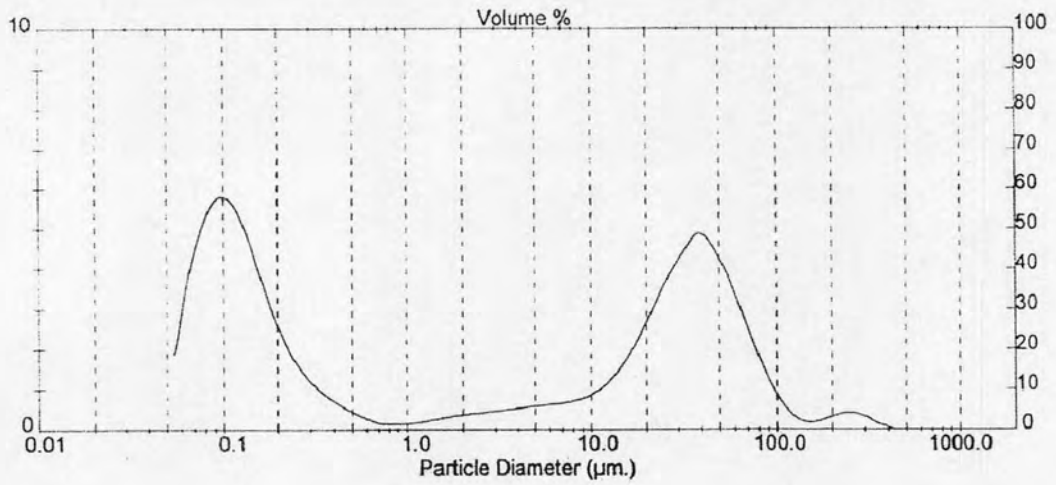


Figure 88 Size and size distribution of F9

Result Statistics

Distribution Type: Volume	Concentration = 0.0067 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 32.5777 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.07 um	D (v, 0.5) = 0.23 um	D (v, 0.9) = 51.10 um
D [4, 3] = 16.46 um	D [3, 2] = 0.18 um	Span = 2.260E+02	Uniformity = 7.242E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	2.59	0.06	2.60
0.06	4.83	0.07	7.43
0.07	6.51	0.08	13.93
0.08	7.43	0.09	21.36
0.09	7.49	0.11	28.86
0.11	6.78	0.13	35.64
0.13	5.55	0.15	41.19
0.15	4.16	0.17	45.35
0.17	2.91	0.20	48.26
0.20	1.95	0.23	50.21
0.23	1.29	0.27	51.50
0.27	0.87	0.31	52.37
0.31	0.61	0.36	52.98
0.36	0.44	0.42	53.42
0.42	0.31	0.49	53.73
0.49	0.21	0.56	53.94
0.58	0.14	0.67	54.08
0.67	0.09	0.78	54.17
0.78	0.08	0.91	54.25
0.91	0.09	1.06	54.34
1.06	0.11	1.24	54.44
1.24	0.14	1.44	54.58
1.44	0.18	1.68	54.76
1.68	0.22	1.95	54.98
1.95	0.26	2.28	55.23
2.28	0.29	2.65	55.52
2.65	0.32	3.09	55.84
3.09	0.36	3.60	56.20
3.60	0.39	4.19	56.60
4.19	0.43	4.88	57.03
4.88	0.48	5.69	57.51
5.69	0.53	6.63	58.04

Size Low (um)	In %	Size High (um)	Under%
6.63	0.60	7.72	58.64
7.72	0.70	9.00	59.34
9.00	0.85	10.48	60.19
10.48	1.09	12.21	61.28
12.21	1.41	14.22	62.68
14.22	1.83	16.57	64.51
16.57	2.32	19.31	66.83
19.31	2.85	22.49	69.69
22.49	3.36	26.20	73.04
26.20	3.75	30.53	76.79
30.53	3.96	35.56	80.76
35.56	4.00	41.43	84.76
41.43	3.91	48.27	88.67
48.27	3.34	56.23	92.01
56.23	2.67	65.51	94.68
65.51	2.01	76.32	96.69
76.32	1.42	88.91	98.11
88.91	0.94	103.58	99.05
103.58	0.57	120.67	99.62
120.67	0.29	140.58	99.91
140.58	0.09	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.28	100.00
222.28	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

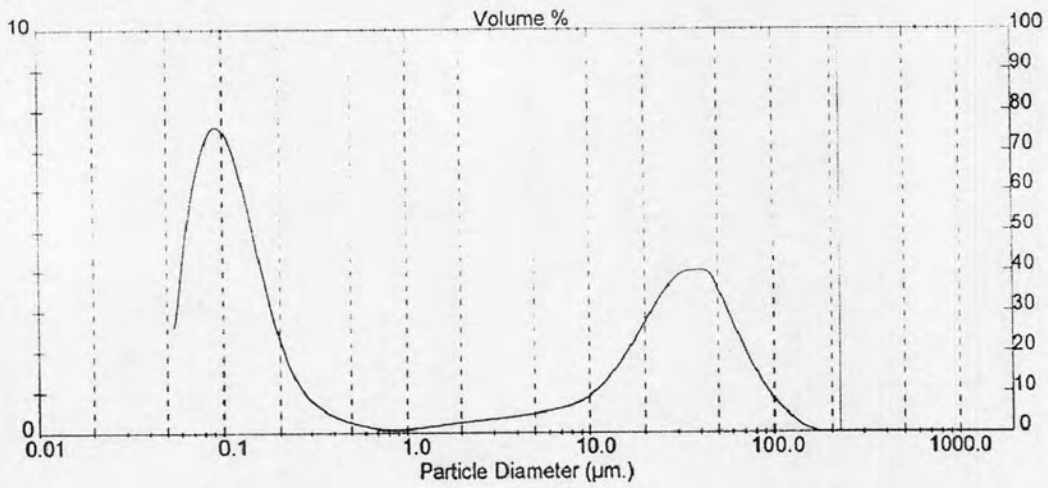


Figure 89 Size and size distribution of F10

Result Statistics

Distribution Type: Volume	Concentration = 0.0122 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 15.5164 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.10 um	D (v, 0.5) = 53.82 um	D (v, 0.9) = 150.36 um
D [4, 3] = 63.34 um	D [3, 2] = 0.39 um	Span = 2.792E+00	Uniformity = 9.234E-01

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	1.04	0.06	1.05	6.63	0.31	7.72	30.58
0.06	1.99	0.07	3.03	7.72	0.37	9.00	30.94
0.07	2.75	0.08	5.78	9.00	0.42	10.48	31.36
0.08	3.27	0.09	9.05	10.48	0.48	12.21	31.84
0.09	3.48	0.11	12.54	12.21	0.54	14.22	32.38
0.11	3.38	0.13	15.91	14.22	0.62	16.57	33.00
0.13	3.00	0.15	18.91	16.57	0.75	19.31	33.74
0.15	2.46	0.17	21.37	19.31	0.95	22.49	34.69
0.17	1.88	0.20	23.25	22.49	1.26	26.20	35.95
0.20	1.38	0.23	24.63	26.20	1.70	30.53	37.64
0.23	1.00	0.27	25.62	30.53	2.28	35.56	39.92
0.27	0.74	0.31	26.36	35.56	3.01	41.43	42.93
0.31	0.56	0.36	26.93	41.43	3.82	48.27	46.75
0.36	0.43	0.42	27.36	48.27	4.66	56.23	51.41
0.42	0.32	0.49	27.67	56.23	5.42	65.51	56.84
0.49	0.22	0.58	27.90	65.51	6.03	76.32	62.87
0.58	0.15	0.67	28.05	76.32	6.46	88.91	69.33
0.67	0.09	0.78	28.14	88.91	6.75	103.58	76.09
0.78	0.09	0.91	28.22	103.58	6.29	120.67	82.38
0.91	0.09	1.06	28.31	120.67	5.51	140.58	87.88
1.06	0.10	1.24	28.41	140.58	4.52	163.77	92.41
1.24	0.12	1.44	28.53	163.77	3.47	190.80	95.88
1.44	0.14	1.68	28.67	190.80	2.42	222.28	98.30
1.68	0.15	1.95	28.82	222.28	1.37	258.95	99.68
1.95	0.16	2.28	28.98	258.95	0.32	301.68	100.00
2.28	0.16	2.65	29.14	301.68	0.00	351.46	100.00
2.65	0.16	3.09	29.30	351.46	0.00	409.45	100.00
3.09	0.15	3.60	29.45	409.45	0.00	477.01	100.00
3.60	0.16	4.19	29.61	477.01	0.00	555.71	100.00
4.19	0.18	4.88	29.79	555.71	0.00	647.41	100.00
4.88	0.21	5.69	30.01	647.41	0.00	754.23	100.00
5.69	0.26	6.63	30.27	754.23	0.00	878.67	100.00

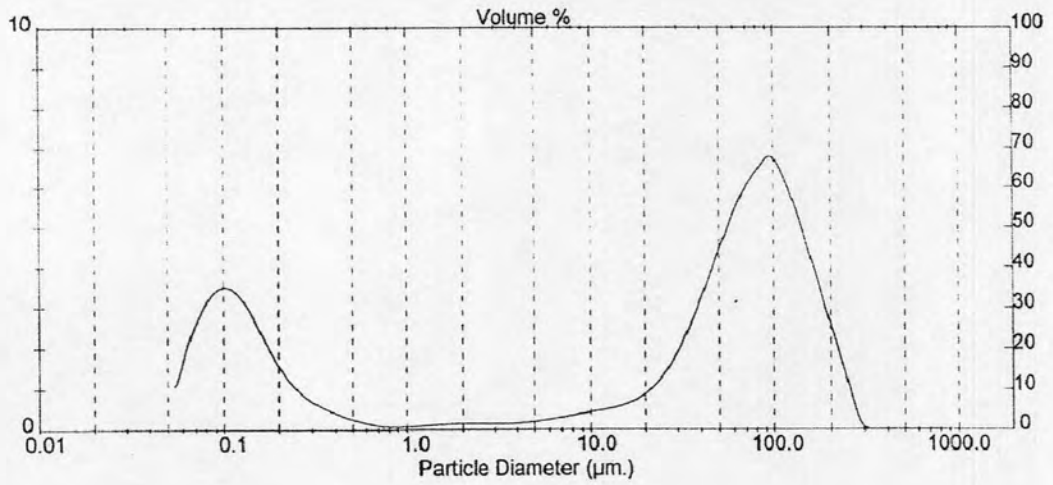


Figure 90 Size and size distribution of F11

Result Statistics

Distribution Type: Volume	Concentration = 0.0121 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 15.1939 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.10 um	D (v, 0.5) = 59.16 um	D (v, 0.9) = 189.60 um
D [4, 3] = 76.82 um	D [3, 2] = 0.39 um	Span = 3.203E+00	Uniformity = 1.034E+00

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	1.07	0.06	1.07	6.63	0.27	7.72	29.45
0.06	2.02	0.07	3.08	7.72	0.31	9.00	29.76
0.07	2.77	0.08	5.85	9.00	0.36	10.48	30.12
0.08	3.26	0.09	9.11	10.48	0.40	12.21	30.52
0.09	3.42	0.11	12.53	12.21	0.45	14.22	30.97
0.11	3.26	0.13	15.79	14.22	0.53	16.57	31.51
0.13	2.85	0.15	18.64	16.57	0.66	19.31	32.16
0.15	2.29	0.17	20.93	19.31	0.86	22.49	33.02
0.17	1.74	0.20	22.67	22.49	1.15	26.20	34.17
0.20	1.26	0.23	23.93	26.20	1.57	30.53	35.74
0.23	0.90	0.27	24.83	30.53	2.12	35.56	37.86
0.27	0.66	0.31	25.49	35.56	2.78	41.43	40.64
0.31	0.50	0.36	25.99	41.43	3.52	48.27	44.16
0.36	0.37	0.42	26.36	48.27	4.27	56.23	48.43
0.42	0.28	0.49	26.64	56.23	4.93	65.51	53.36
0.49	0.20	0.56	26.83	65.51	5.44	76.32	58.80
0.56	0.13	0.67	26.97	76.32	5.74	88.91	64.54
0.67	0.09	0.78	27.06	88.91	5.85	103.58	70.39
0.78	0.09	0.91	27.14	103.58	5.84	120.67	76.23
0.91	0.09	1.06	27.23	120.67	5.31	140.58	81.54
1.06	0.11	1.24	27.34	140.58	4.64	163.77	86.18
1.24	0.13	1.44	27.47	163.77	3.97	190.80	90.15
1.44	0.15	1.68	27.62	190.80	3.31	222.28	93.46
1.68	0.16	1.95	27.78	222.28	2.64	258.95	96.10
1.95	0.17	2.28	27.94	258.95	1.97	301.68	98.06
2.28	0.16	2.65	28.11	301.68	1.30	351.46	99.37
2.65	0.16	3.09	28.28	351.46	0.63	409.45	100.00
3.09	0.16	3.60	28.42	409.45	0.00	477.01	100.00
3.60	0.16	4.19	28.57	477.01	0.00	555.71	100.00
4.19	0.17	4.88	28.74	555.71	0.00	647.41	100.00
4.88	0.20	5.69	28.94	647.41	0.00	754.23	100.00
5.69	0.23	6.63	29.17	754.23	0.00	878.67	100.00

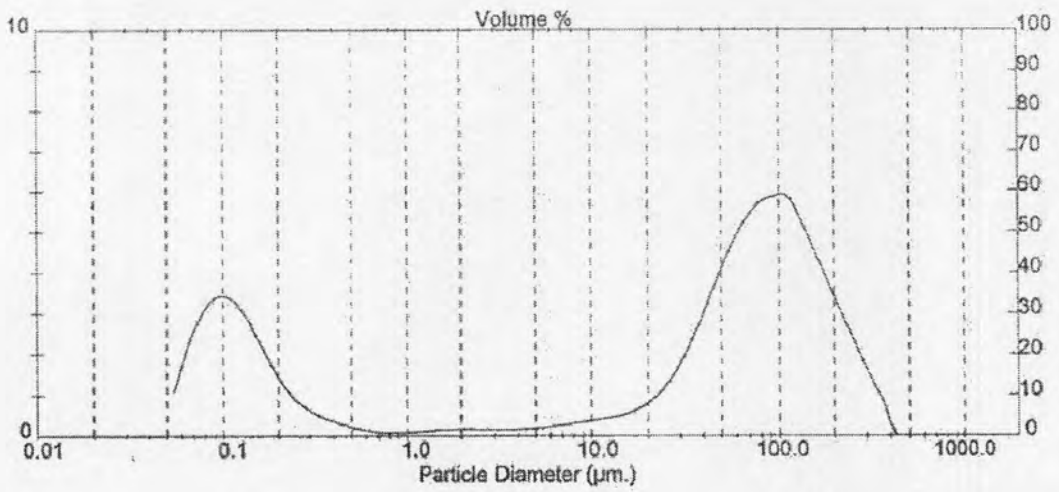


Figure 91 Size and size distribution of F12

Result Statistics

Distribution Type: Volume	Concentration = 0.0089 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 20.4923 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.09 um	D (v, 0.5) = 27.62 um	D (v, 0.9) = 100.29 um
D [4, 3] = 39.66 um	D [3, 2] = 0.29 um	Span = 3.601E+00	Uniformity = 1.273E+00

Size Low (um)	In %	Size High (um)	Under%
0.05	1.45	0.06	1.45
0.06	2.73	0.07	4.18
0.07	3.76	0.08	7.94
0.08	4.43	0.09	12.37
0.09	4.66	0.11	17.02
0.11	4.42	0.13	21.44
0.13	3.84	0.15	25.29
0.15	3.06	0.17	28.35
0.17	2.28	0.20	30.63
0.20	1.62	0.23	32.25
0.23	1.15	0.27	33.40
0.27	0.83	0.31	34.23
0.31	0.63	0.36	34.86
0.36	0.47	0.42	35.33
0.42	0.35	0.49	35.68
0.49	0.25	0.58	35.92
0.58	0.17	0.67	36.09
0.67	0.11	0.78	36.20
0.78	0.10	0.91	36.30
0.91	0.11	1.06	36.40
1.06	0.13	1.24	36.53
1.24	0.16	1.44	36.69
1.44	0.19	1.68	36.87
1.68	0.21	1.95	37.09
1.95	0.23	2.28	37.31
2.28	0.23	2.65	37.54
2.65	0.23	3.09	37.77
3.09	0.24	3.60	38.01
3.60	0.27	4.19	38.28
4.19	0.30	4.86	38.59
4.86	0.35	5.69	38.94
5.69	0.41	6.63	39.35

Size Low (um)	In %	Size High (um)	Under%
6.63	0.47	7.72	39.82
7.72	0.53	9.00	40.34
9.00	0.59	10.48	40.93
10.48	0.67	12.21	41.61
12.21	0.80	14.22	42.41
14.22	1.01	16.57	43.42
16.57	1.32	19.31	44.74
19.31	1.77	22.49	46.51
22.49	2.36	26.20	48.88
26.20	3.08	30.53	51.96
30.53	3.86	35.56	55.81
35.56	4.60	41.43	60.41
41.43	5.20	48.27	65.61
48.27	5.60	56.23	71.21
56.23	5.85	65.51	77.06
65.51	5.35	76.32	82.41
76.32	4.59	88.91	87.00
88.91	3.72	103.58	90.71
103.58	2.86	120.67	93.57
120.67	2.12	140.58	95.69
140.58	1.54	163.77	97.24
163.77	1.13	190.80	98.37
190.80	0.84	222.28	99.21
222.28	0.54	258.95	99.75
258.95	0.25	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

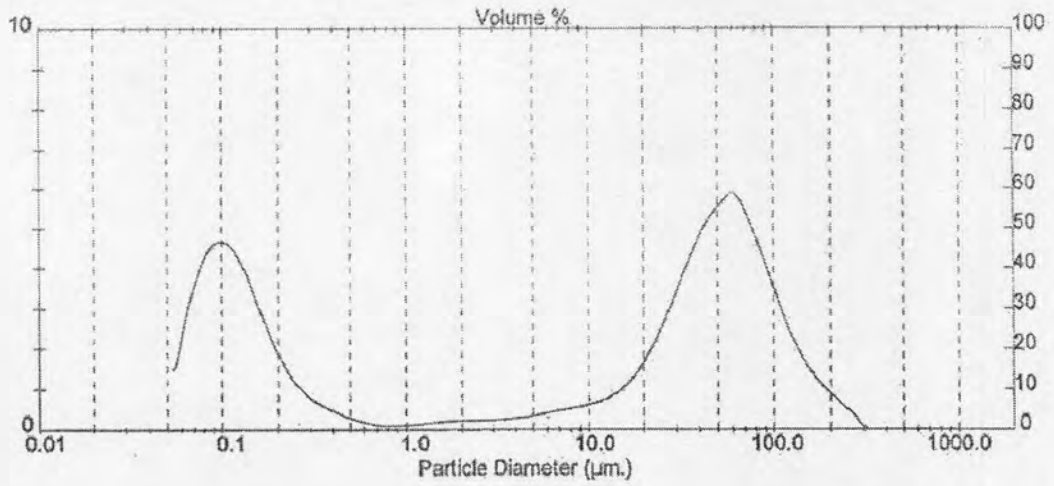


Figure 92 Size and size distribution of F13

Result Statistics

Distribution Type: Volume	Concentration = 0.0200 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 8.7658 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.14 um	D (v, 0.5) = 146.34 um	D (v, 0.9) = 345.45 um
D [4, 3] = 163.84 um	D [3, 2] = 0.68 um	Span = 2.360E+00	Uniformity = 7.047E-01

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	0.54	0.06	0.54	6.63	0.09	7.72	17.31
0.06	1.05	0.07	1.59	7.72	0.10	9.00	17.41
0.07	1.48	0.08	3.08	9.00	0.12	10.48	17.52
0.08	1.81	0.09	4.88	10.48	0.14	12.21	17.67
0.09	1.98	0.11	6.87	12.21	0.17	14.22	17.84
0.11	1.98	0.13	8.85	14.22	0.20	16.57	18.04
0.13	1.81	0.15	10.66	16.57	0.24	19.31	18.28
0.15	1.51	0.17	12.17	19.31	0.28	22.49	18.55
0.17	1.15	0.20	13.32	22.49	0.32	26.20	18.87
0.20	0.83	0.23	14.15	26.20	0.39	30.53	19.27
0.23	0.59	0.27	14.74	30.53	0.50	35.56	19.77
0.27	0.44	0.31	15.18	35.56	0.88	41.43	20.45
0.31	0.34	0.36	15.52	41.43	0.96	48.27	21.41
0.36	0.26	0.42	15.78	48.27	1.38	56.23	22.79
0.42	0.19	0.49	15.98	56.23	1.96	65.51	24.75
0.49	0.14	0.58	16.12	65.51	2.72	76.32	27.48
0.58	0.09	0.67	16.21	76.32	3.65	88.91	31.12
0.67	0.06	0.78	16.26	88.91	4.68	103.58	35.80
0.78	0.05	0.91	16.31	103.58	5.71	120.67	41.52
0.91	0.05	1.06	16.36	120.67	6.62	140.58	48.14
1.06	0.05	1.24	16.41	140.58	7.29	163.77	55.42
1.24	0.06	1.44	16.48	163.77	7.72	190.80	63.15
1.44	0.07	1.68	16.55	190.80	8.00	222.28	71.14
1.68	0.08	1.95	16.63	222.28	7.45	258.96	78.59
1.95	0.08	2.28	16.71	258.96	6.55	301.68	85.14
2.28	0.08	2.65	16.80	301.68	5.41	351.46	90.55
2.65	0.08	3.09	16.87	351.46	4.19	409.45	94.75
3.09	0.07	3.60	16.95	409.45	2.97	477.01	97.72
3.60	0.07	4.19	17.02	477.01	1.75	555.71	99.47
4.19	0.07	4.88	17.09	555.71	0.53	647.41	100.00
4.88	0.07	5.69	17.16	647.41	0.00	754.23	100.00
5.69	0.07	6.63	17.23	754.23	0.00	878.67	100.00

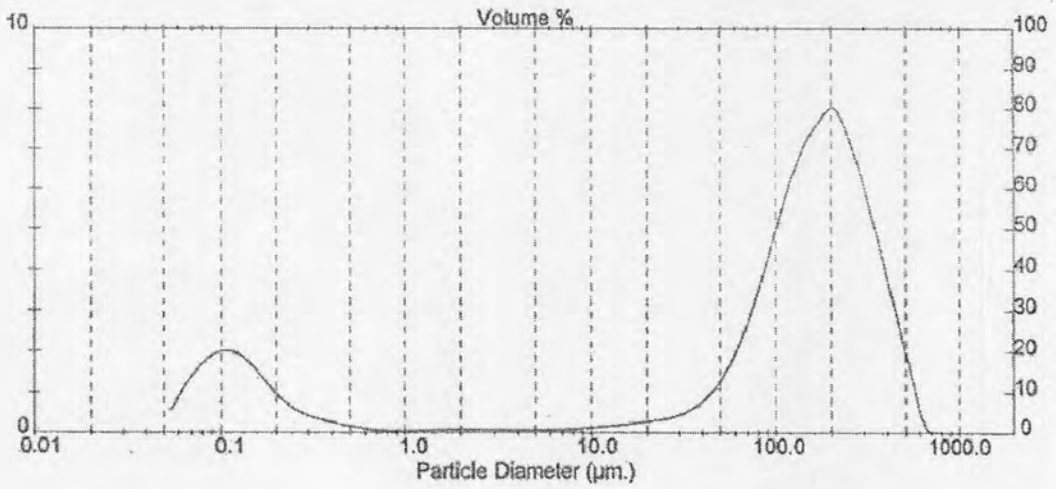


Figure 93 Size and size distribution of F14

Result Statistics

Distribution Type: Volume	Concentration = 0.0060 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 32.7580 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.07 um	D (v, 0.5) = 0.22 um	D (v, 0.9) = 31.07 um
D [4, 3] = 9.49 um	D [3, 2] = 0.18 um	Span = 1.391E+02	Uniformity = 4.160E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	2.56	0.06	2.57
0.06	4.76	0.07	7.32
0.07	6.37	0.08	13.68
0.08	7.23	0.09	20.92
0.09	7.28	0.11	28.20
0.11	6.62	0.13	34.82
0.13	5.54	0.15	40.36
0.15	4.34	0.17	44.70
0.17	3.26	0.20	47.96
0.20	2.39	0.23	50.35
0.23	1.74	0.27	52.09
0.27	1.27	0.31	53.36
0.31	0.94	0.36	54.30
0.36	0.70	0.42	55.00
0.42	0.52	0.49	55.52
0.49	0.37	0.58	55.90
0.58	0.28	0.67	56.18
0.67	0.17	0.78	56.33
0.78	0.17	0.91	56.50
0.91	0.19	1.06	56.69
1.06	0.23	1.24	56.92
1.24	0.29	1.44	57.21
1.44	0.35	1.68	57.56
1.68	0.41	1.95	57.97
1.95	0.46	2.28	58.42
2.28	0.49	2.65	58.91
2.65	0.51	3.09	59.41
3.09	0.54	3.60	59.96
3.60	0.59	4.19	60.55
4.19	0.67	4.88	61.23
4.88	0.79	5.69	62.02
5.69	0.95	6.63	62.96

Size Low (um)	In %	Size High (um)	Under%
6.63	1.15	7.72	64.11
7.72	1.41	9.00	65.52
9.00	1.72	10.48	67.24
10.48	2.09	12.21	69.33
12.21	2.50	14.22	71.83
14.22	2.93	16.57	74.77
16.57	3.37	19.31	78.14
19.31	3.78	22.49	81.93
22.49	3.91	26.20	85.84
26.20	3.75	30.53	89.59
30.53	3.32	35.56	92.91
35.56	2.70	41.43	95.61
41.43	1.99	48.27	97.60
48.27	1.31	56.23	98.91
56.23	0.74	65.51	99.65
65.51	0.35	76.32	100.00
76.32	0.00	88.91	100.00
88.91	0.00	103.58	100.00
103.58	0.00	120.67	100.00
120.67	0.00	140.58	100.00
140.58	0.00	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.26	100.00
222.26	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

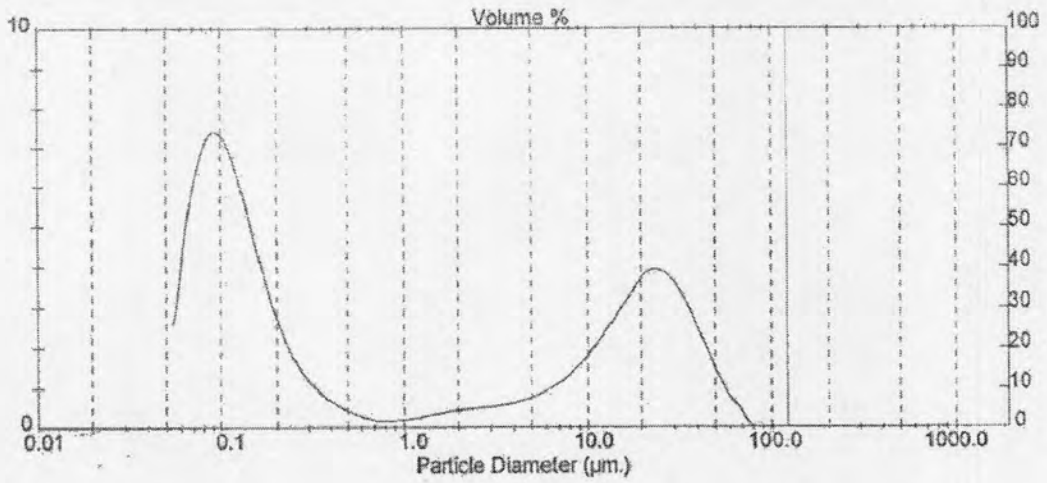


Figure 94 Size and size distribution of F15

Result Statistics

Distribution Type: Volume	Concentration = 0.0095 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 20.4766 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.09 um	D (v, 0.5) = 30.89 um	D (v, 0.9) = 113.55 um
D [4, 3] = 48.35 um	D [3, 2] = 0.29 um	Span = 3.673E+00	Uniformity = 1.441E+00

Size Low (um)	In %	Size High (um)	Under%	Size Low (um)	In %	Size High (um)	Under%
0.05	1.44	0.06	1.44	6.63	0.37	7.72	39.63
0.06	2.73	0.07	4.17	7.72	0.38	9.00	40.01
0.07	3.76	0.08	7.93	9.00	0.39	10.48	40.41
0.08	4.42	0.09	12.35	10.48	0.43	12.21	40.84
0.09	4.65	0.11	17.00	12.21	0.53	14.22	41.37
0.11	4.42	0.13	21.42	14.22	0.71	16.57	42.08
0.13	3.84	0.15	25.26	16.57	1.03	19.31	43.10
0.15	3.07	0.17	28.33	19.31	1.49	22.49	44.60
0.17	2.28	0.20	30.61	22.49	2.14	26.20	46.74
0.20	1.63	0.23	32.24	26.20	2.98	30.53	49.72
0.23	1.15	0.27	33.39	30.53	3.99	35.56	53.65
0.27	0.84	0.31	34.23	35.56	4.84	41.43	58.50
0.31	0.64	0.36	34.87	41.43	5.55	48.27	64.04
0.36	0.48	0.42	35.35	48.27	5.93	56.23	69.97
0.42	0.35	0.49	35.70	56.23	6.03	65.51	76.00
0.49	0.25	0.58	35.95	65.51	5.21	76.32	81.21
0.58	0.17	0.67	36.12	76.32	4.18	88.91	85.39
0.67	0.11	0.78	36.23	88.91	3.15	103.58	88.54
0.78	0.10	0.91	36.33	103.58	2.28	120.67	90.82
0.91	0.11	1.06	36.45	120.67	1.65	140.58	92.47
1.06	0.14	1.24	36.59	140.58	1.26	163.77	93.72
1.24	0.18	1.44	36.77	163.77	1.07	190.80	94.80
1.44	0.21	1.68	36.98	190.80	1.02	222.28	95.81
1.68	0.23	1.95	37.20	222.28	1.00	258.95	96.81
1.95	0.23	2.28	37.43	258.95	0.95	301.68	97.76
2.28	0.22	2.65	37.66	301.68	0.82	351.48	98.58
2.65	0.22	3.09	37.88	351.48	0.63	409.45	99.21
3.09	0.22	3.60	38.10	409.45	0.45	477.01	99.66
3.60	0.24	4.19	38.34	477.01	0.26	555.71	99.92
4.19	0.27	4.88	38.61	555.71	0.08	647.41	100.00
4.88	0.31	5.69	38.92	647.41	0.00	754.23	100.00
5.69	0.34	6.63	39.27	754.23	0.00	878.67	100.00

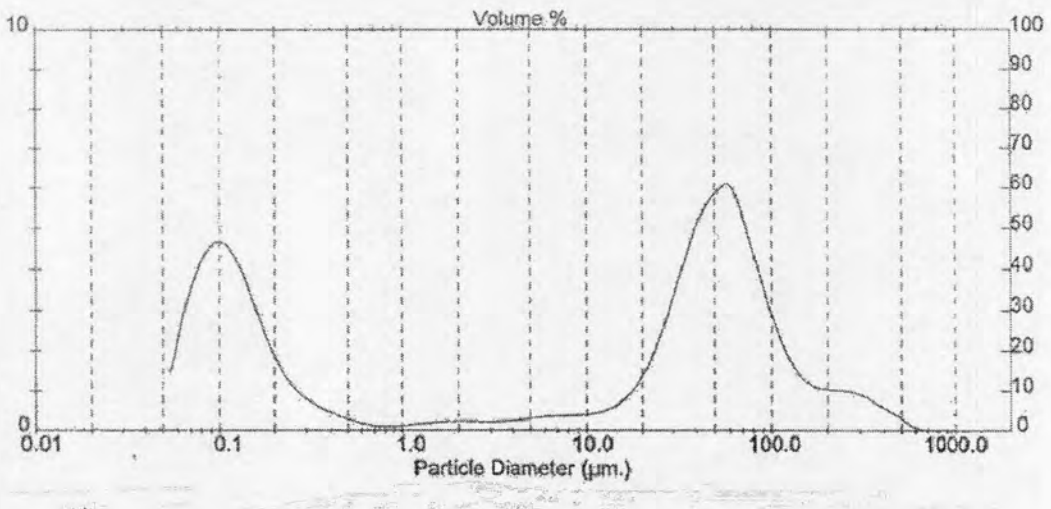


Figure 95 Size and size distribution of F16

Result Statistics

Distribution Type: Volume	Concentration = 0.0065 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 27.8771 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.06 um	D (v, 0.5) = 0.72 um	D (v, 0.9) = 56.10 um
D [4, 3] = 21.52 um	D [3, 2] = 0.22 um	Span = 8.063E+01	Uniformity = 2.978E+01

Size Low (um)	In %	Size High (um)	Under%
0.05	1.92	0.06	1.92
0.06	3.94	0.07	5.56
0.07	5.02	0.08	10.58
0.08	5.93	0.09	16.52
0.09	6.27	0.11	22.79
0.11	6.02	0.13	28.82
0.13	5.29	0.15	34.11
0.15	4.30	0.17	38.40
0.17	3.26	0.20	41.67
0.20	2.38	0.23	44.05
0.23	1.72	0.27	45.76
0.27	1.27	0.31	47.03
0.31	0.97	0.36	48.00
0.36	0.73	0.42	48.73
0.42	0.54	0.49	49.27
0.49	0.39	0.58	49.66
0.58	0.28	0.67	49.92
0.67	0.16	0.78	50.08
0.78	0.15	0.91	50.23
0.91	0.15	1.06	50.39
1.06	0.18	1.24	50.56
1.24	0.22	1.44	50.79
1.44	0.27	1.68	51.06
1.68	0.32	1.95	51.38
1.95	0.35	2.28	51.73
2.28	0.38	2.65	52.11
2.65	0.40	3.09	52.50
3.09	0.42	3.60	52.92
3.60	0.46	4.19	53.38
4.19	0.52	4.88	53.90
4.88	0.59	5.69	54.49
5.69	0.68	6.63	55.17

Size Low (um)	In %	Size High (um)	Under%
6.63	0.80	7.72	55.98
7.72	0.96	9.00	56.94
9.00	1.17	10.48	58.11
10.48	1.45	12.21	59.56
12.21	1.79	14.22	61.35
14.22	2.19	16.57	63.54
16.57	2.63	19.31	66.16
19.31	3.05	22.49	69.22
22.49	3.40	26.20	72.61
26.20	3.81	30.53	76.23
30.53	3.69	35.56	79.92
35.56	3.67	41.43	83.59
41.43	3.23	48.27	86.82
48.27	2.88	56.23	89.50
56.23	2.13	65.51	91.63
65.51	1.66	76.32	93.29
76.32	1.30	88.91	94.59
88.91	1.06	103.58	95.64
103.58	0.90	120.67	96.54
120.67	0.81	140.58	97.35
140.58	0.74	163.77	98.09
163.77	0.66	190.80	98.75
190.80	0.55	222.28	99.30
222.28	0.39	258.95	99.69
258.95	0.23	301.68	99.92
301.68	0.08	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.67	100.00

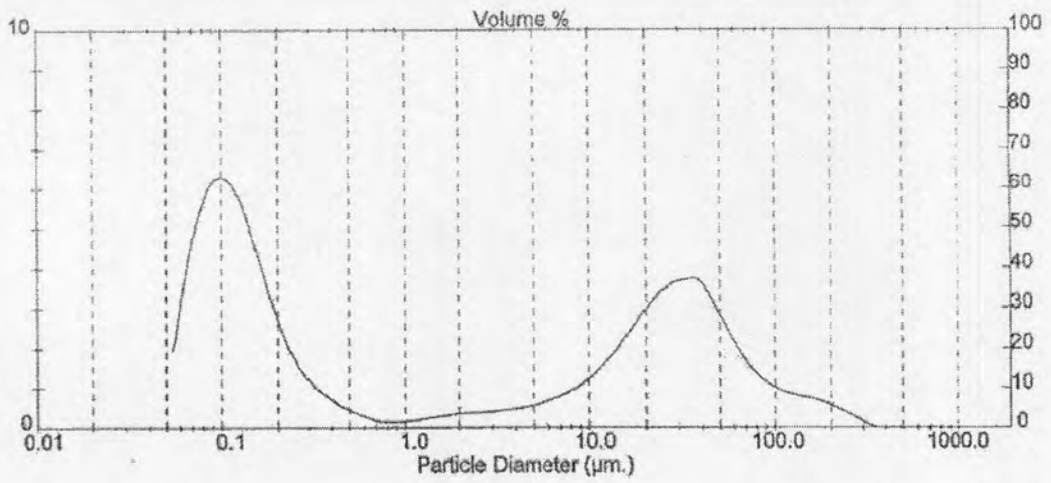


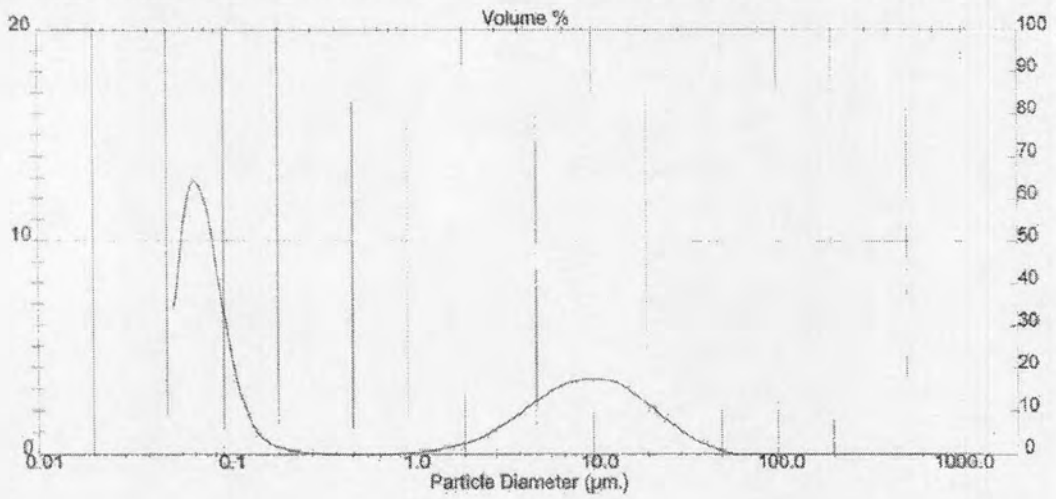
Figure 96 Size and size distribution of optimal formulation

Result Statistics

Distribution Type: Volume	Concentration = 0.0052 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 44.1937 sq. m / g
Mean Diameters:	D (v, 0.1) = 0.06 um	D (v, 0.5) = 0.11 um	D (v, 0.9) = 16.29 um
D [4, 3] = 5.22 um	D [3, 2] = 0.14 um	Span = 1.428E+02	Uniformity = 4.531E+01

Size_Low (um)	In %	Size_High (um)	Under%
0.05	6.68	0.06	6.68
0.06	11.61	0.07	18.29
0.07	12.67	0.08	30.96
0.08	10.45	0.09	41.40
0.09	6.88	0.11	48.28
0.11	3.80	0.13	52.07
0.13	1.86	0.15	53.96
0.15	0.91	0.17	54.86
0.17	0.45	0.20	55.32
0.20	0.24	0.23	55.56
0.23	0.14	0.27	55.70
0.27	0.08	0.31	55.77
0.31	0.05	0.36	55.82
0.36	0.03	0.42	55.85
0.42	0.02	0.49	55.87
0.49	0.01	0.58	55.88
0.58	0.01	0.67	55.89
0.67	0.01	0.79	55.90
0.79	0.04	0.91	55.94
0.91	0.07	1.06	56.01
1.06	0.11	1.24	56.12
1.24	0.17	1.44	56.29
1.44	0.28	1.68	56.56
1.68	0.39	1.95	56.94
1.95	0.56	2.28	57.50
2.28	0.78	2.65	58.28
2.65	1.06	3.09	59.34
3.09	1.40	3.60	60.73
3.60	1.78	4.19	62.51
4.19	2.19	4.88	64.70
4.88	2.60	5.69	67.31
5.69	2.98	6.63	70.29

Size_Low (um)	In %	Size_High (um)	Under%
6.63	3.25	7.72	73.54
7.72	3.43	9.00	76.97
9.00	3.49	10.48	80.47
10.48	3.46	12.21	83.92
12.21	3.36	14.22	87.29
14.22	3.04	16.57	90.32
16.57	2.63	19.31	92.96
19.31	2.18	22.49	95.14
22.49	1.72	26.20	96.86
26.20	1.28	30.53	98.14
30.53	0.88	35.56	99.02
35.56	0.55	41.43	99.58
41.43	0.30	48.27	99.87
48.27	0.13	56.23	100.00
56.23	0.00	65.51	100.00
65.51	0.00	76.32	100.00
76.32	0.00	88.91	100.00
88.91	0.00	103.58	100.00
103.58	0.00	120.67	100.00
120.67	0.00	140.58	100.00
140.58	0.00	163.77	100.00
163.77	0.00	190.80	100.00
190.80	0.00	222.28	100.00
222.28	0.00	258.95	100.00
258.95	0.00	301.68	100.00
301.68	0.00	351.46	100.00
351.46	0.00	409.45	100.00
409.45	0.00	477.01	100.00
477.01	0.00	555.71	100.00
555.71	0.00	647.41	100.00
647.41	0.00	754.23	100.00
754.23	0.00	878.87	100.00



APPENDIX C

Release Data

Table 46 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F1)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F1	0	0.00	0.00	0.00	0.00
	5	76.59	84.47	1.46	3.43
	10	83.77	92.05	1.16	1.70
	15	93.52	98.14	1.34	1.32
	30	93.87	101.33	2.26	0.46
	45	94.16	101.17	2.81	0.43
	60	94.39	100.77	3.28	1.19
	90	93.90	100.44	3.64	1.56
	120	93.64	99.68	3.03	0.42
	180	93.54	99.23	2.86	0.62
	240	92.80	98.30	3.93	1.74

Table 47 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F2)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F2	0	0.00	0.00	0.00	0.00
	5	55.01	69.52	1.62	1.04
	10	68.29	82.03	3.94	2.12
	15	76.24	86.69	4.17	2.45
	30	87.88	95.44	4.75	1.24
	45	88.89	96.20	2.29	0.70
	60	89.60	97.23	1.81	0.82
	90	88.64	97.83	1.17	2.41
	120	88.35	97.25	0.24	1.99
	180	88.18	98.20	0.38	0.73
	240	87.45	97.03	0.56	2.16

Table 48 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F3)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F3	0	0.00	0.00	0.00	0.00
	5	73.54	94.01	2.82	0.87
	10	87.62	100.66	0.12	0.23
	15	90.95	99.80	0.75	0.43
	30	89.51	98.55	1.14	1.75
	45	89.96	98.40	1.85	0.94
	60	89.48	97.29	1.01	2.05
	90	88.90	97.06	1.21	1.11
	120	89.04	95.74	1.35	0.16
	180	88.32	95.40	1.00	0.74
	240	88.22	94.18	1.11	0.15

Table 49 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F4)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F4	0	0.00	0.00	0.00	0.00
	5	71.55	82.36	5.83	3.81
	10	83.41	92.95	6.18	3.54
	15	88.88	95.59	1.47	3.53
	30	97.41	99.50	0.61	1.68
	45	96.48	101.16	0.97	1.58
	60	96.54	100.95	1.73	1.65
	90	96.86	101.22	2.17	0.28
	120	96.65	101.26	2.05	0.93
	180	96.95	101.70	1.70	1.60
	240	96.89	100.50	2.42	0.68

Table 50 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F5)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F5	0	0.00	0.00	0.00	0.00
	5	61.64	74.23	12.84	8.34
	10	72.36	83.69	5.91	8.06
	15	81.00	90.52	4.75	5.55
	30	85.83	95.05	3.48	5.03
	45	89.05	95.82	2.98	4.03
	60	92.81	97.86	1.57	4.04
	90	91.65	98.97	1.43	2.15
	120	91.18	99.52	1.31	2.10
	180	91.02	99.14	0.50	1.83
	240	90.05	98.29	0.19	1.13

Table 51 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F6)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F6	0	0.00	0.00	0.00	0.00
	5	57.14	71.29	0.42	2.02
	10	70.38	87.49	4.70	4.54
	15	79.24	94.64	2.93	1.14
	30	89.28	98.34	1.06	0.84
	45	90.23	99.29	1.40	0.89
	60	90.77	98.74	0.67	0.98
	90	91.17	98.38	0.11	0.86
	120	90.29	97.95	1.53	0.21
	180	90.53	96.25	1.07	0.49
	240	89.31	96.04	1.40	1.06

Table 52 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F7)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F7	0	0.00	0.00	0.00	0.00
	5	72.85	92.57	1.31	0.87
	10	85.87	99.26	1.39	1.18
	15	89.88	100.58	1.56	1.39
	30	91.88	100.09	0.49	0.77
	45	92.88	99.78	0.71	1.01
	60	90.59	97.77	0.48	0.85
	90	90.82	97.68	0.43	0.45
	120	89.15	97.13	0.90	0.54
	180	88.89	95.82	0.98	0.63
	240	88.90	95.88	0.35	0.88

Table 53 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F8)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F8	0	0.00	0.00	0.00	0.00
	5	53.56	64.18	12.49	19.10
	10	68.24	84.37	3.31	6.54
	15	78.58	91.87	2.69	1.13
	30	88.30	98.35	1.91	3.67
	45	90.30	97.96	0.59	3.73
	60	90.95	98.51	1.50	2.35
	90	91.73	98.75	0.57	0.63
	120	91.68	99.75	0.65	0.89
	180	90.97	99.09	1.33	0.67
	240	90.93	98.99	1.26	0.56

Table 54 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F9)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F9	0	0.00	0.00	0.00	0.00
	5	62.27	83.27	2.55	6.05
	10	81.24	91.83	2.29	1.59
	15	84.48	96.10	2.68	1.09
	30	89.02	100.35	0.84	0.88
	45	91.52	100.36	0.29	1.17
	60	91.05	98.83	0.55	1.11
	90	89.98	98.00	0.50	0.45
	120	89.25	97.35	0.64	0.77
	180	88.23	96.53	0.37	0.15
	240	87.43	95.50	0.28	0.16

Table 55 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F10)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F10	0	0.00	0.00	0.00	0.00
	5	76.35	92.61	2.48	0.51
	10	90.56	100.43	3.97	0.90
	15	89.33	99.17	2.01	1.01
	30	92.14	98.99	1.64	0.85
	45	91.87	98.50	1.76	1.43
	60	90.36	97.69	1.11	0.78
	90	89.13	96.65	0.97	0.88
	120	88.41	96.74	0.47	1.59
	180	87.47	96.79	1.23	0.88
	240	86.44	95.87	1.72	1.47

Table 56 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F11)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F11	0	0.00	0.00	0.00	0.00
	5	69.02	95.94	4.17	8.74
	10	86.72	99.80	3.10	1.58
	15	86.88	100.01	3.95	1.03
	30	87.66	98.93	3.62	0.32
	45	91.23	97.81	1.14	0.62
	60	90.30	97.87	0.81	0.29
	90	87.90	96.11	0.55	0.95
	120	87.52	95.39	0.39	0.91
	180	86.38	94.99	0.44	0.74
	240	85.78	93.85	0.87	0.47

Table 57 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F12)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F12	0	0.00	0.00	0.00	0.00
	5	59.79	70.20	4.84	7.31
	10	75.45	92.13	4.43	4.60
	15	83.80	94.50	4.17	5.20
	30	92.04	100.67	1.29	1.60
	45	92.75	99.91	1.34	1.17
	60	92.63	100.17	0.62	1.65
	90	92.29	99.02	0.88	0.18
	120	90.55	97.74	0.28	0.70
	180	90.43	96.03	0.76	0.52
	240	89.25	94.65	0.18	1.13

Table 58 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F13)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F13	0	0.00	0.00	0.00	0.00
	5	70.49	80.35	12.38	0.53
	10	86.11	91.10	4.78	1.96
	15	91.84	97.73	0.01	1.42
	30	92.58	98.56	0.38	0.93
	45	93.41	100.07	0.17	0.51
	60	91.32	96.36	0.18	0.60
	90	91.58	95.92	1.36	1.68
	120	90.75	95.72	0.71	1.33
	180	90.06	94.71	1.24	1.29
	240	89.83	94.07	1.21	1.17

Table 59 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F14)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F14	0	0.00	0.00	0.00	0.00
	5	43.80	50.31	4.89	6.79
	10	81.66	92.33	6.10	6.59
	15	86.75	97.29	3.81	3.76
	30	91.65	99.24	3.30	2.34
	45	91.78	98.41	1.39	0.36
	60	91.56	98.39	1.78	0.92
	90	91.37	98.51	2.31	0.71
	120	89.69	96.71	1.49	1.16
	180	89.73	95.78	0.93	0.54
	240	89.71	95.48	1.05	0.56

Table 60 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F15)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F15	0	0.00	0.00	0.00	0.00
	5	63.94	77.39	2.89	4.76
	10	88.74	89.70	3.75	2.22
	15	92.40	96.88	2.90	4.24
	30	94.46	99.08	1.56	1.88
	45	96.28	99.33	0.33	1.20
	60	97.01	99.88	1.51	0.68
	90	95.80	99.10	1.36	0.24
	120	95.14	98.49	1.01	0.54
	180	93.95	97.93	1.67	0.76
	240	92.97	98.22	0.95	0.42

Table 61 Percentages of asiaticoside and madecassoside released from chitosan microspheres (F16)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
F16	0	0.00	0.00	0.00	0.00
	5	59.65	70.96	3.95	9.81
	10	73.48	91.24	8.37	2.38
	15	85.79	97.27	7.28	4.00
	30	92.81	100.81	3.06	0.74
	45	93.10	101.06	3.19	0.64
	60	91.79	99.57	1.82	1.79
	90	91.83	99.22	1.85	1.40
	120	90.65	98.36	2.75	0.90
	180	89.39	97.02	1.69	0.54
	240	88.90	95.92	3.18	1.92

Table 62 Percentages of asiaticoside and madecassoside released from chitosan microspheres (optimal)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
optimal	0	0.00	0.00	0.00	0.00
	5	46.00	57.76	8.04	6.02
	10	60.00	76.89	4.76	5.58
	15	66.77	82.12	8.98	5.07
	30	83.71	94.36	2.95	3.21
	45	86.88	100.16	4.41	0.67
	60	90.75	98.94	0.91	3.01
	90	91.58	98.86	2.16	1.42
	120	89.60	97.24	0.31	0.63
	180	89.29	96.34	0.27	1.59
	240	88.68	95.40	0.29	1.70

Table 63 Percentages of asiaticoside and madecassoside released from chitosan microspheres (centella extract)

Formulation	Time (min)	%Release (mean, n=3)		SD	
		asiaticoside	madecassoside	asiaticoside	madecassoside
centella extract	0	0.00	0.00	0.00	0.00
	5	69.40	90.95	2.86	1.21
	10	87.68	99.85	1.17	1.36
	15	88.50	99.77	1.88	0.61
	30	94.65	98.56	1.37	2.99
	45	96.27	99.16	0.56	3.26
	60	95.54	98.65	1.36	3.36
	90	95.31	98.39	0.61	1.92
	120	94.54	97.63	1.23	3.22
	180	92.95	97.17	0.71	3.46
	240	93.31	95.81	1.38	3.00

Table 64 Percentages of asiaticoside (pure centella extract) released from Suppocire®AM conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
asiaticoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	25.06	31.61	37.08	31.25	6.02	1.84
	0.33	0.58	54.33	41.71	47.93	47.99	6.31	1.72
	0.50	0.71	64.10	61.38	63.78	63.09	1.49	1.57
	0.75	0.87	73.72	77.89	76.97	76.19	2.19	1.38
	1	1	89.38	88.88	88.78	89.01	0.33	1.04
	2	1.41	87.32	87.87	88.00	87.73	0.36	1.09
	3	1.73	86.05	86.90	87.67	86.87	0.81	1.12
	4	2	85.98	86.44	86.65	86.36	0.35	1.13

Table 65 Percentages of madecassoside (pure centella extract) released from Suppocire® AM conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
madecassoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	32.31	41.29	47.97	40.52	7.86	1.77
	0.33	0.58	61.12	59.34	60.59	60.35	0.91	1.59
	0.50	0.71	77.50	75.35	78.27	77.04	1.51	1.36
	0.75	0.87	86.62	91.68	90.86	89.72	2.72	1.01
	1	1	98.65	98.57	99.60	98.94	0.57	0.03
	2	1.41	97.12	98.92	100.87	98.97	1.88	0.01
	3	1.73	96.89	98.10	99.06	98.02	1.09	0.30
	4	2	96.69	95.08	96.79	96.19	0.96	0.58

Table 66 Percentages of asiaticoside (pure centella extract) released from polyethylene glycol (PEG) conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
asiaticoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	52.03	53.25	39.77	48.35	7.45	1.71
	0.33	0.58	72.83	75.42	78.51	75.59	2.84	1.39
	0.50	0.71	80.57	85.54	84.62	83.58	2.65	1.22
	0.75	0.87	83.92	86.79	88.94	86.55	2.52	1.13
	1	1	86.06	86.91	86.92	86.63	0.49	1.13
	2	1.41	84.82	85.75	85.34	85.31	0.47	1.17
	3	1.73	85.81	85.15	84.74	85.23	0.54	1.17
	4	2	85.05	84.59	84.32	84.65	0.37	1.19

Table 67 Percentages of madecassoside (pure centella extract) released from polyethylene glycol (PEG) conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
madecassoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	33.25	44.82	50.57	42.88	8.82	1.76
	0.33	0.58	91.00	93.65	93.17	92.61	1.41	0.87
	0.50	0.71	91.52	100.92	96.88	96.44	4.71	0.55
	0.75	0.87	98.67	99.28	96.96	98.30	1.20	0.23
	1	1	97.80	94.58	94.48	95.62	1.89	0.64
	2	1.41	95.84	94.33	93.27	94.48	1.29	0.74
	3	1.73	95.71	95.93	94.65	95.43	0.69	0.66
	4	2	95.75	93.18	92.27	93.73	1.80	0.80

Table 68 Percentages of asiaticoside (pure centella extract) released from poloxamer liquid suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
asiaticoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	39.35	39.97	46.23	41.85	3.81	1.76
	0.33	0.58	59.39	62.64	65.58	62.54	3.09	1.57
	0.50	0.71	72.39	74.49	78.60	75.16	3.16	1.40
	0.75	0.87	79.75	81.43	82.25	81.15	1.27	1.28
	1	1	85.01	87.69	88.09	86.93	1.68	1.12
	2	1.41	87.71	87.03	88.30	87.68	0.64	1.09
	3	1.73	86.14	86.51	87.83	86.83	0.89	1.12
	4	2	86.36	86.94	87.42	86.91	0.53	1.12

Table 69 Percentagse of madecassoside (pure centella extract) released from poloxamer liquid suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
madecassoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	50.85	50.39	53.04	51.43	1.41	1.69
	0.33	0.58	75.18	77.97	76.80	76.65	1.40	1.37
	0.50	0.71	91.05	92.36	92.75	92.05	0.89	0.90
	0.75	0.87	98.67	93.64	94.72	95.67	2.65	0.64
	1	1	98.67	96.16	94.24	96.36	2.22	0.56
	2	1.41	98.90	94.40	98.83	97.38	2.58	0.42
	3	1.73	98.30	95.11	97.52	96.98	1.66	0.48
	4	2	97.24	97.36	98.23	97.61	0.54	0.38

Table 70 Percentages of asiaticoside (optimal microspheres) released from Suppocire® AM conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	52.89	58.34	53.01	53.01	3.11	1.66
	0.33	0.58	81.72	80.41	80.25	80.79	0.81	1.28
asiaticoside	0.50	0.71	88.89	88.42	88.71	88.71	0.24	1.05
	0.75	0.87	87.17	87.28	88.77	87.74	0.89	1.09
	1	1	86.19	87.16	85.92	86.42	0.65	1.13
	2	1.41	86.14	85.54	85.28	85.65	0.44	1.16
	3	1.73	85.63	85.10	84.85	85.19	0.40	1.17
	4	2	84.42	85.01	84.47	84.63	0.32	1.19

Table 71 Percentages of madecassoside (optimal microspheres) released from Suppocire® AM conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	74.70	76.01	79.23	76.64	2.34	1.37
	0.33	0.58	91.49	90.50	92.63	91.54	1.07	0.93
madecassoside	0.50	0.71	97.14	95.65	96.02	96.73	1.56	0.78
	0.75	0.87	98.02	98.10	97.54	97.89	0.30	0.32
	1	1	95.59	97.93	94.53	96.01	1.74	0.60
	2	1.41	95.24	96.15	95.73	95.71	0.45	0.63
	3	1.73	92.66	95.13	91.68	93.16	1.77	0.84
	4	2	93.78	94.62	92.78	93.73	0.92	0.80

Table 72 Percentages of asiaticoside (optimal microspheres) released from polyethylene glycol (PEG) conventional suppositories

	Time (hr)	√ Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	25.53	26.15	29.75	27.14	2.28	1.86
	0.33	0.58	66.71	68.28	68.58	67.86	1.01	1.51
asiaticoside	0.50	0.71	89.89	87.02	86.17	87.70	1.95	1.09
	0.75	0.87	91.93	90.16	89.25	90.45	1.36	0.98
	1	1	88.09	88.70	87.48	88.09	0.61	1.08
	2	1.41	87.50	88.29	86.42	87.41	0.94	1.10
	3	1.73	86.49	87.59	85.87	86.65	0.87	1.13
	4	2	85.75	87.27	85.81	86.27	0.86	1.14

Table 73 Percentages of madecassoside (optimal microspheres) released from polyethylene glycol (PEG) conventional suppositories

	Time (hr)	√Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
madecassoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	33.85	34.67	37.53	35.35	1.93	1.81
	0.33	0.58	78.34	80.56	79.83	79.57	1.13	1.31
	0.50	0.71	89.38	98.82	98.62	95.61	5.40	0.64
	0.75	0.87	92.83	99.01	99.63	97.15	3.76	0.45
	1	1	97.06	98.92	97.72	97.90	0.95	0.32
	2	1.41	98.07	98.96	98.65	98.56	0.46	0.16
	3	1.73	97.12	98.09	97.93	97.71	0.52	0.36
	4	2	94.41	97.88	95.93	96.08	1.74	0.59

Table 74 Percentages of asiaticoside (optimal microspheres) released from poloxamer liquid suppositories

	Time (hr)	√Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
asiaticoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	33.56	32.73	34.51	33.60	0.89	1.82
	0.33	0.58	49.49	51.50	51.70	50.90	1.22	1.69
	0.50	0.71	64.09	63.28	61.67	63.02	1.23	1.57
	0.75	0.87	79.24	76.14	75.47	76.95	2.01	1.36
	1	1	81.78	79.37	80.97	80.71	1.23	1.29
	2	1.41	83.36	81.41	82.84	82.53	1.01	1.24
	3	1.73	84.29	81.65	84.75	83.56	1.67	1.22
	4	2	85.14	84.50	87.67	85.77	1.68	1.15

Table 75 Percentages of madecassoside (optimal microspheres) released from poloxamer liquid suppositories

	Time (hr)	√Time	%Release			Mean	SD	Log%Drug Remained
			n1	n2	n3			
madecassoside	0	0	0.00	0.00	0.00	0.00	0.00	2.00
	0.17	0.41	45.00	49.34	48.22	47.52	2.25	1.72
	0.33	0.58	64.05	65.30	66.68	65.34	1.32	1.54
	0.50	0.71	86.01	83,68	81.72	83.80	2.14	1.21
	0.75	0.87	96.85	94.35	94.94	95.38	1.31	0.66
	1	1	99.42	96.73	99.85	98.66	1.69	0.13
	2	1.41	99.88	98.82	100.74	99.82	0.96	-0.73
	3	1.73	99.90	100.81	100.85	100.52	0.54	-
	4	2	99.43	100.55	100.58	100.18	0.65	-

APPENDIX D

Statistical analysis data

Table 76 ANOVA for selected factorial model (%yield)

Source	Sum of squares	df	Mean square	*F*-value	*P*-value (prob>*F*)
Model	446.790	16	27.920	65.240	0.015
A-inlet temp	55.800	1	55.800	130.370	0.008
B-feed	6.050	1	6.050	14.140	0.064
C-%solid	74.480	1	74.480	174.000	0.006
D-%additive	3.290	1	3.290	7.700	0.109
E-ratio	13.650	1	13.650	31.900	0.030
AB	11.220	1	11.220	26.220	0.036
AC	7.340	1	7.340	17.160	0.054
AD	0.001	1	0.001	0.003	0.962
AE	2.740	1	2.740	6.400	0.127
BC	36.480	1	36.480	85.230	0.012
BD	2.540	1	2.540	5.940	0.135
BE	26.060	1	26.060	60.890	0.016
CD	2.120	1	2.120	4.950	0.156
CE	0.730	1	0.730	1.710	0.321
DE	1.420	1	1.420	3.310	0.211
ABCDE	202.854	1	202.854	473.922	0.0021
Pure Error	0.860	2	0.430		
Corrected Total	447.640	18			
* R-Squared	0.9981				

Table 77 ANOVA for selected factorial model (%moisture content)

Source	Sum of squares	df	Mean square	*F*-value	*P*-value (prob>*F*)
Model	169.650	16	10.600	41.730	0.024
A-inlet temp	26.650	1	26.650	104.890	0.009
B-feed	22.350	1	22.350	87.950	0.011
C-%solid	0.020	1	0.020	0.080	0.804
D-%additive	20.180	1	20.180	79.430	0.012
E-ratio	7.940	1	7.940	31.240	0.031
AB	11.410	1	11.410	44.890	0.022
AC	3.090	1	3.090	12.160	0.073
AD	2.010	1	2.010	7.910	0.107
AE	0.011	1	0.011	0.041	0.858
BC	0.520	1	0.520	2.050	0.288
BD	5.120	1	5.120	20.150	0.046
BE	3.640	1	3.640	14.320	0.063
CD	7.690	1	7.690	30.250	0.032
CE	3.430	1	3.430	13.510	0.067
DE	0.210	1	0.210	0.840	0.456
ABCDE	55.3767	1	55.3767	217.933	0.0046
Pure Error	0.5100	2	0.2500		
Corrected Total	170.1500	18			
* R-Squared	0.9970				

Table 78 ANOVA for response surface quadratic model (%yield)

Source	Sum of squares	df	Mean square	*F*-value	*P*-value
Model	184.285	5	36.857	6.068	0.0175
A-Inlet temp	69.004	1	69.004	11.360	0.0119
B-%solid content	12.856	1	12.856	2.116	0.1891
AB	8.009	1	8.009	1.318	0.2886
A^2	19.547	1	19.547	3.218	0.1159
B^2	83.823	1	83.823	13.799	0.0075
Residual	42.521	7	6.074		
Lack of Fit	21.951	3	7.317	1.423	0.3599
Pure Error	20.570	4	5.143		
Corrected Total	226.807	12			
* R-Squared	0.8125				

Table 79 Coefficients for response surface quadratic model (%yield)

Factor	Coefficient estimate	df	Standard error	95% CI	
				Low	High
Intercept	34.430	1	1.102	31.824	37.036
A-Inlet temp	2.937	1	0.871	0.876	4.997
B-%solid content	1.268	1	0.871	-0.793	3.328
AB	1.415	1	1.232	-1.499	4.329
A^2	-1.676	1	0.934	-3.886	0.533
B^2	-3.471	1	0.934	-5.681	-1.262

Table 80 ANOVA for response surface linear model (%moisture content)

Source	Sum of squares	df	Mean square	*F*-value	*P*-value
Model	11.409	2	5.704	10.446	0.0036
A-Inlet temp	10.994	1	10.994	20.134	0.0012
B-%solid content	0.414	1	0.414	0.759	0.4041
Residual	5.461	10	0.546		
Lack of Fit	4.622	6	0.770	3.677	0.1141
Pure Error	0.838	4	0.210		
Corrected Total	16.869	12			
* R-Squared	0.6763				

Table 81 Coefficients for response linear model (%moisture content)

Factor	Coefficient estimate	df	Standard error	95% CI	
				Low	High
Intercept	8.874	1	0.205	8.417	9.331
A-Inlet temp	-1.172	1	0.261	-1.754	-0.590
B-%solid content	-0.228	1	0.261	-0.810	0.355

VITA

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