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ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



APPENDICES

ศูนย์วิทยทรัพยากร
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APPENDIX A

Analysis of Propranolol Hydrochloride

1. The UV-visible spectrophotometric method

1.1 Calibration curve

The UV-visible spectrophotometric method was used to determine the amount of drug release in dissolution test. The relationships between concentrations versus absorbances of propranolol HCl in various media are presented in Table 1A-7A. The calibration curve of propranolol HCl and a linear relationship with the correlation of determination are also illustrated in Figures 1A-7A.

Table 1A Absorbance of propranolol HCl in pH 1.2 buffer solution at 288 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.01	0.203	0.199	0.201	0.201	0.002
20.02	0.398	0.396	0.400	0.398	0.002
30.03	0.593	0.588	0.588	0.590	0.003
40.04	0.792	0.784	0.788	0.788	0.004
50.05	0.982	0.979	0.982	0.981	0.002

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Table 2A Absorbance of propranolol HCl in pH 6.8 buffer solution at 288 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.01	0.201	0.210	0.199	0.203	0.006
20.02	0.399	0.395	0.397	0.397	0.002
30.03	0.597	0.589	0.590	0.592	0.004
40.04	0.789	0.778	0.791	0.786	0.007
50.05	0.974	0.973	0.978	0.975	0.003

Table 3A Absorbance of propranolol HCl in methanol at 287 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.00	0.206	0.205	0.207	0.206	0.001
20.00	0.400	0.402	0.405	0.402	0.003
30.00	0.605	0.605	0.608	0.606	0.002
40.00	0.799	0.810	0.807	0.806	0.006
50.00	0.995	1.012	1.007	1.005	0.009

Table 4A Absorbance of propranolol HCl in deionize water at 287 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.00	0.197	0.199	0.200	0.199	0.002
20.00	0.391	0.391	0.393	0.392	0.001
30.00	0.587	0.592	0.590	0.589	0.002
40.00	0.782	0.781	0.780	0.781	0.001
50.00	0.971	0.972	0.978	0.973	0.004

Table 5A Absorbance of propranolol HCl in 1 M glucose solution at 288 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.00	0.201	0.216	0.199	0.205	0.009
20.00	0.404	0.415	0.396	0.405	0.010
30.00	0.599	0.614	0.585	0.599	0.014
40.00	0.785	0.802	0.792	0.793	0.008
50.00	0.980	1.008	0.974	0.987	0.018

Table 6A Absorbance of propranolol HCl in 2 M glucose solution at 288 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.00	0.205	0.215	0.197	0.206	0.009
20.00	0.407	0.399	0.393	0.400	0.007
30.00	0.592	0.582	0.578	0.584	0.007
40.00	0.789	0.779	0.759	0.776	0.015
50.00	0.983	0.963	0.942	0.962	0.021

Table 7A Absorbance of propranolol HCl in 3 M glucose solution at 289 nm

CONC. (mcg/ml)	1	2	3	AVG	SD
10.00	0.173	0.190	0.191	0.185	0.010
20.00	0.357	0.384	0.387	0.376	0.016
30.00	0.550	0.556	0.557	0.554	0.004
40.00	0.744	0.761	0.742	0.749	0.010
50.00	0.932	0.930	0.917	0.927	0.008

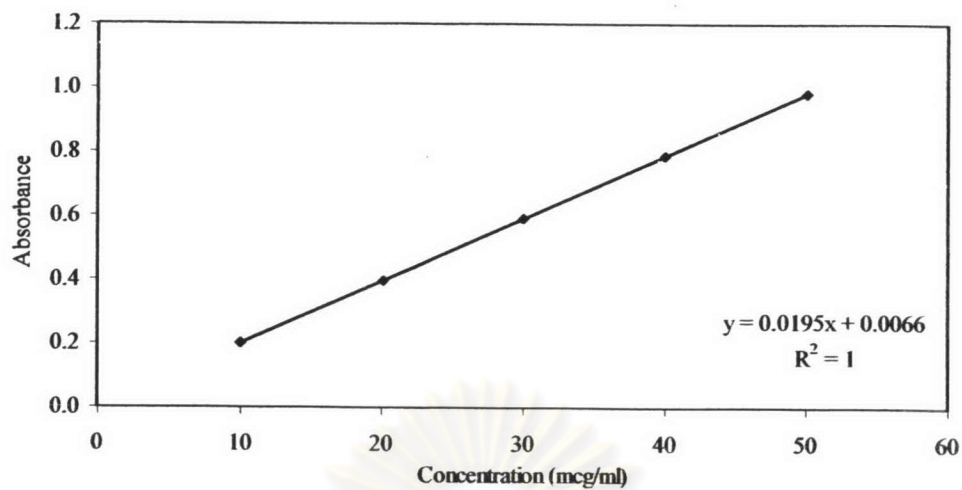


Figure 1A Calibration curve of propranolol HCl in pH 1.2 buffer solution at 288 nm

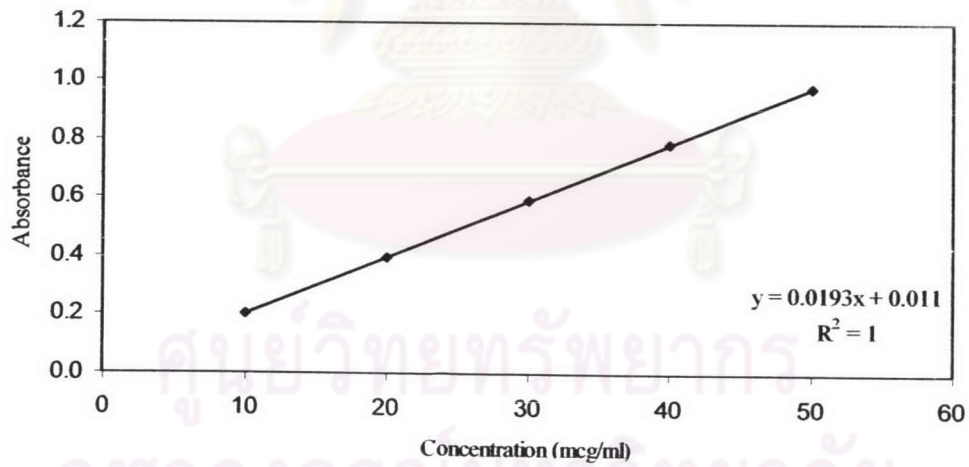


Figure 2A Calibration curve of propranolol HCl in pH 6.8 buffer solution at 288 nm

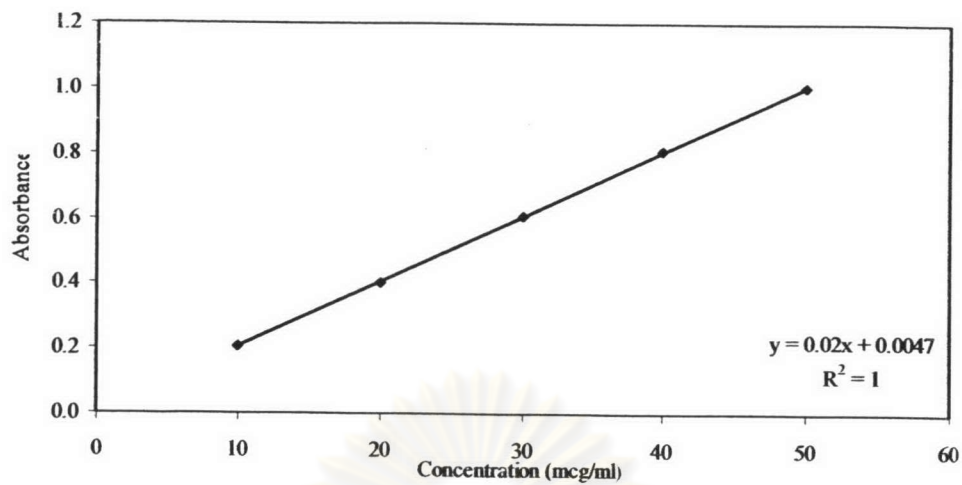


Figure 3A Calibration curve of propranolol HCl in methanol at 287 nm

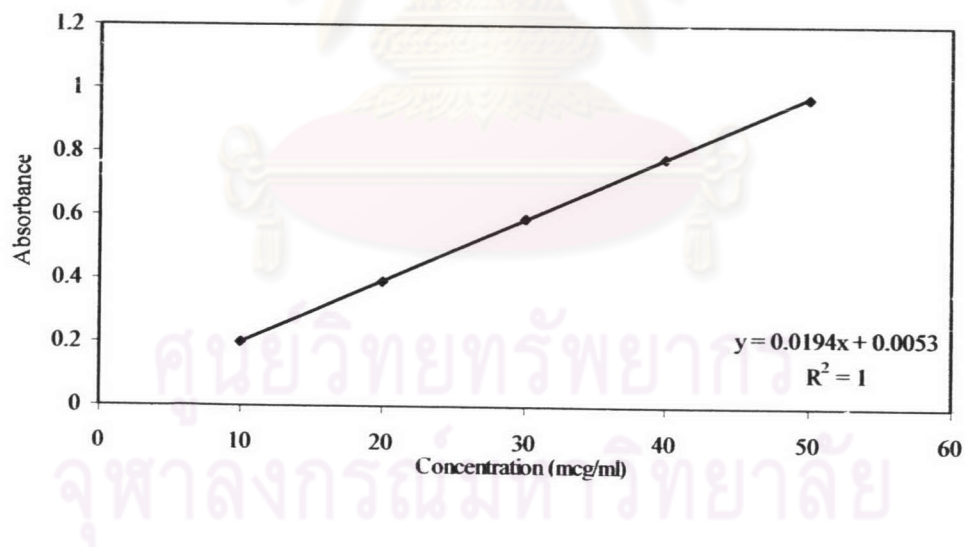


Figure 4A Calibration curve of propranolol HCl in deionize water at 287 nm

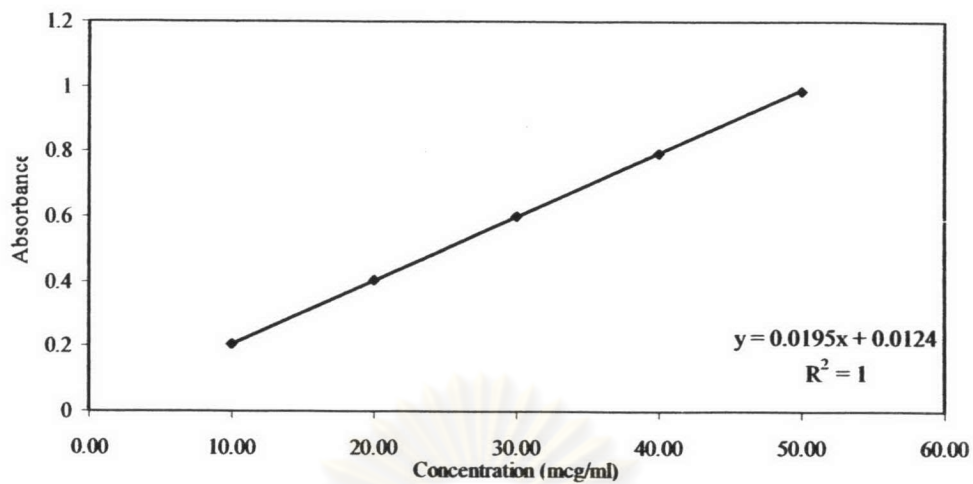


Figure 5A Calibration curve of propranolol HCl in 1 M glucose solution at 288 nm

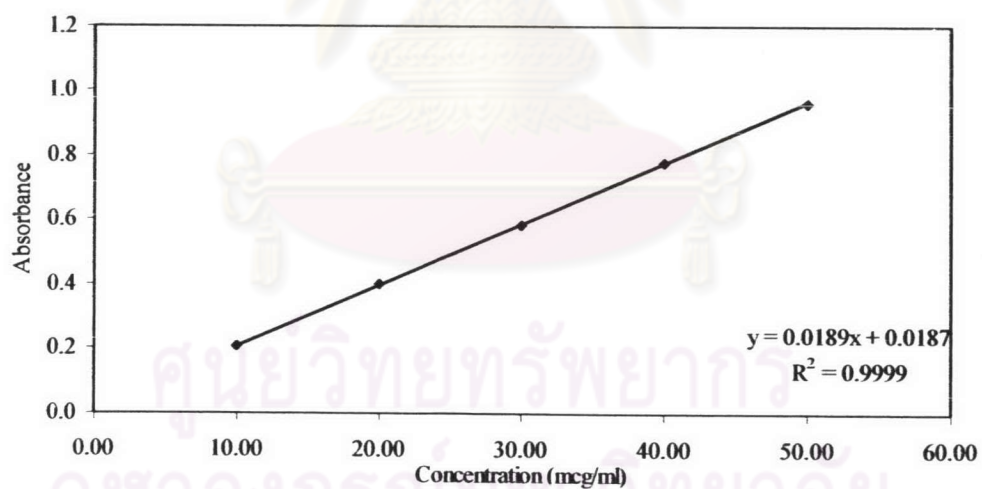


Figure 6A Calibration curve of propranolol HCl in 2 M glucose solution at 288 nm

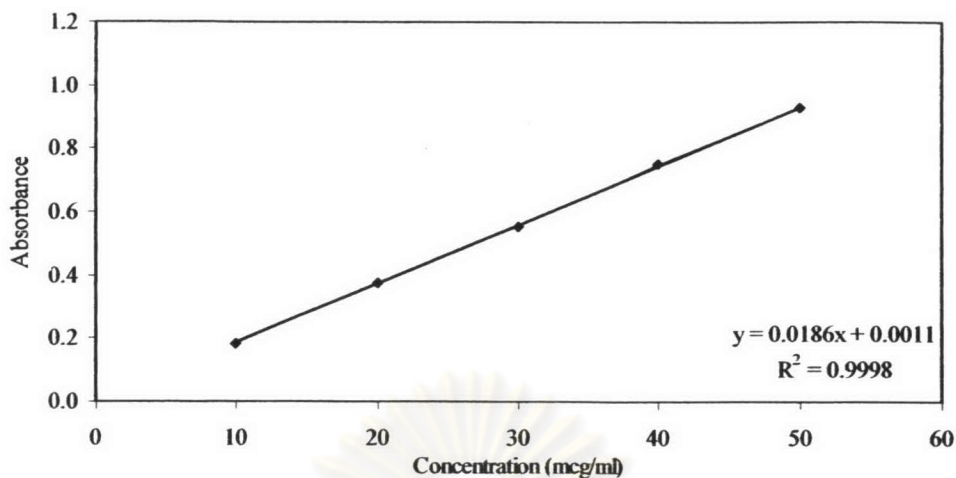


Figure 7A Calibration curve of propranolol HCl in 3 M glucose solution at 289 nm.

2. The high performance liquid chromatography method

2.1 Validation of HPLC method

The drug content of propranolol HCl in tablets was determined by HPLC assay with UV detection. The validation of HPLC method used is presented as follows:

2.1.1 Specificity

Because under the chromatographic condition used, the peak of propranolol HCl had to be completely separated from and not to be interfered by the peak of non-active ingredients, therefore the specificity of HPLC method was evaluated. The validation was made by comparing the chromatograms between non-active ingredients solution with that of standard solution of propranolol HCl.

Figure 8A shows the chromatograms of propranolol HCl solution. Propranolol HCl were eluted at 6.545 minutes. For non-active ingredients, including lactose,

sodium chloride and magnesium stearate, their peaks did not appear under the used conditions of HPLC method. This result indicated that the peak of propranolol HCl was not interfered with the peak of other component in the sample. Therefore, this method having high specificity could be used for analysis of propranolol HCl.

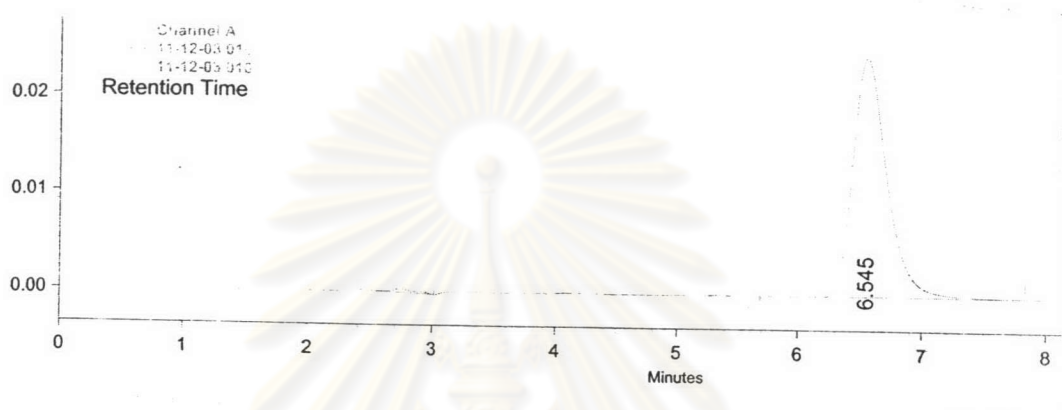


Figure 8A HPLC chromatogram of standard solution of propranolol HCl

2.1.2 Accuracy

The accuracy of an analytical method is the closeness of the test results obtained by that method to the true value. Twenty tablets of film coat tablets (B1) were pulverized by mortar and pestle. The solution containing the mixture of tablet and propranolol HCl were prepared. These final concentrations were equivalent to 150, 200 and 250% of concentration of propranolol HCl in solution which was subjected to assay for drug content. Each sample was determined in triplicate. The percentage of the analytical recovery of each sample was calculated as shown in Table 8A. The mean of percentage of analytical recovered closely to 100%, with a low %CV indicated the high accuracy of this method. Thus, it could be used for analysis of propranolol HCl in all concentrations studies.

Table 8A Percentage of analytical recovery of propranolol HCl assayed by the HPLC method

Actual weight of propranolol HCl (mg)	Calculated concentration of propranolol HCl (mg)	% Analytical recovery
40	38.64	96.36
	39.33	98.07
	39.55	98.89
80	80.13	100.17
	77.98	97.47
	77.87	97.22
120	114.76	95.55
	115.41	96.17
	115.58	96.31
Average		97.3567
SD		1.4819
%CV		1.5221

2.1.3 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 analytical method is usually expressed as the standard deviation or relative standard deviation (coefficient of variation).

Within run precision

Three sets of standard solution of each concentration were analyzed in the same day. The standard solutions having concentration of 1.2, 3.6 and 6 $\mu\text{g/ml}$ were analyzed. The percentage coefficient of variation (%CV) of peak area of propranolol HCl from three sets of standard solutions having the same concentrations was determined as shown in Table 9A.

Between run precision

The between run precision was determined by comparing each concentration of propranolol HCl standard solutions prepared and analyzed on different days. The standard solution having concentration of 1.2, 3.6 and 6 $\mu\text{g/ml}$ was used. The precision determination was done in three days. In each day, determination of each concentration was done in triplicate. The percentage coefficient of variation (% CV) of peak area of propranolol HCl from three sets of standard solutions for each concentration was determined as shown in Table 10A.

All coefficients of variation values were small so it indicated that the HPLC method used was precise for quantitative analysis of propranolol HCl concentration in the range studied.

Table 9A Data of within run precision assayed by HPLC method

propranolol HCl concentration ($\mu\text{g/ml}$)	Concentration ($\mu\text{g/ml}$)					
	Set no.1	Set no.2	Set no.3	AVG	SD	%CV
1.2	1.2091	1.2061	1.2101	1.2084	0.0021	0.1723
3.6	3.5975	3.6002	3.6110	3.6029	0.0072	0.1986
6	5.9975	5.9758	6.0053	5.9929	0.0153	0.2551

Table 10A Data of between run precision assayed by HPLC method

propranolol HCl concentration ($\mu\text{g/ml}$)	Concentration ($\mu\text{g/ml}$)					
	Day 1	Day 2	Day 3	AVG	SD	%CV
1.2	1.2063	1.2262	1.2084	1.2137	0.0109	0.9009
3.6	3.6005	3.5889	3.6029	3.5975	0.0075	0.2078
6	5.9920	6.0111	5.9929	5.9987	0.0108	0.1793

2.1.4 Linearity

The linearity of analytical method is its ability to elicit test results that are directly, or by a well-defined mathematical transformation, proportional to the concentration of analyst in samples within a given range. Propranolol HCl standard solution ranging from 1.2-6 $\mu\text{g/ml}$ were prepared and analyzed. The determination was done in triplicate. Linear regression analysis of peak areas versus their concentrations was performed as shown in Figure 9A. The relationship between peak areas and propranolol HCl concentrations is linear with a coefficient of determination (R^2) value of 0.9999. This result pointed out that HPLC method was acceptable for quantitative analysis of propranolol HCl in the concentration range studied.

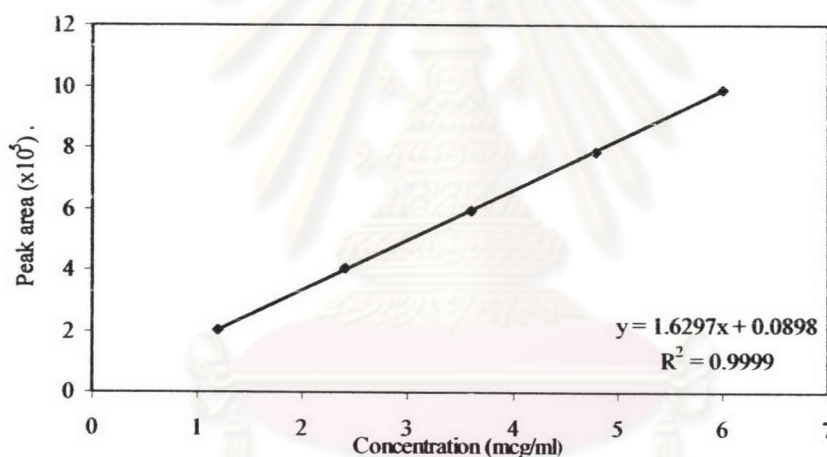


Figure 9A Calibration curve of propranolol HCl assayed by HPLC method

APPENDIX B

Evaluation of Tablets

Table 1B Weight and weight variation of propranolol HCl core tablet containing different amount of sodium chloride

No.	Weight (mg)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	305.7	288.5	306.7	305.7	306.6
2	301.8	302.1	297.8	307.2	295.3
3	300.1	304.5	299.1	294.5	301.1
4	301.9	295.8	312.1	304.6	295.6
5	294.7	301.2	298.2	295.3	304.9
6	300.7	310.3	301.9	298.2	308.3
7	306.8	304.3	305.8	309.8	305.7
8	296.5	313.8	307.7	297.1	303.2
9	303.8	294.0	307.3	305.4	308.1
10	306.5	288.6	320.2	306.1	303.9
11	300.7	293.4	304.1	298.9	304.4
12	299.3	297.3	296.2	293.6	295.2
13	305.3	280.7	309.4	303.0	300.4
14	298.3	296.3	307.4	301.6	298.7
15	308.4	297.2	294.9	291.3	304.1
16	299.9	305.9	297.9	306.5	304.8
17	298.0	290.0	298.8	307.5	305.1
18	297.1	286.5	302.9	306.3	299.0
19	307.0	296.9	309.1	307.5	299.8
20	306.8	288.8	299.5	300.5	302.4
AVG	301.97	296.81	303.85	302.03	302.33
SD	4.08	8.43	6.32	5.49	4.04
%CV	1.35	2.84	2.08	1.82	1.34

Table 2B Weight and weight variation of propranolol HCl coated with different grade of chitosan freshly prepared and after moist heat treatment for 24 hours

No.	Weight (mg)					
	A1	B1	C1	A1:24	B1:24	C1:24
1	361.5	369.0	357.0	358.9	361.5	357.7
2	365.8	372.6	355.3	362.6	364.6	356.0
3	341.5	368.5	351.2	339.0	360.8	351.7
4	356.4	373.9	347.0	353.5	365.9	347.4
5	361.2	364.3	338.9	358.5	356.5	339.6
6	357.0	374.1	341.9	354.1	366.0	342.4
7	369.9	371.2	343.1	367.1	363.6	343.1
8	353.5	374.2	365.7	350.4	366.6	366.1
9	367.4	364.2	351.5	364.7	356.0	352.4
10	372.3	364.5	352.7	369.3	356.8	353.4
11	360.5	376.5	375.7	357.8	368.0	375.9
12	359.8	373.8	353.4	356.9	366.0	354.1
13	367.9	376.7	343.8	369.9	368.1	344.2
14	362.5	367.9	343.3	359.7	360.3	343.8
15	363.8	373.0	355.3	360.8	365.4	355.8
16	352.9	371.2	352.1	350.2	363.2	352.5
17	358.2	369.3	360.1	355.4	361.5	361.1
18	374.3	378.8	354.7	371.6	371.0	355.3
19	375.2	378.4	352.5	372.6	370.4	353.1
20	353.7	367.6	355.7	350.9	360.2	356.3
AVG	361.77	371.49	352.55	359.20	363.62	353.10
SD	8.26	4.50	8.59	8.50	4.38	8.60
%CV	2.28	1.21	2.44	2.37	1.20	2.43

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Table 3B Weight and weight variation of propranolol HCl coated tablet after moist heat treatment for different time interval

No.	Weight (mg)							
	B1	B1:1	B1:3	B1:4	B1:5	B1:6	B1:12	B1:24
1	369.0	348.6	350.6	376.6	375.7	367.9	357.7	361.5
2	372.6	369.5	371.4	368.1	371.0	365.5	357.9	364.6
3	368.5	364.1	362.1	367.1	369.3	374.1	364.4	360.8
4	373.9	369.3	359.4	361.8	364.9	373.0	372.4	365.9
5	364.3	370.8	371.0	369.8	364.4	370.3	358.1	356.5
6	374.1	373.6	363.1	370.4	351.6	364.8	369.0	366.0
7	371.2	359.8	366.3	354.2	373.8	363.7	368.5	363.6
8	374.2	354.7	370.4	361.7	365.8	368.2	372.7	366.6
9	364.2	368.4	374.4	361.4	352.0	370.3	369.0	356.0
10	364.5	375.3	362.8	365.1	377.3	372.1	371.9	356.8
11	376.5	355.5	354.3	363.0	363.8	372.8	372.0	368.0
12	373.8	358.8	350.6	359.4	364.2	360.7	373.3	366.0
13	376.7	361.3	368.1	363.6	351.5	360.2	357.0	368.1
14	367.9	368.4	373.2	366.6	352.1	363.9	367.4	360.3
15	373.0	364.3	369.9	371.0	355.5	349.4	362.9	365.4
16	371.2	357.5	367.6	364.5	358.9	356.9	370.0	363.2
17	369.3	358.9	357.0	367.9	360.6	372.4	370.6	361.5
18	378.8	353.8	367.9	371.5	364.9	371.9	358.6	371.0
19	378.4	371.3	355.1	377.5	344.2	360.9	351.8	370.4
20	367.6	339.6	368.0	364.0	375.5	374.2	352.9	360.2
AVG	371.49	362.18	364.16	366.26	362.85	366.66	364.91	363.62
SD	4.50	9.08	7.42	5.64	9.45	6.63	7.14	4.38
%CV	1.21	2.51	2.04	1.54	2.60	1.81	1.96	1.20

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Table 4B Weight and weight variation of propranolol HCl coated tablet containing different amount of sodium chloride after moist heat treatment for 5 hours

No.	Weight (mg)							
	B2	B3	B4	B5	B2:5	B3:5	B4:5	B5:5
1	372.1	378.2	376.0	369.5	387.1	403.2	367.6	372.5
2	365.7	384.2	369.1	368.5	376.1	377.4	382.6	369.9
3	371.9	366.7	363.7	364.1	374.2	380.0	381.1	362.8
4	387.1	368.7	375.3	362.1	371.9	380.0	377.3	362.9
5	384.8	378.7	372.2	363.8	374.4	375.6	372.1	374.5
6	379.5	366.2	366.5	366.8	355.2	378.2	363.6	374.7
7	385.1	366.6	367.8	363.1	380.4	381.5	380.8	386.0
8	387.6	383.2	362.9	373.9	373.4	387.1	386.7	368.8
9	381.6	380.0	376.7	374.3	372.6	386.7	376.2	371.8
10	371.3	379.3	371.5	362.2	381.2	376.1	367.9	373.0
11	343.1	378.0	369.9	370.2	371.5	386.4	367.6	367.6
12	368.7	382.8	380.8	373.8	364.2	377.0	376.6	367.8
13	391.0	385.8	378.8	374.0	372.7	386.3	378.4	370.2
14	378.8	383.8	373.4	366.0	351.1	383.2	387.2	356.7
15	364.7	376.6	375.1	369.9	366.6	369.7	377.0	374.5
16	379.8	368.7	371.4	370.1	373.4	384.5	378.2	368.4
17	365.7	370.5	379.4	373.0	382.2	388.7	377.4	367.6
18	365.3	382.7	366.2	375.6	381.5	397.3	375.2	372.4
19	355.7	369.6	372.2	366.3	366.7	384.3	383.3	363.5
20	380.6	379.2	370.8	367.1	375.0	390.4	371.4	362.1
AVG	374.01	376.48	371.99	368.72	372.57	383.68	376.41	369.39
SD	11.94	6.75	5.06	4.39	8.73	7.74	6.47	6.24
%CV	3.19	1.79	1.36	1.19	2.34	2.02	1.72	1.69

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Table 5B Hardness of propranolol HCl core tablet containing different amount of sodium chloride

No.	Hardness (kp)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	11.6	9.5	6.8	6.5	3.0
2	12.0	8.2	6.9	6.5	3.4
3	11.6	9.3	8.1	5.9	4.6
4	10.6	9.6	9.4	7.1	3.7
5	9.9	10.1	8.5	6.4	3.7
6	13.4	8.8	9.4	6.0	3.4
7	11.6	9.9	9.7	6.2	4.4
8	11.4	8.1	8.1	6.4	3.5
9	10.6	9.6	8.7	6.1	3.0
10	11.4	8.2	8.0	6.1	2.9
AVG	11.41	9.13	8.36	6.33	3.56
SD	0.94	0.75	0.10	0.35	0.57
%CV	8.27	8.20	11.91	5.56	16.07

Table 6B Hardness of propranolol HCl coated with different grade of chitosan freshly prepared and after moist heat treatment for 24 hours

No.	Hardness (kp)					
	A1	B1	C1	A1:24	B1:24	C1:24
1	35.6	19.8	30.6	40.5	27.2	38.0
2	34.6	22.5	32.8	43.4	30.4	36.7
3	33.7	20.0	31.7	42.2	27.8	36.8
4	34.3	21.3	30.6	43.4	29.8	39.8
5	34.5	21.4	31.1	42.1	30.2	37.2
6	33.5	20.6	30.0	38.9	29.7	36.6
7	33.5	24.3	29.6	43.6	30.4	37.6
8	32.1	21.9	30.6	42.2	29.5	34.8
9	35.8	18.2	32.6	39.3	30.4	38.6
10	37.5	20.0	34.4	37.4	30.4	35.7
AVG	34.51	21.00	31.40	41.30	29.58	37.18
SD	1.50	1.69	1.48	2.16	1.15	1.43
%CV	4.36	8.04	4.71	5.23	3.90	3.83

Table 7B Hardness of propranolol HCl coated tablet after moist heat treatment for different time interval

No.	Hardness (kp)							
	B1	B1:1	B1:3	B1:4	B1:5	B1:6	B1:12	B1:24
1	19.8	31.4	32.4	30.1	28.1	28.5	27.0	27.2
2	22.5	33.3	27.7	30.0	32.3	29.4	27.7	30.4
3	20.0	31.1	29.8	30.2	32.4	26.3	28.1	27.8
4	21.3	33.0	25.4	31.7	28.3	29.8	27.1	29.8
5	21.4	30.7	27.6	28.8	31.7	31.1	27.9	30.2
6	20.6	30.7	29.0	37.9	29.2	26.7	29.0	29.7
7	24.3	31.6	28.5	28.6	32.9	28.6	27.1	30.4
8	21.9	31.4	30.5	30.4	32.2	28.2	29.1	29.5
9	18.2	32.0	28.2	29.2	28.2	28.8	25.8	30.4
10	20.0	34.1	26.9	31.0	30.9	29.0	26.8	30.4
AVG	21.00	31.93	28.60	30.79	30.62	28.64	27.56	29.58
SD	1.69	1.16	1.97	2.67	1.96	1.40	1.02	1.15
%CV	8.04	3.63	6.87	8.68	6.40	4.88	3.69	3.90

Table 8B Hardness of propranolol HCl coated tablet containing different amount of sodium chloride after moist heat treatment for 5 hours

No.	Hardness (kp)							
	B2	B3	B4	B5	B2:5	B3:5	B4:5	B5:5
1	12.5	15.3	15.3	15.5	11.4	10.7	11.6	11.8
2	13.1	16.1	14.9	16.9	10.4	11.3	10.8	11.9
3	14.3	14.9	15.3	15.5	11.2	11.1	11.6	11.8
4	13.7	16.6	15.0	14.9	11.6	12.0	11.0	10.9
5	14.2	14.9	13.0	16.0	12.0	10.4	11.3	10.0
6	15.3	14.0	14.1	13.9	11.1	10.6	11.2	11.2
7	13.7	14.1	14.9	16.2	11.0	10.2	12.4	11.6
8	13.0	14.1	14.2	15.5	10.3	10.3	10.2	11.7
9	13.4	13.1	13.3	15.7	11.1	10.9	11.0	10.2
10	15.4	16.4	15.3	15.2	12.6	11.6	11.3	11.1
AVG	13.86	14.95	14.53	15.53	11.27	10.91	11.24	11.22
SD	0.95	1.16	0.84	0.80	0.69	0.59	0.58	0.68
%CV	6.88	7.74	5.81	5.14	6.11	5.40	5.14	6.06

Table 9B Diameter of propranolol HCl core tablet containing different amount of sodium chloride

No.	Diameter (mm)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	9.57	9.54	9.49	9.53	9.52
2	9.52	9.53	9.53	9.52	9.51
3	9.52	9.54	9.53	9.49	9.48
4	9.52	9.53	9.53	9.50	9.47
5	9.52	9.54	9.53	9.52	9.49
6	9.52	9.55	9.54	9.52	9.51
7	9.52	9.54	9.54	9.52	9.52
8	9.52	9.53	9.54	9.53	9.53
9	9.52	9.56	9.55	9.55	9.53
10	9.52	9.53	9.53	9.53	9.52
AVG	9.53	9.54	9.53	9.52	9.51
SD	0.02	0.01	0.02	0.02	0.02
%CV	0.17	0.10	0.17	0.17	0.22

Table 10B Diameter of propranolol HCl coated with different grade of chitosan freshly prepared and after moist heat treatment for 24 hours

No.	Diameter (mm)					
	A1	B1	C1	A1:24	B1:24	C1:24
1	9.90	9.90	9.91	9.88	9.78	9.88
2	9.89	9.91	9.88	9.89	9.84	9.86
3	9.88	9.89	9.89	9.87	9.84	9.86
4	9.85	9.90	9.89	9.90	9.78	9.88
5	9.87	9.95	9.89	9.88	9.79	9.87
6	9.90	9.94	9.88	9.90	9.81	9.88
7	9.89	9.93	9.90	9.88	9.79	9.88
8	9.90	9.90	9.90	9.88	9.80	9.86
9	9.90	9.87	9.89	9.88	9.86	9.87
10	9.90	9.89	9.88	9.86	9.84	9.86
AVG	9.89	9.91	9.89	9.88	9.81	9.87
SD	0.02	0.02	0.01	0.01	0.03	0.01
%CV	0.17	0.25	0.10	0.12	0.30	0.10

Table 11B Diameter of propranolol HCl coated tablet after moist heat treatment for different time interval

No.	Diameter (mm)							
	B1	B1:1	B1:3	B1:4	B1:5	B1:6	B1:12	B1:24
1	9.90	9.91	9.91	9.88	9.85	9.86	9.80	9.78
2	9.91	9.87	9.90	9.89	9.88	9.81	9.81	9.84
3	9.89	9.86	9.89	9.91	9.87	9.85	9.84	9.84
4	9.90	9.93	9.86	9.86	9.81	9.81	9.86	9.78
5	9.95	9.90	9.88	9.84	9.84	9.81	9.81	9.79
6	9.94	9.85	9.90	9.86	9.82	9.84	9.80	9.81
7	9.93	9.90	9.91	9.88	9.91	9.81	9.83	9.79
8	9.90	9.88	9.91	9.91	9.87	9.90	9.84	9.80
9	9.87	9.88	9.84	9.92	9.84	9.85	9.83	9.86
10	9.89	9.89	9.87	9.92	9.87	9.87	9.79	9.84
AVG	9.91	9.89	9.89	9.89	9.86	9.84	9.82	9.81
SD	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.03
%CV	0.25	0.24	0.24	0.28	0.30	0.32	0.23	0.30

Table 12B Diameter of propranolol HCl coated tablet containing different amount of sodium chloride after moist heat treatment for 5 hours

No.	Diameter (mm)							
	B2	B3	B4	B5	B2:5	B3:5	B4:5	B5:5
1	10.02	10.05	9.97	9.91	9.98	10.00	9.95	9.97
2	10.06	10.02	9.97	9.95	9.97	9.97	9.95	9.94
3	10.05	10.05	9.95	9.92	9.99	9.99	9.95	9.95
4	10.06	10.01	9.97	9.98	9.95	9.95	9.96	9.97
5	10.04	10.02	9.97	9.94	9.99	9.98	9.93	9.99
6	10.04	10.01	10.01	9.94	9.98	9.98	9.95	9.99
7	10.06	10.01	9.97	9.94	9.98	9.99	9.96	9.99
8	10.04	10.01	9.97	9.93	10.01	10.02	9.93	9.96
9	10.04	9.98	10.01	9.93	10.00	10.00	9.92	9.95
10	10.02	9.99	9.96	9.91	9.98	10.00	9.96	9.98
AVG	10.04	10.02	9.98	9.94	9.98	9.99	9.95	9.97
SD	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02
%CV	0.15	0.22	0.20	0.21	0.16	0.19	0.14	0.19

Table 13B Thickness of propranolol HCl core tablet containing different amount of sodium chloride

No.	Thickness (mm)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	4.00	3.55	3.65	3.34	3.27
2	4.00	3.53	3.44	3.29	3.12
3	3.87	3.49	3.54	3.29	3.17
4	4.04	3.57	3.5	3.23	3.06
5	4.05	3.54	3.56	3.43	3.27
6	4.03	3.55	3.54	3.31	3.16
7	4.01	3.67	3.48	3.3	3.14
8	3.89	3.53	3.56	3.42	3.21
9	3.79	3.55	3.57	3.45	3.09
10	4.03	3.46	3.42	3.33	3.23
AVG	3.97	3.54	3.53	3.34	3.17
SD	0.09	0.05	0.07	0.07	0.07
%CV	2.23	1.55	1.92	2.15	2.28

Table 14B Thickness of propranolol HCl coated with different grade of chitosan freshly prepared and after moist heat treatment for 24 hours

No.	Thickness (mm)					
	A1	B1	C1	A1:24	B1:24	C1:24
1	4.39	4.45	4.27	4.37	4.51	4.35
2	4.42	4.44	4.33	4.39	4.30	4.27
3	4.33	4.51	4.28	4.38	4.30	4.3
4	4.30	4.42	4.28	4.39	4.24	4.26
5	4.24	4.38	4.35	4.39	4.22	4.39
6	4.37	4.42	4.34	4.41	4.31	4.37
7	4.36	4.37	4.58	4.37	4.31	4.48
8	4.32	4.34	4.24	4.38	4.35	4.35
9	4.41	4.39	4.32	4.39	4.32	4.34
10	4.43	4.38	4.33	4.37	4.37	4.36
AVG	4.36	4.41	4.33	4.38	4.32	4.35
SD	0.06	0.05	0.09	0.01	0.08	0.06
%CV	1.38	1.11	2.17	0.29	1.84	1.46

Table 15B Thickness of propranolol HCl coated tablet after moist heat treatment for different time interval

No.	Thickness (mm)							
	B1	B1:1	B1:3	B1:4	B1:5	B1:6	B1:12	B1:24
1	4.45	4.33	4.31	4.28	4.27	4.41	4.46	4.51
2	4.44	4.31	4.24	4.20	4.27	4.22	4.22	4.30
3	4.51	4.27	4.20	4.29	4.34	4.23	4.24	4.30
4	4.42	4.32	4.32	4.43	4.35	4.30	4.17	4.24
5	4.38	4.30	4.30	4.42	4.38	4.25	4.45	4.22
6	4.42	4.25	4.25	4.24	4.41	4.23	4.45	4.31
7	4.37	4.35	4.33	4.14	4.19	4.30	4.21	4.31
8	4.34	4.27	4.31	4.28	4.33	4.29	4.31	4.35
9	4.39	4.32	4.31	4.31	4.27	4.10	4.17	4.32
10	4.38	4.30	4.21	4.38	4.22	4.28	4.37	4.37
AVG	4.41	4.30	4.28	4.30	4.30	4.26	4.31	4.32
SD	0.05	0.03	0.05	0.09	0.07	0.08	0.12	0.08
%CV	1.11	0.72	1.13	2.16	1.64	1.85	2.76	1.84

Table 16B Thickness of propranolol HCl coated tablet containing different amount of sodium chloride after moist heat treatment for 5 hours

No.	Thickness (mm)							
	B2	B3	B4	B5	B2:5	B3:5	B4:5	B5:5
1	4.37	4.24	4.03	3.75	4.62	4.58	4.03	3.96
2	4.30	4.23	3.96	3.78	4.50	4.34	4.14	3.97
3	4.29	4.23	4.08	3.82	4.42	4.34	4.18	3.86
4	4.29	4.14	3.96	3.77	4.27	4.33	4.13	3.81
5	4.25	4.25	3.83	3.81	4.51	4.41	4.06	3.93
6	4.40	4.12	4.05	3.68	4.44	4.38	3.97	3.94
7	4.29	4.20	3.94	3.92	4.57	4.28	4.11	3.96
8	4.06	4.09	3.96	3.82	4.48	4.41	4.19	3.95
9	4.25	4.14	4.03	3.74	4.44	4.29	4.02	3.89
10	4.37	4.28	4.14	4.04	4.35	4.44	4.00	3.92
AVG	4.29	4.19	4.00	3.81	4.46	4.38	4.08	3.92
SD	0.09	0.06	0.09	0.10	0.10	0.09	0.08	0.05
%CV	2.21	1.54	2.17	2.67	2.28	2.00	1.90	1.31

Table 17B Disintegration time of propranolol HCl core tablet containing different amount of sodium chloride

No.	Disintegration time (min)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	9.21	8.03	8.05	7.21	8.20
2	9.48	8.03	8.17	7.45	8.34
3	9.48	8.17	8.17	7.45	8.46
4	9.48	8.17	8.31	8.00	8.46
5	10.18	9.24	8.46	8.00	9.05
6	10.39	9.52	8.56	8.11	9.13
AVG	9.70	8.53	8.29	7.70	8.61
SD	0.47	0.67	0.19	0.38	0.39
%CV	4.82	7.86	2.34	4.90	4.50

Table 18B Uniformity of propranolol HCl in core tablet containing different amount of sodium chloride

No.	Uniformity of dosage unit (%)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	102.01	102.06	99.89	97.86	99.06
2	105.79	98.56	101.06	94.79	97.36
3	103.03	98.72	100.43	94.11	97.81
4	105.53	100.32	100.32	103.68	95.62
5	98.58	99.67	100.15	103.73	96.29
6	102.95	99.79	100.10	108.27	94.37
7	105.82	100.04	101.42	109.87	93.09
8	101.82	100.84	99.89	100.11	96.26
9	100.36	101.07	102.82	100.23	97.93
10	99.32	99.59	99.56	97.53	95.83
AVG	102.52	100.07	100.65	101.02	96.36
SD	2.63	1.06	0.96	5.33	1.42
%CV	2.57	1.06	0.96	5.27	1.47

Table 19B Percent label amount of propranolol HCl in core tablet containing different amount of sodium chloride

No.	Label amount (%)				
	Core 1	Core 2	Core 3	Core 4	Core 5
1	102.27	97.65	99.28	98.26	95.66
2	102.32	95.00	94.18	97.53	97.49
3	102.74	97.30	99.25	92.57	101.78
AVG	102.44	96.65	97.57	96.12	98.31
SD	0.26	1.44	2.94	3.10	3.14
%CV	0.25	1.49	3.01	3.22	3.20

Table 20B Percent label amount of propranolol HCl coated tablet containing different amount of sodium chloride

No.	Label amount (%)				
	B1	B2	B3	B4	B5
1	95.20	97.18	95.98	93.09	94.88
2	94.81	94.74	99.39	92.54	94.00
3	95.90	97.94	96.33	97.84	94.86
AVG	95.30	96.62	97.23	94.49	94.58
SD	0.56	1.67	1.88	2.91	0.50
%CV	0.58	1.73	1.93	3.08	0.53

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APPENDIX C

Percentage Amount of Drug Release

Table 1C Cumulative percent drug release of propranolol HCl core tablet (core 1)

Time(min)	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00
5	12.98	13.30	15.03	13.77	1.11
15	32.23	36.36	40.10	36.23	3.93
30	63.76	64.55	70.57	66.30	3.72
45	85.76	89.43	87.56	87.58	1.83
60	91.77	91.73	93.33	92.28	0.91
75	93.00	92.40	94.29	93.23	0.96
90	92.35	91.63	94.03	92.67	1.23

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Table 2C Cumulative percent drug release of propranolol HCl coated tablet (B1) in pH change system

time(min)	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00
30	0.67	1.12	0.92	0.90	0.23
45	3.42	5.16	4.20	4.26	0.87
60	8.40	10.38	9.49	9.43	0.99
75	15.11	16.70	15.19	15.67	0.89
90	22.49	23.23	21.57	22.43	0.83
105	29.89	29.56	27.62	29.02	1.22
120	33.62	32.13	31.16	32.30	1.24
135	39.02	37.16	37.12	37.77	1.09
150	46.74	42.43	42.10	43.76	2.59
180	59.04	52.48	53.07	54.86	3.63
210	69.34	62.82	62.78	64.98	3.78
240	76.98	70.69	70.93	72.87	3.57
270	80.97	75.26	76.05	77.43	3.09
300	83.98	80.16	80.27	81.47	2.18
360	88.10	84.86	85.52	86.16	1.71
420	89.27	87.94	87.72	88.31	0.84
480	90.64	89.88	88.87	89.79	0.89
600	87.26	91.92	92.02	90.40	2.72
720	93.09	94.11	94.92	94.04	0.91
840	94.32	95.33	95.93	95.19	0.82
960	95.67	96.49	96.70	96.28	0.54
1440	97.88	98.18	100.47	98.84	1.42

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Table 3C Cumulative percent drug release of propranolol coated with chitosan A freshly prepared and after moist heat treatment for 24 hours in pH change system

Time (min)	A1					A1:24				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.14	0.21	0.19	0.18	0.04	0.00	0.00	0.00	0.00	0.00
15	0.61	0.58	0.70	0.63	0.06	0.00	0.00	0.00	0.00	0.00
30	2.46	2.45	2.79	2.57	0.19	0.00	0.00	0.00	0.00	0.00
45	5.67	8.10	8.63	7.47	1.58	0.00	0.00	0.00	0.00	0.00
60	14.17	17.58	18.05	16.60	2.12	0.07	0.14	0.00	0.07	0.07
75	26.99	28.99	34.44	30.14	3.86	0.63	0.25	0.08	0.32	0.28
90	53.81	49.15	56.93	53.30	3.92	1.88	0.65	0.35	0.96	0.81
105	77.26	63.28	75.47	72.00	7.61	2.13	0.65	0.35	1.05	0.95
120	91.02	71.72	91.50	84.75	11.29	4.30	4.67	6.22	5.06	1.02
135	99.06	77.81	96.02	90.96	11.49	7.63	5.58	8.78	7.33	1.62
150	100.22	82.31	97.19	93.24	9.58	7.83	5.73	10.65	8.07	2.47
180	100.76	87.03	97.65	95.14	7.20	8.67	7.86	12.17	9.57	2.29
210	101.29	89.75	99.34	96.79	6.17	10.24	10.10	14.99	11.78	2.79
240	101.82	91.75	98.78	97.45	5.16	12.27	11.36	16.82	13.48	2.92
270	102.09	92.26	99.46	97.94	5.09	14.64	13.03	19.08	15.58	3.13
300	101.97	92.86	99.07	97.96	4.65	15.72	15.56	20.99	17.42	3.09
360	102.20	93.85	98.84	98.30	4.20	20.84	21.09	26.13	22.69	2.98
420	102.06	94.21	98.82	98.36	3.95	26.25	24.74	30.44	27.14	2.95
480	102.56	94.03	99.31	98.63	4.31	30.39	28.16	34.74	31.10	3.34
600	102.24	94.69	99.97	98.96	3.87	38.28	35.16	42.08	38.50	3.47
720	102.85	95.13	99.79	99.25	3.89	45.60	41.27	48.16	45.01	3.48
840	102.44	95.78	99.97	99.40	3.37	-	-	-	-	-
960	102.38	95.90	100.10	99.46	3.29	59.43	52.25	58.67	56.78	3.94
1080	102.72	96.10	100.82	99.88	3.41	67.36	56.76	62.71	62.28	5.32
1200	102.76	96.69	100.51	99.98	3.07	71.44	59.12	66.71	65.75	6.22
1440	103.38	97.04	100.87	100.43	3.19	78.07	65.19	70.94	71.40	6.45

Table 4C Cumulative percent drug release of propranolol HCl coated with chitosan C freshly prepared and after moist heat treatment for 24 hours in pH change system

Time (min)	C1					C1:24				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
15	0.35	0.30	0.82	0.49	0.29	0.00	0.00	0.00	0.00	0.00
30	2.39	3.34	2.50	2.74	0.52	0.00	0.00	0.00	0.00	0.00
45	5.77	13.55	5.88	8.40	4.46	0.00	0.00	0.00	0.00	0.00
60	12.43	26.74	11.16	16.78	8.65	0.00	0.00	0.00	0.00	0.00
75	22.86	42.07	17.37	27.43	12.97	0.00	0.00	0.00	0.00	0.00
90	37.13	58.06	27.56	40.92	15.60	0.00	0.00	0.00	0.00	0.00
105	80.59	74.84	58.94	71.46	11.22	0.00	0.00	0.00	0.00	0.00
120	92.06	82.78	70.34	81.73	10.90	0.36	0.25	7.35	2.65	4.07
135	96.15	87.19	77.34	86.89	9.41	9.36	8.39	9.77	9.17	0.71
150	97.28	90.07	80.12	89.16	8.62	10.78	10.88	11.74	11.13	0.53
180	97.58	92.15	87.02	92.25	5.28	13.31	13.51	14.07	13.63	0.39
210	97.35	92.77	91.87	94.00	2.94	15.20	15.53	15.95	15.56	0.38
240	96.59	93.02	92.65	94.09	2.17	17.47	18.10	17.84	17.80	0.31
270	99.98	93.81	95.28	96.35	3.23	19.55	19.56	19.69	19.60	0.08
300	99.51	93.85	95.92	96.43	2.87	21.41	21.30	21.46	21.39	0.08
360	99.35	93.98	95.56	96.30	2.76	24.65	25.57	25.55	25.26	0.52
420	99.88	94.28	98.16	97.44	2.87	28.34	29.50	29.34	29.06	0.63
480	100.30	94.85	98.00	97.72	2.74	31.55	34.29	32.47	32.77	1.39
600	99.95	95.37	100.74	98.69	2.90	38.14	41.56	38.61	39.44	1.85
720	100.42	95.57	99.68	98.56	2.61	43.37	49.01	44.51	45.63	2.98
840	101.42	93.21	99.80	98.15	4.35	-	-	-	-	-
960	101.52	93.63	101.11	98.75	4.44	54.00	58.97	53.85	55.61	2.91
1080	101.02	93.91	101.71	98.88	4.32	56.42	63.37	57.44	59.07	3.76
1200	99.55	93.86	101.58	98.33	4.00	63.54	68.09	61.08	64.24	3.55
1440	101.63	94.07	103.53	99.74	5.01	70.18	74.90	67.78	70.95	3.63

Table 5C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 1 hours with 0 and 200 μ m of passageway in pH change system

Time (min)	B1:1					B1:1:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.18	0.00	0.06	0.10	0.01	0.04	0.06	0.04	0.02
30	0.15	0.25	0.17	0.19	0.05	0.25	0.22	0.19	0.22	0.03
45	0.66	2.11	0.59	1.12	0.86	0.54	0.52	0.63	0.56	0.06
60	1.97	4.96	1.66	2.86	1.82	1.57	1.39	1.06	1.34	0.26
75	5.14	8.35	4.26	5.92	2.16	4.44	3.17	2.70	3.43	0.90
90	9.58	12.87	7.99	10.15	2.49	8.20	5.14	6.06	6.47	1.57
105	15.24	18.28	11.24	14.92	3.53	14.79	8.40	12.04	11.74	3.21
120	24.47	30.08	18.78	24.44	5.65	22.67	25.44	19.79	22.63	2.83
135	27.24	34.01	22.39	27.88	5.83	25.20	30.41	23.27	26.29	3.69
150	30.59	35.71	24.58	30.29	5.57	29.29	32.07	27.51	29.62	2.30
180	32.79	40.74	29.10	34.21	5.95	30.60	39.47	29.18	33.08	5.57
210	36.69	44.88	34.02	38.53	5.66	33.42	43.43	33.76	36.87	5.68
240	40.35	48.57	40.34	43.09	4.75	35.88	47.15	37.48	40.17	6.10
270	44.21	53.36	45.74	47.77	4.90	38.32	50.69	41.55	43.52	6.41
300	47.52	56.37	49.84	51.24	4.59	40.95	53.63	45.39	46.66	6.44
360	54.27	63.53	57.73	58.51	4.68	45.47	58.65	53.35	52.49	6.63
420	60.47	67.45	63.27	63.73	3.52	49.47	62.87	58.46	56.93	6.83
480	64.91	73.34	69.08	69.11	4.21	53.45	67.94	64.84	62.08	7.63
600	73.48	79.96	77.33	76.92	3.26	60.04	75.14	73.09	69.43	8.19
720	79.30	84.71	83.53	82.51	2.84	65.94	79.00	78.98	74.64	7.53
840	82.85	86.64	87.03	85.51	2.31	68.99	81.99	83.40	78.13	7.95
960	85.46	87.59	88.89	87.31	1.73	72.35	85.42	87.13	81.63	8.09
1085	87.30	89.18	90.56	89.01	1.63	75.36	88.17	88.99	84.17	7.65
1200	87.85	90.04	92.60	90.16	2.38	79.01	88.89	91.53	86.48	6.60
1440	88.76	91.72	93.52	91.33	2.40	83.88	90.31	94.58	89.59	5.39

Table 6C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 1 hours with 400 and 600 μ m of passageway in pH change system

Time (min)	B1:1:400					B1:1:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.06	0.00	0.00	0.02	0.03	0.00	0.03	0.00	0.01	0.02
15	0.18	0.20	0.12	0.17	0.04	0.00	0.00	0.00	0.00	0.00
30	0.72	0.33	0.36	0.47	0.22	0.39	0.72	0.40	0.50	0.19
45	1.10	0.77	0.85	0.91	0.17	0.89	1.24	0.59	0.90	0.33
60	2.06	1.72	1.75	1.85	0.19	2.55	2.72	1.60	2.29	0.60
75	4.24	4.15	3.26	3.88	0.54	5.46	4.35	4.06	4.62	0.74
90	7.17	7.34	6.07	6.86	0.69	8.30	6.48	6.06	6.95	1.19
105	13.93	13.38	13.85	13.72	0.30	12.06	10.99	10.05	11.03	1.00
120	32.36	25.43	26.45	28.08	3.74	18.99	20.13	19.27	19.46	0.60
135	37.13	31.96	32.01	33.70	2.97	23.43	23.77	23.79	23.66	0.20
150	41.30	35.16	35.37	37.27	3.49	26.06	26.99	27.95	27.00	0.94
180	48.20	41.23	43.37	44.27	3.57	31.08	31.42	36.34	32.95	2.94
210	53.61	45.80	49.27	49.56	3.91	35.20	36.09	47.56	39.62	6.89
240	58.04	50.09	52.09	53.41	4.13	39.62	39.25	65.70	48.19	15.17
270	60.78	53.96	54.53	56.43	3.78	42.79	41.74	68.66	51.06	15.25
300	60.38	57.14	56.43	57.98	2.11	45.69	45.18	70.75	53.87	14.62
360	64.88	61.70	60.36	62.31	2.32	51.60	50.27	73.49	58.45	13.04
420	67.44	65.44	62.88	65.25	2.28	56.76	54.57	75.91	62.41	11.74
480	72.05	70.16	66.80	69.67	2.66	61.29	58.85	78.23	66.12	10.55
600	75.96	74.03	72.55	74.18	1.71	69.05	66.34	81.45	72.28	8.06
720	79.90	79.82	77.64	79.12	1.28	74.37	71.39	83.96	76.58	6.57
840	82.70	81.20	78.96	80.95	1.88	78.62	74.57	86.12	79.77	5.86
960	84.15	83.31	81.68	83.05	1.25	82.22	81.28	87.31	83.60	3.25
1080	87.42	85.39	84.89	85.90	1.34	84.63	81.90	89.41	85.31	3.80
1200	88.59	85.77	85.31	86.55	1.78	86.91	83.06	89.84	86.60	3.40
1440	89.21	87.16	86.52	88.19	1.45	89.26	85.02	91.59	88.62	3.33

Table 7C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 3 hours with 0 and 200 μm of passageway in pH change system

Time (min)	B1:3					B1:3:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.06	0.04	0.03
15	0.00	0.00	0.00	0.00	0.00	0.22	0.01	0.08	0.11	0.11
30	0.18	0.00	0.00	0.06	0.10	0.23	0.25	0.11	0.20	0.07
45	0.28	0.23	0.36	0.29	0.07	0.46	0.45	0.36	0.43	0.05
60	0.56	0.45	0.52	0.51	0.05	1.04	3.76	0.48	1.76	1.76
75	1.12	1.40	1.55	1.36	0.22	3.02	5.67	1.25	3.31	2.23
90	2.91	2.91	3.34	3.05	0.25	4.89	7.85	3.71	5.48	2.13
105	4.47	4.25	4.78	4.50	0.27	6.08	9.19	5.38	6.89	2.03
120	9.61	8.26	7.86	8.58	0.92	9.86	14.29	12.51	12.22	2.23
135	12.05	10.75	10.22	11.01	0.94	15.24	17.55	15.59	16.13	1.25
150	14.00	12.76	12.29	13.02	0.88	20.87	20.35	18.35	19.86	1.33
180	17.85	16.85	16.50	17.07	0.70	21.44	24.19	21.17	22.27	1.67
210	22.06	21.17	21.12	21.45	0.53	23.10	27.10	23.28	24.49	2.26
240	25.95	25.29	25.43	25.56	0.35	24.71	29.51	25.06	26.43	2.68
270	29.54	29.50	29.56	29.54	0.03	26.33	31.55	26.93	28.27	2.86
300	33.19	32.98	33.40	33.19	0.21	28.31	34.03	28.76	30.37	3.18
360	40.06	40.46	40.51	40.34	0.25	31.68	38.80	32.73	34.40	3.85
420	46.84	47.97	46.57	47.12	0.74	35.64	43.44	36.15	38.41	4.36
480	52.14	53.77	52.10	52.67	0.96	39.51	47.69	39.82	42.34	4.64
600	61.04	63.24	60.48	61.59	1.46	45.90	55.21	46.80	49.30	5.13
720	68.60	70.67	66.21	68.49	2.23	52.52	62.14	53.41	56.02	5.32
840	74.57	77.43	72.00	74.67	2.72	58.02	68.62	60.12	62.25	5.61
960	77.92	80.28	75.41	77.87	2.44	63.92	72.92	64.77	67.20	4.97
1085	80.29	85.24	78.27	81.27	3.59	66.84	76.20	68.37	70.47	5.02
1200	84.44	86.63	80.84	83.97	2.93	69.73	78.96	72.53	73.74	4.73
1440	87.61	92.53	85.17	88.44	3.75	75.64	83.42	78.93	79.33	3.91

Table 8C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment at for 3 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:3:400					B1:3:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.15	0.00	0.05	0.09	0.01	0.00	0.00	0.00	0.01
15	0.06	0.20	0.03	0.09	0.09	0.09	0.00	0.01	0.03	0.05
30	0.32	0.43	0.25	0.33	0.09	0.95	0.97	1.87	1.26	0.53
45	3.01	1.11	0.41	1.51	1.34	4.02	4.14	5.35	4.50	0.74
60	5.17	2.37	2.04	3.20	1.72	5.27	5.41	8.51	6.40	1.83
75	6.10	5.17	4.27	5.18	0.91	6.06	5.94	10.61	7.54	2.66
90	7.64	7.74	7.19	7.53	0.29	7.10	7.70	11.06	8.62	2.13
105	9.00	11.20	9.09	9.76	1.25	13.97	9.22	18.77	13.99	4.77
120	13.61	16.52	15.67	15.27	1.50	18.48	16.43	23.81	19.57	3.81
135	16.32	19.90	18.59	18.27	1.81	20.75	19.65	24.58	21.66	2.59
150	18.87	23.10	20.56	20.84	2.13	22.90	21.69	26.81	23.80	2.67
180	24.17	29.17	25.35	26.23	2.61	26.33	26.05	30.77	27.71	2.65
210	26.82	33.45	29.35	29.87	3.34	29.71	28.89	31.64	30.08	1.41
240	28.50	37.51	31.99	32.67	4.54	33.14	30.10	32.60	31.95	1.62
270	30.33	42.25	34.64	35.74	6.03	35.94	31.15	35.56	34.22	2.66
300	32.24	44.36	37.53	38.04	6.07	38.47	32.52	37.35	36.12	3.16
360	35.73	49.69	42.65	42.69	6.98	42.09	35.00	44.46	40.52	4.93
420	39.20	54.46	47.60	47.09	7.64	45.34	38.41	43.02	42.26	3.52
480	43.17	58.43	51.92	51.17	7.66	48.67	41.96	46.22	45.62	3.40
600	48.53	64.19	58.76	57.16	7.95	53.82	48.67	52.99	51.83	2.76
720	54.50	70.69	65.24	63.48	8.24	58.51	54.34	59.53	57.46	2.75
840	59.68	74.70	71.70	68.69	7.95	62.62	60.14	65.21	62.65	2.53
960	64.71	77.99	74.28	72.33	6.85	66.88	64.94	70.13	67.31	2.62
1080	68.26	80.14	77.38	75.26	6.22	69.11	67.72	73.41	70.08	2.97
1200	71.59	81.85	81.10	78.18	5.72	73.16	72.36	76.43	73.98	2.16
1440	75.97	83.61	84.32	81.30	4.63	78.13	77.39	81.86	79.12	2.40

Table 9C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 4 hours with 0 and 200 μm of passageway in pH change system

Time (min)	B1:4					B1:4:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.08	1.35	0.48	0.76	0.00	0.00	0.00	0.00	0.00
15	0.08	0.10	0.02	0.07	0.05	0.00	0.00	0.06	0.02	0.04
30	0.33	0.19	0.10	0.21	0.11	0.23	0.30	0.34	0.29	0.06
45	0.56	0.79	0.42	0.59	0.19	0.50	0.48	0.78	0.58	0.17
60	0.96	0.93	1.03	0.97	0.05	5.13	0.95	2.46	2.85	2.11
75	1.35	1.35	1.17	1.29	0.10	8.84	1.03	5.81	5.23	3.94
90	2.57	3.09	4.08	3.25	0.77	10.27	2.86	8.29	7.14	3.83
105	7.67	8.23	6.87	7.59	0.68	12.05	4.62	9.99	8.88	3.84
120	12.93	11.35	10.71	11.67	1.14	17.03	9.72	14.62	13.79	3.72
135	13.61	11.55	12.53	12.56	1.03	20.03	12.18	16.37	16.19	3.92
150	14.68	13.34	13.78	13.93	0.68	22.48	14.02	18.27	18.26	4.23
180	16.56	14.65	15.97	15.73	0.98	26.31	17.19	20.97	21.49	4.58
210	18.73	16.33	18.63	17.90	1.35	29.99	20.55	24.40	24.98	4.74
240	21.76	19.99	21.92	21.22	1.07	32.53	23.76	25.26	27.18	4.69
270	22.93	20.79	23.03	22.25	1.26	34.42	26.21	27.28	29.30	4.47
300	23.97	24.31	25.61	24.63	0.87	36.15	28.65	28.89	31.23	4.27
360	29.03	27.86	28.20	28.36	0.60	38.64	33.92	32.18	34.91	3.34
420	33.86	32.19	31.61	32.55	1.17	41.30	37.77	35.01	38.03	3.15
480	37.90	36.35	35.63	36.63	1.16	44.79	41.35	38.08	41.41	3.35
600	45.65	44.03	41.80	43.83	1.93	50.49	48.04	43.22	47.25	3.70
720	52.49	50.34	47.09	49.97	2.72	56.46	51.97	48.27	52.23	4.10
840	59.70	56.43	52.67	56.27	3.52	62.52	57.06	53.73	57.77	4.44
960	64.12	60.58	57.28	60.66	3.42	66.89	60.58	57.97	61.81	4.58
1080	68.45	65.76	60.24	64.82	4.19	71.86	65.49	61.87	66.41	5.06
1200	72.22	69.91	65.32	69.15	3.51	74.95	67.09	65.40	69.15	5.10
1440	99.72	97.19	70.78	89.23	16.02	79.95	71.75	71.42	74.37	4.83

Table 10C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 4 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:4:400					B1:4:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.15	0.00	0.00	0.05	0.09	0.07	0.00	0.00	0.02	0.04
30	0.61	0.59	0.41	0.54	0.11	1.65	1.79	1.09	1.51	0.37
45	1.18	0.82	0.50	0.83	0.34	4.25	4.95	4.11	4.44	0.45
60	3.84	1.04	0.68	1.86	1.73	5.64	7.62	6.70	6.65	0.99
75	4.77	3.52	2.02	3.44	1.38	7.87	8.23	7.55	7.89	0.34
90	7.07	5.66	3.71	5.48	1.69	9.57	8.77	8.23	8.86	0.68
105	15.05	7.77	5.98	9.60	4.81	13.70	11.62	9.48	11.60	2.11
120	18.14	12.55	12.22	14.31	3.33	18.65	14.64	17.31	16.87	2.04
135	19.85	14.99	14.91	16.58	2.83	19.64	17.58	19.82	19.01	1.24
150	20.17	17.18	16.78	18.05	1.85	21.93	20.36	22.31	21.53	1.03
180	23.57	21.15	20.44	21.72	1.64	24.11	23.94	25.99	24.68	1.14
210	25.83	24.61	24.45	24.96	0.75	25.70	26.98	28.85	27.18	1.59
240	27.91	27.92	27.47	27.77	0.26	28.15	30.32	31.78	30.08	1.82
270	29.90	30.86	30.86	30.54	0.56	30.60	32.66	32.40	31.89	1.12
300	32.03	33.01	33.33	32.79	0.68	32.52	35.20	34.13	33.95	1.35
360	36.44	38.51	37.52	37.49	1.04	36.58	37.88	35.75	36.74	1.08
420	39.31	42.20	41.54	41.01	1.52	40.66	40.26	38.32	39.75	1.25
480	42.21	45.55	45.27	44.34	1.86	44.32	43.42	41.54	43.09	1.42
600	47.57	52.40	52.38	50.78	2.78	50.89	48.59	47.83	49.10	1.59
720	52.75	58.49	58.64	56.63	3.36	56.53	54.98	54.45	55.32	1.08
840	56.70	62.22	61.73	60.22	3.05	60.82	59.00	59.12	59.65	1.02
960	60.44	64.98	65.41	63.61	2.75	64.66	62.77	63.68	63.70	0.94
1080	64.27	68.46	70.16	67.63	3.03	67.17	65.89	66.27	66.44	0.66
1200	66.44	71.67	72.29	70.14	3.21	69.76	69.86	69.99	69.87	0.12
1440	72.55	75.36	77.78	75.23	2.62	75.64	74.87	75.22	75.24	0.39

Table 11C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 5 hours with 0 and 200 μ m of passageway in pH change system

Time (min)	B1:5					B1:5:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.03	0.07	0.03	0.03	0.25	0.00	0.00	0.08	0.14
30	0.16	0.20	0.36	0.24	0.11	0.49	0.15	0.25	0.30	0.17
45	0.26	0.14	0.69	0.36	0.29	0.74	0.19	0.38	0.44	0.28
60	0.44	0.56	0.74	0.58	0.15	3.78	2.39	2.99	3.06	0.70
75	0.75	0.68	0.78	0.73	0.05	5.26	4.11	4.52	4.63	0.59
90	1.65	2.85	3.68	2.73	1.02	7.76	5.68	5.68	6.38	1.20
105	3.86	4.91	9.18	5.98	2.82	14.73	7.19	7.89	9.93	4.17
120	8.30	8.89	13.16	10.12	2.65	19.75	13.24	13.39	15.46	3.72
135	11.26	10.34	13.49	11.70	1.62	19.77	15.68	16.11	17.19	2.25
150	11.83	11.09	13.76	12.23	1.38	21.06	17.20	17.75	18.67	2.09
180	14.69	13.82	15.29	14.60	0.74	25.20	18.88	20.36	21.48	3.31
210	16.53	15.77	16.88	16.39	0.57	28.71	20.91	22.17	23.93	4.19
240	17.95	18.18	18.54	18.22	0.30	31.14	23.04	24.41	26.20	4.34
270	20.17	19.79	19.67	19.88	0.26	32.33	24.36	26.39	27.70	4.14
300	22.22	21.59	21.36	21.72	0.44	34.35	26.02	28.37	29.58	4.29
360	26.14	25.15	23.61	24.97	1.27	38.32	29.48	31.95	33.25	4.56
420	29.62	28.39	27.58	28.53	1.03	42.72	33.12	35.69	37.18	4.97
480	32.89	32.06	31.09	32.01	0.90	46.95	36.52	38.61	40.69	5.52
600	37.68	35.39	35.88	36.32	1.21	53.37	41.94	43.69	46.33	6.16
720	42.96	41.57	41.90	42.14	0.73	59.16	47.54	48.80	51.83	6.37
840	47.90	47.22	48.36	47.82	0.57	65.25	52.43	53.57	57.08	7.10
960	52.61	51.99	53.39	52.66	0.70	71.43	56.69	57.85	61.99	8.19
1080	56.84	56.51	58.50	57.28	1.07	74.77	60.72	62.59	66.03	7.63
1200	62.43	62.08	63.37	62.63	0.67	78.19	65.46	66.78	70.14	7.00
1440	68.53	69.31	71.09	69.64	1.31	83.80	71.12	72.86	75.93	6.87

Table 12C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 5 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:5:400					B1:5:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.23	0.16	0.13	0.17	0.05	0.23	0.46	0.00	0.23	0.23
15	0.12	0.02	0.36	0.16	0.18	0.32	0.46	0.00	0.26	0.24
30	1.51	1.18	1.33	1.34	0.16	1.12	1.50	0.83	1.15	0.34
45	3.68	4.13	4.33	4.04	0.33	4.64	5.13	3.78	4.52	0.68
60	6.87	7.32	7.26	7.15	0.25	7.27	8.01	7.05	7.44	0.50
75	7.20	8.18	7.77	7.72	0.50	9.07	11.02	10.10	10.06	0.98
90	7.27	8.17	7.90	7.78	0.46	9.09	11.33	12.27	10.90	1.64
105	13.36	10.85	10.38	11.53	1.60	11.89	19.31	13.84	15.01	3.85
120	16.15	14.68	15.72	15.52	0.75	17.43	24.03	16.91	19.45	3.97
135	17.75	16.85	17.41	17.34	0.46	20.26	24.26	19.19	21.24	2.67
150	20.72	20.30	19.63	20.22	0.55	22.30	24.79	20.57	22.56	2.12
180	23.89	23.81	23.70	23.80	0.10	25.08	29.03	22.93	25.68	3.09
210	25.68	26.58	26.44	26.23	0.48	28.31	30.00	24.06	27.46	3.06
240	27.08	27.74	29.03	27.95	0.99	30.12	31.85	25.36	29.11	3.36
270	29.25	28.64	31.37	29.75	1.44	31.55	33.56	26.84	30.65	3.45
300	30.40	30.61	32.98	31.33	1.43	33.61	35.35	28.43	32.47	3.60
360	32.29	33.28	35.93	33.83	1.89	36.88	37.91	31.26	35.35	3.58
420	35.01	36.66	39.60	37.09	2.32	38.89	40.47	34.63	37.99	3.02
480	38.90	39.69	42.78	40.46	2.05	41.58	43.39	38.04	41.00	2.72
600	45.73	44.57	48.96	46.42	2.27	47.47	47.55	43.14	46.05	2.53
720	52.04	50.41	54.81	52.42	2.22	52.69	52.03	48.43	51.05	2.29
840	56.62	55.66	60.09	57.46	2.33	57.30	56.26	52.69	55.42	2.42
960	63.45	59.32	64.40	62.39	2.70	63.97	60.55	57.20	60.57	3.38
1080	66.71	63.53	68.57	66.27	2.55	64.54	63.85	61.29	63.22	1.71
1200	71.40	57.22	71.48	70.03	2.44	70.18	66.68	65.51	67.46	2.43
1440	80.40	73.17	79.22	77.60	3.88	76.28	71.75	73.27	73.77	2.31

Table 13C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 6 hours with 0 and 200 μm of passageway in pH change system

Time (min)	B1:6					B1:6:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.02
30	0.00	0.00	0.00	0.00	0.00	0.27	0.23	0.12	0.21	0.08
45	0.11	0.07	0.13	0.10	0.03	0.25	0.27	0.20	0.24	0.04
60	0.26	0.22	0.27	0.25	0.03	3.17	2.75	0.87	2.26	1.22
75	0.34	0.35	0.50	0.40	0.09	4.15	4.53	5.33	4.67	0.61
90	1.55	0.84	1.65	1.35	0.45	7.27	7.31	7.51	7.37	0.13
105	3.72	1.96	3.43	3.04	0.95	9.98	9.70	10.27	9.98	0.28
120	8.87	6.27	9.19	8.11	1.60	15.01	14.97	15.98	15.32	0.57
135	11.09	7.67	11.08	9.95	1.97	17.66	18.12	18.28	18.02	0.32
150	12.18	8.54	11.98	10.90	2.05	19.13	19.56	20.06	19.58	0.46
180	12.90	10.48	12.86	12.08	1.38	21.40	21.98	22.83	22.07	0.72
210	13.98	12.36	14.70	13.68	1.20	23.40	23.63	24.31	23.78	0.47
240	15.23	14.26	15.92	15.14	0.83	25.19	25.41	25.44	25.35	0.14
270	16.35	16.32	17.30	16.66	0.56	27.36	27.55	26.95	27.29	0.31
300	17.54	17.55	18.58	17.89	0.60	28.89	29.11	28.53	28.84	0.29
360	20.35	21.09	21.11	20.85	0.43	32.26	32.74	31.99	32.33	0.38
420	23.43	24.61	23.81	23.95	0.60	35.69	36.10	35.60	35.80	0.27
480	26.48	27.48	26.43	26.80	0.59	38.72	40.05	39.12	39.30	0.68
600	32.27	33.49	31.98	32.58	0.80	45.32	46.29	45.51	45.71	0.51
720	37.16	39.42	37.67	38.08	1.18	50.90	52.60	52.52	52.01	0.96
840	41.86	44.30	42.44	42.87	1.28	56.07	57.19	58.20	57.15	1.07
960	46.04	49.26	46.98	47.42	1.66	60.81	61.69	62.84	61.78	1.01
1080	50.23	53.88	51.02	51.71	1.92	64.38	65.15	66.33	65.29	0.98
1200	53.83	57.85	55.67	55.78	2.01	68.75	69.47	70.04	69.42	0.65
1440	60.23	62.95	61.96	61.72	1.38	73.47	74.11	74.81	74.13	0.67

Table 14C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 6 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:6:400					B1:6:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.40	0.33	1.16	0.63	0.46	1.31	1.22	1.06	1.20	0.13
45	0.68	0.38	4.24	1.77	2.15	4.97	4.20	4.46	4.54	0.39
60	0.79	0.57	6.72	2.69	3.49	8.45	7.84	7.74	8.01	0.38
75	2.25	3.48	7.16	4.29	2.56	10.40	10.73	8.55	9.89	1.17
90	5.22	4.63	8.20	6.02	1.91	11.00	11.59	8.88	10.49	1.42
105	7.26	7.62	11.26	8.72	2.21	13.91	13.19	11.21	12.77	1.40
120	12.21	12.56	15.96	13.57	2.07	18.07	17.50	17.00	17.52	0.54
135	14.07	15.26	18.64	15.99	2.37	20.56	20.08	19.79	20.14	0.39
150	17.51	17.07	20.54	18.37	1.89	22.44	23.23	21.52	22.40	0.86
180	21.58	19.87	23.31	21.59	1.72	25.05	26.34	25.03	25.48	0.75
210	25.31	23.52	26.36	25.06	1.43	27.17	29.12	28.87	28.38	1.06
240	28.20	25.72	29.34	27.76	1.85	28.77	30.56	31.30	30.21	1.30
270	30.11	27.25	31.35	29.57	2.10	30.35	32.08	33.77	32.07	1.71
300	31.89	28.89	32.94	31.24	2.10	31.94	33.56	35.35	33.62	1.70
360	36.64	32.14	36.99	35.26	2.70	35.41	36.61	37.63	36.55	1.11
420	40.55	35.12	39.70	38.46	2.92	37.99	39.45	39.44	38.96	0.84
480	45.44	37.91	43.69	42.35	3.94	40.88	42.88	41.77	41.84	1.00
600	53.02	43.39	49.79	48.73	4.90	45.79	49.77	47.28	47.62	2.01
720	59.92	48.89	55.65	54.82	5.56	51.35	57.06	52.16	53.52	3.09
840	65.86	53.65	60.97	60.16	6.14	55.64	63.19	56.61	58.48	4.11
960	71.84	58.79	65.70	65.44	6.52	59.29	68.12	61.51	62.97	4.60
1080	75.48	62.51	68.96	68.98	6.49	63.30	71.93	64.47	66.57	4.68
1200	78.50	66.31	72.14	72.32	6.10	66.33	75.27	68.86	70.15	4.61
1440	83.42	71.02	78.21	77.55	6.23	72.10	79.77	74.22	75.36	3.96

Table 15C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 12 hours with 0 and 200 μm of passageway in pH change system

Time (min)	B1:12					B1:12:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.32	0.12	0.17
45	0.00	0.06	0.00	0.02	0.03	0.13	0.26	2.71	1.03	1.45
60	0.05	0.14	0.07	0.09	0.05	0.12	0.17	5.36	1.88	3.01
75	0.14	0.21	0.15	0.17	0.04	0.19	0.23	7.82	2.75	4.39
90	0.47	0.58	0.25	0.43	0.17	5.48	4.26	10.04	6.60	3.05
105	0.47	5.19	0.25	1.97	2.79	7.57	7.10	15.08	9.92	4.48
120	6.80	9.39	7.88	8.02	1.30	11.41	11.05	15.90	12.79	2.70
135	8.86	11.29	9.87	10.01	1.22	12.61	12.60	18.16	14.45	3.21
150	9.74	12.31	10.90	10.98	1.29	13.49	13.09	18.42	15.00	2.97
180	10.98	13.28	12.48	12.25	1.17	15.72	15.95	19.88	17.18	2.34
210	12.03	13.99	13.17	13.06	0.98	15.97	15.80	20.74	17.50	2.81
240	12.90	15.01	14.24	14.05	1.06	17.95	16.65	21.55	18.72	2.54
270	13.79	16.11	15.30	15.07	1.18	19.22	17.90	21.49	19.54	1.82
300	14.69	17.00	16.56	16.08	1.23	20.41	18.76	20.74	19.97	1.06
360	16.45	19.88	18.21	18.18	1.71	22.67	20.84	21.64	21.72	0.92
420	18.26	20.81	19.87	19.65	1.29	25.17	24.61	22.75	24.18	1.27
480	20.07	22.85	22.12	21.68	1.44	27.06	26.45	22.78	25.43	2.31
600	24.05	27.04	26.44	25.84	1.58	31.17	31.48	33.20	31.95	1.10
720	28.37	31.22	30.86	30.15	1.56	35.11	36.48	38.97	36.85	1.96
840	31.99	35.20	34.26	33.82	1.65	39.17	39.05	44.09	40.77	2.88
960	35.97	39.37	38.26	37.87	1.73	41.89	44.35	47.67	44.64	2.90
1080	39.64	43.08	42.32	41.68	1.81	44.93	48.18	51.92	48.34	3.50
1200	42.82	46.08	45.32	44.74	1.70	47.71	50.33	54.06	50.70	3.19
1440	48.62	52.71	51.14	50.83	2.06	52.51	56.30	60.16	56.32	3.83

Table 16C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 12 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:12:400					B1:12:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.16	0.07	0.25	0.16	0.09	0.34	0.20	0.11	0.22	0.12
45	1.74	2.41	2.32	2.16	0.36	2.40	1.87	1.75	2.01	0.35
60	4.28	5.07	4.78	4.71	0.40	5.06	4.28	4.20	4.51	0.47
75	7.02	7.49	7.22	7.24	0.24	7.50	6.79	6.97	7.09	0.37
90	9.62	9.74	9.52	9.63	0.11	9.72	9.10	9.43	9.42	0.31
105	13.04	11.22	9.52	11.26	1.76	9.72	9.10	9.43	9.42	0.31
120	14.97	13.50	11.48	13.32	1.75	11.35	10.54	9.43	10.44	0.96
135	15.64	14.51	12.72	14.29	1.47	12.99	12.20	16.52	13.90	2.30
150	16.21	14.66	13.87	14.91	1.19	14.05	13.11	20.09	15.75	3.79
180	19.07	15.53	15.38	16.66	2.08	15.47	15.35	22.83	17.88	4.28
210	19.91	16.87	16.71	17.83	1.80	16.72	16.25	23.62	18.86	4.13
240	20.45	17.20	17.42	18.36	1.82	17.94	17.19	24.33	19.82	3.92
270	20.89	18.48	18.63	19.33	1.35	19.23	18.32	25.49	21.01	3.91
300	21.51	18.98	20.00	20.16	1.27	20.41	19.60	25.94	21.98	3.45
360	23.77	21.67	22.28	22.57	1.08	22.45	22.57	27.79	24.27	3.05
420	23.98	24.08	24.01	24.02	0.05	24.66	24.92	29.45	26.34	2.69
480	25.38	26.16	26.71	26.08	0.67	26.77	26.31	31.09	28.06	2.64
600	29.29	30.08	30.50	29.96	0.62	31.35	30.97	34.85	32.39	2.14
720	32.30	34.37	34.55	33.74	1.25	35.50	35.78	38.87	36.72	1.87
840	37.47	42.36	40.53	40.12	2.47	41.14	41.10	44.55	42.26	1.98
960	40.56	46.35	44.91	43.94	3.02	45.21	45.90	48.68	46.60	1.83
1080	44.44	50.52	49.03	48.00	3.17	48.79	49.36	52.99	50.38	2.28
1200	47.40	53.49	52.63	51.17	3.30	52.13	53.03	57.13	54.10	2.67
1440	52.63	58.75	58.42	56.60	3.45	57.72	57.53	62.90	59.39	3.05

Table 17C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 24 hours with 0 and 200 μm of passageway in pH change system

Time (min)	B1:24					B1:24:200				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.09	0.21	0.24	0.18	0.08	0.30	0.36	0.37	0.34	0.04
15	0.06	0.21	0.40	0.22	0.17	0.11	0.35	0.26	0.24	0.12
30	0.03	0.18	0.07	0.09	0.07	0.49	0.35	0.47	0.44	0.07
45	0.17	0.48	0.43	0.36	0.17	1.96	2.10	2.27	2.11	0.15
60	0.16	0.17	0.13	0.15	0.02	3.59	3.75	4.59	3.97	0.54
75	0.10	0.19	0.14	0.14	0.04	5.40	5.74	6.65	5.93	0.65
90	0.22	0.29	0.17	0.23	0.06	7.09	7.65	8.74	7.82	0.84
105	0.28	4.17	0.98	1.81	2.07	8.81	10.26	11.64	10.24	1.41
120	0.61	4.92	0.65	2.06	2.48	10.58	11.24	14.69	12.17	2.21
135	5.02	1.94	4.97	3.98	1.77	12.08	12.75	14.70	13.18	1.36
150	6.67	8.07	7.67	7.47	0.72	13.09	13.22	15.45	13.92	1.33
180	8.83	10.04	9.35	9.41	0.60	14.42	14.18	16.30	14.97	1.16
210	9.32	11.40	10.66	10.46	1.06	15.17	15.42	17.35	15.98	1.19
240	10.30	12.33	11.72	11.45	1.04	16.69	15.97	18.08	16.91	1.07
270	10.96	12.68	11.98	11.88	0.86	16.77	16.46	18.13	17.12	0.89
300	11.93	13.63	12.50	12.68	0.86	17.51	16.91	19.29	17.90	1.24
360	12.91	14.86	14.04	13.94	0.98	18.98	17.67	20.24	18.96	1.29
420	14.26	16.66	15.52	15.48	1.20	20.67	19.29	21.98	20.65	1.34
480	15.83	17.94	16.62	16.80	1.07	21.90	20.50	24.20	22.20	1.86
600	18.67	20.35	19.68	19.56	0.84	24.76	22.73	26.94	24.81	2.10
720	21.26	23.58	22.14	22.33	1.17	27.40	25.30	29.69	27.47	2.19
840	23.01	25.00	24.29	24.10	1.01	29.76	27.92	32.33	30.00	2.22
960	25.90	27.80	26.59	26.76	0.96	32.65	31.20	35.64	33.16	2.26
1080	28.23	30.18	29.08	29.16	0.98	36.13	34.30	39.30	36.58	2.53
1200	30.86	32.17	30.68	31.23	0.81	38.70	37.25	41.86	39.27	2.36
1440	34.71	36.68	34.94	35.44	1.08	43.49	42.34	47.68	44.50	2.81

Table 18C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 24 hours with 400 and 600 μm of passageway in pH change system

Time (min)	B1:24:400					B1:24:600				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.26	0.13	0.36	0.25	0.12	0.15	0.37	0.49	0.34	0.17
45	1.43	1.29	1.96	1.56	0.36	1.75	2.21	2.34	2.10	0.31
60	3.24	3.10	4.13	3.49	0.56	3.55	4.12	4.52	4.06	0.49
75	4.98	4.89	6.20	5.35	0.73	5.58	6.23	6.49	6.10	0.47
90	6.92	6.95	8.51	7.46	0.91	7.78	8.11	8.49	8.12	0.36
105	11.09	7.23	8.91	9.08	1.93	8.82	12.55	12.99	11.45	2.29
120	13.10	9.69	11.45	11.41	1.71	10.19	13.95	13.06	12.40	1.97
135	13.93	11.45	13.20	12.86	1.28	11.86	15.63	15.72	14.41	2.20
150	14.32	11.87	14.33	13.51	1.41	12.62	16.36	17.05	15.34	2.38
180	16.23	13.44	15.65	15.11	1.47	13.84	17.02	17.75	16.20	2.08
210	17.38	14.29	16.49	16.05	1.59	15.33	17.64	18.34	17.10	1.58
240	17.88	14.95	17.14	16.66	1.53	15.73	20.00	19.16	18.30	2.26
270	18.47	15.66	17.90	17.34	1.49	16.23	19.12	19.85	18.40	1.91
300	18.71	16.31	18.41	17.81	1.31	17.04	19.00	20.14	18.73	1.57
360	19.73	17.52	19.12	18.79	1.14	18.66	20.79	21.50	20.32	1.48
420	21.61	18.95	20.19	20.25	1.33	20.27	22.00	22.65	21.64	1.23
480	23.06	20.34	21.64	21.68	1.36	21.45	23.67	23.41	22.84	1.21
600	25.97	22.95	23.90	24.28	1.54	24.11	26.23	25.93	25.42	1.15
720	29.60	25.31	26.67	27.19	2.19	27.02	29.38	27.67	28.02	1.22
840	33.13	28.10	29.31	30.18	2.63	28.79	31.33	28.90	29.67	1.44
960	36.05	30.47	31.86	32.79	2.91	31.03	33.28	33.40	32.57	1.33
1080	39.37	33.28	36.15	36.26	3.04	33.33	35.84	36.61	35.26	1.72
1200	42.78	35.63	39.97	39.46	3.60	35.47	37.39	37.44	36.77	1.12
1440	48.19	40.42	46.60	45.07	4.11	38.22	40.31	40.13	39.55	1.16

Table 19C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 5 hours with 400 μ m of passageway (B1:5:400) in deionized water and 1 M glucose solution

Time (min)	Deionized water					1M Glucose solution				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.01	0.00	0.00	0.00	0.01	0.68	0.27	0.00	0.32	0.34
15	0.11	0.10	0.07	0.09	0.02	0.01	0.33	0.39	0.24	0.21
30	3.82	3.67	3.53	3.68	0.14	13.45	0.04	0.34	4.61	7.65
45	9.33	8.89	8.80	9.01	0.28	21.12	1.95	0.74	7.94	11.43
60	14.54	13.98	14.03	14.18	0.31	29.79	5.25	2.43	12.49	15.05
90	23.23	22.99	23.38	23.20	0.20	39.74	11.94	4.50	18.73	18.58
120	30.50	30.99	30.88	30.79	0.25	46.30	17.75	6.97	23.67	20.32
150	37.27	39.03	37.81	38.04	0.90	51.04	22.25	10.44	27.91	20.88
180	43.07	45.89	43.62	44.19	1.50	54.01	26.64	12.80	31.15	20.97
240	51.85	58.37	54.93	55.05	3.27	55.82	35.32	24.19	38.44	16.05
300	63.64	73.45	65.50	67.53	5.21	60.63	42.72	32.75	45.37	14.13
360	72.59	82.89	73.13	76.20	5.80	64.61	48.91	40.92	51.48	12.06
480	83.32	90.58	85.11	86.34	3.78	70.35	58.80	54.06	61.07	8.38
600	89.00	94.08	90.13	91.07	2.66	76.47	66.17	64.64	69.09	6.43
720	92.57	95.90	92.88	93.78	1.84	78.81	72.45	70.58	73.95	4.31
840	94.22	96.99	95.74	95.65	1.39	82.21	76.33	74.22	77.59	4.14
1020	95.75	97.99	97.39	97.04	1.16	84.71	77.92	77.43	80.02	4.07
1200	96.31	99.53	98.74	98.19	1.68	84.28	79.45	80.76	81.50	2.50
1440	93.88	96.11	95.66	95.21	1.18	87.31	80.76	81.65	83.24	3.56

Table 20C Cumulative percent drug release of propranolol HCl coated with chitosan B after moist heat treatment for 5 hours with 400 μ m of passageway (B1:5:400) in 1M and 2M glucose solution

Time (min)	2M Glucose solution					3M Glucose solution				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	0.00	1.19	0.00	0.40	0.68	0.00	0.00	0.00	0.00	0.00
120	0.54	3.06	0.56	1.39	1.45	0.00	0.00	0.00	0.00	0.00
150	1.42	4.60	2.01	2.67	1.69	0.01	0.00	0.00	0.00	0.00
180	2.78	7.98	3.50	4.75	2.82	0.01	0.00	0.00	0.00	0.01
240	6.11	9.90	8.01	8.04	1.94	0.05	0.00	0.00	0.02	0.03
300	9.67	14.47	11.02	11.72	2.48	0.14	0.00	0.03	0.06	0.07
360	13.30	19.46	13.69	15.49	3.45	3.82	0.00	4.47	2.76	2.41
480	18.26	26.05	19.13	21.15	4.27	9.95	1.29	13.72	8.32	6.37
600	24.71	31.91	25.10	27.24	4.05	15.62	2.81	17.98	12.14	8.16
720	30.06	37.90	30.86	32.94	4.31	13.71	3.39	21.59	12.90	9.12
840	35.65	45.33	36.82	39.27	5.28	15.09	5.20	24.09	14.79	9.45
1020	43.00	52.33	43.32	46.22	5.30	16.81	6.75	27.13	16.90	10.19
1200	49.50	50.23	50.67	50.13	0.59	18.75	9.00	30.65	19.47	10.84
1440	57.78	60.10	56.53	58.13	1.81	53.86	10.12	34.34	32.77	21.91

Table 21C Cumulative percent drug release of propranolol HCl coated tablet containing 16.67 and 33.33 %w/w of sodium chloride after moist heat treatment for 5 hours with 400 μ m of passageway in deionized water

Time (min)	B2:5:400					B3:5:400				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.05	0.02	0.03	0.00	0.00	0.00	0.00	0.00
30	0.28	0.16	0.25	0.23	0.06	0.11	0.14	0.09	0.11	0.03
45	0.52	0.43	0.41	0.45	0.06	0.23	0.30	0.35	0.29	0.06
60	0.79	0.60	0.64	0.68	0.10	0.49	0.49	0.45	0.48	0.02
90	1.12	1.02	0.98	1.04	0.07	0.69	0.69	0.77	0.72	0.04
120	1.41	1.18	1.12	1.23	0.16	0.77	0.80	1.00	0.86	0.13
150	1.71	1.48	1.40	1.53	0.16	1.01	1.16	1.26	1.14	0.13
180	2.11	1.84	1.69	1.88	0.21	1.20	1.30	1.63	1.38	0.23
240	2.74	2.38	2.23	2.45	0.26	1.61	1.75	1.98	1.78	0.19
300	3.42	2.94	2.60	2.98	0.41	2.04	2.13	2.44	2.20	0.21
360	5.21	3.54	3.27	4.00	1.05	2.48	2.69	2.91	2.69	0.21
480	15.48	9.67	7.92	11.03	3.96	7.84	8.87	10.53	9.08	1.35
600	29.53	21.17	18.16	22.95	5.89	21.82	22.40	25.14	23.12	1.77
720	44.04	34.86	30.49	36.46	6.92	40.18	36.85	40.00	39.01	1.87
840	58.25	48.42	43.28	49.98	7.61	53.46	50.63	54.48	52.86	2.00
1020	71.87	65.53	60.95	66.11	5.48	67.38	65.79	69.49	67.55	1.86
1200	79.86	74.91	71.15	75.31	4.37	74.94	74.07	78.17	75.73	2.16
1440	84.86	80.98	78.96	81.60	3.00	82.81	81.77	85.73	83.44	2.05

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Table 22C Cumulative percent drug release of propranolol HCl coated tablet containing 50 and 66.67 %w/w of sodium chloride after moist heat treatment for 5 hours with 400 μ m of passageway in deionized water

Time (min)	B4:5:400					B5:5:400				
	1	2	3	AVG	SD	1	2	3	AVG	SD
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.06	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00
15	0.00	0.10	0.09	0.07	0.06	0.32	0.35	0.17	0.28	0.10
30	0.17	0.36	0.43	0.32	0.14	0.27	0.12	0.14	0.18	0.08
45	0.29	0.46	0.43	0.40	0.09	0.37	0.44	0.44	0.42	0.04
60	0.48	0.69	0.51	0.56	0.11	0.51	0.55	0.52	0.53	0.02
90	0.87	0.93	0.89	0.90	0.03	0.95	0.91	0.90	0.92	0.03
120	0.95	1.21	1.08	1.08	0.13	1.26	1.03	1.03	1.11	0.13
150	1.00	1.08	1.24	1.11	0.12	1.21	1.27	1.23	1.24	0.03
180	1.08	1.34	1.19	1.20	0.13	1.48	1.47	1.26	1.40	0.12
240	1.18	1.45	1.28	1.30	0.13	1.59	1.63	1.59	1.60	0.02
300	1.62	2.05	1.93	1.87	0.22	2.26	2.22	2.34	2.27	0.06
360	1.75	2.12	2.13	2.00	0.22	2.98	2.97	3.05	3.00	0.04
480	5.64	6.82	5.33	5.93	0.78	15.20	9.55	11.87	12.21	2.84
600	17.03	19.36	16.69	17.70	1.45	44.55	43.47	41.80	43.27	1.38
720	31.77	35.77	32.94	33.49	2.05	66.40	64.62	63.06	64.69	1.67
840	45.43	51.19	48.43	48.35	2.88	79.12	77.58	75.90	77.53	1.61
1020	58.98	67.06	64.65	63.56	4.15	88.44	86.84	85.74	87.01	1.36
1200	68.62	77.47	76.73	74.27	4.91	91.97	90.60	89.79	90.79	1.10
1440	77.51	86.70	85.16	83.12	4.93	93.38	94.75	92.08	93.40	1.33

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APPENDIX D

Statistical Analysis

The statistical significance was calculated by Scheffe's equation

Table 1D ANOVA test for RDT of propranolol hydrochloride coated tablets from different grade of chitosan (A, B and C) in pH change system

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	35182.317	2	17591.158	11.791	.008
Within Groups	8951.668	6	1491.945		
Total	44133.985	8			

Table 2D Multiple comparisons for RDT of propranolol hydrochloride coated tablets from different grade of chitosan (A, B and C) in pH change system

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A1	B1	-141.1655*	31.53775	.012	-242.3152	-40.0157
	C1	-19.1493	31.53775	.836	-120.2991	82.0004
B1	A1	141.1655*	31.53775	.012	40.0157	242.3152
	C1	122.0161*	31.53775	.023	20.8664	223.1658
C1	A1	19.1493	31.53775	.836	-82.0004	120.2991
	B1	-122.0161*	31.53775	.023	-223.1658	-20.8664

* The mean difference is significant at the .05 level

Table 3D ANOVA test for RDT of propranolol hydrochloride coated tablets from different grade of chitosan (A, B and C) after moist heat treatment for 24 hours in pH change system

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	174115.61	2	87057.803	82.573	.000
Within Groups	6325.886	6	1054.314		
Total	180441.49	8			

Table 4D Multiple comparisons for RDT of propranolol hydrochloride coated tablets from different grade of chitosan (A, B and C) after moist heat treatment for 24 hours in pH change system

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A1:24	B1:24	-293.0067*	26.51181	.000	-378.0369	-207.9765
	C1:24	4.0560	26.51181	.988	-80.9743	89.0862
B1:24	A1:24	293.0067*	26.51181	.000	207.9765	378.0369
	C1:24	297.0627*	26.51181	.000	212.0324	382.0929
C1:24	A1:24	-4.0560	26.51181	.988	-89.0862	80.9743
	B1:24	-297.0627*	26.51181	.000	-382.0929	-212.0324

* The mean difference is significant at the .05 level

Table 5D ANOVA test for RDT of propranolol hydrochloride coated tablets after moist heat treatment for different time interval in pH change system

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1956674.9	7	279524.993	479.858	.000
Within Groups	9320.248	16	582.515		
Total	1965995.2	23			

Table 6D Multiple comparisons for RDT of propranolol HCl coated tablet after moist heat treatment for different time interval in pH change system

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B1	B1:1	-192.4857*	19.70644	.000	-277.4759	-107.4955
	B1:3	-353.4476*	19.70644	.000	-438.4379	-268.4574
	B1:4	-522.6316*	19.70644	.000	-607.6219	-437.6414
	B1:5	-618.6473*	19.70644	.000	-703.6376	-533.6571
	B1:6	-685.5424*	19.70644	.000	-770.5326	-600.5522
	B1:12	-781.3538*	19.70644	.000	-866.3440	-696.3636
	B1:24	-897.9265*	19.70644	.000	-982.9167	-812.9362
B1:1	B1	192.4857*	19.70644	.000	107.4955	277.4759
	B1:3	-160.9619*	19.70644	.000	-245.9522	-75.9717
	B1:4	-330.1459*	19.70644	.000	-415.1362	-245.1557
	B1:5	-426.1616*	19.70644	.000	-511.1519	-341.1714
	B1:6	-493.0567*	19.70644	.000	-578.0469	-408.0665
	B1:12	-588.8681*	19.70644	.000	-673.8583	-503.8779
	B1:24	-705.4408*	19.70644	.000	-790.4310	-620.4505

- The mean difference is significant at the .05 level

Table 6D Multiple comparisons for RDT of propranolol HCl coated tablet after moist heat treatment for different time interval (Cont.)

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B1:3	B1	353.4476*	19.70644	.000	268.4574	438.4379
	B1:1	160.9619*	19.70644	.000	75.9717	245.9522
	B1:4	-169.1840*	19.70644	.000	-254.1742	-84.1938
	B1:5	-265.1997*	19.70644	.000	-350.1899	-180.2095
	B1:6	-32.0948*	19.70644	.000	-417.0850	-247.1045
	B1:12	-427.9062*	19.70644	.000	-512.8964	-342.9159
	B1:24	-544.4788*	19.70644	.000	-629.4691	-459.4886
B1:4	B1	522.6316*	19.70644	.000	437.6414	607.6219
	B1:1	330.1459*	19.70644	.000	245.1557	415.1362
	B1:3	169.1840*	19.70644	.000	84.1938	254.1742
	B1:5	-96.0157*	19.70644	.020	-181.0059	-11.0255
	B1:6	-162.9108*	19.70644	.000	-247.9010	-77.9205
	B1:12	-258.7222*	19.70644	.000	-343.7124	-173.7319
	B1:24	-375.2948*	19.70644	.000	-460.2851	-290.3046
B1:5	B1	618.6473*	19.70644	.000	533.6571	703.6376
	B1:1	426.1616*	19.70644	.000	341.1714	511.1519
	B1:3	265.1997*	19.70644	.000	180.2095	350.1899
	B1:4	96.0157*	19.70644	.020	11.0255	181.0059
	B1:6	-66.8951	19.70644	.193	-151.8853	18.0952
	B1:12	-162.7065*	19.70644	.000	-247.6967	-77.7162
	B1:24	-279.2791*	19.70644	.000	-364.2694	-194.2889

* The mean difference is significant at the .05 level

Table 6D Multiple comparisons for RDT of propranolol HCl coated tablet after moist heat treatment for different time interval (Cont.)

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B1:6	B1	685.5424*	19.70644	.000	600.5522	770.5326
	B1:1	493.0567*	19.70644	.000	408.0665	578.0469
	B1:3	332.0948*	19.70644	.000	247.1045	417.0850
	B1:4	162.9108*	19.70644	.000	77.9205	247.9010
	B1:5	66.8951	19.70644	.193	-18.0952	151.8853
	B1:12	-95.8114*	19.70644	.021	-180.8016	-10.8212
	B1:24	-212.3841*	19.70644	.000	-297.3743	-127.3938
B1:12	B1	781.3538*	19.70644	.000	696.3636	866.3440
	B1:1	588.8681*	19.70644	.000	503.8779	673.8583
	B1:3	427.9062*	19.70644	.000	342.9159	512.8964
	B1:4	258.7222*	19.70644	.000	173.7319	343.7124
	B1:5	162.7065*	19.70644	.000	77.7162	247.6967
	B1:6	95.8114*	19.70644	.021	10.8212	180.8016
	B1:24	-116.5727*	19.70644	.004	-201.5629	-31.5824
B1:24	B1	897.9265*	19.70644	.000	812.9362	982.9167
	B1:1	705.4408*	19.70644	.000	620.4505	790.4310
	B1:3	544.4788*	19.70644	.000	459.4886	629.4691
	B1:4	375.2948*	19.70644	.000	290.3046	460.2851
	B1:5	279.2791*	19.70644	.000	194.2889	364.2694
	B1:6	212.3841*	19.70644	.000	127.3938	297.3743
	B1:12	116.5727*	19.70644	.004	31.5824	201.5629

* The mean difference is significant at the .05 level

Table 7D ANOVA test for RDT of propranolol hydrochloride coated with chitosan B after moist heat treatment for different time interval and size of passageway in pH change system

		Sum of Squares	df	Mean Square	F	Sig.
B1:1	Between Groups	8866.009	3	2955.336	.735	.560
	Within Groups	32150.857	8	4018.857		
	Total	41016.867	11			
B1:3	Between Groups	22643.263	3	7547.754	2.473	.136
	Within Groups	24421.002	8	3052.625		
	Total	47064.266	11			
B1:4	Between Groups	4320.122	3	1440.041	.966	.455
	Within Groups	11924.287	8	1490.536		
	Total	16244.409	11			
B1:5	Between Groups	30380.462	3	10126.821	4.751	.035
	Within Groups	17050.453	8	2131.307		
	Total	47430.915	11			
B1:6	Between Groups	87359.717	3	29119.906	20.816	.000
	Within Groups	11191.142	8	1398.893		
	Total	98550.859	11			
B1:12	Between Groups	17818.387	3	5939.462	8.662	.007
	Within Groups	5485.723	8	685.715		
	Total	23304.110	11			
B1:24	Between Groups	17012.501	3	5670.834	10.257	.004
	Within Groups	4422.922	8	552.865		
	Total	21435.423	11			

Table 8D Multiple comparisons for RDT of propranolol hydrochloride coated with chitosan B after moist heat treatment for different time interval and size of passageway in pH change system

Formula	(I) Orifice	(J) Orifice	Mean Difference (I-J)	Std. Error	Sig.
B1:1	0.00	200.00	-70.0165	51.76136	.627
		400.00	-11.9107	51.76136	.997
		600.00	-41.3812	51.76136	.885
	200.00	0.00	70.0165	51.76136	.627
		400.00	58.1058	51.76136	.744
		600.00	28.6353	51.76136	.957
	400.00	0.00	11.9107	51.76136	.997
		200.00	-58.1058	51.76136	.744
		600.00	-29.4704	51.76136	.953
	600.00	0.00	41.3812	51.76136	.885
		200.00	-28.6353	51.76136	.957
		400.00	29.4704	51.76136	.953
B1:3	0.00	200.00	-112.4376	45.11190	.183
		400.00	-33.1599	45.11190	.907
		600.00	-82.6338	45.11190	.397
	200.00	0.00	112.4376	45.11190	.183
		400.00	79.2777	45.11190	.430
		600.00	29.8038	45.11190	.930
	400.00	0.00	33.1599	45.11190	.907
		200.00	-79.2777	45.11190	.430
		600.00	-49.4739	45.11190	.756
	600.00	0.00	82.6338	45.11190	.397
		200.00	-29.8038	45.11190	.930
		400.00	49.4739	45.11190	.756

* The mean difference is significant at the .05 level

Table 8D Multiple comparisons for RDT of propranolol hydrochloride coated with chitosan B after moist heat treatment for different time interval and size of passageway in pH change system (Cont.)

Formula	(I) Orifice	(J) Orifice	Mean Difference (I-J)	Std. Error	Sig.
B1:4	0.00	200.00	19.7817	31.52286	.939
		400.00	45.5650	31.52286	.580
		600.00	44.7591	31.52286	.593
	200.00	0.00	-19.7817	31.52286	.939
		400.00	25.7833	31.52286	.878
		600.00	24.9775	31.52286	.887
	400.00	0.00	-45.5650	31.52286	.580
		200.00	-25.7833	31.52286	.878
		600.00	-.8058	31.52286	1.000
	600.00	0.00	-44.7591	31.52286	.593
		200.00	-24.9775	31.52286	.887
		400.00	.8058	31.52286	1.000
B1:5	0.00	200.00	113.2820	37.69444	.094
		400.00	123.1373	37.69444	.067
		600.00	110.6932	37.69444	.103
	200.00	0.00	-113.2820	37.69444	.094
		400.00	9.8553	37.69444	.995
		600.00	-2.5888	37.69444	1.000
	400.00	0.00	-123.1373	37.69444	.067
		200.00	-9.8553	37.69444	.995
		600.00	-12.4441	37.69444	.990
	600.00	0.00	-110.6932	37.69444	.103
		200.00	2.5888	37.69444	1.000
		400.00	12.4441	37.69444	.990

*The mean difference is significant at the .05 level

Table 8D Multiple comparisons for RDT of propranolol hydrochloride coated with chitosan B after moist heat treatment for different time interval and size of passageway in pH change system (Cont.)

Formula	(I) Orifice	(J) Orifice	Mean Difference (I-J)	Std. Error	Sig.
B1:6	0.00	200.00	171.8098*	30.53842	.004
		400.00	208.8581*	30.53842	.001
		600.00	202.4519*	30.53842	.001
	200.00	0.00	-171.8098*	30.53842	.004
		400.00	37.0483	30.53842	.698
		600.00	30.6421	30.53842	.800
	400.00	0.00	-208.8581*	30.53842	.001
		200.00	-37.0483	30.53842	.698
		600.00	-6.4062	30.53842	.997
	600.00	0.00	-202.4519*	30.53842	.001
		200.00	-30.6421	30.53842	.698
		400.00	6.4062	30.53842	.997
B1:12	0.00	200.00	77.9022*	21.38092	.041
		400.00	73.7687	21.38092	.053
		600.00	103.4330*	21.38092	.009
	200.00	0.00	-77.9022*	21.38092	.041
		400.00	-4.1336	21.38092	.998
		600.00	25.5308	21.38092	.708
	400.00	0.00	-73.7687	21.38092	.053
		200.00	4.1336	21.38092	.998
		600.00	29.6644	21.38092	.609
	600.00	0.00	-103.4330*	21.38092	.009
		200.00	-25.5308	21.38092	.708
		400.00	-29.6644	21.38092	.609

*The mean difference is significant at the .05 level

Table 8D Multiple comparisons for RDT of propranolol hydrochloride coated with chitosan B after moist heat treatment for different time interval and size of passageway in pH change system (Cont.)

Formula	(I) Orifice	(J) Orifice	Mean Difference (I-J)	Std. Error	Sig.
B1:24	0.00	200.00	89.8463*	19.19835	.011
		400.00	87.6917*	19.19835	.013
		600.00	82.7087*	19.19835	.018
	200.00	0.00	-89.8463*	19.19835	.011
		400.00	-2.1547	19.19835	1.000
		600.00	-7.1377	19.19835	.986
	400.00	0.00	-87.6917*	19.19835	.013
		200.00	2.1547	19.19835	1.000
		600.00	-4.9830	19.19835	.995
	600.00	0.00	-82.7087*	19.19835	.018
		200.00	7.1377	19.19835	.986
		400.00	4.9830	19.19835	.995

* The mean difference is significant at the .05 level

Table 9D ANOVA test for RDT of propranolol hydrochloride coated tablets containing different amount of sodium chloride after moist heat treatment for 5 hours with 400 μ m of passageway in deionized water

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	873572.81	4	218393.202	199.298	.000
Within Groups	10958.138	10	1095.814		
Total	884530.95	14			

Table 10D Multiple comparisons for RDT of propranolol hydrochloride coated tablets containing different amount of sodium chloride after moist heat treatment for 5 hours with 400 μm of passageway in deionized water

(I) Formula	(J) Formula	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B1:5:400	B2:5:400	-615.0913*	27.02855	.000	-715.9053	-514.2774
	B3:5:400	-606.8814*	27.02855	.000	-707.6954	-506.0674
	B4:5:400	-642.1644*	27.02855	.000	-742.9784	-541.3504
	B5:5:400	-432.0260*	27.02855	.000	-532.8400	-331.2120
B2:5:400	B1:5:400	615.0913*	27.02855	.000	514.2774	715.9053
	B3:5:400	8.2099	27.02855	.999	-92.6040	109.0239
	B4:5:400	-27.0731	27.02855	.903	-127.8870	73.7409
	B5:5:400	183.0653*	27.02855	.001	82.2514	283.8793
B3:5:400	B1:5:400	606.8814*	27.02855	.000	506.0674	707.6954
	B2:5:400	-8.2099	27.02855	.999	-109.0239	92.6040
	B4:5:400	-35.2830	27.02855	.787	-136.0970	65.5310
	B5:5:400	174.8554*	27.02855	.001	74.0414	275.6694
B4:5:400	B1:5:400	642.1644*	27.02855	.000	541.3504	742.9784
	B2:5:400	27.0731	27.02855	.903	-73.7409	127.8870
	B3:5:400	35.2830	27.02855	.787	-65.5310	136.0970
	B5:5:400	210.1384*	27.02855	.000	109.3244	310.9524
B5:5:400	B1:5:400	432.0260*	27.02855	.000	331.2120	532.8400
	B2:5:400	-183.0653*	27.02855	.001	-283.8793	-62.2514
	B3:5:400	-174.8554*	27.02855	.001	-275.6694	-74.0414
	B4:5:400	-210.1384*	27.02855	.000	-310.9524	-109.3244

* The mean difference is significant at the .05 level

Table 11D ANOVA test for RDT of propranolol hydrochloride coated tablets after moist heat treatment for 5 hours with 400 μm of passageway in deionized water and glucose solutions with different osmolality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1779250.8	3	593083.599	95.885	.000
Within Groups	49483.016	8	6185.377		
Total	1828733.8	11			

Table 12D Multiple comparisons for RDT of propranolol hydrochloride coated tablets after moist heat treatment for 5 hours with 400 μm of passageway (B1:5:400) in deionized water and glucose solutions with different osmolality

(I) Medium	(J) Medium	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
0.00 M	1.00 M	-245.9050*	64.21514	.032	-470.1855	-21.6246
	2.00 M	-714.7841*	64.21514	.000	-939.0646	-490.5037
	3.00 M	-982.8902*	64.21514	.000	1207.1706	-758.6098
1.00 M	0.00 M	245.9050*	64.21514	.032	21.6246	470.1855
	2.00 M	-468.8791*	64.21514	.001	-693.1595	-244.5987
	3.00 M	-736.9852*	64.21514	.000	-961.2656	-512.7047
2.00 M	0.00 M	714.7841*	64.21514	.000	490.5037	939.0646
	1.00 M	468.8791*	64.21514	.001	244.5987	693.1595
	3.00 M	-268.1061*	64.21514	.021	-492.3865	-43.8256
3.00 M	0.00 M	982.8902*	64.21514	.000	758.6098	1207.1706
	1.00 M	736.9852*	64.21514	.000	512.7047	961.2656
	2.00 M	268.1061*	64.21514	.021	43.8256	492.3865

* The mean difference is significant at the .05 level

APPENDIX E

Percentage Tablet Swelling and size change of Passageway

Formula	Time	Size of passageway (%)						Size of tablet (%)					
		1		2		3		1		2		3	
		AVE	SD	AVE	SD	AVE	SD	AVE	SD	AVE	SD	AVE	SD
B1:5:400	0	99.64	100.10	100.26	100.00	0.32	98.67	100.38	100.95	100.00	1.19		
	6	90.86	102.41	96.09	96.45	5.78	110.69	112.28	111.18	111.38	0.81		
	12	95.48	100.25	83.01	92.91	8.90	111.62	110.56	111.42	111.20	0.56		
	24	95.63	98.71	93.63	95.99	2.56	110.16	108.16	108.49	108.93	1.07		
B2:5:400	0	99.59	101.14	99.28	100.00	1.00	99.91	100.27	99.83	100.00	0.24		
	6	100.52	84.36	95.85	93.58	8.32	102.89	102.24	103.29	102.80	0.53		
	12	93.22	101.30	101.76	98.76	4.80	103.81	104.05	104.53	104.13	0.37		
	24	93.99	95.70	100.05	96.58	3.12	102.89	103.93	103.97	103.60	0.62		
B3:5:400	0	100.05	98.81	101.14	100.00	1.16	99.87	100.15	99.99	100.00	0.14		
	6	92.90	97.88	96.48	95.75	2.56	103.75	103.59	103.75	103.69	0.09		
	12	93.99	107.20	88.40	96.53	9.65	104.60	104.56	105.00	104.72	0.25		
	24	99.59	98.96	97.88	98.81	0.86	104.87	105.24	106.74	105.62	0.99		
B4:5:400	0	98.41	99.80	101.80	100.00	1.71	99.81	99.65	100.53	100.00	0.47		
	6	93.17	100.41	103.34	98.97	5.23	102.65	102.49	102.69	102.61	0.11		
	12	93.17	93.79	91.64	92.87	1.11	103.37	104.53	105.09	104.33	0.88		
	24	72.53	78.08	97.64	82.75	13.19	105.37	105.84	105.81	105.67	0.26		
B5:5:400	0	102.34	95.95	101.70	100.00	3.52	100.11	99.99	99.91	100.00	0.10		
	6	90.99	93.23	98.03	94.08	3.60	106.89	106.77	106.73	106.80	0.08		
	12	103.78	102.02	96.11	100.64	4.02	110.77	111.41	111.58	111.25	0.43		
	24	105.22	105.86	104.42	105.17	0.72	113.96	114.44	112.22	113.54	1.17		

Table IE Percentage of tablet swelling and size of passageway of propranolol HCl coated tablet after moist heat for 5 h in deionized water

VITAE

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