Chapter No.	Table No.	Title of Table	Page No.
	2.1	Bisphosphonates with their relative potency	26
	2.2	Drug profile of risedronate sodium (RSNa)	28
	2.3	Literature Review on RSNa used in osteoporosis treatment	31
•	2.4	Drug profile of atorvastatin (ATO)	33
2	2.5	Literature review on ATO used in treatment of osteoporosis	35
	2.6	Strategies to enhance the transdermal permeation of drugs to treat osteoporosis	42
	2.7	Literature review on glycerosomes.	45
	2.8	Literature review on PECN	49
	3.1	Calibration data of ATO in methanol	70
	3.2	Calibration data of Atorvastatin in phosphate buffer pH 7.4	72
	3.3	Accuracy and precision for ATO in PBS pH 7.4	74
	3.4	Calibration of Atorvastatin in phosphate buffer pH 5.5	75
3	3.5	Accuracy and precision for ATO in PBS pH 5.5	76
3	3.6	Calibration data for ATO by HPLC	77
	3.7	Accuracy and precision for ATO by RP-HPLC	79
	3.8	Calibration Data of ATO in Plasma by RP-HPLC	81
	3.9	Accuracy and precision for ATO in plasma by RP-HPLC	83
	3.10	Calibration data of Risedronate in distilled water	84

## LIST OF TABLES

	3.11	Calibration Data of RSNa by HPLC	86
	3.12	Accuracy and precision for RSNa by HPLC	88
	3.13	Calibration data of RSNa in plasma by HPLC	90
	3.14	Accuracy and precision for RSNa in plasma by HPLC	92
	4.1	Organoleptic characteristics of drugs	96
4	4.2	Characteristic peaks of ATO in FTIR spectra	97
	4.3	Characteristic peaks of RSNa in FTIR	98
	5.1	Parameter screening and optimization of drug loaded glycerosomes	107
	5.2	variables selected for DSD for optimization of ATO loaded Glycerosomes.	108
	5.3	Various release kinetic models	112
	5.4 Interpretation of release exponents (n)	112	
	5.5	Risk analysis to identify critical parameters for formulation of ATO loaded glycerosomes	118
-	5.6	Selection of method of preparation and lipid	119
5	5.7	Effect of process parameters for formation of lipid film	120
	5.8	Optimized process parameters for lipidic thin film formation	122
	5.9	Effect of process parameters for preparation of glycerosomes	124
	5.10	Constant process variables for preparation of glycerosomes	125
	5.11	Effect of formulation parameters on preparation of ATO loaded glycerosomes	126
	5.12	Experimental runs and their results for ATO loaded glycerosomes	129

-	5.13	Summary of ANOVA results of different model for vesicle size	130
_	5.14	ANOVA results of design model for vesicle size	131
	5.15	Summary of ANOVA results for vesicle size	131
-	5.16	Summary of ANOVA results of different model for % EE	137
	5.17	ANOVA results of design model for % EE	138
-	5.18	Summary of ANOVA results for % EE	138
	5.19	Variables for desirability plot and goals for response	144
-	5.20	Predicted and observed responses of optimized ATO loaded glycerosomes	145
_	5.21	Check point batch analysis	147
-	5.22	Predicted responses for selected solution along with standard deviation	148
	5.23	Characterization of ATO loaded glycerosomes	152
-	5.24	Rheological power law fitting parameters for glycerosomes	154
	5.25	In vitro drug release profile for ATO loaded glycerosomes in pH 5.5	156
	5.26	In vitro drug release profile of ATO loaded glycerosomes in pH 7.4	157
-	5.27	Drug release kinetic models for ATO loaded glycerosomes in pH 5.5	158
-	5.28	Drug release kinetic models for ATO loaded glycerosomes in pH 7.4	158
-	5.29	Ex vivo skin permeation profile of ATO loaded glycerosomes	160
	5.30	In vitro cell permeability profile	163
	5.31	Stability study profile	165

	Process variables studied for glycerosomes	
6.1	formulation development	175
6.2	Formulation variables studied for glycerosomes formulation development	175
6.3	Variables selected for DSD for optimization of RSNa loaded Glycerosomes.	176
6.4	Risk analysis to identify critical parameters for formulation of RSNa loaded glycerosomes	182
6.5	Selection of method of preparation and lipid	183
6.6	Optimized process parameter for lipidic thin film formation	184
6.7	Effect of process parameters for preparation of glycerosomes	186
6.8	Process variables for preparation of glycerosomes	188
6.9	Effect of formulation parameters on preparation of RSNa loaded glycerosomes	189
6.10	Experimental runs and their results for RSNa loaded glycerosomes	191
6.11	Summary of ANOVA results of different models for vesicle size	192
6.12	ANOVA results of design model for vesicle size	193
6.13	Summary of ANOVA results for vesicle size	193
6.14	Summary of ANOVA results of different models for % EE	198
6.15	ANOVA results of design model for % EE	199
6.16	Summary of ANOVA results for % EE	199
6.17	Variables for desirability plots and goals for response	205
6.18	Predicted and observed responses of optimized RSNa loaded glycerosomes	207
6.19	Check point batch analysis	209
6.20	Predicted responses for selected solution along with standard deviation	209
6.21	Physicochemical characterization of RSNa loaded glycerosomes	213

6.22	Rheological power law fitting parameters for glycerosomes	214
6.23	In vitro drug release profile for RSNa loaded glycerosomes in pH 5.5	216
6.24	In vitro drug release profile of RSNa loaded glycerosomes in pH 7.4	217
6.25	Drug release kinetic models for RSNa loaded glycerosomes in pH 5.5	218
6.26	Drug release kinetic models for RSNa loaded glycerosomes in pH 7.4	218
6.27	Ex vivo skin permeation profile of RSNa loaded glycerosomes	219
6.28	In vitro cell permeability profile	223
6.29	Stability study profile at different storage condition	225

	7.1	Process and formulation variables studied for ATO loaded PECN formulation development	232
_	7.2	Variables investigated in ATO loaded PECN using BBD.	233
	7.3	Selection of polyelectrolytes	238
	7.4	Risk analysis to identify critical parameters for formulation of ATO loaded PECN	240
	7.5	Effect of process parameters on preparation of ATO loaded PECN	242
	7.6	Effect of formulation parameters on preparation of ATO loaded PECN	243
	7.7	Experimental runs of ATO loaded PECN by BBD	247
	7.8	Summary of ANOVA results of different model for particle size	248
	7.9	ANOVA results of quadratic model for particle size	249
_	7.10	Summary of ANOVA results for particle size	249
_	7.11	Summary of ANOVA results of different model for % EE	254
	7.12	ANOVA results of quadratic model for % EE	255

7

7.13	Summary of ANOVA results for % EE	256
7.14	Variables for desirability plot and goals for response	260
7.15	Predicted and observed responses of optimized ATO loaded PECN	262
7.16	Check point batch analysis	264
7.17	Predicted responses for selected solution along with standard deviation	264
7.18	In vitro drug release profile for ATO loaded PECN in PBS 5.5	270
7.19	In vitro drug release profile of ATO loaded PECN in PBS 7.4	271
7.20	Drug release kinetic models for ATO loaded PECN in pH 5.5	272
7.21	Drug release kinetic models for ATO loaded PECN in pH 7.4	272
7.22	Ex vivo skin permeation profile	273
7.23	In vitro cell permeability profile	276
7.24	Stability study profile	278

	8.1	Process and formulation variables studied for RSNa loaded PECN formulation development	285
	8.2	Variables investigated in RSNa loaded PECN using BBD.	285
	8.3	Selection of polyelectrolytes	290
8	8.4	Risk analysis to identify critical parameters for formulation of RSNa loaded PECN	292
o	8.5	Effect of process parameters on preparation of RSNa loaded PECN	294
	8.6	Effect of formulation parameters on preparation of RSNa loaded PECN	295
	8.7	Experimental runs of RSNa loaded PECN by BBD	298
	8.8	Summary of ANOVA results of different model for particle size	299

	8.9	ANOVA results of quadratic model for particle size	300
-	8.10	Summary of ANOVA results for particle size	300
-	8.11	Summary of ANOVA results of different models for % EE	304
	8.12	ANOVA results of design model for % EE	305
-	8.13	Summary of ANOVA results for % EE	305
-	8.14	Variables for desirability plot and goals for response	310
-	8.15	Predicted and observed responses of optimized RSNa loaded PECN	312
-	8.16	Check point batch analysis	314
-	8.17	Predicted responses for selected solution along with standard deviation	314
-	8.18	In vitro drug release profile for RSNa loaded PECN in PBS pH 5.5	319
-	8.19	In vitro drug release profile of RSNa loaded PECN in PBS pH 7.4	320
-	8.20	Drug release kinetic models for RSNa loaded PECN in PBS pH 5.5	321
-	8.21	Drug release kinetic models for RSNa loaded PECN in PBS pH 7.4	321
-	8.22	Ex vivo skin permeation profile	322
-	8.23	In vitro cell permeability profile	325
	8.24	Stability study profile	327
	9.1	Process and formulation variables studied for transdermal patch development	335
-	9.2	Selection of polymer for preparation of transdermal	342

9

)	9.2	Selection of polymer for preparation of transdermal patch	342
	9.3	Effect of process parameters on preparation of transdermal patch	344
	9.4	Effect of formulation parameters on preparation of transdermal patch	347

9.5	Optimized process and formulation parameters for transdermal patch	348
9.6	Physicochemical characteristics of ATO loaded glycerosomal transdermal patches	350
9.7	Physicochemical characteristics of RSNa transdermal patches	351
9.8	Screening and optimization of permeation enhancer for drug-PECN transdermal patch	353
9.9	Selection of concentration of permeation enhancer for drug-PECN transdermal patch	354
9.10	Physicochemical characteristics of ATO-PECN transdermal patches	355
9.11	Physicochemical characteristics of RSNa-PECN transdermal patches	357
9.12	Ex vivo skin permeation profile of ATP, ALP and AGP.	359
9.13	Ex vivo skin permeation profile of RTP,RLP and RGP.	361
9.14	Ex vivo skin permeation profile of ATP, AWTP and APTP	364
9.15	Ex vivo skin permeation profile of RTP, RWTP and RPTP.	366

	10.1	Study design for pharmacokinetic study	386
-	10.2	Study design for pharmacodynamic study	391
-	10.3	Plasma concentration of ATO vs time profile.	395
10	10.4	Pharmacokinetic parameters of ATO loaded formulations	396
10	10.5	Plasma concentration of RSNa vs time profile	399
	10.6	Pharmacokinetic parameters of RSNa loaded formulations	400
	10.7	Analysis of bone weight, bone volume and bone density for bone samples	406
-	10.8	Serum profile of calcium and inorganic phosphorous	409