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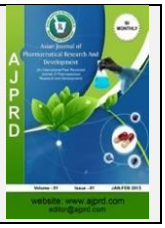

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Research Article

Development and Optimization of Liquisolid Compact Tablet of Ebastine

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ABSTRACT

Ebastine is a second-generation non-sedating antihistaminic drug indicated for the prevention and treatment of allergic rhinitis and chronic idiopathic urticaria. It is classified under Biopharmaceutical Classification System Class II and exhibits poor aqueous solubility, resulting in dissolution-limited oral absorption. The present work was undertaken to develop and optimize liquisolid compact tablets of Ebastine in order to improve dissolution behavior and pharmaceutical performance.

Solubility of Ebastine was evaluated in various non-volatile solvents. Based on maximum drug solubility, Cremophor RH 40 was selected as non-volatile liquid vehicle. Neusilin US2 and Aerosil 200 were selected as carrier and coating materials respectively. Drug-excipient compatibility studies were performed using Fourier Transform Infrared Spectroscopy and Differential Scanning Calorimetry. The formulation was optimized using Design Expert® version 10 software by response surface methodology employing 3^2 full factorial design. Drug concentration in liquid medication (Cd) and carrier-coating ratio (R) were selected as independent variables, while angle of repose and cumulative percentage drug release at 20 minutes were selected as dependent responses.

The optimized formulation was obtained with Cd value of 15.0 and carrier-coating ratio of 26.7. Validation batches confirmed close agreement between predicted and observed values. Crospovidone was selected as suitable superdisintegrant and optimized at 7%. The optimized formulation showed acceptable flow properties and post-compression characteristics. Comparative dissolution study demonstrated faster release than marketed conventional tablet. FTIR studies confirmed compatibility between drug and excipients. DSC and PXRD analysis indicated reduced crystallinity and improved dispersion of drug in final formulation. Accelerated stability study at 40 ±2°C and 75 ±5% RH for one month showed no remarkable change in tablet characteristics.

The study confirmed that liquisolid compact technology is a promising and effective approach for enhancing dissolution of poorly water-soluble Ebastine.

Keywords: Ebastine, Liquisolid compact, dissolution enhancement, Cremophor RH 40, factorial design,

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INTRODUCTION

Oral drug delivery remains the most preferred and widely accepted route of administration due to patient convenience, cost effectiveness, ease of manufacturing, and improved compliance. Tablets and capsules represent the most commonly prescribed pharmaceutical dosage forms because they are stable, portable, and allow accurate dose administration.

Despite these advantages, one of the most significant challenges associated with oral dosage forms is poor aqueous solubility of drug molecules. Drug solubility directly influences dissolution behavior, absorption, and ultimately bioavailability. A drug intended for oral administration must first dissolve in gastrointestinal fluids before permeating through biological membranes. When solubility is poor,

dissolution becomes slow and incomplete, leading to delayed onset of action and lower systemic availability.

Biopharmaceutical Classification System

The Biopharmaceutical Classification System classifies drugs on the basis of aqueous solubility and intestinal permeability into four categories.

Class I: high solubility and high permeability

Class II: low solubility and high permeability

Class III: high solubility and low permeability

Class IV: low solubility and low permeability

For BCS Class II drugs, dissolution is the rate-limiting step for absorption. Therefore, improvement of dissolution significantly influences therapeutic performance.

Ebastine belongs to BCS Class II. It demonstrates good permeability but poor aqueous solubility, making dissolution enhancement a critical formulation objective.

Approaches used for dissolution enhancement

Various formulation techniques are reported to improve dissolution of poorly soluble drugs.

Common approaches include:

- Micronization
- Nanocrystal Formation
- Solid Dispersion
- Ph Adjustment
- Co-Solvency
- Cyclodextrin Complexation
- Self-Emulsifying Systems
- Salt Formation
- Hydrotropy
- Liquisolid Systems

Although several techniques are effective, many involve expensive equipment, complicated processing, or scale-up limitations.Liquisolid compact technology provides a comparatively simple and practical alternative.

Liquisolid compact technology

Liquisolid compact technology involves dissolving or suspending the drug in a non-volatile liquid vehicle and converting this liquid medication into dry, non-adherent, free-flowing and compressible powder by blending with selected carrier and coating materials.

The technique improves dissolution through:

- enhanced wetting
- increased molecular dispersion
- larger effective surface area
- improved penetration of dissolution medium
- possible reduction in crystallinity

The technology is attractive because it can be processed using conventional tablet compression and does not require sophisticated instrumentation.

Drug profile of Ebastine

Ebastine is a second-generation H1 antihistamine used in management of allergic disorders.

Therapeutic indications include, allergic rhinitis&chronic idiopathic urticaria. It offers, prolonged duration of action, effective symptom relief, minimal sedation, However, its poor aqueous solubility limits dissolution and may affect oral bioavailability.Improving dissolution of Ebastine is therefore pharmaceutically relevant.

Allergic rhinitis and therapeutic importance

Allergic rhinitis is an inflammatory disorder of nasal mucosa mediated by immunoglobulin E. It develops after exposure to allergens and produces symptoms such as sneezing, nasal itching, rhinorrhea and congestion.The prevalence of allergic rhinitis continues to increase globally and significantly affects quality of life.Antihistamines remain first-line therapy because histamine released from mast cells is a major mediator of symptoms.Ebastine is widely prescribed because of effectiveness and favorable safety profile.Improved dissolution may contribute to faster therapeutic availability.

Rationale of present study

Ebastine demonstrates low aqueous solubility and belongs to BCS Class II. Since dissolution is the limiting factor for absorption, formulation improvement is required.

Liquisolid compact technology was selected because:

- It Enhances Wetting
- Improves Dissolution
- Supports Direct Compression
- Is Economical
- Is Reproducible
- Offers Practical Scale-Up Potential

Cremophor RH 40 was selected as liquid vehicle after solubility study. Neusilin US2 and Aerosil 200 were selected as carrier and coating system.Optimization was carried out by factorial design to obtain best formulation characteristics.

MATERIALS AND METHODS

Materials

Ebastine was obtained as a gift sample from Triveni Pharmaceutical (Vapi) Pvt. Ltd., India. Cremophor RH 40, polyethylene glycol 200, polyethylene glycol 400, polyethylene glycol 600 and propylene glycol were procured from Astron Chemicals (India) Pvt. Ltd. Tween 20, Tween 80 and glycerine were obtained from Loba Chemie Pvt. Ltd., Mumbai. Neusilin US2 was supplied by Gangawal Chemical Ltd., Mumbai and Aerosil 200 was obtained from Astron Chemicals (India) Pvt. Ltd. Sodium starch glycolate, crospovidone and croscarmellose sodium were used as superdisintegrants. Magnesium stearate was used as lubricant. All chemicals and reagents used during the study were of analytical grade.

Instruments

Analytical weighing balance, dissolution test apparatus, UV-visible spectrophotometer, Fourier Transform Infrared spectrophotometer, Differential Scanning Calorimeter, Powder X-ray diffractometer, rotary tablet compression machine, hardness tester, Roche friabilator, disintegration test apparatus and stability chamber were used throughout the investigation.

UV-visible analysis was performed using Shimadzu UV spectrophotometer. FTIR studies were performed using Shimadzu FTIR spectrometer. Differential scanning calorimetry was performed using Shimadzu DSC instrument. Powder X-ray diffraction analysis was carried out using XRD system.

Preformulation studies

Preformulation study of Ebastine was carried out before formulation development to determine physical and pharmaceutical characteristics.

The study included:

- Organoleptic Evaluation
- Melting Point
- Angle Of Repose
- Bulk Density
- Tapped Density
- Carr's Index
- Hausner Ratio
- Λmax Determination
- FTIR
- DSC
- PXRD

These parameters helped identify the physicochemical properties of the drug and suitability for liquisolid formulation.

Organoleptic evaluation

Ebastine was visually examined for colour and physical appearance.The sample was found to be a white crystalline powder with uniform appearance.

Melting point determination

Melting point of Ebastine was determined using capillary tube method.Drug sample was filled into capillary tube and heated gradually.The temperature at which melting occurred was recorded.Observed melting point was found within official range.

Flow property studies

Angle of repose

Angle of repose was determined using funnel method.Powder was allowed to flow through a funnel placed at fixed height above flat surface.The angle formed by powder pile was measured.

Formula:**$\tan\theta = h / r$**

Where:θ = angle of repose, h = height, r = radius

Bulk density

Accurately weighed powder was transferred into measuring cylinder.Volume occupied before tapping was recorded.Formula: **Bulk density = Weight / Bulk volume**

Tapped density

Cylinder was tapped until constant volume obtained.Formula:**Tapped density = Weight / Tapped volume**

Carr's index

Formula: **Carr's Index = (Tapped density - Bulk density) / Tapped density ×100**

Hausner ratio

Formula: **Hausner ratio = Tapped density / Bulk density**

UV spectrophotometric analysis

Determination of λmax in methanol

Ebastine stock solution was prepared in methanol.Appropriate dilution was scanned using UV spectrophotometer.Maximum absorbance observed at **252 nm**.

Determination of λmax in dissolution medium

Stock solution prepared in **0.1 M HCl containing 0.5% SLS**, Maximum absorbance recorded at **256 nm**

Calibration curve

Calibration in methanol

From the stock solution of Ebastine (1000 µg/ml), a secondary stock solution of **100 µg/ml** was prepared by transferring **10 ml** of stock solution into a **100 ml volumetric flask** and making up the volume with methanol. From this secondary stock solution, aliquots of **0.6, 0.8, 1.0, 1.2, 1.4, 1.6 and 1.8 ml** were accurately transferred into separate **10 ml volumetric flasks** and diluted up to the mark with methanol to obtain concentrations of **6, 8, 10, 12, 14, 16 and 18 µg/ml**, respectively. The absorbance of each solution was measured at **252 nm** using methanol as blank, and the calibration curve was constructed by plotting concentration versus absorbance.

Calibration in 0.1 M HCl + 0.5% SLS

100 mg of Ebastine was dissolved and then volume was make-up to 100 ml with 0.1 M HCl with containing 0.5%w/v of SLS to obtain a standard stock solution having concentration of 1000 µg/ml of Ebastine.

FTIR spectroscopy

FTIR analysis of Ebastine was carried out by KBr pellet technique.Drug and potassium bromide were triturated and compressed.Samples scanned between:**4000-450 cm^{-1}**, Characteristic peaks were recorded.

Differential scanning calorimetry

DSC analysis was carried out to determine thermal behavior.Drug sample was placed in aluminium pan.

Temperature range:**30-250°C**Heating rate:**10°C/min**

Powder X-ray diffraction

PXRD study was performed to evaluate crystalline nature.Scanning range:**5-40° (2θ)**, Sharp peaks confirmed crystallinity.

Solubility study

Excess Ebastine was added to selected solvents.Samples shaken for **48 hours at 25°C**, Centrifuged.Filtered.

Analyzed spectrophotometrically.

Selection of carrier and coating material

Flowable liquid-retention potential was considered.Neusilin US2 selected as carrier.Aerosil 200 selected as coating material.

Drug-excipient compatibility

Physical mixtures prepared.Analyzed by FTIR.Drug and excipients showed compatibility.

Preparation of liquisolid compact

Drug dissolved in selected liquid vehicle.Carrier material added gradually.Coating material blended.Dry free-flowing powder obtained.

Preliminary trial batches

Preliminary batches prepared to optimize:

- Carrier-Coating Ratio
- Drug Concentration

Evaluated for flow and dissolution.

Experimental design

Optimization was performed using **3^2 full factorial design**

Independent variables:

X_1 = Drug concentration in liquid medication

X_2 = Carrier-coating ratio

Responses:

Y_1 = Angle of repose

Y_2 = Cumulative % release at 20 min

Polynomial equation:**$Y = b0 + b1X1 + b2X2 + b11X1^2 + b22X2^2 + b12X1X2$**

Formulation of factorial batches

Tablet compression

Optimized blend was compressed using rotary tablet machine.

Pre-compression evaluation

Blend tested for:

- Bulk Density
- Tapped Density
- Carr's Index
- Hausner Ratio
- Angle of Repose

Post-Compression Evaluation

Tablets tested for:

- Hardness
- Friability
- Weight Variation
- Drug Content
- Disintegration Time

Comparative dissolution study

Optimized formulation compared with marketed tablet.

Conditions:

- IP type I apparatus
- 100 rpm
- 37 ±0.5°C

Drug release monitored.

Stability study

Optimized tablets wrapped and stored at:**40 ±2°C / 75 ±5% RH**for **1 month**Evaluated periodically.

RESULTS AND DISCUSSION

Preformulation studies of Ebastine

Preformulation study was carried out to establish the physical and pharmaceutical characteristics of Ebastine prior to formulation development. The drug was observed as white crystalline powder. Melting point was found in the range of **82-86°C**, confirming identity and purity.

Flow properties were evaluated to understand handling characteristics during formulation. Angle of repose, density parameters and compressibility studies indicated acceptable flow. UV analysis confirmed λmax in methanol and dissolution medium. The observations correlated with literature and confirmed suitability of the drug for further development.

Table 1: Characterization of pure Ebastine

Parameter	Observation
Appearance	White crystalline powder
Melting point	82-86°C
Angle of repose	35.04 ± 1.03
Bulk density (g/ml)	0.32 ± 0.03
Tapped density (g/ml)	0.38 ± 0.04
Carr's index (%)	15.37 ± 1.90
Hausner ratio	1.17 ± 0.03
λmax in methanol	252 nm
λmax in dissolution medium	256 nm

FTIR analysis of pure Ebastine

FTIR analysis was performed to confirm characteristic functional groups.

Characteristic peaks observed:

- **C=O stretching - 1678.55 cm^{-1}**
- **C-N stretching - 1168.07 cm^{-1}**
- **C-O stretching - 1035.92 cm^{-1}**
- **C-H stretching - 1359.91 cm^{-1}**

Observed peaks confirmed identity of Ebastine.

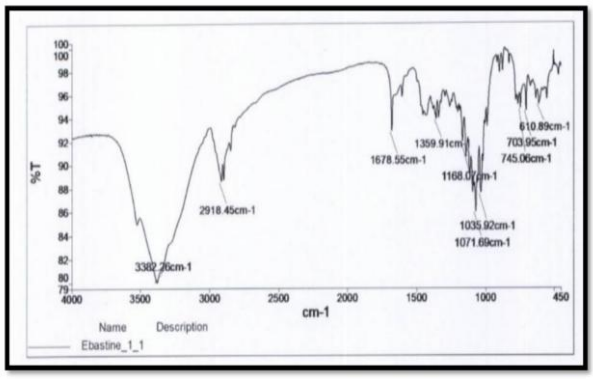

Figure 1: FTIR spectrum of pure Ebastine

Differential scanning calorimetry

DSC thermogram of Ebastine showed sharp endothermic peak at **86°C**, confirming crystalline nature and purity.

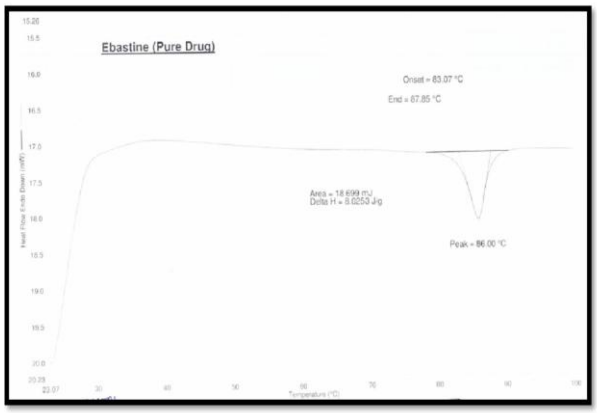

Figure 2: DSC thermogram of pure Ebastine

Powder X-ray diffraction

PXRD analysis showed sharp diffraction peaks indicating crystalline structure of pure drug.

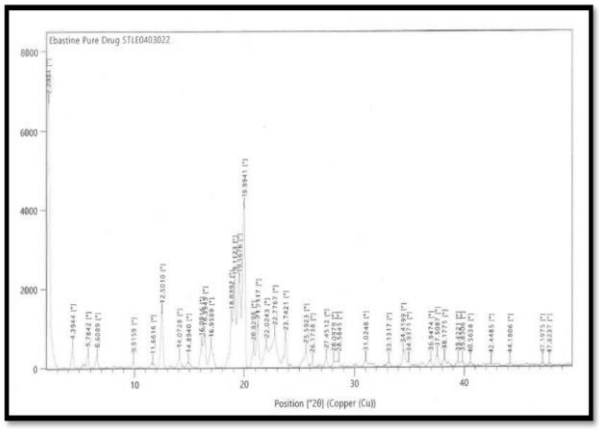

Figure 3: PXRD of pure Ebastine

Solubility study

Solubility of Ebastine was studied in selected non-volatile solvents.Cremophor RH 40 demonstrated highest solubility.

Table 2: Solubility study of Ebastine

Solvent	Solubility (mg/gm)
Cremophor RH 40	315.53 ± 1.65
Tween 20	181.14 ± 1.78
Tween 80	155.45 ± 1.02
PEG 600	125.86 ± 1.29
PEG 400	116.34 ± 1.46
Propylene glycol	67.49 ± 0.64

Cremophor RH 40 was selected as non-volatile solvent due to highest drug solubilization.

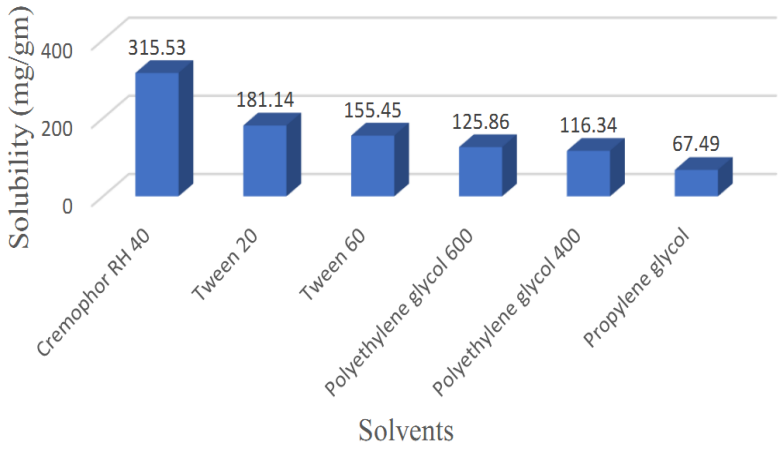

Figure 4: Solubility study graph

Selection of carrier and coating material

Neusilin US2 demonstrated excellent adsorption and carrier performance.Aerosil 200 showed efficient coating and dry powder formation.Both provided free-flowing powder suitable for compression.

Drug-excipient compatibility

FTIR spectra of drug and excipients showed characteristic peaks retained without major shift, No incompatibility observed.

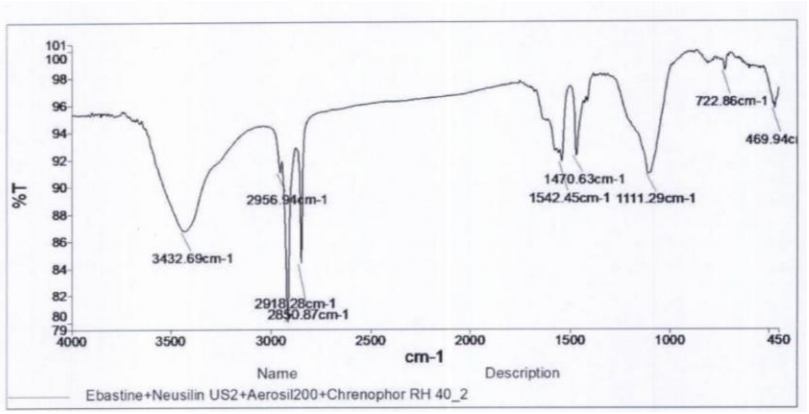

Figure 5: Drug-excipient compatibility FTIR spectra

Preliminary trial batches

Preliminary batches were prepared for optimization of flow and dissolution.

Table 3: Preliminary trial batch evaluation

Batch	Angle of repose
A1	31.57 ± 0.13
A2	31.45 ± 0.40
A3	**30.14 ± 0.17**
A4	36.12 ± 0.26
A5	38.24 ± 0.18

A3 showed improved flow.

In vitro release of preliminary batches

Table 4: Drug release of preliminary batches

Batch	0 min	10 min	15 min	20 min	30 min	45 min
B1	0	38.67 ± 1.79	53.12 ± 1.09	78.77 ± 1.59	88.45 ± 1.55	93.58 ± 2.41
B2	0	49.61 ± 1.25	68.71 ± 1.54	84.01 ± 1.87	91.74 ± 2.36	94.32 ± 1.44
B3	**0**	**47.65 ± 1.69**	**66.89 ± 1.26**	**86.18 ± 1.66**	**96.66 ± 1.97**	**98.84 ± 1.96**
B4	0	50.44 ± 1.35	69.11 ± 1.92	83.22 ± 1.42	92.12 ± 1.67	96.06 ± 1.47
B5	0	51.52 ± 1.22	69.63 ± 1.68	82.54 ± 1.36	92.04 ± 2.01	95.19 ± 1.36

B3 showed maximum release.

Optimization by factorial design

Translation of coded values into actual units

Independent variables and variable levels

Independent variables	Low (-1)	Medium (0)	High (+1)
Drug concentration in liquid medication (%) (X_1)	15	20	25
Carrier coating ratio (R) (X_2)	20	25	30

Sr. No.	Dependent variables

1	Angle of repose (°) (Y_1)
2	% cumulative drug release at 20 min (Y_2)

Table 5: Experimental design of factorial batches

Factoria	X_1	X_2	Actual X_1 (%Cd)	Actual X_2 (R)
F1	-1	-1	15	20
F2	0	-1	20	20
F3	+1	-1	25	20
F4	-1	0	15	25
F5	0	0	20	25
F6	+1	0	25	25
F7	-1	+1	15	30
F8	0	+1	20	30
F9	+1	+1	25	30

Table 6: Composition of factorial batches

Batch	Cd (%)	R	W (mg)	Lf	Carrier (Q)=W/Lf (Neusilin	Coating (q)=Q/R (Aerosil 200)
F1	15	20	66.67	0.603	110.56	5.53
F2	20	20	50.00	0.603	82.91	4.14
F3	25	20	40.00	0.603	66.33	3.31
F4	15	25	66.67	0.574	116.14	4.64
F5	20	25	50.00	0.574	87.10	3.48
F6	25	25	40.00	0.574	69.68	2.78
F7	15	30	66.67	0.139	479.64	15.98
F8	20	30	50.00	0.139	359.71	11.99
F9	25	30	40.00	0.139	287.76	9.59

Optimization of Ebastine liquisolid compact was carried out using **3^2 full factorial design**. Drug concentration in liquid medication (**X_1**) and carrier coating ratio (**X_2**) was selected as independent variables because both parameters significantly influence powder flow and drug release.

Drug concentration in liquid medication was evaluated at three levels **15%, 20% and 25%**, while carrier coating ratio was studied at **20, 25 and 30**.Angle of repose (**Y_1**) and percentage cumulative drug release at 20 minutes (**Y_2**) were selected as dependent variables.Nine experimental batches were prepared according to factorial design.

The design allowed evaluation of individual and combined influence of both formulation variables on flow properties and dissolution behavior and supported selection of optimized formulation using statistical software.

Table 7: Experimental results of factorial batches

Batch N	X_1 (% Cd)	X_2 (R)	Y_1 (Angle of repose, °)	Y_2 (% cumulative drug release at 20 min)
F1	15	20	29.82 ± 0.69	76.83 ± 1.46
F2	20	20	28.91 ± 0.54	64.81 ± 1.56
F3	25	20	26.98 ± 0.87	58.86 ± 1.47
F4	15	25	30.12 ± 0.34	81.74 ± 2.04
F5	20	25	28.73 ± 0.77	67.78 ± 1.55
F6	25	25	26.89 ± 1.20	62.79 ± 1.16

F7	15	30	33.31 ± 0.93	85.61 ± 1.04
F8	20	30	31.86 ± 0.51	77.82 ± 1.36
F9	25	30	28.68 ± 0.58	71.85 ± 1.78

Table 8: Regression coefficients and p-values of responses

Variables	Y_1 (Angle of repose) Coefficient	P value	Y_2 (% cumulative drug release at 20 min) Coefficient	P value
Intercept	28.94	0.0017	68.90	0.0040
X_1	-1.78	0.0005	-8.45	0.0010
X_2	1.36	0.0012	5.80	0.0029
X_1X_2	-0.45	0.0461	1.05	0.2748
X_1^2	-0.53	0.0694	2.81	0.0865
X_2^2	1.35	0.0060	1.86	0.1944

Table 9: Statistical summary of quadratic model

Quadratic model	R^2	Adjusted R^2	Predicted R^2	SD	%CV
Y_1 (Angle of repose)	0.9937	0.9832	0.9362	0.27	0.92
Y_2 (% cumulative drug release at 20 min)	0.9887	0.9700	0.8827	1.58	2.19

Statistical analysis of the quadratic model demonstrated excellent fitting for both dependent responses.For **angle of repose (Y_1)**, the model showed **R^2 value of 0.9937**, indicating that 99.37% of variability in the response was explained by formulation variables. The adjusted R^2 (**0.9832**) and predicted R^2 (**0.9362**) were in close agreement, confirming adequacy and predictive reliability of the model.For **percentage cumulative drug release at 20 minutes (Y_2)**, the model exhibited **R^2 value of 0.9887**, demonstrating strong correlation between observed and predicted values. The adjusted R^2 and predicted R^2 values also confirmed good model predictability.The low standard deviation values (**0.27 for Y_1 and 1.58 for Y_2**) indicated minimal experimental error.Similarly, percentage coefficient of variation values (**0.92% and 2.19%**) were low, confirming reproducibility and precision of the experimental design.These findings established that the selected quadratic model was statistically valid and suitable for optimization of Ebastine liquisolid compact formulation.

Polynomial equations

For angle of repose:$Y_1 = +28.94 - 1.78X_1 + 1.36X_2 - 0.45X_1X_2 - 0.53X_1^2 + 1.35X_2^2$

For cumulative drug release:$Y_2 = +68.90 - 8.45X_1 + 5.80X_2 + 1.05X_1X_2 + 2.81X_1^2 + 1.86X_2^2$

Table 10: ANOVA for dependent variables

For Y_1 = Angle of repose

Source	Sum of squares	Degree of freedom	Mean square	F value	P value	Result
Regression	35.12	5	7.02	94.89	0.0017	Significant
Residual	0.22	3	0.074	—	—	—
Total	35.34	8	—	—	—	—

For Y_2 = % cumulative drug release at 20 min

Source	Sum of squares	Degree of freedom	Mean square	F value	P value	Result
Regression	656.83	5	131.37	52.66	0.0040	Significant
Residual	7.48	3	—	—	—	—
Total	664.31	8	—	—	—	—

Analysis of variance was performed to determine statistical significance of the selected quadratic model for both dependent variables.For **angle of repose (Y_1)**, the regression model showed an **F value of 94.89** with **p value 0.0017**,

indicating that the model was statistically significant. The residual error was low, confirming good agreement between experimental and predicted values.For **percentage cumulative drug release at 20 minutes (Y_2)**, the regression model showed an **F value of 52.66** with **p value 0.0040**, indicating significant influence of formulation variables on drug release.In both responses, p values were less than **0.05**, confirming statistical significance of the model.

ANOVA and response surface analysis

ANOVA showed significance of model.P value <0.05.Response surface plots demonstrated:

- Increasing R Improved Drug Release
- Higher Cd Decreased Release
- Angle Of Repose Affected By Both Variables

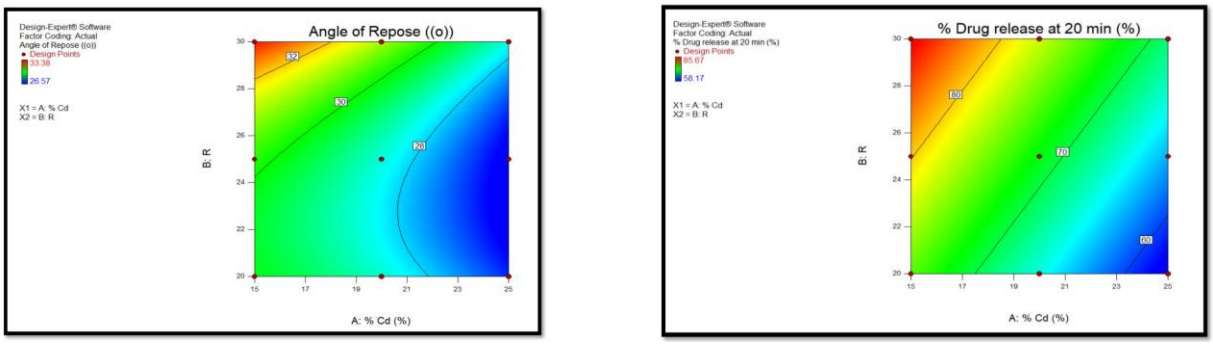

Figure 6: Contour plot

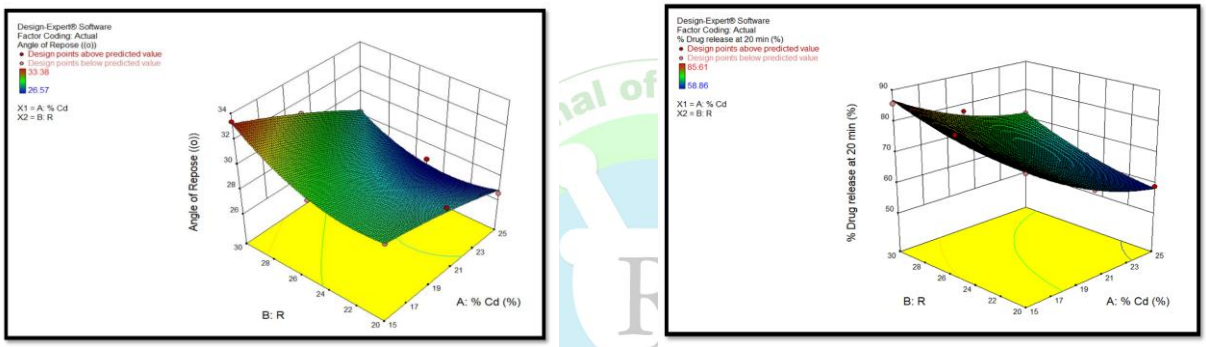

Figure 7: Response surface plot

Validation of design and optimized formulation

After statistical analysis and response surface evaluation, optimized and checkpoint formulations were selected from the overlay plot region generated by Design Expert® software. These batches were prepared to validate the mathematical model and verify the predicted responses experimentally.The optimized batch was obtained with **drug concentration in liquid medication (Cd) of 15.0** and **carrier-coating ratio (R) of 26.7**, while the checkpoint batch contained **Cd 15.8** and **R 27.2**.Experimental observations were found to be in close agreement with predicted values, indicating accuracy of model fitting and reliability of optimization.

Table 11: Formula for optimized and checkpoint batch

Batch	Cd	R
Optimized batch	15.0	26.7
Checkpoint batch	15.8	27.2

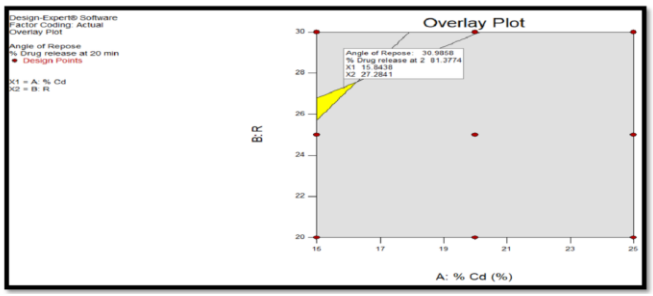

Figure 8: Check Point Batch (CPB)

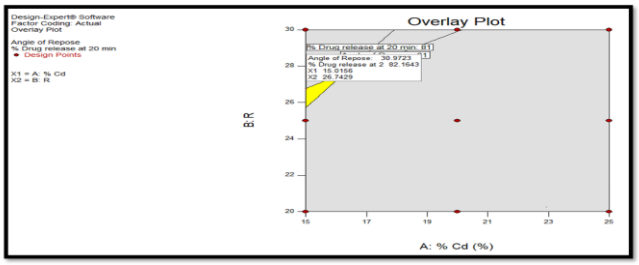

Figure 9: Optimized Batch (OPB)

Table 12: Validation of optimized and checkpoint batch

Parameter	Predicted	Observed
Angle of repose	30.97	30.32 ± 0.57
Drug release (%)	82.16	82.17 ± 0.87

The observed results were nearly identical to predicted values, confirming successful optimization.

Selection of superdisintegrant

Selection of suitable superdisintegrant was carried out to obtain rapid tablet disintegration and improve drug release.Three superdisintegrants were evaluated:

- Sodium Starch Glycolate
- Crospovidone
- Croscarmellose Sodium

Among these, crospovidone demonstrated faster disintegration.

Table 13: Selection of superdisintegrating agent

Superdisintegrant	Disintegration time (sec)
Sodium starch glycolate	180 ± 0.54
Crospovidone	162 ± 0.76
Croscarmellose sodium	165 ± 0.82

Crospovidone was selected.

Selection of crospovidone concentration

Further optimization of crospovidone concentration was carried out.

Table 14: Selection of crospovidone concentration

Concentration (%)	Disintegration time (sec)
5	163 ± 0.67
7	143 ± 0.74
9	141 ± 0.45

Although 9% showed marginally lower disintegration time, **7%** was selected considering formulation performance and tablet characteristics.

Final optimized tablet composition

After optimization, final tablet formulation was prepared.

Table 15: Composition of optimized liquisolid compact tablet

Ingredient	Quantity (mg)
Ebastine	76.67
Neusilin US2	118.21
Aerosil 200	4.42
Crospovidone	14
Magnesium stearate	2
Total weight	215.30

The powder blend remained dry and free-flowing and was suitable for compression.

Evaluation of pre-compression parameters

Powder blend was evaluated before compression.

Table 16: Pre-compression parameters

Parameter	Result
Bulk density	0.28 ± 0.02
Tapped density	0.31 ± 0.03
Carr's index (%)	12.36 ± 1.89
Hausner ratio	1.14 ± 0.02
Angle of repose	30.85 ± 0.55

These values confirmed acceptable powder flow and compressibility.

Evaluation of post-compression parameters

Compressed tablets were evaluated for pharmacopeial quality.

Table 17: Post-compression parameters

Parameter	Result
Appearance	Uniform
Weight variation	Passed
Hardness	Acceptable
Friability	Within limit
Drug content	98.65 ± 0.66
Disintegration time	142 ± 0.17 sec

The tablets showed acceptable hardness and friability with satisfactory uniformity and drug content.

Comparative in vitro drug release study

The optimized liquisolid compact tablet was compared with marketed Ebastine tablet.The liquisolid compact showed significantly improved release profile.At 20 minutes:

- **Optimized tablet = 82.02 ± 1.47%**
- **Marketed tablet = 46.21 ± 1.04%**

Improved dissolution can be attributed to:

- Improved Wetting
- Enhanced Surface Area
- Better Drug Dispersion
- Reduced Crystallinity

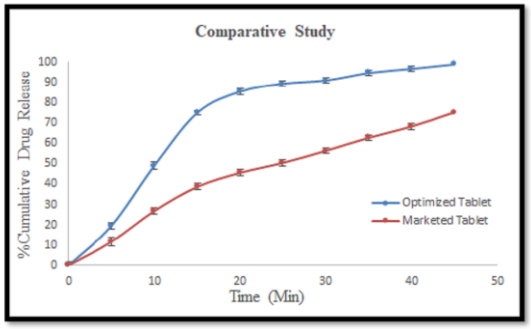

Figure 10: Comparative in vitro drug release profile

FTIR of optimized formulation

FTIR spectra of optimized formulation showed characteristic peaks retained without major shift.

This confirmed compatibility and absence of chemical interaction.

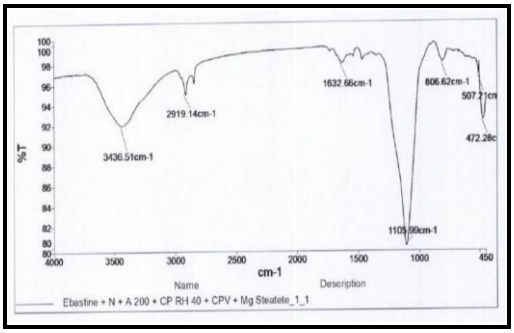

Figure 11: FTIR spectra of optimized formulation

Differential scanning calorimetry of optimized formulation

DSC thermogram of optimized formulation showed reduction in intensity of drug melting peak.

This suggested conversion of crystalline drug into amorphous or molecularly dispersed form.

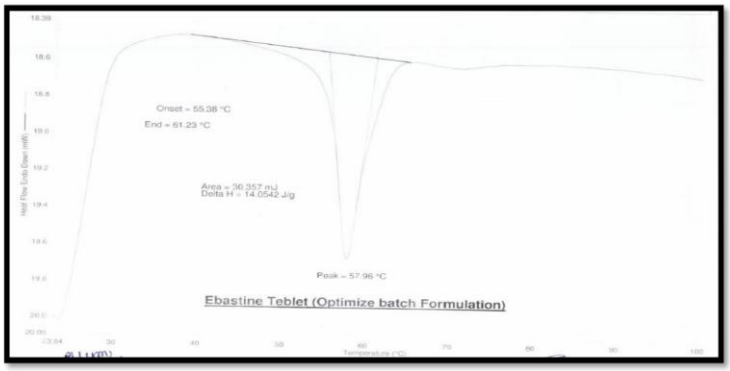

Figure 12: DSC thermogram of optimized formulation

Powder X-ray diffraction of optimized formulation

PXRD pattern of optimized formulation showed reduction in sharp crystalline peaks.

This supported decrease in crystallinity and improved dispersion.

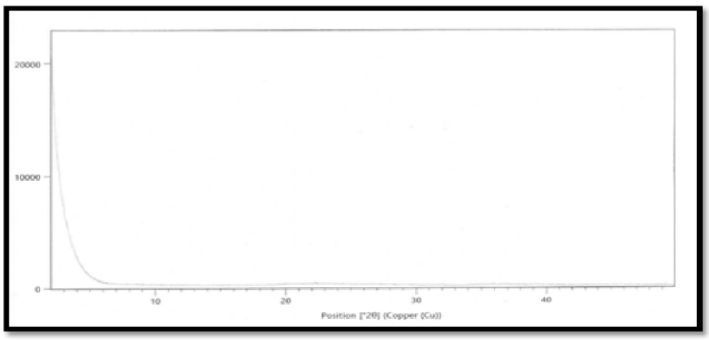

Figure 13: PXRD pattern of optimized formulation

Stability studies

Accelerated stability study was performed at: **40 ±2°C / 75 ± 5% RH**for **one month**

Formulation remained stable.

Table 18: Stability study of optimized liquisolid compact

Parameter	Initial	After 1 month
Appearance	No chan	No change
Drug content	Accepta	Acceptable
Dissolution	Maintair	Maintained
Disintegration	Accepta	Acceptable

No significant change was observed.

CONCLUSION

The present findings indicate that liquisolid compact technology can serve as an effective platform for enhancing dissolution of poorly water-soluble antihistaminic drugs and may offer improved oral bioavailability and therapeutic efficacy."The present investigation successfully developed and optimized liquisolid compact tablets of Ebastine.Ebastine showed maximum solubility in Cremophor RH 40, which was selected as non-volatile solvent. Neusilin US2 and Aerosil 200 successfully converted liquid medication into dry compressible powder. Optimization using Design Expert® software and 3^2 factorial design generated reproducible formulation.

Crospovidone at 7% provided satisfactory disintegration.

The optimized tablets demonstrated for acceptable flow properties, acceptable compression, satisfactory tablet characteristics, enhanced dissolution compared with marketed tablet, compatibility between drug and excipients, reduced crystallinity&stability under accelerated conditions. The study confirmed that liquisolid compact technology is an effective and promising strategy for enhancement of dissolution of poorly water-soluble Ebastine and may contribute to improved oral bioavailability and therapeutic performance.

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