

Design Optimization and Evaluation of Vonoprazan Fumarate Medicated Chewing Gum by Direct Compression Method

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Abstract—The present study aimed to formulate and evaluate medicated chewing gum containing Vonoprazan Fumarate as a novel oral drug delivery system for improved patient compliance and rapid drug release. Preformulation studies including melting point, solubility, FTIR, DSC, and UV spectroscopy confirmed the identity, purity, and compatibility of the drug with selected excipients. The λ_{max} of Vonoprazan Fumarate was observed at 281 nm, and the calibration curve showed good linearity within the concentration range of 5–25 $\mu\text{g/mL}$. Medicated chewing gum formulations were prepared by direct compression using PVA, mannitol, glycerine, sucralose, peppermint, and talc. The formulations were evaluated for pre- and post-compression parameters and found within acceptable limits. Among all batches, formulation B2 showed optimum performance with satisfactory physicochemical properties and nearly 99.00 % drug release within 60 minutes. Optimization using Central Composite Design confirmed the significant effect of formulation variables. Stability studies indicated that the optimized formulation remained stable during storage conditions.

Index Terms—Vonoprazan Fumarate, Medicated Chewing Gum, Oral Drug Delivery System, Direct Compression, Central Composite Design, Drug Release.

I. Introduction

Drug delivery systems play an important role in achieving the desired therapeutic effect by delivering active pharmaceutical ingredients effectively into the body. Among various routes of administration, the oral route is the most preferred due to its convenience, safety, ease of administration, and better patient compliance. However, conventional oral dosage forms such as tablets and capsules may present limitations including delayed onset of action, first-pass metabolism, and swallowing difficulties in pediatric and geriatric patients. To overcome these limitations, novel drug delivery systems have been developed to improve drug release, bioavailability, and patient acceptability.

Medicated chewing gum (MCG) is an innovative oral drug delivery system designed to release active ingredients during chewing for local or systemic absorption. It offers advantages such as ease of administration without water, rapid drug release, improved patient compliance, taste masking, and prolonged contact time with the oral mucosa. Due to these benefits, medicated chewing gum has gained considerable attention in pharmaceutical research and development.

Vonoprazan Fumarate is a potassium-competitive acid blocker (P-CAB) used in the treatment of acid-related gastrointestinal disorders such as gastroesophageal reflux disease and peptic ulcer disease. It provides rapid and potent suppression of gastric acid secretion compared to conventional proton pump inhibitors. The present study focuses on the formulation and evaluation of medicated chewing gum containing Vonoprazan Fumarate using the direct compression method to develop a patient-friendly dosage form with improved drug release and therapeutic effectiveness.

II. Material & Method

Materials:

Sr. No.	Materials	Grade	Supplier/Manufacturers
1.	Vonoprazan Fumarate	Pharma	Swapnroop Drugs & Pharmaceuticals, Pharma Ltd; C. Sambhajinagar
2.	Polyvinyl Acetate	Pharma	Jinedra Scientific, Jalgaon
3.	Mannitol	Pharma	Jinedra Scientific, Jalgaon
4.	Glycerin	Pharma	Jinedra Scientific, Jalgaon
5.	Sucralose	Pharma	Medley Pharma, Mumbai
6.	Peppermint Flavor	Pharma	Medley Pharma Ltd., Mumbai
7.	Talc	Pharma	Jinedra Scientific, Jalgaon

UV estimation of Vonoprazan Fumarate –

Preparation of Vonoprazan Fumarate stock solution (100 µg/ml):-

Weight accurately 10 mg of Vonoprazan Fumarate and transfer into a 100 ml volumetric flask. Add some quantity of 0.001 N HCl and shake the solution thoroughly to dissolve Vonoprazan Fumarate then finally make the volume up to 100 ml by using 0.001 N HCl.

Calibration Curve of Vonoprazan Fumarate 0.1N HCL

The stock solution of Vonoprazan Fumarate was prepared by dissolving 10 mg in 0.001 N HCl and the final volume was made up to 100 ml. The solutions in concentration range of 5-25 µg/ml were prepared by

appropriate dilution of stock solution. The absorbance of these solution was measured spectrophotometrically at λ_{max} 218.5 nm. Plotted the graph of absorbance of Vonoprazan Fumarate against concentration in MS Excel and determined slope and intercept. The calibration curve of fexofenadine HCl in 0.001 N HCl depicted in figure no.

Method for Preparation of Vonoprazan Fumarate by Direct Compression Method:

- 1) Weighed all ingredients accurately.
- 2) Pass powders through Sieve no.60 to ensure uniformity.
- 3) Heat the PVA at 60-70⁰c (if required slight moisture).
- 4) Add Glycerine slowly acts as plasticizers & Mix until a Soft, flexible mass forms.
- 5) Add Vonoprazan Fumarate slowly into the PVA mass & add continuously to ensure uniform drug distribution.
- 6) Add Mannitol, Peppermint flavour & Sucralose & mix to form non-sticky dough like mass.
- 7) Add talc to reduce stickiness.
- 8) Powder materials was Punch in 10 mm punch.



Fig No. 1 Tablet Compression Machine

III. Experimental Design

Modern optimization techniques using are a vital aid in formulation development as they help in developing the best possible formulation under a given set of conditions, this saving time; money and developmental efforts. Current investigation aim at developing Medicated Chewing Gum of taste masked Vonoprazan Fumarate by using optimization technique. Central Composite Design (CCD) is most efficient in estimating the influence of individual variables (main effects) and their interaction using minimum experimentation. Based on preliminary trials, levels of PVA were selected as 10, 12, and 14 % whereas levels of Mannitol were selected 3, 5, and 7 %.

Ten formulations were generated by taking nine possible combination among which center point was repeated 2 times and mean were taken for further study. The two factors viz. PVA and Mannitol were varied, as required by the experimental design, and the factor levels suitably coded. The amount of other excipients was kept as constant. Two factor, three levels CCD was used and response surface methodology was applied to investigation the relative significance of the two variables, PVA (X1) and Mannitol (X2) and their interaction on the responses i.e. %drug release (Y1) and friability (Y2). The Central Composite Design contains an imbedded factorial design with center points. CCD comprises of a combination of a two level factorial points, axial or star point and a central points. The axial point for the two factor problem include, $(\pm\alpha, 0)$ and $(0, \pm\alpha)$, where is the distance of the axial points from the center. The statistical experimental design was generated, evaluated for the quality of fit of the model and regression coefficient were calculated were calculated. To graphically show the influence of factor on the responses, the contour plots were generated using the Design-Expert software (Version 7.1.5 Stat-Ease Inc. Minneapolis, USA).

Table No. 5.5: Independent Variables and Their Levels of Central Composite Design

Independent Variables	Unit	Levels				
		$-\alpha$	Low	Medium	High	$+\alpha$
Polyvinyl Acetate (X1)	mg	9.1715	10	12	20	14.8284
Mannitol (X2)	Mg	2.1715	15	5	60	7.8284

Table No. 5.6: Response Variables of Central Composite Design

Response Variables	Unit	Response Variables
% Drug Release (Y1)	%	% Drug Release (Y1)
Friability (Y2)	Minutes	Friability (Y2)

Table No.3. Composition of Vonoprazan Fumarate Medicated Chewing Gum Batches by Central Composite Design

Ingredients (mg/MCG)	Batches								
	F1	F2	F3	F4	F5	F6	F7	F8	F10
Vonoprazan Fumarate	13.36	13.36	13.3 6	13.36	13.3 6	13.36	13.36	13.36	13.36
PVA	132.42	47.57	90	60	60	90	120	120	90
Mannitol	330	330	330	300	360	372.42	300	360	287.57
Glycerin	49.21	134.06	91.6 4	151.64	91.6 4	49.21	91.64	31.64	134.07
Sucralose	15	15	15	15	15	15	15	15	15
Peppermint Flavor	10	10	10	10	10	10	10	10	10
Talc	50	50	50	50	50	50	50	50	50
Total wt. (mg)	600	600	600	600	600	600	600	600	600

***All ingredients are in mg**

Evaluation Parameters of Medicated Chewing Gum –

Pre-Compression Parameters –

1 Bulk Density –

It refers to packing of particles. Bulk density is used to determine the amount of drug that occupies the volume in mg/ml. Bulk density is the mass per unit volume of a loose powder bed. It is the ratio of total mass of powder to the bulk volume of powder.

▪It was measured by pouring the weighed powder (passed through standard sieve 20#) into a measuring cylinder and initial weight was noted.

▪This initial volume is called the bulk volume. From this the bulk density is calculated according to the formula mentioned below.

▪It is expressed in g/ml and is given by formula,

$$BD = \frac{\text{Weight of powder}}{\text{Bulk volume of powder}}$$

2 Tapped Density –

Tapped density of a powder is the ratio of the powder to the volume occupied by the powder after it has been tapped for a defined period of time. It is the ratio of total mass of the powder to the powder.

▪ Volume was measured by tapping the powder for 750 times and the Tapped volume was noted it the difference between these two volumes is less than 2%.

▪If it is more than 2%, tapping is continued for 1250 times and tapped volume was noted. Tapping was continued until the difference between successive volumes is less than 2% (in a bulk density apparatus).

▪It is expressed in g/ml and is given by formula,

$$TD = \frac{\text{Weight of powder}}{\text{Tapped volume of powder}}$$

3 Flow Properties –

Compressibility Index and Hausner's Ratio:-

The compressibility index (CI) is a measure of the propensity of a powder to consolidate. As such, it is a measure of the relative importance of inter-particulate interactions. In free flowing powder, such interactions

are generally less significant, and the bulk and tapped densities will be closer i value. It can be calculated by using equation,

$$\% \text{ CI} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Density}} \times 100$$

4 Hausner's Ratio:-

The Hausner's ratio is closely related to compressibility index. It can be calculated using equation,

$$\text{Hausner's Ratio} = \frac{\text{Tapped Density}}{\text{Bulk Density}}$$

Table No. Relationship between Carr's Index, Hausner's Ratio and Flow Character

% Compressibility Index	Flow Character	Hausner's Ratio
< 10	Excellent	1.0 - 1.11
11 -15	Good	1.12 – 1.18
16 -20	Fair	1.19 – 1.25
21- 25	Passable	1.26 – 1.34
26 – 31	Poor	1.35 – 1.45
32 - 37	Very poor	1.46 – 1.59
>38	Very poor	>1.60

4 Angle of Repose –

The angle of Repose has long been used to characterize bulk solids. Angle of Repose is a characterization related to inter-particulate friction or resistance to movement between particles. According to the USP, it issue the constant, three dimensional angle assumed by a cone-like pile of material formed by any of several different methods.

It is calculated by using equation,

$$\theta = \tan^{-1}(h/r)$$

Where, h = height of pile

r = radius of base of pile

Table No. : Relationship between Angle of Repose and Flowability

Sr. No.	Angle of Repose	Flow Property
1.	25 – 30	Excellent
2.	31 -35	Good
3.	36 – 40	Fair
4.	41 – 45	Passable
5.	46 – 55	Poor
6.	56 – 65	Very poor
7.	>66	Very poor

Post-Compression Parameters -

1 Weight Variation – In these test 20 whole MCG were weighed accurately and calculated the average weight and compared with individual weight of MCG. The value of weight variation is expressed in %. It is expressed by this formula,

$$\text{Weight Variation} = (IW - Aw) / Aw \times 100 \%$$

Where, IW = Individual Weight of MCG

Aw = Average weight of MCG

- The requirements are met if the weights of not more than 2 of the MCG different from the average weight by more than the percentage listed in the accompanying table and no MCG differ in weight by more than double that percentage.

Table No. 5.10: Weight Variation Tolerance

Average Weight of MCG (mg)	Percentage Difference
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130 or less	± 10
From 130 to 324	± 7.5
More than 324	± 5

2 Thickness -

- MCG thickness is the only dimensional variable related to the process. It is an important parameter to be controlled to facilitate packaging. It is measured by micrometer. MCG thickness must be controlled within a $\pm 5\%$ variation of a standard value.
- Thickness of all the formulations were measured using a Vernier caliper. It is expressed in mm.

3 Hardness –

- The hardness test is performed to provide a measure of MCG strength. MCG should be hard enough to withstand packaging and shipping but not so hard as to create undue difficulty upon chewing.
- MCG hardness is determined using equipment from various suppliers that measure the force needed to break up the MCG. Usually a random sample of MCG (10 to 20) that have been allowed to age for at least 24 hr. after production (to ensure equilibration of stresses and forces within the MCG) are individually tested and the mean hardness value determined. The coefficient of variation is also determined. High variation in MCG hardness value are not unusual although abnormally high coefficients of variation may indicate excessive weight variation, blend non-uniformity, poor tooling control etc.
- MCG hardness of all formulations were measured using Monsanto hardness tester. It is expressed in kg/cm^2 .

4. Friability –

The friability test gives an indication of the MCG's ability to resist chipping and abrasion on handling during packaging and shipping. Usually for conventional MCG a friability value of 1 % or less is desirable, while for chewable MCG (due to the lower hardness of the MCG) friability values of up to 4% are acceptable. The friability test is done using a Roche friabilitor or its modifications.

- Friabilitor subjects the MCG to the combined effects of abrasion and shock by utilizing a plastic chamber that rotates at 25 rpm, dropping the MCG from a height of 6 inches with each revolution.
- 20 MCG were accurately pre-weighed and placed in the friabilitor and was operated for 100 revolutions (at 25 rpm for 4 min) and then MCG were dedusted and reweighed.

▪The % friability is determined from weight loss is calculated by using this formula,

$$\% F = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

Stability Studies-

Stability testing of dosage forms or drug products is carried out to evaluate time- dependent changes, if any occurring with the dosage forms. Stability testing may be accelerated or real time under ambient conditions. Accelerated stability study is used to predict quickly potential changes that may occur in a product. However it must be pointed out that results obtained under stress conditions include high temperature, high relative humidity especially and high light intensities. There are three areas of major concern in the stability testing of Medicated Chewing Gum: - organoleptic, chemical, physical stability.

IV. Result and Discussion

1. Characterization of Vonoprazan Fumarate -

4.1 Organoleptic Properties -

Table No. 4.1.1: Organoleptic Properties-

Sr. No.	Properties	Specifications	Observation
1.	Colour	White	White
2.	Odour	Odourless	Odourless
3.	Taste	Bitter	Bitter

4.1.2 Melting Point –

Table No. 4.2: Melting point of Vonoprazan Fumarate –

Drug Vonoprazan Fumarate	Melting Point Apparatus	DSC (Sharp Peak)
Standard	203-209°C	206-208°C
Observed	208-216°C	210.14-216.80°C

4.2 UV Estimation of Vonoprazan Fumarate –

4.2.1 Determination of Vonoprazan Fumarate –

A solution of Vonoprazan Fumarate was prepared in 0.1N HCl & UV spectrum was recorded using UV visible spectrophotometer (Shimadzu 1800). The spectra of Vonoprazan Fumarate in 0.1N HCL scanned in the range of 200 -400 nm & wavelength was observed at 281 nm.

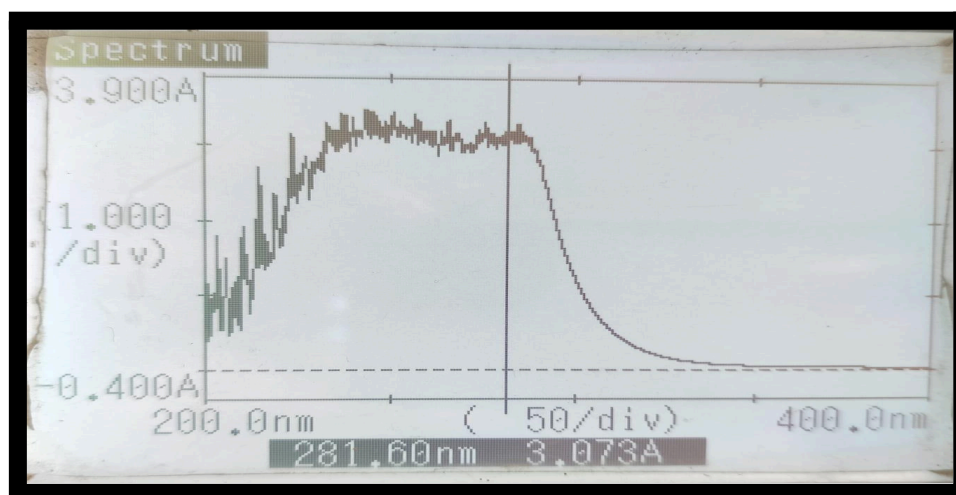


Fig. No. 4.1: Wavelength Maxima of Vonoprazan Fumarate HCl in 0.1 N HCl

Standard Calibration Curve of Vonoprazan Fumarate:

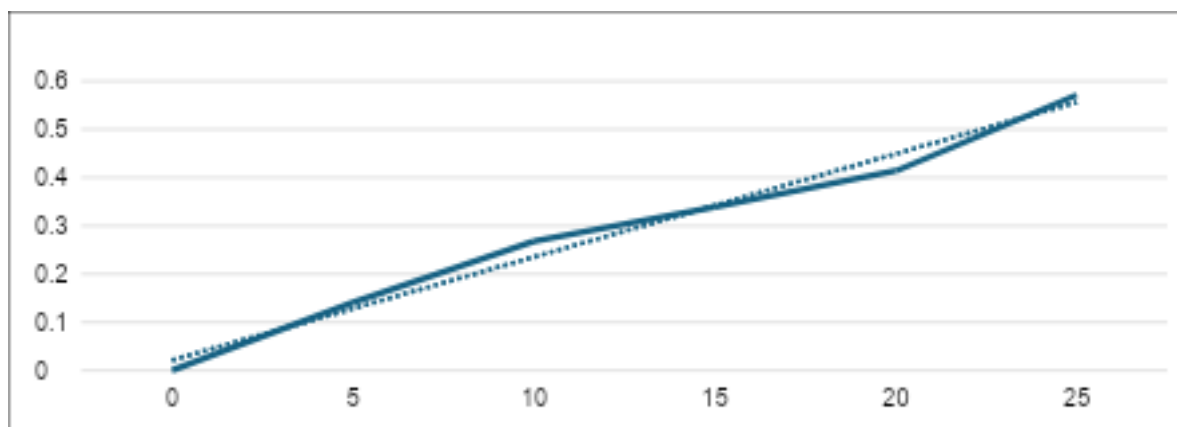


Fig. No. 4.2: Calibration Curve of Vonoprazan Fumarate in 0.1 N HCl

The standard calibration curve of Vonoprazan Fumarate was obtained by plotting the absorbance of the standard solution against its concentration at **281nm**.

Solubility of Vonoprazan Fumarate

Table No. 4.4: Solubility of Vonoprazan Fumarate in Different Solvent System

Sr. No.	Media	Solubility status
1	Water	Slightly soluble
2	Methanol	Freely soluble
3	Ethanol	Soluble
4	0.1 N HCl	Freely soluble

Fourier Transform Infrared Spectroscopy:

1 FTIR Spectra of Vonoprazan Fumarate:

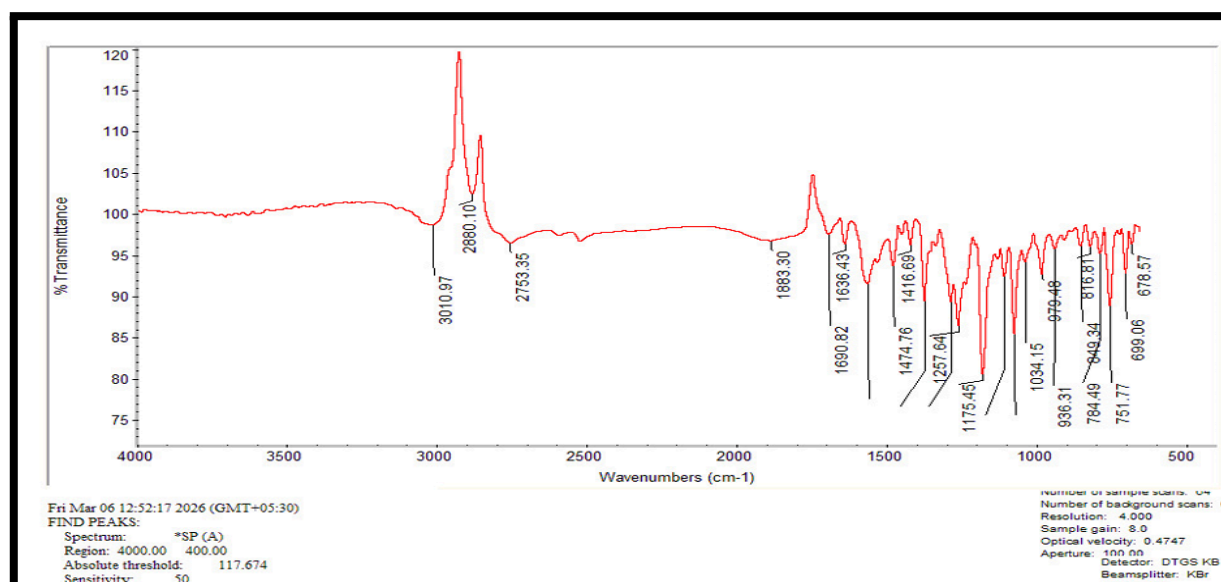


Fig. No. FTIR Spectrum of Vonoprazan Fumarate

2 FTIR Spectrum of PVA:

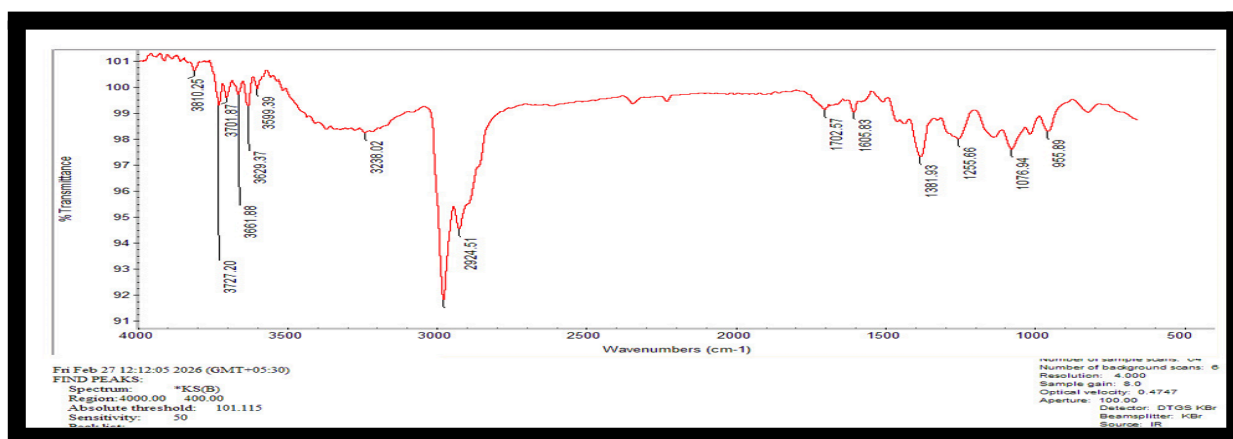


Fig. No.: FTIR Spectrum of PVA

3 FTIR Spectrum of Blend:

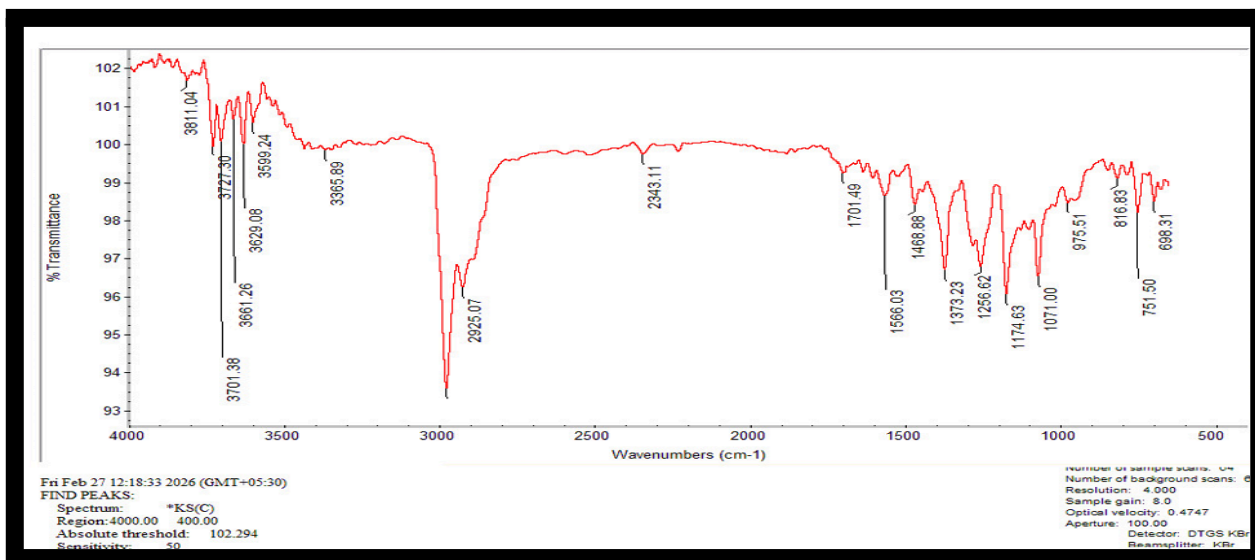


Fig. No. 4.5: FTIR Spectrum of Blend

Differential Scanning Colorimetry (DSC):

The DSC Thermogram showed the Sharp Endothermic Peak at 210.14°C represented the melting point of Vonoprazan Fumarate

1 DSC Spectrum of Vonoprazan Fumarate:

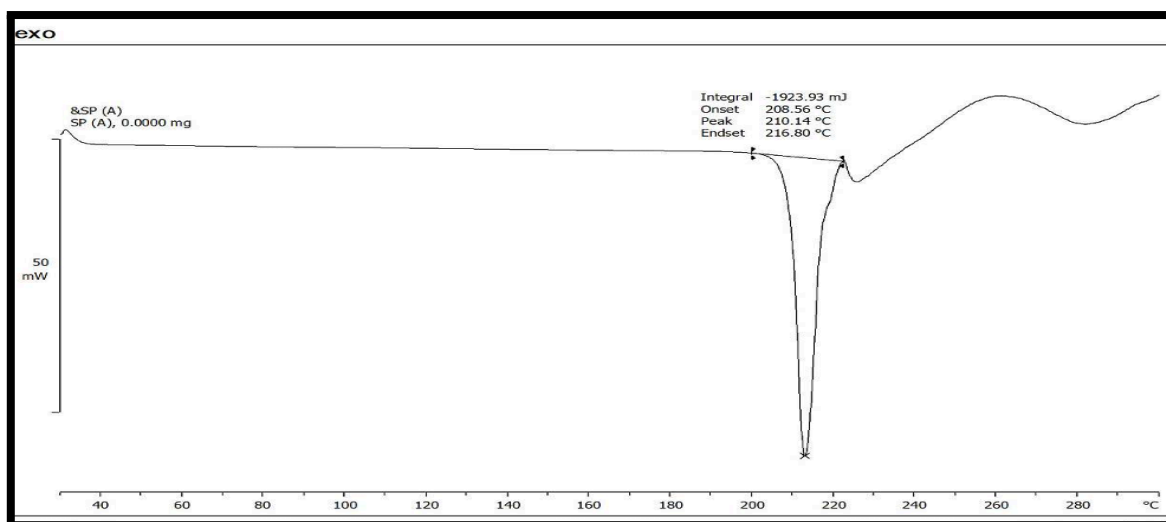


Fig. No. : DSC Thermogram of Pure Vonoprazan Fumarate

2: DSC Spectrum of PVA:

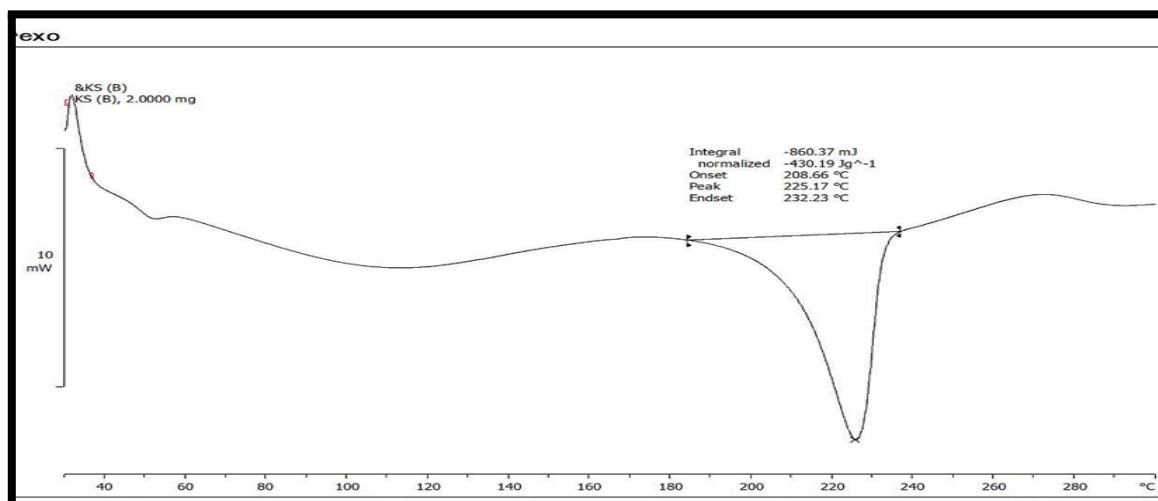


Fig. No. : DSC Thermogram of PVA

3: DSC Spectrum of Blend:

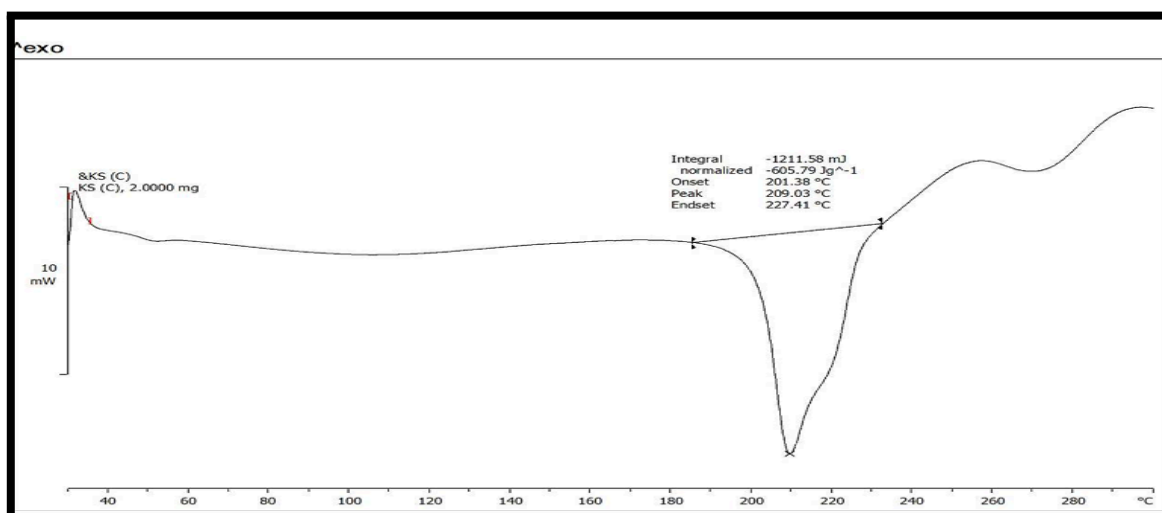


Fig. No. 4.8: DSC Thermogram of Blend

Table No. : Thermal Transition & Enthalpy Values of Vonoprazan Fumarate & PVA with Blend:

Sr. No.	Chemical	DSC Thermal Transition (°C)	Enthalpy (Jg ⁻¹)
1.	Vonoprazan Fumarate	210.14°C	- Jg ⁻¹
2.	PVA	225.17 °C	- 430.19 Jg ⁻¹
3.	Blend	209.03 °C	-605.79 Jg ⁻¹

Evaluation of Batches of MCG Vonoprazan Fumarate Generated by CCD:

Table no. Pre-compression Parameter of Batches Generated by CCD:

Batches	Bulk Density (gm/ml)	Tapped Density (gm/ml)	Carr's Index (%)	Hausner's Ratio	Angle of Repose (Degree)
B1	0.46 ± 0.01	0.54 ± 0.02	14.81 ± 0.06	1.17 ± 0.03	27.42 ± 0.05
B2	0.48 ± 0.02	0.56 ± 0.01	14.28 ± 0.08	1.16 ± 0.04	28.15 ± 0.07
B3	0.50 ± 0.01	0.58 ± 0.03	13.79 ± 0.05	1.15 ± 0.02	26.83 ± 0.04
B4	0.47 ± 0.02	0.56 ± 0.02	16.07 ± 0.07	1.19 ± 0.01	29.10 ± 0.06
B5	0.49 ± 0.01	0.57 ± 0.01	14.03 ± 0.04	1.16 ± 0.03	25.64 ± 0.05

B6	0.46 ± 0.03	0.55 ± 0.02	16.36 ± 0.05	1.20 ± 0.02	28.46 ± 0.08
B7	0.51 ± 0.02	0.59 ± 0.03	13.55 ± 0.06	1.15 ± 0.04	26.18 ± 0.03
B8	0.48 ± 0.01	0.57 ± 0.02	15.78 ± 0.09	1.18 ± 0.01	29.02 ± 0.04
B9	0.52 ± 0.02	0.60 ± 0.01	13.33 ± 0.03	1.15 ± 0.02	25.88 ± 0.06
B10	0.49 ± 0.03	0.58 ± 0.02	15.51 ± 0.04	1.18 ± 0.03	28.74 ± 0.05

Table no. Post-Compression Parameter of Batches Generated by CCD:

Batches	Thickness (mm)	Hardness (kg/cm ²)	Weight Variation (mg)	Friability (%)	Drug Release (%)
B1	4.20 ± 0.02	5.6 ± 0.01	598 ± 0.24	0.3 ± 0.03	89
B2	4.10 ± 0.01	4.1 ± 0.01	603 ± 0.33	0.75 ± 0.04	99
B3	4.50 ± 0.02	5.1 ± 0.02	600 ± 1.00	0.5 ± 0.01	97.22
B4	3.90 ± 0.03	3.6 ± 0.01	605 ± 2.00	0.69 ± 0.03	98
B5	4.13 ± 0.01	3.7 ± 0.01	599 ± 2.00	0.81 ± 0.01	96
B6	4.60 ± 0.02	5.4 ± 0.01	602 ± 1.33	0.82 ± 0.02	90
B7	4.30 ± 0.03	4.7 ± 0.02	604 ± 0.33	0.6 ± 0.03	95.24
B8	4.00 ± 0.02	4.2 ± 0.01	597 ± 0.33	0.72 ± 0.01	90.89
B9	4.40 ± 0.01	5.2 ± 0.01	601 ± 2.00	0.7 ± 0.02	97.22
B10	4.20 ± 0.02	4.5 ± 0.01	603 ± 2.00	0.52 ± 0.01	93

Table No. % In-Vitro Drug Release of Optimized Batches by DoE Software:

Batches	% Drug Release of Vonoprazan Fumarate of Optimized Batches Time (min)						
	0	5	10	15	30	45	60
B1	00	28.04	34.81	47.86	69.14	76.39	89.00
B2	00	29.50	43.03	58.50	70.59	76.40	99.00

B3	00	33.35	47.37	61.88	82.67	86.05	97.22
B4	00	25.62	35.77	49.79	66.94	85.77	98.00
B5	00	36.74	43.02	54.63	65.38	86.03	96.00
B6	00	29.49	40.61	55.59	71.55	81.22	90.00
B7	00	44.47	52.21	61.88	88.47	92.34	95.24
B8	00	34.32	47.37	58.49	80.25	85.09	90.89
B9	00	33.35	47.37	61.88	82.67	86.05	97.22
B10	00	37.71	47.37	54.14	71.06	86.05	93.00

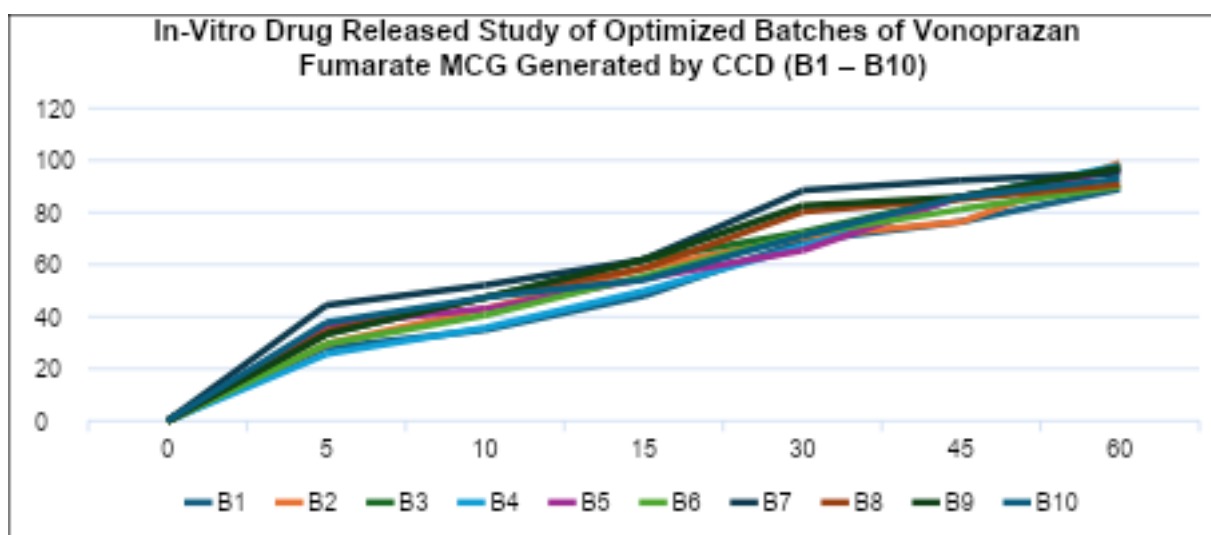


Fig. No. 6.10: In-Vitro Drug Released Study of Optimized Batches of Vonoprazan Fumarate MCG Generated by CCD (B1 – B10)

V. Optimization and Data Analysis

Optimization:

Table No. : Result of Optimization Batches by Central Composite Design

Batches	Variable Level in Coded Form			
	PVA	Mannitol	Drug Release (%)	Friability (%)
B1	+ α	0	89.00	0.3

B2	$-\alpha$	0	99.00	0.75
B3	-1	0	97.22	0.50
B4	0	-1	98.00	0.69
B5	0	+1	96.00	0.81
B6	-1	$+\alpha$	90.00	0.82
B7	+1	-1	95.24	0.60
B8	+1	+1	90.89	0.72
B9	-1	0	97.22	0.70
B10	-1	$-\alpha$	93.00	0.52

Data Analysis:

The general central composite design was applied to optimize the MCG Vonoprazan Fumarate. The Response surface methodology analyze data clearly indicate that the % DR, DT values were mainly depending upon the selected independent variables. The regression equations for the responses fitted in linear model were generated. ANOVA was used to identify the significant effect. Obtain value of F is larger than critical F value, the result was found to be significant at that level of probability ($p < 0.05$). Only statistically significant ($p < 0.05$) coefficient were included in regression equation.

A. % Drug Release:

Final equation in term of coded form,

$$\%DR = + 94.56 - 2.57 X_1 - 0.1.23 X_2$$

Concerning dissolution, the result of multiple linear regression analysis showed that the coefficients X1 bear a negative sign and X2 bear a negative sign. It revealed that % drug release increases with decrease in PVA complex and while % drug release decrease with increase in mannitol. Less amount of mannitol was expected to increase the % drug release. ANOVA was used to identify the significant effect. The result was found to be significant at that level of probability ($p = 0.0269$)

B. Friability:

Final equation in terms coded form,

$$\text{Friability} = +0.6410 - 0.1020 X_1 + 0.0830 X_2$$

Concerning disintegration, the result of multiple linear regression analysis showed that the coefficients X1 bear a negative sign and X2 bear a positive sign. It revealed that friability decreases with increase in PVA and while friability increases with increase in mannitol. It was observed that further increase in concentration of PVA led to the decreases in friability. ANOVA was used to identify significant effect. Obtained value of F is larger than critical F-value, the result was found to be significant at that level of probability ($p = 0.0464$)

Table No.: Result of Analysis of Variance for Batches by CCD of MCG Vonoprazan Fumarate:

	DF*	SS*	MS*	F*	P Value	
Y1 = %DR						
Model	2	74.59	37.30	6.33	0.0269	Significant
Residual	7	4125	5.89	-	-	
Total	9	115.84	-	-	-	
Y2= Friability						
Model	2	0.1385	0.0692	4.91	0.0464	Significant
Residual	7	0.0986	0.0141	-	-	
Total	9	0.2371	-	-	-	

*DF indicates degree of freedom; SS (Sum of Square); MS (Mean Sum of Square) and F is

(Fisher's Ratio)

Graphical Representation:

Response Dissolution (Y1)

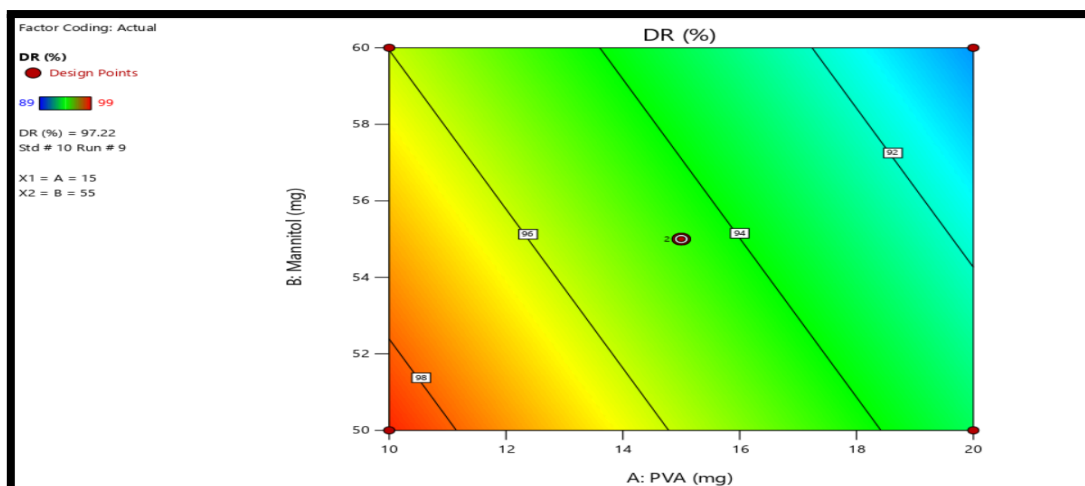


Fig. No.: Response Surface Contour Graph Showing the Influence of PVA (X1) and Mannitol (X2) on % Drug Release (Y1)

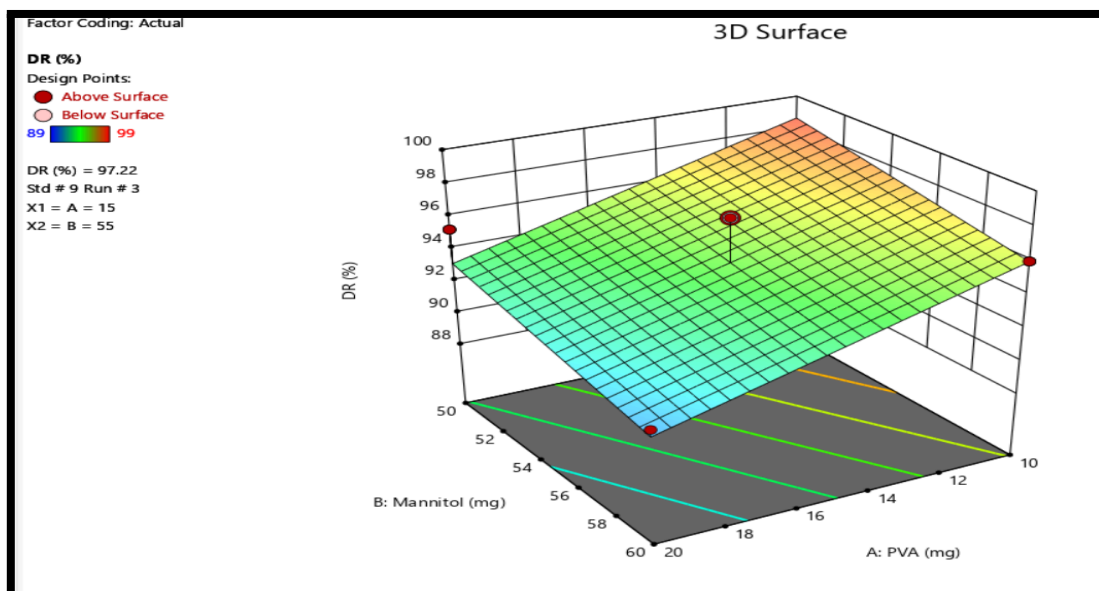


Fig. No. : Response Surface 3D Graph Showing the Influence of PVA (X1) and Mannitol (X2) on % Drug Release (Y1)

Response Friability (Y2)

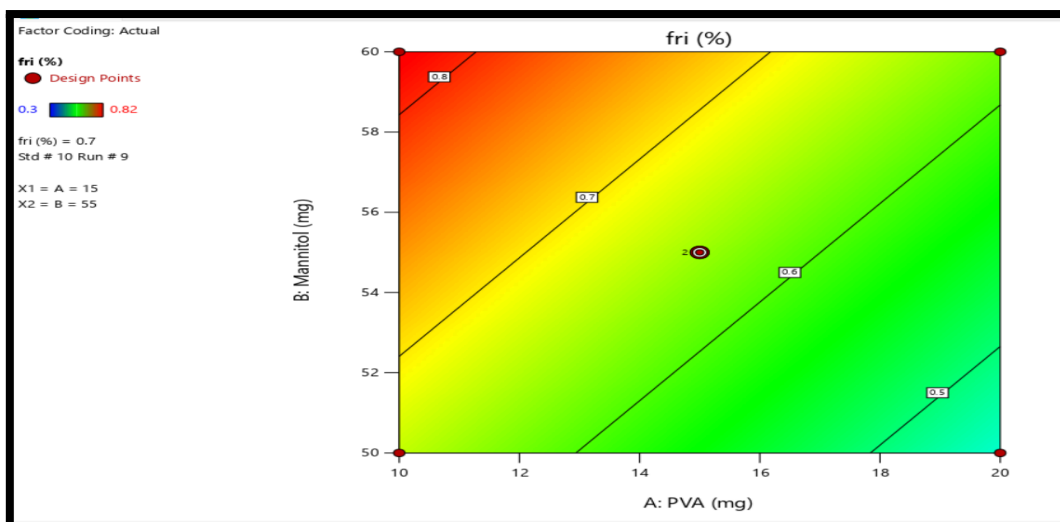


Fig. No. : Response Surface Contour Graph Showing the Influence of PVA (X1) and Mannitol (X2) on the Friability (Y2)

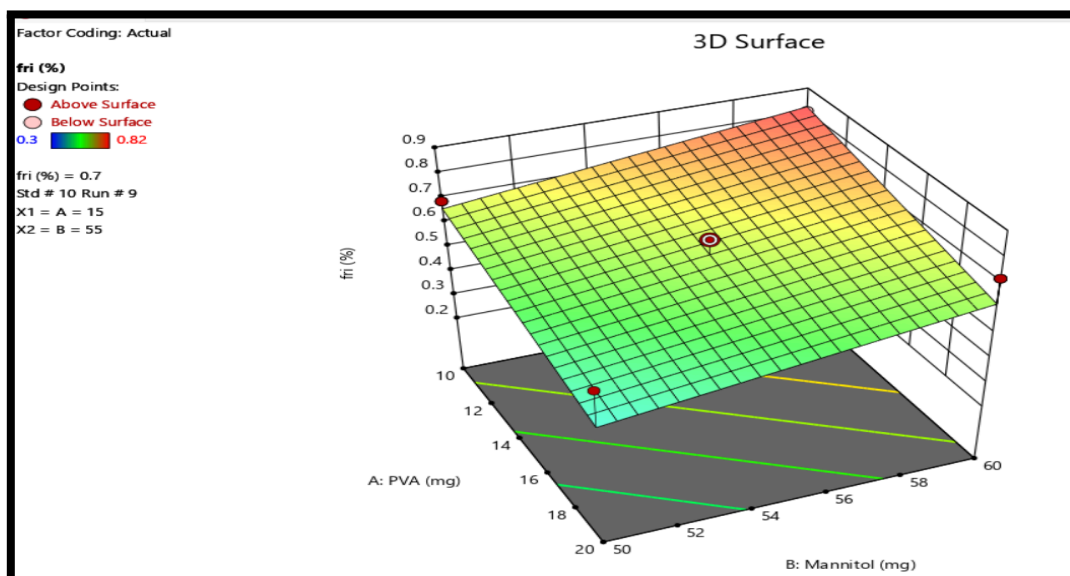


Fig. No. : Response Surface 3D Graph Showing the Influence of PVA (X1) and Mannitol (X2) on the Friability (Y2)

VI. Stability Study

I) Stability Study:

Short Term Stability Study for Optimized Batch Vonoprazan Fumarate MCG:

Table No.: Stability Study of Optimized Batch of Vonoprazan Fumarate MCG:

Parameters	Condition $40 \pm 2 \text{ }^\circ\text{C} / 75 \% \pm 5\% \text{ RH}$
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		Initial	15 Days	1 Month
Physical	Average Weight (mg)	600	599	599
	Thickness(mm)	4.13	4.12	4.12
	Hardness (kg/cm²)	4.2	4.1	4.1
	Friability (%)	0.75	0.74	0.74
Chemical	Drug Release (%)	97.55	97.94	97.29
	Drug Content (%)	96.89	96.70	96.95

VII. CONCLUSION

The present study successfully developed and evaluated medicated chewing gum containing Vonoprazan Fumarate as a novel oral drug delivery system. The formulation exhibited satisfactory physicochemical properties, good drug–excipient compatibility, acceptable pre- and post-compression characteristics, and efficient in-vitro drug release. Among all formulations, batch B2 demonstrated optimum performance with nearly 99% drug release within 60 minutes. Optimization using Central Composite Design confirmed the significant influence of formulation variables on drug release and mechanical properties. Stability studies revealed that the optimized formulation remained stable under specified storage conditions without significant changes. Overall, the developed medicated chewing gum represents a stable, patient-friendly, and effective alternative dosage form for Vonoprazan Fumarate, with potential for rapid drug delivery, improved bioavailability, and enhanced patient compliance.

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