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Optimizing Irbesartan Fast Dissolving Tablets Using Natural Polysaccharides for Enhanced Drug Delivery and Patient Compliance

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Abstract

Hypertension, a common health issue, requires effective, patient-friendly treatments. Irbesartan, an Angiotensin II receptor antagonist, is frequently used to manage hypertension, but its low solubility restricts bioavailability. This study aimed to develop and optimize fast-dissolving tablets (FDTs) of Irbesartan by utilizing a natural polysaccharide from Glycyrrhiza glabra as a superdisintegrant to enhance wetting time, disintegration time, and drug release, thus improving patient compliance and therapeutic effectiveness. Glycyrrhiza glabra polysaccharide was isolated and evaluated for superdisintegrant potential in Irbesartan FDTs. A full factorial design was implemented to optimize formulation variables, including the concentrations of natural polysaccharide, sodium starch glycolate (SSG), and microcrystalline cellulose (MCC). The key quality attributes—wetting time, disintegration time, and drug release were assessed, and observed responses were compared with predictions to validate model accuracy. The optimized formulation exhibited a predicted wetting time of 43.71 seconds, drug release of 96.37%, and disintegration time of 76.83 seconds, while observed values were 45.62 seconds, 97.59%, and 79.28 seconds, respectively, yielding % predicted error values of 4.18%, 1.25%, and 3.09% all below 5.0%, confirming model reliability. This study successfully developed optimized Irbesartan FDTs with improved performance, demonstrating that Glycyrrhiza glabra polysaccharide is an effective superdisintegrant. Further, in vivo studies are recommended to confirm the optimized formulation's therapeutic benefits in clinical settings.

Keywords: Factorial Design, *Glycyrrhiza glabra* natural polysaccharide (Mucilage), Hypertension, Irbesartan, Optimization.

Introduction

Hypertension remains a significant global health issue, necessitating effective and patient-friendly therapeutic strategies. Among the various routes of drug administration, the oral route is the most widely accepted due to its convenience, patient compliance, and ability to deliver both local and systemic effects. Tablets are the most common solid oral dosage form, offering a simple method of administration, precise dosing, self-medication, and avoidance of the pain associated with injections. However, traditional tablets and capsules can present challenges for pediatric and geriatric patients, who may have difficulty swallowing, highlighting the need for alternative formulations (1, 2). Fast-dissolving tablets (FDTs) have emerged as an innovative solution, particularly for those with swallowing difficulties. These tablets rapidly disintegrate in the mouth within minutes, facilitating quick onset of action and enhanced bioavailability (3). FDTs are a semisolid dosage form that disperses or dissolves in the oral cavity, eliminating the need for water and improving patient compliance. The oral route of medication administration is widely accepted, accounting for 50-60% of total dosage forms due to its simplicity and effectiveness (4). Irbesartan, an angiotensin II receptor antagonist commonly prescribed for hypertension management, has

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has poor water solubility and undergoes first-pass metabolism, limiting its bioavailability. Developing Irbesartan into an FDT format can enhance its therapeutic efficacy by promoting faster disintegration and dissolution, which leads to improved absorption in the upper gastrointestinal tract (GIT) (5). Recent advancements in drug delivery systems (DDS) have emphasized the use of natural polymers, such as plant-derived natural polysaccharides, due to their biocompatibility, low cost, and availability. Natural polysaccharides, like those derived from Glycyrrhiza glabra (licorice root), are known for their hydrophilic properties and ability to act as effective superdisintegrants. These polysaccharides are capable of absorbing saliva rapidly, swelling, and facilitating quick tablet disintegration. The use of Glycyrrhiza glabra natural polysaccharide as a superdisintegrant in the formulation of Irbesartan FDTs presents a promising alternative to synthetic disintegrants, enhancing drug release profiles and improving patient comfort (6). Incorporating natural excipients such as Glycyrrhiza glabra in pharmaceutical formulations is subject to regulatory guidelines, including those related to the safety and approval of natural polysaccharides as excipients in drug products. Exploring the mechanisms by which Glycyrrhiza glabra polysaccharide enhances disintegration and dissolution would further clarify its role in enhancing FDT performance. This research focuses on the formulation and optimization of Irbesartan FDTs using isolated Glycyrrhiza glabra natural polysaccharide. The primary objective is to enhance key performance metrics such as wetting time, disintegration time, and drug release, employing a full factorial design approach. This approach will enable a comprehensive analysis of formulation variables, leading to the development of a robust, effective, and patient-friendly dosage form for hypertension management. Additionally, the study will address the regulatory requirements for the use of natural polysaccharides and investigate their advantages and disadvantages compared to synthetic disintegrants, considering factors such as cost, biocompatibility, and sustainability.

Materials and Method

The materials used in this study were carefully selected to optimize the formulation of fast dissolving tablets (FDTs). Irbesartan, the active pharmaceutical ingredient (API), was the primary component. Liquorice obtained from local market Ahmedabad was employed as a natural superdisintegrant, chosen for its excellent hydrophilic properties that facilitate rapid tablet disintegration and enhance drug release. Sodium Starch Glycolate (SSG) and Microcrystalline Cellulose (MCC) were incorporated as additional disintegrates to further improve the tablet's disintegration profile. Mannitol was used as a filler to enhance tablet bulk and palatability, while Magnesium Stearate and Talc were utilized as a lubricant and Glidant, respectively, to ensure efficient tablet manufacturing and prevent sticking during compression. All materials were of analytical reagent (AR) grade, selected for their high quality and compatibility with Irbesartan to achieve the desired therapeutic outcomes and improve patient compliance.

Isolation of Natural Polysaccharide

The natural polysaccharide from *Glycyrrhiza glabra* (liquorice root) was isolated using a standard extraction process, as depicted in (Figure 1). Fresh liquorice roots were thoroughly cleaned to remove any dirt and impurities, then dried and ground into a fine powder. The powdered root material was soaked in distilled water for several hours with continuous stirring to facilitate the release of natural polysaccharide into the water. After sufficient soaking, the mixture was filtered through a muslin cloth to separate the natural polysaccharide solution from the solid residue. The filtrate was then treated with ethanol in a 1:3 ratio (filtrate to ethanol) to precipitate the natural polysaccharide. The precipitated natural polysaccharide was collected by filtration, washed with acetone to remove any remaining impurities, and dried at a low temperature (40-50°C) to prevent degradation. The dried natural polysaccharide was powdered using a mortar and pestle and stored in an airtight container for further use in tablet formulation. This isolated natural polysaccharide, characterized by its hydrophilic nature and swelling properties, was used as a natural superdisintegrant in developing fast dissolving tablets (FDTs) to enhance the disintegration and dissolution profile of Irbesartan (7).

Figure 1: A) Extraction of Natural Polysaccharide, B) Isolated Natural Polysaccharide (Mucilage)

Preparation of Fast Dissolving Tablets (FDTs)

Formulation Design: The formulation of Irbesartan fast dissolving tablets (FDTs) was optimized using a 2^3 full factorial design, as detailed in Table 1, to systematically evaluate the effects of three independent variables on the critical quality attributes of the tablets. The three factors studied were the concentrations of Glycyrrhiza glabra natural polysaccharide, Sodium Starch Glycolate (SSG), and Microcrystalline Cellulose (MCC). This experimental design allowed for the assessment of both individual and interactive effects of these variables on key response parameters, such as wetting time, disintegration time, and drug release. By investigating high and low levels for each factor, a comprehensive understanding of their influence on the FDT formulation was achieved, enabling the optimization of tablet characteristics for improved therapeutic efficacy and patient compliance (8).

Direct Compression Method: The fast dissolving tablets were prepared using the direct compression method, a straightforward and efficient technique widely used in tablet manufacturing. The formulation ingredients were selected and prepared according to the proportions specified in (Table 2): Formulae for the Preparation of Fast Dissolving Tablets as Per Experimental Design. Irbesartan, as the active pharmaceutical ingredient, was blended with the chosen superdisintegrants, Glycyrrhiza glabra natural polysaccharide and SSG, and MCC, which functioned as both a binder and a disintegrant to facilitate rapid tablet breakdown in the oral cavity. The blend was carefully mixed to ensure uniform distribution of the active ingredient and excipients. Additional excipients, such as mannitol as a filler to enhance tablet bulk and palatability, and talc and magnesium stearate as a Glidant and lubricant respectively, were included to improve the tablet's mechanical properties and manufacturing process. The mixed powder blend was then directly compressed into tablets using a rotary tablet press, ensuring uniform weight and hardness across all batches. The compression parameters were optimized to achieve the desired tablet characteristics without compromising the rapid disintegration and dissolution properties. This method provided a robust and scalable approach for producing Irbesartan FDTs with excellent bioavailability and patient compliance.

Characterization of Isolated Natural Polysaccharide

Natural Polysaccharide Yield Percentage

The yield of natural polysaccharide from Glycyrrhiza glabra was calculated to determine the extraction efficiency. The plant material was extracted with water, filtered, and the natural polysaccharide was dried to a constant weight. The yield percentage was calculated using the formula (9).

Solubility Profile and Swelling Index

The solubility of the natural polysaccharide was tested in water, ethanol, methanol, and chloroform. It was highly soluble in water, moderately soluble in ethanol and methanol, and insoluble in chloroform, indicating its suitability as a hydrophilic superdisintegrants (10). The swelling index in water confirmed its capacity to swell rapidly, a desirable property for fast dissolving tablets.

Identification Test

To confirm the presence of natural polysaccharide, the isolated powder was treated with 1% Ruthenium Red solution. A color change to violet confirmed natural polysaccharide content, verifying its purity and effectiveness as a natural superdisintegrants (11).

Evaluation of Tablets

Wetting Time

The wetting time of the fast dissolving tablets (FDTs) was evaluated to assess how quickly the tablet begins to disintegrate upon contact with moisture, which is critical for patient compliance and rapid onset of action. The wetting time was measured using a folded tissue paper method. A piece of tissue paper was folded twice and placed in a small petri dish containing 5 ml of distilled water. The tablet was then carefully placed on the paper, and the time taken for the water to completely wet the tablet surface was recorded in seconds. This method provides an indication of how quickly the tablet will disintegrate in the mouth upon contact with saliva (12).

In-vitro Dissolution Study

The in-vitro dissolution profile of the FDTs was studied to determine the rate and extent of drug release, which is essential for ensuring therapeutic efficacy. The dissolution study was performed using a USP type-II dissolution apparatus (paddle type) with a paddle rotation speed of 50 rpm. The dissolution medium consisted of 900 ml of phosphate buffer at pH 6.8, maintained at a temperature of 37 ± 0.5°C to simulate physiological conditions in the gastrointestinal tract. Samples were withdrawn at predetermined intervals and analyzed for drug content using a UV-visible spectrophotometer at the appropriate wavelength. The cumulative percentage of Irbesartan released over time was calculated to evaluate the dissolution characteristics of each formulation.

Disintegration Test

The disintegration time of the FDTs was assessed to evaluate how quickly the tablet disintegrates into smaller particles, which is crucial for rapid drug release and absorption. The disintegration test was conducted using a modified method with Sorenson's buffer at pH 6.8, designed to simulate the salivary conditions in the oral cavity. This test involved placing the tablet in a cylindrical basket containing 6 ml of Sorenson's buffer, where 4 ml was placed below a sieve, and 2 ml above it. The time taken for the tablet to disintegrate completely and pass through the 10-mesh screen was recorded. The average disintegration time of six tablets was calculated to ensure consistency and reliability of the results (13).

Optimization and Validation

To analyze the data generated from the factorial design and to optimize the formulation, Design Expert software was employed. This software facilitated the statistical evaluation of the experimental results, allowing for the determination of the most significant factors and their interactions affecting the tablet's performance. Critical quality attributes, including wetting time, disintegration time, and drug release, were used as response variables to assess the effectiveness of each formulation. The software generated response surface plots and regression models to visualize the effects and optimize the formulation conditions. An additional optimized batch (F9) was also prepared based on the findings from these runs. Optimized batch (F9) was validated by comparing the predicted and observed values for the critical quality attribute, confirming the robustness and reliability of the formulation process. This approach ensured the development of a fast dissolving tablet with enhanced bioavailability and patient compliance, tailored for effective hypertension management (14).

Statistical Analysis

Data Analysis

The statistical analysis of the experimental data was performed to optimize the formulation of fast dissolving tablets (FDTs) of Irbesartan by understanding the impact of various formulation variables. Multiple regression analysis was applied to fit polynomial equations, modeling the relationship between the independent variables (concentrations of Glycyrrhiza glabra natural polysaccharide, Sodium Starch Glycolate (SSG), and Microcrystalline Cellulose (MCC)) and the dependent responses (wetting time, disintegration time, and drug release). This approach allowed for quantifying the effects of each variable and their interactions on the responses.

Analysis of Variance (ANOVA)

To determine the statistical significance of the fitted model, an Analysis of Variance (ANOVA)

was conducted. ANOVA helped test the significance of the regression coefficients and the model terms by comparing the model variance to the residual error variance. A p-value of less than 0.05 was considered statistically significant, indicating that the factors and their interactions significantly influenced the responses. The F-value provided insight into the relative importance of each factor and their interactions, ensuring that the optimized model was reliable and robust for predicting tablet performance (15).

Contour Plots

Contour plots were utilized to visually represent the interaction between the formulation variables and their effects on the critical quality attributes of the tablets. These plots illustrated the response surface by showing lines of constant response (such as wetting time, disintegration time, or drug release) as a function of two factors while keeping the third factor constant. Contour plots provided a clear graphical interpretation of how different combinations of the formulation variables affected the tablet characteristics, helping to identify optimal conditions for achieving desired outcomes. The use of contour plots, in conjunction with regression analysis and ANOVA, enabled a comprehensive understanding of the formulation space and facilitated the development of an optimized FDT formulation with enhanced bioavailability and patient compliance (16).

Table 1: 2^3Factorial Design with Upper and Lower Limits of all Factors

3 Factors	***2 Levels***	
	-1	**+1**
Liquorice Natural polysaccharide	5	15
Conc. of S.S.G.	6	12
Conc. of M.C.C.	20	40

Table 2: Formulae for the Preparation of Fast Dissolving Tablets as Per Experimental Design

Ingredients	**Quantity in 'mg'**							
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
Irbesartan	50	50	50	50	50	50	50	50
Liquorice Natural polysaccharide	15	15	5	15	5	5	15	5
S.S.G.	6	12	12	6	6	6	12	12
M.C.C.	40	20	20	20	40	20	40	40
Magnesium stearate	1	1	1	1	1	1	1	1
Talc	1	1	1	1	1	1	1	1
Mannitol	87	101	111	108	97	117	81	91
Total	200	200	200	200	200	200	200	200

Results

Characterization of Isolated Natural Polysaccharide

Natural Polysaccharide Yield Percentage: The extraction process resulted in a yield of 12.30 grams of natural polysaccharide from 200 grams of liquorice root, corresponding to a yield percentage of 6.15% (Table 3). This yield indicates moderate extraction efficiency, demonstrating that the isolation method was effective in recovering a sufficient amount of natural polysaccharide for further use in formulation development.

Solubility Profile: The solubility studies revealed that the isolated natural polysaccharide was highly soluble in water, forming a gel-like substance in hot water, while it was insoluble in ethanol (Table 4). This high solubility in water confirms the hydrophilic nature of the natural polysaccharide, which is desirable for its role as a superdisintegrant, as it facilitates rapid tablet disintegration upon contact with saliva or other aqueous media.

Identification Test: The identification of the isolated natural polysaccharide was confirmed by a positive reaction with a 1% Ruthenium Red solution, which turned the solution violet, indicating the presence of natural polysaccharide (Table 5). This color change confirms the successful isolation of natural polysaccharide and its purity, ensuring that the isolated material is suitable for use in pharmaceutical formulations as a natural superdisintegrant.

Table 3: Percent Yield of Isolated materials

Isolated Material	Quantity Used	Material Obtained (Yield)	% Yield (yield/quantity used*100)
Liquorice Natural Polysaccharide	200 gram	12.30 grams	6.15 %

Table 4: Solubility of Isolated Materials in Various Solvents

Isolated Material	Solvent	Solubility
Liquorice Natural Polysaccharide	Water	Soluble
	Hot water	Forms gel like substance
	Ethanol	Insoluble

Table 5: Results for Identification Test of Isolated Materials

Isolated Materials	Observation for Natural Polysaccharide	Result
Liquorice Natural Polysaccharide	The solution turns violet color when treated with Ruthenium Red Solution	Natural polysaccharide was present **(+)**

Evaluation of Fast Dissolving Tablets (FDTs)

The evaluation of Irbesartan fast dissolving tablets (FDTs) was conducted to assess the impact of varying concentrations of Glycyrrhiza glabra natural polysaccharide, Sodium Starch Glycolate (SSG), and Microcrystalline Cellulose (MCC) on wetting time, drug release, and disintegration time (Table 6).

Wetting Time: Wetting times ranged from 43.05 seconds to 83.46 seconds. The shortest wetting time was observed in formulations with high natural polysaccharide and MCC but low SSG levels (Run 1), indicating faster moisture absorption with these combinations.

Drug Release: Drug release percentages varied from 70.73% to 99.1%. The highest release was achieved in formulations with high natural polysaccharide and SSG but low MCC levels (Run 2), suggesting that this combination enhances drug dissolution.

Disintegration Time: Disintegration times ranged from 63.71 seconds to 121.43 seconds. The quickest disintegration was seen in formulations with high natural polysaccharide and MCC and low SSG levels (Run 1), while the slowest was noted when all components were at high levels (Run 8), indicating a denser matrix formation.

Table 6: Result of Data Obtained from Experiment and DoE Study of FDT (Batch: F 1-8)

	Independent Variable			Dependent Response		
Run	Factor-1 (A) Liquorice Natural Polysaccharide	Factor-2 (B) S.S.G.	Factor-3 (C) M.C.C.	Response-1 Wetting Time (Sec.)	Response-2 Drug Release (%)	Response-3 Disintegration Time (Sec.)
1	+1	-1	+1	43.05	81.49	63.71
2	+1	+1	-1	47.21	99.1	68.05
3	-1	+1	-1	49.76	72.98	70.31
4	+1	-1	-1	48.19	70.73	69.64
5	-1	-1	+1	50.65	74.62	74.19
6	-1	-1	-1	83.46	74.8	69.93
7	+1	+1	+1	77.57	86.27	113.49
8	-1	+1	+1	83.42	75.57	121.43

Optimization and Validation of Formulation

The formulation of Irbesartan fast dissolving tablets (FDTs) was optimized using a 2^3 full factorial design, resulting in the selection of Batch F9 as the optimal formulation, as shown in (Table 7). Batch F9, prepared with high levels of Glycyrrhiza glabra natural polysaccharide and

SSG, and a moderate level of MCC, achieved a predicted wetting time of 43.71 seconds, drug release of 96.37%, and disintegration time of 76.83 seconds. The high desirability score of 0.872 indicates a well-balanced formulation with rapid onset and enhanced bioavailability.

Visualizing Optimization: Contour Plots

The optimization of the fast dissolving tablets (FDTs) formulation was further elucidated using contour plots, as depicted in (Figure 2-4). These plots illustrate the interactions between different factors—Liquorice natural polysaccharide, Sodium Starch Glycolate (SSG), and Microcrystalline Cellulose (MCC)—on key response variables, including wetting time, drug release, and disintegration time. The contour plots reveal the optimal ranges for each factor, ensuring the formulation meets the desired criteria for effective drug delivery. (Table 6) presents the data from the experimental runs and Design of Experiments (DoE) study, showing the impact of varying concentrations of the disintegrants on tablet performance. The use of contour plots helped in visualizing the effects of these factors and aided in refining the formulation to achieve the optimal batch (F9) with the desired attributes.

Validation of Optimized Formulation

The observed results for Batch F9 as shown in (Table 8) closely matched the predicted values, with a wetting time of 45.62 seconds, drug release of 97.59%, and disintegration time of 79.28 seconds. The percentage predicted error (% PE) for all parameters was below 5%, confirming the model's accuracy and the formulation's robustness. These findings validate the optimized formulation, demonstrating its effectiveness in improving patient compliance and therapeutic efficacy for hypertension management.

Table 7: Result of Predicted Composition of Optimized Formulation by QbD Batch FDT (Batch-F9)

Liquorice Natural polysaccharide	S.S.G.	M.C.C.	Wetting Time (Sec.)	Drug Release (%)	Disintegration Time (Sec.)	Desirability
15	12	35	43.71	96.37	76.83	0.872

Table 8: Results of Optimized Formulation of FDT (Batch-F9)

Variables	Predicted Response	Observed Response	% Predicted Error (% PE)	Acceptance Criteria for % PE
Wetting Time (Sec.)	43.71	45.62	4.18	Less than 5.0 %
Drug Release (%)	96.37	97.59	1.25	Less than 5.0 %
Disintegration Time (Sec.)	76.83	79.28	3.09	Less than 5.0 %

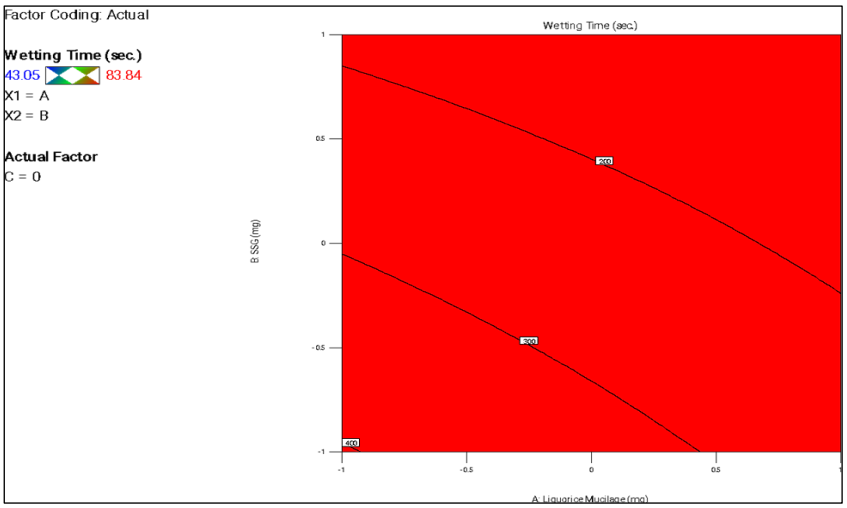

Figure 2: Contour Plot for Wetting Time

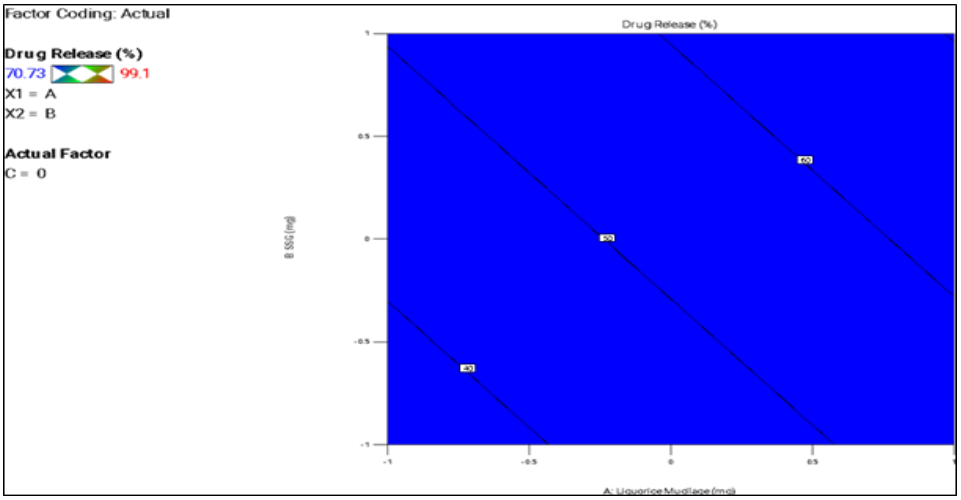

Figure 3: Contour Plot for the Drug Release

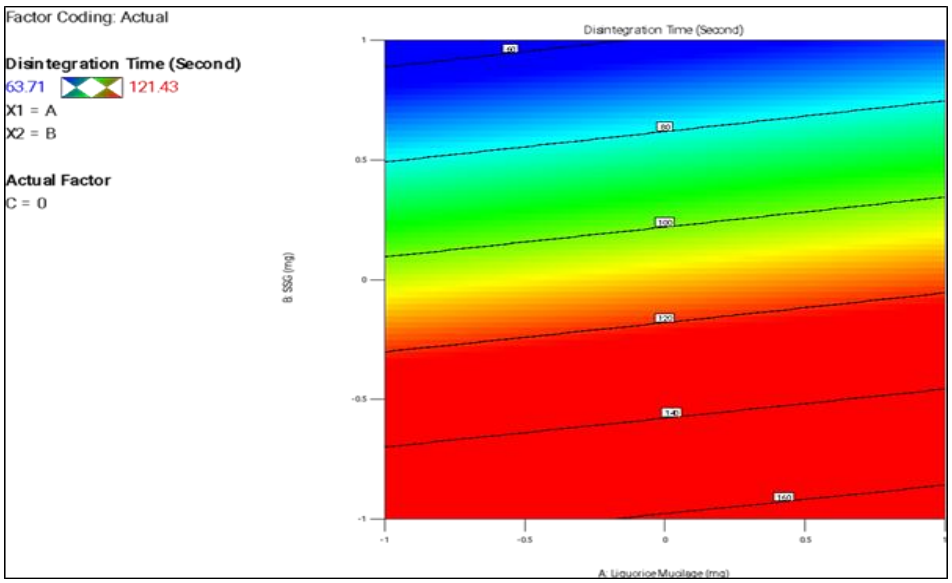

Figure 4: Contour Plot for the Disintegration Time

Implications for Formulation Development

This study demonstrates the potential of using Glycyrrhiza glabra natural polysaccharide as a natural superdisintegrant in the formulation of Irbesartan fast dissolving tablets (FDTs). The optimized formulation, achieved through a systematic factorial design, shows that natural excipients can effectively enhance tablet disintegration, dissolution, and overall bioavailability. This approach not only provides a cost-effective and biocompatible alternative to synthetic disintegrants but also improves patient compliance, particularly for those with swallowing difficulties. The findings suggest that the methodology used here can be applied to other drug formulations to improve therapeutic outcomes and patient experience. Future work could explore other natural polymers to further enhance the effectiveness and safety of FDTs.

Discussion

This study successfully developed fast-dissolving tablets (FDTs) of Irbesartan using Glycyrrhiza glabra polysaccharide, demonstrating its potential as a natural excipient for enhancing drug disintegration and release. Compared to synthetic disintegrants, natural polysaccharides offer advantages such as improved biocompatibility, sustainability, and lower toxicity. The polysaccharide's hydrophilic properties enabled rapid disintegration, aligning with findings from studies on other natural excipients like guar gum. Variability in extraction methods and plant source quality remains a challenge for consistent formulation. As seen in previous reports, standardizing these processes is critical for ensuring reproducibility. Additionally, while promising in vitro results were observed, further in vivo studies are required to confirm the clinical

benefits and bioavailability improvements. The applicability of Glycyrrhiza glabra polysaccharide for other drugs also warrants further exploration. A full factorial design allowed for optimal formulation and systematic analysis, offering a more reliable method than traditional trial-and-error approaches. This study demonstrates the feasibility of using Glycyrrhiza glabra as an excipient in FDTs. Still, future research, including in vivo validation and evaluation of other natural polysaccharides, is needed to assess its clinical potential fully. The study's limitations include potential formulation challenges associated with the isolation of the natural polysaccharide from Glycyrrhiza glabra, which may impact the reproducibility of results, as well as the need for further validation through in vivo studies to confirm the clinical efficacy of the optimized fast dissolving tablets.

Conclusion

This study demonstrates the innovative use of *Glycyrrhiza glabra* natural polysaccharide as a natural superdisintegrant in Irbesartan fast dissolving tablets (FDTs), providing an effective alternative to synthetic disintegrants. With a yield of 6.15%, the natural polysaccharide showed excellent hydrophilic properties and swelling capacity, crucial for enhancing tablet disintegration and dissolution. The optimized formulation (Batch F9) achieved a wetting time of 43.71 seconds, drug release of 96.37%, and disintegration time of 76.83 seconds, as shown in Table 7, highlighting the successful balance of ingredients and rapid drug action. The high desirability score of 0.872 and close agreement between predicted and observed values validate the formulation's robustness and effectiveness. By leveraging natural natural polysaccharide, this research advances the development of FDTs that improve bioavailability and patient compliance while promoting sustainable pharmaceutical practices. These findings suggest that natural polymers like Glycyrrhiza glabra can significantly enhance drug delivery systems. Future studies should explore in vivo validation and the use of other natural polymers to further enhance the therapeutic potential of FDTs. In summary, this study focused on improving the bioavailability of Irbesartan, an angiotensin II receptor antagonist for hypertension, through the formulation of fast dissolving tablets (FDTs) using a natural polysaccharide from Glycyrrhiza glabra as a superdisintegrant. A full factorial design optimized key variables, resulting in an FDT with a predicted wetting time of 43.71 seconds, drug release of 96.37%, and disintegration time of 76.83 seconds. The observed values confirmed the predictions, validating the effectiveness of the natural polysaccharide. Overall, the study demonstrates the potential of these optimized FDTs as a patient-friendly dosage form for hypertension management, with recommendations for further in vivo studies.

Abbreviations

FDT: Fast Dissolving Tablet, SSG: Sodium Starch Glycolate, MCC: Microcrystalline Cellulose, DoE: Design of Expert, % PE: Percentage Predicted Error.

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Author Contributions

Dr Segu Prathyusha conceptualized the study and designed the experimental framework, while Dr Madhavi Kasturi led the natural polysaccharide isolation and characterization. Ms Kirti Chandrahar Godse managed the tablet formulation and optimization, and Dr Rajmeet Singh handled the statistical analysis. Dr Sanjesh Rathi contributed to the experimental setup and data interpretation, with Dr Shrinivas Bumrela overseeing procedures and manuscript revisions. Priya Chhotulal Jain performed solubility tests and natural polysaccharide yield analysis, Dr. Priyanka Goswami contributed to the validation of experimental results and provided critical feedback on the research approach, and Shubham Singh assisted with data collection and manuscript drafting.

Conflict of Interest

The author declares that there are no conflicts of interest.

Ethics Approval

This study did not require ethical approval (not involve human participants or animal subjects).

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