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Review Paper

Design And Optimization of Gliclazide Fast Dissolving Tablets Employing Grewia Gum as A Novel Natural Superdisintegrant for Improved Antidiabetic Therapy

Dipak Parmar*, Dr. Sheetal Buddhadev, Dr. Darshit Ram, Dr. Santosh Kirtane

Noble University, Junagadh, Gujarat, India.

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ABSTRACT

The Present Study Focused On Developing And Optimizing Mucoadhesive Buccal Patches Of Gliclazide Using The Natural Polymer Grewia Gum To Enhance Bioavailability And Bypass First-Pass Metabolism. The Objectives Were To Formulate Patches With Varying Polymer Compositions, Evaluate Their Physicochemical And Mechanical Properties, And Assess In Vitro Drug Release, Swelling Behavior, And Ex Vivo Permeation. Grewia Gum Was Chosen Due To Its Natural Origin, Biocompatibility, And Excellent Swelling And Mucoadhesive Properties, Making It Ideal For Controlled Buccal Drug Delivery. Buccal Patches Were Prepared By The Solvent Casting Method Using Varying Ratios Of Grewia Gum Alone And Combined With Polymers Such As HPMC And Carbopol, Along With Suitable Plasticizers. Compatibility Studies Confirmed No Drug-Excipient Interactions. The Patches Were Evaluated For Thickness, Weight Variation, Folding Endurance, Surface Ph, Drug Content Uniformity, Tensile Strength, And Mucoadhesive Strength. Swelling Index And Ex Vivo Permeation Studies Assessed Hydration Behavior And Drug Diffusion Across Buccal Mucosa. The Optimized Batch Showed Ideal Physicochemical Properties, Satisfactory Mechanical Strength, And A Surface Ph Near Neutrality For Patient Acceptability. It Exhibited A Balanced Swelling Profile, Strong Mucoadhesion, And The Highest Drug Permeation Among Formulations. In Vitro Drug Release Demonstrated A Sustained Release Pattern Governed Predominantly By A Non-Fickian Diffusion Mechanism. Stability Studies Confirmed The Optimized Patch Remained Stable With No Significant Changes In Drug Content Or Release Profile. In Conclusion, Grewia Gum Significantly Enhanced The Performance Of Gliclazide Buccal Patches, Highlighting Its Potential As An Effective Natural Polymer For Controlled Drug Delivery. The Optimized Formulation Presents A Promising Alternative To

*Corresponding Author: Dipak Parmar

Address: Department Of Pharmaceutics, Faculty Of Pharmacy - Noble University, Junagadh, Gujarat, India

Email ✉: dipakparmar10715@gmail.com

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Conventional Dosage Forms, Improving Therapeutic Efficacy And Patient Compliance In Diabetes Management.

INTRODUCTION

The **Oral Route** Is The Most Common Method For Drug Administration, Accounting For Nearly **60%** Of Marketed Dosage Forms, Primarily Oral Solids. Despite Its Advantages, Challenges Such As **Reduced Bioavailability, Slow Onset, And Swallowing Difficulties** Have Increased The Use Of Parenteral And Liquid Formulations. Liquid Orals (E.G., Syrups, Suspensions) Help Some Patients But Often Have Dosing Inaccuracies, While Parenteral Routes Can Cause Pain.

Swallowing Difficulties Affect Specific Groups Like **Children, Elderly, And Travelers** Without Water Access, Causing Low Compliance. This Has Driven The Development Of **Fast-Dissolving Dosage Forms**, Which Rapidly Disintegrate In The Mouth Without Water, Offering A Convenient Alternative.

Many Orally Administered Drugs Undergo Significant **First-Pass Metabolism**, Reducing

Bioavailability. These Limitations Have Spurred The Growth Of **Fast Dissolving Drug Delivery Systems** Since The Late 1970s As Substitutes For Conventional Tablets.

Mucosal Drug Delivery Through The Buccal Route Is Gaining Attention For Improving Safety And Therapeutic Effectiveness For Both Local And Systemic Conditions. Buccal Mucoadhesive Systems Use **Water-Soluble Polymers** With Mucoadhesive Properties To Adhere To Moist Tissues, Avoiding Drawbacks Of The Sublingual Route Such As Unpleasant Taste, Drug Dilution By Saliva, Odor, And Local Anesthetic Effects.

MATERIALS AND METHODS

2.1. Solvent Casting Method

2.1.1. Preparation Of Mucoadhesive Buccal Patches By Solvent Casting Method

Materials:

The Following Materials Collected For The Experimental Work Done.

Table 1: List Of Materials

SR.NO.	DRUG/EXCIPIENTS	GRADE
1	Gliclazide	AR
2	HPMC	AR
3	Carbopol934p	AR
4	Na Alginate	AR
5	Poliviny Alcohol	AR
6	Eudragitl-100	AR
7	Tween 80	AR

Table 2: Natural Polymer List

Sr No.	POLYMER	ISOLATEDFROM	BOTANICALNAME	FAMILY
1	Grewia Gum	Bark	<i>Grewia Mollis</i>	Malvaceae

➤ The **Buccal Patches** Were Formulated Using The **Solvent Casting Method**. The Required Quantity Of Polymer Was Gradually Added And Dissolved In Distilled Water With Thorough Mixing. The Drug Was Then Dissolved In This Polymer Solution In Small

Amounts. A Plasticizer Was Added To The Mixture And Mixed Well. The Resulting Solution Was Poured Into Petri Dishes And Dried In A Hot Air Oven At **40°C**. After Drying, The Patches Were Carefully Removed Using A Sharp Blade, Stored In A



Desiccator For **24 Hours**, And Then Cut Into Pieces Of The Desired Shape And Size.

Table 3: Composition Of Mucoadhesive Buccal Patches Of Gliclazide

Formulation	Gliclazide (Mg)	Grewia Gum (Mg)	HPMC K15M (Mg)	Carbopol 934P (Mg)	Eudragit RL-100 (Mg)	Propylene Glycol (%)	Distilled Water (ML)
F1	82.00	350	100	50	–	10	40
F2	82.00	400	150	50	–	10	40
F3	82.00	450	200	50	–	10	40
F4	82.00	350	–	50	100	10	40
F5	82.00	400	–	50	150	10	40
F6	82.00	450	–	50	200	10	40
F7	82.00	400	100	50	100	10	40
F8	82.00	400	150	50	50	10	40
F9	82.00	400	200	50	100	10	40
F10	82.00	400	200	50	50	10	40

RESULTS AND DISCUSSION:

Evaluation Of Physicochemical Properties Of Grewia Gum Powder:

The Extracted **Grewia Gum** Showed Suitable Organoleptic And Physicochemical Properties For Use In **Gliclazide Buccal Patches**. Organoleptically, The Gum Was A **Light Brown, Fine, Free-Flowing Powder** With No Characteristic Odor And A Bland, Mucilaginous Taste, Indicating Good Patient Acceptability For Buccal Use.

The Solubility Profile Demonstrated That Grewia Gum Is **Insoluble In Organic Solvents** Like Ethanol, Acetone, And Chloroform, But Forms A **Viscous Colloidal Dispersion In Water** And Hydrates Completely In Hot Water To Produce A Thick Mucilage, Confirming Its **Hydrophilic Nature**.

The Ph Of The Dispersion Ranged From **6.2 To 6.4**, Near Neutral, Ensuring Compatibility With Buccal Mucosa And Reducing The Risk Of Irritation.

Table 4: Organoleptic Properties Of Isolated Grewia Gum Powder

Organoleptic Properties	
Color	Light Brown Powder
Odor	Odorless
Taste	Bland, Mucilaginous
Appearance	Fine, Free-Flowing Powder
Solubility Behavior	
Solubility In Water	Forms Viscous Colloidal Dispersion
Solubility In Hot Water	Completely Hydrates Forming Thick Mucilage
Solubility In Ethanol (95%)	Insoluble
Solubility In Acetone	Insoluble
Solubility In Chloroform	Insoluble
Ph (1% W/V Dispersion)	6.2

From A Physicochemical Perspective, **Grewia Gum** Exhibited A **Moderate Yield (14.5%)** And **Acceptable Moisture Content (7.8%)**, Indicating

Good Stability. Its **Swelling Index (285%)** And **Viscosity (410 Cps)** Demonstrate Excellent Water Uptake And Gel-Forming Ability, Essential For



Mucoadhesion And **Controlled Drug Release** In Buccal Patches. This Enables The Formation Of A Hydrated Three-Dimensional Network From Which The Drug Can Efficiently Diffuse.

The Gum's **Hygroscopic Nature**—Its Ability To Absorb Moisture—Was Assessed, As Excessive Hygroscopicity Can Alter Dosage Form Properties. Flow Properties Were Evaluated By:

- **Bulk Density:** 0.52 G/ML
- **Tapped Density:** 0.67 G/ML
- **Carr's Index:** 22.4%

- **Hausner Ratio:** 1.29

These Indicate **Passable Flow Characteristics**, Suitable For Uniform Casting Of Patches.

Additionally, The **Ash Value (3.1%)** Indicates Low Inorganic Impurities, While **Loss On Drying (8.2%)** Reflects Acceptable Residual Moisture.

Overall, These Properties Confirm **Grewia Gum** As A Promising Natural Polymer For Buccal Patch Formulation, Offering Desirable **Swelling, Adhesion, And Film-Forming** Characteristics.

Table 5 : Physicochemical Properties Of Isolated Grewia Gum Powder

Physicochemical Properties	
Yield (%)	14.5%
Moisture Content (%)	7.8%
Ash Value (%)	3.1%
Swelling Index (%)	285%
Viscosity (1% Solution, Cps)	410 Cps
Bulk Density (G/ML)	0.52 G/ML
Tapped Density (G/ML)	0.67 G/ML
Carr's Index (%)	22.4%
Hausner Ratio	1.29
Ph Of Mucilage	6.4
Loss On Drying (%)	8.2%

CALIBRATION DATA :

The Calibration Graph Exhibited A Straight-Line Relationship With A Correlation Coefficient ($R^2 \approx 0.9998$), Demonstrating Strong Linearity And Confirming The Method's Suitability For

Quantitative Analysis Of Gliclazide In Formulation Studies. This Calibration Curve Can Reliably Determine Unknown Gliclazide Concentrations In Subsequent Analyses.

Table 6 : Calibration Data Of Gliclazide In Phosphate Buffer Ph 7.4

Conc (µg/ML)	Absorbance At 229 Nm (A)
0	0
2.0	0.1023
4.0	0.2017
6.0	0.3105
8.0	0.4034
10.0	0.5039
12.0	0.6008
16.0	0.8013

Regression (Linear Fit Of Absorbance Vs Concentration): $Y = 0.05x + 0.0031$
 $R^2 = 0.9998$



Where Y = Absorbance, X = Concentration Correlation Coefficient: $R^2 = 0.9998$
 ($\mu\text{g}/\text{ml}$) Standard Deviation Of Residuals (Sy/X): 0.0031

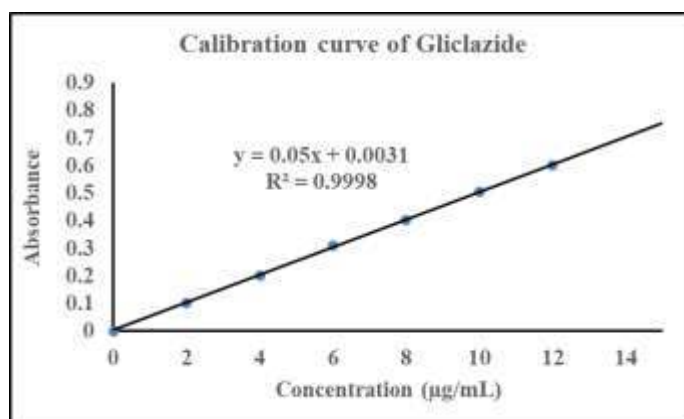


Figure 1: Calibration Curve Of Gliclazide In Buffer Ph 7.4

FT-IR Studies :-

The Spectral Data Showed That The Major Drug Peaks Appeared At Similar Values Across All Physical Mixtures Of The Drug And Polymers, With No Significant Changes In IR Peaks. This

Indicates That The Drug Is Molecularly Dispersed Within The Polymers Or Drug-Loaded Formulations, Confirming The Absence Of Any Interactions Between The Drug And Polymers.

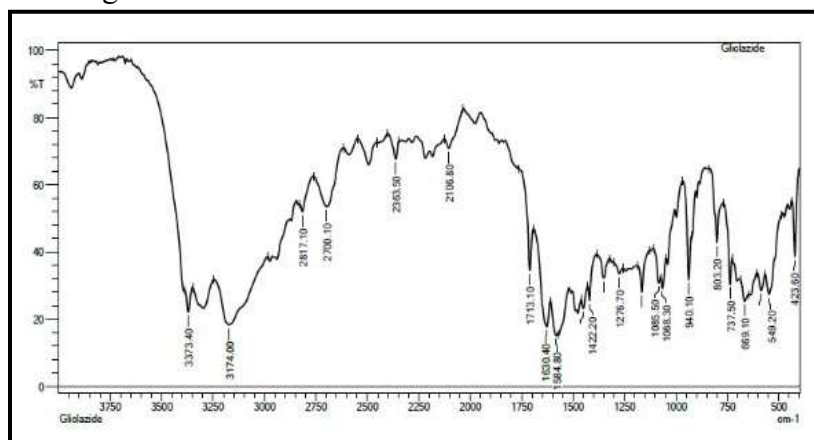


Figure 2: FTIR Graph For Gliclazide

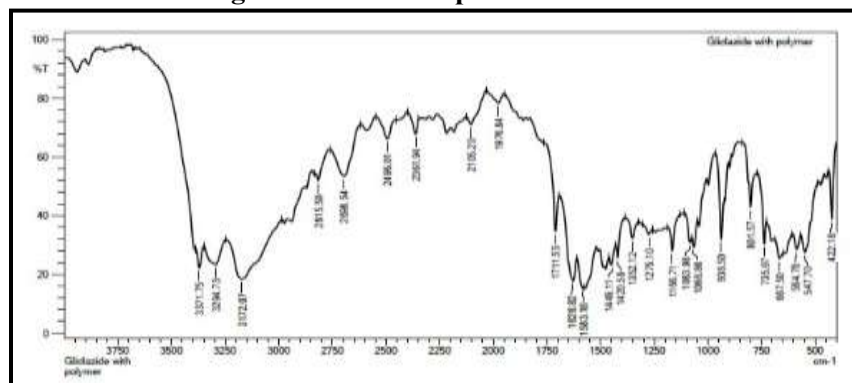


Figure 3: FTIR Graph For Gliclazide With Polymer Mixture

The FTIR Spectrum Of Pure Gliclazide Shows Characteristic Peaks Corresponding To Its Functional Groups. A Prominent Absorption Band

Near 3300 cm^{-1} Is Attributed To N–H Stretching Of The Sulfonylurea Moiety. A Strong Peak Around 1700 cm^{-1} Indicates C=O Stretching Of



The Amide Group. Peaks Between **1150–1350 Cm^{-1}** Correspond To **S=O Stretching** Vibrations Of The Sulfonyl Group. Additionally, Peaks Near **1600 Cm^{-1}** Arise From **Aromatic C=C Stretching**, Confirming The Drug's Structural Integrity As Per Official Values.

PHYSICOCHEMICAL PARAMETERS OF DRUG :-

The Organoleptic Evaluation Of Gliclazide Revealed That It Is A White To Off-White, Fine Powder With A Bitter Taste And No Significant Odor, Which Is Typical Of Sulfonylurea Drugs.

Table 7: Organoleptic Properties Of Gliclazide

Parameter	Observation
Physical State	Fine Powder
Colour	White To Off-White Fine Powder
Odour	Odourless To Slightly Characteristic
Taste	Slightly Bitter

SOLUBILITY

Gliclazide Is **Practically Insoluble In Water** But Exhibits Better Solubility In Organic Solvents Like **Acetone** And **Chloroform**, With Limited Solubility In **Alcohol** And **Buffer Media**. This

STUDY:

Poor Aqueous Solubility Underscores The Need For Formulation Strategies Such As **Buccal Patches** Or **Controlled-Release Systems** To Improve Its Dissolution And Bioavailability.

Table 8: Solubility Gliclazide In Various Solvents

Solvent	Solubility
Water	Practically Insoluble
Methanol	Slightly Soluble
Ethanol (95%)	Sparingly Soluble
Acetone	Freely Soluble
Chloroform	Soluble
0.1 N Hcl	Slightly Soluble
Phosphate Buffer Ph 6.8	Slightly Soluble

EVALUATION OF MUCOADHESIVE BUCCAL PATCHES OF GLICLAZIDE :-

Evaluating Buccal Patches Is Essential To Ensure Quality, Performance, And Patient Acceptability Of **Gliclazide** Formulations. The Assessment Focuses On Physicochemical, Mechanical, And Surface Properties That Affect Drug Release, Mucoadhesion, And Stability.

Key Evaluation Parameters Include:

- **Weight Variation** And **Thickness** To Ensure Uniform Drug Distribution And Consistency In Casting
- **Folding Endurance** To Assess Mechanical Strength And Flexibility

- **Surface Ph** To Confirm Compatibility With Buccal Mucosa And Prevent Irritation
- Systematic Evaluation Of These Parameters Aids In Optimizing The Formulation, Ensuring Reproducibility, And Selecting The Best Buccal Patch For Effective Drug Delivery.

PHYSICAL APPEARANCE AND SURFACE TEXTURE OF PATCHES:

These Parameters Were Checked Simply With Visual Inspection Of Patches And By Feel Or Touch. The Observation Reveals That The Patches Are Having Smooth Surface And They Are Elegant In Appearance.

Table 9: Physical Evaluation Of Mucoadhesive Buccal Patches Of Gliclazide

Formulation	Average Weight (Mg)	Thickness (Mm)	Folding Endurance	Surface Ph
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F1	35.66±1.15	0.53±0.05	252.33±3.51	6.30±0.05
F2	36.66±0.57	0.55±0.05	260.00±1.00	6.13±0.05
F3	40.33±1.15	0.56±0.05	267.66±3.51	5.56±0.11
F4	26.00±1.73	0.51±0.01	224.33±2.08	6.26±0.05
F5	29.66±1.15	0.54±0.05	225.33±4.50	6.40±0.35
F6	32.33±1.15	0.53±0.05	245.66±2.08	5.71±0.37
F7	30.66±1.52	0.52±0.01	230.33±2.64	6.33±0.26
F8	32.26±1.52	0.53±0.05	246.00±1.95	5.62±0.15
F9	36.66±0.57	0.55±0.05	269.66±2.00	6.48±0.20
F10	36.26±1.52	0.55±0.05	266.00±1.95	5.76±0.20

EVALUATION OF BUCCAL PATCHES :-

- **Weight** Uniformity:
The Patches' Weights Ranged From 26.00 Mg To 40.33 Mg, Indicating Acceptable Uniformity.
- Formulations F1–F3 Had Higher Weights Due To Increased Grewia Gum And HPMC K15M Concentrations.
- F4–F6 Showed Lower Weights Because Of Eudragit RL-100, Which Is Less Hydrophilic With Lower Bulk Density.
- Triple Polymer Systems (F7–F10) Had Intermediate Weights Reflecting Balanced Polymer Compositions.
- **Thickness:**
Thickness Ranged From 0.51 Mm To 0.56 Mm, Showing Minimal Variation And Uniform Casting.
- Slightly Higher Thickness In F2, F3, F9, F10 Corresponded To Increased Polymer Concentration.
- Lower Thickness In F4 Was Due To Reduced Hydrophilic Polymer And Presence Of Hydrophobic Eudragit.
- **Folding** Endurance:
Values Ranged From 224 To 269, Indicating Good Mechanical Strength And Flexibility.
- Highest Folding Endurance (>265) Observed In F3, F9, F10, Attributed To Higher Polymer Concentration And Better Plasticization.
- Lower Values In F4, F5 Likely Due To Rigidity From Higher Eudragit Content.

CONCLUSIONS

The Study Aimed To Develop And Optimize Mucoadhesive Buccal Patches Of Gliclazide To Enhance Bioavailability And Bypass First-Pass Metabolism. Key Points Include:

- Ten Formulations (F1–F10) Were Prepared Using Different Hydrophilic Polymers (HPMC, Carbopol, Grewia Gum) And Film-Forming Agents.
- Polymer Ratio Significantly Influenced Physicochemical And Drug Release Properties.
- Compatibility Studies Confirmed No Drug–Polymer Interactions.
- All Patches Showed Acceptable Thickness, Weight Uniformity, Folding Endurance, Surface Ph (Near Neutral), And Drug Content Uniformity.
- In Vitro Drug Release Demonstrated Controlled, Sustained Release Influenced By Polymer Composition.
- Swelling Studies Showed Increased Swelling With Higher Hydrophilic Polymer Content, Enhancing Mucoadhesion And Drug Diffusion.
- Ex Vivo Permeation Confirmed Effective Drug Permeation; Optimized Formulations Showed Higher Permeation Due To Balanced Swelling And Matrix Integrity.
- Stability Studies Under Accelerated Conditions Indicated No Significant Changes In Drug Content Or Release Profile.



The F8 Formulation Was Identified As The Optimized Batch, Showing:

- Highest Controlled Drug Permeation (71.40% Over 12 Hours)
- Balanced Hydrophilic (Grewia Gum, HPMC K15M) And Hydrophobic (Eudragit RL-100) Polymers Forming A Well-Structured Matrix
- Sustained Therapeutic Action Suitable For Buccal Delivery

The Drug Release Mechanism Was Predominantly Non-Fickian (Anomalous) Transport, Governed By Diffusion And Polymer Relaxation. Stability Results Confirmed Suitability For Long-Term Use.

Overall, The Study Demonstrated That Gliclazide Mucoadhesive Buccal Patches Can Improve Therapeutic Efficacy And Bioavailability, Offering A Promising Alternative To Conventional Oral Dosage Forms.

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REFERENCES

1. Alagga, A. A. (2024). Drug Absorption. In Statpearls. Statpearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK557489/>
2. Padhye, T., Et Al. (2021). A Comprehensive Review Of The Strategies To Improve Oral Drug Absorption With Special Emphasis On The Cellular And Molecular Mechanisms.

European Journal Of Pharmaceutical Sciences.

<https://doi.org/10.1016/j.ejps.2021.105921>

3. Sayed, O. M. (2024). Oral Mucosal Absorption: Mechanisms, Methods, And Challenges In Drug Delivery. Pharaoh Academy. Retrieved From <https://pharaohacademy.com/oral-mucosal-absorption-review>
4. Cheng, L., Et Al. (2020). Food Effects On Oral Drug Absorption. *Pharmaceutics*, 12(7), 631. <https://doi.org/10.3390/pharmaceutics12070631>
5. Reddy, P. C. (2011). A Review On Bioadhesive Buccal Drug Delivery Systems. *African Journal Of Pharmacy And Pharmacology*, 5(20), 2237-2246. <https://doi.org/10.5897/AJPP11.131>
6. Alqahtani, M. S., Et Al. (2021). Advances In Oral Drug Delivery. *Frontiers In Pharmacology*, 12, 618411. <https://doi.org/10.3389/fphar.2021.618411>
7. Standring, S. (2023). Anatomy, Head And Neck, Oral Cavity (Mouth). In Statpearls. Statpearls Publishing. Retrieved From <https://www.ncbi.nlm.nih.gov/books/NBK555959/>
8. Patel, S., & Kamath, V. (2024). Oral Cavity: Anatomy, Tongue Muscles, Nerves And Vessels. Kenhub. Retrieved From <https://www.kenhub.com/en/library/anatomy/oral-cavity>
9. Brizuela, M., Et Al. (2023). Histology, Oral Mucosa. In Statpearls. Statpearls Publishing. <https://www.ncbi.nlm.nih.gov/books/NBK557154/>
10. Wikipedia Contributors. (2005). Oral Mucosa. In Wikipedia, The Free Encyclopedia. Retrieved November 10, 2025, From



https://en.wikipedia.org/wiki/Oral_mucosa

11. Martinez, M. N., & Amidon, G. L. (2002). A Mechanistic Approach To Understanding The Factors Affecting Drug Absorption: A Review Of Fundamentals. *Journal Of Clinical Pharmacology*, 42(6), 620-643. <https://doi.org/10.1177/0097000204200605>
12. Davis, S. S., & Hardy, J. G. (2023). Factors Affecting Drug Absorption And Distribution. In *Pharmacokinetics* (Pp. 55-72). Elsevier. <https://doi.org/10.1016/B978-0-12-824068-7.00004-8>
13. Sun, C., & Lee, V. H. (2024). Oral Drug Absorption: Physicochemical, Physiological, And Formulation Factors. *Clinical Pharmacology & Therapeutics*, 115(3), 523-537. <https://doi.org/10.1002/Cpt.3032>
14. Thakur, R. R., & Kumar, M. (2010). Mucoadhesive Drug Delivery System: An Overview. *Pharmaceutics*, 2(2), 83-92. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3077973/>
15. Reddy, P. C. (2011). A Review On Bioadhesive Buccal Drug Delivery Systems. *African Journal Of Pharmacy And Pharmacology*, 5(20), 2237-2246. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3148614/>

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