

**“FORMULATION AND EVALUATION OF NIOSOMAL GEL  
FOR THE TREATMENT OF PERIODONTITIS”**

**A**

**Thesis**

**Submitted for partial fulfillment of the requirement for the award of the degree of**

**MASTER OF PHARMACY**

**(PHARMACEUTICS)**

**Submitted by**

**A Bharti Reddy**

**M PHARM IV SEMESTER**

**(PHARMACEUTICS)**

**(Enrollment No. GGV/20/06301)**

**(Roll no.20704002)**

**Supervised by**

**Dr. Akhlesh Kumar Jain**

**(Assistant Professor, Department of Pharmaceutics)**



**Session 2020-2022**

**DEPARTMENT OF PHARMACY GURU GHASIDAS VISHWAVIDYALAYA  
BILASPUR (C.G.)**

# **“FORMULATION AND EVALUATION OF NIOSOMAL GEL FOR THE TREATMENT OF PERIODONTITIS”**

A

Thesis

Submitted for partial fulfillment of the requirement for the award of the degree of

MASTER OF PHARMACY

(PHARMACEUTICS)

Submitted by

**A Bharti Reddy**

M PHARM IV SEMESTER

(PHARMACEUTICS)

(Enrollment No. GGV/20/06301)

(Roll no.20704002)

Supervised by

**Dr. Akhlesh Kumar Jain**

(Assistant Professor, Department of Pharmaceutics)



Session 2020-2022

**DEPARTMENT OF PHARMACY GURU GHASIDAS VISHWAVIDYALAYA  
BILASPUR (C.G.)**



**DEPARTMENT OF PHARMACY**

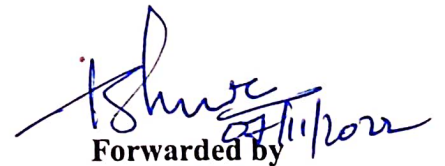
**GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.), 495009**

(A Central University established by the Central University Act 2009 No. 25 of 2009)

**FORWARDING CERTIFICATE**

This is to certify that Miss **A Bharti Reddy** of M. Pharm 4th Semester (Pharmaceutics), bearing Enrollment no. GGV/20/06301 has submitted master of pharmacy dissertation entitled as **“FORMULATION AND EVALUATION OF NIOSOMAL GEL FOR THE TREATMENT OF PERIODONTITIS”**, for the partial fulfillment of the requirement for the degree of Master of Pharmacy (Pharmaceutics). She has submitted her Dissertation under the supervision of **Dr. Akhlesh Kumar Jain** (Assistant Professor, Department of Pharmaceutics). Her dissertation is satisfactory, and is not submitted anywhere else for the award of any degree. I hereby forward her dissertation for M. Pharm degree in Pharmaceutics during the academic session 2020-2022.

Date: 07/11/2022

  
Forwarded by

**Dr. Bharti Ahirwar**

**Head of Department**  
**Department of Pharmacy**  
**Guru Ghasidas Vishwavidyalaya**  
**(A Central University)**  
**Bilaspur (C.G.)**



**DEPARTMENT OF PHARMACY**

**GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.), 495009**

(A Central University established by the Central University Act 2009 No. 25 of 2009)

**CERTIFICATE**

This is to be certified that Miss **A Bharti Reddy** of M. Pharm 4th Semester (Pharmaceutics), bearing **Enrollment No. GGV/20/06301** has submitted her Dissertation entitled **“FORMULATION AND EVALUATION OF NIOSOMAL GEL FOR THE TREATMENT OF PERIODONTITIS”** to **Guru Ghasidas Vishwavidyalaya, Bilaspur** in the partial fulfillment of the requirement for the degree of Master of Pharmacy (Pharmaceutics). I hereby forward her dissertation for the award of M. Pharm. (Pharmaceutics) during the academic session 2020-2021.

Date: 4/11/22

  
4/11/22

**SUPERVISOR**

**Dr. Akhlesh Kumar Jain**

**Assistant Professor**

**Department of Pharmaceutics**



**DEPARTMENT OF PHARMACY**

**GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.), 495009**

(A Central University established by the Central University Act 2009 No. 25 of 2009)

**DECLARATION**

I, **A Bharti Reddy** bearing **Enrollment No. GGV/20/06301**, hereby declare that my M.Pharm entitled **“FORMULATION AND EVALUATION OF NIOSOMAL GEL FOR THE TREATMENT OF PERIODONTITIS”** submitted to **Guru Ghasidas University, Bilaspur** and this dissertation composed by me under the direct guidance and suggestion received from my supervisor **Dr.Akhlesh Kumar Jain** (Assistant Professor, Department of Pharmaceutics) for the partial fulfillment of the requirement for the award of degree of Master of Pharmacy in Pharmaceutics. I further declare that to the best of my knowledge the dissertation does not contain any part of work, which has been submitted for the award of any degree either in the University or in any other University/Deemed University without proper citation

Date:

**4/11/22**

**A BHARTI REDDY**

**M. Pharm. 4<sup>th</sup> Semester**

**Pharmaceutics**

## ACKNOWLEDGMENT

A first & most essentially humble solicitation to the supreme power that always Showers his blessing on me. The GOD is giving me a chance to live and an opportunity to do higher studies in this noble field of pharmacy.

A single flower cannot make a garden or a single star cannot make the beautiful shiny sky at the night in the same way any research work can never be an outcome of a single individual's talent or effort. It is just like climbing a high peak, step by step accompanied with bitterness, hardship, frustration, encouragement, trust and with so many people's kind help.

First of all, with reverence and gratitude, I express my benevolent thanks to my guide Dr. Akhlesh Kumar Jain Asst. Prof (Pharmaceutics) Department of Pharmacy, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) for his supervision, advice, guidance along with the freedom of work that he gave me. To work under the guidance of such an eminent person have been great and inexplicable experiences, which will ever remember in my life.

I am also thankful to Dr. Bharti Ahirwar (HOD) Department of pharmacy, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) for providing me the required facilities and also their timely words of advice, despite of their busy schedule.

I am immensely thankful to my teachers Dr. S.K. Lanjhiyana, Dr. Manoj Kumar, Dr. Sunil Jain, Dr. Ravishankar Pandey, Mrs. Shivani Rai Paliwal, Dr. Kedar Meena, Dr. K. Kesavan, Dr. Akhilesh Jain, and Dr. S.H. Bodakhe.

My Special thanks goes to respected Mr. Mohan Ms, Nivedita Gautam, Mr. Shanni Kant Bharti, Ms. Keerti Mishra, Ms. Sakshi Tiwari, Mr. Sournava Jana, Mr. Bala ji, Mr. Avadh,

I am also thankful to non-teaching staff especially and Mr. Murlidhar Gupta, Mr. Nityanand Singh, Mrs. Veena Vaishnav, Mr. Virendera Verma & Mr. Dharendra Sahoo (Lab in charge of pharmaceutics) Mr. Vishnu. Mr. Giri for organizing required resources and for the assistance. For their kind help and providing me all facilities rendered during the study.

A friend in need is a friend indeed, a friend gives hope when life is low, a friend is place when you have nowhere to go, a friend is honest, a friend is true. I am grateful to for Tipti Karri, and Balram Kaushik her & his motivation, critical suggestion at all time.

Its pleasure to express my gratitude whole heartly to my batch mates Neha, Jyoti, Priyanjana, Vagesh, and Reena.

My deepest gratitude goes to my family who stood with me at all the times and whose support enabled me to stand confidently against all difficult times.

**A BHARTI REDDY**

## CONTENTS

<b>CHAPTER No.</b>	<b>TITLE</b>		<b>PAGE No.</b>
<b>1.</b>	<b>INTRODUCTION</b>		<b>1</b>
	1.1	Periodontitis	1
		1.1.1 Types of periodontitis	3
		1.1.2 Risk factors	4
		1.1.3 Diagnosis	6
		1.1.4 Treatment strategy	7
		1.1.5 Localized intrapocket drug delivery	9
		1.1.6 Current & future development	15
	1.2	Niosomes	19
		1.2.1 Various types of niosomes	19
		1.2.2 Factor affecting the formation of niosome	20
		1.2.3 Methods for formulation of niosome	22
		1.2.4 Applications of niosomes	24
		1.2.5 Proniosomes	26
<b>2.</b>	<b>DRUG PROFILE AND LITERATURE REVEIW</b>		<b>28</b>
	2.1	Celecoxib	28
	2.2	Doxycycline	29
	2.3	Literature Review	30
	2.4	Research Envisaged	33
	2.5	Plan of work	34



<b>3.</b>	<b>PREFORMULATION STUDIES</b>		<b>36</b>
	3.1	Physical properties	36
	3.2	Melting point (MP)	36
	3.3	UV spectrophotometry	37
		3.3.1 UV spectrophotometry of Celecoxib	37
		3.3.2 UV spectrophotometry of Doxycycline	39
		3.3.3 Simultaneous determination of UV spectrophotometry of Doxycycline and Celecoxib	40
	3.4	Solubility studies	42
	3.5	Partition Coefficient	43
	3.6	Infrared (IR) spectroscopy	44
		3.6.1 IR spectroscopy of pure Celecoxib	44
		3.6.3 IR spectroscopy of Doxycycline formulation	45
	3.7	Result and Discussion	46
<b>4.</b>	<b>FORMULATION DEVELOPMENT AND CHARACTERIZATION</b>		<b>47</b>
	4.1	Materials	47
	4.2	Method of preparation of niosomes	47
		4.2.1 Formulation variables and optimization technique for preparation of niosomes	47
	4.3	Formulation of niosomes entrapped carbapol gel	48
	4.4	Evaluation of niosomes	48
		4.4.1 Morphological characterization	48
		4.4.2 Particle size and Zeta Potential Analysis	49
		4.4.3 Entrapment efficiency	52

		4.4.4 Scanning electron microscopy	54
		4.4.5 In vitro drug release studies of niosomes	55
		4.4.6 Stability studies of the niosomes	58
	4.5	Evaluation of niosomal gel	60
		4.5.1 Physical appearance	60
		4.5.2 Determination of pH and viscosity	60
		4.5.3 Spreadability test	61
		4.5.4 Texture Profile Analysis	61
		4.5.5 Scanning electron microscopy	63
		4.5.6 IR spectroscopy of lyophilized niosomal gel	64
		4.5.7 DSC analysis for the determination of the gel–lipid transition temperature	67
		4.5.8 In vitro drug release studies of niosomal gel	69
		4.5.9 Model fitting	72
		4.5.10 Microbiological Evaluation	77
		4.5.11 Stability analysis of niosomal gel.	79
	4.6	Result and Discussion	81
<b>5.</b>	<b>SUMMARY AND CONCLUSION</b>		<b>86</b>
	5.1	Summary	86
	5.2	Conclusion	91
<b>6.</b>	<b>REFERENCES</b>		