Dr. Rajendra Gode College of Pharmacy, Malkapur
Functional MoUs

Sl. No.	Name of the MoU / Collaboration / linkage	Name of the collaborating agency / institution / industry / corporate house with whom the MoU / collaboration / linkage is made, with contact details	Year of signing MoU / collaboration / linkage	Duration of MoU / collaboration / linkage
1	MoU with Industry	Flagship Biotech International Pvt Ltd, navi Mumbai	2023	Five years
2	MoU with Private Traning Academy	Uttung Bharari Training Academy, Mulund Mumbai	2023	Five years
3	MoU with Academic Institute	Vidnyan Mahavidyalayas, Malkapur	2023	Five years
4	MoU with training Institute	Jivan Sanjivani Human Research institute, Sangli	2022	Five years
5	MoU with Medical	Pradhan mantri Janaushadhi Kendra	2022	Five years
6	MoU with Civil Hospital Malkapur	Civil Hospital Malkapur	2022	Five years
7	MoU with Industry	Chaitnya Biologicals, Malkapur	2022	Five Years
8	MoU with training Institute	Jivan Sanjivani Human Research institute, Sangli	2020	Three years
9	MoU with Civil Hospital Malkapur	Civil Hospital Malkapur	2019	Three years
10	MoU with Industry	Chaitnya Biologicals, Malkapur	2018	Two Years
11	MoU with Industry	MEB Pharma Pvt. Ltd. (Formerly known as N. M. Pharma) Navsal Akola	2018	Five Years

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

MEMORANDUM OF UNDERSTANDING

Between

DR. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR, DIST.-BULDANA MAHARASHTRA

And

FLAGSHIP BIOTECH INTERNATIONAL PVT. LTD
MAHAPE, NAVI MUMBAI, MAHARASHTRA

This Memorandum of Understanding (MOU) is entered into as of date 15th March 2023 by and

Between

DR. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR, DIST.-BULDANA MAHARASHTRA

And

FLAGSHIP BIOTECH INTERNATIONAL PVT. LTD
MAHAPE, NAVI MUMBAI, MAHARASHTRA

The agreement has entered into this MOU because they:

RECOGNIZE the mutual interest in the training and development and dissemination of knowledge.

RECOGNIZE the importance of skill development in promoting industry collaboration and increase contribution and also

RECOGNIZE the importance of the industry partner within its field of expertise.

This MOU will enable the parties to:

FOSTER collaboration between two parties.

SET the ground for long term institute industry partnerships by joint industry-institute activities.

STRENGTHEN the skills of manpower by exchange of visiting experts for the purpose of personality and skill development of young pharmacists.

PROVIDE sufficient knowledge to students of institution.

The parties hereby agree to establish collaboration according to terms and conditions set out time to time.

This MOU may also involve parties by mutual consent, which may be added later by written addendum to this MOU.

The MOU shall remain in force for a period of 05 years from the date of its signature and seal, and may be terminated by either side by giving six months' notice to that effect in writing.

Signed at Malkapur on this Wednesday, 15th March 2023

(Dr. P.K. Deshmukh)
Principal

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur
Dist.Buldana.

Authorized signatory on behalf of **DR. RAJENDRA GODE COLLEGE OF PHARMACY, MALKAPUR, DIST.-BULDANA MAHARASHTRA**

Seal:

Dr.Rajendra Gode College of Pharmacy Malkapur

Signed at Malkapur on this Wednesday, 15th March 2023

(Mr. Nitin Patil)
Director, Marketing

Authorized Signatory on behalf of FLAGSHIP BIOTECH INTERNATIONAL PVT. LTD MAHAPE, NAVI MUMBAI, AHARASHTRA

Seal:

FLAGSHIP BIOTECH INTERNATIONAL PVT. LTD. MUMBAI INDIA

Date: 15th March 2023

MEMORANDUM OF UNDERSTANDING

Between

DR. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR, DIST.-BULDANA MAHARASHTRA

And

UTTUNG BHARARI TRAINING ACADEMY
MULUND, MUMBAI, MAHARASHTRA

This Memorandum of Understanding (MOU) is entered into as of date 15th March 2023 by and

Between

DR. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR, DIST.-BULDANA MAHARASHTRA

And

UTTUNG BHARARI TRAINING ACADEMY
MULUND, MUMBAI, MAHARASHTRA

The agreement has entered into this MOU because they:

RECOGNIZE the mutual interest in the training and development and dissemination of knowledge.

RECOGNIZE the importance of skill development in promoting industry collaboration and increase contribution and also

RECOGNIZE the importance of the industry partner within its field of expertise.

This MOU will enable the parties to:

FOSTER collaboration between two parties.

SET the ground for long term institute industry partnerships by joint industry-institute activities.

STRENGTHEN the skills of manpower by exchange of visiting experts for the purpose of personality and skill development of young pharmacists.

PROVIDE sufficient knowledge to students of institution.

The parties hereby agree to establish collaboration according to terms and conditions set out time to time.

This MOU may also involve parties by mutual consent, which may be added later by written addendum to this MOU.

The MOU shall remain in force for a period of 05 years from the date of its signature and seal, and may be terminated by either side by giving six months' notice to that effect in writing.

Signed at Malkapur on this Wednesday, 15th March 2023

(Dr. P.K. Deshmukh)
Principal

Principal,
Dr.Rajendra Gode College of Pharmacy,Malkapur
Dist.Buldana.

Authorized signatory on behalf of **DR. RAJENDRA GODE COLLEGE OF PHARMACY, MALKAPUR, DIST.-BULDANA MAHARASHTRA**

Seal:

Dr. Rajendra Gode College of Pharmacy ★ Malkapur

Signed at Malkapur on this Wednesday, 15th March 2023

(Mr. Nitin Patil)
Founder

For UTTUNG BHARARI TRAINING ACADEMY

Proprietor

Authorized Signatory on behalf of UTTUNG BHARARI TRAINING ACADEMY

UTTUNG BHARARI TRAINING ACADEMY ★ MUMBAI

Seal:

Date: 15th March 2023

MEMORANDUM OF UNDERSTANDING ON COLLABORATION

BETWEEN

Vidnyan Mahavidyalaya, Malkapur Dist. Buldhana

AND

Dr. Rajendra Gode College of Pharmacy, Malkapur, Dist: Buldana

(February 21, 2023)

MEMORANDUM OF UNDERSTANDING ON COLLABORATION BETWEEN

Vidnyan Mahavidyalaya, Malkapur Dist. Buldhana
AND
Dr. Rajendra Gode College of Pharmacy, Malkapur, Dist: Buldana

This MoU is entered into on the 21th day of February, 2023 between Vidnyan Mahavidyalaya, Malkapur Dist. Buldhana and Dr. Rajendra Gode College of Pharmacy, Malkapur, Dist: Buldana.

OBJECTIVES OF THE MoU:

1. To promote and enhance academic interest of Vidnyan Mahavidyalaya, Malkapur Dist. Buldhana and Dr. Rajendra Gode College of Pharmacy, Malkapur, Dist: Buldana.
2. To provide and get advice for implementation of quality of education in both Colleges.
3. To encourage undergraduate students for Post-Graduation.
4. To promote research/continuing education activities between both the Colleges.

1. FIELD OF COOPERATION:

a. Both the organizations shall evolve a mutually acceptable schedule to develop programs, hold seminars and exchange visits.

b. The said academic interaction and intellectual assimilation may include -

- Faculty/staff exchange for the overall development of students.
- Faculty/staff exchange for Interdisciplinary Research related interactions.
- To Implement NSS related activities in collaboration with both colleges like inter university NSS Camp, Celebrating national events etc.
- Exchange of students for the development in-
  - i. Soft Skill and Professional development
  - ii. Employability Skills
  - iii. Changing world and Job opportunity (Seminar & Workshops)
  - iv. Field Visits/ Surveys/ Industrial visit.
  - v. Study Tour for student sensitization and development
  - vi. Open learning Software – Moodle

- Seminars, research, conferences and workshops:
- Collaborations in the sharing of scientific information, intellectual property, articles and publications abiding to rules and regulations with respect to IPR norms.
- Collaborations for sharing knowledge especially related to teaching, learning and evaluation methods.
- Placements and executive training
- Provide Instrument Outsourcing facilities at discounted rates

2. **EXCHANGE OF STUDENTS/TEACHERS (Terms & Conditions):**

A. Reciprocal arrangements based on mutually acceptable terms shall be accomplished to give an impetus to collaborative research and joint projects. Teachers, researchers, guides, and students of both the organizations shall be encouraged to work in tandem in the laboratories, workshops, faculties and departments of both the organizations with prior permissions.

B. Issues relating to travel, boarding, lodging, miscellaneous expenses shall be borne by the respective organization according to the policies of every organization.

C. Organizing workshops, conferences, FDPs & MDPs in collaborative arrangements.

3. **MISCELLLANEOUS (Confidentiality & Validity):**

a. The details for the efficacious implementation of this Memorandum of Understanding shall be jointly worked out on mutually acceptable terms within the parameters of the policies, rules and regulations of both the organizations.

b. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any term(s) and condition(s) of this agreement.

c. The MoU shall remain in force for a period of 3 years from the date of its signature and seal, and may be terminated by either side by giving a six months' notice to that effect in writing. However, notwithstanding the notice of the intent to terminate the memorandum, all rights, obligations and corresponding duties and subsisting therein shall be respected and mandated till the finalization and accomplishment thereof.

d. The parties to this MoU undertake to treat as CONFIDENTIAL AND PRIVILEGED information of the other organization, which is so classified in advance.

e. The terms of confidentiality and mode of disclosure shall be as per mutually acceptable terms.

f. Both organizations will designate persons who will have responsibility for coordination and implementation of this agreement.

g. This MoU is extended in duplicate with each copy being an official version and having equal legal validity.

By signing below, the institute and the college, acting by their duly authorized officers have caused this Memorandum of Understanding to be executed, effective as of the day and year first written above.

On Behalf of
The College

21/12/23

Principal
Dr. Rajendra Gode College of Pharmacy
Malkapur, Dist. Buldana (M.S.)

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur
Dist.Buldana.

On Behalf of
The College

Principal
Vidnyan Mahavidyalaya,
Malkapur Dist. Buldhana (M.S.)

Principal,
Vidnyan Mahavidyalaya,
Malkapur,Dist.Buldana.

Vidnyan Mahavidyalaya Dist. Buldana. Malkapur

In presence of

21/12/2023

Dr. Vaibhao S. Adhao
IQAC Coordinator,
Dr. Rajendra Gode College of Pharmacy
Malkapur, Dist. Buldana (M.S.)

Dr. Rajendra Gode College of Pharmacy Malkapur

Dr. Yogesh P.Patil
IQAC Coordinator,
Vidnyan Mahavidyalaya, Malkapur
Dist. Buldhana

Dr. Y. P. PATIL
IQAC Co-ordinator
Vidnyan Mahavidyalaya
Malkapur, Dist. Buldana.

Vidnyan Mahavidyalaya Dist. Buldana. Malkapur

Memorandum of Understanding (MOU)

BETWEEN

Dr. Rajendra Gode College of Pharmacy, Malkapur (Dist.: Buldana), Maharashtra, India

AND

Jivan Snajivani Human Research Institute Sangali Branch —IFRA Institute Jalgaon

This MOU entered into 05 May 2022 by and between **Dr. Rajendra Gode College of Pharmacy, Malkapur (Dist.: Buldhana), Maharashtra, India** (Here after called party one) **& Institute of Personality Development IFRA Jalgaon (Project of Jivan Snajivani** H.R.D. **Institute, Sangali)** (Here after called party Two) **Dr. Rajendra Gode College of Pharmacy, Malkapur, Maharashtra** Is approved by all India council for technical education (AICTE), New Delhi and Pharmacy council of India and affiliated to Maharashtra state board technical education Mumbai. Institute of Personality Development IFRA Jalgaon (Project of Jivan Snajivani H.R.D. Institute, Sangali) is working in the field of leadership & soft skill development all over Maharashtra since last 21 years. The aforesaid organization are referred to individually as party and collectively as parties.

1. Objective of MOU

The objectives of the MOU are:

1) To promote and enhance academic interest between both the parties.
2) To provide advice for implementation of quality education to both the parties.
3) To develop soft skill by personality devolvement & quality improvement of students and staff.
4) To promote continuous self-assessment of student and staff.

2. Technical areas of collaboration

1. A Continuing quality improvement program to improve quality of staff/students at party one through short term/long term training / workshop. Staff/students of party two could also be sent to party one for necessary guidance.
2. Provide academic interaction by delivering special lecture by both parties on topic of relevance to soft skill, leadership technique require for modern pharmaceutical industry and retail /wholesale pharmacy.
3. Provide necessary help in organizing workshop/conferences and personality development programs at both parties.
4. Provide necessary support to parties with hard and soft copies/journal for up gradation of knowledge.
5. To facility the training/students.

3. Propose modes of collaboration

Both parties propose to collaborate to following,

A) Cooperation and promotion of education and training in areas of mutual interest.
B) Any other appropriate mode of interaction agreed upon between both parties.

A specific plan will be work out by the parties depending upon availability of resources.

4. Terms and conditions

a) For continuing education if any, party one teachers/students, the financial arrangement will Be made by party one.

B) For continuing education if any to party two resources personnel, the financial arrangement will be made by party two.

c) The staff /employee of both parties can use the educational facilities available at both parties For short time .

d) Usages of party one infrastructure can be allowed for limited period subject to its Availability, approval of head of respective department of party one

e) Usages of party two infrastructures can be allowed for limited period subject to its Availability, approval of head of respective department of party two.

f) This MOU may be amended, renewed and terminated by mutual written agreement of Both parties at any time .

g) Either party shall have the right to terminate this MOU upon 30 days prior written notice to be the other party.

5. Confidentiality

Both parties agreed to hold in confidence all information /data designed by parties as being confidential which is obtained from either party or created during performance of MOU and will not disclosure the same to any third party without written consent of other party.

6. Duration of MOU

This MOU unless extended by mutual written consent of the parties shall expires in 5 years after effective date specify in the opening paragraph.

7. Coordinator

Both parties will designate person who will have responsibility for coordination and implementation of this agreements.

8. Sign in duplicate

This MOU is executed in duplicate with each copy being an official version and having equal legal validity .by signing bellow ,the parties acting by their duly authorized officers have caused this memorandum of understanding to be executed effective as of the day and year first above written.

On behalf of

(Dr. P. K. Deshmukh)
Signature of Pincipal
Dr. Rajendra Gode College of Pharmacy, Malkapur

Principal,
Dr.Rajendra Gode College of Pharmacy, Malkapur
Dist.Buldana

Dr.Rajendra Gode College of Pharmacy * Malkapur

(Mr.Aejaz M.Shaikh)
Signature of Regional project officer
Jivan Sanjivani H.R.D.Institute Sangali Branch —IFRA Institute,Jalgaon

INDIRA BAHUUDDESHIYA SHIKSHAN SANSTHA, BULDANA'S

Dr. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR

Buldana Road, MALKAPUR – 443101 Dist – Buldana (M.S.)
Mob. 8308827339
E-mail : drgcopmalkapur@gmail.com, Web : www.drgcop.co.in

Recognized by AICTE & PCI, New Delhi ; Affiliated to S.G.B. Amravati University, Amravati & M.S.B.T.E. Mumbai.

Founder President: Late Dr. Rajendraji V. Gode., Ex- Minister, Govt. of Maharashtra.

Shri.Yogendra R.Gode
President

Dr. P. K. Deshmukh
Principal

Ref. No. DRGCOPM/2022/3063A **Date :** 02/05/2022

To,
The Proprietor,
Pradhan Mantri Bhartiya Jan Aushadhi Kendra,
Malkapur (M.S.)

Subject: - Proposal for Memorandum of Understanding (MOU)

Dear Sir,

We are the fastest growing man power industry in the field of pharmacy situated in vidarbha region. With our mission 'Gateway to global knowledge' we strive to build the dynamic and intellectual technocrats having sounded practical and research hand. We are running undergraduate and post graduate programmes with magnificent lab infrastructure and at par instrumental facilities.

Now, we are looking forward towards the Pharmacy shops like Pradhan Mantri Bhartiya Jan Aushadhi Kendra, Malkapur for the technical assistance to develop the budding pharmacist. With an intention to promote interdisciplinary productive research, we are eager to sign the MOU between these two organizations. It will be a huge opportunity for the students and faculty of either side. Its our humble request to please go through our proposal and do the needful in this regard. Your help in this regard is highly motivational and appreciable.

Hoping for long term relationship.

With regards!

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal
Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

MEMORANDUM OF UNDERSTANDING

This memorandum of understanding is signed between:

The IBSS Dr Rajendra Gode College of Pharmacy, located at Buldana Road, Malkapur, established in 2005 affiliated to SGB Amravati University, Amravati

AND

Pradhan Mantri Bhartiya Jan Aushadhi Kendra, Malkapur

With an objective to disseminate and advance knowledge by providing instructional, research and extension facilities in such branches of earning as it may deem fit and it shall endeavor to provide students and teachers the necessary atmosphere and facilities for the promotion of:

i. **Innovations in education leading to restructuring of courses, new methods of teaching and learning and integral development of personality.**
ii. **Studies in various disciplines**
iii. **Inter-disciplinary and multi-disciplinary studies**
iv. **National integration, secularism and international understanding.**

NOW, therefore the

IBSS Dr Rajendra Gode College of Pharmacy, Malkapur

AND

Pradhan Mantri Bhartiya Jan Aushadhi Kendra, Malkapur.

Have intended, agreed and consented to the following terms and deeds in pursuance of a common intent to promote and develop the research study.

AND/OR

Make provisions for research and for the advancement and dissemination of knowledge

AND/OR

To organize and to undertake extra-mural studies and extension services

1. Field of Co-operation:

A.Both the institutions shall evolve a mutually acceptable schedule to develop programs, hold seminars and exchange visits.

B.The said academic interaction and intellectual assimilation may include:-

i. Faculty/staff development and exchange:

ii. Exchange of students:

iii. Seminars, research, conferences and workshops

iv. Collaborations in the sharing of academic data, scientific information, intellectual property, articles and publications

v. Advice surgeries, placements and execute training.

2. EXCHANGE OF STUDENTS/TEACHERS:

A. Reciprocal arrangements based on mutually acceptable terms shall be accomplished to give an impetus to collaborative research and joint projects. Teachers, researchers, guides, and students of both the institutions shall be encouraged to work in tandem in the laboratories, workshops, faculties and departments of both the institutions.

B. Issues relating to travel, boarding, lodging, miscellaneous expenses shall be incorporated in this Para and shall vary according to the rules, regulations and policies of every institution.

3. MISCELLLANEOUS:

A. The details for the efficacious implementation of this Memorandum of Understanding shall be jointly worked out on mutually acceptable terms within the parameters of the policies, rules and regulations of both the institutions.

B. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any tem(s) and condition(s) of this agreement.

C. The intent and implementation of this memorandum is **SUBJECT** to the policies

of the respective states (in case of international agreements) and the laws of the land.

D. The MOU shall remain in force for a period of **Five** years from the date of its signature and seal, and may be terminated by either side by giving a six months notice to that effect in writing. However, notwithstanding the notice of the intent to terminate the memorandum, all rights, obligations and corresponding duties and subsisting there in shall be respected and mandated till the finalization and accomplishment thereof.

E. The parties to this **MOU** undertake to treat as **CONFIDENTIAL ANDPRIVILEGED** information of the other institution, which is so classified in advance.

The terms of confidentiality and mode of disclosure shall be as per mutually acceptable terms.

F. This MOU shall require the ratification of the competent academic/executive body of both the institutions.

Signed at …… on..... 2022

(.....)

Authorized signatory on behalf of IBSS Dr Rajendra Gode College of Pharmacy, Malkapur

Seal: Dr. Rajendra Gode College of Pharmacy Malkapur

Date: 02/05/2022

(.....)

Authorized Signatory on behalf of Pradhan Mantri Bhartiya Jan Aushadhi Kendra, Malkapur.

Seal: Pradhan Mantri Bhartiya Janaushadhi Kendra PMBJK 03632 RECEIVED SIGN

Date: 02/05/2022

INDIRA BAHUUDDESHIYA SHIKSHAN SANSTHA, BULDANA'S

Dr. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR

Buldana Road, MALKAPUR – 443101 Dist – Buldana (M.S.)
Mob. 8308827339
E-mail : drgcopmalkapur@gmail.com, Web : www.drgcop.co.in

Recognized by AICTE & PCI, New Delhi ; Affiliated to S.G.B. Amravati University, Amravati & M.S.B.T.E. Mumbai.

Founder President: Late Dr. Rajendraji V. Gode., Ex- Minister, Govt. of Maharashtra.

Shri. Yogendra R.Gode
President

Dr. P. K. Deshmukh
Principal

Ref. No. DRGCOPM/2022/3064 **Date :** 11/04/2022

To,
The Civil Surgeon,
District Hospital,
Buldana (M.S.)

Subject: - Proposal for Memorandum of Understanding (MOU)

Dear Sir,

We are the fastest gro[illegible] man power industry in the field of pharmacy situated in vidarbha region. [illegible] our mission 'Gateway to global knowledge' we strive to build the dynamic [illegible] intellectual technocrats having sounded practical and research hand. We are r[illegible]ning diploma, undergraduate and post graduate programmes with magnificent [illegible] infrastructure and a[illegible]par instrumental facilities.

Now, we are looking fo[illegible]rd towards the Govt. Hospital, Malkapur for the technical assistance to develo[illegible]he budding pharmacist. With an intention to promote interdisciplinary pro[illegible]ctive research, we are eager to sign the MOU between these two organizatio[illegible] will be a huge opportunity for the students and faculty of either side. It's our [illegible]ble request to please go through our proposal and do the needful in this regard. [illegible]ur help in this regard is highly motivational and appreciable.

Hoping for long term re[illegible]nship.

With regards!

आवक - जावक
विभाग
जिल्हा रुग्णालय,बुलडाणा
2 MAY 2022

Copy to

1) Medical Officer, Govt. Hosp[illegible] Malkapur.

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal
Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

MEMORANDUM OF UNDERSTANDING

This memorandum of understanding is signed between:

The IBSS, Dr. Rajendra Gode College of Pharmacy, located at Buldana Road, Malkapur, established in 2005 affiliated to MSBTE, Mumbai & SGB Amravati University, Amravati

AND

Govt. Hospital, Malkapur (M.S.)

With an objective to disseminate and advance knowledge by providing instructional, research and extension facilities in such branches of earning as it may deem fit and it shall endeavor to provide students and teachers the necessary atmosphere and facilities for the promotion of:

i. **Innovations in education leading to restructuring of courses, new methods of teaching and learning and integral development of personality.**
ii. **Studies in various disciplines**
iii. **Inter-disciplinary and multi-disciplinary studies**
iv. **National integration, secularism and international understanding.**

NOW, therefore the

IBSS, Dr. Rajendra Gode College of Pharmacy, Malkapur

AND

Govt. Hospital, Malkapur.

Have intended, agreed and consented to the following terms and deeds in pursuance of a common intent to promote and develop the curriculum study.

AND/OR

Make provisions for research and for the advancement and dissemination of knowledge

AND/OR

To organize and to undertake extra-mural studies and extension services

1. **Co-operation in establishing teaching, research and clinical links and providing a suitable environment for Diploma, undergraduate and postgraduate training and education in Pharmacy**

2. **Co-operation in facilitating professional development in Pharmacy**

3. **Hospital visit**

4. **Mutual collaboration for the provision of excellence in patient care.**

5. **MISCELLLANEOUS:**

A. The details for the efficacious implementation of this Memorandum of Understanding shall be jointly worked out on mutually acceptable terms within the parameters of the policies, rules and regulations of both the institutions.

B. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any tem(s) and condition(s) of this agreement.

C. The intent and implementation of this memorandum is **SUBJECT** to the policies of the respective states (in case of international agreements) and the laws of the land.

D. The MOU shall remain in force for a period of Five years from the date of its signature and seal, and may be terminated by either side by giving a six months noticeto that effect in writing. However, notwithstanding the notice of the intent to terminatethe memorandum, all rights, obligations and corresponding duties and subsistingtherein shall be respected and mandated till the finalization and accomplishmentthereof.

E. The parties to this **MOU** undertake to treat as **CONFIDENTIAL AND PRIVILEGED** information of the other institution, which is so classified in advance. The terms of confidentiality and mode of disclosure shall be as per mutually acceptableterms.

F. This MOU shall require the ratification of the competent academic/executive body of both the institutions.

Signed at ..... on 10/05/.. 2022

(.....)

Authorized signatory on behalf of IBSS College of Pharmacy, Malkapur

Seal:

Date: 10/05/2022

(.....)

Authorized Signatory on behalf of Govt. Hospital , Malkapur.

Seal:

Date: 10/05/2022

INDIRA BAHUUDDESHIYA SHIKSHAN SANSTHA, BULDANA'S

Dr. RAJENDRA GODE COLLEGE OF PHARMACY
MALKAPUR

Buldana Road, MALKAPUR – 443101 Dist – Buldana (M.S.)
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Founder President: Late Dr. Rajendraji V. Gode., Ex- Minister, Govt. of Maharashtra.

Shri. Yogendra R.Gode
President

Dr. P. K. Deshmukh
Principal

Ref. No. DRGCOPM/2022/3063.

Date : 11/04/2022.

To,

The Manager,
Chaitanya Biologicals,
Malkapur (M.S.)

Subject: - Proposal for Memorandum of Understanding (MOU)

Dear Sir,

We are the fastest growing man power industry in the field of pharmacy situated in vidarbha region. With our mission 'Gateway to global knowledge' we strive to build the dynamic and intellectual technocrats having sounded practical and research hand. We are running diploma, undergraduate and post graduate programmes with magnificent lab infrastructure and at par instrumental facilities.

Now, we are looking forward towards the venerated organization like Chaitanya Biologicals, Malkapur for the technical assistance to develop the budding pharmacist. With an intention to promote interdisciplinary productive research, we are eager to sign the MOU between these two organizations. It will be a huge opportunity for the students and faculty of either side. It's our humble request to please go through our proposal and do the needful in this regard. Your help in this regard is highly motivational and appreciable.

Hoping for long term relationship.

With regards!

Principal
Dr. Rajendra Gode College of Pharmacy,
Malkapur, Dist- Buldana.

Dr. Rajendra Gode College of Pharmacy Malkapur

MEMORANDUM OF UNDERSTANDING

This memorandum of understanding is signed between:

The IBSS, Dr. Rajendra Gode College of Pharmacy, located at Buldana Road, Malkapur, established in 2005 affiliated to MSBTE, Mumbai & SGB Amravati University, Amravati

AND

Chaitanya Biologicals, Malkapur (M.S.)

With an objective to disseminate and advance knowledge by providing instructional, research and extension facilities in such branches of earning as it may deem fit and it shall endeavor to provide students and teachers the necessary atmosphere and facilities for the promotion of:

i. **Innovations in education leading to restructuring of courses, new methods of teaching and learning and integral development of personality.**
ii. **Studies in various disciplines**
iii. **Inter-disciplinary and multi-disciplinary studies**
iv. **National integration, secularism and international understanding.**

NOW, therefore the

IBSS, Dr. Rajendra Gode College of Pharmacy, Malkapur

AND

Chaitanya Biologicals, Malkapur.

Have intended, agreed and consented to the following terms and deeds in pursuance of a common intent to promote and develop the research study.

AND/OR

Make provisions for research and for the advancement and dissemination of knowledge

AND/OR

To organize and to undertake extra-mural studies and extension services

1. Field of Co-operation:

A. Both the institutions shall evolve a mutually acceptable schedule to develop programs, hold seminars and exchange visits.

B. The said academic interaction and intellectual assimilation may include:-

I. Faculty/staff development and exchange

II. Exchange of students, Industrial visits

III. Seminars, research, conferences and workshops

IV. Collaborations in the sharing of academic data, scientific information, intellectual property, articles and publications

V. Advice surgeries, placements and execute training.

2. EXCHANGE OF STUDENTS/TEACHERS:

A. Reciprocal arrangements based on mutually acceptable terms shall be accomplished to give an impetus to collaborative research and joint projects. Teachers, researchers, guides, and students of both the institutions shall be encouraged to work in tandem in the laboratories, workshops, faculties and departments of both the institutions.

B. Issues relating to travel, boarding, lodging, miscellaneous expenses shall be incorporated in this Para and shall vary according to the rules, regulations and policies of every institution.

3. MISCELLLANEOUS:

A. The details for the efficacious implementation of this Memorandum of Understanding shall be jointly worked out on mutually acceptable terms within the parameters of the policies, rules and regulations of both the institutions.

B. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any term(s) and condition(s) of this agreement.

C. The intent and implementation of this memorandum is **SUBJECT** to the policies of the respective states (in case of international agreements) and the laws of the land.

D. The MOU shall remain in force for a period of Five years from the date of its signature and seal, and may be terminated by either side by giving a six months notice to that effect in writing. However, notwithstanding the notice of the intent to terminate the memorandum, all rights, obligations and corresponding duties and subsisting therein shall be respected and mandated till the finalization and accomplishment thereof.

E. The parties to this **MOU** undertake to treat as **CONFIDENTIAL AND PRIVILEGED** information of the other institution, which is so classified in advance. The terms of confidentiality and mode of disclosure shall be as per mutually acceptable terms.

F. This MOU shall require the ratification of the competent academic/executive body of both the institutions.

Signed at ..... on 15/04/ **2022**

(.....)

Authorized signatory on behalf of IBSS Dr. Rajendra Gode College of Pharmacy, Malkapur

Dr. Rajendra Gode College of Pharmacy * Malkapur

Seal:

Date: 15/04/2022

(.....)

Authorized Signatory on behalf of Chaitanya Biologicals, Malkapur.

Chaitanya Biologicals Pvt. Ltd. * MALKAPUR-443101 * 75/2, N.H.No. 6, By Pass, Malkapur, Dist. Buldana. (M.S.) (India)

Seal:

Date: 15/04/2022

Memorandum of Understanding (MOU)

BETWEEN

Dr. Rajendra Gode College of Pharmacy, Malkapur (Dist.: Buldana), Maharashtra, India

AND

Jivan Snajivani Human Research Institute Sangali Branch —IFRA Institute Jalgaon

This MOU entered into 01 Jan 2020 by and between **Dr. Rajendra Gode College of Pharmacy, Malkapur (Dist.: Buldhana), Maharashtra, India** (Here after called party one) **& Institute of Personality Development IFRA Jalgaon (Project of Jivan Snajivani** H.R.D. **Institute, Sangali)** (Here after called party Two) **Dr. Rajendra Gode College of Pharmacy, Malkapur, Maharashtra** Is approved by all India council for technical education (AICTE), New Delhi and Pharmacy council of India and affiliated to SGBAU, Amravati. Institute of Personality Development IFRA Jalgaon (Project of Jivan Snajivani H.R.D. Institute, Sangali) is working in the field of leadership & soft skill development all over Maharashtra since last 21 years. The aforesaid organization are referred to individually as party and collectively as parties.

1. Objective of MOU

The objectives of the MOU are:

1) To promote and enhance academic interest between both the parties.
2) To provide advice for implementation of quality education to both the parties.
3) To develop soft skill by personality devolvement & quality improvement of students and staff.
4) To promote continuous self-assessment of student and staff.

2. Technical areas of collaboration

1. A Continuing quality improvement program to improve quality of staff/students at party one through short term/long term training / workshop. Staff/students of party two could also be be sent to party one for necessary guidance.
2. Provide academic interaction by delivering special lecture by both parties on topic of relevance to soft skill, leadership technic require for morden pharmaceutical industry and retail /wholesale pharmacy.
3. Provide necessary help in organizing workshop/conferences and personality development programs at both parties.
4. Provide necessary support to parties with hard and soft copies/journal for upgradation of knowledge.
5. To facilate the training/students.

3. Propose modes of collaboration

Both parties propose to collaborate to following,

A) Cooperation and promotion of education and training in areas of mutual interest.
B) Any other appropriate mode of interaction agrred upon between both parties.

A specific plan will be work out by the parties depending upon availibity of resources.

4. Terms and conditions

a) For continuing education if any, party one teachers/students, the financial arrangement will Be made by party one.

B) For continuing education if any to party two resources personnel, the financial arrangement will be made by party two.

c) The staff /employee of both parties can use the educational facilities available at both parties For short time .

d) Usages of party one infrastructure can be allowed for limited period subject to its Availabity, approval of head of respective department of party one

e) Usages of party two infrastructure can be allowed for limited period subject to its Availabity, approval of head of respective department of party two.

f) This MOU may be amended, renewed and terminated by mutual written agreement of Both parties at any time .

g) Either party shall have the right to terminate this MOU upon 30 days prior written notice to be the other party.

5. Confidentiality

Both parties agreed to hold in confidence all information /data designed by parties as being confindenal which is obtained from either party or created during performance of MOU and will not disclosure the same to any third party without written consent of other party.

6. Duration of MOU

This MOU unless extended by mutual written consent of the parties shall expires in 3 years after effective date specify in the opening paragraph.

7. Coordinator

Both parties will designate person who will have responsibility for coordination and implementation of this agreements.

8. Sign in duplicate

This MOU is executed in duplicate with each copy being an official version and having equal legal validity .by signing bellow ,the parties acting by their duly authorized officers have caused this memorandum of understanding to be executed effective as of the day and year first above written.

On behalf of

(Dr. V N Shrikhande)

Signature of Principal

Dr. Rajendra Gode College of Pharmacy, Malkapur

(Mr.Aejaz M.Shaikh)

Signature of Regional project officer

Jivan Sanjivani H.R.D.Institute Sangali

Branch —IFRA Institute,Jalgaon

INDIRA BAHUUDDESHIYA SHIKSHAN SANSTHA'S

COLLEGE OF PHARMACY

Buldana Road, **Malkapur,** 443101, (M.S.)
Recognised by AICTE & PCI New Delhi & Affiliated to S.G.B. Amravati University, Amravati
Phone : (07267) 227337/39
Fax. : (07267) 227338
E-mail : cop_malkapur@rediffmail.com
Web.: Ibsscop.co.in

Founder President : Late **Dr. Rajendraji Gode,** Ex.- Minister, Govt. of Maharashtra.

Shri. Yogendra R. Gode
President

Dr. V. N. Shrikhande
Principal

Ref. No. COPM/3884/2019

Date : 04/02/2019

To,
The Medical Officer ,
Govt. Hospital,
Malkapur (M.S.)

Subject: - Proposal for Memorandum of Understanding (MOU)

Dear Sir,

We are the fastest growing man power industry in the field of pharmacy situated in vidarbha region. With our mission 'Gateway to global knowledge' we strive to build the dynamic and intellectual technocrats having sounded practical and research hand. We are running diploma, undergraduate and post graduate programmes with magnificent lab infrastructure and at par instrumental facilities.

Now, we are looking forward towards the Govt. Hospital, Malkapur for the technical assistance to develop the budding pharmacist. With an intention to promote interdisciplinary productive research, we are eager to sign the MOU between these two organizations.It will be a huge opportunity for the students and faculty of either side. Its our humble request to please go through our proposal and do the needful in this regard. Your help in this regard is highly motivational and appreciable.

Hoping for long term relationship.

With regards!

Received
10/2/19

Principal

IBSS College of Pharmacy,
Malkapur, Dist. - Buldana
(M.S.)

डॉ.अमोल सदाशिव नाफडे
Reg.No.2006/11/3389
(वै.अ.)उ.जि.रु.मलकापूर.

MEMORANDUM OF UNDERSTANDING

This memorandum of understanding is signed between:

The IBSS College of Pharmacy, located at Buldana Road, Malkapur, established in 2005 affiliated to SGB Amravati University, Amravati

AND

Govt. Hospital , Malkapur (M.S.)

With an objective to disseminate and advance knowledge by providing instructional, research and extension facilities in such branches of earning as it may deem fit and it shall endeavor to provide students and teachers the necessary atmosphere and facilities for the promotion of:

i. **Innovations in education leading to restructuring of courses, new methods of teaching and learning and integral development of personality.**
ii. **Studies in various disciplines**
iii. **Inter-disciplinary and multi-disciplinary studies**
iv. **National integration, secularism and international understanding.**

NOW, therefore the

IBSS College of Pharmacy, Malkapur

AND

Govt. Hospital , Malkapur.

Have intended, agreed and consented to the following terms and deeds in pursuance of a common intent to promote and develop the research study.

AND/OR

Make provisions for research and for the advancement and dissemination of knowledge

AND/OR

To organize and to undertake extra-mural studies and extension services

1. Field of Co-operation:

A. Both the institutions shall evolve a mutually acceptable schedule to develop programs, hold seminars and exchange visits.

B. The said academic interaction and intellectual assimilation may include:-

i. Depute students for practical training

ii. Visit to your firm

iii. Seminars, research, conferences and workshops

iv. Collaborations in the sharing of academic data, scientific information, intellectual property, articles and publications

v. Placements and execute training.

2. EXCHANGE OF STUDENTS/TEACHERS:

A. Reciprocal arrangements based on mutually acceptable terms shall be accomplished to give an impetus to collaborative research and joint projects. Teachers, researchers, guides, and students of both the institutions shall be encouraged to work in tandem inthe laboratories, workshops, faculties and departments of both the institutions.

B. Issues relating to travel, boarding, lodging, miscellaneous expenses shall be incorporated in this Para and shall vary according to the rules, regulations and policiesof every institution.

3. MISCELLLANEOUS:

A. The details for the efficacious implementation of this Memorandum ofUnderstanding shall be jointly worked out on mutually acceptable terms within theparameters of the policies, rules and regulations of both the institutions.

B. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any tem(s) and condition(s) of this agreement.

C. The intent and implementation of this memorandum is **SUBJECT** to the policies of the respective states (in case of international agreements) and the laws of the land.

D. The MOU shall remain in force for a period of Five years from the date of its

signature and seal, and may be terminated by either side by giving a six months noticeto that effect in writing. However, notwithstanding the notice of the intent to terminatethe memorandum, all rights, obligations and corresponding duties and subsistingtherein shall be respected and mandated till the finalization and accomplishmentthereof.

E. The parties to this **MOU** undertake to treat as CONFIDENTIAL **ANDPRIVILEGED** information of the other institution, which is so classified in advance.

The terms of confidentiality and mode of disclosure shall be as per mutually acceptableterms.

F. This MOU shall require the ratification of the competent academic/executive body of both the institutions.

Signed at ..... on 10/02/2019

(.....Principal.....)

Authorized signatory on behalf of IBSS College of Pharmacy, Malkapur

Principal
College of Pharmacy
MALKAPUR-443 101
Dist.Buldana

Seal:

I.B.S.S. Buldana's College of Pharmacy Malkapur

Date: 10/02/2019

(.....Bhande.....)

Authorized Signatory on behalf of Govt. Hospital , Malkapur.

Medical Superintendent(Class-1)
Sub-District Hospital, Malkapur
Dist.Buldana.

Seal:

Date: 10/02/2019

INDIRA BAHUUDDESHIYA SHIKSHAN SANSTHA'S

COLLEGE OF PHARMACY

Buldana Road, **Malkapur,** 443101, (M.S.)
Recognised by AICTE & PCI New Delhi & Affiliated to S.G.B. Amravati University, Amravati
Phone : (07267) 227337/39
Fax. : (07267) 227338
E-mail : cop_malkapur@rediffmail.com
Web.: Ibsscop.co.in

Founder President : Late **Dr. Rajendraji Gode,** Ex.- Minister, Govt. of Maharashtra.

Shri. Yogendra R. Gode
President

Dr. V. N. Shrikhande
Principal

Ref. No. Cofm/3912/2016

Date : 22/02/2016.

To,

The Manager,
Chaitanya Biologicals
Malkapur (M.S.)

Subject: - Proposal for Memorandum of Understanding (MOU)

Dear Sir,

We are the fastest growing man power industry in the field of pharmacy situated in vidarbha region. With our mission 'Gateway to global knowledge' we strive to build the dynamic and intellectual technocrats having sounded practical and research hand. We are running undergraduate and post graduate programmes with magnificent lab infrastructure and at par instrumental facilities.

Now, we are looking forward towards the venerated organization like Chaitanya Biologicals, Malkapur for the technical assistance to develop the budding pharmacist. With an intention to promote interdisciplinary productive research, we are eager to sign the MOU between these two organizations.It will be a huge opportunity for the students and faculty of either side. Its our humble request to please go through our proposal and do the needful in this regard. Your help in this regard is highly motivational and appreciable.

Hoping for long term relationship.

With regards!

Principal

IBSS College of Pharmacy,

Malkapur, Dist. – Buldana (M.S.)

I.B.S.S. College of Pharmacy Malkapur

Received
22/02/16
Dr. R. B. Pyle

Chaitanya Biologicals Pvt. Ltd. Malkapur

MEMORANDUM OF UNDERSTANDING

This memorandum of understanding is signed between:

The IBSS College of Pharmacy, located at Buldana Road, Malkapur, established in 2005 affiliated to SGB Amravati University, Amravati

AND

Chaitanya Biologicals, Malkapur (M.S.)

With an objective to disseminate and advance knowledge by providing instructional, research and extension facilities in such branches of earning as it may deem fit and it shall endeavor to provide students and teachers the necessary atmosphere and facilities for the promotion of:

i. Innovations in education leading to restructuring of courses, new methods of teaching and learning and integral development of personality.
ii. Studies in various disciplines
iii. Inter-disciplinary and multi-disciplinary studies
iv. National integration, secularism and international understanding.

NOW, therefore the

IBSS College of Pharmacy, Malkapur

AND

Chaitanya Biologicals, Malkapur.

Have intended, agreed and consented to the following terms and deeds in pursuance of a common intent to promote and develop the research study.

AND/OR

Make provisions for research and for the advancement and dissemination of knowledge

AND/OR

To organize and to undertake extra-mural studies and extension services

1. Field of Co-operation:

A.Both the institutions shall evolve a mutually acceptable schedule to develop programs, hold seminars and exchange visits.

B.The said academic interaction and intellectual assimilation may include:-

i. Faculty/staff development and exchange:

ii. Exchange of students:

iii. Seminars, research, conferences and workshops

iv. Collaborations in the sharing of academic data, scientific information, intellectual property, articles and publications

v. Advice surgeries, placements and execute training.

2. EXCHANGE OF STUDENTS/TEACHERS:

A. Reciprocal arrangements based on mutually acceptable terms shall be accomplishedto give an impetus to collaborative research and joint projects. Teachers, researchers,guides, and students of both the institutions shall be encouraged to work in tandem inthe laboratories, workshops, faculties and departments of both the institutions.

B. Issues relating to travel, boarding, lodging, miscellaneous expenses shall beincorporated in this Para and shall vary according to the rules, regulations and policiesof every institution.

3. MISCELLLANEOUS:

A. The details for the efficacious implementation of this Memorandum ofUnderstanding shall be jointly worked out on mutually acceptable terms within theparameters of the policies, rules and regulations of both the institutions.

B. The parties to this memorandum may, by mutual consent, add modify, amend, delete, review or revise any tem(s) and condition(s) of this agreement.

C. The intent and implementation of this memorandum is SUBJECT to the policies of the respective states (in case of international agreements) and the laws of the land.

D. The MOU shall remain in force for a period of two years from the date of its

signature and seal, and may be terminated by either side by giving a six months noticeto that effect in writing. However, notwithstanding the notice of the intent to terminatethe memorandum, all rights, obligations and corresponding duties and subsistingtherein shall be respected and mandated till the finalization and accomplishmentthereof.

E. The parties to this **MOU** undertake to treat as **CONFIDENTIAL ANDPRIVILEGED** information of the other institution, which is so classified in advance.

The terms of confidentiality and mode of disclosure shall be as per mutually acceptableterms.

F. This MOU shall require the ratification of the competent academic/executive body of both the institutions.

Signed at ..... on..... 2016

(.....)

Principal
College of Pharmacy
Malkapur-443 101
Dist. Buldana

Authorized signatory on behalf of IBSS College of Pharmacy, Malkapur

Seal: IBSS Buldana's College of Pharmacy Malkapur

Date:

(.....)

Authorized Signatory on behalf of Chaitanya Biologicals, Malkapur.

Seal: Chaitanya Biologicals Pvt. Ltd. MALKAPUR-443101

Date: 22/02/16

MEMORANDUM OF UNDERSTANDING

BETWEEN

Principal , Dr. Rajendra Gode College of Pharmacy, Malkapur

And

N. M. Pharma, Navsal, Akola

This Memorandum of Understanding (MoU) is entered into as of a date 19-01-2018 by & between the Dr. Rajendra Gode College of Pharmacy, Malkapur.

The agreement has entered into this MOU because they:

- Recognize the mutual interest in the field of research, training & development & dissemination of knowledge also.
- Recognize the importance of manufacturing, inventory control, in process & finished product, packaging of pharmaceuticals, collaboration & increased contribution.
- Recognize the importance of the industry partner within its field of expertise.
- Recognize the current development in pharmaceutical industry.

This MoU will enable the parties to

Objective

1) Share facilities of industry & institution
2) Set the ground for long term institution-industry partnerships by joint industry& research activities.
3) Strengthen the research development by exchange of visiting expert for the purpose of conducting research.
4) Provide sufficient knowledge to student of institution.
5) The parties hereby agree to establish collaboration according to terms & Conditions set out time to time.
6) This MoU may also involve parties by mutual consent, which may be added later by written addendum to this MOU.

Duration: This MOU unless extended by mutual return consent by the institute shall expire in five years after the effective date specified in MOU.

Dr.Rajendra Gode College of Pharmacy,
Malkapur

N. M. Pharma, Navsal,
Akola

owner

Dr.V.N.Shrikhande
Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur
Dist.Buldana.

Authorized person of the Industry

Verified by

Signed by

Date 29/01/2018

Date 29/01/2018

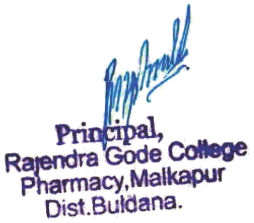
Official Stamp

Official Stamp

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

ACADEMIC YEAR 2021-22			
Sl. No.	**Name of the collaborating agency / institution / industry / corporate house with whom the MoU / collaboration / linkage is made, with contact details**	**List the actual activities under each MOU and web -links year-wise**	**Number of Teacher/ Students participating in Activity**
1	Uttung Bharari Training Academy, Mulund Mumbai	Skill Devcelopment workshop	**70 students and 3 Teachers**
2	Chaitnya Biologicals, Malkapur	Training for the students	05 Students
3	Vidnyan Mahavidyalayas, Malkapur	Guest Lecture on Research methodology	60 students
4		Industrial visit to A-Klass Pharmaceutical Industry	25 students
5	Chaitnya Biologicals, Malkapur	Industrial visit to Chaitnya Biologicals, Malkapur	50 Students, 2 Teachers
6	Jivan Sanjivani Human Research institute, Sangli	Training for the students	70 students and 5 Teachers
7	MEB Pharma Pvt. Ltd. (Formerly known as N. M. Pharma) Navsal Akola	Webinar on Basic of GMP Practices in Pharma Industry	19 students and 1 Teacher
8	Pradhan mantri Janaushadhi Kendra	OnlineTraining and Orientation Programme	40 Students and 2 Teachers



Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

ACADEMIC YEAR 2019-20			
Sl. No.	**Name of the collaborating agency / institution / industry / corporate house with whom the MoU / collaboration / linkage is made, with contact details**	**List the actual activities under each MOU and web -links year-wise**	**Number of Teacher/ Students participating in Activity**
1	Chaitnya Biologicals, Malkapur	Training for the students	4 Students
2	Civil Hospital Malkapur	Government Hospital Visit, Malkapur	25 Students

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

ACADEMIC YEAR 2018-19			
Sl. No.	**Name of the collaborating agency / institution / industry / corporate house with whom the MoU / collaboration / linkage is made, with contact details**	**List the actual activities under each MOU and web -links year-wise**	**Number of Teacher/ Students participating in Activity**
1	Chaitnya Biologicals, Malkapur	Training for the students	4 Students

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

ACADEMIC YEAR 2017-18			
Sl. No.	**Name of the collaborating agency / institution / industry / corporate house with whom the MoU / collaboration / linkage is made, with contact details**	**List the actual activities under each MOU and web -links year-wise**	**Number of Teacher/ Students participating in Activity**
1	Chaitnya Biologicals, Malkapur	Industrial training and Visit	3 students
2	Jivan Sanjivani Human Research institute, Sangli	Training for the students	30 students and 2 Teachers
3		Industrial Visit to Glenmark Pharmaceuticals, Baddi, Himachal Pradesh	40 students and 3 Teachers

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity	Step Up the Most Important Journey of Your life with positive attitude
Brief Report on activity	 
Photograph	Dr. Rajendra Gode College of Pharmacy, Malkapur has organised 'Expert Guidance on "Step Up the Most Important Journey of Your life with positive attitude" on 10 January 2023. Mr. Nitin B Patil was the Resource person, who is a Founder, Uttung Bharari Training Academy, Mumbai. In his presentation, Mr. Nitin B Patil guide the students about the 5 mantras of positive attitude. He focused on how positive attitude help to achieve success in life. He provided insights and advice on how to secure good marks in examination using positive attitude. He also shared the tips and trick to be adopted in day to day route in like affirmation, meditation, gratitude etc. The seminar was attended by students, faculties and proved to be very informative and interactive. The participants not only learned but enjoyed and actively participate during the seminar.
In-charge	Prof. A. D. Taktode

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

CHAITANYA BIOLOGICALS PVT. LTD.

75/2, Malkapur By-Pass, N.H.No.06, Malkapur- 443101
Dist. Buldana (M.S.),India

08/06/2022

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Divya Kharode, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 30/05/2022-07/06/2022 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

CHAITANYA BIOLOGICALS PVT. LTD.

75/2, Malkapur By-Pass, N.H.No.06, Malkapur- 443101
Dist. Buldana (M.S.),India

13/07/2021

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Sopan Borhade, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial inplant training from 05/07/2021-12/07/2021 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

CHAITANYA BIOLOGICALS PVT. LTD.

75/2, Malkapur By-Pass, N.H.No.06, Malkapur- 443101
Dist. Buldana (M.S.),India

10/12/2021

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Pankaj Davhale, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 02/012/2021-08/12/2021 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

CHAITANYA BIOLOGICALS PVT. LTD.

75/2, Malkapur By-Pass, N.H.No.06, Malkapur- 443101
Dist. Buldana (M.S.),India

13/07/2021

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Siddhesh Harne, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in- plant training from 05/07/2021-12/07/2021 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Guest Lecture on Research Methodology by Dr. Wankhede, Principal, Vidnyan Mahavidyalaya, Malkapur
Photos of Activity	
Summary of Event	Dr. Rajendra Gode College of Pharmacy, Malkapur organized a guest lecture on Research methodology on 12 Jan 2023 under the MOU activity. The guest lecture covered various research design, research gap, research problem identification etc by Dr. Wankhede, Principal Vidnyan Mahavidyalaya, Malkapur. They stressed on the points that students need to have improve their research skill. The workshop was attended by B. Pharm Pharm First year students and proved to be very informative and interactive.
Name of Coordinator and team members	Dr. G. D. Mehetre

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Industrial Visit to A - KLASS Pharmaceuticals Ltd. Khamgaon dated 24th November 2022
Photos of Activity	  
Summary of Event	Dr. Rajendra Gode College of Pharmacy, Malkapur B. Pharmacy students visited A - KLASS Pharmaceuticals Ltd. Khamgaon on 24th November 2022. A-KLASS Pharmaceuticals Ltd. Khamgaon is a known organization in the region engaged in manufacturing of popular pharmaceutical products. The visit was organised as a part of institute's vision and mission to do continuous efforts to help students grow by way of teaching, experiential learning. Practical approach. Students observed and understood the establishment of a Pharmaceutical manufacturing unit. The officials made them known about the various departments of the company such as Production, Packaging, Quality Control and Quality Assurance etc. This industrial visit activity was organised successfully by efforts of team DRGCOP, Malkapur including Prof. Rahul A. Darakhe under the guidance of Principal Dr. P. K. Deshmukh. Students happily attended the activity and were thankful to A-KLASS Team as well DRGCOP.
Name of Coordinator and team members	Prof. R. A. Darakhe

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Industrial Visit of Chaitanya Biologicals Pvt. Ltd. Malkapur dated 03/10/2022
Photos of Activity	
Summary of Event	Training and Placement Cell has organized Industrial visit for final year students on dated 03/10/2022 to Chaitanya Biologicals Pvt Ltd. Malkapur. Prof. M.P. More and Prof. Prof P.M.Padole has conducted the activity and visited along with students. Total 50 students (25 boys, 25 girls) students have visited the industry and understood about production process. During visit student has studied following section and understand the working of each section. Starting from Raw material section grouped into quarantine, approved materials subsections, Manufacturing section in that reactor section, filtration section and ultrafiltration section followed by spray drying, blending and packaging section. At the end student visited Effluent treatment plant, purified water generation system, finished goods store, quality control section, and quality assurance section. With assistance and communication with plant head, QA executive participated in training and guide students. The drive was concluded with brief introduction of production process and functions of QA section.
Name of Coordinator and team members	Prof. Mahesh More, Prof. P.M. Padole

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy, Malkapur
Dist. Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Personality Development Workshop by Mr. Mr. Ajaj. M. Shaikh, Regional Project officer, Jeevan Sanjivani H.R.D. Institute Sangali.
Photos of Activity	  
Summary of Event	Dr. Rajendra Gode College of Pharmacy, Malkapur organized two day workshop on "Personality Development" from 5 May 2022 to 6 May 2022 under the MOU activity The workshop covered various module of Personality Development such as Self-image, Ambitious nature, Self-confidence, Decision making, Creativity & mental health etc. conducted by Mr. Ajaj. M. Shaikh, Regional Project officer, Jeevan Sanjivani H.R.D. Institute Sangali. They stressed on the points that students need to have improve their inner strength, this will help them in achieving success by increasing their confidence. The workshop was attended by B. Pharm & D. Pharm First year students and proved to be very informative and interactive. The participants not only learned but enjoyed and actively participate in various activities during the workshop. The Principal, Dr. P. K. Deshmukh, encourage students to build up their personality so they will survive in the throat cutting competition.
Name of Coordinator and team members	Dr. S.B. Sapkal

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
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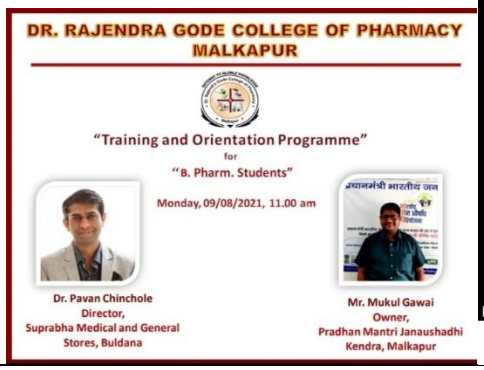
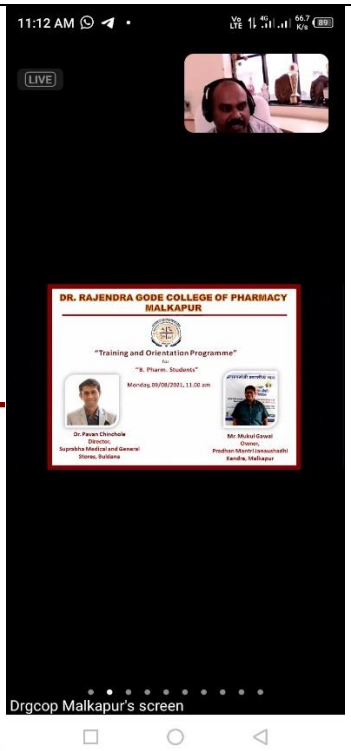
Pharmacy, Malkapur
Dist. Buldana.

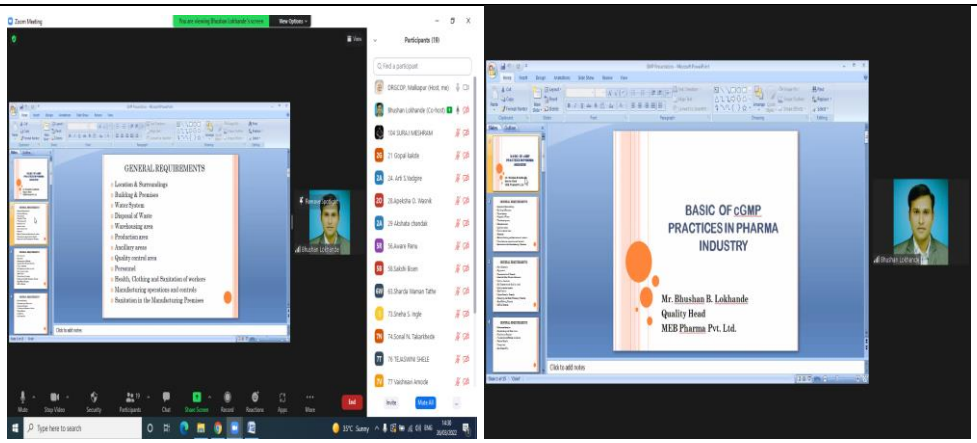
Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Training and Orientation Programme for B. Pharm Students dated 09/08/2021
Photos of Activity	 
Summary of Event	Under the MoUs Activity, DRGCOP, Malkapur in Association with Pradhan Mantri Janaushadhi Kendra, Malkapur Organized Guest Lecture on entrepreneurship development for students on the topic "Entrepreneurship" on 09/08/2021 by Mr. Mukul Gawai and Dr. Pavan Chinchole. The guest speaker enlighten the students about documentation, license, GST, Billing etc. Students & pharmacy entrepreneurs actively participate and involve in interactive session. Mr. Mukul Gawai advised all the Participants to use digital app & social media to improve sell of medicine over the counter. Prof. M. W. Babhulkar & Dr. S.B. Sapkal compere the webinar. Thankful to Prof. R.A. Darakhe for coordination & Special thanks to organizing Committee, Prof. G. D. Mehetre, Prof. R. R. Thenge, Dr. V S Adhao for timely help.
Name of Coordinator and team members	Prof. R.A. Darakhe

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Rajendra Gode College
Pharmacy,Malkapur
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity	Webinar on Basic of GMP Practices in Pharma Industry.
Brief Report on activity	
Photograph	Under the MoU activity Dr. Rajendra Gode College of Pharmacy, Malkapur has arranged the webinar session on 26/03/2022 for B. Pharm Final yr students on Basic of GMP Practices in Pharma Industry. Mr.Bhushan Lokhande, Assistant Manager (Quality Assurance), MEB Pharma (Formerly known as N. M. Pharma) Navsal, Akola delivered his talk on cGMP, and its requirement as per the regulation. He guides the students regarding basic requirement of pharma industry. He also talks on the expections of the Pharma Industry with the students, and how one has to improve the quality and competency to enter in the Pharma Industry. Students also interact enthusiastically during the question answer session. The webinar session was host by Prof. R R. Thenge.
In-charge	Prof. R R. Thenge.

Dr. Rajendra Gode College of Pharmacy Malkapur

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Dist. Buldana (M.S.),India

08/06/2019

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. MayuiAtak, student of Dr. RajendraGode College of Pharmacy, Malkapur has attended seven days industrial inplant training from 01/06/2019- 07/06/2019 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

04/12/2019

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Divya Patil, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 25/11/2019- 03/12/2019 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

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of Pharmacy,Malkapur.
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Dist. Buldana (M.S.),India

08/06/2019

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Mamta Bhagat, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 01/06/2019-07/06/2019 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

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Dr.Rajendra Gode College of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

04/12/2019

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Sejal Patil, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 25/11/2019 - 03/12/2019 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Government Hospital Visit, Malkapur on dated 21/11/2019
Photos of Activity	  
Summary of Event	Under the signed MoUs between Government Hospital Malkapur and Dr. Rajendra Gode College of Pharmacy, Malkapur performed various activities like awareness about HIV, contagious Diseases. Communicable and non-communicable diseases. Hospital Visit has been scheduled for students of First Year B. Pharmacy to get information about various roles and responsibilities of hospital staff. The students were also acquainted with role of hospital pharmacist, inventory management, etc. Dr. Deshmukh Madam and In-charge guided the students and motivated regarding healthcare system in India.
Name of Coordinator and team members	Prof. Rahul Darakhe

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Dist. Buldana (M.S.),India

08/11/2018

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Pranjal Kolte, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 01/11/2018- 07/11/2018 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

07/06/2018

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Harihar Wadekar, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 30/05/2018-06/06/2018 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

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of Pharmacy,Malkapur.
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Dist. Buldana (M.S.),India

07/06/2018

To WHOM SO EVER IT MAY CONCERN

This is to certify that Mr. Ananta Ghonge, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 30/05/2018-06/06/2018 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt. Ltd. Manager Q.A. MALKAPUR

Dr. Rajendra Gode College of Pharmacy Malkapur

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Dist. Buldana (M.S.),India

08/11/2018

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Snehal Kandelkar, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 01/11/2018-07/11/2018 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

20/10/2017

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Prajkta Shelke, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 11/10/2017-18/10/2017 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt. Ltd. Manager Q.A. MALKAPUR

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

20/10/2017

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Komal Chambhare, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 11/10/2017-18/10/2017 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

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Dist. Buldana (M.S.),India

20/10/2017

To WHOM SO EVER IT MAY CONCERN

This is to certify that Miss. Pallavi Garmode, student of Dr. Rajendra Gode College of Pharmacy, Malkapur has attended seven days industrial in-plant training from 11/10/2017-18/10/2017 in our organization in Manufacturing, Quality control and Quality assurance Department.

During the training, we found her sincere and hard working.

We wish all the very best for her future

For Chaitanya Biologicals Pvt. Ltd.

Authorized Signatory

Manager

Chaitanya Biologicals Pvt.Ltd. Manager Q.A. MALKAPUR

Dr.Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

Workshop on "Personality Development"

Dr. Rajendra Gode College of Pharmacy, Malkapur organized two day workshop on "Personality Development" from 18-19 August 2017. The workshop covered various module of Personality Development such as Self image, Ambitious nature, Self confidence, Decision making, Creativity & mental health etc. conducted by Mr. Ajaj. M. Shaikh, Regional Project officer, Jeevan Sanjivani H.R.D. Institute Sangali. They stressed on the points that students need to have improve their inner strength, this will help them in achieving success by increasing their confidence. The workshop was attended by B. Pharm & D. Pharm First year students and proved to be very informative and interactive. The participants not only learned but enjoyed and actively participate in various activities during the workshop.

Dr. Rajendra Gode College of Pharmacy Malkapur

Principal,
Dr.Rajendra Gode College
of Pharmacy,Malkapur.
Dist.Buldana.

Dr. Rajendra Gode College of Pharmacy, Malkapur
MoUs Activity Report

Name of Activity with Date	Industrial Visit – Glenmark Pharmaceuticals, Baddi, Himachal Pradesh on dated 27/12/2017
Photos of Activity	 
Summary of Event	Dr. Rajendra Gode College of Pharmacy, Malkapur B. Pharmacy students visited Glenmark Pharmaceuticals, Baddi, Himachal Pradesh on 27th December 2017. Glenmark Pharmaceuticals, Baddi, is a known organization in the region engaged in manufacturing of popular pharmaceutical products. The visit was organised as a part of institute's vision and mission to do continuous efforts to help students grow by way of teaching, experiential learning, practical approach. Students observed and understood the establishment of a Pharmaceutical manufacturing unit. The officials made them known about the various departments of the company such as Production, Packaging, Quality Control and Quality Assurance etc. This industrial visit activity was organised successfully by efforts of team DRGCOP, Malkapur including Prof. Mahesh Narkhede under the guidance of Principal Dr. V. N. Shrikhande. Students happily attended the activity and were thankful to Glenmark Pharmaceuticals Team as well DRGCOP.
Name of Coordinator and team members	Prof. Mahesh Narkhede

Dr. Rajendra Gode College of Pharmacy ★ Malkapur

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of Pharmacy,Malkapur.
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DR. RAJENDRA GODE COLLEGE OF PHARMACY

Affiliated to SGBAU, Amravati, MSBTE, Mumbai Approved by PCI & AICTE, New Delhi

Research Collaborations

(National/International)

GATEWAY TO GLOBAL KNOWLEDGE

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Sr. No.	**Name of Author from Host Institute**	**Name and Designation of Author from Collaborating Institute (National)**	**Name and Designation of Author from Collaborating Institute (International)**	**Outcome of publication (Title)**	**Journal Name (ISSN)**	**Volume (issue), Year, Page No.**	**Name of the Indexing Database /Impact Factor**	**Page No.**
National								
1	Prof. S. B. Sapkal, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Prof. PA Gangane, Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Once a Daily Tablet Formulation and In-vitro Evaluation of HPMC based Intra Gastric Floating Tablet of Levofloxacin	Research Journal of Pharmaceutical Science and Technology (P 0974-3618, E 0974-360X)	8(4), 2015, 395-401	Scopus/ Web of Science/Pubmed	**1**
2	R R Popat, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	N M Mahajan Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Method Development and validation for the estimation of Acephate by using Reverse Phase HPLC	World Journal of Pharmacy and Pharmaceutical Sciences (2278-4357)	5(1), 2016, 1167-1172	Scopus/ Web of Science/Pubmed	**2**
3	R R Popat, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	N M Mahajan Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Green Bioanalytical Chemistry : A Review	Journal of Current Pharma Research (2230-7842)	6(2), 2016, 1809-1824	Scopus/ Web of Science/Pubmed	**3**
4	S D Mhaske, Department of Pharmacology, Dr. Rajendra Gode College of Pharmacy, Malkapur	Mrunal Shirsath, Centre for Research and Development, Pacific University, Udaipur, Rajasthan		Assessement of Antipsoriasis Antiinflammatory Anesthetic combination as therapy in Psoriasis, Eczema, Ringworm infection Associated with Minimize the Side Effects of Dithranol	Journal of Medicinal Chemistry and Drug Discovery (2347 - 9027)	8, 2016, 1 - 12	Scopus/ Web of Science/Pubmed	**4**
5	LN Barde, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Vijay B Mathur, Research Scientist, Zim Laboratories, Nagpur		Development and Validation of Analytical Method for Determination of Monocrotophos Using High Performance Liquid Chromatography	Indo American Journal of Pharmaceutical Research (2231-6876)		Scopus/ Web of Science/Pubmed	**5**
6	R R Thenge, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Nilesh Tekade, SGSPS Institute of Pharmacy, Kaulkhed, Akola		Preparation and Characterization of Co-crystals of Diacerin	Indonesian Journal of Pharmacy (2338-9427)	28(1), 2017, 34-41	Scopus/ Web of Science/Pubmed	**6**
7	R R Thenge, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	N M Mahajan Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Design and Development of Crystallo-co-Agglomerate of Ritonavir for the Improvement of Physicochemical Properties	Turkish Journal of Pharmaceutical Sciences (2148 - 6247)	15(3), 2018, 248-255	Scopus/ Web of Science/Pubmed	**7**

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Sr. No.	**Name of Author from Host Institute**	**Name and Designation of Author from Collaborating Institute (National)**	**Name and Designation of Author from Collaborating Institute (International)**	**Outcome of publication (Title)**	**Journal Name (ISSN)**	**Volume (issue), Year, Page No.**	**Name of the Indexing Database /Impact Factor**	**Page No.**
8	VS Adhao, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	J Sharma, BR Ambedkar University, Agra, UP		Development and Validation of Stability Indicating RP-HPLC Method for Determination of Ceritinib	Indonesian Journal of Pharmacy (2338-9427)	28(4), 2017, 241-248	Scopus/ Web of Science/Pubmed	**8**
9	S B Sapkal, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	J Krishna, B R Ambedkar University, Srikakulam, Andhra Pradesh		Solubility and Dissolution Enhancement of Valsartan by Solid Dispersion Technique Using Natural Polymer	World Journal of Pharmaceutical Research (2277-7105)	7(15), 2018, 708-729	Scopus/ Web of Science/Pubmed	**9**
10	R R Thenge, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	N M Mahajan Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Design and Invitro Evaluation of Extended Release Tablet of Nateglinide	Journal of Drug Delivery and Therapeutics (2250-1177)	8(5), 2018, 235-239	Scopus/ Web of Science/Pubmed	**10**
11	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	JS Bayas, JSPM Charak College of Pharmacy and Research, Pune		In-vitro studies and Evaluation of telmisartan marketed Tablet	Journal of Drug Delivery and Therapeutics (2250-1177)	9(1), 2019, 74-78	Scopus/ Web of Science/Pubmed	**11**
12	SA Chavhan, Department of Pharmacognosy, Dr. Rajendra Gode College of Pharmacy, Malkapur	AN Ugale, Department of Pharmacognosy, Government College of Pharmacy, Amravati		Development of Stability Indicating Assay Method for Antiemetic Drugs in Combined Dosage Formulation	Current Trends in Pharmacy and Pharmaceutical Chemistry (	1(1), 2019, 92-103	Scopus/ Web of Science/Pubmed	**12**
13	R R Thenge, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	N M Mahajan Department of Pharmaceutics, Dadasaheb Balpande College of Pharmacy, Besa, Nagpur		Formulation and Evaluation of Buccoadhesive Drug Delivery System for Lovastatin	Journal of Drug Delivery and Therapeutics (2250-1177)	9(2), 2019, 6 - 12	Scopus/ Web of Science/Pubmed	**13**
14	VS Adhao, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	J Sharma, BR Ambedkar University, Agra, UP		Development and Validation of Stability Indicating RP-HPLC Method for Determination of Safinamide Mesylate	Jordan Journal of Pharmaceutical Sciences	13(2), 2020, 149 - 152	Scopus/ Web of Science/Pubmed	**14**

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Sr. No.	**Name of Author from Host Institute**	**Name and Designation of Author from Collaborating Institute (National)**	**Name and Designation of Author from Collaborating Institute (International)**	**Outcome of publication (Title)**	**Journal Name (ISSN)**	**Volume (issue), Year, Page No.**	**Name of the Indexing Database /Impact Factor**	**Page No.**
15	G D Mehetre, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	A Dubey, Chatrapati Shahuji Maharaj University, Kanpur		Formulation Development and Invitro -Invivo Evaluation of Gastroretentive floating tablet incorporating Clarithromycin	Journal of Drug Delivery and Therapeutics (2250-1177)	9(5), 2019, 67-81	Scopus/ Web of Science/Pubmed	**15**
16	SA Shinde, Department of Pharmacognosy, Dr. Rajendra Gode College of Pharmacy, Malkapur	VD Rangari, Guru Ghasidas Vishwavidyala, Bilaspur, Chattishgarh		Formulation and Phytopharmacological Activity studies of Fresh Juice of Acacia Arabica stem and Leaves for the treatment of Variety of Dentral problems	International Journal of Chemistry and Pharmaceutical Sciences (2321-3132)	7(11), 2019 187-195	Scopus/ Web of Science/Pubmed	**16**
17	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	D Cheke, Deparment of General Medicine, Kashibai Navale Medical College and Hospital, Pune		Coronavirus: Hotspot on Coronavirus disease 2019 in India	Indian Journal of Medicial Sciences	72(1), 2020, 29- 35	Scopus/ Web of Science/Pubmed	**17**
18	G D Mehetre, Deparment of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	PG Mehetre, Government Nursing School, General Hospital, District Health Services, Buldana		A Review of COVID 19 Diagnosis, Treatment and Prevention	European Journal of Biomedical and Pharmaceutical Sciences	7(6), 2020, 197-206	Scopus/ Web of Science/Pubmed	**18**
19	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	RR Narkhede, Department of Medicinal Chemistry, National Institute of Pharmaceutical Training and Research, Raebareli, Lucknow		The Molecular Docking Study of Potential Drug Candidates Showing AntiCovid-19 Activity by Exploring of Therapeutic Target of SARs-CoV-2	Eursian Journal of Medicine and Oncology	4(3), 2020, 185-195	Scopus/ Web of Science/Pubmed	**19**
20	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	RR Narkhede, Department of Medicinal Chemistry, National Institute of Pharmaceutical Training and Research, Raebareli, Lucknow		Recognition of Natural Products as Potential Inhibitors of COVID 19 Main Protease (Mpro): Insilico Evidences	Natural Products and Bioprospecting	10, 2020, 297-306	Scopus/ Web of Science/Pubmed	**20**
21	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	SD Shinde, Department of Pharmacology, RD Bhakt's College of Pharmacy, Jalna		The Berberis Aristata Ameliorates Oxazolone induced contact dermatitis: Invivo and Insilico Evidences	Advances in Traditional Medicine	2020	Scopus/ Web of Science/Pubmed	**21**

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22	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	RR Narkhede, Department of Medicinal Chemistry, National Institute of Pharmaceutical Training and Research, Raebareli, Lucknow		Repurposing of Anthelmintic Drugs Against SARS-CoV-2 (Mpro and RdRp): Novel Disease, Older Therapeutics	Letters in Applied Nanobioscience (2284-6808)	10(2), 2021, 2331-2338	Scopus/ Web of Science/Pubmed	**22**
23	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	S. Mutalik, Manipal College of Pharmaceutical Sciences, Manipal Academy of Higher Education, Manipal, Karnataka		One Pot Development of Spray Dried Cationic Proliposome dry powder insufflation: Optimization, Characterization and Biointeractions	Journal of Drug Delivery Science and technology (E 2588-8943, P 1773-2247)	61, 2021, 102298	5.062	**23**
24	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	J B Naik, Director, University Institute of Chemical Technology, KBC North Maharashtra University, Jalgaon		Recent advances in phytochemical-based Nano-formulation for drug-resistant Cancer	Medicine in Drug Discovery (2590-0986)	10, 2021, 100082	Scopus/ Web of Science/Pubmed	**24**
25	J P Ambhore, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	Prashant S. Kharkar, Department of Pharmaceutical Sciences and Technology, Institute of Chemical technology, Mumbai		A Concise Analytical Profile of Efavirenz: Analytical Methodologies	Critical Reviews in Analytical Chemistry (P1040-8347, E 1547-6510)	52(7), 2022, 1583-1592	5.686	**25**
26	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	P O Patil, Department of Pharmaceutical Chemistry, H R Patel Institute of Pharmaceutical Education and Research, Shirpur		Eco-friendly synthesis of surface grafted Carbon nanotubes from sugarcane cubes for development of prolonged release drug delivery platform	International Journal of Nanodimensions (P 2008-8868, E 2228-5059)	12(3), 2021, 211 - 221	Scopus/ Web of Science/Pubmed	**26**
27	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	R E Mutha, Department of Pharmacognosy, H R Patel Institute of Pharmaceutical Education and Research, Shirpur		Electrostatic deposition assisted preparation, characterization and evaluation of chrysin liposomes for breast cancer treatmen	Drug Development and industrial pharmacy (P0363-9045, E 1520-5762)	47(5), 2021, 809-819	2.295	**27**

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29	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	P O Patil, Department of Pharmaceutical Chemistry, H R Patel Institute of Pharmaceutical Education and Research, Shirpur		Fabrication of N-doped graphene@ TiO2 nanocomposites for its adsorption and absorbing performance with facile recycling	NanoBiomedicine and Engineering (2150-5578)	13(2), 2021, 179-190	Scopus/ Web of Science/Pubmed	**28**
29	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Minal T. Harde, Department of Pharmaceutical Chemistry, Modern College of Pharmacy, Pune		One step synthesis approach of mesoporous silica packed with graphene oxide nanosheet: Characterisation and drug release aspects	Materials Technology (P 1066-7857, E 1753-5557)	37(11), 2022, 1677-1690	3.846	**29**
30	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Prajackta Dandekar, Department of Pharmaceutical Sciences and Technology, Institute of Chemical technology, Mumbai		Development of cross-linked collagen/pullulan ocular film for sustained delivery of Besifloxacin using novel spin-coating technique	Journal of Materials Research (P 0884-2914, E 2044-5326)	36, 2021, 3278–3292	2.909	**30**
31	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	SD Shinde, Department of Pharmacology, RD Bhakt's College of Pharmacy, Jalna		Quinazoline: An update on current status against convulsios	Journal of Molecular Structure (0022-2860)	1248, 2022, 131384	3.841	**31**
32	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	P O Patil, Department of Pharmaceutical Chemistry, H R Patel Institute of Pharmaceutical Education and Research, Shirpur		Green synthesis of Fe-doped Ag-loaded reduced graphene oxide ternary nanocomposite for efficient photocatalytic degradation of toxic dyes	Advances in Natural Sciences: Nanoscience and Nanotechnology (2043-6262)	12, 2021, 035004	Scopus/ Web of Science/Pubmed	**32**
33	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Rahul S Tade, Department of Pharmaceutics, H. R.Patel Institute of Pharmaceutical Education and Research, Shirpur		Graphene quantum dots (GQDs) nanoarchitectonics for theranostic application in lung cancer	Journal of Drug Targeting (P 1061-186X, E 1029-2330)	30(3), 2022, 269-286	3.48	**33**

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34	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Abdulla Sherikar, Department of Pharmacology, SVKM's Institute of Pharmacy, Dhule		Preparation and Evaluation of Silymarin-Loaded Solid Eutectic for Enhanced Anti-Inflammatory, Hepatoprotective Effect: In Vitro–In Vivo Prospect	Oxidative Medicine and Cellular Longevity (P 1942-0900, E 1942-0994)	2021, 2021, 1818538	7.31	**34**
35	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	A Rajput, Department of Pharmaceutics, Poona College of Pharmacy, Bharati Vidyapeeth Deemed to be University, Pune		A key role by polymers in microneedle technology: a new era	Drug Development and industrial pharmacy (P0363-9045, E 1520-5762)	47(11), 2021, 1713-1732	3.728	**35**
36	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	GB Patil, Department of Pharmaceutics, H R Patel Institute of Pharmaceutical Education and Research, Shirpur		Gossypol-Embedded Casein Nanoparticles for Potential Targeting of Ovarian Cancer: Formulation, Characterization, and Anticancer Activity	Journal of Pharmaceutical Innovation (P 1872-5120, E 1939-8042)	61, 2022	2.538	**36**
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37	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	S. Mutalik, Manipal College of Pharmaceutical Sciences, Manipal Academy of Higher Education, Manipal, Karnataka	Ruth Prassl, Gottfried Schatz Research Centre for cell signaling, Metabolism and Aging, Medical University of Graz, Austria	Black Phosphorus as Multifaceted Advanced Material Nanoplateforms for Potential Biomedical Applications	Nanomaterials (2079-4991)	11, 2021, 13	5.719	**37**
38	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	J B Naik, Director, University Institute of Chemical Technology, KBC North Maharashtra University, Jalgaon	A Mujumdar, Department of Chemical and Biochemical Engineering, Western University, London	A meticulous overview on drying-based (spray-, freeze-, and spray-freeze) particle engineering approaches for pharmaceutical technologies	Drying Technology (P 0737-3937, E 1532-2300)	39(11), 2021, 1447-1491	3.556	**38**
39	P K Deshmukh, Professor and Principal Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	S. Mutalik, Manipal College of Pharmaceutical Sciences, Manipal Academy of Higher Education, Manipal, Karnataka	Sai HS Boddu, Department of Pharmaceutical Sciences, College of Pharmacy and Health Sciences, Ajman University, Ajman, UAE	Surface architectured metal organic frameworks-based biosensor for ultrasensitive detection of uric acid: Recent advancement and future perspectives	Microchemical Journal (0026-265X)	169, 2021, 106567	4.821	**39**

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40	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur		VR Pasupuleti, Department of Biomedical Sciences and Therapeutics, Faculty of Medicine and Health Sciences, University of Malaysia Sabah, Malaysia	Therapeutic outcomes of Isatin and its derivative against multiple diseaes: Recent Development in Drug Discovery	Pharmaceutics (MDPI) (1999-4923)	15, 2022, 272	6.525	**40**
41	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	J B Naik, Director, University Institute of Chemical Technology, KBC North Maharashtra University, Jalgaon	A Mujumdar, Department of Chemical and Biochemical Engineering, Western University, London	Statistical optimization of voriconazole nanoparticles loaded carboxymethyl chitosan-poloxamer based in situ gel for ocular delivery: In vitro, ex vivo, and toxicity assessment	Drug Delivery and Translational Research (P 2190-393X, E 2190-3948)	12, 2022, 3063–3082	5.671	**41**
42	R Cheke, Department of Pharmaceutical Chemistry, Dr. Rajendra Gode College of Pharmacy, Malkapur	PS Kharkhar, Deparment of Pharmaceutical Sciences and Technology, Institute of Chemical Technology, Mumbai	VR Pasupuleti, Department of Biomedical Sciences and Therapeutics, Faculty of Medicine and Health Sciences, University of Malaysia Sabah, Malaysia	Molecular Insights into Coumarin Analogues as Antimicrobial Agents: Recent Developments in Drug Discovery	Antibiotics (2079-6382)	11, 2022, 566	5.222	**42**
43	Mahesh P. More, Department of Pharmaceutics, Dr. Rajendra Gode College of Pharmacy, Malkapur	Sathish Dyvawanpelly, Department of Pharmaceutical Sciences and Technology, Institute of Chemical Technology Mumbai	Vijayabhaskarreddy, Drug Research Program, Faculty of Pharmacy, University of Helsinki, Viikinkaari Helsinki, Finland	Progress on Thin Film Freezing Technology for Dry Powder Inhalation Formulations	Pharmaceutics (MDPI) (1999-4923)	14 (12), 2022, 2632	6.525	**43**

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RESEARCH ARTICLE

Once a daily Tablet Formulation and In Vitro Evaluation of HPMC Based Intra Gastric Floating Tablet of Levofloxacin

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ABSTRACT:
The aim of this study was to develop a new intra-gastric floating tablet for controlled delivery of Levofloxacin for the treatment of peptic ulcer disease caused by *Helicobacter pylori* (*H. pylori)*. The method of preparation is direct compression method. HPMC, K-grade and effervescent material sodium bicarbonate formed the floating layer. The release layer contained Levofloxacin and various polymers such as HPMC-K15M, HPMC-K100M, PVP-K30 and MCC in combination with the drug. The in vitro drug release was studied in pH 1.2 HCl using USP dissolution Apparatus II at 50 rpm. Zero-order, first-order, Higuchi and Korsmeyer et al. models were used to estimate the kinetics of drug release. Optimized formulation released approximately 98% drug in 12 h *in vitro*, while the floating lag time was 49 sec and the tablet remained floatable throughout all studies. Optimized formulation (D3) followed the Korsmeyer and Peppas model and showed no significant change in physical appearance, drug content, floatability and invitro dissolution pattern after storage at 45 ^{0}C/75% RH for three month.

KEYWORDS: *H. pylori* infection, Methocel matrices, swelling index, Data analysis.

INTRODUCTION:
Floating drug delivery systems were used to prolong the gastric residence time of drug delivery systems. They remain buoyant in the stomach for prolonged period of time without affecting the gastric emptying rate of other contents. A floating dosage form is useful for those drugs that act locally in the proximal gastrointestinal tract (GIT), are unstable in lower parts of GIT, or are poorly absorbed in the intestine [1]. The gastro\ retentive drug delivery systems can remain in the stomach and assist in improving the oral sustained delivery of drugs that have an absorption window in a particular region of the gastrointestinal tract. These systems help in continuously releasing the drug before it reaches the absorption window, thus ensuring optimal bioavailability [2].

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Hydrophilic polymer matrices are commonly used as oral drug delivery systems because of their good compatibility. Drug release from hydrophilic matrix tablets is controlled by formation of a hydrated viscous layer around the tablet which acts as a barrier to drug release by opposing penetration of water into tablet and also movement of dissolved solutes out of the matrix tablets. The overall drug release process is influenced not only by drug solubility but also by the physical and mechanical properties of the gel barrier that forms around the tablet. The extent of matrix swelling, erosion, and diffusion of drug determines the kinetics as well as the mechanism of drug release [3]. Methocel matrices hydrate rapidly only at the surface, retaining their original air bubbles and extending floatation beyond 8 h. Further addition of sodium bicarbonate (8–24%) maintains also their floatability longer than 8 h. The addition of sodium bicarbonate to Methocel matrices expands their volume due to gas bubbles formed after reaction with an acidic dissolution medium, increasing their hydration volume [4].

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METHOD DEVELOPMENT AND VALIDATION FOR THE ESTIMATION OF ACEPHATE BY USING REVERSED PHASE HPLC

Popat R R[1*], Adhao V S[1], Barde L N[1], Mahajan N M[2], Thenge R R[1] and Ajmire P V[1]

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ABSTRACT

A reversed-phase high performance liquid chromatography (RP-HPLC) method was developed and validated for the estimation of Acephate in bulk form. The separation was achieved on C18 Hypersil BDS column (250mm × 4.6 mm i.d., 5.0 µm) using water and methanol in the ratio 80:20 v/v as mobile phase and at a flow rate of 1.2mL/min. Detection was carried out using a PDA detector at215 nm. The total chromatographic analysis time per sample was about 8.0min with Acephate eluting at retention timeof about 4.8min. The method was validated for accuracy, precision, specificity, linearity and sensitivity. Validation studies demonstrated that this HPLC method is simple,specific, rapid, reliable and reproducible. The standard curve was linear over the concentration range of 1-50µg/mL withR^2 close to one (0.9994). The limit of detection (LOD) and limit of Quantitation (LOQ) obtained for Acephate were 0.015 µg/ml and 0.04µg/mL, respectively. The developed and validated method was successfully applied for the quantitative analysis of Acephate in the bulk form. The high recovery and low relartive standard deviation confirm the suitability of the proposed method for the determination of Acephate inbulk form.

KEYWORD: Organophosphorus, Pesticides, Quantitative.

1. INTRODUCTION

Organophosphorus pesticides (OPPs) are a class of pesticides that generally act as cholinesterase inhibitors and are used for the control of a broad range of pests on cotton, rice, tobacco, sorghum, sugarcane and vegetables.[1] The use of these pesticides has resulted in worldwide increase in food production the control of disease carrying vectors and insect pest. However, OPPs are toxic to all animals and humans. For evaluation of environmental

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Review Article

Green Bioanalytical Chemistry: A Review

R.R. Popat*[1], V.S. Adhao[1], R.R. Thenge[1], P.V. Ajmire[1], L.N. Barde[1], N.M. Mahajan[2]

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Abstract

Green Chemistry is the utilisation of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products. Green chemistry is about Waste minimisation at source, Use of catalysts in place of reagents, Using non-toxic reagents, Use of renewable resources, Improved atom efficiency, Use of solvent free or recyclable environmentally benign solvent systems. The introduction of the dimension of green chemistry into the assessment of analytical methods should be a natural development trend in chemistry and should coincide with its general policy. Some of the principles of green chemistry, such as, prevention of waste generation; safer solvents and auxiliaries; design for energy efficiency; safer chemistry to minimize the potential of chemical accidents; development of instrumental methods are directly related to analytical chemistry. Investigation of GAC methodologies encompasses a number of strategies to minimize or to eliminate the use of toxic substances and the generation of wastes. The main focus has been the development of new routes to minimize the amounts of side products and to replace toxic solvents. Recent trends in green bioanalytical chemistry involves various strategies as development of chiral stationary phases for HPLC separation; advances in analytical chemistry using the unique properties of ionic liquids, chemical sensors and biosensors, bio analysis based on nanoporous materials, materials-based approaches to minimizing solvent usage in analytical sample preparation, microplasmas for analytical applications of lab-on-a-chip, applications of nanomaterials in enantio separation and related techniques, recent trends in counter-current chromatography.

Keywords: Green bioanalytical chemistry, Green Chemistry, HPLC, nanomaterials; Waste management.

1. Introduction

The introduction of the dimension of green chemistry into the assessment of analytical methods should be a natural development trend in chemistry and should coincide with its general policy.

Some of the principles of green chemistry, such as, prevention of waste generation; safer solvents and auxiliaries; design for energy efficiency; safer chemistry to minimize the potential of chemical accidents; development of instrumental methods are directly related to analytical chemistry.[1]

History

The term green chemistry was first used in 1991 by P. T. Anastas in a special program

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Research Article

ASSESSMENT OF ANTI-PSORIASIS-ANTI-INFLAMMATORY-ANESTHETIC COMBINATION AS A THERAPY IN PSORIASIS, ECZEMA, RINGWORM INFECTION ASSOCIATED WITH MINIMIZE THE SIDE EFFECTS OF DITHRANOL

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ABSTRACT

Skin diseases are the common infectious diseases in human. Existing combination of Dithranol & salicylic acid is available in the market in India. (Ointment Ringozone(R)) A stiff dithranol 0.5% ointment shows colour changes, degradation and loss of potency after adverse storage. Varying strength of salicylic acid were added in an attempt to protect the dithranol. The most common corticosteroids used topically for anti-inflammatory activity . Indication of Betamethasone valerate are anti-inflammatory, on eczema, psoriasis. Lignocaine hydrochloride produces local anesthetic effect which will reduces irritation and burning sensation of skin. Also the Betamethasone valerate and Lignocaine HCL combine given in dental anesthetics. The most commonly used treatment for all types of hyperpigmentary disorders is topical hydroquinone. Corticosteroids are also given with hydroquinone in hyperpigmentation during healing step. Salicylic acid is a widely used keratolytic agent in the treatment of hyperkeratosis conditions such as

INDO AMERICAN JOURNAL OF PHARMACEUTICAL RESEARCH

DEVELOPMENT AND VALIDATION OF ANALYTICAL METHOD FOR DETERMINATION OF MONOCROTOPHOS USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Barde Laxmikant N[*1], Adhao Vaibhav S[1], Popat Ritesh R[1], Shrikhande Vinayak N[1], Mathur Vijay B[2]

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Keywords

Organophosphorus Pesticides, Monochrotophos, HPLC.

ABSTRACT

A method was developed to determine monocrotophos solution using high performance liquid chromatography (HPLC) with ultraviolet absorption detection. The proposed method was quite reproducible and sensitive enough to replace the troublesome gas-liquid chromatographic analysis for monocrotophos solution.[2,12] A reversed-phase high performance liquid chromatography (RP-HPLC) method was developed and validated for the estimation of monocrotophos in bulk form. The separation was achieved on C18 Hypersil BDS column (250 mm × 4.6 mm i.d., 5.0 µm) using water and acetonitrile in the gradient mode as mobile phase and at a flow rate of 1.0 mL/min. Detection was carried out using a UV detector at 254 nm. The total chromatographic analysis time per sample was about 25.0 min with monocrotophos eluting at retention time of about 11.31 min. The method was validated for accuracy, precision, specificity, linearity and sensitivity. Validation studies demonstrated that this HPLC method is accurate, specific, rapid, reliable and reproducible. The standard curve was linear over the concentration range of 25-125µg/mL with R^2 close to one (0.999). The developed and validated method was successfully applied for the quantitative analysis of motocrotophos in the bulk form.

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Research Article

PREPARATION AND CHARACTERIZATION OF CO-CRYSTALS OF DIACEREIN

Raju Rameshrao Thenge*, VB. Patond[1], Vaibhav Suresh Adhao [1], Prashant Vishnupant Ajmire[1], Laxmikat Niranjan Barde , Nilesh M. Mahajan[2], Nilesh P. Tekade[3]

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ABSTRACT

Diacerein, an anti-inflammatory drug used in the treatment of osteoarthritis. Being a BCS class II drug, it has poor solubility, dissolution rate, and other physicochemical properties. Thus the aim of present study was to prepare co-crystals of diacerein to improve solubility and dissolution rate. The diacerein co-crystals were prepared using urea and tartaric acid as conformer by Solvent drop grinding method. The diacerein co-crystals were characterized by scanning electron microscopy (SEM), Fourier Transform Infrared Spectroscopy (FT-IR), Differential scanning calorimetry (DSC) and X-ray diffractometry (XRD). The co-crystals were evaluated for solubility, dissolution rate, and other physicochemical properties and compared with commercial diacerein. The co-crystals exhibit the difference in the size and shape of crystals. The FT-IR spectra of diacerein co-crystals showed slightly different in the characteristic peaks compared to commercial diacerein sample. DSC data indicate the decrease in the melting endotherm of co-crystals compares to diacerein. The co-crystals with urea showed an increase and intense peak and co-crystals with tartaric acid showed decreased number of peaks compared to commercial diacerein. The co-crystals of diacerein formulated into the Tablet and evaluated for tablet properties. The tablet formulation showed improved tablet characteristics as well as dissolution rate compared to commercial diacerein.

Keywords: Co-crystals, Diacerein, physicochemical properties, FT-IR

INTRODUCTION

Crystal habit and internal structure of a drug can affect bulk and physicochemical properties, which range from the flowability to chemical stability. Crystals are characterized by the repetitious spacing of constituent atoms or molecules in a three-dimensional array, whereas amorphous forms have atoms or molecules randomly placed as in a liquid. Crystallization is a spontaneous arrangement of particles to a repetitive ordered array i.e. regular geometrical pattern (Subrahmanyam *et al.*, 2000). When applied solid the adjective crystalline, implies an ideal crystal in which structural units termed unit cells are repeated regularly and indefinitely in three dimensions in a space (Vippagunta *et al.*, 2001). An ideal crystal is constructed by the regular spatial repetition of identical structural units (Saifee *et al.*, 2009) Crystal form can be crucial to the performance of dosage form (Hickey *et al.*, 2007)

Over the last decade, there has been growing interests in the design of pharmaceutical co- crystals, which has emerged as a potential method for enhancing the bioavailability of drug with low solubility (Bittain *et al.*, 2006). To start with, it is necessary to important definitions: co-crystal and pharmaceutical co- crystals. Co-crystal can be defined in a number of ways. A restrictive definition utilized by that co-crystals are structurally homogenous crystalline materials containing two or more components present in definite stoichiometric amounts. The co-crystals components are discrete neutral molecular reactants which are solid at ambient temperature (Gagniere *et al.*, 2009). Based on this definition of co-crystal, a pharmaceutical

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ORIGINAL ARTICLE

Design and Development of Crystallo-co-agglomerates of Ritonavir for the Improvement of Physicochemical Properties

Fizikokimyasal Özelliklerin İyileştirilmesi için Ritonavirin Kristalo-Koaglomeratlarının Tasarımı ve Geliştirilmesi

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ABSTRACT

Objectives: The aim of the present study was to obtain CCA of ritonavir to improve the solubility, dissolution rate, and other physicochemical properties.

Materials and Methods: Ritonavir agglomerates were prepared using the CCA technique. Acetone-water containing HPMC K-15, PEG-6000, PVP K-30 was used as the crystallization medium. The agglomerates were evaluated for saturation solubility, micromeritic properties, yield, and drug content. The agglomerates were also characterized using FTIR, DSC, XRPD and SEM.

Results: The growth of particle size and the spherical form of the agglomerates resulted in the formation of products with good flow and packing properties. The improved compaction properties of the agglomerated crystals were due to the fragmentation that occurred during compression. DSC and XRD studies showed that ritonavir particles crystallized in the presence of HPMC, PEG-6000, PVP K-30 and diluents did not undergo structural modifications. The solubility and dissolution rate of ritonavir agglomerates were improve compare to pure ritonavir.

Conclusion: CCA was successfully applied to improve the physicochemical properties of ritonavir.

Key words: Crystallo-co-agglomeration, solubility, dissolution, ritonavir

ÖZ

Amaç: Bu çalışmanın amacı, çözünürlük, çözünme hızı ve diğer fizikokimyasal özelliklerini iyileştirmek için ritonavirin CCA'larını elde etmektir.

Gereç ve Yöntemler: Ritonavir aglomeraları, CCA tekniği kullanılarak hazırlandı. Kristalizasyon ortamı olarak HPMC K-15, PEG-6000, PVP K-30 içeren aseton-su kullanıldı. Aglomeratlar, doygunluk çözünürlüğü, mikromeritik özellikler, verim ve etkin madde içeriği açısından değerlendirildi. Aglomeratlar ayrıca FTİR, DSC, XRPD ve SEM kullanılarak karakterize edildi.

Bulgular: Aglomeratların partikül büyüklüğünün ve küresel formunun büyümesi, iyi akış ve paketleme özelliklerine sahip ürünlerin oluşumu ile sonuçlandı. Aglomere olmuş kristallerin iyileşmiş sıkıştırma özellikleri, sıkıştırma sırasında meydana gelen parçalanmadan kaynaklanmıştır. DSC ve XRD çalışmaları, HPMC, PEG-6000, PVP K-30 ve seyrelticilerin varlığında kristalleşen ritonavir partiküllerinin yapısal modifikasyonlara maruz kalmadığını gösterdi. Ritonavir aglomeratlarının çözünürlüğü ve çözünme hızı, saf ritonavir ile karşılaştırılır derecede gelişti.

Sonuç: Ritonavirin fizikokimyasal özelliklerini iyileştirmek için kristalo-koaglomerasyonu başarıyla uygulanmıştır.

Anahtar kelimeler: Kristalo-koaglomerasyon, çözünürlük, çözünme, ritonavir

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Research Article

DEVELOPMENT AND VALIDATION OF STABILITY INDICATING RP-HPLC METHOD FOR DETERMINATION OF CERITINIB

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ABSTRACT

The purpose of the present work was to develop new, simple, specific, accurate and precise stability indicating RP-HPLC method for determination of ceritinib. In the present study, stress testing of ceritinib was carried out according to ICH guidelines Q1A (R2). ceritinib was subjected to stress conditions of hydrolysis, oxidation, photolysis and neutral decomposition. Extensive degradation was found to occur in acidic condition. Mild degradation was observed in basic and at thermal conditions. Successful separation of drug from degradation products formed under stress conditions was achieved on a Hypersil BDS C18 column (250×4.6mm, 5.0µ particle size) using acetonitrile: acetate buffer (pH 3.7±0.05) (50:50 v/v), at a flow rate of 1.0mL/min and column was maintained at 40°C. Quantification and linearity were achieved at 272nm over the concentration range of 5-100µg/mL for ceritinib. The Correlation Coefficient was found to be 0.9960. The method was validated for specificity, linearity, accuracy, precision, LOD, LOQ and robustness. The developed method will be useful for routine analysis for samples of stability studies in the formulation and development.

Keywords: Stability-indicating, HPLC, ceritinib, validation, stress testing.

INTRODUCTION

Ceritinib, 5-Chloro-N4-[2-[(1-methylethyl)sulfonyl]phenyl]-N2-[5-methyl-2-(1-methyl-ethoxy)-4-(4-piperidinyl)phenyl] 2,4-pyrimidine diamine, is an anaplastic lymphoma kinase (ALK) inhibitor which induces complete tumor regression in a xenograft model of EML4-ALK-positive lung cancer. The alternative names of ceritinib are LDK 378, NVP-LDK 378, ZykadiaTM. Ceritinib is a highly selective inhibitor of an important cancer target, ALK (Heudi, *et. al.,* 2014). Ceritinib, a recently approved drug by Food and Drug Administration, is used for the treatment of late-stage (metastatic) non-small cell lung cancer (Waters, 2014). The recommended dosage of ceritinib is 750 mg administered orally once daily on an empty stomach (Shaw, *et al.,* 2014). The chemical structure of ceritinib (Figure 1).

An ultrafast, sensitive, selective, and robust LDTD-APCI-MS/MS method was developed for the quantification of ceritinib in human plasma (Lanshoeft, 2015). A stability

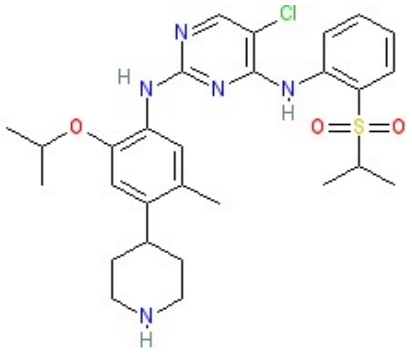

Figure 1. Structure of Ceritinib

indicating reversed-phase high-performance liquid chromatographic (RP-HPLC) method for estimation of ceritinib was reported (Kumar., 2014). Since, there are only two HPLC method reported in the literature for the estimation of ceritinib in pharmaceutical dosage forms

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SOLUBILITY AND DISSOLUTION ENHANCEMENT OF VALSATAN BY SOLID DISPERSION TECHNIQUE USING NATURAL POLYMER

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ABSTRACT

The purpose of this study was to prepare and characterize solid dispersions of the poorly water soluble antihypertensive agent valsartan with natural carriers such as Xanthan gum, gaur gum and gum acacia to improve its aqueous solubility and rate of dissolution by solvent evaporation technique. All the formulations showed marked improvement in the solubility behavior and improved drug release. From all the formulations VS7 was found to be optimized formulation based on the characterization, solubility and dissolution studies. The results obtained showed that the aqueous solubility and rate of dissolution was significantly improved when formulated in solid dispersion as compare to pure drug. The enhancement of dissolution rate depends on the nature and amount of the carrier and increases with the increase in the concentration of the carrier. Increase in the dissolution rate may be attributed to; the reduced particle size of drug deposited on the surface of carrier and enhanced wettability of the drug particles by the carrier. The optimized formulations were evaluated by X-ray diffractometry (XRD), Differential scanning Calorimetry (DSC), Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM).

KEYWORDS: Valsartan, solid dispersions, Xanthan gum, gaur gum, gum acacia, solubility.

INTRODUCTION

Compounds with poorly aqueous solubility are increasingly posing challenge in the development of new drug coming directly from synthesis or from high throughput screening

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DESIGN AND IN VITRO EVALUATION OF EXTENDED RELEASE TABLET OF NATEGLINIDE

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ABSTRACT

The aim of present study is to formulate and evaluate extended release matrix tablet of Nateglinide by direct compression method using different polymer like HPMC K4 and HPMC K15. Matrix tablet of nateglidine were prepared in combination with the polymer HPMC K4, HPMC K15, along with the excipients and the formulations were evaluated for tablet properties and *in vitro* drug release studies. Nateglinide matrix tablet prepared by using polymer such as HPMC K4 and HPMC K15, it was found that HPMC K15 having higher viscosity as compare to HPMC K4 therefore different concentration of polymer were studied to extend the drug release up to 12 h. The tablets of Nateglinide prepared by direct compression had acceptable physical characteristics and satisfactory drug release. The study demonstrated that as far as the formulations were concerned, the selected polymers proved to have an acceptable flexibility in terms of in-vitro release profile. In present the study the percent drug release for optimize batch was found to 94.62%. Hence it can be conclude that Nateglinide extended release matrix tablet can prepared by using HPMC. The swollen tablet also maintains its physical integrity during the drug release study.

Keywords: Tablet, *in-vitro* drug release, Nateglinide, HPMC

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INTRODUCTION

Oral drug delivery systems is the most convenient mode of drug administration compared to other dosage forms due to its high patient compliance and flexibility.[1] In conventional oral dosage forms drug dosage must be administered several times which results in fluctuating drug levels in plasma. These limitations of conventional dosage form can be overcome by formulation of sustained release dosage forms which provides drug release in an amount sufficient to maintain the therapeutic drug level over extended period of time, with release profiles sustained by the special technological construction and design of the system[2-3]. An alternative to administration of another dose is to use a dosage form that will provide sustained drug release, and therefore, maintain plasma drug concentrations. Oral extended release drug delivery system becomes a very promising approach for those drugs that are given orally but having the shorter half-life and high dosing frequency. Controlled release formulations are much desirable and preferred for such therapy because they offer better patient compliance, maintain uniform drug levels, reduced dose and side effects and increased margin of safety for high potency drugs[4] . Nateglinide is an oral antihyperglycemic agent used for the treatment of non-insulin-dependent diabetes mellitus (NIDDM). belongs to the meglitinide class of short secretagogues, which act by binding to β cells of the pancreas to stimulate insulin release[5]. The short biological half-life (nearly 1.5hr) favours development of sustained release formulations[6]. Nateglinide is dosed three times daily before meals there is a rapid rise in plasma insulin, with peak levels approximately 1 hour after dosing and a fall to baseline by 4 hours after dosing. However, fluctuations of drug concentration in plasma may occur, resulting in side

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In-vitro studies and evaluation of telmisartan marketed tablets

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ABSTRACT

Tablets or capsules taken orally remain one of the most effective means of treatment available. The effectiveness of such dosage forms relies on the drug dissolving in the fluids of the gastrointestinal tract prior to absorption into the systemic circulation. The present study reveals the evaluation of four marketed sample of Telmisartan tablets. The main aim of the study is to conduct dissolution test on the tablets to determine the compliance with a given official monograph. Four different marketed samples of Telmisartan were purchased from local market. The Telmisartan tablets were evaluated for the various in-vitro tablet properties such as thickness, hardness, friability, weight variation, drug content, disintegration time and dissolution rate. *In-vitro* dissolution test is conducted on four different brands of telmisartan tablets to assess their equivalency. All the four marketed samples of Telmisartan have shown good tablet properties and comply with the pharmacopoeial specification. The *in- vitro* dissolution showed the 80% drug release within one hour from all the four brands which complies with the specification of pharmacopoeia.

Key words: Telmisartan, *In-vitro* Dissolution Profile, hardness, disintegration.

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INTRODUCTION

Seventy-six percent of patients achieve a full response to treatment (Diastolic BP ≤ 90mm Hg or ≥ 10mm Hg reduction) and 22% had an inadequate response to telmisartan therapy (Diastolic BP > 90mm Hg or < 7mm Hg reduction). Overall, heart rate was reduced from 78.0 to73.8 beats/min after 6 months of treatment. The dosage was increased in 24% of patients because of the insufficient BP reduction with the lower dosage Global tolerability was rated as very good, good, moderate or poor in 75%, 22%, 1% and 1% of patients, respectively. There were no significant differences in global tolerability ratings between the patient groups. Telmisartan had only a minor or no effect on serum creatine levels across all patient groups. Serious adverse events were reported in 0.06% of patients and included death in 6 patients. None of the deaths were considered drug-related.[1-4]

The solubility/dissolution behavior of a drug is key determinant to its oral bioavailability, being the rate-limiting step to absorption of drugs from the gastrointestinal tract. Consequently poor solubility has low bioavailability increase in dosage, large inter and intra-subject variation in blood drug concentrations under fed versus fasted conditions.[5-7]

A drug may be a substance for diagnosis, cure, mitigation, prevention or treatment of disease in human beings or animals, which act by altering any structure or function of body of human being or animal. Every year number of drugs is introduced into the market. The total drug absorption into the body when administered i.e. *In-vivo* and dissolution tests is used to determine the absorption of drug *In-vitro* i.e. IVIVC absorption of the drug.[9-13]

Drug absorption from a solid dosage form after oral administration depends on the release of the drug substance from the drug product, the dissolution or solubilization of the drug under physiological conditions, and the permeability across the gastrointestinal tract. Because of the critical nature of the first two of these steps, *In-vitro* dissolution may be relevant to the prediction of *In-vivo* performance. Based on this general consideration, *In-vitro* dissolution tests for immediate release solid oral dosage forms, such as tablets and capsules, are used to

1) Assess the lot-to-lot quality of a drug product;

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RESEARCH ARTICLE

Development of Stability Indicating Assay Method for Antiemetic Drugs in Combined Dosage Formulation

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ABSTRACT

A new stability indicating reversed-phase high performance liquid chromatography method was developed for assay of Domperidone and Pantoprazolein tablet. The separation was achieved on column (4.6 × 250mm, 5µm) using methanol and water (60:40, v/v) as mobile phase for assay and flow rate 0.7ml/min. Detection was carried out in U.V detector at 285.0 nm. The retention time of 4.36min approximately for Domperidone and Pantoprazole. The system suitability test shows the response with retention time, theoretical plate, tailing factor and peak area for both the drugs. The force degradation study was carried out by acid, alkali, peroxide and neutral at RT and the % degradation was 5.45% by acid5.50% by base6.24% by peroxide. The validation of method carried out using ICH guidelines. The developed method was accurate, precise, economic, fast, and selective for simultaneous determination of Domperidone and Pantoprazolein combined tablet formulation. The method gave good resolution for drugs.

Keywords: Domperidone, Pantoprazole, reversed phase high performance liquid chromatography, Stability-indicating method.

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CONTENTS

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MODIFICATION AND CHARACTERIZATION OF LOVASTATIN CRYSTALS

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ABSTRACT

Lovastatinan anti-cholesteremic drug used in the treatment of hypertension. Being a BCS class II drug, it has poor solubility and dissolution rate. Thus the aim of present study was to modify the crystals of lovastatin in the presence of additives to improve solubility, dissolution rate and other physicochemical properties. The lovastatin crystals were prepared using solvent evaporation method in the presence of additives such as PVP-K30, PEG-4000 and Poloxamer 407.The modified crystals of lovastatin were characterized by Scanning electron microscopy, FT-IR spectroscopy, Differential scanning calorimetry and X-ray diffractometry.Also the modified crystals were evaluated for solubility, dissolution rate and other physicochemical properties and compared with commercial lovastatin. The modified crystals exhibit the difference in the size and shape when compare to commercial lovastatin indicate the habit modification. The FT-IR spectra of modified crystals in the presence of additives showed no difference in the characteristic peaks compared to commercial lovastatin. DSC data indicate the decrease in the melting endotherm of modified crystals indicate the polymorphic changes. The XRD spectra of modified crystals in the presence of additives showed decrease in number of peaks indicate the polymorphic changes. The Modified crystals showed improved solubility and dissolution rate.

KEYWORDS: Crystals, Lovastatin, Solubility, FT-IR, DSC, Dissolution rate.

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Development and Validation of Stability Indicating RP-HPLC Method for Determination of Safinamide Mesylate

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ABSTRACT

A new, simple, specific, accurate and precise RP-HPLC method was developed for determination of Safinamide Mesylate. In the present study, stress testing of Safinamide Mesylate was carried out according to ICH guidelines Q1A (R2). Safinamide Mesylate was subjected to stress conditions of hydrolysis, oxidation, photolysis and neutral decomposition. Successful separation of drug from degradation products formed under stress conditions was achieved on a Hypersil BDS C18 column (250 mm × 4.6 mm, 5.0 µ particle size) using Methanol: Phosphate Buffer pH 6.8 (80:20 % v/v), at a flow rate of 1.0 mL/min and column was maintained at 40˚C. Higher degradation was found to occur in acidic, alkaline, oxidative and photolytic condition. Lesser degradation was observed at thermal conditions. Quantification and linearity was achieved at 226 nm over the concentration range of 40 - 180 µg/mL for Safinamide Mesylate. The method was validated for specificity, linearity, accuracy, precision, LOD, LOQ and robustness.The developed method is suitable for the routine analysis as well as stability studies.

Keywords: Stability-indicating, HPLC, Safinamide Mesylate, Validation, Stress Testing.

INTRODUCTION

Safinamide mesylate is the methanesulfonic acid form of its active component safinamide, a selective and reversible monoamine oxidase B (MAO-B) inhibitor. It is used for the treatment of Parkinson's disease (PD), safinamide potently modulates dopamine (DA), a substrate of MAO-B, suppressing DA uptake and reversibly binds to MAO-B blocking the function of MAO-B, which lead to the relief of PD symptoms.[1] Besides MAO-B inhibition, safinamide exhibits novel anticonvulsant activities, including sodium channel blockade, calcium channel blockade and glutamate release inhibition.[2]Safinamide mesylate is an orally available derivative from chemical class of · ñ amino amides, with multiple mechanisms of action involving inhibition of MAO-B and Dopamine reuptake used in the treatment of epilepsy and Parkinsonísdisease. Chemically, Safinamide mesylate is, (S)-(+)–2-[4-(3-fluoro-benzyl-oxy-benzyl-amino)propanamide]methane-sulfonate (1:1 salt).[1,2] The Structure is given in Figure 1.

Literature survey reveals that only one enantiomeric chiral chromatographic method[3], a bioassay in fluids human and various animals[4] and a HPLC method[5]has been reported for the estimation of Safinamide mesylate. The aim of the present study is to develop a simple, precise and accurate stability indicating reversed-phase HPLC method[6,7,10,11] for the estimation of Safinamide mesylate in pharmaceutical dosage form as per ICH guidelines.[8,9]

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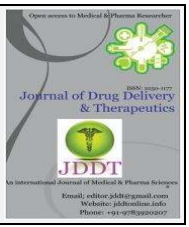

Open Access Research Article

Formulation-Development and *In-Vitro-In Vivo* Evaluation of Gastroretentive Floating Tablet Incorporating Clarithromycin

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ABSTRACT

The objective of the work is to summarize the applicability, manufacturing possibilities, excipients and the types of floating drug delivery systems and to optimize a floating, mucoadhesive system using Clarithromycin as the drug aiming at the eradication of Helicobacter pylori having desired floating and drug release properties based on preliminary excipient examination. Direct compressed (DC) tablet was chosen as dosage form being a cost-effective technology for pharmaceutical industry requiring fewer procedures. Before the implementation of the pharmaceutical technological aims, analysis of critical factors influencing the manufacture was carried out. Reproducible manufacturing processes are required to achieve suitability and tablets uniformity to achieve the uniform properties of tablets, which could influence experimental parameters. Ishikawa diagram evaluation was created, which is a commonly used graphical method to identify factors resulting in an overall effect on product design and quality imperfection. The aim was to reveal affecting factors on uniformity of DC tablets in order to standardize all possible conditions and adjustments. Critical factors are indicated separately in particular method sections.

Keywords: H. pylori, Clarithromycin, Floating Tablets, *In Vitro* Evaluation, *In Vivo* Evaluation.

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1. INTRODUCTION:

The most frequent application of medicines is the peroral way of administration, which provides easy to take option, relatively low therapeutic cost, various formulations and applicable technologies [1]. Its spread is shown by the fact that more than 50% of commercially available medicines are orally applied preparations [2]. Higher patient compliance may be experienced due to their easy application. Although among the per os administered preparations, few are designed with biopharmaceutical aspect meeting with the physiological environment of the dosage forms. While until the 90's not much, however nowadays more frequently modified drug delivery systems are designed containing special excipients and/or manufactured with special technological methods[1]. With novel preparations having controlled release, patient compliance can be increased more, namely multiple daily administrations can be reduced to once a day administration. Another advantage can be a local drug delivery, with which not only the administration of the medicine can be improved, but also the site-specific efficiency of a particular applied active pharmaceutical ingredient (API) may be optimized.

Based on the Dévay's proposal biopharmaceutical classification system of pharmaceutical preparations, the following classes of drug delivery systems can be distinguished [1]:

1.1 Time controlled systems based on the effect of time after their administration and the time interval of effect can be the following:

1.1.1 Rapid (e.g. solutions, effervescent preparations, fast dissolving or disintegrating tablets),

1.1.2 Sustained (e.g. extended tablets or tablet implants),

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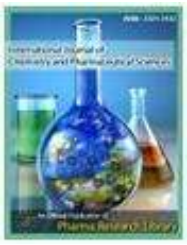

RESEARCH ARTICLE

Formulation and Phytopharmacological Activity Studies of Fresh Juice of *Acacia Arabica* Stem and Leaves for the Treatment of Variety of Dental Problems

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ABSTRACT

It is well known that use of plant material for oral healthcare and treatment of periodontal disorder is common in many cultures and many of such remedies are very effective with respect to long term health. From literature review, it comes to know that *Acaciaarabica* stem is used as chewing stick and claimed to be useful for health of gum. The objective of the proposed study is to perform the phytochemical studies on the fresh juice of babul stem and leaves. It is further envisaged to study anti-inflammatory, analgesic and antimicrobial properties of the dried fresh juice. Objective shall further be extended to convert the dried fresh juice to a suitable formulation for the treatment of variety of dental problems. Phytochemical tests suggest presence of carbohydrates, steroids, tannins and flavonoids in leaf and stem juice both. Leaf juice at the dose of 200mg/kg bodyweight was found to be very effective in imparting analgesic effect. In the anti-inflammatory studies leaf juice at the doses of 50, 100 and 200mg/kg body weight was effective to reduce inflammation. The activity of leaf juice was more than that of stem juice but both can be claimed to have analgesic and anti-inflammatory activity. The activity may be due to presence of tannins, steroids and flavonoids. The dry juice was incorporated into a mouthwash formulation at 1% leaf juice, 1% stem juice and 1%leaf and stem juice both of which formulation no. 3 with leaf and stem juice 1% both was better in taste, odour and colour.

Keywords: Anti-inflammatory, Analgesic, Mouthwash, *Acaciaarabica*

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CONTENTS

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Indian Journal of Medical Sciences

Review Article

Coronavirus: Hotspot on coronavirus disease 2019 in India

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ABSTRACT

The novel coronavirus disease (COVID-19) or also known as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) has been recognized as the cause of respiratory infection in Wuhan, Hubei Province, China, in late December 2019. As of April 5, 2020, this epidemic had spread to worldwide with 12,03,485 confirmed cases, including 62,000 deaths. The World Health Organization has declared it a Global Public Health Crisis. Coronavirus causes respiratory illness coughing, sneezing, breathlessness, and fever including pneumonia. The disease is transmitted person to person through infected droplets. At present, the research on novel coronavirus is still in the primary stage. Based on the published study, we thoroughly summarize the history and origin, microbiology and taxonomy, mode of transmissions, target receptor, clinical features, diagnosis, prevention, and treatment about COVID-19. This short report writes in hope for providing platform to community and researcher dealings against with the novel coronavirus and providing a reference for further studies.

Keywords: Coronavirus, COVID-19, Severe acute respiratory syndrome-CoV

INTRODUCTION

The novel coronavirus (2019-nCOV) as well, severe acute respiratory syndrome 2 (SARS-CoV-2) was first detected from patients with pneumonia of an unknown reason in Wuhan City of Hubei territory of China to the worldwide in December 2019.[1] Since it has been confirmed as the pathogen for the novel coronavirus, recently named as coronavirus disease 2019 (COVID-19) by the World Health Organization. Globally, until April 5, 2020, there have been reported 12,03,485 confirmed cases and 62,000 deaths.[2,3] India has reported 3577 cases till date. The coronavirus may cause various respiratory infection such as coughing, sneezing, pneumonia, fever, breathlessness, and lung infection. The disease is transmitted by direct contact with infected droplets and the incubation period ranges from 2 to 14 days. COVID 19 is mild in most peoples in some elderly peoples having underlying medical problem such as diabetes, chronic respiratory disorders, and cardiovascular disease are more possible to develop severe illness such as pneumonia, acute respiratory distress syndrome, and multiorgan dysfunction.[4,5]

HISTORY AND BEGINNING OF CORONAVIRUS

Coronavirus is first observed in the mid-1930[6] and first human coronavirus found in 1960 as a cold.[7] Around 500 patients were recognized as flu-like system according the study was done

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A REVIEW OF COVID-19 (CORONAVIRUS DISEASE-2019) DIAGNOSIS, TREATMENTS AND PREVENTION

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ABSTRACT
There is a new world health crisis threatening the public with spread of COVID-19 (Coronavirus Disease-2019). Since December 2019, when Covid-19 emerged in Hunan seafood market at Wuhan, South China and rapidly spread throughout the world, the virus outbreak has been declared a public health emergency of international concern by World Health Organization (WHO). We here summarized the current clinical characteristics data to guide potential COVID-19 about Prevention, Diagnosis, Treatments and Prevention of COVID-19. In this review, we extracted data from various Research Reports, WHO guidelines and other articles. It is important to caution the readers that new data updating nearly every hour regarding clinical characteristics, diagnosis, treatment strategies, and outcomes of COVID-19. Throughout the world the disease has caused varying degrees of illness. Patient shows various symptoms usually fever, cough, sore throat, breathlessness, fatigue, and malaise among others. The disease is being cured through general treatment, symptomatic treatment, by using antiviral drugs, oxygen therapy and by the immune system. It is necessary to identify the potential cases as soon as possible and isolate the suspected people from the confirmed cases of COVID-19, to prevent the potential transmission of infection to other patients and health care staff.

KEYWORDS: Coronavirus Disease-2019, COVID-19, respiratory syndrome, symptoms, SARS, treatment.

INTRODUCTION
Coronaviruses are a large family of viruses which may cause disease in animals or humans.[1] Seven Coronaviruses can produce infection in people around the world but commonly people get infected with these four human coronaviruses: 229E, NL63, OC43, and HKU1. They usually cause a respiratory infection ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) and the most recently discovered coronavirus (COVID-19) causes infectious disease.[1] This zoonotic disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The WHO originally called this infectious disease Novel Coronavirus-Infected Pneumonia (NCIP) and the virus had been named 2019 novel coronavirus (2019-nCoV). On 11th Feb 2020, the (WHO) officially renamed the clinical condition COVID-19 (a shortening of Corona Virus Disease-19), which was announced in a tweet. An outbreak of COVID-19 caused by the 2019 novel coronavirus (SARS-CoV-2) began in Wuhan, Hubei Province, China in December 2019, the current outbreak is officially a pandemic.[2] Since knowledge about this virus is rapidly evolving, readers are urged to update themselves regularly. "Fig.1".[3]

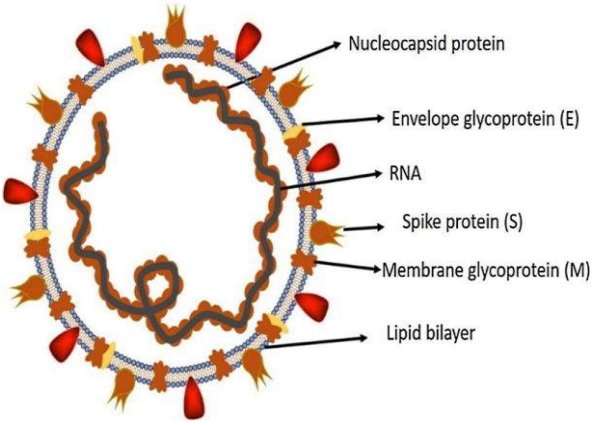

Figure 1: A structure of Respiratory Syndrome (SARS) coronavirus.

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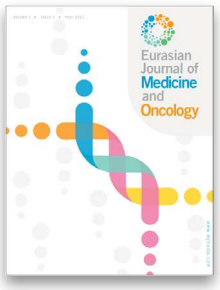

Research Article

The Molecular Docking Study of Potential Drug Candidates Showing Anti-COVID-19 Activity by Exploring of Therapeutic Targets of SARS-CoV-2

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Abstract

Objectives: The novel human coronavirus designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first emerged in late 2019 in Wuhan, China. This virus spread rapidly around the globe, causing the respiratory illness called coronavirus disease 2019 (COVID-19). In view of the multiple threats and disorder posed by the pandemic, scientists around the world have been racing to understand SARS-CoV-2 and investigate the pathophysiology of this disease to find potential treatments and effective therapeutic drug candidates.

Methods: The virtual interaction of the COVID-19 main protease (Mpro) in complex with the inhibitor N3 (Research Collaboratory for Structural Bioinformatics Protein Data Bank [PDB] ID: 6LU7) with antiviral and antimalarial drugs was measured, as well as that of the SARS spike glycoprotein-human angiotensin-converting enzyme II (ACE2) complex (PDB ID: 6CS2) with antimalarial drugs currently on the market using the AutoDock Vina suite (O. Trott, The Scripps Research Institute, La Jolla, CA, USA).

Results: The binding energy result obtained from the docking of 6LU7 with ligands of oseltamivir, ritonavir, remdesivir, ribavirin, favipiravir, chloroquine, and hydroxychloroquine was found to be -4.7, -7.3, -6.5, -5.6, -5.4, -5.1, -5.3 kcal/mol, respectively. The binding energy from the docking of 6CS2 with ligands of chloroquine, and hydroxychloroquine was -7.1 and -6.8 kcal/mol, respectively. The docking results suggested drug molecules of oseltamivir, ritonavir, remdesivir, ribavirin, and favipiravir had a greater capability to inhibit SARS-CoV-2 since they demonstrated high affinity interactions with the COVID-19 Mpro in complex with the N3 inhibitor. Chloroquine and hydroxychloroquine also showed prominent binding interaction with the SARS spike glycoprotein-human ACE2 complex.

Conclusion: The results of this study suggest that these drugs are promising candidates for antiviral treatment with high potential to fight the SARS-CoV-2 strain.

Keywords: Antiviral drugs, hydroxychloroquine, SARS-CoV-2 protease

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Since December 2019, much of the world has suffered from the outbreak of coronavirus disease 2019 (COVID-19), the disease caused by a novel human coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] From its origin in Wuhan, China, it spread rapidly around the globe to affect all but Antarctica.[2] The World Health Organization declared it a pandemic in March 2020. As of April 14, 2020, 1,924,679 cases of COVID-19 infection had been reported worldwide, with 119,955 patient deaths and 445,405 patients who recovered.[3]

Novel approaches to drug design and discovery are being utilized to explore therapeutic drug candidates for COVID-19. Molecular docking is a promising tool for drug discovery and development through the study of the interaction of ligand (drug) molecules inside the binding pocket of a target protein (receptor).[4] It offers the opportunity to

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ORIGINAL ARTICLE

Recognition of Natural Products as Potential Inhibitors of COVID-19 Main Protease (Mpro): In-Silico Evidences

Rohan R. Narkhede[1] · Ashwini V. Pise[1] · Rameshwar S. Cheke[2] · Sachin D. Shinde[3]

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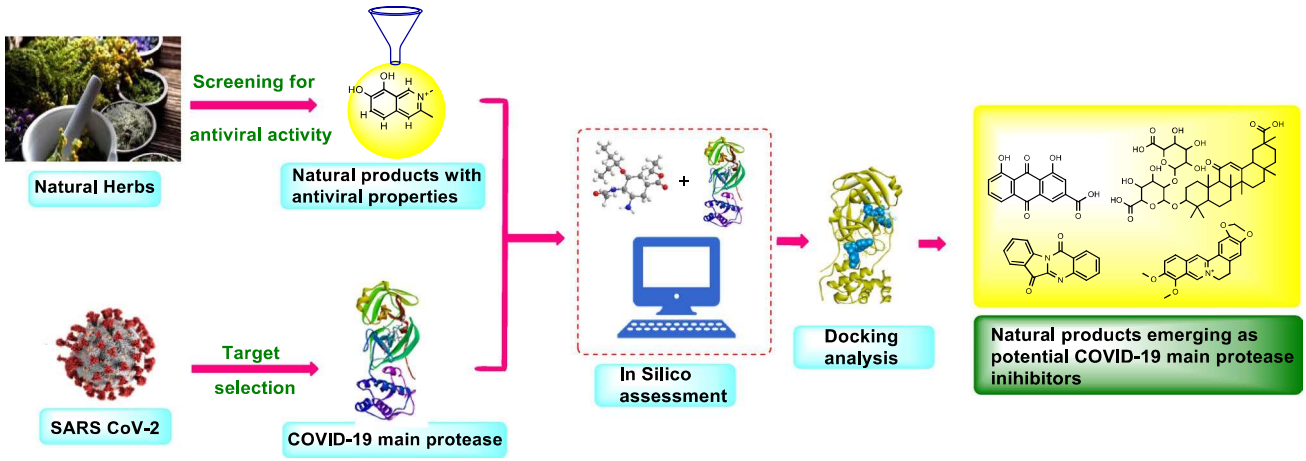
Abstract

SARS-CoV-2 (2019-nCoV) emerged in 2019 and proliferated rapidly across the globe. Scientists are attempting to investigate antivirals specific to COVID-19 treatment. The 2019-nCoV and SARS-CoV utilize the same receptor of the host which is COVID-19 of the main protease (Mpro).COVID-19 caused by SARS-CoV-2 is burdensome to overcome by presently acquired antiviral candidates. So the objective and purpose of this work was to investigate the plants with reported potential antiviral activity. With the aid of in silico techniques such as molecular docking and druggability studies, we have proposed several natural active compounds including glycyrrhizin, bicylogermecrene, tryptanthrine, β-sitosterol, indirubin, indican, indigo, hesperetin, crysophanic acid, rhein, berberine and β-caryophyllene which can be encountered as potential herbal candidate exhibiting anti-viral activity against SARS-CoV-2. Promising docking outcomes have been executed which evidenced the worthy of these selected herbal remedies for future drug development to combat coronavirus disease.

Graphic Abstract



Keywords nCoV-2019 · COVID-19 main protease · Herbal remedies · Docking study · Druggability

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1 Introduction

COVID-19 became a global risk to the healthcare system of almost every nation around the world. In the back of December 2019, a novel coronavirus strain was identified which was initially named as 2019 novel coronavirus (2019-nCoV) and it was evolved during an outbreak in Wuhan,

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RESEARCH ARTICLE

The *Berberis aristata* Ameliorates oxazolone induced contact dermatitis: in-vivo and in silico evidences

Sachin D. Shinde[1] · Rameshwar S. Cheke[2] · Prafulla R. Tathe[3] · Pankaj G. Jain[4] · Rohan R. Narkhede[5]

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Abstract

The objective of the present study was to evaluate the effect of *Berberis aristata* (BA) against oxazolone induced contact dermatitis in Balb/c mice and molecular docking with TLR-1 and TLR-2. Dermatitis was induced in Balb/c mice by sensitizing with topical application of 100 µl oxazolone (2%) and the effect of BA was screened in two doses (200 mg/kg and 400 mg/kg P.O.). The effect was evaluated by the change in ear thickness, anti-inflammatory cytokine (TNF-α, IL-6, and IL-1β) and oxidative stress on the sixth day in ear tissue homogenate. The ear skin of all group mice was subjected to histological analysis. This work was further evidenced by the docking of berberine with crystal structure of TLR1-TLR2 heterodimer caused by using the binding of tri-acylated lipopeptide (PDB ID: 2Z7X). In this study, we found that a significant reduction in ear thickness was found in BA (200 mg/kg and 400 mg/kg) as compared to 100 µl oxazolone(2%) treated mice. The reduction level of GSH and SOD found in 100 µl oxazolone (2%) sensitized mice. BA (200 mg/kg and 400 mg/kg) treated animals showed an increase in GSH and SOD levels. A significant reduction in inflammatory cytokines was observed in BA treated mice and indicates anti-inflammatory activity against oxazolone. Histopathological analysis showed minimal infiltration of lymphocytes and moderate harm to skin cells and layer in BA treated mice. Docking studies revealed promising binding interaction of berberine withTLR1-TLR2 heterodimer which can attribute to its anti dermatic effect. This present research shows that BA has a dose-dependent effect in contact dermatitis attenuated by oxazolone.

Keywords Oxazolone · Dermatitis · *Berberis aristata* · Cytokine · In silico study

Introduction

Dermatitis is a continual inflammatory disease associated with the immune system characterized through the infiltration of activated T cells, dermal angiogenesis, epidermal hyperplasia, and expanded cytokine levels (Guttman-Yassky et al. 2011; Zheng et al. 2009). The superiority of acute dermatitis is growing gradually and impacts about 25 million human beings in North America and Europe and is probably the most enormous immune-mediated pores and skin disease in adults(Furue and Kadono 2017; Menter 2016). Clinically of dermatitis are adjustments inside the skin as scales, thickening, redness(Charman et al. 2003). Histological symptoms of dermatitis lesions are the formation of Munro's microabscesses containing neutrophils, parakeratosis, ortohypokeratosis, and invasion of leukocytes such as CD4 + and CD8 + T cells, mast cells, dendritic cells, and macrophages into epidermis and dermis (Petersen 2006). Many published reports proved that Toll-like receptors (TLR) play a key role in inflammation-related to hapten-based innate immune activation, in dermatic condition activation of TLR-1 and TLR- 2 occurs (Schmidt et al. 2016). The underlying pathophysiological mechanism involved in dermatitis is provoked synthesis

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Article
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Repurposing of Anthelmintic Drugs against SARS-CoV-2 (Mpro and RdRp): Novel Disease, Older Therapeutics

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Abstract: Since late December 2019, the entire nations are facing the novel enemy of COVID-19, which has imposed a tremendous burden on the researchers across the globe to develop a treatment for it. Recognition of main protease and RNA dependent RNA polymerases as a promising target of SARS-CoV-2 encouraged us to repurpose some older antihelmintic drugs against COVID-19. In this constructive research, we have investigated anthelmintic drugs' antiviral activity, including ivermectin, doramectin, and selamectin, for their antiviral potential against SARS-CoV-2 by employing *in silico* tools. The selected drugs, including ivermectin, doramectin, and selamectin, were encountered as potential inhibitors of SARS-CoV-2 RNA-dependent RNA polymerases with an affinity of -9.2, -10.0, and -10.2 kcal/mol. They were found to exhibit main protease inhibitor activity with an affinity of -8.3, -8.7, and -9.0, respectively. Thus, using the repurposing approach in conjugation within *silico* tools, we have proposed ivermectin, doramectin, and selamectin as potential antivirals against SARS-CoV-2.

Keywords: COVID-19; anthelmintic drugs; RNA dependent RNA polymerases; main protease; *in silico* tools.

1. Introduction

The entire era faces the outbreak of pandemic COVID 19, which was previously recognized under the term of pneumonia invading in China's areas, especially in Wuhan, in late December 2019 [1–3]. SARS-CoV strain is recognized as frightful among the coronavirus producing massive deaths after spreading across nearly all the nations [4]. Similar to SARS-CoV, MERS-CoV emerged in Saudi Arabia and has about 2,500 cases, with 800 deaths [5]. The common clinical manifestations of COVID-19 include respiratory complications, fever, dry cough, muscle ache, and malaise [6]. World Health Organization declares COVID-19 as pandemic on 11 March 2020, which is ruinous for across the entire nations [7]. As of 26 August 2020, there has been 2,12,94,845 cases of COVID-19 are reported worldwide, along with more than 7,61,779 deaths all over the nations (Coronavirus Outbreak. Available at https://www.worldometers. info/coronavirus/). The developed countries, including the USA, Spain, and Italy, are suffering from the extreme death rate, which is rapidly increasing (Coronavirus Outbreak. Available at https://www.worldometers. info/coronavirus/). The

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Research paper

One- pot development of spray dried cationic proliposomal dry powder insufflation: Optimization, characterization and bio-interactions

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ARTICLE INFO

Keywords:
Tramadol
Carboxymethyl chitosan
Proliposomes

ABSTRACT

In the present investigation, one-pot synthesis method has been reported for the preparation of tramadol loaded proliposomes (PLs) coated with chitosan (CCPLs) and carboxymethyl chitosan (CM-ChPLs) for intranasal administration. Spray drying method used for formulation of PLs was optimized using Design of Experiment (DoE). The formulated PLs were extensively characterized and evaluated. The formulation was assessed for biocompatibility using cell viability assay, along with estimation of inflammatory potential of PLs, *in vitro* drug permeation across nasal mucosa, *in vitro* mucoadhesion study, nasal mucosa penetration study and analysis of powder spray pattern. The prepared PLs were also assessed for their interactions and stability under various physiological conditions. The interaction of different PLs with serum protein and mucin was assessed using DLS and zeta potential measurement. The stability study demonstrated superiority of coated PLs over uncoated PLs. The cell viability study confirmed the biocompatibility of developed PLs while confocal microscopy confirmed enhanced permeation of coated PLs across nasal mucosa. All PLs were stable in simulated nasal fluid. The *in vitro* drug release studies demonstrated sustained release which was also supported by results obtained after *ex vivo* permeation study. The overall results confirmed that type of surface modification and surface charge along with particle size plays an important role in type and extent of interaction of PLs with proteins and mucin. This could directly or indirectly affect the diffusion or penetration of nanoliposomes across mucosa and ultimately affects *in vivo* results.

1. Introduction

The concept of drugs getting absorbed systemically is quite old and potential of this route for drug delivery has been reported previously by many researchers from early 1980s [1–5].The pioneer work for exploring nasal route for delivery of therapeutic agents was done by Hussain et al., in 1979. Delivery of drugs through nasal route presents distinct benefits such as vast surface of the nasal cavity from where drugs pass directly into the systemic circulation after being absorbed and richly vascularised epithelial cells facilitates in avoiding the first-pass liver metabolism which makes it an attractive route for drug delivery [6]. Apart from convenience of administration and safety of being non-invasive, nasal route results in rapid onset of action in comparison with sublingual, transdermal and oral route [7]. However, low permeation across nasal mucosa along with rapid muco-ciliary clearance (which decreases the retention time of dosage form on nasal epithelium) are some of the major disadvantages associated with nasal route of drug delivery [8]. To enhance the time of residence of drug on nasal epithelium and to reduce mucociliary clearance, several modifications were performed in past such as use of viscosity enhancer [9] and bio-adhesive microsphere [10] to name a few.

Powder formulations for nasal administration have been reported

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Research Paper

Recent advances in phytochemical-based Nano-formulation for drug-resistant Cancer

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Inhibition of expressed proteins

ABSTRACT

The graph of drug resistance in cancer is reportedly increasing in terms of therapeutic efficiency. As per the WHO reports, around 70% of death reported in low- and middle-income countries. The increase in death toll was imparted from improper diagnosis and inadequate therapy. The 25% increase in disease burden may be laden due to resistance mutations in cancer during treatment. Exposure of high concentrations of chemotherapeutic agents leads to toxicity in the normal cells. Long-term conventional chemotherapy develops acquired resistance. The conventional therapeutics was not able to target the cancer cell specifically and need to promulgate the use of nanocarrier or bioengineering for the polychemotherapy. Phytochemicals are natural constituents providing alternative therapeutic approach to minimize the resistance. The present review highlights the nano-therapeutic approaches pondering over the conventional chemotherapy. The phytochemicals are extracted, isolated, and purified from daily dietary fibers or natural plants. Natural extractives act via multiple pathways and provide optimum effectiveness against resistance cancer. The poor solubility and bioavailability are major constraints in combination therapy. The nanotechnological approach improves the functional properties transportation across cell barriers, and improves bioavailability. The present review highlights the phytochemical based nanoformulations in improving the therapeutic response and several alternative ways to target resistance cancer. The major implications of phytochemical and chemotherapeutic combination therapy could lead in the future.

1. Introduction

Cancer is an important health issue that comprises a large group of disease in all populations. Low- and middle-income countries have major challenges in eradicating cancer due to limited resources available. The estimated global burden of cancer will nearly double (29–37 million) by 2040 with a major impact in lower middle-income countries. The statistical explicit of mortality rate in cancer development was highlighted in Figure 1.

The conventional therapeutic approaches rely on chemotherapeutic delivery, surgery, or radiation therapy. Cancer cells rapidly divide, expand, and coinfect adjacent cells. The radiation therapy rapidly destroys the

Abbreviations: MDR, multidrug resistance; CDk2, cyclin-dependent kinase2; mTOR, mammalian target of rapamycin; TNK, tenecteplase; PI3K, phosphoinositide 3-kinase; Bcl 1, B-cell lymphoma 1; Bcl 2, B-cell lymphoma 2; DNA, deoxyribonucleic acid; GSH, glutathione SH; GST, glutathione S-transferases; GPxn, glutathione peroxidases; ROS, reactive oxygen species; STAT3, signal transducer and activator of transcription 3; NFKB, nuclear factor kappa light chain enhancer of activated B cells; VEGF, vascular endothelial growth factor; PI3K, the phosphoinositide 3-kinase; CIP2A, cancerous inhibitor of PP2A; PP2A, protein phosphatase 2A; COX, cyclooxygenase; MAPK, a mitogen-activated protein kinase; ERK, extracellular-signal-regulated kinase; P-gp, P-glycoprotein; G2M, Gaussian-2 Method; PAPR, poly (ADP-ribose) polymerase; JAK, Janus kinase; MMP, matrix metalloproteinase; MAPK, mitogen-activated protein kinase; PBA, pyridine-3-Boronic Acid; PLGA, poly (D,L-lactic-*co*-glycolic acid; PLA, polylactic acid; QUE, quercetin; MMP9, matrix metallopeptidase 9; MEL-A, mannosylerythritol lipid-A; OVCAR-3, ovarian cancer; MLKL, mixed-lineage kinase domain-like protein; HK, honokiol; DHA, dihydroartemisinin; EpCam, epithelial cell adhesion molecule; PAMAM, polyamidoamine; CNTs, carbon nanotubes; SWCNTs, single-walled CNTs; Cur, curcumin; PTX, pertussis toxin.

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REVIEW ARTICLE

A Concise Analytical Profile of Efavirenz: Analytical Methodologies

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ABSTRACT

Non-nucleoside reverse transcriptase inhibitors are the prime members of antiretroviral therapy that are presently employed for the management of the human immunodeficiency virus. It uses an enzyme i.e., reverse transcriptase to convert its ribonucleic acid into reverse transcription; these agents impede the function of reverse transcriptase and reverse transcription counter human immunodeficiency virus from replicating. Efavirenz is the first-generation non-nucleoside reverse transcriptase inhibitor agent. Similar to the other non-nucleoside reverse transcriptase inhibitor agents; it is prescribed with other inhibitors in combination for regimens antiretroviral therapy. To enhance survival and avoid aggressive infections in patients affected with human immunodeficiency virus infection, adequate antiretroviral therapy is the most significant treatment. Accordingly, the development and validation of such therapeutic agents are challenging work for the analysts. Therefore, the proposed review integrally addresses the analytical reports of efavirenz recorded in the literature databases like Scopus, Web of Science, Google Scholar, Pub-Med, and through many other sources. It has been remarked that for the development of efavirenz many analytical techniques were used for addressing the qualitative and quantitative estimation of efavirenz from various pharmaceutical and biological matrices. This review plan to review the stereochemistry, mechanism of action, resistance, pharmacokinetics, pharmacodynamics, safety and adverse reaction, and various analytical approaches assessed for the same. The hyphenated and chromatographic techniques are frequently used for analysis of cited drug.

KEYWORDS

Analytical methods; antiretroviral therapy; efavirenz; HIV; pharmaceutical; matrices

Introduction

Mortality and morbidity related to the Human Immunodeficiency Virus (HIV) have significantly controlled with the highly active combination antiretroviral therapy (ART).[1] Because of the very slow rate of success as those who are administering just one HIV inhibitor at a period, healthcare specialists started ART in 1996. The beginning of antiretroviral therapy (three-drug candidates) marked a pivotal movement in the history of HIV treatment. The modern treatment design has turned what used to be a disease with a very poor perspective into a manageable disease.[2] However, nowadays management course of therapy is restricted by the intolerance, near and far-term toxicities, and the resistance emergence of medicinal agents. There are seven classes of medication for HIV, consisting of around thirty different drugs; non-nucleoside reverse transcriptase inhibitor (NNRTI), nucleoside reverse transcriptase inhibitors (NRTIs), post-attachment inhibitors, protease inhibitors (PI), CCR5 antagonists, integrase strand transfer inhibitors (INSTIs).

Primary procedures of therapy typically consist of twice NTRIs paired with a third vital antiretroviral inhibitor, which may also be the group of NNRTI, INSTI, or PI, may have a booster that might be ritonavir or cobicistat.[3]

Efavirenz (EVZ) is an NNRTI agent, permitted for HIV treatment by the United States of Food and Drug Administration (USFDA) from 1998. It expanded quickly to be commonly used for the same in developed nations. Current recommendations suggest EVZ is with two NNRTIs, either abacavir/lamivudine or emtricitabine/tenofovir as preferred first-line regimens for the management of HIV-affected patients.[4]

Chemistry

EVZ is designated as a derivative of benzoxazinone, which is a white or slightly yellowish crystalline in nature with a melting point ranging from 136 to 141 °C. EVZ structurally ((S)-6-chloro-4-(cyclopropylethynyl)-1,4-dihydro-4-(trifluoromethyl)-2*H*-3,1-benzoxazin-2-one).

It having molecular formula $C_{14}H_9ClF_3NO_2$ and a molecular mass is 315.68 gm/moL, respectively.[5,6] The chiral carbon atom was observed on EVZ at position 4. In published studies, the 4S stereoisomer is mainly exploited for marketed pharmaceutical matrices. It demonstrated a

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ORIGINAL ARTICLE

Eco-friendly synthesis of surface grafted Carbon nanotubes from sugarcane cubes for the development of prolonged release drug delivery platform

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Abstract

Surface grafting of nanocarriers could modulate their properties and characteristics. As carbon nanotubes synthesis is a very tricky process and requires high-end methods, hence the present investigation was aimed to develop an eco-friendly method for synthesis carbon nanotubes (CNTs) and subsequent surface grafting for enhanced drug delivery application. The present study elaborates two-step chemical modifications; wherein the first step is catalytic cleavage of natural precursor in the presence of ferrocene and the second step involve chemical grafting of Acyclovir (ACV) as a model drug to understand the drug release behaviour. The catalytic cleavage of sugarcane cubes (natural precursor) was carried out in a closed copper tube, which prevents oxidation and results in a conversion of tubular nanostructures to amorphous carbon. The covalent attachment of ACV on purified CNTs (fCNTs) was done using carbodiimide chemistry. The preliminary Uv-Vis absorbance spectra defined at 260 nm was arised due to π-π* stacking of aromatic C-C bonds. The Fourier Transforms Infrared Spectroscopy (FTIR) indicates the hydroxyl stretch at 3300 cm-1 while amide I bond formation was observed at 1672 cm^{-1}. The XRD spectra confirmed successful synthesis of CNTs. The calculated average crystallite size (Scherer equation) of synthesized CNTs was found to be 42.84 and 44.45 nm; it was also in accordance with the morphological observation as confirmed simultaneously using SEM analysis. The covalently attached ACV was released up to 80% during 8h of *in vitro* drug release study. The surface grafting potential of CNTs was found to be promising compared to other nanomaterials.

Keywords: *Acyclovir; Amorphous Carbon; Carbodiimide Chemistry; Natural Precursor; Purification.*

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INTRODUCTION

Even though the investigation on allotropic forms of carbon was begun before 1990, but the most intuitive form of carbon allotrope i.e. carbon nanotubes (CNTs) were reported in 1991[1]. Numerous classical approaches for the synthesis of CNTs are reported by academic researchers and industry experts for their promising physicochemical properties. In case of CNTs, the

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RESEARCH ARTICLE

Electrostatic deposition assisted preparation, characterization and evaluation of chrysin liposomes for breast cancer treatment

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ABSTRACT

Chrysin (CHR), a flavone found in multiple vegetables, fruits and mushrooms has been explored so far as a neurotropic, anti-inflammatory and anti-cancer biomolecule. Despite the stated therapeutic potential, low solubility and bioavailability limit its therapeutic benefit. To circumvent these drawbacks, development of chrysin liposomes (CLPs) is reported in the present investigation. The CLPs were developed by electrostatic deposition assisted film hydration method using chitosan/lecithin to protect chrysin in the nano-lipoidal shell. Developed CLPs were extensively characterized by DSC, XPRD, FE-SEM, TEM, particle size, polydispersity index, zeta potential, percent drug loading and encapsulation efficiency. These CLPs were further characterized by *in vitro* dissolution, *in vivo* bioavailability, *in vitro* anticancer and stability study. Suitable particle size, PDI and ZP implying stabilization of developed CLPs. The % DL and % EE was found to be 3.56 ± 0.13 and 90.5 ± 1.49 respectively. DSC and PXRD study revealed amorphous transition of CHR, which may help to increase its solubility and dissolution profile. *In vivo* pharmacokinetic study demonstrated more than 5-fold increase in relative bioavailability of CLPs. The in silico molecular docking study results demonstrated the electrostatic interaction between two polymers. The present study suggests that chitosan could protect and encapsulate chrysin which eventually enhances its cytotoxicity as well as bioavailability.

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Electrostatic deposition; film hydration; chrysin; liposomes; in silico molecular docking

Introduction

Encapsulation of bioactive drug using polymeric coating is beneficial due to its nontoxic, nonimmunogenic and biodegradable properties, along with protection of drug with improved biocompatibility [1–3]. In addition to this, issue of poor aqueous solubility and bioavailability of many bioactive compounds could be resolved using techniques like nanoencapsulation [4].

The electrostatic deposition method is based on the deposition of one polymer material on another in liquid form followed by evaporation of the solvent to form encapsulation of the subsequent polymer. This technique of encapsulation attracted researchers in recent years; herein it coats the active ingredient with the assistance of polymeric matrix [1]. The electrostatic deposition based microencapsulation approach has also been used for the preparation of hydrogels [5], microemulsion [6], liposomes [7] to name a few.

Out of the many approaches used for drug encapsulation, liposomes are widely used for both hydrophilic and hydrophobic drugs such as antioxidants, antimicrobials and other pharmacologically important compounds [8]. However, organic residual effect, leakages of active compounds and instability during storage of traditional liposomes may restrict their applications [9,10]. So as to conquer these limitations, polycationic polymer like chitosan could be used as a coating material which forms polyelectrolyte complex with oppositely charged polymeric material by intermolecular electrostatic deposition [11,12].

Chrysin (CHR), a flavone found in multiple vegetables, fruits, and mushrooms, has been suggested as neurotrophic for nerve cells, anti-inflammatory, and anti-amyloidogenic [13]. The CHR has been known as an anti-cancer and wellbeing-promoting compound [14]. In several biological tests, it has demonstrated that it may be effective against many disorders. The CHR may block most cancer-related pathways and inhibits cancer by fostering apoptosis and moderating cell death due to autophagy. Hence, extensive research in this direction should be focused on in the coming years to validate its possible clinical use in cancer.

The main objective of the present study was to encapsulate CHR in liposomal form using the electrostatic deposition technique for protection and further enhancement in bioavailability. For the same, biocompatible and biodegradable biological macromolecules viz. chitosan (CHN) and soya lecithin (SOL) were used which form a polymeric nanoshell with the aim to shield CHR against degradation and to enhance its biocompatibility [15,16]. Being a polycationic macromolecule, chitosan, through intermolecular electrostatic deposition, form polyelectrolyte complexes with oppositely charged macromolecules [17]. Developed chrysin liposomes (CLPs) were further characterized using different physicochemical parameters like particle size (PS), polydispersity index (PDI), zeta potential (ZP), entrapment efficiency (% EE), drug loading (% DL), differential scanning calorimetry (DSC), transmission

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Supplemental data for this article can be accessed here.

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Research Article

Fabrication of N-Doped Graphene@TiO_2 Nanocomposites for Its Adsorption and Absorbing Performance with Facile Recycling

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Abstract

The present work aims to synthesize nitrogen-doped reduced graphene oxide-titanium dioxide nanocomposite (N-rGO@TiO_2) using a simple, eco-friendly method and its applications in spectroscopic detection of heavy metal ions such as lead (Pb^{2+}), mercury (Hg^{2+}), and chromium-VI [Cr(VI)] in potable water. Initially, TiO_2 nanoparticles loaded N doped rGO sheets were fabricated by an ecological method using *Gossypium hirsutum* (cotton) seeds extract as a green reducing agent. Then, the N-rGO@TiO_2 nanocomposites were subjected for characterizations such as spectroscopic techniques, particle size analysis, zeta potential analysis, and spectroscopic sensing. Notably, the results of this study confirmed that N-rGO@TiO_2 exhibited countless stupendous features in terms of sensing of an analyte. Briefly, the UV-visible spectroscopy and Fourier transform infrared (FTIR) spectroscopy confirmed the successful synthesis of N-rGO@TiO_2. The SEM images showed the wrinkled, folded, and cross-linked network structures that confirmed the surface modification and nitrogen doping in the rGO sheet and synthesis of N-rGO@TiO_2. The EDAX study confirmed the elemental composition of the N-rGO@TiO_2 nanocomposite. Finally, due to the larger surface area, porous nature, high electron mobility, etc. the N-rGO@TiO_2 probe provides the lower detection limit for Pb^{2+}, Hg^{2+}, and Cr (VI) as low as 50 nM, 15 µM, and 25 nM, respectively. Concisely, our study affirms the admirable sensitivity of N-rGO@TiO_2 nanocomposite to the Pb^{2+}, Hg^{2+}, and Cr (VI) in potable water can provide better environmental remediation.

Keywords: Graphene oxide, N-rGO@TiO_2, Nanocomposite, Cotton-seed, Heavy metals, Biodegradable, Sensing

Introduction

Over the past two decades, graphene-based materials are gaining tremendous attention from a scientific fraternity in various fields [1-3]. It may because of its astonishing properties and potential to revolutionize the scientific sector [3-5]. Graphene can be used to fabricate several dimension materials such as 1D nanostructure [6], 2D layer stacked films [7], 3D graphene hydrogel [7-9], and aerogel [10-13], etc. Out

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One step synthesis approach of mesoporous silica packed with graphene oxide nanosheet: Characterisation and drug release aspects

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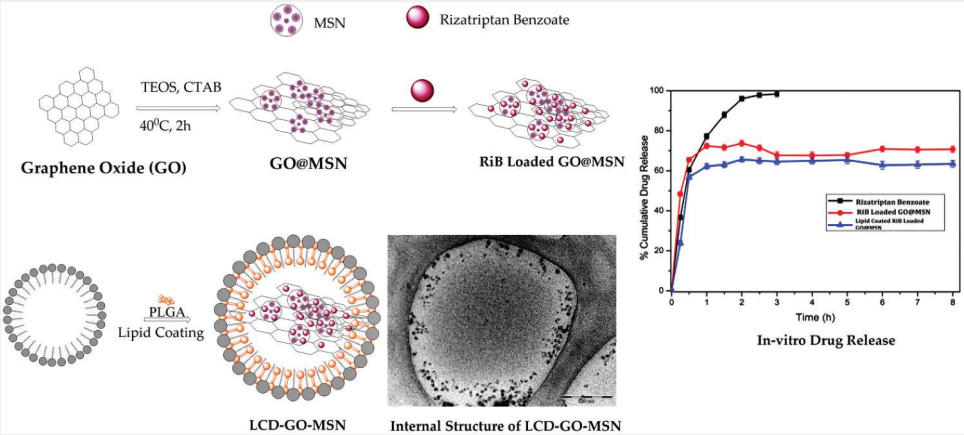
ABSTRACT

The motive of the present investigation was to establish a novel, hybrid multifunctional lipid-coated graphene oxide mesoporous silica nanocomposite (GO-MSN) for controlled delivery of Rizatriptan Benzoate (RiB). The lipid coating helps to achieve a longer circulation time of the fabricated carrier for targeted delivery of RiB. The modified Hummers method with slight modification gives a uniform sheet of GO, subsequently sol-gel approach use to synthesized mesoporous silica for the preparation of nanocomposite. The in-vitro RiB release from RiB-GO-MSN and lipid decorated GO-MSN was found to be 70.74% and 63.45% respectively. The lipid coating retards the release of RiB around 8 h. The entrapment efficiency of RiB-MSN and GO-MSN were found to be 48.17% and 62.29% respectively. In the presence of GO, RiB entrapment increases as RiB may entrap within inter and intra spacing of GO. The present investigation oversee, simple methodology adopted for synthesis of GO-MSN can effectively deliver RiB towards brain for the management of migraine.



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Graphene oxide; Mesoporous silica; Bilayer lipid coating; Migrain; Brain Targeting

Introduction

Over the past few decades, revolutionary development in the field of nanotechnology has demonstrated remarkable advances and novel applications in drug delivery and biomedical applications. The nanoscale drug delivery carrier includes functionalised nanomaterial such as polymeric gold nanoparticle, liposomes, dendrimers, metallic nanoparticles, fullerenes, protein nanoparticles, self-assembly nanoparticles, ferric oxide nanoparticles, polymer, lipid and ceramic based nanoparticles, etc for biomedical and drug delivery applications [1,2]. The nanocomposite interaction with biological systems has gain crucial importance to investigate the efficacy and safety of drug carriers. Comparing conventional formulations, nanomedicine enables lowering dose requirement, increases therapeutic efficacy, increase in safety with minimum systemic cytotoxicity. Among variety of nanomaterials, graphene oxide-mesoporous silica (GO-MSN) nanoparticles emerged as one of the smart, novel, hottest, hybrid, functionalised nanocomposite designed by incorporation of two different nanomaterials that possesses several attractive features as effective drug carrier [3,4]. The successful conjugation of graphene oxide (GO) with MSN broadens the ultimate applications of alone or individual MSN and GO. GO-MSN a very popular

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Development of cross-linked collagen/pullulan ocular film for sustained delivery of Besifloxacin using novel spin-coating technique

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Spin coaters are ideal tools for the preparation of thin and ultrathin films. In the present investigation, an attempt has been made to develop a novel and simplified method for the preparation of cross-linked collagen (CCG)/pullulan film. Marine collagen (MCG) has been modified, and crosslinking efficiency was preliminarily confirmed by observing an increase in CH_2–CH_2 stretching using vibrational spectroscopy, dynamic light scattering, X-ray diffraction, etc. The spray drying of CCG and Besifloxacin (BFN)–CCG produced spherical-shaped particles as confirmed from surface morphological observations. The molecular weight of MCG was slightly decreased after crosslinking (CCG) and shifted from 4205 to 4112 Da indicating the copolymerization. The emergence of high intensity peak in Nuclear Magnetic Resonance at 63 ppm was assigned for covalent bond formation in CCG. The BFN–CCG pullulan film (67.38%) showed an increase in dissolution time at the end of 12 h. Developed BFN–CCG pullulan film demonstrated enhanced antibacterial effect against *Staphylococcus Aureus* and *Escherichia Coli.*

Introduction

Structural and functional complexities are more in the eyes as compared to other organs of the human body and even to other mammals. The common infection to the anterior as well as a posterior section of the eye may possibly be due to a variety of bacteria, viruses, fungi, and other parasites. The superior position of the eye might be responsible for co-infection. The presence of the lachrymal gland and several protective enzymatic systems can be potentially protected from serious infections. The bacterial infection could occur easily in children and geriatric patients. Globally, around 32–74% of cases of ocular infection contribute to infection caused by bacteria. Both gram-positive and gram-negative bacteria can infect the ocular cavity, mainly *Staphylococci* and *Pseudomonas Aeruginosa, Klebsiella Pneumonia, Escherichia Coli* to name a few [1, 2].

The conventional eye drop formulations are not able to destroy the bacteria instantly, due to less residence time in the ocular cavity. Hence, the conventional drug delivery system may not provide optimum results in terms of therapeutic output. Residence time on the ocular surface for a prolonged period of time and corneal permeability across barriers are the two major challenges in designing ophthalmic formulation [3]. Most bacterial infections can be cured by fluoroquinolone derivatives and are mostly prescribed for eye infections. The fluoroquinolones inhibit the bacterial cell cycle and block DNA replication, which directly binds to DNA gyrase, topoisomerase IV, or both. Besifloxacin (BFN), a model drug selected in the present approach is a fourth-generation fluoroquinolone derivative, which acts on gram-positive bacteria. The BFN contributes to an enhanced spectrum of activity because of a high affinity towards DNA gyrase and Topoisomerase IV [4, 5].

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Review

Quinazoline: An update on current status against convulsions

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ABSTRACT

Epilepsy is one of the most frequent chronic neurological disorder extremely threatening the life and good health. More than 70 million individuals suffering from epilepsy worldwide and it required long-term therapy. Many epileptic patients not fully satisfied with currently available treatment likewise, frequent drugs have shown a lack of efficacy, side effects, and drug interaction. Therefore, the search for antiepileptics with greater selectivity and lesser toxicity continues to be the focus and task in medicinal chemistry. Quinazoline represents a distinct class of biologically active nitrogen heterocyclic nucleus with great anticonvulsants potential. In the past few years, persistent medicinal chemistry efforts have developed diverse structurally functionalized potential quinazoline derivatives for anticonvulsant potential. This work report covers most current efforts taken in the design, development, and anticonvulsant efficacy of quinazoline analogs from 2015 to 2020.

1. Introduction

Heterocycles is a leading group of organic compounds. The most common and naturally occurring heterocycles include those having five- or six-membered rings containing nitrogen (N) oxygen (O) and sulfur (S) [1,2]. Therapeutic entities or drugs having nitrogen and sulfur containing heterocyclic ring have tremendous pharmacological applications [3]. In medicinal chemistry incredible courtesy has been paid for preparation of pharmaceuticals, different agrochemicals and vaternary products [4]. Nitrogen-containing heterocycles engage a lager territory in the field of heterocyclic analogs [5]. Several N-containing heterocycles such as indole, triazole, oxindole, quinilone, quinazoline, and quinoxaline have been synthesized or found in natural products [6,7]. Among all the heterocyclic hybrids we picked quinazoline ring for this collection as it has wide spectrum of pharmacological actions with minimal toxicity profile.

Quinazoline (1,3-diazanaphthalene) (Fig. 1) is a heterocyclic hybrid [8] having molecular formula $C_8H_6N_2$ [9]. It is composed two fused six-member aromatic ring i.e., benzene and pyrimidine ring having solubility in water. Researchers got fascinated since 1888 with the finding of peganine (vasicine). Quinazoline synthetically prepared in the laboratory by Gabriel in 1903 [10] while firstly isolated form Chinese plant aseru [11]. Synthesis of quinazoline has been done by various research groups (Fig. 2) were they employed the different strategies like application of catalyst, reaction conditions, and different naming reactions. No wonder quinazoline frameworks serve as the broad spectrum of pharmacological actions such as anticancer [12,13], antimicrobial [14–16], antibacterial [17–19], anti-inflammatory [20–22], antihistaminic [23–25], antidiuretic [26,27], antioxidant [28–30], antiviral [31–33], antidiabetic [34–36], antitubercular [37–39] and so on.

Epilepsy is a neurological disorder characterized by recurrent seizures, mostly affecting over 1–2% of the world population [40,41]. Approximately 70 million individuals suffer from epilepsy worldwide with majority of the them residing in the developing nations. Most of these patients are deprived of suitable medication [42,43]. Epilepsy, if not prevent, is accompanying with progressively weakened thought and function, brain damage, and other neurologic deficits [44,45]. The exact reason of seizures in most cases is unknown [46]. In few patients, epilepsy occurs as a conse-

Abbreviations: AEDs, Anti-epileptic drugs; CNS, Central nervous system; MES, Maximal electroshock; scPTZ, Subcutaneous pentylenetetrazole; GABAA, Gamma-aminobutyric acid type A; p-TsOH, p-Toluenesulfonic acid; ED_{50}, Median effective dose; SAR, Structure activity relationship; NMDA, N-methyl-D-aspartic acid; AMPA, (R,S)-2-amino-3- (3-hydroxy-5-methylisoxazol-4-yl) propionic acid; TD_{50}, Median toxic dose; Et3N, Triethylamine; BBB, Blood brain barrier; GAA, Glacial acetic acid; EWG, Electron withdrawing group; EDG, Electron donating group; $SOCl_2$, Thionyl chloride; RMSD, Root mean square density; DMF, Dimethylformamide.

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Green synthesis of Fe-doped Ag-loaded reduced graphene oxide ternary nanocomposite for efficient photocatalytic degradation of toxic dyes

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Abstract

The green synthesis of iron nanoparticles (FeNPs) doped and silver nanoparticles (AgNPs) loaded reduced graphene oxide (rGO) (Fe-Ag@rGO) nanocomposite and its applications in methylene blue (MB), malachite green (MG), rhodamine B (RB) degradation were reported. Initially, AgNPs loaded rGO (Ag@rGO) nanocomposites were synthesised simultaneously by an ecological method using *Tamarindus indica* shell extract as a green reducing agent. Then, the doping of FeNPs into rGO@Ag nanocomposites afforded Fe-Ag@rGO nanocomposite. Interestingly, the finding of this study confirmed that the Fe-Ag@rGO nanocomposites exhibited countless stupendous features in terms of dye degradation. Briefly, the UV-visible spectroscopy and Fourier-transform infrared spectroscopy (FTIR) study confirmed the synthesis of Fe-Ag@rGO nanocomposite. The scanning electron microscopy (SEM) images showed the spherical shape with cross-linked network structures that confirmed the surface modification and synthesis of Fe-Ag@rGO nanocomposite. Finally, the dye degradation potential of the photocatalyst was found to be 97.20%, 98.43%, and 97.33%, for MB, MG, RB, respectively. Herein, the improved photocatalytic performance of the Fe-Ag@rGO was found due to the larger surface area, porous nature, high electron mobility, and synergistic effect of the Fe-Ag@rGO nanocomposite. Additionally, the effective interfacial hybridisation of 'Ag', and doping of 'Fe' on the rGO sheet extended the duration of the photogenerated electron (e^-) hole pairs that can also be contributing to dye degradation. Conclusively, the present experiment provides the new Fe-Ag@rGO nanocomposite to the dye degradation, which could be improved environmental remediation.

Keywords: dye degradation, nanocomposite, Fe-Ag@rGO, Tamarindus indica shells, graphene oxide, Green synthesisClassification numbers, 2.00, 5.00, 5.11

1. Introduction

Today is the era of accelerated industrialisation, which has seen rapid developments and has played an essential role in

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REVIEW ARTICLE

Graphene quantum dots (GQDs) nanoarchitectonics for theranostic application in lung cancer

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ABSTRACT

Lung cancer (LC) is heading up as a substantial cause of mortality worldwide. Despite enormous progress in cancer management, LC remains a crucial problem for oncologists due to the lack of early diagnosis and precise treatment. In this context, numerous early diagnosis and treatment approaches for LC at the cellular level have been developed using advanced nanomaterials in the last decades. Amongst this, graphene quantum dots (GQDs) as a novel fluorescent material overwhelmed the horizons of materials science and biomedical fields due to their multifunctional attributes. Considering the complex nature of LC, emerging diagnostic and therapeutic (Theranostics) strategies using GQDs proved to be an effective way for the current practice in LC. In this line, we have abridged various approaches used in the LC theranostics using GQDs and its surface-engineered motif. The admirable photophysical attributes of GQDs realised in photolytic therapy (PLT), hyperthermia therapy (HTT), and drug delivery have been discussed. Furthermore, we have engrossed the impasse and its effects on the use of GQDs in cancer treatments from cellular level (*in vivo-in vitro*) to clinical. Inclusively, this review will be an embodiment for the scientific fraternity to design and magnify their view for the theranostic application of GQDs in LC treatment.

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KEYWORDS
Lung cancer; graphene quantum dots; theranostics; photolytic/hyperthermia therapy; drug delivery

Introduction

Global cancer risk is elevating gradually and results in a greater mortality rate per year. As per the fresh report of GLOBOCAN 2020, about 19.3 million cases and nearly 10.0 million deaths by cancer were recorded in 2020. Epidemiologists suggested that there would be probable 28.4 million new cases of cancer to befall nearly in 2040. Amongst all cancers, lung cancer (LC) has positioned on second diagnostic occurrence followed by breast cancer (11.7%) and crossed about 11.4% mortality rate, led by 1.8 million deaths (18%) in 2018 [1]. Besides, LC mortality is probable to reach 2.45 million globally by 2030. Principally, LC is a complex form of (adenocarcinoma) which increasing worldwide as an utmost cause of mortality. Generally, adenocarcinoma is known as the cancer of glandular mucus-producing cells (especially lungs). As per literature, LC is classified into four types: invasive adenocarcinoma (IA), adenocarcinoma in-situ (AIS), and minimally invasive adenocarcinoma (MIA) and other variants (e.g. lipidic) (Figure 1(A)). Besides this, the World Health Organisation (WHO) gives a sub-classification of lung adenocarcinomas as per their cellular origin. It includes acinar cells, papillary cells, bronchoalveolar, and mucus-secreting [2]. Literature survey advocated that there is a scarcity in our current knowledge of cancer statistics due to changing epidemiological trends of LC amongst developing countries [3]. In this context, it is observed that there is a vital role of the Human Development Index (HDI) in cancer mortality and morbidity in several countries. Both developed and developing countries experiencing an evident rise in the augmented effects of cancer risk factors. Moreover, there is an alarming rise in LC incidents in non-smokers as well. Notably, some major risk factors associated with the LC are smoking, exposure to second-hand smoke, previous radiation therapy, exposure to radon gas, exposure to asbestos and other carcinogens, and hereditary history of LC. Besides, the world is evidenced by the residual burden of different respiratory infections associated with LC. For example, Coronavirus disease 2019 (COVID-19), its emergence in 2020, and recurrence in 2021 have been overwhelmed the global healthcare systems. At this juncture, COVID-19 is becoming a major risk factor for LC patient's treatment. However, an extensive survey regarding the precise impact of COVID-19 associated with a patient suffering from LC is not available to date [4,5].

Current diagnostics and management strategies for LC

Despite the significant development in cancer therapeutics, several risk factors escalating in front of the developed and developing nations. Recently, Sung et al. reviewed the global cancer prevalence, which suggested the frequent diagnostic appearance as well as morbidity of LC up to 2020 which raised significantly after 2018 (Figure 1(B)) [1,6].

The traditional methods including X-ray, magnetic resonance imaging (MRI), Computed tomography (CT), or positron-electron microscopy (PET) scanning are commonly used for the diagnosis of cancer. Primary screening of LC by traditional methods is dependent on the severity and phases of LC. Unfortunately, the lack of site-specific localisation or inability to detect micrometer-sized tumours becomes inconclusive in the early detection of LC. Apart from this, sputum cytology, biopsy, and bronchoscopy methods are commonly used for the diagnosis of LC.

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Research Article

Preparation and Evaluation of Silymarin-Loaded Solid Eutectic for Enhanced Anti-Inflammatory, Hepatoprotective Effect: *In Vitro–In Vivo* Prospect

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Solubility of phytochemicals is a major concern for drug delivery, permeability, and their biological response. However, advancements in the novel formulation technologies have been helping to overcome these challenges. The applications of these newer technologies are easy for commercialization and high therapeutic outcomes compared to conventional formulations. Considering these facts, the present study is aimed to prepare a silymarin-loaded eutectic mixture with three different ratios of Polyvinylpyrrolidone K30 (PVP K30) and evaluating their anti-inflammatory, and hepatoprotective effects. The preliminary phytochemical and characterization of silymarin, physical mixture, and solid dispersions suggested and successfully confirmed the formation of solid dispersion of silymarin with PVP K30. It was found that the solubility of silymarin was increased by 5-fold compared to pure silymarin. Moreover, the *in vitro* dissolution displayed that 83% of silymarin released within 2 h with 2.8-fold increase in dissolution rate compared to pure silymarin. Also, the *in vivo* study suggested that the formulation significantly reduced the carbon tetrachloride- ($0.8620\pm0.05034^{**}$ for 1 : 3 ratio), paracetamol- ($0.7300\pm0.01517^{**}$ for 1 : 3 ratio), and ethanol- ($0.8100\pm0.04037^{**}$ for 1 : 3 ratio) induced hepatotoxicity in rats. Silymarin solid dispersion was prepared using homogenization methods that have prominent anti-inflammatory effect ($0.6520\pm0.008602^{**}$ with 8.33%) in carrageenan-induced rat paw model.

1. Introduction

Solid solution is an interchangeable solution state while solute interacting strongly in the form of eutectics. Solid dispersion method maximizes interaction with water and profoundly incorporates hydrogen bonds. Furthermore, it allows the intercalation of the lipophilic substance centrally giving the odor of hydrophilic monolayer polymer. Solid dispersion is widely used and a well-explored technique for the enhancement of solubility at both laboratory and commercial scale [1]. But macerates of plants or animal displayed the limited solubility in aqueous environment, and recent

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REVIEW ARTICLE

A key role by polymers in microneedle technology: a new era

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ABSTRACT

The skin serves as the major organ in the targeted transdermal drug delivery system for many compounds. The microneedle acts as a novel technique to deliver drugs across the different layers of the skin, including the major barrier stratum corneum, in an effective manner. A microneedle array patch comprises dozens to hundreds of micron-sized needles with numerous structures and advantages resulting from their special and smart designs. The microneedle approach is much more advanced than conventional transdermal delivery pathways due to several benefits like minimally invasive, painless, self-administrable, and enhanced patient compliance. The microneedles are classified into hollow, solid, coated, dissolving, and hydrogel. Several polymers are used to fabricate microneedle, such as natural, semi-synthetic, synthetic, biodegradable, and swellable polymers. Researchers in the preparation of microneedles also explored the combinations of polymers. The safety of the polymer used in microneedle is a crucial aspect to prevent toxicity *in vivo*. Thus, this review aims to provide a detailed review of microneedles and mainly focus on the various polymers used in the fabrication of microneedles.

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KEYWORDS
Microneedle; transdermal drug delivery; biocompatible; biodegradable; polymer

Introduction

Microneedles

The use of combined methods in pharmaceutical science and health care allows us to attain higher success in research activities. The transdermal drug delivery system (TDDS) is considered the emerging system in drug delivery due to its distinctive advantages compared to other routes of administration, such as peroral and injectable [1]. Hence, TDDS is widely preferred for delivering drugs, macromolecules, and immune biologicals locally and systemically. However, the poor penetration of the substances across the stratum corneum (SC) is acting as the main hurdle in the TDDS. One of the novel and innovative approaches is microneedles (MNs) to overcome this limitation. Hence, various researchers have started working in microneedle technology to overcome the pitfalls of other drug delivery systems and transport drugs across SC [2].

Considering the development in needles in 1844, drugs were administered to the patients using hypodermic needles *via* the intravenous route. Approximately 16 billion injections are administered worldwide, and it is sought to be the widely preferred medical device [3]. The hypodermic needles are provided several advantages as devices for the systemic administration of the drug and bioactive. It is also suitable for most pharmaceuticals, which suffer from low gastrointestinal tract absorption and undergo enzymatic breakdown [4]. In the case of administration of medications through the intravenous route *via* hypodermic needle is accompanied by a sensation of pain and psychological disturbances in patients having a fear of a needle.

Many efforts were made to overcome this limitation of the hypodermic needles, especially in designing the hypodermic needle to make them painless and patient-friendly drug delivery systems. Hence, hybrid structures MNs were innovated between transdermal patches and hypodermic needles [5], consisting of several needles of different dimensions based on use. One of the eminent pioneers and well-known researchers in the field, Mark Prasuintz, classified the MNs as the third-generation system in transdermal drug delivery [6]. This type of medical unit results in the micron-sized opening onto the skin post-application and can be explored for the administration of several drugs. In the case of the dimensions, the length of the MNs ranged from 250 and 1000 μm, and sharp tip portion than hypodermic needles [7]. The first patent in the field of microneedles was filed by scientists of Alza corporation (Gerstel and Martin) in 1976 and projected that these small (micron size) microneedles could be helpful for delivery in a painless manner *via* transdermally [8]. During this phase, three organizations, Alza Corporation, Becton Dickinson, and Georgia Tech Institute, are the first to start research on the microneedle drug delivery system [9].

MNs consist of a single or an array of needles of micron-scale (length of 0.2–1.5 mm in length), which offer a minimally invasive way to overcome the significant hurdle (i.e. SC) of the skin. The needles are efficient enough to puncture the SC and generate transport channels of tiny size for easy application [10,11].

Several fabrication techniques are used, such as pressure molding, injection molding casting, computer numerical control (CNC), etc., which can be used at an industrial scale. Many of these

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ORIGINAL ARTICLE

Gossypol-Embedded Casein Nanoparticles for Potential Targeting of Ovarian Cancer: Formulation, Characterization, and Anticancer Activity

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Abstract

Background The present study intends to investigate the ability of gossypol-loaded casein nanoparticles (gossypol-loaded CAS NPs) for the treatment of ovarian cancer. The key emphasis of this study was to synthesize and characterize gossypol-embedded casein NPs by the desolvation technique.

Method Casein is used as a polymer to fabricate the NPs; the fabricated nanoparticles are then characterized using UV–visible spectroscopy, FTIR spectroscopy, SEM, EDX, zeta potential and size analysis, and DSC to explore the efficiency and strength. The role of cross-linked casein nanoparticles was observed to improve the blood bioavailability of gossypol.

Results The particle size of the optimized batch was found to be 278 ± 5 nm, and the PDI is 0.399; the zeta potential was found to be − 14.88 mV, and the % CDR of the optimized batch was found to be 55.66%. The cytotoxicity of gossypol-loaded CAS NPs was tested in vitro against a human breast cancer cell line (MCF-7) and found to be considerable.

Conclusions The gossypol-loaded casein NPs were successfully synthesized with important advantages such as being easy to prepare, stable, and cost-effective with their applicability in ovarian cancer.

Keywords Ovarian cancer · Gossypol · Nanoparticles · Nanotechnology

Abbreviations

IARC	International Agency for Research on Cancer
CAS	Casein
CAS NPs	Casein nanoparticles
NPs	Nanoparticles
SEM	Scanning electron microscopy
EDX	Energy-dispersive X-ray analysis
DSC	Differential scanning calorimetry
PDI	Polydispersity index
CDR	Cumulative drug release
XRD	X-ray diffraction
MCF-7	Michigan Cancer Foundation-7
SRB	Sulforhodamine B
RPMI	Roswell Park Memorial Institute Medium
ACTREC	Advanced Centre for Treatment, Research & Education in Centre
ZP	Zeta potential

Background

According to the International Agency for Research on Cancer (IARC), in 2020 there were 19.29 million new cancer cases and 9.95 million cancer deaths worldwide. By 2040, the global burden is expected to grow to 28.8 million new cancer cases and 16.2 million cancer deaths in the population. The future burden of cancer patients is likely to be even greater due to the increasing prevalence of risk factors such as smoking, poor diet, physical inactivity, and others [1, 2].

Gossypol is a non-volatile yellow pigment that was discovered in 1889 in the seeds and roots of *Gossypium* plants, notably cotton plants. The knowledge of gossypol's biological activity increased after it was identified in cottonseed-based supplements for livestock [3]. There were some reports on the toxicological effects of the components of the cotton plant [4]. Along with this, some researchers have tried to focus on the beneficial effects

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International Collaboration

nanomaterials

MDPI

Review

Black Phosphorus as Multifaceted Advanced Material Nanoplatforms for Potential Biomedical Applications

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Abstract: Black phosphorus is one of the emerging members of two-dimensional (2D) materials which has recently entered the biomedical field. Its anisotropic properties and infrared bandgap have enabled researchers to discover its applicability in several fields including optoelectronics, 3D printing, bioimaging, and others. Characterization techniques such as Raman spectroscopy have revealed the structural information of Black phosphorus (BP) along with its fundamental properties, such as the behavior of its photons and electrons. The present review provides an overview of synthetic approaches and properties of BP, in addition to a detailed discussion about various types of surface modifications available for overcoming the stability-related drawbacks and for imparting targeting ability to synthesized nanoplatforms. The review further gives an overview of multiple characterization techniques such as spectroscopic, thermal, optical, and electron microscopic techniques for providing an insight into its fundamental properties. These characterization techniques are not only important for the analysis of the synthesized BP but also play a vital role in assessing the doping as well as the structural integrity of BP-based nanocomposites. The potential role of BP and BP-based nanocomposites for biomedical applications specifically, in the fields of drug delivery, 3D printing, and wound dressing, have been discussed in detail to provide an insight into the multifunctional role of BP-based nanoplatforms for the management of various diseases, including cancer therapy. The review further sheds light on the role of BP-based 2D platforms such as BP nanosheets along with BP-based 0D platforms—i.e., BP quantum dots in the field of therapy and bioimaging of cancer using techniques such as photoacoustic imaging and fluorescence imaging. Although the review inculcates the multimodal therapeutic as well as imaging role of BP, there is still research going on in this field which will help in the development of BP-based theranostic platforms not only for cancer therapy, but various other diseases.

Keywords: bioimaging; wound healing; 3D printing; surface modification; characterization

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1. Introduction

The discovery of Black Phosphorus (BP) dates back to a hundred years ago. It all began with Bridgman [1], who brought about the conversion of white phosphorus to black phosphorus under a high temperature and pressure. Later, Hultgren et al. [2] demonstrated

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A meticulous overview on drying-based (spray-, freeze-, and spray-freeze) particle engineering approaches for pharmaceutical technologies

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ABSTRACT

Drying is an indispensable operation in the preparation of pharmaceutical powders and always remained one of the energetic tasks in the pharmaceutical industry. Improving the stability, solubility, and dissolution of pharmaceutical products are being prime objectives of the drying process, intending to produce the products loving the dry state. Although there are voluminous literatures available concerning drying operations, there is scant information available regarding the applicability of drying in drug delivery and process scale-up. The current communication embodies the different particle engineering technologies of drying viz. spray-, freeze-, and spray-freeze drying. In addition, potential uses of drying in the taste masking, and the development of inhalable powders presented briefly. Recent advancements in the drying of novel drug delivery systems is the major focus of the present review. In our opinion, the commercial aspects, regulatory guidelines, and scale-up strategies presented herein provide an opportunity to readers, researchers, and industrialists to ruin the critical issues during drying operations and aid in developing quality pharmaceutical technologies.

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KEYWORDS
Particle engineering; shell formation; spray drying; freeze drying; solubility; crystallinity

1. Introduction

Drying was extensively studied from ancient times. Since then peoples were utilizing the capability of drying techniques in storing material, food, grains, and so forth for a longer period. The drying techniques are now transferred into various adaptive processes. The transformation of the solution, suspension, and emulsion into a dried powder has primarily been used in the drying process at a commercial scale. Many chemicals, pharmaceutical, biological, food industries are principally using the drying technique in the process. Almost maximum numbers of active drug substances, pharmaceutical excipient, food ingredient, intermediates, and so forth are available in powder form and utilizing any one of the methods of drying.[1,2] The modification or improvement of the powder characteristics is possible with the help of drying technologies to improve the solubility and dissolution characteristics of the pharmaceutical powders. In biological process enzymes, proteins extracted from animals or plants are converted into dried powder. The suitability of using the drying technique not only improves the solubility but also increases flow characteristics.[3] The flow characteristics of powdered materials are immensely important in transportation and long-term storage. The powdered materials improve the processing capability of the pharmaceutical manufacturing process and control. Due to uniform size, low moisture level makes the pharmaceutical powder easy to mix, blend, and flow from the hopper to the filling cavity.[4,5] The optimum moisture contained in powder helpful for increasing the compression and compaction characteristics of solid dosage forms. While designing dosage form particle properties of active pharmaceutical ingredients and excipients play an important role. Properties of pharmaceutical powder can be modified by surface engineering or surface chemistry which explores the applicability of powdered dosage forms like the enteric coating of

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Review Article

Surface architectured metal organic frameworks-based biosensor for ultrasensitive detection of uric acid: Recent advancement and future perspectives

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ABSTRACT

Gout is the world's most popular inflammatory arthritis and the prevalence of gout is rapidly rising worldwide. Typically, gout develops in a single joint as excessive swelling and intense pain wherein excessive deposition of uric acid (UA) crystals results in inflammation of the joint. Accordingly, UA is considered an effective biomarker to diagnose gout. Recently, the use of innovative sensors has attracted great attention, as it is effortless, responsive, quick, and powerful. While the traditional sensors for UA assessment are widely used, they pose many limitations and hurdles in terms of sensitivity, selectivity, and simplicity. In this vein, metal ions and organic ligand-based metal–organic framework (MOF) have gained much attention for the recognition of UA due to its larger surface area, porosity, high sensitivity, and defined selectivity. In this review, we provide details on the latest developments of MOF-centered biosensors for sensitive detection of UA. The status of gout, fundamentals of MOF, and MOF availed for detection of UA have been elaborated. Besides, we highlighted the nanoparticles and conjugates that rely on advanced strategies along with MOF that boost the sensitivity and selectivity towards the UA. Interestingly, different surface architectured MOFs biosensors showed a lower detection limit for UA from μM to nM. Finally, the threats and potential opportunities for MOF-based UA biosensors have been summarized. Therefore, based on ongoing research, the commercialization of this advanced platform for the biosensing of diverse biomarkers will open a new door for the *in vitro* diagnosis of assorted diseases.

1. Introduction

From its inception, arthritis is a severe health issue of a joint in almost all developed and developing nations. Arthritis is a term that derives from the Greek word "disease of the joint." Commonly, it can be stated as acute inflammation or chronic inflammation of the joint that is sometimes with the effect of pain and sometimes co-exists with structural damage [1]. As many as 100 classes of arthritis have been characterized according to the research. Generally, it can be classified into two type's namely non-inflammatory arthritis and inflammatory arthritis. In the first category, non-inflammatory arthritis is commonly known as osteoarthritis, while inflammatory arthritis is categorized

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pharmaceuticals

Review

Therapeutic Outcomes of Isatin and Its Derivatives against Multiple Diseases: Recent Developments in Drug Discovery

Rameshwar S. Cheke [1,*], Vaishali M. Patil [2], Sandip D. Firke [3], Jaya P. Ambhore [1], Iqrar A. Ansari [3], Harun M. Patel [3], Sachin D. Shinde [4], Visweswara Rao Pasupuleti [5,6,7,*], Md Imtaiyaz Hassan [8], Mohd Adnan [9], Adel Kadri [10,11] and Mejdi Snoussi [9,12]

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Abstract: Isatin (1*H* indole 2, 3-dione) is a heterocyclic, endogenous lead molecule recognized in humans and different plants. The isatin nucleus and its derivatives are owed the attention of researchers due to their diverse pharmacological activities such as anticancer, anti-TB, antifungal, antimicrobial, antioxidant, anti-inflammatory, anticonvulsant, anti-HIV, and so on. Many research chemists take advantage of the gentle structure of isatins, such as NH at position 1 and carbonyl functions at positions 2 and 3, for designing biologically active analogues via different approaches. Literature surveys based on reported preclinical, clinical, and patented details confirm the multitarget profile of isatin analogues and thus their importance in the field of medicinal chemistry as a potent chemotherapeutic agent. This review represents the recent development of isatin analogues possessing potential pharmacological action in the years 2016–2020. The structure–activity relationship is also discussed to provide a pharmacophoric pattern that may contribute in the future to the design and synthesis of potent and less toxic therapeutics.

Keywords: chemotherapeutic agent; anticancer drugs; isatin derivatives; drug design and development; heterocyclic compounds; therapeutic targeting

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ORIGINAL ARTICLE

Statistical optimization of voriconazole nanoparticles loaded carboxymethyl chitosan-poloxamer based in situ gel for ocular delivery: In vitro, ex vivo, and toxicity assessment

Sagar R. Pardeshi[1] · Mahesh P. More[2] · Pritam B. Patil[3] · Arun Mujumdar[4] · Jitendra B. Naik[1]

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Abstract

The research study reflects the development of novel voriconazole (VCZ) loaded nanoparticles (NPs) for prolonged delivery for the management of ocular diseases. The in situ ophthalmic gel was prepared by incorporating NPs into carboxymethyl chitosan (CMCh) and poloxamer. The central composite design was used to optimize the process for the preparation of nanoparticles by the o/w solvent evaporation method. The developed nanoparticles were evaluated for the encapsulation efficiency (89.6 ± 1.2%), particle size (219.3 ± 1.8 nm), polydispersity index (PDI, 0.1), zeta potential (−21.1 ± 1.12 mV), saturation solubility, DSC study, and drug release. The etherification process grafts carboxyl surface functional groups, on chitosan, and was confirmed by FTIR and NMR studies. The developed CMCh-poloxamer based gelling system was found to be clear and transparent with gelation temperature varying from 33 to 40 °C. The nanoparticle-loaded gel containing CMCh demonstrated enhanced antifungal activity against *Candida albicans*. The optimized batch containing CMCh showed improved mucoadhesion by 2.86-fold compared to VCZ nanosuspension. The drug release was prolonged up to 8 h with an ex vivo study suggesting the enhanced permeation across goat cornea estimated via fluorescent microscope. The hen's egg chorioallantoic membrane study revealed that the formulation was non-irritant and tolerated by the chorioallantoic membrane. The present study concludes that the VCZ loaded nanoparticulate in situ ophthalmic gel using CMCh may act as a potential alternative for traditional eye drops.

Keywords Voriconazole · Nanoparticles · In situ gel · Chitosan · Carboxymethyl chitosan · Poloxamer

Introduction

Fungal keratitis and conjunctivitis can result from a fungal infection in the eyes. It is a serious infection of the corneal tissue triggered by various fungi including *Aspergillus*, *Fusarium*, or *Candida* [1]. Severe corneal ulcers and visual loss may occur if treatment is delayed [2]. One of the most challenging issues in the area of ophthalmology is treating ocular fungal infections. Furthermore, the eye is a tiny, complicated organ with a limited amount of tear fluid for medication retention and absorption [3]. The effective proportion of the applied dosage accessible for absorption is reduced by tear film turnover and blinking. The remaining portion of the dosage must then get past the corneal epithelium's tight connections to be absorbed and offer treatment [4]. The most common approach for ocular medication administration is topical eye drops, as it is easy to use, non-invasiveness, and therefore highly acceptable by patients [5]. Eye drops, on the other hand, have certain disadvantages, such as loss of drug in the precorneal part of the eye, limited corneal penetration, require multiple administration, and reduced bioavailability to less than 5% [6]. Also, traditional ocular dose forms, including solutions and suspensions, have several disadvantages, including the drug's fast precorneal clearance owing to nasolacrimal drainage [7]. The requirement for recurrent application and, in particular, pulse release from solutions

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Review

Molecular Insights into Coumarin Analogues as Antimicrobial Agents: Recent Developments in Drug Discovery

Rameshwar S. Cheke [1,*], Harun M. Patel [2], Vaishali M. Patil [3,*], Iqrar Ahmad Ansari [2], Jaya P. Ambhore [1], Sachin D. Shinde [4], Adel Kadri [5,6], Mejdi Snoussi [7,8], Mohd Adnan [7], Prashant S. Kharkar [9], Visweswara Rao Pasupuleti [10,11,12,*] and Prashant K. Deshmukh [13]

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Simple Summary: Coumarins are a large family of benzopyrones, and more than 1300 coumarins have been reported to date. Natural, as well as synthetic, coumarins have demonstrated a diverse activity spectrum. On the other hand, the demands of the current health scenario witnessing morbidity and mortality due to microbial infections and multidrug-resistant bacterial strains, the well-reported phytochemical coumarin can be of interest. Some of the well-reported coumarin analogues as antimicrobial agents include β-lactum derivatives, coumarin-based 1,2,3-triazole compounds, the miconazole analogue, coumarin-substituted pyrazole hybrids, pyranocoumarin, coumarin−sulphonamide hybrids, pyranocoumarins, coumarin−sulphonamide derivatives, chromenylpyrazoles candidates, 3-amidocoumarins analogues, uracil−coumarin hybrids, indolinedione−coumarin hybrids, coumarin−imidazole hybrids, coumarin-fused pyrazolones and methyl thiazole derivatives, coumarin−theophylline hybrids, etc. In the present review, several methods for the synthesis of coumarin derivatives as antimicrobial agents are reported, along with structure−activity relationship (SAR) studies focusing on the developments reported since 2016.

Abstract: A major global health risk has been witnessed with the development of drug-resistant bacteria and multidrug-resistant pathogens linked to significant mortality. Coumarins are heterocyclic compounds belonging to the benzophenone class enriched in different plants. Coumarins and their derivatives have a wide range of biological activity, including antibacterial, anticoagulant,

pharmaceutics

Review

Progress on Thin Film Freezing Technology for Dry Powder Inhalation Formulations

Sagar R. Pardeshi [1], Eknath B. Kole [2], Harshad S. Kapare [3], Sachin M. Chandankar [4], Prashant J. Shinde [1], Ganesh S. Boisa [1], Sanjana S. Salgaonkar [1], Prabhanjan S. Giram [3,5], Mahesh P. More [6,*], Praveen Kolimi [7], Dinesh Nyavanandi [8], Sathish Dyawanapelly [9,*] and Vijayabhaskarreddy Junnuthula [10,*]

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Abstract: The surface drying process is an important technology in the pharmaceutical, biomedical, and food industries. The final stage of formulation development (i.e., the drying process) faces several challenges, and overall mastering depends on the end step. The advent of new emerging technologies paved the way for commercialization. Thin film freezing (TFF) is a new emerging freeze-drying technique available for various treatment modalities in drug delivery. TFF has now been used for the commercialization of pharmaceuticals, food, and biopharmaceutical products. The present review highlights the fundamentals of TFF along with modulated techniques used for drying pharmaceuticals and biopharmaceuticals. Furthermore, we have covered various therapeutic applications of TFF technology in the development of nanoformulations, dry powder for inhalations and vaccines. TFF holds promise in delivering therapeutics for lung diseases such as fungal infection, bacterial infection, lung dysfunction, and pneumonia.

Keywords: thin film freezing; dry fine powder; novel drug delivery; poorly soluble drug; pulmonary; inhalation

1. Introduction

Recently, the dissolution profile of water-insoluble medications has been significantly improved by using the particle engineering technique known as thin film freezing (TFF) [1]. TFF is the evolution of a fast-freezing technique to form films and produce powdered drug particles. The API and stabilizer solution are immediately iced onto a cryogenically frozen surface in the TFF process, after which the frozen particles are collected, and the solvent is sublimated. The supercooling of the API and stabilizer solution minimizes the phase separation and nucleation, which possibly converts the crystalline drug to an amorphized form [2]. Additionally, the high freezing rate increases the number of liquid crystals and lowers the particle size. The amorphous composition with enhanced surface area contributes to an increased rate of drug dissolution. Zhang et al. formulated a fenofibrate

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