BUKTI PLENARY SPEAKER

International Conference on Pharmaceutical Sciences (ICOPS2023)

18-19 Mei 2023

Berjudul:

Nanoparticles and Nanostructured Lipid Carriers for Skin Delivery

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Keynote/Plenary Speaker Invitation

1 message

MOHD. RUSHDI BIN HJ. ABU BAKAR . <rushdi@iium.edu.my> Wed, Dec 14, 2022 at 8:42 AM
To: "c_avanti@staff.ubaya.ac.id" <c_avanti@staff.ubaya.ac.id>
Cc: "M. TAHER BIN BAKHTIAR" <mtaher@iium.edu.my>, Muhammad Salahuddin Haris <solah@iium.edu.my>

Dear Assoc. Prof. Dr. Christina Avanti,

We hope this message finds you well. We're reaching out today with an exciting speaking opportunity for your consideration. We're honored to invite you to speak at the International Conference on Pharmaceutical Sciences (ICOPS) 2023. The theme of the conference "Dermatopharmaceutics: The Epitome of Skin Science" fits very well with your passion and expertise, hence the entire ICOPS 2023 team feel you would be the perfect person to address our audience of like-minded researchers and professionals.

ICOPS 2023 will take place in Kuala Lumpur, Malaysia on 18th-19th May 2023. We are anticipating an audience of about 150. Our goal is to provide a forum for academicians, researchers, and industry to present their findings, ideas, and innovation in the field of pharmaceutical sciences, particularly those that are relevant to the theme of the conference. We believe your voice would be a critical addition to that conversation given your expertise in transdermal/topical systems and skin delivery.. Your talk could be up to 30 minutes on any relevant topics you're interested in. As a token of appreciation, we will cover the costs of your travel, accommodation and conference registration fee.

Please let us know by 16/12/2023 whether you may be interested in joining us at ICOPS 2023 as a highly-anticipated speaker. Thank you for your time and consideration, and we very much look forward to hearing from you.

Thank you

Best regards,

Dr. Mohd Rushdi Abu Bakar
On behalf of Scientific Committee
ICOPS 2023

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Invitation as a Plenary Speaker

1 message

MOHD. RUSHDI BIN HJ. ABU BAKAR . <rushdi@iium.edu.my> Wed, Jan 11, 2023 at 8:13 AM
To: Christina Avanti <c_avanti@staff.ubaya.ac.id>
Cc: "M. TAHER BIN BAKHTIAR" <mtaher@iium.edu.my>, HAZAN HARYANTI ABDUL HALIM <haryanti@iium.edu.my>

Dear Assoc. Prof. Dr. Christina,

Pursuant to our previous communication, please find the attached letter of invitation to be a plenary speaker at the 2nd International Conference on Pharmaceutical Sciences (ICOPS) 2023. We would like to clarify that we've made a mistake on the category of the speaker we offered to you previously, it should be plenary, not keynote. Regardless of the change, you will still be our guest of honour and we will also still cover the costs of your travel, accommodation and waive your conference registration fees..

We would be very grateful if you could email us your photo and CV and provide us with the proposed title of your speech. Your CV is needed for the registration of the conference with the Malaysian Pharmacists Society, while your photo and title of your speech are required in the promotion of the event.

We very much look forward to hearing from you soon.

Thank you

Best regards,

Dr. Mohd Rushdi Abu Bakar
Scientific Committee
ICOPS 2023

Dr. Christina Avanti.pdf
581K

IIUM/308/19/4/2

10 January 2023

Assoc. Prof. Dr. Christina Avanti
Vice Rector for Student Affairs and Alumni
Universitas Surabaya
Raya Kalirungkut, Surabaya, Indonesia

Dear Assoc. Prof. Dr.,

INVITATION AS A PLENARY SPEAKER FOR THE 2ND INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS) 2023

The Kulliyyah (Faculty) of Pharmacy, International Islamic University Malaysia (IIUM) will be organising 2nd International Conference on Pharmaceutical Sciences (ICOPS) 2023. The theme of this conference is 'Dermatopharmaceutics: The Epitome of Skin Science'.

It is with utmost pleasure to extend this invitation to you as our speaker and guest of honour of this event. The conference will be held on 18 and 19 May 2023 in Putrajaya. We hope you will be able to accept this invitation. We believe your expertise will benefit the participants and contribute to the success of this event.

For any further inquiries, please contact our secretariat at +609 570 3080 or email rushdi@iium.edu.my.

Thank you.

'LEADING THE WAY'

ASSOC. PROF. DR. HAZRINA AB. HADI (PhD., RPh)
Chairperson,
2nd International Conference on Pharmaceutical Sciences (ICOPS) 2023

Kulliyyah of Pharmacy
International Islamic University Malaysia
Jalan Sultan Haji Ahmad Shah
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INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS) 2023
Dermatopharmaceutics: The Epitome of Skin Science
18th -19th May 2023
DoubleTree by Hilton Putrajaya Lakeside
ABOUT THE CONFERENCE
This two-day conference will have plenary and keynote speakers from different countries to share their expertise in the field of dermatopharmaceutics.
PLENARY SPEAKERS
PROF. DR. MAURICE VAN STEENSEL
Research Director
Skin Research Institute of Singapore
Singapore
"Development of Functional Dermato-cosmetics"
PROF. DR. MOHD CAIRUL IQBAL MOHD AMIN
Professor in Pharmaceutics
Faculty of Pharmacy
Universiti Kebangsaan Malaysia
Malaysia
"Strategies in Overcoming Skin Barriers: Superior Approaches via Advanced Transdermal Drug Delivery"
DR. DRA. CHRISTINA AVANTI M.SI., APT.
Associate Professor
Department of Pharmaceutics
Faculty of Pharmacy
Universitas Surabaya
Indonesia
"Nano Formulations for Topical Delivery"
DR. KATRIEN VAN BOCXLAER
Research Associate
Department of Biology
University of York
United Kingdom
"Pathway to a New Treatment for Cutaneous Leishmaniasis"
MR. KOTARO IWASAKI
Researcher
New Modality Research Group
Research Dept.
Maruho Co., Ltd.
Japan
"Application of Digital Technologies for Topical Formulation Design"
KEYNOTE SPEAKER
PROF. EMERITA DATUK DR. ASMA BINTI ISMAIL (FASc.)
"Advances in S&T and The Impact It Can Have on Research in Skin Globally and Its Trend in Malaysia"
IIUM Ibn Sina Chair Holder
National Academic Laureate 2022
50 over 50: Asia 2023 by Forbes Magazine
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2ND INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS 2023)
DOUBLETREE BY HILTON, PUTRAJAYA - 18 & 19 MAY 2023
PROGRAMME ITINERARY

TIME	DAY 1 (18 May 2023)
08.00-08.30	Registration
08.30-08.35	Welcoming Address by Master of Ceremony
08.35-08.40	Recitation of Al-Qur'an & Dua'a
08.40-08.50	Welcoming Speech by Dean, Kulliyyah of Pharmacy, IIUM
08.50-09.00	Opening Speech and Officiation by **Prof. Emerita Datuk Dr. Asma Ismail, FASc.**
09.00-09.45	**Keynote: Prof. Emerita Datuk Dr. Asma Ismail, FASc.** ***Title:*** *Advances in S&T and the Impact It Can Have on Research in Skin Globally and Its Trend in Malaysia*
09.45-10.00	**Photography Session & Tea Break**
10.00-10.30	**Plenary I: Prof. Dr. Mohd Cairul Iqbal Mohd Amin (Universiti Kebangsaan Malaysia)** ***Title:*** *Strategies for Overcoming Skin Barriers: Superior Approaches via Advanced Transdermal Drug Delivery*
10.30-11.00	**Plenary II: Assoc. Prof. Dr. Dra. Christina Avanti (Universitas Surabaya, Indonesia)** ***Title:*** *Nanoparticles and Nanostructured Lipid Carriers for Skin Delivery*
Session 1	**Oral Presentation Session 1** **Chairperson 1: Prof. Dr. Mohd. Cairul Iqbal Mohd Amin**
11.00-11.20	**Invited Speaker I: Dr. Goh Choon Fu (Universiti Sains Malaysia)** ***Title:*** *Emerging Biomaterials for Dermal Drug Delivery: Leveraging the Innate Resources in Malaysia to Their Utmost Potential*
11.20-11.35	**Presenter I: Pattarawadee Sumthong Nakmee (Kasetsart University Thailand)** ***Title:*** *Terpenoid Profiling of Thai Strain Cannabis Leaves (Cannabis Sativa L. Subsp. Sativa) by Headspace (Hs) Couple with GC/MS*
11.35-11.50	**Presenter II: Yee Shan Shim (Universiti Sains Malaysia)** ***Title:*** *Mitragynine Delivery Through the Skin: A Promising Route for Kratom Administration*
11.50-12.10	**Invited Speaker II: Dr. Fu Ju Yen (Malaysian Palm Oil Board)** ***Title:*** *Role of Palm Oil Derivatives in Dermal and Cosmeceutical Formulations*
12.10-12.25	**Presenter III: Jess Ong Wei Ting (UCSI University)** ***Title:*** *Incorporation of Green-Synthesised Silver Nanoparticles into Topical Gel Formulation for Acne Treatment*
12.25-12.40	**Presenter IV: Md Rahimullah Miah (North East Medical College, Bangladesh)** ***Title:*** *Impact of Unregulated Wireless Sensor Technology to Enable Early Growth of Liver Cancer*
12.40-14.00	**Poster Viewing Session 1 & Lunch Break**
Session 2	**Oral Presentation Session 2** **Chairperson 2: Assoc. Prof. Dr. Dra. Christina Avanti**
14.00-14.20	**Invited Speaker III: Assoc. Prof. Dr. Ng Shiow Fern (Universiti Kebangsaan Malaysia)** ***Title:*** *Autologous Platelet-Rich Plasma Loaded in Chitosan-Nanocrystalline Cellulose Hydrogel Dressings for Full-Thickness Wound Healing*
14.20-14.35	**Presenter V: Rana Sejare (Universiti Sains Malaysia)** ***Title:*** *Physicochemical, Mechanical and Adhesiveness Evaluation of Palm Kernel Oil Loaded Emulsion Nanofibers as Topical Moisturizing Carrier*
14.35-14.50	**Presenter VI: Wong Li Ching (Universiti Sains Malaysia)** ***Title:*** *The Loading of Microfluidic-Generated Nanoemulsions into Biomass Cellulosic Hydrogels for Dermal Drug Delivery*

2ND INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS 2023)
DOUBLETREE BY HILTON, PUTRAJAYA - 18 & 19 MAY 2023
PROGRAMME ITINERARY

TIME	DAY 1 (18 May 2023)
14.50-15.05	**Presenter VII: Puguh Novi Arsito (Universitas Muhammadiyah Yogyakarta)** ***Title:*** *Structure-Activity Analysis and Mechanism Studies of Flavonoids from Milletia Brandisiana as Multitarget Agent against Alzheimer Disease Pathogenesis*
15.05-15.35	**Poster Viewing Session 2 & Tea Break**
15.35-15.55	**Invited Speaker IV: Dr. Fatimah Mohd Nor (KPJ Ampang Puteri Specialist Hospital)** ***Title:*** *Skin lesions. Aesthetic or therapeutic?*
15.55-16.10	**Presenter VIII: Rifki Febriansah (Universitas Muhammadiyah Yogyakarta)** ***Title:*** *Isolation and Identification of the Active Compound in Streptomyces sp. GMY01 Bacteria as Anti Breast Cancer Agent by In Vitro Study*
16.10-16.25	**Presenter IX: Indra Putra Taufani (Universitas Muhammadiyah Yogyakarta)** ***Title:*** *Mitochondrial ROS Induced by ML385, an NRF2 Inhibitor Aggravates the Ferroptosis in Human Lung Epithelial BEAS-2B Cells*
16.25-16.40	**Presenter X: Sabtanti Harimurti (Universitas Muhammadiyah Yogyakarta)** ***Title:*** *Design and Evaluation of Nano Serum of VCO Moringa Leaf Extract*
END OF DAY 1	

2ND INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS 2023)
DOUBLETREE BY HILTON, PUTRAJAYA - 18 & 19 MAY 2023
PROGRAMME ITINERARY

TIME	DAY 2 (19 May 2023)
08.00-08.30	Registration
08.30-09.00	**Plenary III: Mr. Kotaro Iwasaki (Maruho Co., Ltd., Japan)** ***Title:*** *Topical Drug Formulation Research using Digital Technology*
09.00-09.30	**Plenary IV: Dr. Katrien van Bocxlaer (University of York, United Kingdom)** ***Title:*** *Pathway to a New Treatment for Cutaneous Leishmaniasis*
09.30-10.00	**Plenary V: Prof. Dr. Maurice van Steensel (Skin Research Institute of Singapore)** ***Title:*** *Developing Functional Skincare*
10.00-10.15	**Tea Break**
Session 3	**Oral Presentation Session 3** **Chairperson 3: Mr. Kotaro Iwasaki**
10.15-10.35	**Invited Speaker V: Assoc. Prof. Ts. Dr. Goh Bey Hing (Monash University Malaysia)** ***Title:*** *Cosmeceuticals: Harnessing Nature's Wisdom*
10.35-10.50	**Presenter XI: Alfiah Amaliyah/Zikra Aulia (Universitas Muhammadiyah Yogyakarta)** ***Title:*** *In Vitro Analysis of Anti Neoplastic and Cell Migration Inhibitor Activity of Selaginella Doederleinii and Centella Asiatica Extracts towards Lung Cancer Htb-183*
10.50-11.05	**Presenter XII: Sharifah Shakirah Syed Omar (International Islamic University Malaysia)** ***Title:*** *An In Vivo Study on Human Skin on the Effects of Retinoic Acid Loaded Nanosponge Gel Cream Formulation vs Commercial Formulation*
11.05-11.25	**Invited Speaker VI: Dr. Mariam Firdhaus Mad Nordin (Universiti Teknologi Malaysia)** ***Title:*** *Halea & Natxtract: Innovative Natural Skincare Products using Water-Based Extraction Technology*
11.25-11.40	**Presenter XIII: Rizal Zaim Ramli (International Islamic University Malaysia)** ***Title:*** *Effect of Benincasa Hispida Seed Extract towards Protein Expression of AHR, OVOL-1 and CYP1A1*
11.40-11.55	**Presenter XIV: Nuraqilah Zulkifli (International Islamic University Malaysia)** ***Title:*** *Development and Characterization of Benzoyl Peroxide and Stingless Bee Honey Emulgel Formulations*
11.55-12.15	**Poster Viewing Session 3**
12.15-14.45	**Lunch Break & Friday Prayer**
Session 4	**Oral Presentation Session 4** **Chairperson 4: Dr. Katrien van Bocxlaer**
14.45-15.05	**Invited Speaker VII: Dr. Nurul Izza Nordin (SIRIM)** ***Title:*** *Nutricosmetics and Microbiome Skincare: New Dimension in Skin Health and Beauty Care?*
15.05-15.20	**Presenter XV: Noor Shimariza Ashikin Wan Hussin (International Islamic University Malaysia)** ***Title:*** *Effect of Centrifuge Speed and Sonication Amplitude on Size of Nanosponge*
15.20-15.35	**Presenter XVI: Nurul Huda Heri (Universiti Kuala Lumpur Royal College of Medicine Perak)** ***Title:*** *Topical Cyclosporine-Loaded Nanoemulsion for Anti-Psoriatic Treatment: In Vivo Evaluation*
15.35-15.50	**Presenter XVII: Yusuf Alif Pratama (Universitas Airlangga Indonesia)** ***Title:*** *Virtual Screening of Bioactive Compounds and Their ADMET Prediction Of Curcuma Xanthorriza Roxb. Rhizome as a Potential Eczema Therapy*
15.50-16.05	**Tea Break**
16.05-16.20	**Invited Speaker VIII: Assoc. Prof. Dr. Chan Siok Yee (Universiti Sains Malaysia)** ***Title:*** *When Pharmaceutical Meets Electrospinning: New Opportunities for Dermatopharmaceutics Delivery System*

2ND INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS 2023)
DOUBLETREE BY HILTON, PUTRAJAYA - 18 & 19 MAY 2023
PROGRAMME ITINERARY

TIME	DAY 2 (19 May 2023)
16.20-16.40	Award Giving Ceremony
16.40-16.50	Closing Ceremony by the Chairperson of ICOPS 2023
END OF DAY 2	

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Re: Request Submission of Abstract for Plenary Talk at ICOPS 2023

1 message

MOHD. RUSHDI BIN HJ. ABU BAKAR . <rushdi@iium.edu.my> Wed, May 10, 2023 at 1:36 PM
To: Christina Avanti <c_avanti@staff.ubaya.ac.id>
Cc: HAZAN HARYANTI ABDUL HALIM <haryanti@iium.edu.my>, Muhammad Salahuddin Haris <solah@iium.edu.my>, "International Conf. on Pharmaceutical Sciences (ICOPS2023)" <icops@iium.edu.my>

Dear Dr. Christina,

We acknowledge receipt of your email with the abstract.

We look forward to meeting you at the conference.

Thank you very much.

Best regards,
Scientific & Publication Committee
ICOPS 2023

On Wed, 10 May 2023 at 14:23, Christina Avanti <c_avanti@staff.ubaya.ac.id> wrote:

> Dear Dr. Mohd. Rusdi Bin Hj. Abu Bakar,
>
> I am writing to submit my abstract for the upcoming conference on ICOPS 2023. The title of my presentation is "Nanoparticle and Nanostructured Lipid Carriers for Skin Delivery", and it focuses on the use of nanotechnology for natural cosmetic delivery in dermatopharmaceutics.
>
> Thank you for the opportunity to present our studies and I look forward to seeing you at the conference.
>
> Sincerely,
> Christina Avanti
> --
> *Christina Avanti, PhD*
> *Associate Professor in Pharmaceutical Technology*
> *Vice-Rector for Student Affairs and Alumni*
> *Universitas Surabaya*
> *Raya Kalirungkut, Surabaya, Indonesia*
> *Phone: +62 31 2981000*
>
> On Wed, Apr 19, 2023 at 9:59 AM MOHD. RUSHDI BIN HJ. ABU BAKAR . <rushdi@iium.edu.my> wrote:
>
> > Dear Respected Plenary Speakers of ICOPS 2023,
> >
> > The Scientific and Publication Committee is in the process of compiling the abstracts from plenary speakers for the publication of an abstract book (with ISBN) during the conference. We would be very grateful if you could submit to us the abstract of your talk in accordance with the format of the attached template **latest by Friday 5th April 2023**.
> >
> > Please let us know if you have any questions or concerns.
> >
> > Thank you
> >
> > Best regards,
> > Scientific & Publication Committee
> > ICOPS 2023

Nanoparticle and Nanostructured Lipid Carriers for Skin Delivery

Christina Avanti[1,*], Endang Wahyu Fitriani[1], Ni Luh Dewi Aryani[1]

[1]Department of Pharmaceutics, Faculty of Pharmacy, University of Surabaya (UBAYA), Jalan Raya Kalirungkut, Surabaya 60293, Indonesia

*Corresponding author e-mail: c_avanti@stff.ubaya.ac.idi

Abstract

Introduction: The use of nanoparticles and nanostructured lipid carriers (NLCs) for skin delivery has gained significant attention in recent years due to the ability to enhance the bioavailability and efficacy of active ingredients in natural cosmetic formulations. The aim of this presentation is to provide an overview of nanoparticles and nanostructured lipid carriers (NLCs) for skin delivery, and to discuss the advantages of using NLCs for natural cosmetic delivery. **Materials and method:** In this presentation, we will discuss the basics of nanoparticles and NLCs, the advantages of using NLCs for skin delivery, and the role of NLCs in improving skin penetration of active ingredients**. Results and Discussion:** We will also highlight the importance of natural active ingredients, such as tea tree oil, ubiquinone, glutathione, mangosteen, oleanolic acid, bakuchiol, and other natural ingredients in dermatopharmaceutics, and how they can be encapsulated in NLCs for optimal skin delivery. Additionally, we will present our research findings on NLCs for natural cosmetic delivery, including characteristics and the efficacy in enhancing the skin permeation of natural active ingredients. **Conclusion:** The presentation provides insights into the potential applications of NLCs for skin delivery and their role in enhancing the bioavailability and efficacy of natural active ingredients in dermatopharmaceutics.

KEYWORDS: Nanoparticle, nanostructured lipid carriers, skin delivery

Draft Review Article

Nanoparticle and Nanostructured Lipid Carriers for Skin Delivery

Christina Avanti [1,*], Endang Wahyu Fitriani[1] and Ni Luh Dewi Aryani[1]

[1] Department of Pharmaceutics, Faculty of Pharmacy, University of Surabaya (UBAYA), Jalan Raya Kali-rungkut, Surabaya 60293, Indonesia; c_avanti@staff.ubaya.ac.id,

* **Correspondence:** c_avanti@staff.ubaya.ac.id; Tel.: +62-31-2981000 (CA)

Abstract: (1) Background: The use of nanoparticles and nanostructured lipid carriers (NLCs) for skin delivery has gained significant attention in recent years due to the ability to enhance the bioavailability and efficacy of active ingredients in natural cosmetic formulations. This presenta-tion aims to provide an overview of nanoparticles and nanostructured lipid carriers (NLCs) for skin delivery, and to discuss the advantages of using NLCs for natural cosmetic delivery; (2) Methods: In this presentation, we will discuss the basics of nanoparticles and NLCs, the ad-vantages of using NLCs for skin delivery, and the role of NLCs in improving skin penetration of active ingredients; (3) Results: We will also highlight the importance of natural active ingredients, such as tea tree oil, ubiquinone, glutathione, mangosteen, oleanolic acid, bakuchiol, and other natural ingredients in dermatopharmaceutics, and how they can be encapsulated in NLCs for optimal skin delivery. Additionally, we will present our research findings on NLCs for natural cosmetic delivery, including characteristics and efficacy in enhancing the skin permeation of natural active ingredients; (4) Conclusions: The presentation provides insights into the potential applications of NLCs for skin delivery and their role in enhancing the bioavailability and efficacy of natural active ingredients in dermatopharmaceutics.

Keywords: Nanoparticle; nanostructured lipid carriers; skin delivery

1. Introduction

In recent years, there has been a growing interest in the use of nanoparticles and nanostructured lipid carriers (NLCs) for skin delivery of natural active ingredients in dermatopharmaceutics. NLCs are a novel pharmaceutical formulation composed of a blend of solid and liquid lipids stabilized by emulsifiers [1]. They are promising delivery systems due to their ease of manufacturing processes, biocompatibility, biodegradabil-ity, and other advantages that could be related to specific routes of administration or the nature of the materials loaded into these delivery systems [2].

This article will discuss the exciting developments in the use of nanoparticles and NLCs for skin delivery and the advantages of using NLCs for natural cosmetic delivery. We will explore the role of NLCs in improving skin penetration of active ingredients and discuss previous research as well as our findings on the effectiveness of NLCs for de-livering a range of natural active ingredients for dermatopharmaceutics, including tea tree oil, ubiquinone, glutathione, mangosteen, Oleanolic acid, bakuchiol, and more.

The skin plays a crucial role in protecting the body from external threats such as UV radiation, pathogens, and chemicals. However, the skin is also prone to various diseases and disorders such as acne, psoriasis, eczema, skin cancer, and aging. The treatment of these conditions requires the use of effective and safe dermatological products [3]. Dermatopharmaceutics is essential in the development of dermatological products. It enables the incorporation of active pharmaceutical ingredients (APIs) into various dosage forms and delivery systems that are optimized for skin absorption and retention. This includes the use of nanoparticles, liposomes, and other carrier systems that can enhance the permeation of APIs through the skin barrier. Dermatopharmaceutics also involves the use of natural ingredients and novel delivery systems to provide improved efficacy, reduced side effects, and improved patient compliance [4].

The history and development of dermatological formulations can be traced back to ancient civilizations. The Egyptians, for example, used a variety of natural ingredients such as honey, milk, and oils to treat skin diseases and disorders [5]. The Greeks and Romans also used various topical remedies for skin conditions, including ointments, creams, and poultices [6]. However, the modern era of dermatological formulations began in the late 19th and early 20th centuries, with the development of synthetic in-gredients and the scientific study of skin physiology. In 1872, a German chemist named Paul Unna developed the first modern topical preparation, which was an ointment containing zinc oxide and salicylic acid for the treatment of skin disorders such as acne and eczema [7].

In the early 20th century, the use of topical corticosteroids revolutionized the treatment of inflammatory skin conditions. The first topical corticosteroid, hydrocorti-sone, was introduced in the 1950s and quickly became a mainstay in dermatological therapy. Since then, there have been significant advancements in dermatological for-mulations. The introduction of liposomes in the 1970s opened up new avenues for drug delivery to the skin. In the 1990s, the use of microemulsions and nanotechnology al-lowed for the development of smaller and more efficient drug delivery systems [7]. In recent years, there has been a growing interest in

the use of natural ingredients and green chemistry in dermatological formulations, leading to the development of plant-based and organic products [6].

2. The role of NLCs in improving skin penetration

Nanoparticles and nanostructured lipid carriers (NLCs) are advanced delivery systems that have shown great potential for enhancing the efficacy of active ingredients in dermatopharmaceutics. Nanoparticles are particles with a size range of 1 to 1000 nanometers, while NLCs are composed of a mixture of solid and liquid lipids that form nano-sized particles [7].

One of the key advantages of using NLCs for skin delivery is their ability to over-come the limitations of traditional delivery systems such as emulsions, which may have stability issues and limited penetration capabilities. NLCs can protect the active ingre-dients from degradation, prolong their release, and enhance their solubility, resulting in improved skin penetration and increased bioavailability [2].

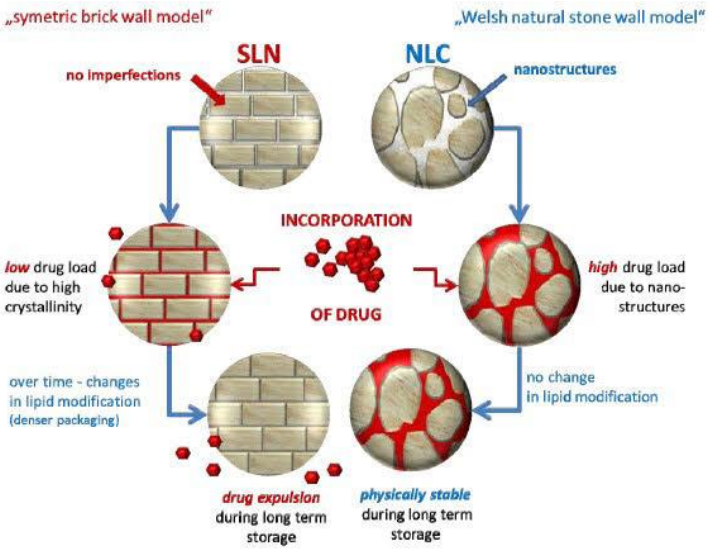

Figure 1. Schematic illustration of SLN versus NLC structure (modified from Beloqui, A et al. Nanomedicine: NBM 2018, 12 (1), 143-61).

Figure 1 illustrates the difference in structure between solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC). NLCs consist of a mixture of solid and liquid lipids, which results in a less ordered lipid matrix that improves drug loading efficiency and prevents drug leaching and oxidation during storage. On the other hand, SLNs consist of solid lipids and a stabilizer, forming a solid lipid matrix that entraps hydrophobic drugs. SLNs are highly biocompatible and biodegradable but have a lim-ited drug loading capacity of about 25% concerning the lipid matrix. NLCs, on the other hand, have a higher drug-loading capacity and a more sustained drug release than SLNs [8].

Aditya et al. (2014) compared the effectiveness of different lipid nanocarriers for the delivery of quercetin. The study evaluated the stability, particle size, and drug re-lease of solid lipid nanoparticles (SLN), nanostructured lipid carriers (NLC), and lipid nanoemulsions (LNE). The results showed that NLCs had the highest drug loading capacity and the most sustained drug

release compared to SLNs and LNEs. The study concluded that NLCs could be a promising delivery system for quercetin due to their improved stability, drug-loading capacity, and sustained drug release. The study pro-vides valuable insights into the potential of NLCs for the delivery of natural compounds with therapeutic benefits [9].

The composition of NLCs can be easily modified to optimize the delivery of specific active ingredients, making them highly versatile for use in dermatopharmaceutics. NLCs have also shown promising results in enhancing the therapeutic effects of natural ingredients such as curcumin, resveratrol, and tea tree oil, which have an-ti-inflammatory, antioxidant, and anti-microbial properties. In addition, NLCs can im-prove the stability and efficacy of these natural ingredients, which may be susceptible to degradation and loss of activity. The improved skin penetration of active ingredients delivered by NLCs can also result in enhanced efficacy and reduced dosages, thereby minimizing potential adverse effects [2].

NLCs are composed of a mixture of solid and liquid lipids, which are stabilized by surfactants. The solid lipids used in NLC matrices include stearic acid, carnauba wax, glyceryl tristearate, glyceryl monostearate, and cetyl palmitate. The liquid lipids used in NLC matrices include soybean oil, oleic acid, vitamin E, corn oil, and squalane. The surfactants used in NLC matrices include Tweens, lecithin, poloxamer 188, sodium dodecyl sulfate, and sodium deoxycholate.

Solid lipids are used in NLC matrices to provide stability and control the release of active ingredients. Solid lipids can also improve the bioavailability of active ingredients by enhancing their solubility and penetration into the skin. Liquid lipids are used in NLC matrices to improve the fluidity and flexibility of the lipid matrix, which can en-hance the stability and bioavailability of active ingredients. Surfactants are used in NLC matrices to stabilize the lipid matrix and prevent aggregation of the nanoparticles.

The choice of lipids and surfactants used in NLC matrices can have a significant impact on the properties and performance of the nanoparticles. Different combinations of lipids and surfactants can be used to optimize the stability, solubility, and bioavaila-bility of active ingredients. For example, the use of glyceryl monostearate as a solid lipid and oleic acid as a liquid lipid has been shown to improve the stability and bioavaila-bility of quercetin, a natural antioxidant and anti-inflammatory agent [9]. Similarly, the use of poloxamer 188 as a surfactant has been shown to improve the stability and bio-availability of curcumin, a natural anti-inflammatory agent.

Nanostructured lipid carriers (NLCs) are advanced delivery systems that have several key advantages over traditional delivery systems. NLCs protect the active in-gredients from degradation and provide a longer shelf life than traditional delivery systems, which means that they can be stored for longer periods without losing their efficacy. This is due to the presence of liquid lipids in NLCs formulation, which mini-mizes the expulsion of loaded drugs after formulation and during the storage period. NLCs can show more controllable release profiles in comparison to traditional delivery systems. This is due to the less ordered lipid matrix of NLCs, which can prolong the release of active ingredients from the matrices. NLCs can improve the solubility of ac-tive ingredients in the lipid matrix, which can enhance their bioavailability and efficacy. This is due to the presence of liquid lipids in NLCs formulation, which can increase

drug solubility in the lipid matrix. NLCs can enhance the skin penetration of active ingredients, resulting in improved therapeutic effects [10]. NLCs have a higher drug loading capacity than traditional delivery systems, which means that they can carry a larger amount of active ingredients per unit of volume. This can result in more efficient drug delivery and reduced dosages, which can minimize potential adverse effects. NLCs are biocompatible and biodegradable, which means that they are less likely to cause adverse effects and are more environmentally sustainable than traditional delivery systems.

3. Role of NLCs in improving skin penetration of active ingredients

NLCs improved skin penetration of active ingredients. The smaller size of NLCs ensures closer contact with the stratum corneum, which can enhance the skin penetra-tion of active compounds. The occlusive properties of NLCs can increase skin penetra-tion of active ingredients. NLCs improve skin hydration, occlusion, and skin targeting. The comparability of lipids in sebum and NLCs facilitates deeper and more remarkable penetration of the lipid nanoparticles across the skin. Overall, NLCs have shown promise in improving the skin penetration of active ingredients, making them a prom-ising drug delivery system for various applications [11].

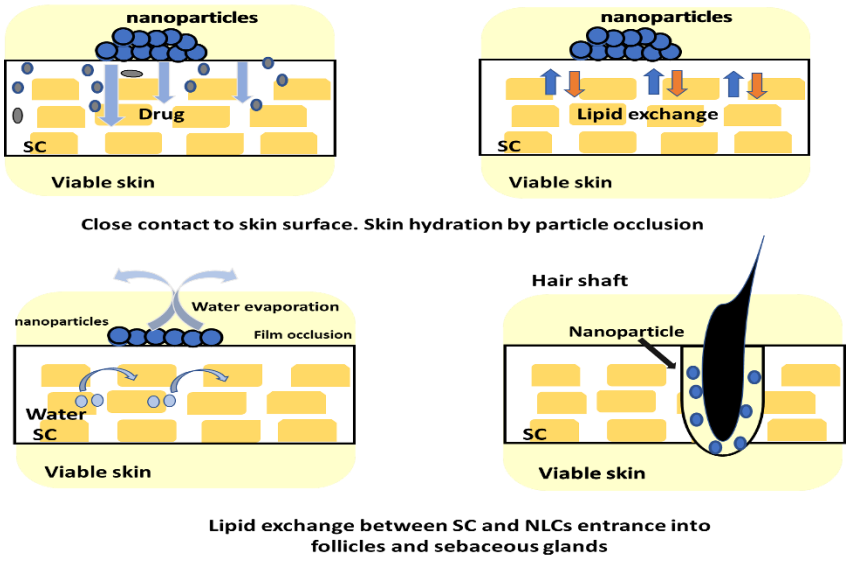

Figure 2. Possible mechanism of skin permeation by NLCs (Modified from Kaur et al. Asian Pac. J. Health Sci., 2015; 2(2): 76-93).

Figure 2 illustrates the possible mechanisms for skin permeation enhancement of drugs or active ingredients from NLCs. Nanosized particles can closely interact with the outer layers of the skin, including the tiny spaces between skin cells. This allows the active ingredients to spread on the surface. When the water in these nanosystems evaporates after application, the particles create a sticky layer that seals the skin. This leads to increased moisture in the outer skin layer, which opens up spaces between skin cells. This moisture also affects how the drug is distributed within the skin. Particles larger than 100 nanometers are generally too big and inflexible to pass through this outer layer of the skin.

Although these particles don't go through the outer skin layer, they can still be absorbed by the skin. Because the outer skin layer is rich in fats, nanoparticles made of fats that attach to

the skin can facilitate the exchange of fats between the skin and the nanoparticles. These fat-based nanoparticles also have the potential to transport drugs through hair follicles. Each follicle is linked to an oil-producing gland, which releases a mixture of fats. This oily environment is favorable for trapping fat-based nanoparticles. Some types of fat in these nanoparticles may speed up their entry into the follicles and glands.

4. Natural ingredients commonly used in cosmetics.

The world of cosmetics has witnessed a profound transformation in recent years, with a discernible shift towards harnessing the power of nature. Natural ingredients have emerged as cornerstones in cosmetic formulations, each endowed with unique mechanisms of action. These ingredients, categorized by their primary functions include moisturizers, antioxidants, anti-inflammatories, antibacterial and antifungal agents, skin brighteners, and anti-aging compounds.

Among the quintessential components of any skincare regimen, moisturizers play a pivotal role in maintaining skin hydration and integrity. Shea butter, derived from the African shea tree, stands as a paragon of emollients. Its rich lipid profile ensures deep and lasting hydration, making it an indispensable ingredient for dry and sensitive skin. Alongside, aloe vera gel, coconut oil, and glycerin complement this cohort, collectively forming a formidable arsenal against dehydration and epidermal stress.

The battle against free radicals and oxidative stress is waged with an array of nat-ural antioxidants. Vitamin C, an exemplar of this category, stands tall with its potent ability to neutralize free radicals, bolstering collagen synthesis and imparting radiance to the skin. Vitamins E and Coenzyme Q10 join this fray, fortifying the skin's defenses against premature aging. Green tea extract, a trove of polyphenols, and rosehip oil, abundant in beta-carotene and lycopene, further augment this protective shield.

NLC increases in vivo penetration of Coenzym Q10. Additionally, molecular modeling in silico was performed by molecular docking to predict and explain the re-sults of the experimental study [12]. Intermolecular interactions consist of ionic, ion-dipole, dipole-dipole, hydrogen, van der Waals, and hydrophobic bonds [13]. The 3D visualization of coenzyme Q10-lipid demonstrated that functional groups of coenzymes Q10 still exist in the interaction of coenzyme Q10-lipid.

Inflammation, a formidable adversary, finds its match in natural anti-inflammatory agents. Chamomile extract, with its soothing properties, provides respite for irritated skin, while turmeric extract, a venerable curcumin source, exerts its anti-inflammatory prowess. Lavender oil and tea tree oil emerge as versatile allies, quelling redness and irritation, making them indispensable components for sensitive skin formulations [14].

Nature's pharmacy harbors a diverse array of compounds adept at combating mi-crobial threats. Tea tree oil, known for its potent antimicrobial properties, and neem oil, with its multifaceted antibacterial and antifungal attributes, are prominent members of this arsenal. Oregano oil, thyme extract, and grapefruit seed extract further reinforce this frontline defense against pathogens, ensuring the skin's health and vitality.

The quest for a radiant complexion finds solace in skin-brightening agents. Licorice extract, revered for its melanin-inhibiting properties, and Vitamin C, a luminary in re-ducing hyperpigmentation, lead the charge. Niacinamide, bearberry extract, and al-pha-arbutin join their ranks, bestowing a luminous glow and even complexion to the skin.

Aging gracefully is facilitated by an array of natural anti-aging champions. Retinol, an established force in cellular rejuvenation, and hyaluronic acid, a moisture-retaining marvel, restore suppleness and firmness to the skin. Peptides, resveratrol, and collagen supplement this lineup, replenishing the skin's resilience and vitality [15].

5. NLCs for skin delivery of natural active ingredients

Natural ingredients in cosmetic formulations have become increasingly popular in recent years due to a growing interest in green and sustainable products. There are several reasons why natural ingredients in cosmetic formulations are important. They are generally considered safer than synthetic ingredients as they are less likely to cause skin irritation or allergic reactions. Many natural ingredients also have an-ti-inflammatory and soothing properties that can benefit the skin. Natural ingredients are often more environmentally sustainable than synthetic ingredients, as they are re-newable and biodegradable. They are also often sourced from organic or sustainable farming practices, which can have a positive impact on the environment. Many natural ingredients, such as green tea, aloe vera, and vitamin E, have potent antioxidant prop-erties that can help protect the skin from damage caused by free radicals. This can help to prevent premature aging and improve the overall health of the skin. Natural ingre-dients can be used in a variety of cosmetic formulations, including creams, lotions, se-rums, and masks. They can also be combined with other natural ingredients to create unique and effective formulations.

Using NLCs for skin delivery has shown promising results in enhancing the sta-bility and skin penetration of active ingredients, resulting in improved therapeutic ef-fects. A study explored the use of NLCs for the delivery of ubiquinone to the skin, which improved its stability and skin penetration, resulting in enhanced anti-oxidant and an-ti-inflammatory effects [16]. Another study investigated the use of NLCs for the deliv-ery of ubiquinone and vitamin E to the skin. The encapsulation of these natural ingre-dients in NLCs improved their stability and skin penetration, resulting in enhanced anti-oxidant and anti-aging effects [16].

Oleanolic acid is a naturally occurring pentacyclic triterpenoid compound found in many plants, including olive leaves, rosemary, and lavender. It has been widely studied for its various pharmacological properties, including anti-inflammatory, antioxidant, anti-tumor, and anti-microbial activities. In dermatopharmaceutics, oleanolic acid is used primarily for its anti-inflammatory and antioxidant properties, which make it a promising ingredient for the development of skincare and cosmetic products. It has been shown to have protective effects against UV-induced skin damage, as well as to reduce inflammation and oxidative stress in the skin. Additionally, oleanolic acid has been investigated for its potential as a treatment for various skin conditions, including acne, psoriasis, and atopic dermatitis [17].

Several studies have explored the use of oleanolic acid in various delivery systems, including liposomes and nanostructured lipid carriers, to improve its stability, solubil-ity, and

bioavailability. These delivery systems have shown promise in enhancing the penetration of oleanolic acid into the skin, thus improving its therapeutic effects. Lip-osomes improved the solubility and stability of oleanolic acid and enhanced its skin penetration, resulting in improved anti-inflammatory and wound-healing effects. NLCs for the delivery of oleanolic acid to the skin improved the solubility and stability of oleanolic acid and enhanced its skin penetration, resulting in improved an-ti-inflammatory and antioxidant effects [18]. Another study found that liposomes improved the solubility and stability of oleanolic acid and enhanced its skin penetration, resulting in improved anti-inflammatory and antimicrobial effects [19].

Tea tree oil is a natural essential oil that has antimicrobial and anti-inflammatory properties. It has been studied for its potential in treating scabies, but the evidence is limited and the results are mixed. One study found that a 5% tea tree oil cream was ef-fective in treating scabies in 68% of patients, while another study found that a 10% tea tree oil cream was no more effective than a placebo [20, 21].

Bakuchiol is a natural ingredient that has gained attention in dermatopharmaceu-tics due to its anti-aging properties. Several studies have explored the use of bakuchiol in various delivery systems, including liposomes and nanostructured lipid carriers, to improve its stability, solubility, and bioavailability. One study investigated the potential of a nanostructured lipid carrier (NLC) loaded with bakuchiol for the treatment of photoaging. The study found that the NLC formulation of bakuchiol demonstrated significant antioxidant and anti-inflammatory activity, which can help in reducing skin aging. The researchers concluded that the NLC loaded with bakuchiol could be a promising anti-aging product for topical application [22]. Another study evaluated the efficacy of liposomal formulations of bakuchiol for the treatment of acne vulgaris. The study showed that the liposomal formulation of bakuchiol exhibited superior activity against Propionibacterium acnes, which is a bacterium involved in the development of acne. The researchers concluded that the liposomal formulation of bakuchiol could be a potential treatment option for acne vulgaris [23].

NLCs have been shown to enhance the therapeutic effects of natural ingredients such as curcumin, ascorbyl palmitate, α-mangostin, resveratrol, and tea tree oil. One possible mechanism is that NLCs can improve the skin penetration of natural ingredi-ents, which can enhance their therapeutic effects [15, 24].

A study found that NLCs can increase the bioavailability and antitumoral activity of curcumin by entrapping it into NLCs. Another study found that NLCs can improve the stability of curcumin, reducing its degradation and enhancing its anti-inflammatory effects [25]. It was also reported that NLCs improve the stability and in vitro permeation of curcumin. The optimized curcumin-loaded NLCs had uniformly spherical shapes with a mean diameter of 263.9 nm. The permeation ability of Cur-LNCs and Cur-NLCs-Gel were characterized in vitro. The results showed that the optimized Cur-LNCs represented uniform nano-sized particles with high entrapment efficiency and zeta potential. Cur-NLCs and the gel formulation showed improved skin permea-tion in vitro. The permeation mechanism was researched by histopathology study. The results suggested that the NLC-based formulation had the potential to improve the ef-ficacy of curcumin [25]. Another study investigated the use of curcumin-

loaded NLCs for enhanced skin-retained topical delivery. The study aimed to improve the permeation of poorly soluble curcumin into topical skin layers for the treatment of chronic inflammatory disorder psoriasis and microbial-mediated acne vulgaris. Curcumin-NLC showed extended in-vitro release for up to 48 hours, whereas free curcumin showed 100% drug release within 4 hours. Ex-vivo skin permeation studies revealed 3.24-fold improved permeation and skin retention in the case of curcumin-loaded NLC gel compared to free curcumin gel [26].

The study formulated Ascorbyl Palmitate in NLC with various types of lipids, prepared using the HPH method for 3 cycles at 500 bar. The results showed that the optimized AP-loaded NLCs had particle sizes ranging from 170-250 nm, with a poly-dispersity index (PI) less than 0.3. The encapsulation efficiency (EE) was close to 100%. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) analysis re-vealed non-spherical particle shapes. The permeation ability of AP-loaded NLCs and NLC-gel were characterized in vitro. The results showed that the NLC-based formula-tion had the potential to improve the efficacy of AP [27].

A study by Samprasit et al. (2022) focused on enhancing antioxidant activity using dual drug-loaded Nanostructured Lipid Carriers (NLCs) containing alpha-mangostin (M) and resveratrol (R) for topical delivery. These NLCs were prepared using the high-pressure homogenization (HPH) method over 3 cycles at 500 bar. The optimized dual drug-loaded NLCs exhibited a particle size between 170-250 nm, with a polydis-persity index (PI) below 0.3. Encapsulation efficiency (EE) was nearly 100%. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) analyses revealed non-spherical particle shapes. In vitro characterization of permeation ability was con-ducted for both dual drug-loaded NLCs and NLC-gel. The results demonstrated the potential of the NLC-based formulation in enhancing the effectiveness of al-pha-mangostin and resveratrol [28].

In our study, we discovered that Tea Tree Oil (TTO) demonstrated in vitro anti-fungal activity comparable to ketoconazole cream, a widely recognized antifungal agent. We successfully developed TTO-loaded Nanostructured Lipid Carriers (NLCs) using a combination of various solid and liquid lipids, ensuring favorable storage stability for up to one month, along with potent antifungal potential. These NLCs were prepared through the high-shear homogenization method, employing formulations with diverse lipid types. The optimized TTO-loaded NLCs displayed a particle size ranging from 170-250 nm, with a low polydispersity index (PI) of less than 0.3. The encapsulation ef-ficiency (EE) was nearly 100%. Microscopic analysis using scanning electron microscopy (SEM) and atomic force microscopy (AFM) revealed non-spherical particle shapes. Ad-ditionally, we conducted in vitro assessments of the antifungal activity of TTO-loaded NLCs, demonstrating their potential for enhanced efficacy compared to traditional formulations. This research showcases the promising application of NLC-based formulations for improving the antifungal properties of Tea Tree Oil (29). Tea tree oil-loaded NLCs provide good stability and potential for topical antifungal, it can be shown in Figure 3.

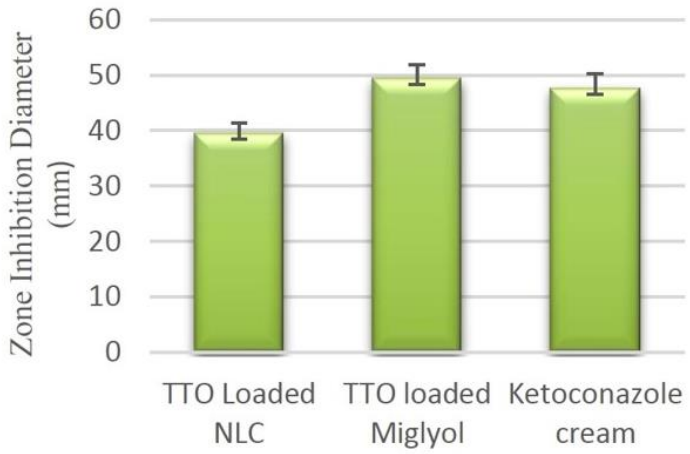

Figure 3. Diameters of zones of inhibition produced by TTO-loaded NLCs, TTO-loaded Miglyol 812, and ketoconazole cream against Candida albicans (n=3) (modified from Fitriani et al, J. Southwest Jiaotong Univ 2022, 57(1), 205-211).

Nanostructured lipid carriers (NLCs) have been developed for the encapsulation and controlled release of vitamin D3, a lipophilic vitamin. The NLC matrix consisted of oleic acid, glyceryl monostearate, and Tween 80. Vitamin D3 was encapsulated in NLC using the HPH method. The results showed that the optimized NLCs had a particle size of 132.9 nm, a zeta potential of -41.9 mV, and an encapsulation efficiency of 85.6%. NLCs were able to release vitamin D3 in a controlled manner. NLCs were stable and had a relatively uniform size distribution [30].

6. The use of liposomes to improve stability and efficacy

Liposomes are spherical vesicles composed of a phospholipid bilayer that can en-capsulate both hydrophilic and hydrophobic active ingredients. They are widely used in dermatological formulations due to their ability to improve the penetration of active ingredients into the skin, prolong their release, and protect them from degradation [31].

Using liposomes for skin delivery has several advantages, including their ability to target specific layers of the skin, such as the stratum corneum or the epidermis, thereby enhancing the bioavailability and efficacy of the active ingredient. The composition of liposomes can also be easily modified to optimize their stability, size, and charge, al-lowing for customized delivery of active ingredients [31].

Recent studies have explored the use of liposomes for the delivery of bakuchiol, a natural ingredient with anti-aging properties, and mangosteen extract, a natural ingre-dient with anti-inflammatory and antioxidant properties. The results showed that the encapsulation of these natural ingredients in liposomes improved their stability, in-creased their penetration into the skin, and enhanced their therapeutic effects [32]. Encapsulated bakuchiol resulting in better skin performance compared to bakuchiol oils can be seen in Figure 4 and Figure 5.

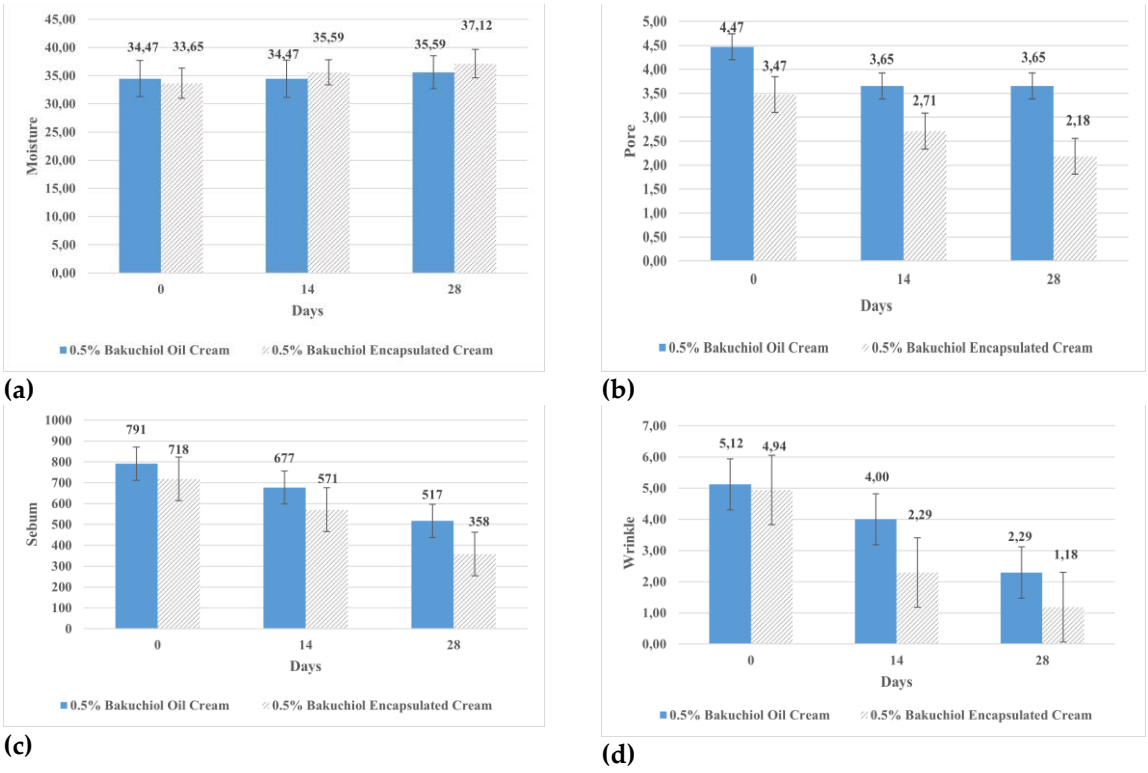

Figure 4. Encapsulated bakuchiol results in better skin performance compared to bakuchiol oils (a) Moisturizer, (b) Pore, (c) Sebum, and (d) Wrinkle [29].

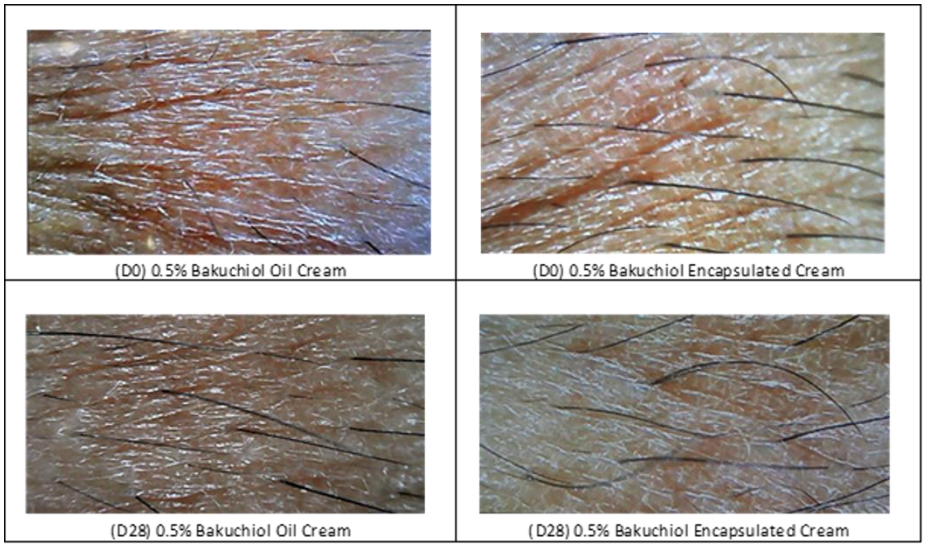

Figure 5. Skin appearance after the application of bakuchiol oil cream 0.5% (left) and en-capsulated bakuchiol cream (right) on day 0 and day 28 using a skin analyzer [29].

Another study investigated the use of liposomes for the delivery of ubiquinone to the skin. The results showed that the encapsulation of ubiquinone in liposomes im-proved its stability and penetration into the skin, resulting in enhanced antioxidant and anti-aging effects [31].

Liposomes have also shown promising results in improving the stability and skin penetration of natural ingredients such as mangosteen extract and α-mangostin. A study reported the use of liposomes for the delivery of mangosteen extract to the skin, which improved its stability

and penetration into the skin, resulting in enhanced an-ti-inflammatory and antioxidant effects [32]. The use of liposomes for the delivery of α-mangostin to the skin also improved its stability and skin penetration, resulting in enhanced anti-inflammatory and antimicrobial effects. It was also reported that the use of liposomes for the delivery of mangosteen pericarp extract to the skin, improved its stability and skin penetration, resulting in enhanced antioxidant and anti-aging effects [32].

7. NLC's Manufacturing Methods

Nanostructured lipid carriers (NLCs) are a versatile class of delivery systems, and their preparation encompasses various techniques. These methods include high-pressure homogenization (HPH), solvent emulsification/evaporation, micro emulsification, film-ultrasonic method, supercritical fluid (SCF) extraction, emulsifica-tion solvent diffusion, solvent injection or solvent displacement, phase inversion tech-nique, multiple emulsion method, and membrane contractor technique.

High-pressure homogenization (HPH) is a widely utilized technique for large-scale NLC production. It involves subjecting lipids to intense pressure, reducing them to submicron sizes. This method can be performed at both elevated temperatures (hot HPH) and below room temperature (cold HPH), allowing flexibility in production conditions.

Solvent emulsification/evaporation involves dissolving lipids and the active in-gredient in an organic solvent, which is then emulsified in an aqueous phase with a surfactant. The subsequent evaporation of the organic solvent under reduced pressure yields NLCs. High-pressure homogenization in SLNs and NLCs can be carried out in two ways, hot or cold high-pressure. The difference between High-pressure homoge-nization and emulsification-solvent evaporation can be shown in Figure 6 and Figure 7.

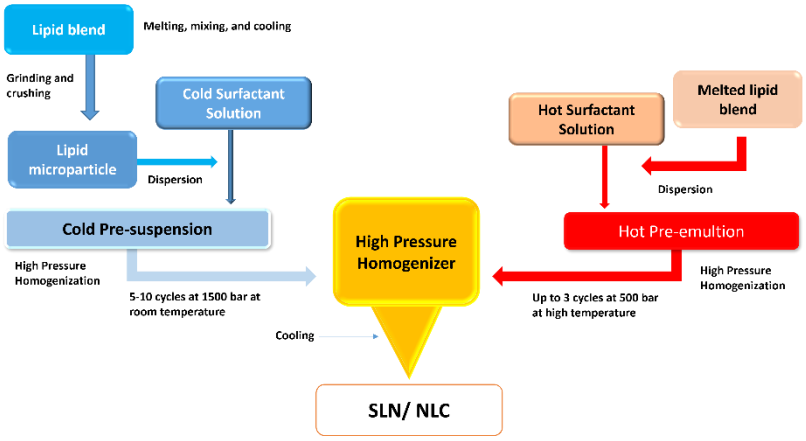

Figure 6. Hot and Cold High-Pressure Homogenization Technique in The Production Of SLN/NLC ((Modified from Kaur et al. Asian Pac. J. Health Sci., 2015; 2(2): 76-93).

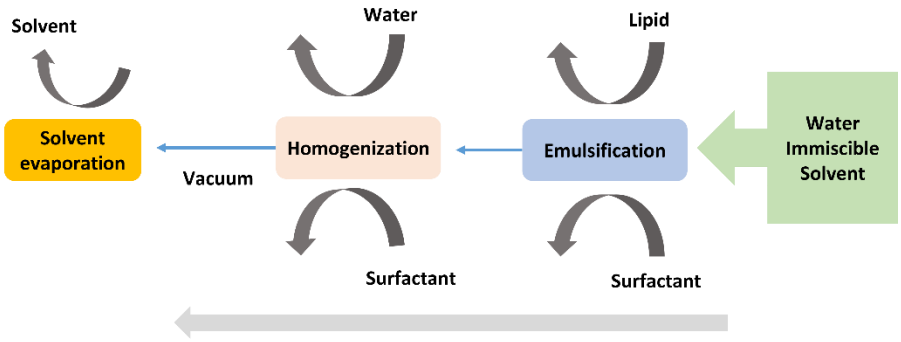

Figure 7. Emulsification-solvent evaporation ((Modified from Kaur et al. Asian Pac. J. Health Sci., 2015; 2(2): 76-93).

Microemulsification entails forming a microemulsion containing lipids and the active ingredient, followed by cooling to create NLCs.

Emulsification solvent diffusion, solvent injection or solvent displacement, phase inversion technique, multiple emulsion method, membrane contractor technique, film-ultrasonic method, and supercritical fluid (SCF) extraction represent additional methods in the preparation of NLCs. Each of these methods offers unique advantages and may be chosen based on specific characteristics of the drug and desired particle size [33]. NLCs shape and surface morphology characteristics are commonly used in Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), and atomic force microscopy (AFM). Electron microscopy (SEM/TEM) can be used for par-ticle size distribution of NLCs. Zeta potential of NLCs characteristic using Optical mi-croscopy, and Photon correlation spectroscopy (PCS)/ Dynamic light scattering. The other characterization can be seen in Table 1.

Table 1. NLCs Characterization

Characterization	Instrument/ Metode
Rheology	Viscometer
In Vitro release	Dialysis membrane dissolution test apparatus/ Franz diffusion cell
Encapsulation efficiency (EE)	Analytical methods according to active ingredients
Drug loading (DL)	DSC, X-Ray diffractometer
Liquid Crystallinity	
physical stability	

8. Conclusion

The presentation provides insights into the potential applications of NLCs for skin delivery and their role in enhancing the bioavailability and efficacy of natural active ingredients in dermatopharmaceutics. The NLCs hold significant promise in enhancing the efficacy of natural active ingredients in skincare formulations. These technologies offer improved stability, solubility, and skin penetration, ultimately leading to enhanced therapeutic outcomes for various skin conditions.

Supplementary Materials: not applicable.

Author Contributions: Conceptualization, CA, EWF, and NLDA.; methodology, CA; software, EWF, and NLDA; validation, CA, and EWF; formal analysis, CA, EWF, NLDA; investigation, CA.; resources, CA, EWF, NLDA.; data curation, CA, EWF, NLDA; writing—original draft preparation, CA; writing—review and editing, CA; visualization, CA, EWF, NLDA; supervision, CA, and NLDA.; project administration, CA, EWF, and NLDA. All authors have read and agreed to the published version of the manuscript.

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Nanoparticle and Nanostructured Lipid Carriers for Skin Delivery

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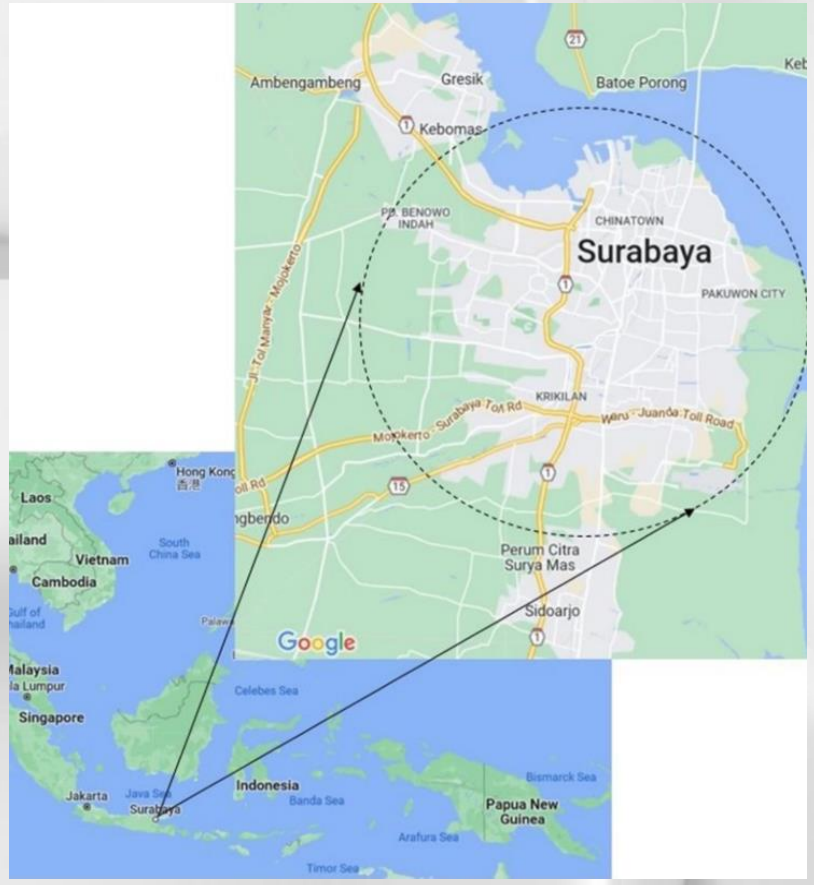

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OUTLINE

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1. Nanoparticles and nanostructured lipid carriers (NLCs)
2. Advantages of using NLCs for skin delivery
3. Role of NLCs in improving skin penetration of active ingredients
4. current research on NLCs for natural cosmetic delivery

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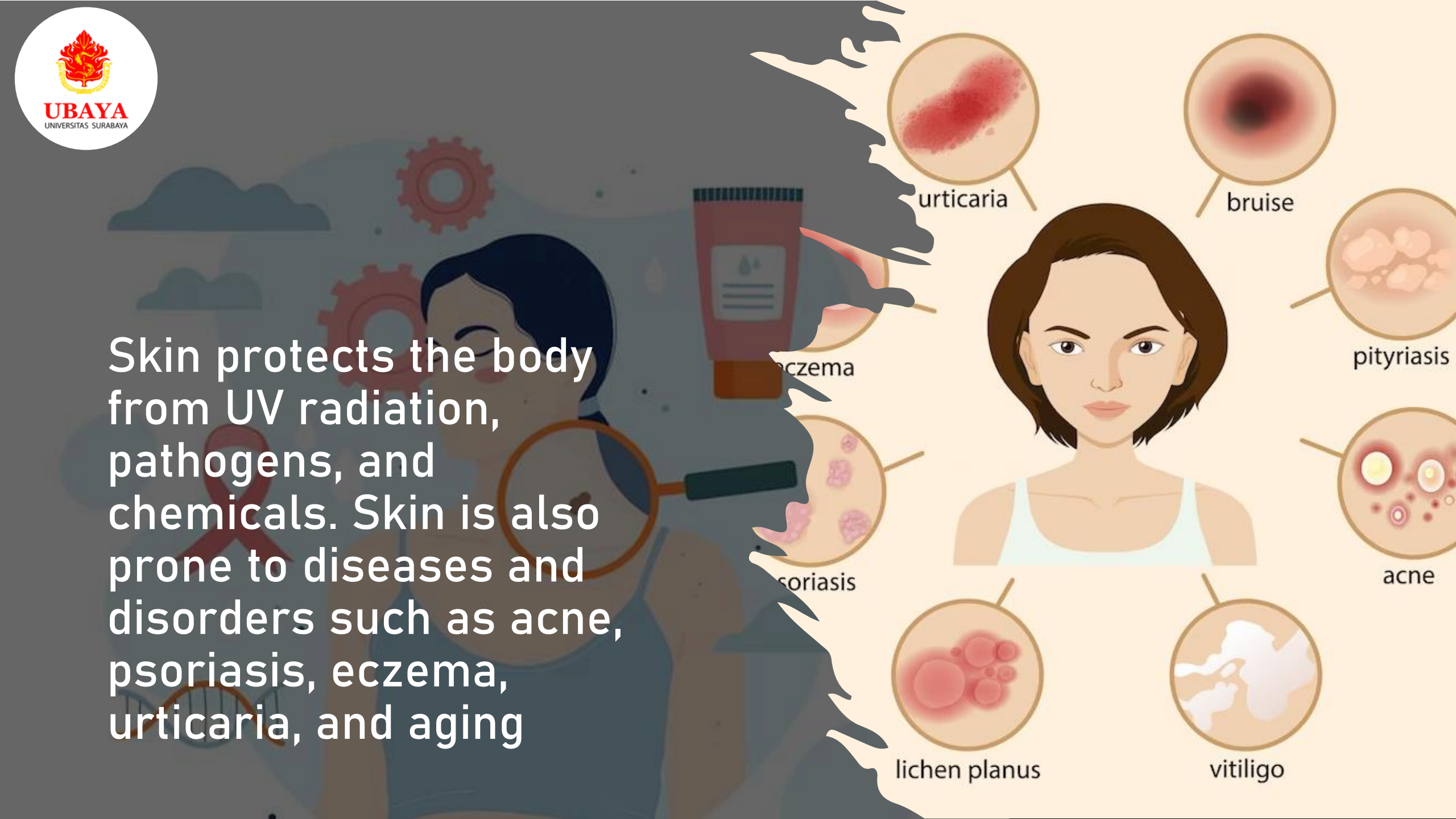
Skin protects the body from UV radiation, pathogens, and chemicals. Skin is also prone to diseases and disorders such as acne, psoriasis, eczema, urticaria, and aging



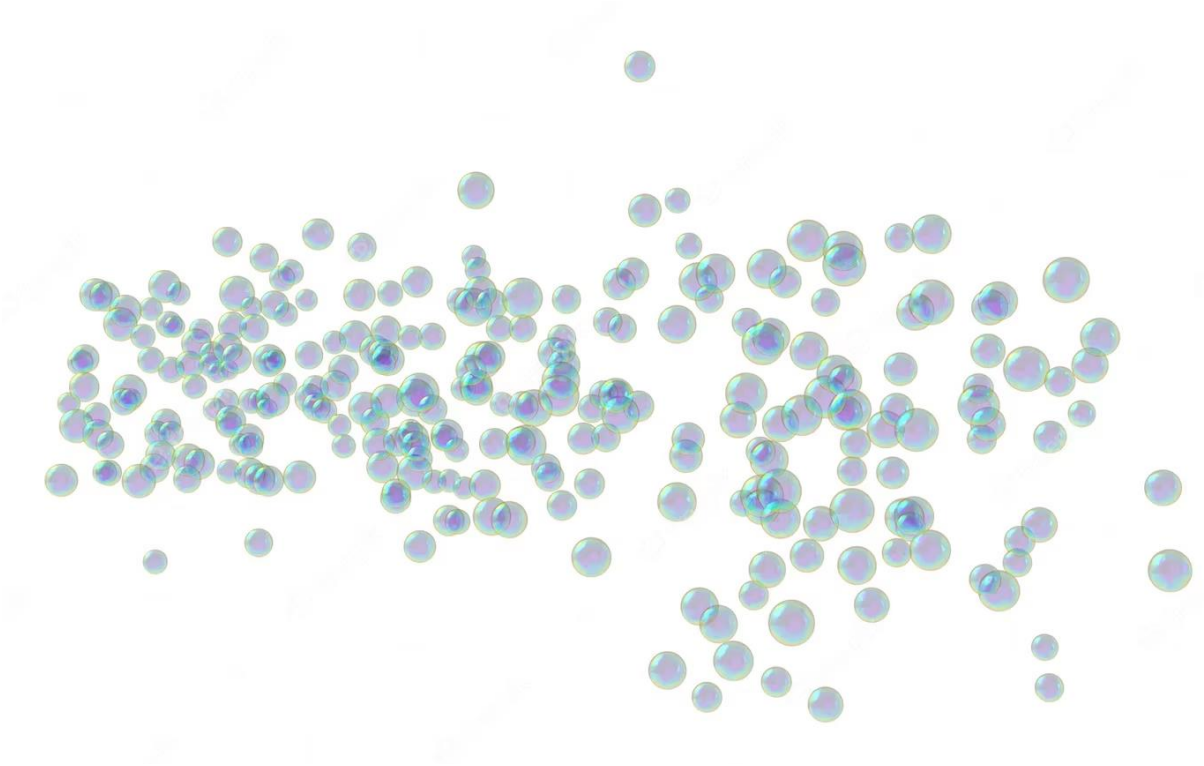
Skin protects the body from UV radiation, pathogens, and chemicals. Skin is also prone to diseases and disorders such as acne, psoriasis, eczema, urticaria, and aging

- Dermatopharmaceutics enables the incorporation of active pharmaceutical ingredients (APIs) into various dosage forms and delivery systems.

- The use of nanoparticles, liposomes, NLC, etc enhancing the permeation of APIs through the skin barrier.

Nanoparticles, solid lipid nanoparticles (SLNs) and nanostructured lipid carriers (NLCs)

- ✓ Nanoparticles are particles with a size range of 1 to 1000 nanometers
- ✓ Solid lipid nanoparticles (SLNs) are composed of solid lipids that form a nano-sized particle
- ✓ nanostructured lipid carriers (NLCs) are composed of a mixture of solid and liquid lipids that form a nano-sized particle.



as the matrix for encapsulating and delivery of APIs

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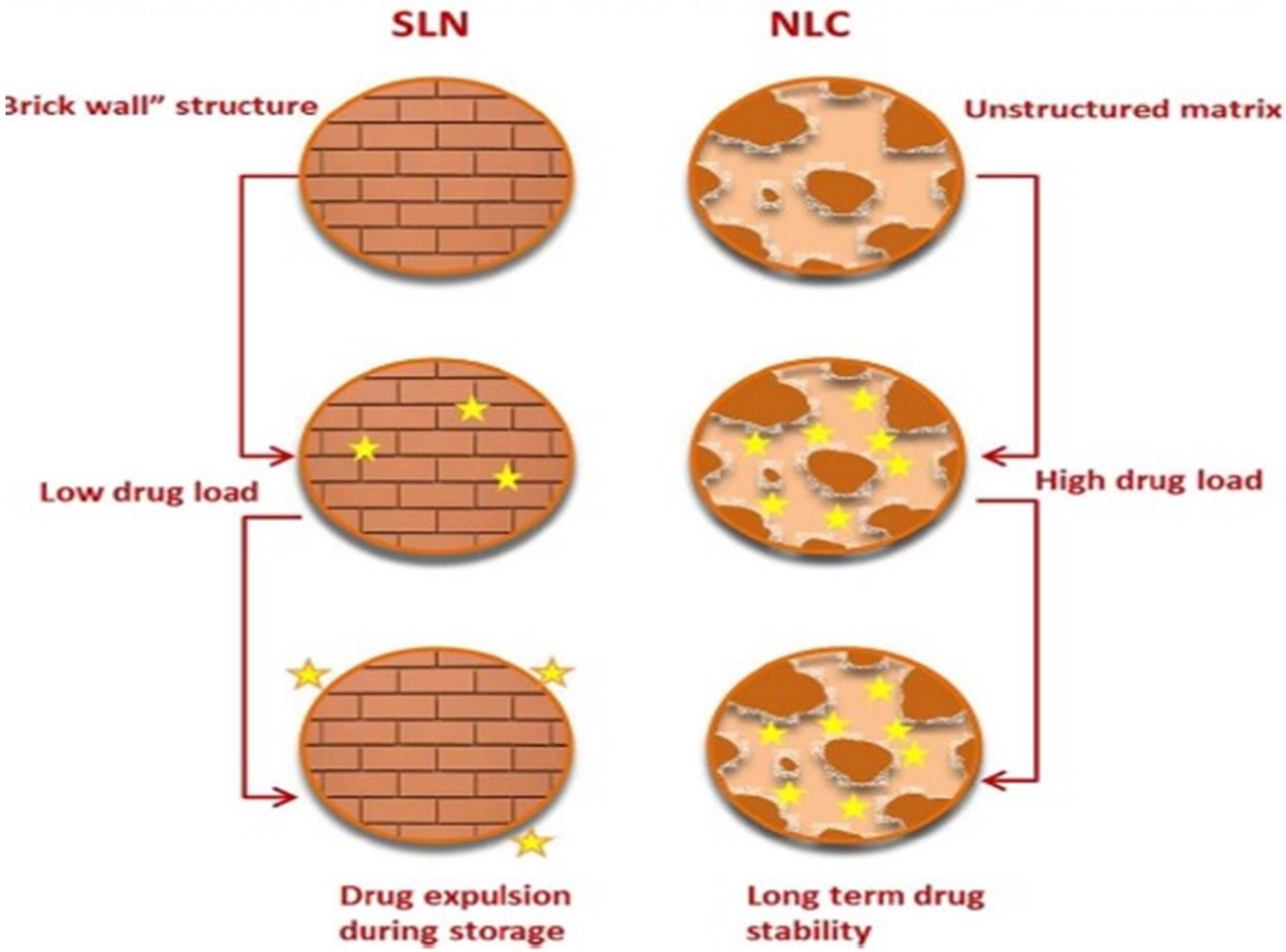
A. Beloqui et al / Nanomedicine: Nanotechnology, Biology, and Medicine 12 (2016) 143–161



A comparative study of lipid nanocarriers for quercetin

- solid lipid nanoparticles (SLN)
- nanostructured lipid carriers (NLC)
- lipid nano-emulsions (LNE)

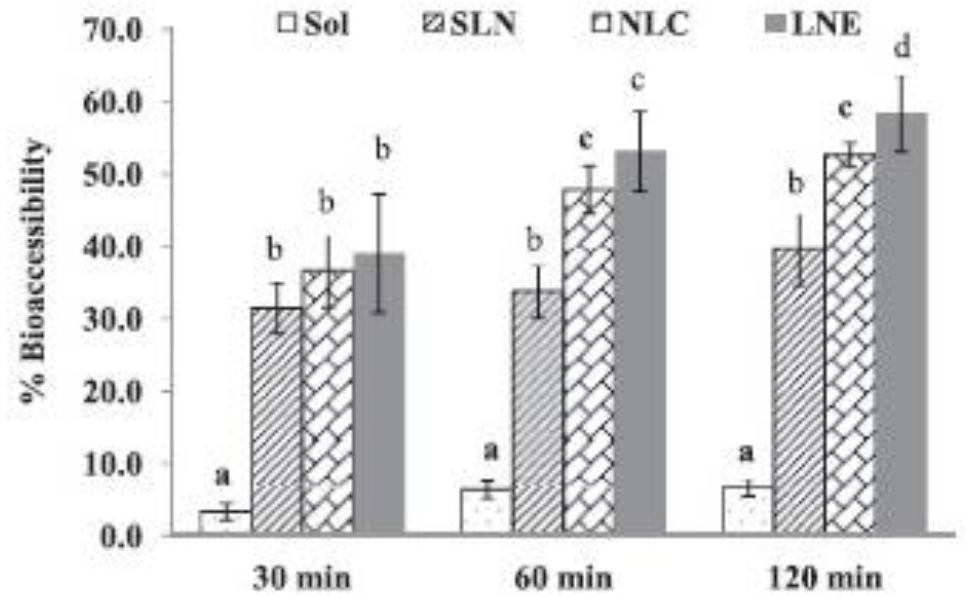


Fig. 3. Time dependent bioaccessibility of quercetin in simulated intestinal condition (mean ± S.D.; $n = 3$). SOL: quercetin dispersed in solution; SLN: solid lipid nanoparticles; NLC: nanostructured lipid carriers; LNE: lipid nanoemulsions. $^{*}P < 0.05$, statistically significant.

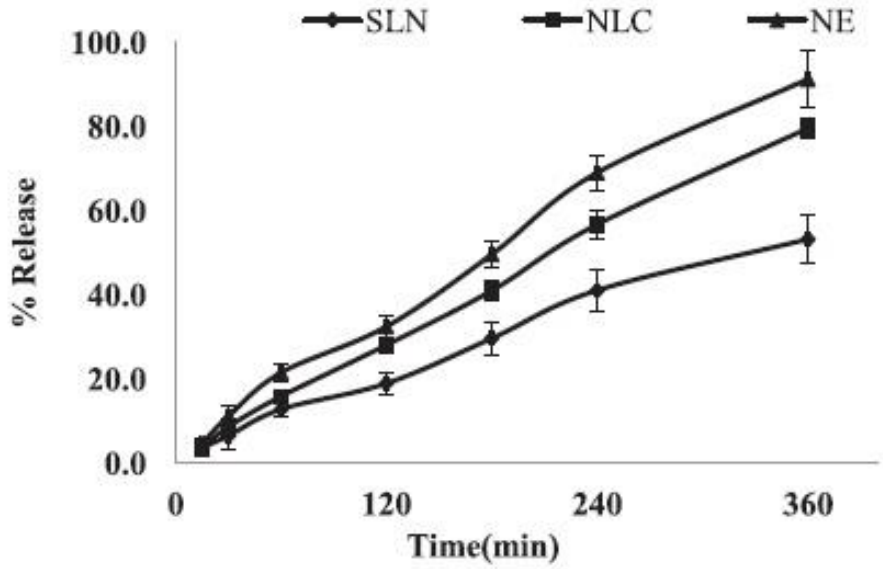


Fig. 4. *In vitro* release profile of quercetin from nanocarriers under enzyme free simulated intestinal condition (mean ± S.D.; $n = 3$). SLN: solid lipid nanoparticles; NLC: nanostructured lipid carriers; LNE: lipid nanoemulsions.

Aditya et al. LWT - Food Science and Technology 59 (2014)

Common lipids and surfactants used for NLC matrices

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Solid Lipids

Asam stearate
Carnauba wax
Glyceryl tristearate
Glyceryl monostearat
Cetyl palmitate

Liquid Lipids

Soybean oil
Oleic acid
Vitamin E
Corn oil
Squalane

surfactants

Tweens
Lecithin
Poloxamer 188
Sodium dodecyl sulfate
Sodium deoxycholate

Key advantages of Advanced delivery NLCs compared to Traditional delivery

Advance delivery (1)	Advance delivery (2)
✓ protect the active ingredients from degradation, ✓ prolong the release, ✓ Enhance the solubility, ✓ improved skin penetration ✓ increased bioavailability	✓ easily modified composition ✓ enhancing therapeutic effects of natural ingredients

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Role of NLCs in improving skin penetration of active ingredients

The smaller size of NLCs ensures a closer contact with the stratum corneum, which can enhance the skin penetration of active compounds.

The occlusive properties of NLCs can increase skin penetration of active ingredients.

NLCs improve skin hydration, occlusion, and skin targeting.

The comparability of lipids in sebum and NLCs facilitates deeper and remarkable penetration of the lipid nanoparticles across the skin.

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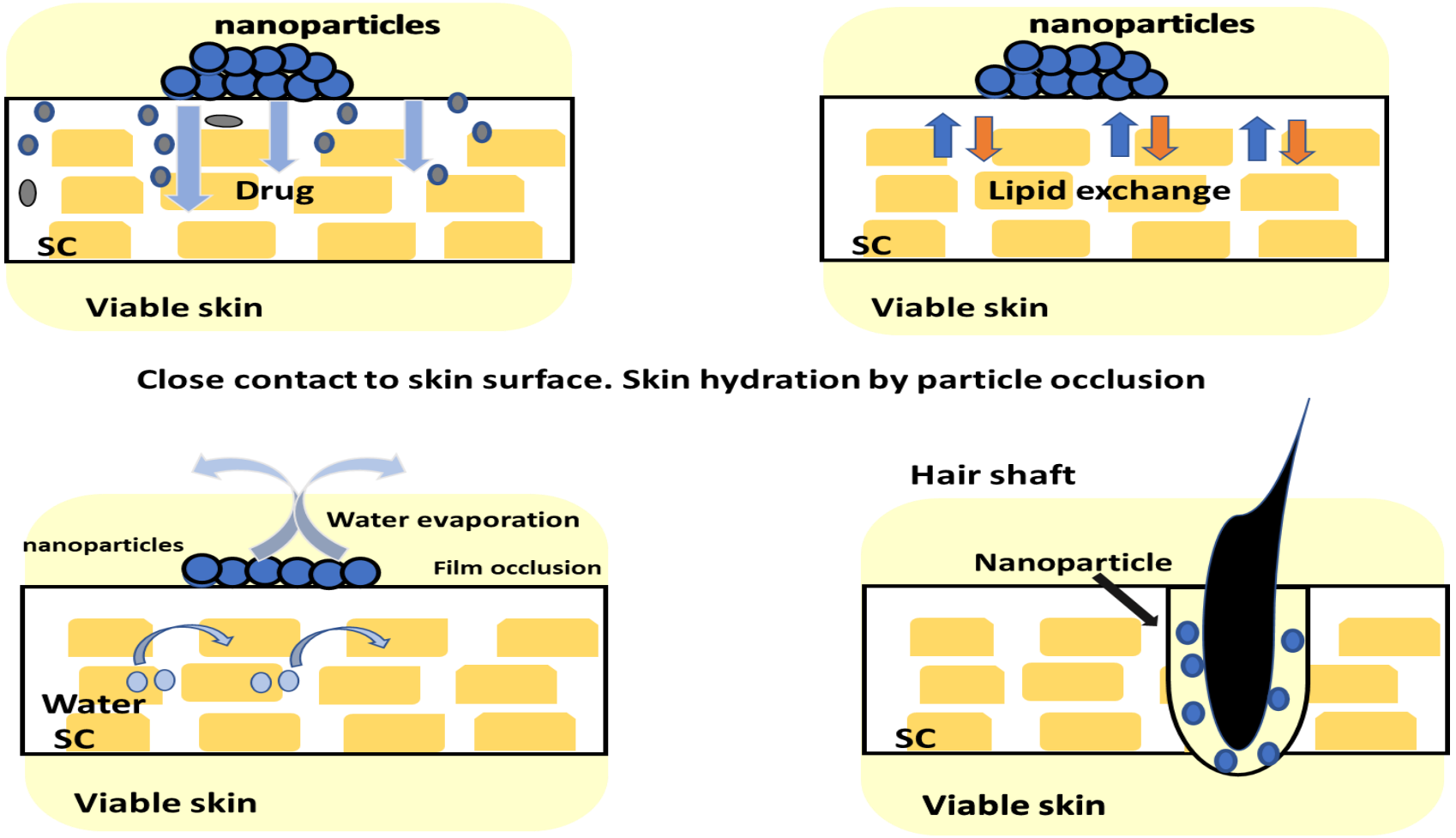
Possible mechanisms for skin permeation enhancement of drugs or active ingredients from NLCs



Kaur et al. *Asian Pac. J. Health Sci.*, 2015; 2(2): 76-93

Natural ingredients commonly used in cosmetics, classified by the primary mechanism of action (1)

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Moisturizers	• Hyaluronic acid • Rosehip oil	• Ceramides • Fatty acids
Antioxidants	• Green tea extracts • Resveratrol	• mangosten extracts • Ubiquinone
Anti-Inflammatories	• Chamomile extracts • Aloe vera	• Centella extracts • Licorice extracts

Natural ingredients commonly used in cosmetics, classified by the primary mechanism of action (2)

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Antibacterial and antifungal	• Tea tree oil • Glycerin	• Essential oils •
Skin brightener	• Niacinamide • Vitamin C	• Licorice extracts • Kojic acid
Anti-aging	• Bakuchiol • Ferulic Acid	• Sea Buckthorn Oil • Pomegranate Extract

NLCs enhancing therapeutic effects of natural ingredients

- curcumin,
- Ascorbyl palmitate
- α-mangostin
- resveratrol
- tea tree oil

10.2174/2210681209666181226153741

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NLCs improve the stability and in vitro permeation of curcumin

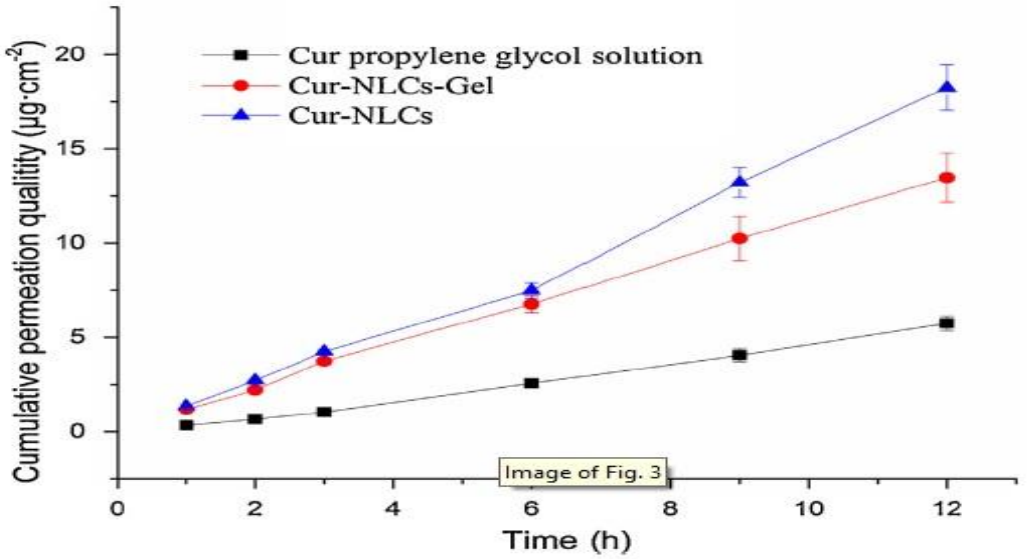

Fig. 3. *In vitro* permeation profiles of Cur from Cur-NLCs, Cur-NLCs-Gel and Cur propylene glycol solution through excised mice skins.

- ✓ Optimized Cur-LNCs had uniformly spherical shapes with a mean diameter of 263.9 nm.
- ✓ Cur-NLCs and the gel formulation showed the improved skin permeation in vitro.
- ✓ The permeation mechanism was researched by histopathology study.

https://doi.org/10.1016/j.colsurfa.2016.06.054

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NLCs improve the stability and efficacy of Ascorbyl palmitate

AP was formulated in NLC with various types of lipids, prepared using the HPH method for 3 cycles at 500 bar

Results:

- ✓ particle size 170-250 nm, polydispersity index (PI) less than 0.3.
- ✓ encapsulation efficiency (EE) was close to 100%.
- ✓ Scanning electron microscopy (SEM) and atomic force microscopy (AFM) analysis revealed non-spherical particle shapes.

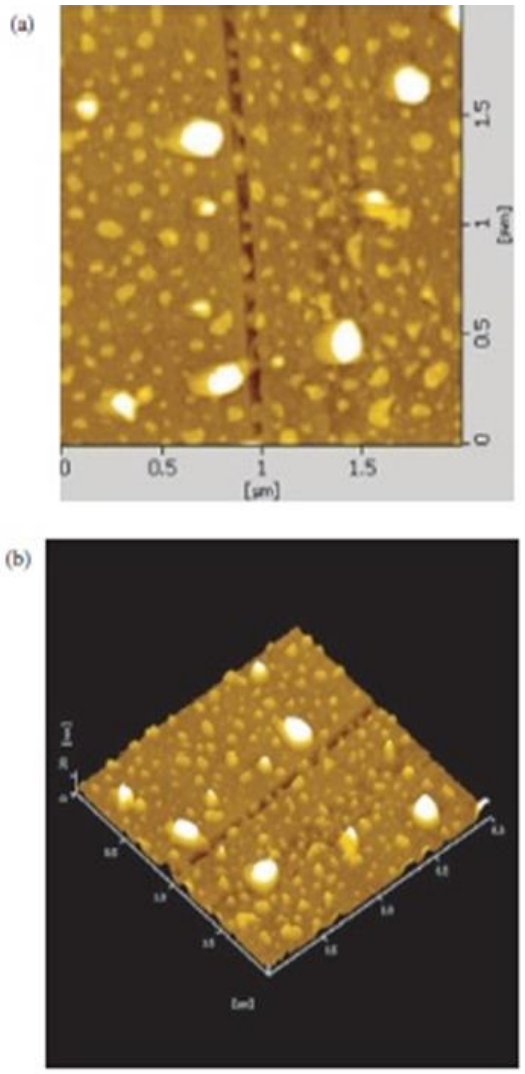
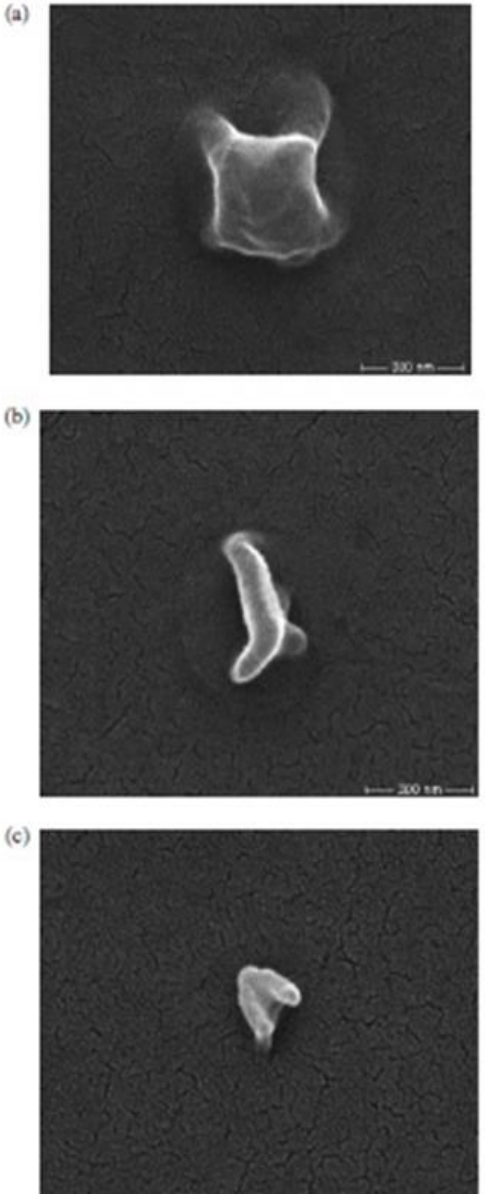
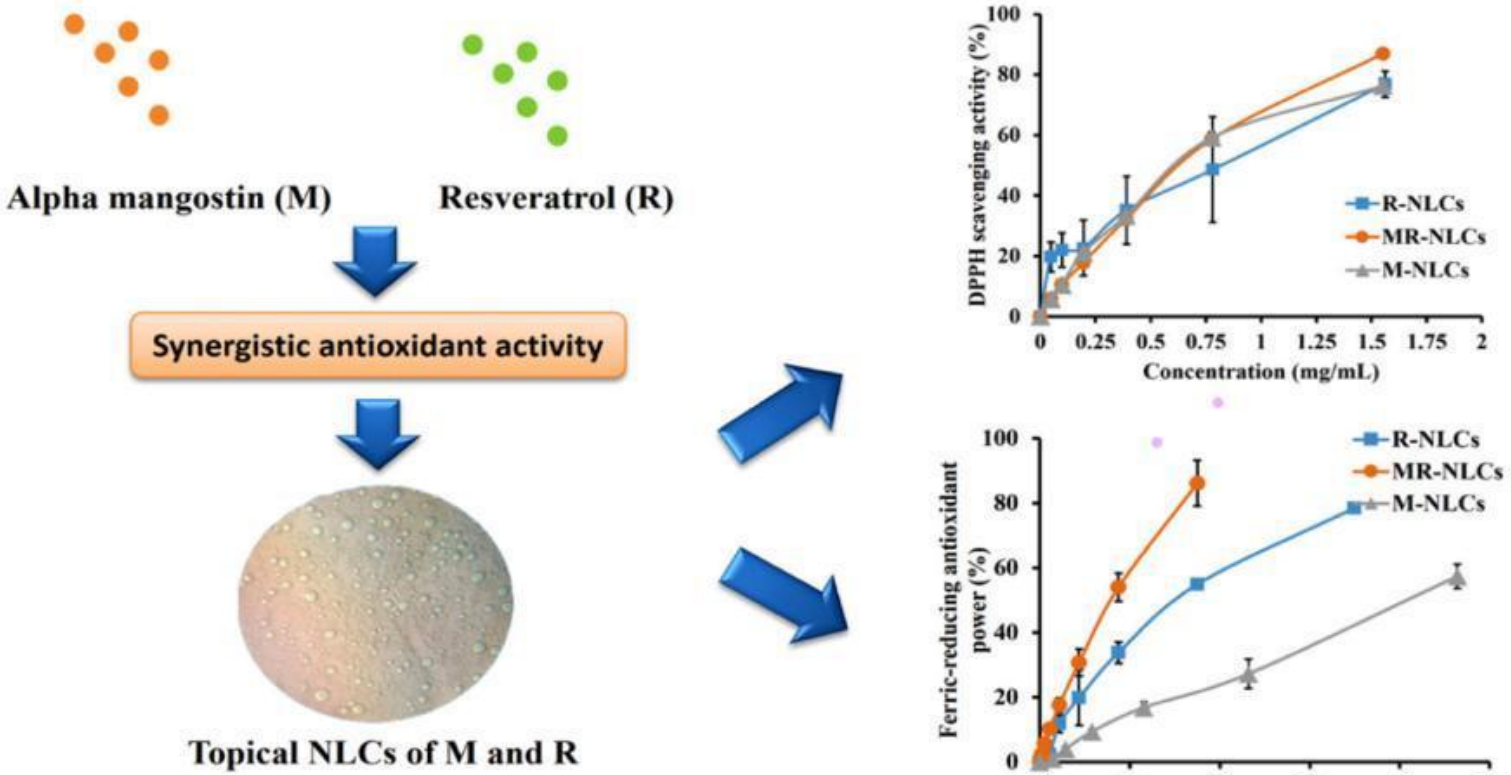


Figure 2. AFM images in non contact mode at 2 μm scan range of AP-loaded GMS. (a) Topographic mode and (b) 3D mode.



DOI: 10.1080/02652040701817762

Dual drug-loaded NLCs of alpha-mangostin (M) and resveratrol (R) enhance antioxidant activity



M and R maintained their synergistic antioxidant activity after being loaded into the NLCs.

•DOI: 10.2174/2211738510666220426112508

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TTO-loaded NLCs provide good stability and potential for topical antifungal.

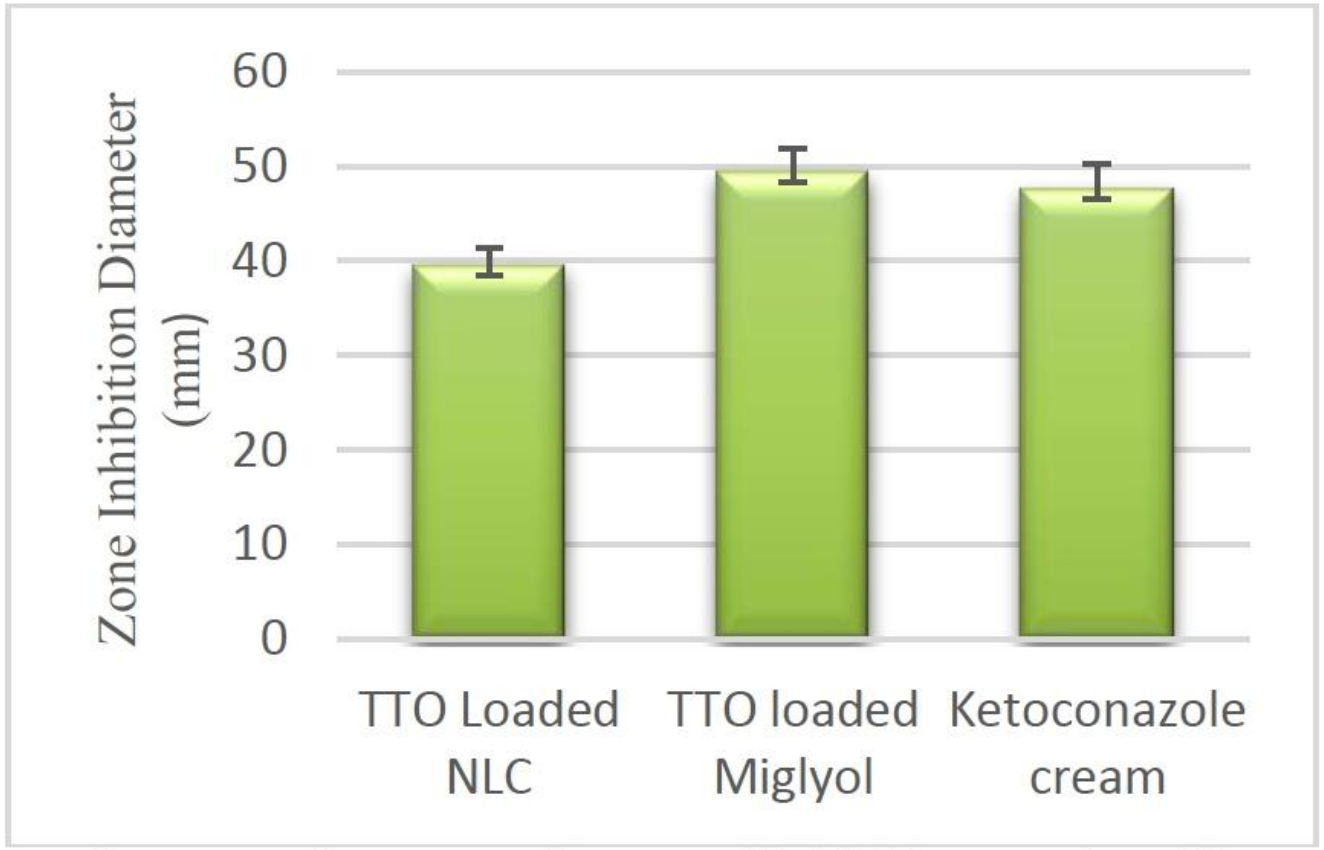
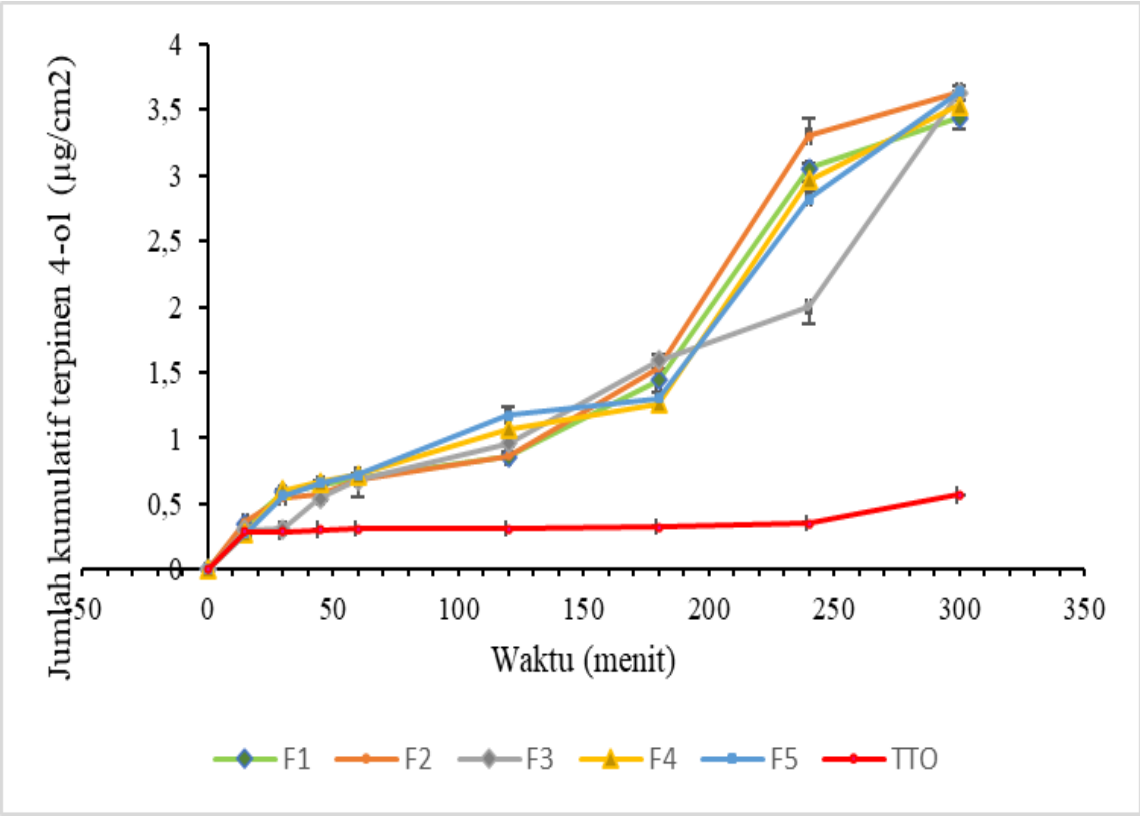


Figure 2. Diameters of zones of inhibition produced by TTO-loaded NLCs, TTO-loaded Miglyol 812, and ketoconazole cream against *Candida albicans* (n = 3)

DOI : 10.35741/issn.0258-2724.57.1.18

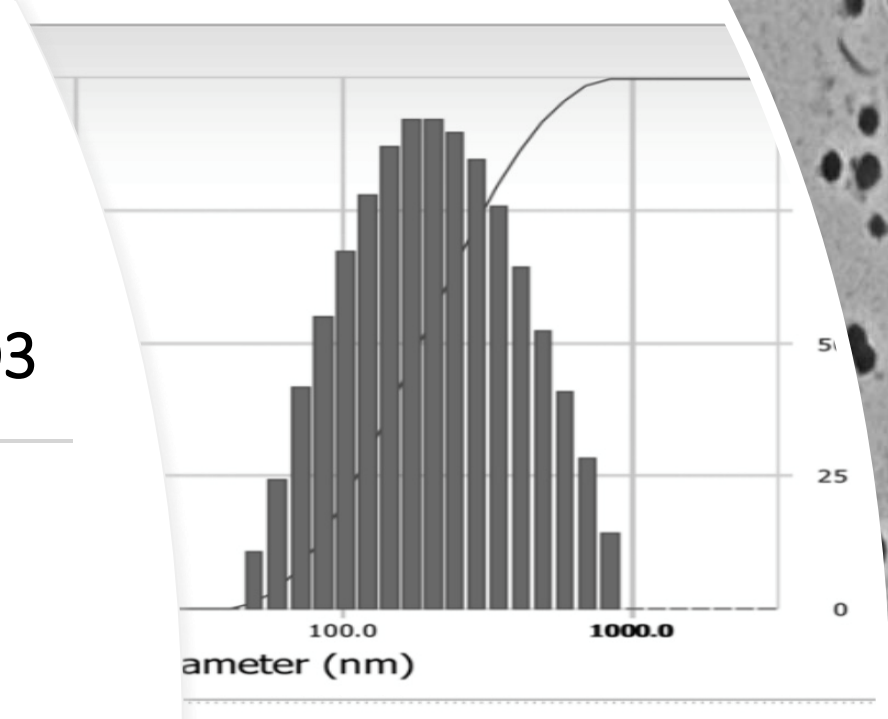
In-vitro penetration

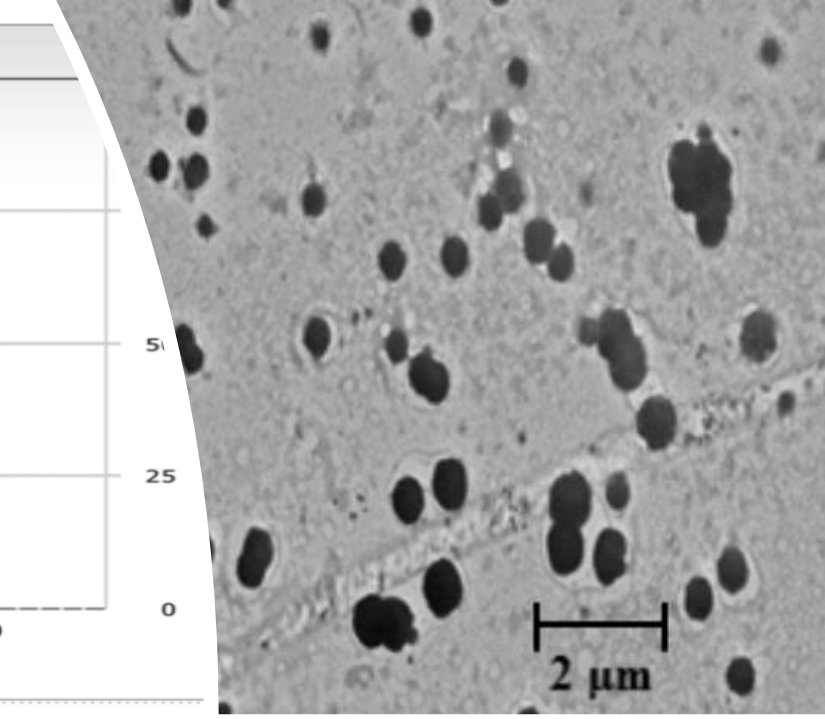


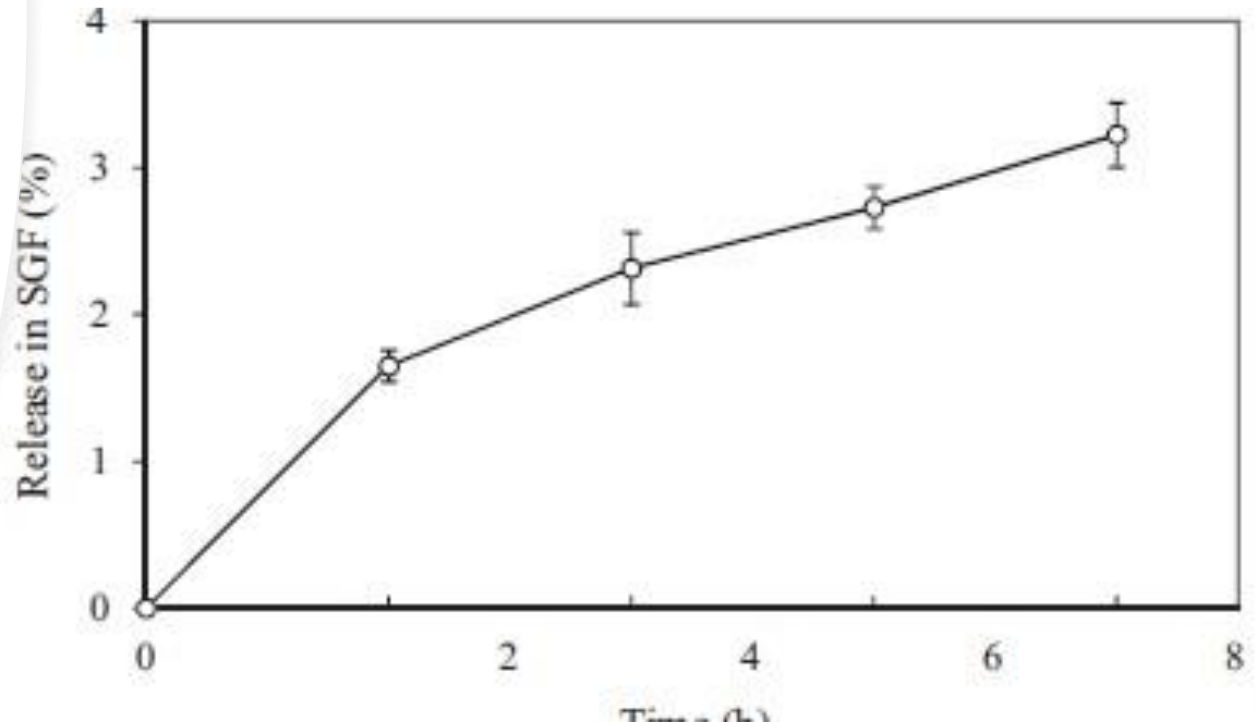
Formula	Jumlah kumulatif (µg/cm²)	Flux (µg/cm2.h)	Cp (cm/h)	Enhancement ratio
NLC 1	3,43850	0,0535	1,19 x 10^{-05}	15,57
NLC 2	3,63973	0,0579	1,29 x 10^{-05}	16,85
NLC 3	3,63143	0,0506	1,12 x 10^{-05}	14,71
NLC 4	3,53385	0,0535	1,19 x 10^{-05}	15,57
NLC 5	3,64016	0,0540	1,2 x 10^{-05}	15,71
TTO	0,56712	0,0034	7,64 x 10^{-07}	1

Development of nanostructured lipid carriers for the encapsulation and controlled release of vitamin D3

- Vitamin D3 encapsulated in NLC using the HPH method.
- The NLC matrix consisted of oleic acid, glyceryl monostearate, and Tween 80.
- Particle size 132.9 nm, a zeta potential of -41.9 mV, and an encapsulation efficiency of 85.6%.
- NLCs were able to release vitamin D3 in a controlled manner
- NLCs were stable and had a relatively uniform size distribution.







NLC's Manufacturing Methods

Hot/cold High pressure homogenization	Solvent emulsification–evaporation	Microemulsion technique	Emulsification solvent diffusion
Solvent injection (or solvent displacement)	Phase inversion technique	Multiple emulsion method	Membrane contractor technique

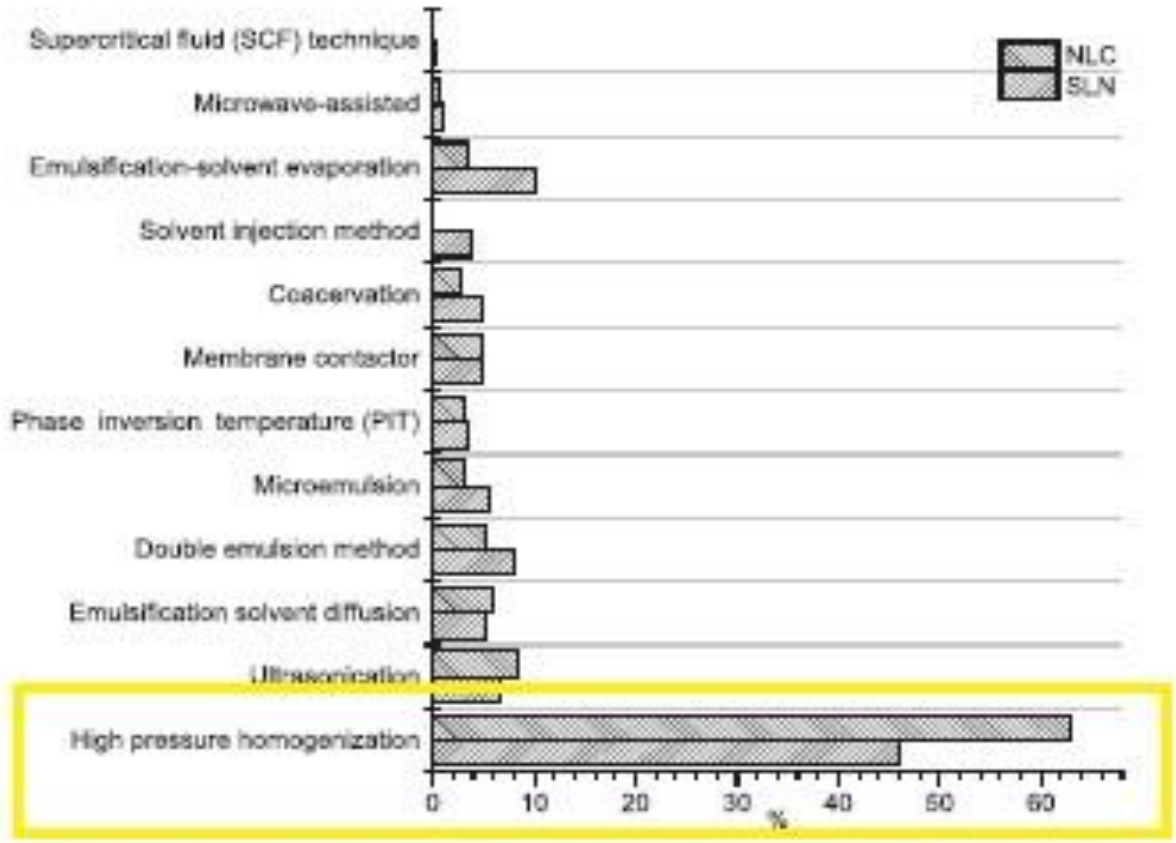
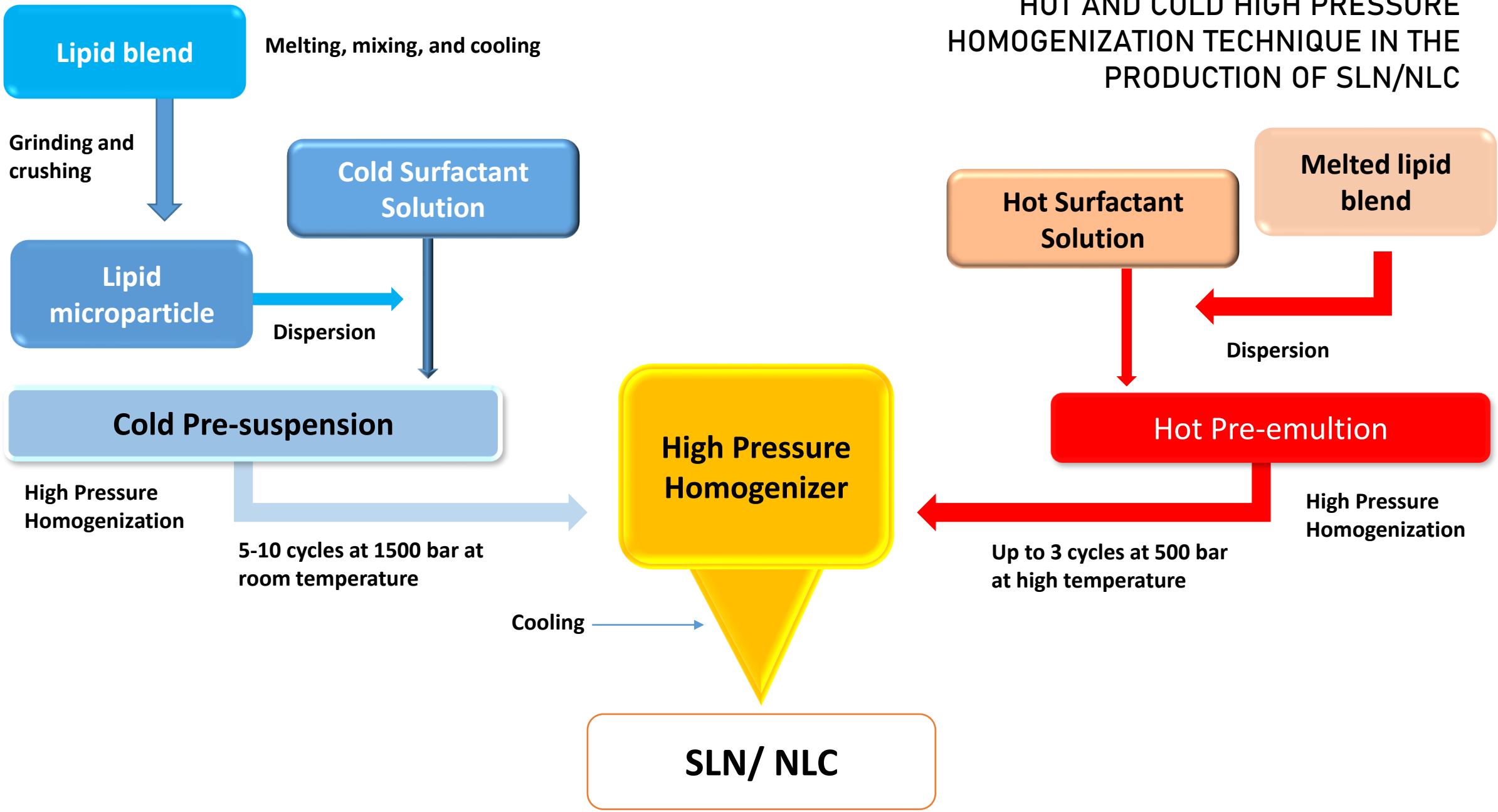


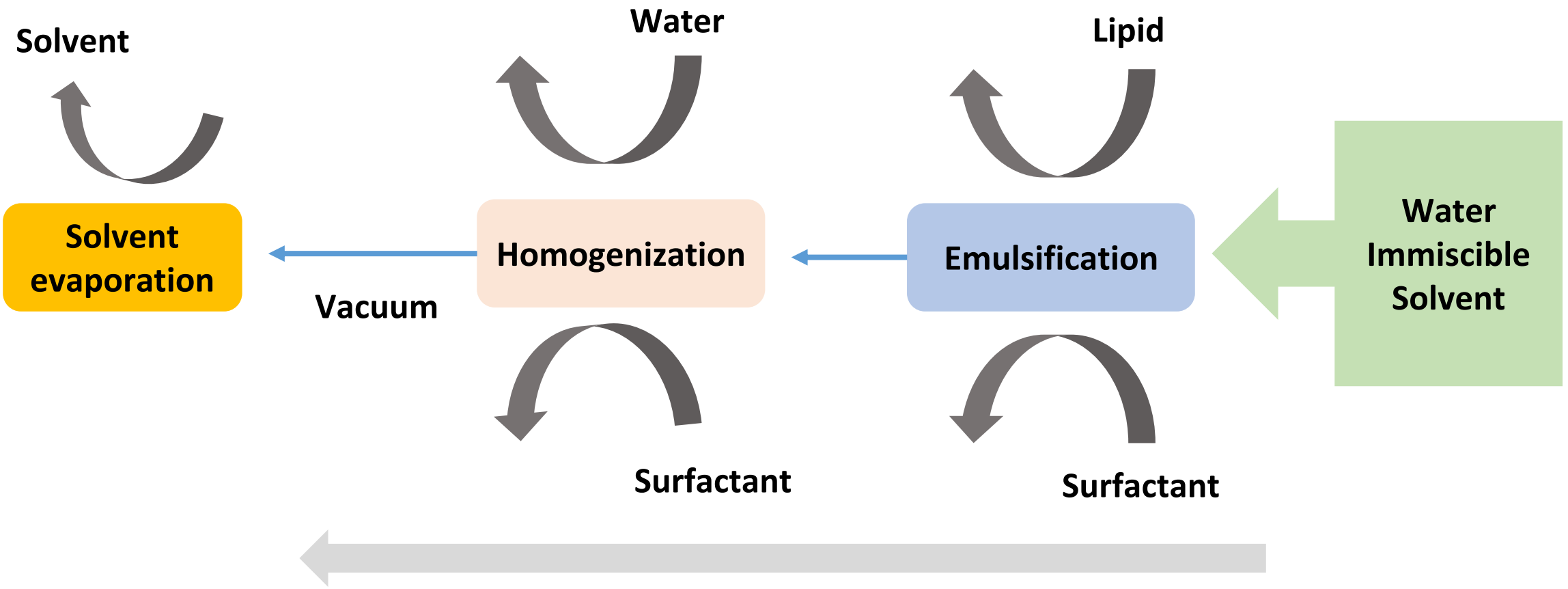
Fig. 3-2. Percentage distribution of the most known methods for the preparation of lipid nanoparticles.

Commonly used and versatile techniques are high-pressure homogenization and emulsification-solvent evaporation

A. Gordillo-Galeano, C.E. Mora-Huertas. European Journal of Pharmaceutics and Biopharmaceutics 133 (2018) 285–308

HOT AND COLD HIGH PRESSURE HOMOGENIZATION TECHNIQUE IN THE PRODUCTION OF SLN/NLC



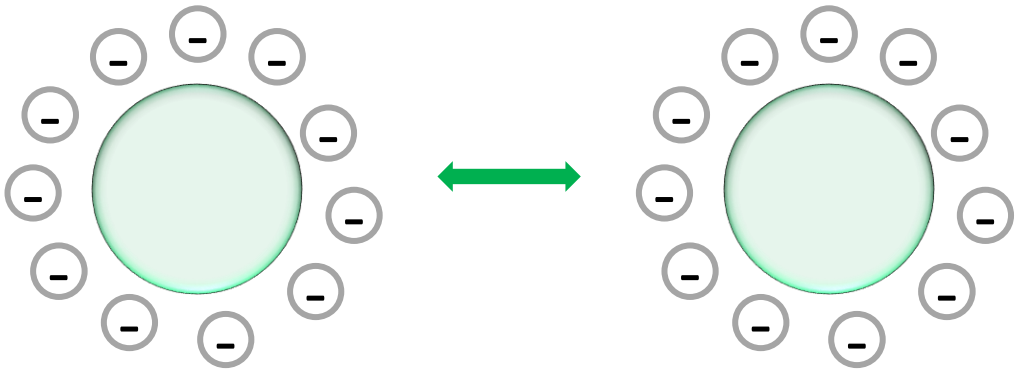


SCHEMATIC DIAGRAM OF EMULSIFICATION AND SOLVENT EVAPORATION

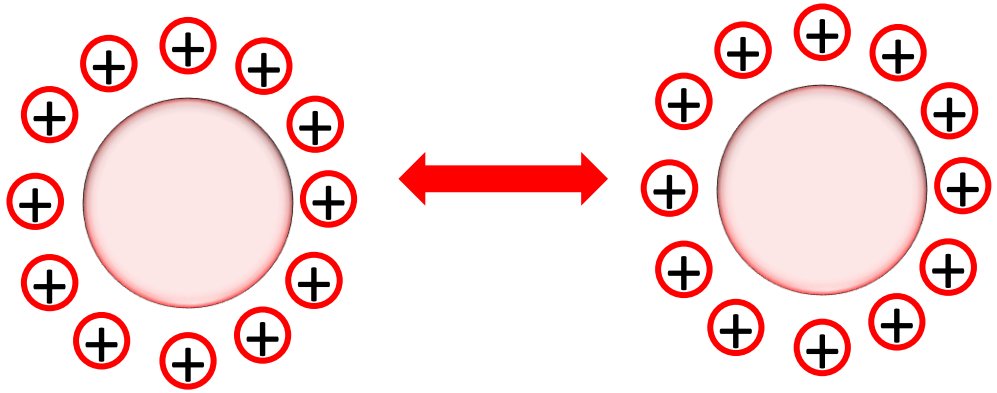
NLCs characterization (1)

Characteristics	Methods
• Shape and surface morphology	▪ Transmission electron microscopy (TEM) ▪ Scanning electron microscopy (SEM) ▪ Atomic force microscopy (AFM)
• Particle size distribution	• Electron microscopy (SEM/TEM)
• Zeta potential	• Optical microscopy • Photon correlation spectroscopy (PCS)/ Dynamic light scattering

Zeta potential << 0

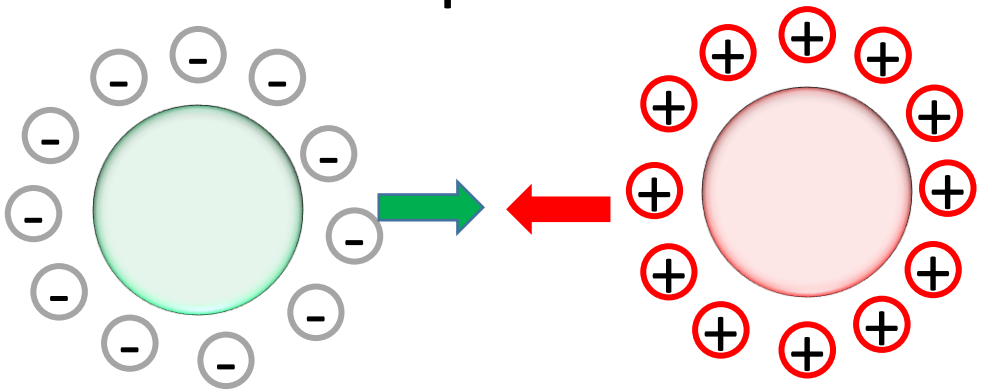


Zeta potential >> 0



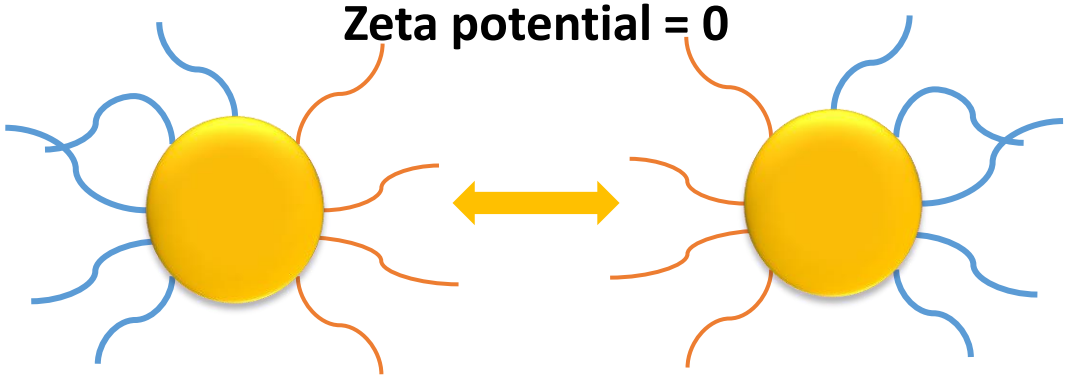
Electrostatic Stabilization

Zeta potential = 0



Coalescence

Zeta potential = 0



Steric Stabilization

NLCs characterization (1)

Characteristics

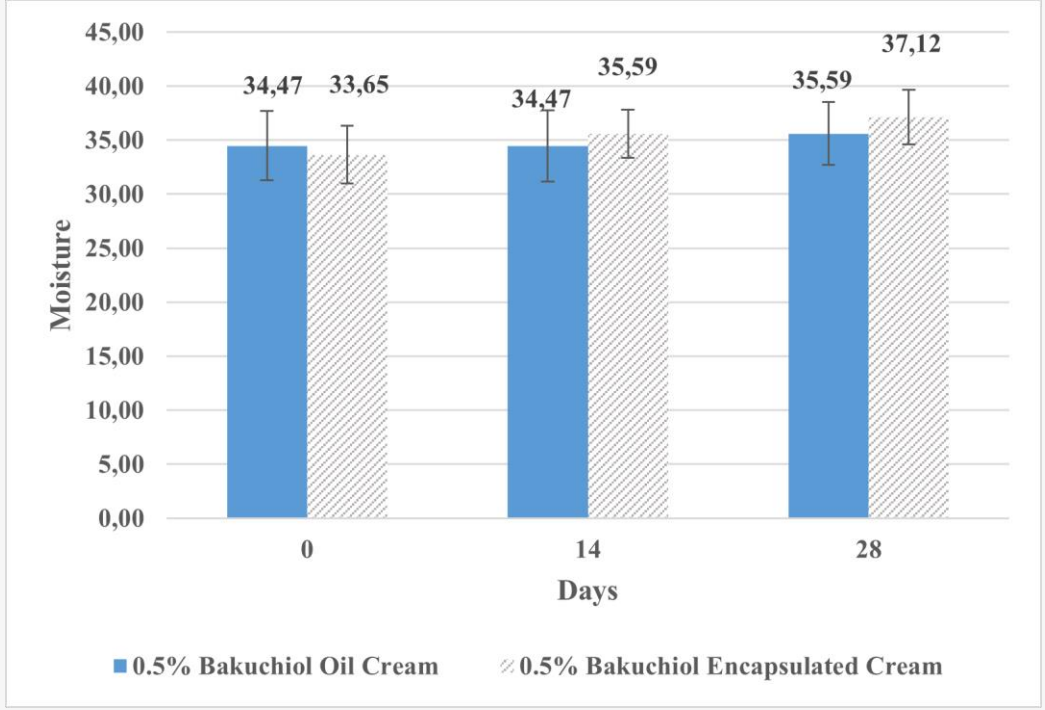
- Reology
- In vitro release

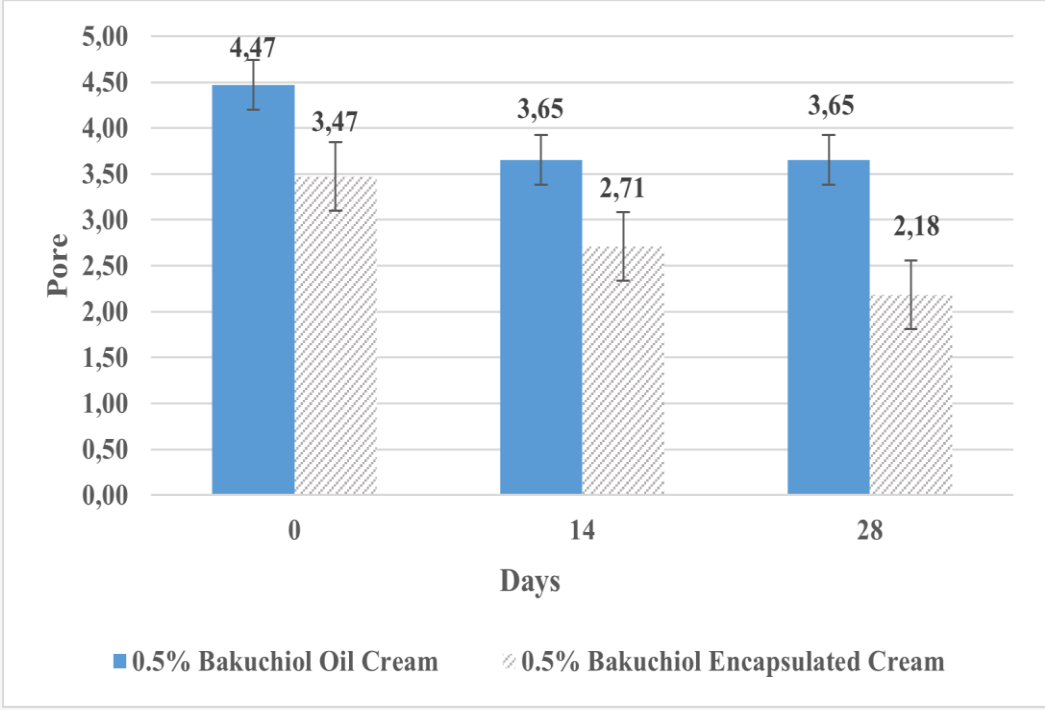
- Encapsulation efficiency (EE)
- Drug loading (DL)
- Liquid Crystallinity
- physical tability

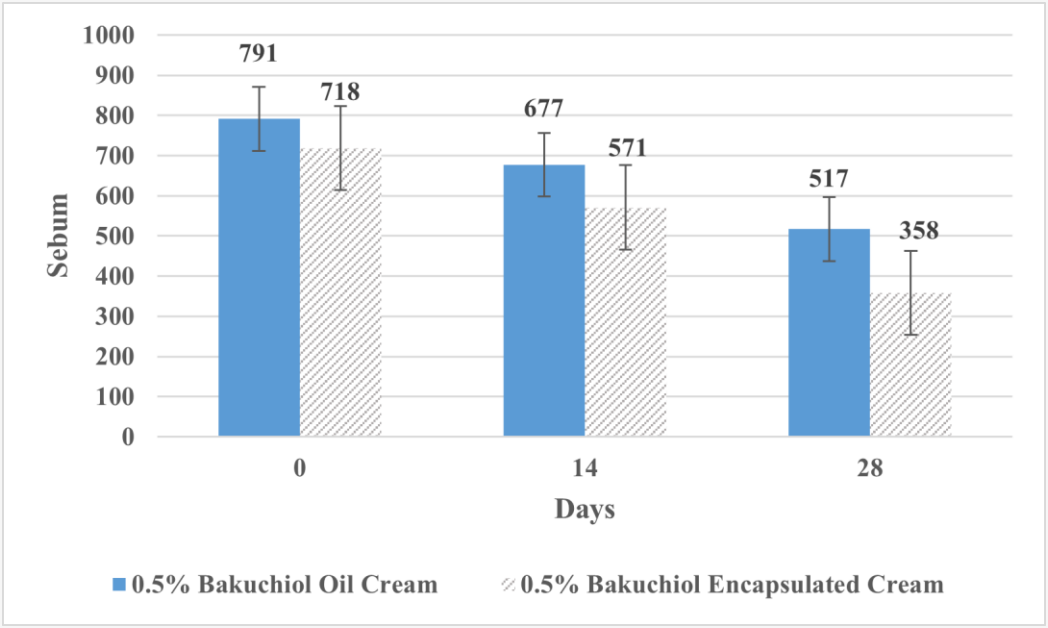
Instrumen/ Metode

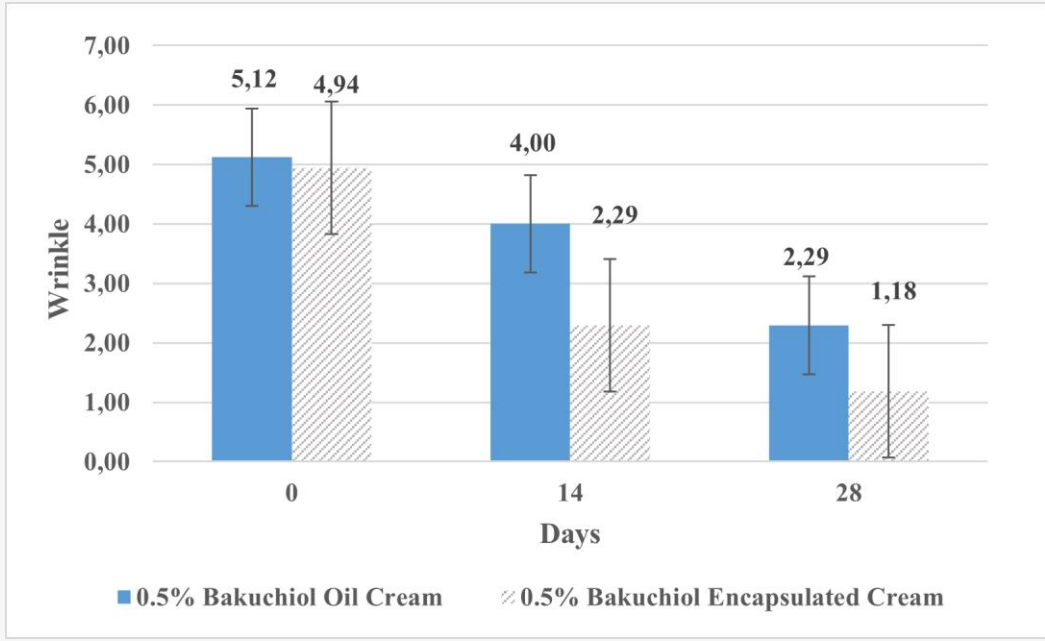
- Viskometer
- Dialysis membrane dissolution test apparatus/ Franz diffution cell
- Metode analisa sesuai bahan aktif
- DSC, X-Ray diffractometer

Encapsulated bakuchiol resulting in better skin performance compared to bakuchiol oils

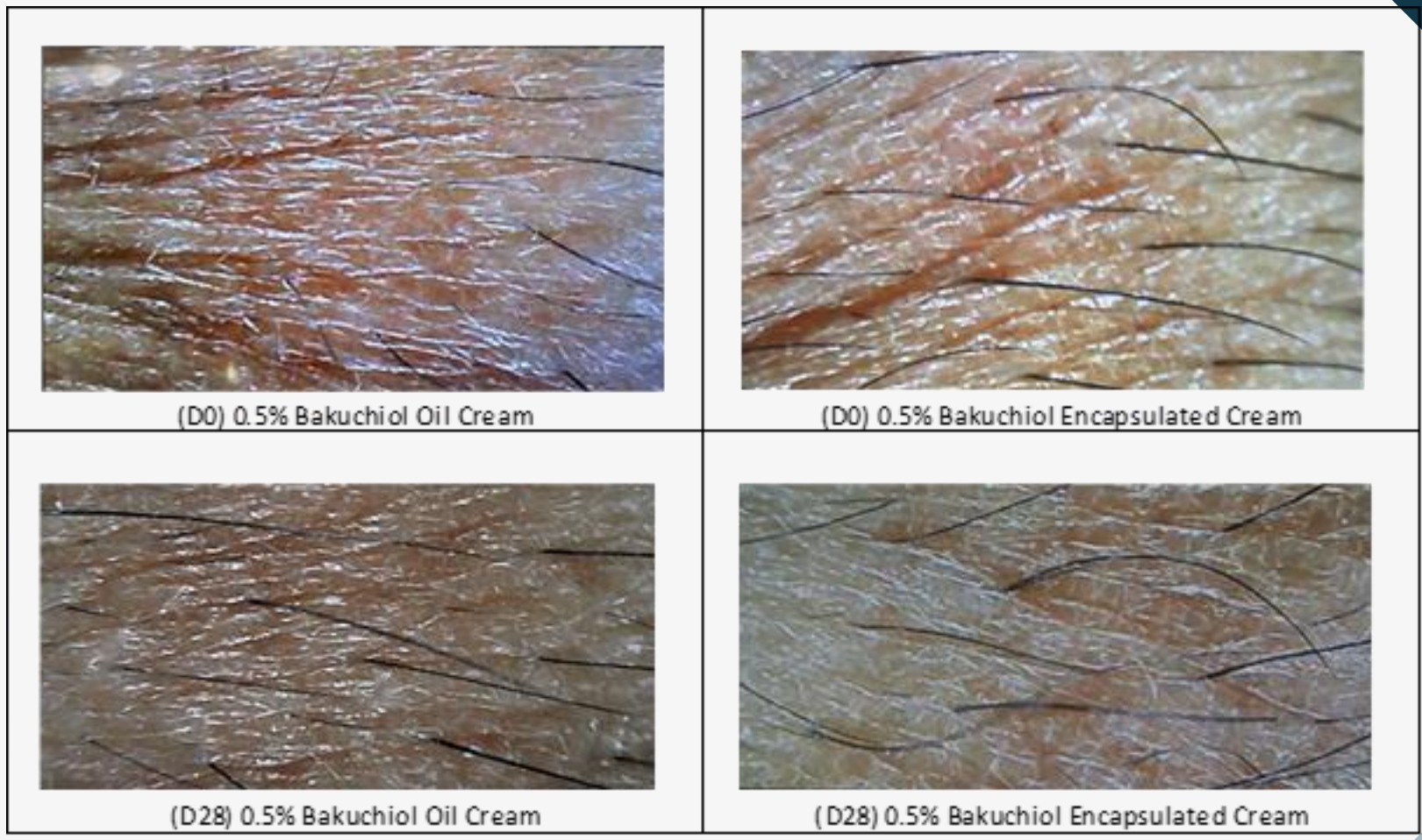


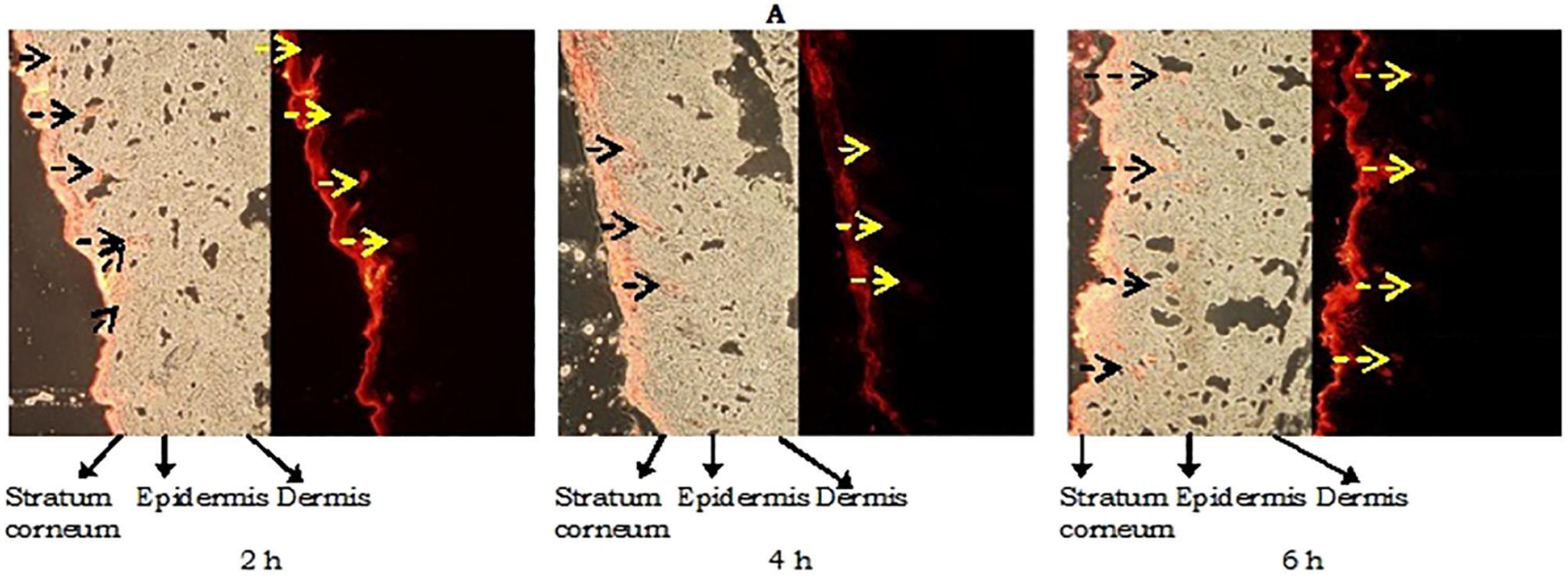


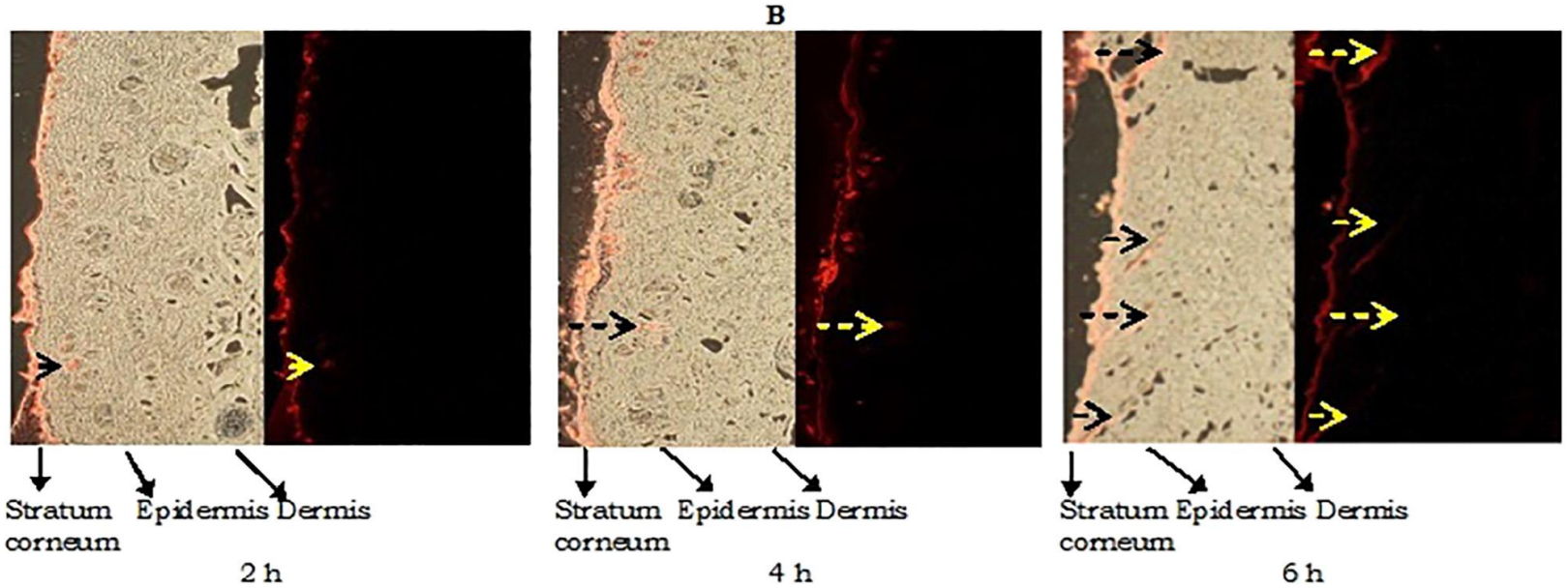




Encapsulated bakuchiol resulting in better skin performance compared to bakuchiol oils



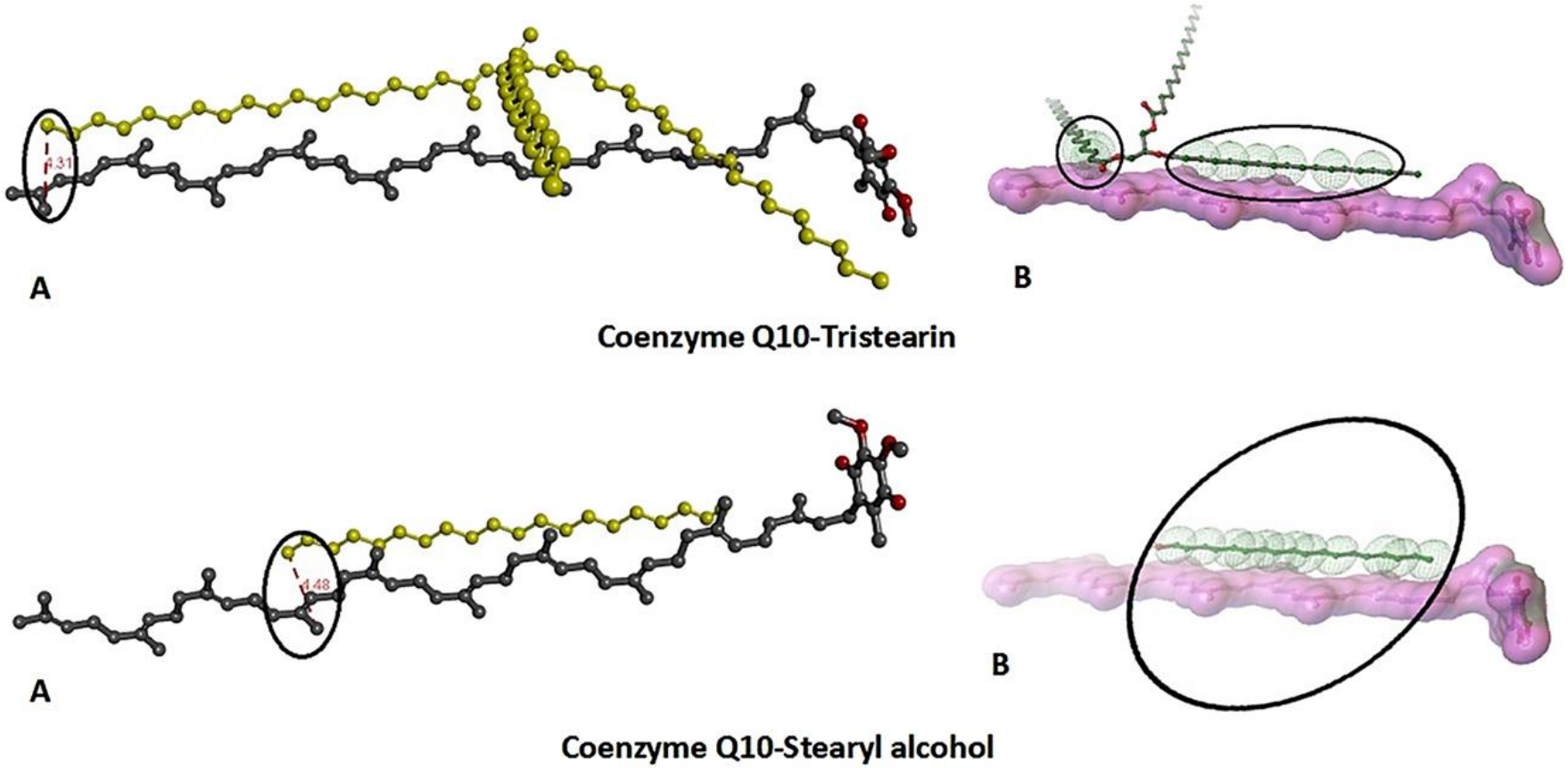




→ A

NLC increase in vivo penetration of Coenzym Q10

→ B



In silico molecular docking

Thanks!

Christina Avanti

c_avanti@staff.ubaya.ac.id

Our ref. : IIUM/308/19//4/2
Date : 12 May 2023

Assoc. Prof. Dr. Dra. Christina Avanti M.Si., Apt.
Department of Pharmaceutics
Faculty of Pharmacy
Universitas Surabaya
Raya Kalirungkut, Surabaya
Indonesia

Dear Assoc. Prof. Dr.,

APPOINTMENT AS A CHAIRPERSON FOR ORAL PRESENTATION AT THE INTERNATIONAL CONFERENCE ON PHARMACEUTICAL SCIENCES (ICOPS) 2023

We are pleased to appoint you as one of our chairperson for the oral presentation during the conference. Below is the schedule:

Day/Date/Time	Venue	Session
Thursday/18 May 2023 14:00 – 16:40	Kenyir Ballroom	Oral Presentation Session 2

We believe that your experience and knowledge lend support to our event.

Thank you very much.

'LEADING THE WAY'

ASSOC. PROF. DR. HAZRINA AB. HADI (PhD., RPh)
Chairperson,
2nd International Conference on Pharmaceutical Sciences (ICOPS) 2023

Kulliyyah of Pharmacy
International Islamic University Malaysia
Jalan Sultan Haji Ahmad Shah
25200 Bandar Indera Mahkota
Kuantan, Pahang

Telephone: (+609) 570 4802 / 4818 / 4816 |Fax: (+609) 571

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Re: Confirmation for the flight and accommodation - ICOPS 2023

1 message

Sriviowarti Noerdin <pnsri@iium.edu.my> Tue, May 16, 2023 at 2:42 PM
To: Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id>, Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Dear Dr. Christina

Thank you for your email.
Transportation has been arranged to pick up you from the airport to the hotel according to your flight schedule. In addition, we have also arranged transportation for your departure as well. The best practice here at KLIA is for passengers to pre-check-in first prior to your day of departure and advisable to be at the airport 2 hours prior to your flight schedule.

Feel free to let us know if you have any further concerns or enquiries.
Thank you and we are looking forward to receiving your arrival here at our conference.

On Tue, May 16, 2023 at 3:07 PM Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id> wrote:

> Dear Ms. Sriviowarti Noerdin,
>
> Thank you for accepting the proposed schedule on 18 May, 2023. We really appreciate the cooperation in this matter. Dr. Christina will be arriving tomorrow on 17 May, 2023. As we reschedule the return flight from 20 May to 19 May, we send you the updated ticket for the return flight on 19 May. Thank You
>
> Best regards,
> Intan Sukma
>
> On Mon, May 15, 2023 at 7:48 PM Sriviowarti Noerdin <pnsri@iium.edu.my> wrote:
>
> > Dear Intan Sukma (Ms.)
> >
> > Thank you for your email. I just received information from the Scientific Committee ICOPS 2023 regarding this matter.
> > Dr Christina plenary talk schedule is on 18/5 10.30-11.00. In the afternoon, she will chair oral presentation session 2, from 2pm -3.05pm and 3.35pm-4.40pm.
> > I attached the ICOPS 2023 Program Itinerary for your further information.
> > Thank you,
> >
> > Best regards,
> >
> > Sriviowarti Noerdin
> > ICOPS 2023
> >
> > On Mon, May 15, 2023 at 4:05 PM Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id> wrote:
> >
> > > Dear Ms. Sriviowarti Noerdin,
> > >
> > > As there has been no confirmation related to the change of schedule for Dr. Christina lecture session, we would like to seek your kind attention and cooperation to confirm the schedule for Dr. Christina lecture session in International Conference on Pharmaceutical Sciences (ICOPS) 2023 on 18 May, 2023. We apologize for the inconvenience this may have caused. Would you please let us know if the proposed schedule fits in with your schedule, so we could arrange any other matters related. Thank you.
> > >
> > > Best regards,
> > > Intan Sukma
> > >
> > > On Thu, May 11, 2023 at 8:44 AM Sriviowarti Noerdin <pnsri@iium.edu.my> wrote:
> > >
> > > > Dear Ms Intan Sukma

I have already informed Dr. Solahuddin, the person in charge of the scientific committee regarding Dr. Christina would like to change the slot and leave early.
Thank you
Have a safe journey.

On Mon, May 8, 2023 at 2:37 PM Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id> wrote:

Dear Ms. Sriviowarti Noerdin,

Thank you for the confirmation regarding the reservation in DoubleTree Hotel. Unfortunately, Mrs. Christina has another seminar on 19 May, 2023 in Surabaya. She asked me to discuss the possibility of rescheduling her lecture session in the upcoming International Conference on Pharmaceutical Sciences (ICOPS) 2023. She proposed her lecture session on 18 May, 2023, therefore Mrs. Christina could leave on the morning of 19 May. However, she offers her sincere apologies for the inconvenience. We would appreciate your cooperation in this matter.

Best regards,
Intan Sukma

On Mon, May 8, 2023 at 9:28 AM Sriviowarti Noerdin <pnsri@iium.edu.my> wrote:

Dear Ms. Intan Sukma

Thank you for email on behalf of *Assoc. Prof. Christina Avanti Ph.D.* We will arrange accordingly and ICOPS 2023 would reserve the room for Mrs. Christina at the DoubleTree hotel from 17th until 20th May (4 days 3 night). Looking forward to meeting Prof in ICOPS 2023. Thank you.

Best regards,

Sriviowarti Noerdin
Committee
International Conference on Pharmaceutical Sciences (ICOPS) 2023
Kulliyyah of Pharmacy
International Islamic University
Malaysia.

On Fri, May 5, 2023 at 12:54 PM Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id> wrote:

Dear Ms. Sriviowarti Noerdin

On behalf of Associate Professor Christina Avanti Ph.D., I enclose the flight ticket giving detailed information about the departure and arrival time for the upcoming International Conference on Pharmaceutical Sciences (ICOPS) 2023, on 18th-19th May 2023, in Malaysia. Regarding the accommodation, please confirm if the committee would reserve the room for Mrs. Christina at the DoubleTree hotel from 17th until 20th May (4 days 3 night).

We look forward to your kind acknowledgement of this email.

On behalf of

Assoc. Prof. Christina Avanti Ph.D.

Intan Sukma (Ms.)
Sekretariat Rektorat Universitas Surabaya
Jalan Ngagel Jaya Selatan 169
Surabaya-60284
Telp: +6231-2981100
email: *rektorat@unit.ubaya.ac.id*

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Tel: 09-5706400 ext 3047
Mobile:0139814911
Fax: 09-5716775

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Sekretariat Rektorat Universitas Surabaya
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Surabaya - 60284
Telp.: +6231-2981100
email: *rektorat@unit.ubaya.ac.id*

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Thanks & regards

Sriviowarti bt Noerdin
Medical Laboratory Technologist
Department of Basic Medical Sciences,
Kulliyah of Pharmacy,
International Islamic University of Malaysia,
Jln Sultan Ahmad Shah, Bandar Indera Mahkota,
25200, Kuantan,
Pahang

Tel: 09-5706400 ext 3047
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Thanks & regards

Sriviowarti bt Noerdin
Medical Laboratory Technologist
Department of Basic Medical Sciences,
Kulliyah of Pharmacy,
International Islamic University of Malaysia,
Jln Sultan Ahmad Shah, Bandar Indera Mahkota,
25200, Kuantan,
Pahang

Tel: 09-5706400 ext 3047
Mobile:0139814911
Fax: 09-5716775

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

Re: Keynote/Plenary Speaker Invitation

1 message

Christina Avanti <c_avanti@staff.ubaya.ac.id> Thu, Jul 13, 2023 at 10:48 AM
To: "MOHD. RUSHDI BIN HJ. ABU BAKAR ." <rushdi@iium.edu.my>
Cc: "M. TAHER BIN BAKHTIAR" <mtaher@iium.edu.my>, Muhammad Salahuddin Haris <solah@iium.edu.my>
Bcc: Sekretariat Rektorat UBAYA <rektorat@unit.ubaya.ac.id>

Dear Dr. Mohd Rushdi Abu Bakar,

I hope this message finds you well.
I wanted to reach out regarding the International Conference on Pharmaceutical Sciences (ICOPS) 2023 that took place in Kuala Lumpur, Malaysia two months ago. I want to express my gratitude once again for the invitation to speak at the conference.

As the conference has already concluded, I understand that the logistics, including the coverage of travel expenses, accommodation, and conference registration fees, have likely been finalized. However, I wanted to touch base with you to inquire about the status of the reimbursement process for the costs associated with coverage of my travel expenses.

If any outstanding materials or information are required from my end to facilitate the reimbursement process, please let me know, and I will be more than happy to provide the necessary documentation or assistance. I understand that organizing such an event involves various post-event tasks, and I appreciate your attention to this matter.

Thank you once again for the opportunity to speak at ICOPS 2023, and I look forward to hearing from you regarding the reimbursement process.

Warm regards,
Christina Avanti, PhD
Associate Professor
Vice Rector for Student Affairs and Alumni
Universitas Surabaya
Raya Kalirungkut, Surabaya, Indonesia
Phone: +62 31 2981000

On Wed, Dec 14, 2022 at 8:39 AM MOHD. RUSHDI BIN HJ. ABU BAKAR . <rushdi@iium.edu.my> wrote:

> Dear Assoc. Prof. Dr. Christina Avanti,
>
> We hope this message finds you well. We're reaching out today with an exciting speaking opportunity for your consideration. We're honored to invite you to speak at the International Conference on Pharmaceutical Sciences (ICOPS) 2023. The theme of the conference "Dermatopharmaceutics: The Epitome of Skin Science" fits very well with your passion and expertise, hence the entire ICOPS 2023 team feel you would be the perfect person to address our audience of like-minded researchers and professionals.
>
> ICOPS 2023 will take place in Kuala Lumpur, Malaysia on 18th-19th May 2023. We are anticipating an audience of about 150. Our goal is to provide a forum for academicians, researchers, and industry to present their findings, ideas, and innovation in the field of pharmaceutical sciences, particularly those that are relevant to the theme of the conference. We believe your voice would be a critical addition to that conversation given your expertise in transdermal/topical systems and skin delivery.. Your talk could be up to 30 minutes on any relevant topics you're interested in. As a token of appreciation, we will cover the costs of your travel, accommodation and conference registration fee.
>
> Please let us know by 16/12/2023 whether you may be interested in joining us at ICOPS 2023 as a highly-anticipated speaker. Thank you for your time and consideration, and we very much look forward to hearing from you.
>
> Thank you
>
> Best regards,
>
> Dr. Mohd Rushdi Abu Bakar
> On behalf of Scientific Committee

> ICOPS 2023

Christina Avanti 1135 _ <c_avanti@staff.ubaya.ac.id>

ICOPS 2023 Certificate of Appreciation

1 message

International Conf. on Pharmaceutical Sciences (ICOPS2023) . <icops@iium.edu.my> Fri, Jul 21, 2023 at 3:59 PM
To: Christina Avanti <c_avanti@staff.ubaya.ac.id>

Dear Assoc. Prof. Dr. Dra. Christina Avanti,

Hello and good day to you. May this email reach you while you are in the best of health.

The ICOPS 2023 Organising Committee would like to extend our sincerest thank you for your excellent speech at our conference. Thank you very much for sharing your expertise with our participants and for capturing the audience so well. We are honoured to have your support as the speaker. The event would not be possible without you. Attached is the certificate of appreciation for your contribution.

Thank you & best regards,
I*COPS 2023 Organising Committee*

Dr. Christina.pdf
324K

AN INTERNATIONAL AWARD-WINNING INSTITUTION FOR SUSTAINABILITY

CERTIFICATE OF APPRECIATION

PRESENTED TO:

Assoc. Prof. Dr. Dra. Christina Avanti

For sharing her invaluable time and participation as a "Plenary Speaker" during the:

International Conference on Pharmaceutical Sciences (ICOPS) 2023

"DERMATOPHARMACEUTICS:

THE EPITOME OF SKIN SCIENCE"

held on 18 – 19 May 2023

at DoubleTree by Hilton Putrajaya Lakeside, Malaysia

ASSOC. PROF. DR. JULIANA MD JAFFRI
Advisor of ICOPS 2023
Kulliyyah of Pharmacy
International Islamic University Malaysia

ASSOC. PROF. DR. HAZRINA AB HADI
Chairperson of ICOPS 2023
Kulliyyah of Pharmacy
International Islamic University Malaysia