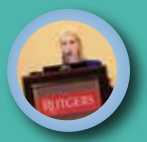
# Center for Dermal Research



# 2017-2018 ANNUAL REPORT

Rutgers
THE STATE UNIVERSITY OF NEW JERSEY

New Jersey Center for Biomaterials

## 2007

- June 25, 2007 - 1st Annual Skin Workshop
- September 30, 2008 - 2nd Annual Skin Workshop

## 2011

- March 3, 2011 - Official launch of the Center for Dermal Research/CDR
- May 24, 2011 - First BADF/CDR Skin Course offered
- October 12, 2011 - 4th Annual Skin Workshop

## 2012

- By 2012 we had a total of 30 students graduate with a PhD or Masters degree from CDR
- Launch of the CDR Website
- Dermaceutics Course switched from Fall to Spring in 2012

## 2013

- September 24, 2013 - First CDR/TRI Joint Seminar
- Fall 2013 - First Innovations in Dermatological Sciences Conference

## 2015

- April 2015 – Sonia Trehan hired as CDR's Industrial Project Manager
- Spring 2015 - 3rd time Dermaceutics course was offered

## 2016

- CDR 5th Anniversary celebration during 4th Innovations in Dermatological Sciences event in Fall 2016

## 2017

- January 2017- 42 students total graduate with PhD or Masters degree
- Fall 2017 - First annual joint CDR/BASF Workshop launched in Tarrytown, NJ

## 2018

- 4th Dermaceutics Course - Spring 2018
- Sonia Trehan promoted to Assistant Research Professor

# Center for Dermal Research

The New Jersey Center for Biomaterials, 145 Bevier Road, Suite 101
Piscataway, New Jersey 08854 – Tel: 848.445.3589

It has been eleven years since the first Annual Skin Workshop was offered on June 25, 2007 and seven years since the Center for Dermal Research CDR was launched on March 3rd, 2011. It is amazing to realize how we have grown over the years since the initial meeting with less than 50 attendees including speakers. Now we have a two-day annual conference "Innovations in Dermatological Sciences" at a large local New Jersey hotel venue with 150-200 attendees, 20+ sponsors, exhibitors and attendees not only from the tri-state area but also from Europe and the Far East. Requests for webinar participation for the event were received from as far as India and China and two attendees flew in specially for the event all the way from Japan. In Fall 2017 and 2018 we had two very successful conferences with excellent speakers, venue and networking, interesting and varied exhibits and posters. The 2017 event was focused on "Harnessing the Skin Microbiome" and the one in 2018 on the "Future of Dermatologicals and Cosmeceuticals". We are looking forward to our next conference on September 8-10th 2019 at the Doubletree Hotel Somerset, NJ and to our Personal Care and Cosmetics Regulatory and Compliance Elements Workshop on June 4th 2019 at Rutgers University, Life Sciences Building Auditorium.

We congratulate our CDR Sponsors of the Year: in 2017 the award was presented to Colgate Palmolive and in 2018 to Tergus Pharma and we thank all the sponsors/donors for our events for all their support. During 2017-2018 we offered a total of 32 CDR Seminars!!!! This is on average over one per month!! Among these we had joint seminars with Colgate Palmolive, Basic and Applied Dermatology Forum (BADF), and TRI Princeton. The CDR offered a one semester graduate-level course on "Dermaceutics" in Spring 2018 with many participants from local industry. As an elective/ core graduate course we have on average over 50 registrants which tops every other graduate course offered at Rutgers University in total numbers of participants. The CDR also participated as co-hosts for events with TRI Princeton for their Fall Skin Course in 2017 and 2018 and with BASF for their Skin Workshop 2017 in Tarrytown, NJ.

The main highlights in the Laboratory for Drug Delivery (LDD) included the start in 2018 of a four year funded exchange program with Europe termed ORBIS (Open Research Biopharmaceutical Internship Support) grant under the Maria Skodowska-Curie Actions of Horizon 2020 (H2020-MSCA-RISE-2017). Four Universities, one research institute (The Pharmaceutical Institute-Warsaw, Poland) and four pharmaceutical companies are involved in this large consortium and Rutgers, The State University of NJ and the CDR are the only US partner. The lead scientist Dr. Janina Lulek, Professor and Head, Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland visited the CDR in May 2018 to kick off the start to the four year program and she was followed by 8 more junior and senior visiting scientists from Poznan and Warsaw, Poland. The scientists stayed for varying periods of one month to nearly one year at the CDR. In addition, the laboratories of Drs. Joachim Kohn (Chemistry/NJCBM) and Leonid Kagan (Pharmacy) acted as co-hosts for two of the visiting scientists Ewelina Wieczorek and Dr. Katarzyna Kosicka, respectively.

The CDR is involved in other international exchange programs and we hosted two PhD students from Chiang Mai University in Thailand (6 months each), one intern Barbara Bartoletti from the University of Nice, France (3 months), Caroline Mellac from Ecole Nationale Superieure Agronomique de Toulouse, France (3 months), a PhD student Hongmei Lin from University of Chinese Medicine, Beijing, China (one year) and PhD student Jemima Moraes from Universitade Federal de Sao Paolo, Brazil who has been with us since Sept 2017. In addition, a faculty member from the Chiang Mai University Prof. Chandarat Ampasavate visited in May 2018 and Dr. Indu Pal Kaur (a Fulbright Scholar) was at the CDR/LDD for 6 months from the Panjab University in India.

In 2017-2018 we graduated Peter Ji Zhang with a PhD degree from the Michniak-Kohn LDD and his thesis was entitled "Investigation of microemulsions and their microstructures for transdermal and dermal drug delivery". Dr. Sonia Trehan our Research Assistant Professor and CDR Laboratory Manager left the CDR and joined Johnson & Johnson in Fall 2018. We have added Keyaara Robinson from Edenbridge Pharmaceuticals, LLC, Parsippany, NJ as a new part-time PhD student to the group as well as Drs. Sharon Haynie from Hypatia Technology Works, LLC, Philadelphia PA as well as Allyson Maron and Amra Tabakovic both from Croda, NJ.

In May 2018, our Event Coordinator Louli Kourkounakis moved to a another position at Rutgers and we welcomed Hannah Carter as the new Outreach Events Specialist to the CDR. Hannah comes to the CDR with a wealth of marketing, social media and graphic design experience and a background in the personal care/cosmetic industry. The transition was smooth and Hannah is doing a wonderful job at the CDR together with Suzanne Squires, our Contracts Manager, Malak Awad, our accountant and John Watkins, our IT Specialist. We thank them all for all their hard work and contributions to the running of the CDR and the LDD.

A big thank you to all of our 2017-2018 sponsors/donors and CDR industry members!!!! Particular appreciation goes to the main sustaining donor for the annual symposium The David M.C. Ju Foundation and to Dr. Bill Ju who provides so much encouragement and support for the CDR annual symposium. We also thank our hard-working Programming Committees for both years for all their hours of work, speaker suggestions and participation in the success of the two conferences.

Our entire CDR team as well as laboratory members and CDR partners wish you all a wonderful healthy and happy New Year and we hope to see you all at 2019 CDR Seminars, Workshops and the annual CDR symposium!!!

Center for Dermal Research

# CDR Membership Program

**This year we expanded our CDR Advisory Council to include the following members:**

Abhijit Bidaye - Croda

Angela Christiano - Dermatology, Columbia University

Gary Cleary - Cape Therapeutics, Inc.

Adam Friedman - George Washington School of Medicine and Health Sciences

Vince Gruber, JEEN International

William Ju - Advancing Innovation in Dermatology, Inc.

Peter Landa - Estee Lauder

John Lyga - Avon

Gopi Menon - Consultant

Amy Pappert - Rutgers, RWJ Medical School

Miri Seiberg - Seiberg Consulting

The Center for Dermal Research offers pharmaceutical, personal care, cosmetic and other companies an opportunity to participate in its programs and meetings. Membership affords companies and their key employees opportunities to learn about the latest developments at the Center for Dermal Research at Rutgers and to meet scientists and researchers who are making progress in developing new concepts and products in the science. Through their participation members also have the opportunity to contribute to the research that is being conducted by the Center.

**Double-Diamond Level** *($50,000).* The membership affords companies with more say in how their membership funds are spent and grants them further access to resources at the CDR.

- Sponsor a student or graduate student who will present a talk at the company once a semester (two presentations per membership year)
- Opportunity for an employee to shadow a Lab Tech or Researcher for a week
- Attendance for two new employees at a lab training session
- Two seats on the CDR Advisory Board
- Six attendees at CDR events held through the membership year
- 1/2 day per month face time with Dr. Bozena Michniak-Kohn and/or key lab members
- Two seats on CDR Program Committees
- Full access to Archived Lectures
- Your company will be able to present an exhibit at most events, your company representative will have the opportunity to present a 15-minute talk to the attendees, and your company logo will also be featured prominently in all meeting and event marketing materials.
- Special seating at the VIP table during the reception with CDR leadership and speakers of the evening.

Jon Anderson-Actives International
Nava Dayan-Skin Science & Research
Robert Falcone

William Ju-Advancing Innovation in Derm
Amy Pappert-Rutgers-RWJ
Gregory Biancone-Gregory Biancone Consulting

Miri Seiberg-Seiberg Consulting
Joe VanDyk-Clinical Research Laboratories
Babar Rao

Center for Dermal Research

# CDR Membership Program

**Diamond Level** *($20,000)*. This member level opens up a whole new realm of opportunities and level of involvement for members of the CDR.

- One seat on the CDR Advisory Board
- Six attendees at CDR events held through the membership year
- 1/4 day per month face time with Dr. Bozena Michniak-Kohn and/or key lab members
- One seat on CDR Program Committees
- Full access to Archived Lectures
- Your company will be able to present an exhibit at most events, your company representative will have the opportunity to present a 10-minute talk to the attendees, and your company logo will also be featured prominently in all meeting and event marketing materials.
- Special seating at the VIP table during event reception with CDR leadership and speakers of the evening.

**Platinum Level** (*$5000*). Your company will be able to present an exhibit at most events, your company representative will have the opportunity to present a 5-minute talk to the attendees, and your company logo will also be featured prominently in all meeting and event marketing materials. Attendance of up to four company representatives at reduced or no cost for all CDR events held through the membership year. * In addition, special seating at the VIP table during the reception with CDR leadership and speakers of the evening.

**Gold Level** (*$2500*). Your company will be able to present a tabletop exhibit at most events and your company logo will also be featured in all meeting and event marketing materials. Attendance by up to two company representatives at reduced or no cost for any CDR event held through the membership year.

**Silver Level** (*$1000*). Your company's logo will be featured in all meeting and event marketing materials. Attendance by one company representatives at any CDR event held through the membership year at reduced or no cost.

**Individual Memberships** (*$250*). Attendance at any CDR event held through the membership year at reduced or no cost.

Jon Anderson-Actives International
Nava Dayan-Skin Science & Research
Robert Falcone

William Ju-Advancing Innovation in Derm
Amy Pappert-Rutgers-RWJ
Gregory Biancone-Gregory Biancone Consulting

Miri Seiberg-Seiberg Consulting
Joe VanDyk-Clinical Research Laboratories
Babar Rao

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# Current Lab Members

## Graduate Students

**Dina Ameen**
PhD Student

**Ben Goodyear**
Part-time
PhD Student

**Vinam Puri**
PhD Student

**Parin Shah**
Part-time
PhD Student

**Keyaara Robinson**
Part-time
PhD Student

**Anika Haq Alam**
PhD Student

**Julia Zhang**
Part-time
PhD Student

**Amitkumar Virani**
Part-time
PhD Student

**Rose Soskind**
PhD/PharmD
Student

**Phunsuk Anataworaskul**
PhD Student/
International Visitor

**Panikchar Wichayapreechar**
PhD Student/
International Visitor

**Jemima Moraes**
PhD Student/
International Visitor

Center for Dermal Research

# Current Staff Members

**Louli Kourkounakis**
*Program and Event Coordinator 2013-2018*

**Suzanne Squires**
*Associate Director*

**Hannah Carter**
*Outreach Events Specialist*

**Sonia Trehan, PhD**
*General Manager of CDR Industrial Projects 2015-2018*

**John Watkins**
*IT Specialist*

**Malak Awad**
*Senior Accountant*

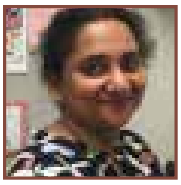
**Sasha Hutnick**
*Administrative Assistant to Sangya Varma*

**Nnadilim Okafur**
*Executive Research Assistant to Joachim Kohn*

**Carmen Castro**
*Senior Program Coordinator 2010-2017*

**Carol Lenardson**
*Accounting Supervisor 2012-2017*

**Hima Doshi**
*Executive Research Assistant to Joachim Kohn/Personnel Coordinator 2016-2018*



**Srilekha Vangala**
*Personnel Administrator*

CENTER FOR DERMAL RESEARCH

# ORBIS
## (Open Research Biopharmaceutical Internships Support)

On the 5th July 2017 the European Commission awarded 2,268 million € for the realization of a prestigious, international and intersectoral project no. 778051 entitled ORBIS (Open Research Biopharmaceutical Internships Support). The four-year-long (2018-2022) grant was favorably evaluated in the Research and Innovation Staff Exchange (RISE) call under the Maria Skłodowska-Curie Actions of Horizon 2020 Framework Program (H2020-MSCA-RISE-2017). The consortium lead is Dr. Janina Lulek of the Faculty of Pharmacy, Poznan University of Medical Sciences (PUMS) and the US partner is Dr. Bozena Michniak-Kohn, Ernest Mario School of Pharmacy and the Center for Dermal Research (CDR) at Rutgers-The State University of New Jersey.

Four universities, one research institute and four pharmaceutical companies from seven countries will participate in the ORBIS project. Among the consortium partners and beneficiaries are: Pharmaceutical Research Institute (Poland), Trinity College Dublin (Ireland), University of Helsinki (Finland), Applied Process Company Ltd. (Ireland), Farmak JSC (Ukraine), Physiolution GmbH (Germany), Zentiva k.s. (Czech Republic). Our, Partner Organization is Rutgers, The State University of New Jersey (USA)-and in particular the Center for Dermal Research (CDR) founded and lead by its Director Dr. Bozena B. Michniak-Kohn, Professor in Pharmaceutics, Ernest Mario School of Pharmacy. During the four years of the proposal Rutgers CDR will host 98-person months of visiting scientists from the ORBIS consortium. The first visitors already visited the CDR in May 2018.

The ORBIS project is a response to the current scientific, economic and social challenge of increasing the effectiveness and productivity of drug development process, both for innovative and (super)generic drugs. This goal can be achieved by interdisciplinary cooperation between the academics from different fields of pharmaceutical sciences and the employees of R&D sector in commercial enterprises. For the sake of this overarching objective, the core of ORBIS is constituted by international, intersectoral exchange of researchers between academic centers and pharmaceutical companies – the consortium partners. During the secondments planned in the project, young and experienced scientists will cooperate with the hosting institutions on the most relevant and up-to-date issues of drug development process, such as: synthesis optimization for new active ingredients, preformulation studies, development of novel oral, dermal and transdermal dosage forms, as well as their biopharmaceutical evaluation with new methods of testing.

CENTER FOR DERMAL RESEARCH

# IN-VITRO RELEASE (IVRT) AND IN-VITRO SKIN PERMEATION TESTING (IVPT)

In vitro permeation testing (IVPT) or skin permeation testing is a critical tool for evaluating drug delivery into the various skin layers and for understanding the formulation selection for topical or transdermal application. The Center for Dermal Research (CDR) is well equipped with Franz diffusion permeability testing equipment, which includes water-jacketed models as well as heat block models. FDC-24 heat blocks have the capacity to handle up to 24 Franz diffusion cells which allows the evaluation of six replicates for three different formulations with a control in a single heat block.

We develop and validate suitable HPLC analytical methods for screening drugs as well as personal care and cosmetic actives. Optimized formulations are evaluated for drug/active distribution in different skin layers. The flux of actives across human cadaver skin can be determined by quantifying levels of compounds in the Franz cell receptor medium, collected at various time intervals. We have access to various U.S. accredited tissue banks and companies specializing in donated skin samples and disease-state tissue models. Depending on the project needs, an appropriate model can be selected for testing. We have explored various skin models including freshly-excised human skin (mostly from abdominal surgeries), human cadaver skin, skin from porcine ears (to study anti-acne drugs), tissue engineered skin models (EpidermFT for example), Strat-M (MilliporeEMD) and in-vitro disease-state skin such as the atopic dermatitis model.

Stratum corneum (SC) the uppermost layer of the skin forms a major barrier to permeation of topically applied compounds. It is important to use undamaged skin samples in our permeability experiments where the SC is intact and performing as it would in vivo. Thus, a skin integrity test is always performed as part of any IVPT protocol. At CDR, we use a fairly sophisticated, wireless, portable and easy-to-use instrument Vapometer (Delfintec, Finland) to measure transepidermal water loss (TEWL) as an indicator of skin integrity. Vapometer data is stored for every IVPT experiment we perform at the Center.

Release studies of actives through polymeric synthetic membranes such as polysulfone, cellulose acetate/nitrate mixed ester is termed in-vitro release testing (IVRT). This is performed to order to understand and establish the release kinetics of a drug from the formulations such as polymer or lipid based nanoparticles, organogels, complexes and liposomes. IVRT studies can be performed either by mounting cellulose acetate membranes on Franz diffusion cells to closely simulate topical application or by using dialysis tubes or dialysis cassettes with appropriate molecular weight cut-off values. Rates of drug release from particular formulations and fluxes through human cadaver skin are important data required for research and development endeavors and FDA filings.

*FDC-24 diffusion assay heat block*

*Water jacketed permeation equipment*


*Skin integrity testing on intact skin*

*Skin integrity testing on human cadaver skin mounted on Franz diffusion cells*

CENTER FOR DERMAL RESEARCH

# NANOCARRIERS AS DRUG DELIVERY VEHICLES AT THE CENTER FOR DERMAL RESEARCH

Nanoparticles as drug delivery carriers have been explored for various topical and transdermal applications for more than two decades. Nano-sized particles are utilized as beneficial drug carriers to address various challenges of poor penetration/permeation in topical and transdermal drug delivery. These nanostructures can provide a protective polymeric or lipid coating to help stabilize certain photosensitive drug molecules and to reduce skin irritation caused by their direct topical contact. Nanocarriers have the potential to improve the solubility of hydrophobic drugs that are suitable for skin permeation but a challenge to incorporate in adequate amounts in the final formulation. Nanocarriers can be further modified to provide controlled release, targeted treatments and can serve as reservoirs in skin layers or hair follicles, which facilitates the distribution of the drug molecules throughout the skin including into the deeper layers.

For many years, the research group of Prof. Michniak-Kohn has focused on the design, development and testing of polymeric and lipid based nanoparticles (nanosuspensions, nanoemulsions, liposomes, solid lipid nanoparticles and ethosomes) for topical and transdermal drug delivery. Research efforts have been directed towards targeting several disease states including atopic dermatitis, psoriasis, skin cancer and skin aging issues, and for systemic (transdermal) delivery using gels and patches for treatment of Alzheimer's disease, epilepsy, and for antiinflammatory and antioxidant effects. At the Center, we characterize these nanocarriers for particle size and surface charge, and evaluate in-vitro drug release, skin permeation, skin irritation as well as pro-inflammatory cytokine release. We are implementing computer modeling and Quality By Design approaches to complement experimental protocols in order to achieve better design space and gain a greater understanding of the effects of critical processes and formulation parameters on final product characteristics. Some examples of our studies are provided below.

## Ethosomes

Ethosomes are novel lipid carriers for enhanced delivery through the skin and are soft malleable vesicles composed mainly of phospholipids, ethanol (relatively high concentrations), and water. Ethanol is an efficient permeation enhancer that increases the fluidity of stratum corneum layers by acting on intercellular regions to overcome poor penetration through the skin barrier. We have performed extensive research work to incorporate various natural alkaloids alone or in combination into ethosomes to achieve an efficient topical formulation with synergistic anti-melanoma effects. Our preference is to develop industry scalable manufacturing processes such as solvent infusion???? Not sure what Sonia had in mind here and single injection methods to formulate these nanocarriers, to ensure future commercial feasibility of the product.

## Polymer based nanocarriers

Biodegradable polymers that can self-assemble into nano-sized structures are a promising platform for the development of topical drug delivery systems. TyroSpheres, developed by scientists at the New Jersey Center for Biomaterials at Rutgers- The State University of New Jersey, are an example of such nanospheric drug carriers. The technology has been patented and also extensively reported in the scientific literature (Figure 1). These nanoparticles have been shown to deliver drugs preferentially to the upper skin layers, thus having the ability to increase the therapeutic efficacy and safety of the applied drugs.

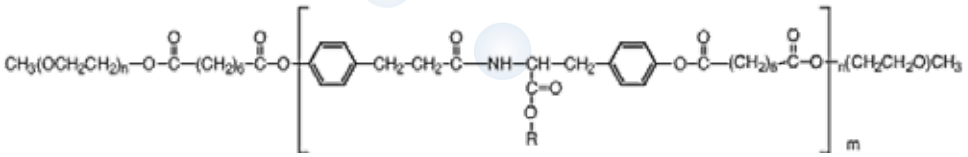


*Figure 1. Tyrosine-derived polymers used for TyroSpheres*

Center for Dermal Research

# Nanocarriers as drug delivery vehicles at the Center for Dermal Research — *continued*

Dynamic light scattering showed that the size of nanospheres in solution was in the range of 40-45 nm, with low variation in size (Figure 2). This size remained consistent after leaving the nanospheres at 25°C for 30 days. Transmission electron microscopy images confirmed the morphology of nanosphere structures (Figure 3).

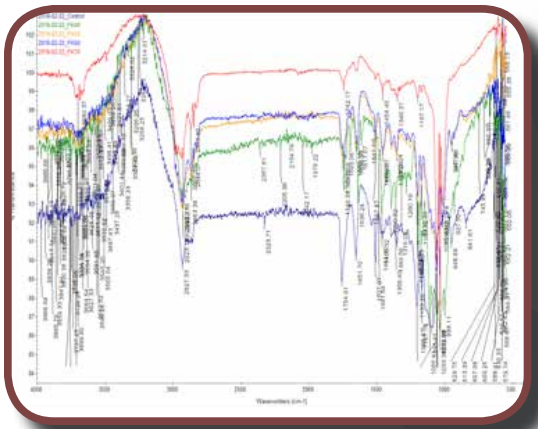


*Figure 2. Fourier-transform infrared spectra of empty and drug-loaded TyroSpheres*

We are developing TyroSphere formulations for treating a variety of skin disorders, including atopic dermatitis, psoriasis, acne, and alopecia areata, all of which need more targeted delivery within the skin layers that will ultimately lead to enhanced therapeutic outcomes.

## Solid lipid nanoparticles

Solid lipid nanoparticles (SLNs) are sub-micron sized colloidal carriers with drug dispersed in matrix of solid lipids (Figure 4) such as triglycerides (tri-stearin), partial glycerides (Imwitor, Compritol® 888), fatty acids (stearic acid, palmitic acid), and steroids (cholesterol) and waxes (cetyl palmitate), and are usually composed of a physiological lipid dispersed in aqueous surfactant solution. We are investigating SLNs as delivery vehicles for navigating drugs that are hard to deliver into and through skin and nail. Achieving effective end points against various diseases such as onychomycosis, as well as for wound healing and anti-ageing is the ultimate goal. We have already successfully incorporated some flavonoids, anti-Alzheimer's, antifungal and anticancer drugs into solid lipid matrices for efficient and controlled drug delivery.

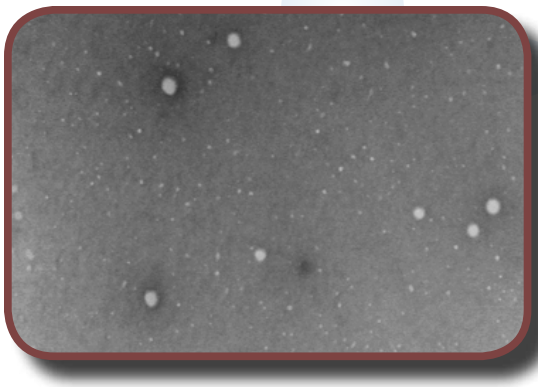


*Figure 3. Transmission electron microscopy image of drug-loaded nanospheres*

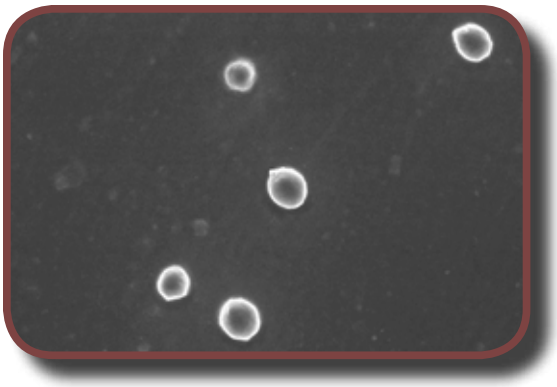


*Figure 4: Transmission electron microscopy images of solid lipid nanoparticles containing antifungal agents*

Center for Dermal Research

# Transdermal delivery of drugs for treatment of Alzheimer's disease

The transdermal route possesses several advantages over other routes, such as avoidance of first pass effect, gastro-intestinal side effects and/or metabolism, improved efficacy, and decreased toxicity. Also, it presents a very appealing choice for the treatment of Alzheimer's disease (AD). Indeed, transdermal patches offer exceptional advantages for the AD patients by reducing the pill burden, thus improving compliance. Moreover, a study involving 1059 AD patients' caregivers revealed that 70% of them preferred transdermal patches over capsules. The preference was based on the ease of application of the patch and less interference with everyday life. In addition, there is an advantage to being able to see the applied patch as opposed to remembering if the patient has or has not taken their oral medication especially in patients who have impaired memory.

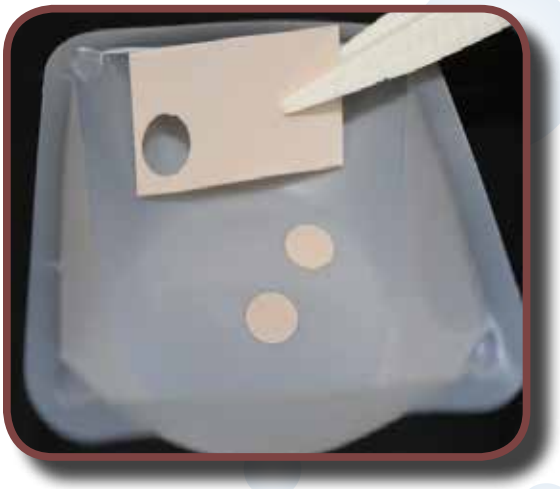


*Figure 5: Transdermal patches made using film casting in our laboratory*

The objective of this research is to develop transdermal patches for delivery of AD drugs (Figure 5). Basically, there are two different types of patches; reservoir type and matrix type (the more popular design). Our objective is to formulate and characterize a transdermal patch containing a combination of drug molecules for AD, which are currently administered to these AD patients by oral routes (tablets and capsules). A drug in adhesive patch is formulated by dissolving the drug(s) in an acrylate polymer matrix containing a penetration enhancer. For this purpose, several acrylate and silicon polymers have been investigated in order to select a candidate polymer blend that offers the most efficient delivery of drug(s). In addition, 10 different penetration enhancers were compared evaluated for their enhancement effect. The optimization of the formulation included a study of the effect of concentration of the API on the flux, and effect of addition of crystallization inhibitor. We have evaluated percutaneous absorption of AD drugs through transdermal patches using vertical Franz diffusion cell mounted with human cadaver skin (Figure 6). The developed patches are designed to be applied once daily to deliver the drug at the therapeutic level with minimum irritation.

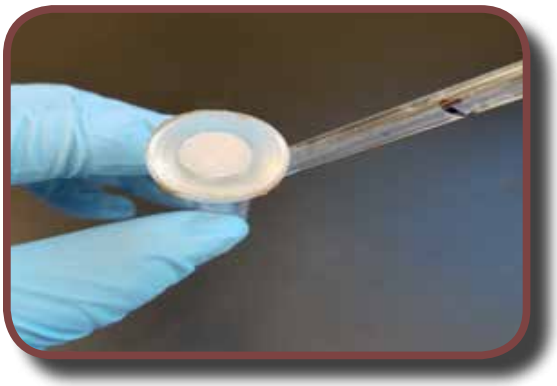


*Figure 6: Transdermal patch with anti-Alzheimer's drug mounted on human cadaver skin to evaluate its transdermal delivery*

Center for Dermal Research

# Transungual (Nail) Drug Delivery

Transungual drug delivery refers to the drug transport across the nails to achieve targeted drug delivery for treatment of nail diseases. Onychomycosis is a fungal disease of the nail that is growing rapidly worldwide especially in the older population. The condition involves discoloration, brittleness and thickening of the nails. It is a recurring disease seen more in toenails than in fingernails and the challenge is to achieve effective drug delivery topically rather than by the oral route, the latter posing greater risks of systemic adverse effects. A transungual drug transport system provides a better delivery route than oral or systemic treatment of fungal infections due to its better adherence, localized action and minimum systemic side effects .

*Figure 7: Human cadaver nails*

Transungual drug delivery studies at the Center for Dermal Research have been expanded significantly with interest in deep nail layer delivery. We are working with novel formulations containing different anti-fungal drugs to achieve effective delivery. After establishing initial analytical characterization of anti-fungal drugs and human cadaver nails, we have begun permeation studies using modified Franz Diffusion Cells with nail adapters (Figure 7, Figure 8).

Efforts are being made not only towards achieving drug permeation through the nail, but also understanding lateral diffusion of drugs in the nail layers. We have collaborations with our partners at TRI Princeton and other research groups with the latest technology platforms and testing capabilities to enhance our efforts in this area.
Currently, we are focusing on developing different formulation strategies with potential antifungal molecules such as terbinafine hydrochloride, econozaole, ketoconazole, and others to target the disease and achieve effective antifungal therapies. We are exploring various formulations such as microemulsion/nanoemulsion gels, lipid nanostructures and nail lacquers for treating fungal infections (Figure 4).

*Figure 8: Franz diffusion cell with nail adapters*

CENTER FOR DERMAL RESEARCH

# 2017 INNOVATIONS IN DERMATOLOGICAL SCIENCES

## "Harnessing the Skin Microbiome"

Our fifth annual conference on dermatology took place on Monday and Tuesday, October 2-3, 2017 at the Renaissance Woodbridge Hotel in Iselin, NJ. The theme of this year's conference was "Harnessing the Skin Microbiome". Throughout the two-day program speakers addressed addressed the property of the skin microbiome and the implications for research.

### PROGRAM COMMITTEE 2017

**Bozena Michniak-Kohn**
Rutgers, The State University of New Jersey – Center for Dermal Research

**Francois Berthiaume**
Rutgers, The State University of New Jersey

**Angela Christiano**
Columbia University

**Laurence De-Thumm**
Colgate-Palmolive

**William Ju**
Advancing Innovation in Dermatology, Inc.

**Louli Kourkounakis**
Rutgers, The State University of New Jersey – Center for Dermal Research

**John Lyga**
Avon

**Becky Minnillo**
Society for Investigative Dermatology

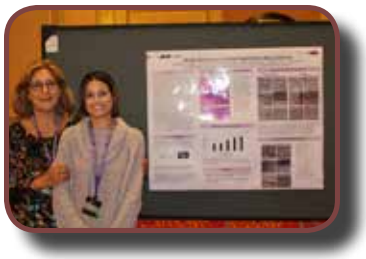
**Otto Mills**
Rutgers, The State University of New Jersey

**Samir Mitragotri**
University of California, Santa Barbara

**David Moore**
GSK Consumer Healthcare

**Amy Pappert**
Rutgers, The State University of New Jersey – RWJMS

**Miri Seiberg**
Seiberg Consulting

CENTER FOR DERMAL RESEARCH

# 2018 INNOVATIONS IN DERMATOLOGICAL SCIENCES

## "Future of Dermatologicals & Cosmeceuticals"

Our sixth annual conference on dermatology took place on Monday and Tuesday October 8-9, 2018 at the Renaissance Woodbrigge Hotel in Iselin, NJ. The theme of this years conference was "Future of Dermatologicals & Cosmeceuticals." Throughout the two-day program speakers addressed formulation issues and new formulation approaches and skin models, skin visualization and 3D Printing.


### PROGRAM COMMITTEE 2018

**Bozena Michniak-Kohn**
Rutgers, The State University of New Jersey – Center for Dermal Research

**James Allred**
Advancing Innovation in Dermatology, Inc.

**Robert Bianchini**
Rodan + Fields, LLC

**Miki Blumenberg**
NYU School of Medicine

**Tom Boyd**
Colgate Palmolive Company

**Jamie Breslin**
Advancing Innovation in Dermatology, Inc.

**Angela Christiano**
Columbia University

**Laurence Du-Thumm**
Colgate Palmolive Company

**William Ju**
Advancing Innovation in Dermatology, Inc.

**Peter Landa**
Estee Lauder

**John Lyga**
Avon Products, Inc.

**Otto Mills**
Rutgers, The State University of New Jersey

**Amy Pappert**
Rutgers, The State University of New Jersey – RWJMS

**Miri Seiberg**
Seiberg Consulting


Center for Dermal Research

# TRI Skin Course

TRI, in collaboration with the Center for Dermal Research at Rutgers University, held another successful skin measurement science course on October 10th and 11th. The course attracted 35 attendees from a wide range companies and academic groups. It also attracted, alongside the TRI presenters, some very high-quality external speakers; Laurie Joseph (Rutgers University), Kavita Beri (Rutgers University and BE Mind Body Skin), Michael Southall (Johnson & Johnson), Prof. K.P. Ananth (University of Cincinnati), Neena Tierney (NeoStrata), Prof. Bob Imhof (London South Bank University and Biox Systems Ltd), Carol Flach (Rutgers University), Prof. Bozena Michniak-Kohn (Rutgers University), Matthieu Jomier (Newtone Inc.) and Eduardo Ruvolo (Bayer Consumer Health). Many thanks to our external speakers for their continued support.

This year the course was refreshed to focus even more on the knowledge and tools required to make good skin measurements in product development and for claims support. New presentations were introduced to cover claims substantiation and experimental design for skin testing. In addition, more space was given to cover a wider range of skin measurement techniques.

The instrumental showcase is a long-standing and very popular part of the course. This year, attendees had hands-on demonstrations in the laboratories on TEWL testing, wrinkle measurements, FTIR on skin and skin moisture measurements. Many thanks to our instrument suppliers (Biox Systems, Skin Test Equipment, Remspec, Perkin Elmer and Bossa Nova) for their continued help and support with this.

The course finished with a British-style pub quiz, where teams of attendees were challenged to answer a range of questions based on information shared by the speakers during the course. In good pub quiz tradition some random music questions were also thrown in! It did get quite competitive, but good fun was had by all.

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# VISITING SCIENTISTS IN CDR 2017-2018

**Kavita Beri, M.D.**
practicing clinician dermatologist from Ocean City, NJ, Spring 2015-present.

**Samuel Gurion-Arsiquaud, Ph.D.**
spectroscopist from TRI, Princeton NJ. Spring 2015-present.

**Daphne Benderly, Ph.D.**
from Presperse, NJ specializing in polymer chemistry and characterization. July 2016-present.

**Sharon Haynie, Ph.D.**
from Hypatia Technology Works, LLC, Philadelphia, PA. Specialist in drug delivery systems. Fall 2018-present.

**Komal Shahani, Ph.D.**
from Croda, NJ specializing in polymers and personal care products for skin. September 2016-May 2017.

**Arsalan Khan, Ph.D.**
from Croda, NJ specializing in polymers and personal care products for skin. September 2016-present.

**Allyson Maron, Ph.D.**
from Croda, NJ specializing in polymers and personal care products for skin. September 2017-present.

**Amra Tabakovic, Ph.D.**
from Croda, NJ specializing in polymers and personal care products for skin. July 2018-present.

**Natalia Shub, Ph.D. Merial, NJ**
specializing in skin permeability testing, veterinary formulations and formulation optimization. September 2016-September 2017.

**Michael Liu, Ph.D.**
from Zymeron Corporation, Research Triangle Park, NC, Vice-President R&D specializing in regenerative medicine for dermatology. August 2016-present.


# International Visitors in CDR 2017-2018

**Professor Janina Lulek, Ph.D.**
Professor & Head, Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. May-June 2018.

**Anna Juszczak-Wzgarda, M.Sc.**
Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. June-September 2018.

**Ewelina Wieczorek, M.Sc.**
Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. June-September 2018.

**Marek Rychter, M.Sc.**
Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. June-September 2018.

**Michal Falkowski, M.Sc.**
Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. June-September 2018.

**Wioleta Maruszak, Ph.D.**
Pharmaceutical Research Institute, R&D Analytical Chemistry Dept., Warsaw, Poland. Funded by Orbis RISE grant. August 2018.

**Katarzyna Mroz, M. Eng.**
Pharmaceutical Research Institute, R&D Analytical Chemistry Dept., Warsaw, Poland. Funded by Orbis RISE grant. August-October 2018.

**Katarzyna Kosicka, Ph.D.**
Department of Pharmaceutical Technology, Poznan University of Medical Sciences, Poznan, Poland. Funded by Orbis RISE grant. August 2018-February 2019.

**Piotr Rudzki, Ph.D.**
Pharmaceutical Research Institute, R&D Analytical Chemistry Dept., Warsaw, Poland. Funded by Orbis RISE grant. October 2018.

**Professor Chandarat Ampasavate Ph.D.**
Faculty of Pharmacy, Chiang Mai University, Chiang Mai, Thailand. Funded by Researchers & Research Projects for Industry Project of Thailand Research Fund. May 2018.

**Phunsuk Anantaworasakul**
Ph.D. student at College of Pharmacy, Chiang Mai University, Chiang Mai, Thailand. Funded by Researchers & Research Projects for Industry Project of Thailand Research Fund. May-December 2018.

**Panikchar Wichayapreechar**
Ph.D. student at College of Pharmacy, Chiang Mai University, Chiang Mai, Thailand. Funded by Researchers & Research Projects for Industry Project of Thailand Research Fund. May-December 2018.

**Dean & Professor Indu Pal Kaur M.Pharm. Ph.D., PDCR, Fulbright Scholar**
Dean Faculty of Pharmaceutical Sciences, Professor & Head, Dept of Pharmaceutics, University Institute of Pharmaceutical Sciences, Panjab University Chandigarh 160014, India. November 2017-May 2018.

**Barbara Bartoletti**
Intern from Universite Nice Sophia Antipolis Cedex, France from Bioengineering Department. June-September 2017.

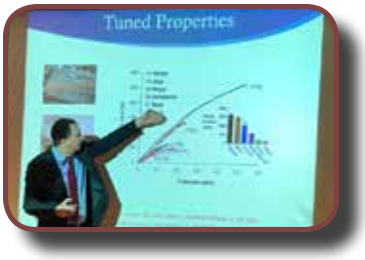
**Jemima Moraes**
Ph.D. candidate in Translational Medicine: Pharmacy & intern from Universitade Federal de Sao Paolo (UNIFESP), Sao Paolo, Brazil with CAPES scholarship (Brazilian Federal Agency for Support and Evaluation of Graduate Education) awarded for September 2017 to present. Working on topical formulations containing various clay minerals, clay mineral microstructure and effects on active delivery into the skin layers.

**Caroline Mellac**
Ph.D. candidate & intern from Ecole Nationale Superieure Agronomique de Toulouse, France. Masters Program in Engineering and Management. September 2016-May 2017.

**Hongmei Lin M.S.**
School of Chinese Materia Medica, Beijing University of Chinese Medicine, Beijing China. February 2017-February 2018.

# Center for Dermal Research

## CDR Seminars 2017-2018




## CDR Gatherings 2017-2018

CENTER FOR DERMAL RESEARCH

# CALENDAR OF EVENTS 2017

January 30th CDR Seminar Series – **Patricia M. Brieva, L'Oreal** "Organic Acid Applications within the Cosmeceutical Industry 'Chemical Peels'"

February 15th CDR Seminar Series – **Joanna Jacków**, "Gene-corrected Fibroblast Therapy for Recessive Dystrophic Epidermolysis Bullosa Using a SIN COL7A1 Retroviral Vector"

February 27th CDR Seminar Series joint with TRI Princeton – **Samuel Gourion Arsquaud, TRI Princeton**, "Infrared Spectroscopy and Imaging Relevant Methods to Investigate Important Skin Parameters like natural moisturizing factor (NMF), skin barrier function, active delivery etc…"

March 13th CDR Seminar Series – **Peter R. Hilliard, Colgate Palmolive**, The Technology Behind Antiperspirants and Deodorants"

April 24th CDR Seminar Series joint with Colgate Palmolive – **Aixing Fan, Colgate Palmolive**, "Introduction to Surfactants in Skin Cleansers"

April 25th BADF Event – **Steve Herman, Diffusion, LLC** "Topical Semi-solid Microstructure and its Significance in Formulations Performance and Efficacy"

May 15th CDR Seminar Series – **Zsolt Szabados, Presperse**, " Sunscreen Formulations and its Challenges"

May 22nd CDR joint Seminar – **David B. Lebo, Temple University**, " Is there a Better in vitro Model for Transungual Permeation"

June 5th Joint Event with TRI Princeton – **Michael Koganov, Ashland Inc.**, "Harmoniance™: Multifunctional and Sustainable Zeta Fraction from Sacred Lotus"

August 3rd CDR Seminar Series joint TRI Princeton – **Kevin J. Mills, Proctor & Gamble**, "Analysis of Gene Expression Profiles of Multiple Skin Diseases Identifies a Near Universal Signature of Disrupted Homeostasis"

August 28th CDR Seminar Series – **Amy Either, BASF**, "Understanding Formulation Design through the Microscope Lens"

September 25th CDR Seminar Series – **Hilary Baldwin, Dermatologist**, "Acne and Inflammation: A Chicken or the Egg Conundrum (For That Matter, Where is the Egg and Who is the Chicken?)"

October 2-3rd Innovations in Dermatological Sciences – "Harnessing the Skin Microbiome"

October 16th CDR Seminar Series – **Ilya Raskin, Rutgers**, "Novel Botanicals for Skin Care and Health"

November 6th CDR Seminar Series – **Carl Germano, Phytotek**, "Feeding the Subcutaneous Endocannabinoid System: Beautiful & Healthy Skin with Hemp Based Phytocannabinoids"

December 6th CDR Seminar Series – **Bill Welsh, Rutgers**, "Avalanche, a novel computational tool for property prediction of bioactive molecules"

Center for Dermal Research

# Calendar of Events 2018

January 22nd CDR Seminar Series – **Kavita Beri, Beri Esthetique**, "Skin Microbiome as a Tool to Influence Skin Barrier Function and its Future in Regenerative Medicine & Cosmetic Innovation"

February 12th CDR Seminar Series – **Indu Kaur, Panjab University**, "Probiotic Formulations for Skin: Scope and Issues"

March 20th BADF Event – **Lee Hall and Lydia Grossov**, " Website Content Creation to Boost Search Engine Optimization (SEO) and Credibility"

April 16th CDR Seminar Series – **Claudio Ortiz, Colgate Palmolive**, " Fragrance Encapsulation Technologies in Personal Care Products"

April 30th CDR Seminar Series joint with Colgate Palmolive – **Srdjan Maksimovic, Colgate Palmolive**, "TRPV Channels and Their Role in Skin Health"

May 3rd CDR Seminar Series joint with TRI Princeton – **Phil Cummins, PGC Consultants**, "The Application of Measurement Science in the Cosmetic and Personal Care World"

May 7th CDR Seminar Series – **Michael Davitz, Leason Ellis LLC**, "Patenting a Pharmaceutical Product"

June 11th CDR Seminar Series – **Julie Bianchini, Johnson & Johnson**, "Clinical Improvements in Dry Skin Through Topical Delivery of Deep Skin Hydration"

June 25th CDR Seminar Series – **Peter Landa, Estee Lauder**, "Domestic and International SPF and Sunscreen Usage Guidelines"

July 30th CDR Seminar Series – **Monica Guan, BASF**, "Exploration into Topical Pharmaceutical Excipient Functionality and Versatility: Kolliwax GMS II"

September 17th CDR Seminar Series – **Miri Seiberg, Seiberg Consulting**, "Senior Skin"

September 24th CDR Seminar Series – **Gopi Menon, Avon**, " Stratum Corneum: Why a "Dead" Layer should Elicit such Fascination?"

October 8-9th Innovations in Dermatological Sciences – "Future of Dermatologicals & Cosmeceuticals"

October 15th CDR Seminar Series – **Robert Falcone, Intergris3 BioSolutions LLC.**, "Advantages and Challenges of In-vitro and In-Silico tests in Claim Substantiation"

October 24th CDR Seminar Series – **Margareth Marques, US Pharmacopeia**, "Products Applied to the Skin- Quality Attributes and Performance Tests"

December 3rd CDR Seminar Series – **Boaz Mizrahi, Israel Institute of Technology**, " New Directions in Skin Adhesion"

December 10th CDR Seminar Series joint with TRI Princeton – **Miroslav Blumenberg, New York University**, "Epidermal Transcriptional Responses to Common Dwellers"


## 2017-2018 Publications

1) Silva, S. De, Michniak-Kohn, B. , Leonardi, G. R. An overview about oxidation in clinical practice of skin aging. Anais Brasileiros de Dermatologica (2017), May-June, 92 (3), 367-374. Doi: 10.1590/abd1806-4841.20175481.Review. PMID 29186250.
2) Ramezanli, T., Kilfoyle, B. Zhang, Z., Michniak-Kohn, B. Polymeric nanospheres for topical delivery of Vitamin D3. International Journal of Pharmaceutics, 2016, http://dx.doi.org/10.1016/j.ijpharm.2016.10.072 and (2017), 516, 196-203. PMID 27810351.
3) Ameen, D. and Michniak-Kohn, B. Transdermal delivery of dimethyl fumarate for Alzheimer's disease: Effect of penetration enhancers. International Journal of Pharmaceutics, 2017, August 30; 529 (1-2), 426-473; doi:10.1016/j.pharm.2017.07.031. Epub. 2017 July 12. PMID 28709939.
4) Trehan, S., Michniak-Kohn, B., Beri, K. Plant stem cells in cosmetics: current trends and future directions. Future Science, 2017. Published on line https://doi.org/10.4155/fsoa-2017-0026 July 12th 2017 and Future Science, 2017, 3 (4), FSO226. PMID 29134115.
5) Shah, P., Goodyear, B., Michniak-Kohn, B.B. A Review: Enhancement of solubility and oral bioavailability of poorly soluble drugs. Advance Pharmaceutical Journal, 2017, 2 (5), 161-173.
6) Adeleke, O.A., Tsia, P-C., Karry, K., Monama, N.O., Hayeshi, R.K., Michniak-Kohn, B. An isoniazid-loaded monolayer orodispersible strip for tuberculosis treatmet and prophylaxis: Methodical design, optimization and evaluation. International Journal of Pharmaceutics, 2018, 547, 347-359. https:/doi.org/10.1016/j/pharm.2018.06.004. PMID 29879506.
7) Lin, H., Michniak-Kohn, B., Xia, Z., Xu, L., Kang, Q., Chen, C., Ma, S., Wu, Q. Transdermal delivery of compounds with different lipophilicity and molecular weight from W/O microemulsions analyzed by UPLC-Q-TOF/MS and LC-MS/MS. Current Drug Delivery, 2017, Dec 21; doi: 10:2174/1567201815666171221125411. [Epub ahead of print]. PMID 29268684.
8) Haq, A. Dorrani, M., Goodyear, B., Joshi, V., Michniak-Kohn, B., Membrane Properties for Permeability Testing: Skin versus synthetic membranes, International Journal of Pharmaceutics, 2018, Jan 26 539 (1-2), 58-64. PMID 29366943.
9) Zhang, J., Michniak-Kohn, B.B. Investigation of microemulsion and microemulsion gel formulations for dermal delivery of clotrimazole. International Journal of Pharmaceutics, 2018, Jan 30; 536 (1), 345-352. https://doi.org/10.1016/j.ijpharm.2017.11.041. PMID 29170117.
10) Ramezanli, T., Michniak-Kohn, B. Development and characterization of a topical gel formulation of adapalene-Tyrospheres and its clinical efficacy assessment. Molecular Pharmaceutics, 2018, July 31, doi:10.1021/acs.molpharmaceut.8b00318 (Epub ahead of print). PMID 29996653.
11) Haq, A., Goodyear, B. Ameen, D., Joshi, V., Michniak-Kohn, B. Strat-M Synthetic membrane: Permeability comparison to human cadaver skin. Int. J. Pharmaceutics, 2018, Aug 25; 547 (1-2); 432-437 doi: 10.1016/j.ijpharm.2018.06.012. Epub. 2018 June 14. PMID 29890259.
12) Ameen, D., Michniak-Kohn, B. Development and in vitro evaluation of pressure sensitive adhesive patch for the transdermal delivery of galantamine. European Journal of Pharmaceutics and Biopharmaceutics, 2018 (in press).
13) Haq, A., Michniak-Kohn, B. Effects of solvents and penetration enhancers on transdermal delivery of thymoquinone: permeability and skin deposition study. Drug Delivery, 2018 (in press).

## Published Book Chapters 2017-2018

1) Tsai, P., Ramezanli, T., Wadie, D., Trehan, S., Martos, N., Zheng, Z., Michniak-Kohn, B.B. Selection considerations for membranes and models for in vitro-ex vivo permeation studies. In "Dermal Drug Delivery Systems: From Innovation to Production", 2nd Edition edited by Ghosh, Tapash, CRC Press, Inc., ISBN 13: 9781466582705 and 10: 1466582707, August 15, 2017.
2) Langley, N., Michniak-Kohn, B. Osborne, D.W. (Editors) The Role of Microstructure in Topical Drug Product Development. Also co-author on Chapter entitled: "In Vitro Release as a Critical Quality Attribute in Topical Product Development". Springer Publishing, 2019. In Press.
3) Michniak-Kohn, B., Ramezanli, T., Romanski, F., Milow, C., Shah, K. Advanced formulation techniques including innovative materials in "Cosmetic Formulation: Principles and Practice" Chapter 18, edited by Benson, H., Leite e Silva, V., Roberts, M., and Walters, K. CRC Press Taylor and Francis Group, 2019. In Press.
4) Trehan, S. Soskind, R., Moraes, J., Puri, V., Michniak-Kohn, B. Natural products and stem cells and their commercial aspects in cosmetics in "Cosmetic Formulation: Principles & Practice" Chapter 14, edited by Benson, H., Leite e Silva, V., Roberts, M., and Walters, K. CRC Press Taylor and Francis Group, 2019. In Press.

## Presentations 2017-2018

1) Michniak-Kohn, B. Skin Penetration Studies. Principles and Practice of Skin Measurement Science two-day Course, TRI Princeton & Center for Dermal Research CDR, TRI Princeton, October 10-11, 2018. INVITED SPEAKER.
2) Michniak-Kohn, B. Overview of Research at the Center for Dermal Research CDR at Rutgers, The State University of New Jersey. 2018 University Contacts two-day Symposium at Lubrizol Headquarters, Brecksville, Ohio. May 22 and 23rd, 2018. INVITED SPEAKER.
3) Michniak-Kohn, B. Targeted delivery of adapalene to hair follicles for treatment of acne. Drug Formulation and Drug Delivery Symposium at Touro College of Pharmacy, New York City, NY. May 24th, 2018. INVITED SPEAKER.
4) Michniak-Kohn, B.B. Excipient functionality to meet future needs. Presented at the CDR/BASF Workshop entitled Discovery of Excipient Functionality in Topical Formulation Design, Tarrytown, NY, December 5th 2017. INVITED SPEAKER.
5) Michniak-Kohn, B. Topical dosage forms and formulations: Foundations lecture in Workshop on Dermatological Drug Products: Developmental & Regulatory Considerations. Nov. 11-12, 2017. This was a two-day Pre-meeting Workshop at the AAPS Annual Meeting & Exposition, Nov 12-16, 2017, San Diego Convention Center, San Diego, CA. INVITED SPEAKER.
6) Michniak-Kohn, B. Topical Delivery of Actives: Key Principles. Advances in Skin Science, Measurement & Treatment Course, TRI Princeton & Center for Dermal Research CDR, TRI Princeton, October 4-5, 2017.
7) Michniak-Kohn, B. Topically-applied nanocarriers for the treatment of acne. MadiMed Conference: Red de Materiales, Dispositivos y Medicamentos at University of Habana, Habana, Cuba July 5th 2017.

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## Published Abstracts 2018-2018

1) Ameen, D., Alam, A., Michniak-Kohn, B. Transdermal permeation of dimethyl fumarate with nicotine in human skin-effect of pH. Controlled Release Society Annual Meeting & Exposition, July 16-19, 2017 Hynes Convention Center, Boston, MA.
2) Haq, A., Chandler, M., Michniak-Kohn, B. Application of Hansen solubility parameters and FFE Software in predicting drug permeation and for the selection of best pharmaceutical excipinets for delivery of active molecules through the skin. Gordon Research Conference "Barrier Function of Mammalian Skin: Convergence of Biological and Technological Frontiers of Skin Barrier" Waterville Valley, New Hampshire, USA, August 13-18, 2017.
3) Nallaseth, F.S., Michniak-Kohn, B., Bradeanu, I.L., Foty, R.A., Woodbury, D., Medina, D., Jia, D., Walton, K., Batheja, P., Tsai, P-C. Multi-cue induction of skin morphogenesis in 3D co-cultures traced with lineage specific markers and research plans for synchrotron Fourier transform infra-red (SR-FTIR) microspectroscopy. Programme CoLuAa XXV 2017 at University of Copenhagen, Copenhagen, Denmark, October 30, 2017.
4) Adeleke, O.A., Karry, K. M., Tsai, P.C., Michniak-Kohn, B.B. Design and evaluation of a nano-enabled oral film of rifampicin for tuberculosis treatment. AAPS Annual Meeting & Exposition, Nov 12-16, 2017, San Diego Convention Center, San Diego, CA.
5) Haq, A., Goodyear, B., Ameen, D., Joshi, V., Michniak-Kohn, B. Strat-M synthetic membrane: Permeability comparison to human cadaver skin. AAPS Annual Meeting & Exposition, Nov 12-16, 2017, San Diego Convention Center, San Diego, CA.
6) Lin, H., Trehan, S., Michniak-Kohn, B. Development and evaluation of co-loaded berberine chloride and evodiamine ethosomes for the treatment of melanoma. AAPS Annual Meeting & Exposition, Nov 12-16, 2017, San Diego Convention Center, San Diego, CA.
7) Michniak-Kohn, B. Topical Dosage Forms and Formulations: Foundation Lecture at AAPS Workshop on Dermatological Products-Developmental and Regulatory Considerations. AAPS Annual Meeting & Exposition, Nov 12-16, 2017, San Diego Convention Center, San Diego, CA. INVITED PODIUM SPEAKER.
8) Lin, H., Trehan, S., Michniak-Kohn, B. Enhanced epidermal localization of topically applied co-loaded berberine and evodiamine using ethosomes. 71st Annual Society for Cosmetic Chemists Scientific Meeting and Technology Showcase, December 11-12, 2017, The Westin New York at Times Square.
9) Moraes, J.D.D., Leonardi, G. R., Guerra, L.O., Trehan, S., Michniak-Kohn, B. B. Investigation of clay mineral for skin photoprotection by in vitro and in vivo assays. 71st Annual Society for Cosmetic Chemists Scientific Meeting and Technology Showcase, December 11-12, 2017, The Westin New York at Times Square.
10) Soskind, R., Trehan, S., Michniak-Kohn, B. B. Design, development and in vitro characterization of Vitamin E loaded polymeric nanoparticles for topical delivery. 71st Annual Society for Cosmetic Chemists Scientific Meeting and Technology Showcase, December 11-12, 2017, The Westin New York at Times Square.
11) Puri, V., Ramzan, M., Trehan, S., Pal Kaur, I., Michniak-Kohn, B. Ungual delivery of ketoconazole using solid lipid nanoparticles. Controlled Release Society Annual Meeting & Exposition, July 22-24, 2018, New York Hilton Midtown Manhattan Hotel, New York, NY.
12) Gourion-Arsiquaud, S., Ramzan, M., Trehan, S., Wyluda, K., Zhang, Q., Michniak-Kohn, B., Pal Kaur, I. Investigation of the permeation of solid lipid nanoparticles loaded with ketoconazole into skin layers using spectroscopic imaging techniques. Controlled Release Society Annual Meeting & Exposition, July 22-24, 2018, New York Hilton Midtown Manhattan Hotel, New York, NY. ORAL PRESENTATION.
13) Haq, A., Michniak-Kohn, B. Transdermal delivery of thymoquinone: Solubility, permeability and skin deposition study. Controlled Release Society Annual Meeting & Exposition, July 22-24, 2018, New York Hilton Midtown Manhattan Hotel, New York, NY.
14) Soskind, R., Kohn, J.B., Michniak-Kohn, B. Tyrospheres loaded with Vitamin E and tacrolimus for topical delivery applications. Controlled Release Society Annual Meeting & Exposition, July 22-24, 2018, New York Hilton Midtown Manhattan Hotel, New York, NY.
15) Ameen, D., Michniak-Kohn, B. Development and evaluation of dimethyl fumarate nano-structured lipid carriers using microemulsion method. Controlled Release Society Annual Meeting & Exposition, July 22-24, 2018, New York Hilton Midtown Manhattan Hotel, New York, NY.
16) Soskind, R. Michniak-Kohn, B. Characterization of compound loading into polymer nanospheres for dermal applications. 4th International Conference on Biomedical Polymers & Polymeric Materials, July 15-18, 2018, Krakow, Poland.
17) Ameen, D., Michniak-Kohn, B. Development & evaluation of dimethyl fumarate nano-structured lipid carriers using microemulsion method. Innovations in Dermatological Sciences: Future of Dermaceuticals & Cosmeceuticals, Renaissance Woodbridge, NJ, Oct 7-9, 2018.
18) Haq, A., Michniak-Kohn, B. Transdermal delivery of thymoquinone: Solubility, permeability & skin deposition study. Innovations in Dermatological Sciences: Future of Dermaceuticals & Cosmeceuticals, Renaissance Woodbridge, NJ, Oct 7-9, 2018.
19) Jackow, J., Rami, A., Soskind, R., Guo, Z., Hansen, C., Hayashi, R., DeLorenzo, D., Michniak-Kohn, B., Christiano, A., Development of liposomes for CRISPR/Cas9 gene-editing in vivo deleivery for recessive dystrophic epidermolysis bullosa treatment. Innovations in Dermatological Sciences: Future of Dermaceuticals & Cosmeceuticals, Renaissance Woodbridge, NJ, Oct 7-9, 2018.
20) Rudzki, P., Maruszak, W., Pesta, E., Trehan, S., Michniak-Kohn, B. Dermal microdialysis & bioequivalence of topical drugs: a perfect marriage? Innovations in Dermatological Sciences: Future of Dermaceuticals & Cosmeceuticals, Renaissance Woodbridge, NJ, Oct 7-9, 2018.
21) Haq, A., Michniak-Kohn, B. Effects of solvents and penetration enhancers on transdermal delivery and skin deposition of thymoquinone, an anti-inflammatory phytochemical. AAPS Annual Meeting & Exposition 2018 PharmSci 360, Walter E. Washington Convention Center, Washington DC, November 4-7, 2018.
22) Soskind, R. Michniak-Kohn, B. Investigating drug loading capacity of TyroSpheres, a polymer-based nanocarrier system for use in dermal delivery. AAPS Annual Meeting & Exposition 2018 PharmSci 360, Walter E. Washington Convention Center, Washington DC, November 4-7, 2018.
23) Ameen, D., Gruytch, R., Michniak-Kohn, B. Microfluidic devices for in vitro testing of aluminum salt antiperspirant performance. AAPS Annual Meeting & Exposition 2018 PharmSci 360, Walter E. Washington Convention Center, Washington DC, November 4-7, 2018.
24) Ameen, D., Michniak-Kohn, B. Development and in vitro evaluation of pressure sensitive adhesive patch for the transdemal delivery of galantamine. AAPS Annual Meeting & Exposition 2018 PharmSci 360, Walter E. Washington Convention Center, Washington DC, November 4-7, 2018.
25) Zhang, Q., Puri, V., Trehan, S., Michniak-Kohn, B., Kaur, I.P., Gurion-Arsiquaud, S. Spectroscopic imaging techniques highlight the permeation improvement of ketoconazole inot the skin by solid lipid nanoparticles (SLN). AAPS Annual Meeting & Exposition 2018 PharmSci 360, Walter E. Washington Convention Center, Washington DC, November 4-7, 2018.

Center for Dermal Research

# CDR PARTNERSHIPS

**TRI Princeton** is an independent, non-profit scientific research and education organization founded in 1930 by an act of US Congress. Over the decades, TRI has evolved into a full-service independent research and testing facility, specializing in porous materials, textiles, fibers, bio-materials, polymers, and films. TRI provides research solutions to a wide variety of domestic and international industrial companies, governmental organizations, and academic institutions.

With the range of instruments and methodologies, characterization goes well beyond just visualization, but deeper into the analysis, identification, and localization of molecular and structural components within the sample. The technical platform encompasses a powerful set of cutting-edge tools and techniques along with complementary approaches for material characterization and analysis, especially well-suited for the study of bio-materials such as hair, skin, nail, bone and/or teeth. These analyses and information can then be correlated to a host of different biophysical parameters. Furthermore, the techniques are exceptional in applications for testing, understanding and comparing variations or changes in biomaterials with relation to specific conditions like aging, diseases, environmental stresses (e.g. UV exposure), chemical exposure, and product treatments (product application or drug therapy). More importantly, changes that occur in these biomaterials and bio-substrates as a function of various factors (whether extrinsic or intrinsic influences) can be established and monitored in specific areas of interest such as at the surface or deep inside the structures of interest.

**Contact Info: SGourion@triprinceton.org**

**Basic and Applied Dermatology Forum (BADF)**
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Otto H. Mills Jr., PhD, F.C.P. Adjunct Professor, Department of Dermatology Rutgers -Robert Wood Johnson Medical School. Otto Mills joined the University of Pennsylvania's Graduate Group on Molecular Biology in 1965 and the Department of Dermatology, School of Medicine in 1967. His first appointment at the University of Medicine and Dentistry of New Jersey, Robert Wood Johnson Medical School was in 1984, where he is a member of the Department of Dermatology. He has lectured by invitation at universities and medical meetings in the United States, Europe and Asia and authored or co-authored over two hundred and fifty publications.

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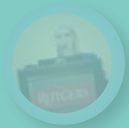

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