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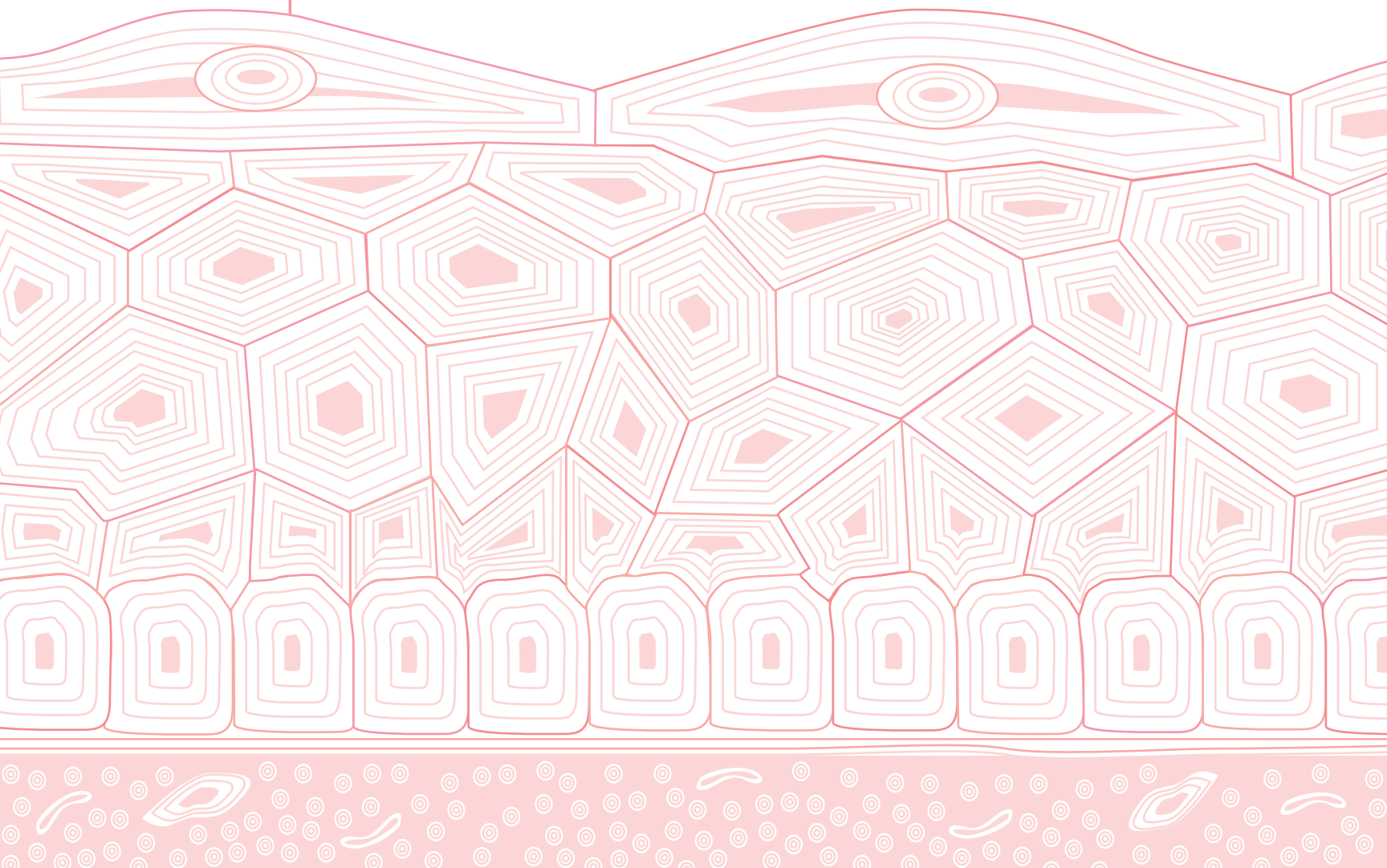
Consulate General of Switzerland

SKIN

RESEARCH IN INDIA



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EXECUTIVE SUMMARY

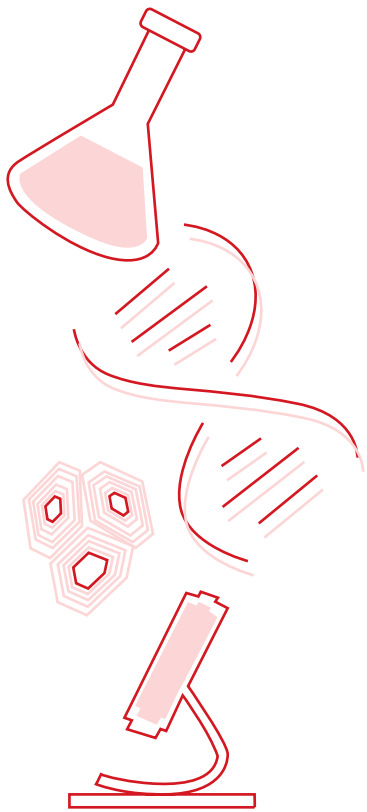
Skin research is emerging both in India and Switzerland as a topic of importance. swissnex India, with its mission to connect the dots between Switzerland and India in research, has brought out this report to provide insights to Swiss researchers on the current state of skin research in India. In this report, we've tried to identify key people, showcase impactful recent publications, list active associations, give a sample list of important conferences and, most importantly, highlight Indo-Swiss collaboration opportunities with funding options to sustain these collaborative efforts.

High prevalence of skin diseases, easy access to large samples and translational nature of research have led to skin research gaining prominence in India. Scimago Journal & Country Rank, places India at 8th spot in dermatology research in the world in 2016[1] in terms of number of papers published. Of late, there have been exceptional research outputs from Indian labs in skin research published in top dermatology journals.

Switzerland has been promoting skin research quite seriously and in October 2016, universities and hospitals in Zurich, Switzerland, launched a large-scale skin research project named Skintegrity that aims to position Zurich as the leading global skin research centre.

The highlight of this report is the identification of the top 5 areas of research focus in skin research in India and presentation of two recent publications from each of the focus areas. These have been identified based on relevance of research in the Indian context, secondary research of publications in top journals since 2015 and through direct interactions with researchers representing the diverse nature of skin research in India. swissnex India is grateful to Indian researchers for their valuable time in shaping this report.

We find a good overlap between Skintegrity and India's research ambit including research on skin diseases and tissue repair disorders. We hope that this report serves to facilitate new collaborations between Switzerland and India.



[1] http://www.scimagojr.com/countryrank.php?category=2708&area=2700&year=2016

01
BACKGROUND

Switzerland's focus on skin research as an interdisciplinary science and India's huge potential in this field, provide ample scope for new partnerships and collaborations in skin related medical, pharma and biotechnology.

Skin, the largest and outermost organ of an animal body acts as the principal protective layer shielding against threats from the surrounding environment. It is a complex organ that interacts with both the internal and external environments physiologically as well as pathologically. Hence, its role is crucial in animal anatomy for survival. The vast interface of the skin allows for both systemic and localised exchange of signals that help in identifying and understanding a number of medical conditions via diagnostics. Such diagnostics enables medical care providers to deliver targeted interventions and therapeutic solutions through the skin to treat various medical conditions. This high possibility to engage in a wide array of translational research has led to a piqued interest in skin research.

1.1
Skin research in India – an interdisciplinary science

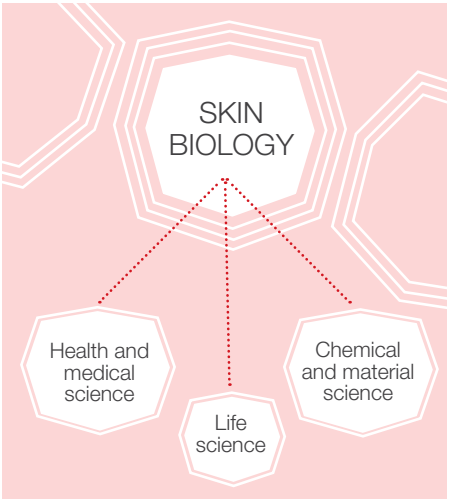
In India, skin biology research, as an area of interest, started emerging in 2008. It is an interdisciplinary science that has multiple linkages and plays an interventional role aiming to provide translational therapeutic interventions to various skin and related ailments. The various major disciplines of science involved include[2]

- **Health and medical science:** Research in areas of dermatology, immunology, natural medicines & medicinal plants, parasitology & tropical medicine, pharmacology & pharmacy and genetics & genomics fall under this discipline.

- **Life science:** Cell biology, molecular biology and micro biology are the major areas under this discipline.

- **Chemical and material science:** Wound healing and tissue engineering form the major part of skin research from this discipline which corresponds to the fields of biochemistry, material engineering and medicinal chemistry.

Thus, the various disciplines of science involved in skin biology research in India are quite diverse, highly interdisciplinary and collaborative in nature.



[2]Identified as under the standard classification of google scholar

1.2
A topic of importance

Various statistics point to high prevalence of skin diseases in India. According to a Frost and Sullivan study[3], 10 to 12% of the Indian population suffers from skin diseases. A report by Institute for Health Metrics and Evaluation (IHME), University of Washington - Global Burden of Diseases[4] corroborates this by stating that skin disease was one of the top 5 prevalent health problems in India in 2015. The report also ranked skin disease at the 7th position as a problem that causes the most disability among Indians.

These statistics establish the high impact and prevalence of skin diseases in India. The statistics also mean easy access to large, heterogenic samples for research and denotes a huge potential for translational research.

1.3
Skin research focus in Switzerland

Switzerland has a high level of expertise in fundamental as well as clinical applications in skin research. The project Skintegrity[5] positions Zurich as the leading global centre for skin research with main research focus on developing new therapies and diagnostic procedures for skin diseases and tissue repair disorders.

The unique feature of the project is that it is designed as a highly collaborative and interdisciplinary model that draws from the results of fundamental research for translation into clinical practice consistently. Skintegrity brings together academic researchers, clinicians and industry people from various fields providing holistic training and exposure to skin research.

1.4
Objective and scope of this report

Amidst this increasing focus in skin research in Switzerland and the huge potential of India in this field, swissnex India - part of the Consulate General of Switzerland in Bangalore, India that connects India and Switzerland in science, technology, education and innovation - looks to facilitate symbiotic Indo-Swiss academic collaborations in the area of skin related medical, pharma and biotechnology research.

This report is a reference handbook to present convenient and comprehensive pointers on Indian skin research. The report showcases reviews of recent research outputs from Indian labs, the ecosystem governing the skin research space in India (associations, meetings and funding) and highlights the potential for Indo-Swiss collaborations.

[3]http://www.frost.com/prod/servlet/press-release.pag?docid=290556966

[4]http://www.healthdata.org/india

[5]http://www.news.uzh.ch/en/articles/2016/Forschungskooperation.html

02
SKIN RESEARCH IN INDIAN ACADEMIA

Many studies have come out investigating the biochemical, immunological and clinical aspects of Visceral Leishmaniasis in India. For instance, researchers in Banaras Hindu University have received NIH grants for studies on the immune regulation, disease progression and transmission of Visceral Leishmaniasis.

Academic research is lab based basic biology research and deals with a variety of areas linked to dermatology and skin biology. Skin biology research started emerging as an area of interest from 2008. Despite the late start, according to latest available data from Scimago Journal & Country Rank, India is ranked 8th in dermatology research in the world in 2016[6] in terms of number of papers published.

Skin research carried out can be broadly grouped based on the aspect of skin being studied. Significant research efforts are aimed at understanding various infectious diseases affecting the skin like leishmaniasis and elephantiasis. Visceral leishmaniasis or kala azar is a dangerous condition that is endemic in a few states in India. Many studies have come out investigating the biochemical, immunological and clinical aspects of Visceral Leishmaniasis in India. For instance, researchers in Banaras Hindu University have received NIH grants for studies on the immune regulation, disease progression and transmission of Visceral Leishmaniasis.

Skin pigmentation and pigmentation disorders such as vitiligo is another area of focus in Indian labs. Pathogenesis and management of vitiligo is the main focus of research pertaining to vitiligo in India. Apart from research on mice models and primary skin, forward and reverse genetic approaches are being used in zebrafish models to identify the molecular players involved in maintaining the epidermal integrity, which is an essential component for the skin to perform its barrier function. Aside of vitiligo, work on skin pigmentation from a genetic aspect is probed by a few people.

Basic biology of skin is also being studied by labs using a variety of animal models. Wound healing is a common theme among many skin labs in India relating to both burn injury wounds and diabetic wounds. A variety of models are being used to probe scar less and cost-effective wound healing. Further, drug delivery through skin is also being probed at institutes with an engineering focus.

[6]http://www.scimagojr.com/countryrank.php?category=2708&area=2700&year=2016

03
INDIAN ACADEMIC RESEARCHERS AND KEY RESEARCH OUTPUTS

This chapter provides a ready reference list of top academic researchers followed by a detailed review of top 10 recent research outputs that highlights the core competencies and the focus of research in India since 2015.

3.1
Top academic skin researchers in India

along with their area of work and contact details are given below for ready reference:

1

PI (Dr.): Rajesh Gokhale

Institution: National Institute of Immunology (NII)

Area of Research: Skin immunology, auto immune diseases, leukoderma, understanding skin pigmentation homeostasis

Office Address: National Institute of Immunology, Aruna Asaf Ali Marg, New Delhi -110067

Tel: 91 11 26717121 | E-mail: rsg@nii.ac.in

2

PI (Dr.): Srikala Raghavan

Institution: INstem

Area of Research: Role of integrins in regulating epidermal homeostasis, mechanism(s) by which altered tissue homeostasis induces an inflammatory response, role of small RNAs in epithelial stem cells.

Office Address: Institute for Stem Cell Biology and Regenerative Medicine, GKVK – Post, Bellary Road, Bangalore - 560065

Tel: 91 80 23666743
E-mail: srikala@instem@res.in
https://www.instem.res.in/faculty/srikala

3

PI (Dr.): Colin Jamora

Institution: INstem

Area of Research: Tissue regeneration and repair with focus on how stem cell decisions are made to produce and maintain a tissue, how these decisions are skewed either during diseases (e.g. cancer, diabetes, and inflammatory diseases) or during physiological processes (wound-healing), elucidating the network of signals exchanged between epidermal cells and surrounding cells within the organ to produce an appropriate wound-healing response.

Office Address: Institute for Stem Cell Biology and Regenerative Medicine, GKVK - Post, Bellary Road, Bangalore-560065

Tel: 91 80 23666001
E-mail: colinj@instem.res.in
https://www.instem.res.in/faculty/colin

4

PI (Dr.): Gopal C Kundu

Institution: National Centre for Cell Science (NCCS)

Area of Research: Tumor biology, chemical biology, angiogenesis and nanomedicine research.

Office Address: Laboratory of Tumor Biology, Angiogenesis and Nanomedicine Research, National Centre for Cell Science, Pune - 411007

Tel: 91 20 25708104
E-mail: kundu@nccs.res.in

5

PI (Dr.): Munia Ganguli

Institution: Institute of Genomics & Integrative Biology (IGIB)

Area of Research: Developing cell penetrating peptides for delivery of nucleic acids and nanoparticles in vitro and in vivo - in particular to the skin and retina, understanding the role of glycosaminoglycans in gene delivery.

Office Address: Room No. 225, CSIR-IGIB, Sukhdev Vihar, Mathura Road, New Delhi -110025

Tel: 91 11 29879225 | E-mail: mganguli@igib.in | https://www.igib.res.in/?q=MuniaGanguli

6

PI (Dr.): Vivek T Natarajan

Institution: Institute of Genomics & Integrative Biology (IGIB)

Area of Research: Skin pigmentation in molecular level.

Office Address: Sukhdev Vihar, Mathura Road, New Delhi - 110020

Tel: 91 11 29879203
E-mail: tnvivek@igib.in
https://www.igib.res.in/?q=VivekT.Natarajan

7

PI (Dr.): Archana Singh

Institution: Institute of Genomics & Integrative Biology (IGIB)

Area of Research: Pathophysiology of skin in vitiligo focussing on the role of keratinocytes in disease initiation and progression.

Office Address: Sukhdev Vihar, Mathura Road, New Delhi-110025

Tel: 91 11 29879223
E-mail: archana@igib.in
https://www.igib.res.in/?q=Archana

8

PI (Dr.): Biman B Mandal

Institution: Biomaterial and Tissue Engineering Laboratory, Indian Institute of Technology Guwahati (IITG)

Area of Research: Tissue engineering, regenerative medicine, bio materials, drug delivery systems, human stem cells, 3D disease tissue models.

Office Address: Department of Biosciences and Bioengineering, N-Block, Room no - N-107, IIT Guwahati - 781039, Assam

Tel: 91 361 2582225
E-mail: biman.mandal@iitg.ernet.in
http://www.iitg.ac.in/biman.mandal/ps.html

9

PI (Dr.): Amitava Das

Institution: Centre for Chemical Biology

Area of Research: Stem cells for regenerative medicines, cellular and molecular signal transduction for translational therapies in cancer stem cells and liver fibrosis/cirrhosis.

Office Address: CSIR-Indian Institute of Chemical Technology, Tarnaka, Hyderabad - 500007, Telangana

Tel: 91 40 27191873
E-mail: amitavadas@iict.res.in
http://www.iictindia.org/staffprofiles/staffprofile.aspx?qry=1799

10

PI (Dr.): Veena Koul

Institution: Centre for Biomedical Engineering (CBME)

Area of Research: Biomaterials, medical devices, clinical diagnostics, drug delivery systems, medical chemistry and polymer chemistry.

Office Address: Indian Institute of Technology Delhi, Hauz Khas,New Delhi-110016

Tel: 91 11 26591041
E-mail: veenak@cbme.iitd.ac.in
http://cbme.iitd.ac.in/content/prof-koul-veena

11

PI (Dr.): Kumarasamy Thangaraj

Institution: Centre for Cellular and Molecular Biology (CCMB)

Area of Research: Genetics of skin pigmentation.

Office Address: Centre for Cellular & Molecular Biology. Habsiguda, Uppal Road, Hyderabad - 500007, Telangana

Tel: 91 40 27182828
E-mail: thangs@ccmb.res.in
http://www.ccmb.res.in/index.

12

PI (Dr.): Rajni Rani

Institution: National Institue of Immunology (NII)

Area of Research: Immunogenetic and immune factors associated with infectious diseases including leprosy and autoimmune disorders like vitiligo among others

Office Address: National Institute of Immunology, Aruna Asaf Ali Marg, New Delhi - 110067

Tel: 91 11 26717121 | E-mail: rajni@nii.ac.in | http://www.nii.res.in/research/rajni-rani

13

PI (Dr.): K Natarajan

Institution: School of Life Sciences, Jawaharlal National University (JNU)

Area of Research: Cell and Molecular biology/molecular genetics: transcription, chromatin and gene regulation.

Office Address: School of Life Sciences, JNU Ring Rd, Jawaharlal Nehru University, New Delhi - 110067

Tel: 91 11 26704512
E-mail: nat0200@mail.jnu.ac.in
http://www.jnu.ac.in/FacultyStaff/ShowProfile.asp?SendUserName=natarajan

14

PI (Dr.): T V Anil Kumar

Institution: Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum

Area of Research: Experimental and toxicological pathology, use of animal derived ECM for tissue engineering and regenerative medical applications.

Office Address: Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram - 695011, Kerala

Tel: 91 471 2520305
E-mail: tvanilkumar@sctimst.ac.in
https://www.sctimst.ac.in/People/tvanilkumar

15

PI (Dr.): Jyotirmoy Chatterjee

Institution: School of Medical Science and Technology, IIT Kharagpur

Area of Research: Multimodal medical imaging analysis, regenerative medicine, pre-cancer, natural healing agents.

Office Address: B-126, IIT Campus, Kharagpur - 721302

Tel: 91 32 22282302
E-mail: jchatterjee@smst.iitkgp.ernet.in
http://www.smstweb.iitkgp.ernet.in/faculty/jyotirmoy-chatterjee

16

PI (Dr.): Debdoot Sheet

Institution: IIT Kharagpur

Area of Research:
1) Computational medical imaging, machine learning, image and multidimensional signal processing, visualization and augmented reality.

2) Co-founder SkinCurate Research Pvt. Ltd that develops technologies for patient comfort centric total skin theranostics.

Office Address: IIT Campus, Kharagpur - 721302

Tel: 91 32 22283082
Email: debdoot@ee.iitkgp.ernet.in
http://www1.iitkgp.ac.in/fac-profiles/showprofile.php?empcode=2bfcQ&depts_name=EE
http://www.skincurate.com/

3.2

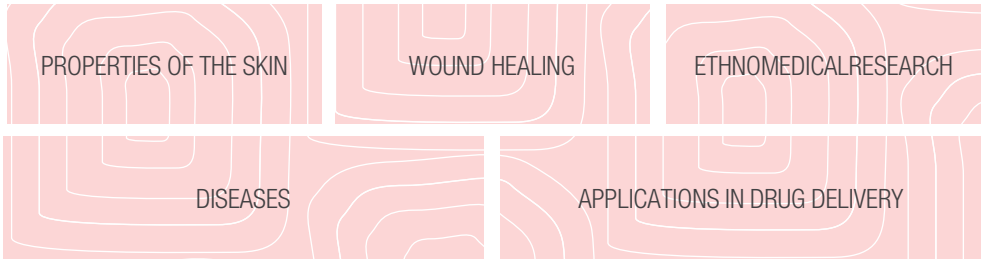
Review of top 10 recent skin research outputs from India

The government of India is keen on improving and supporting science and technology research in the country. This is denoted by a 22% increase in budget funding for science and technology research in 2017-18 over 2016-17[7]. Given the increased government support and the high prevalence of skin disease, skin biology research is set to produce more ground-breaking research in the coming years.

This section reviews 10 recent important research papers across top 5 focus areas in skin biology research in India. The focus areas have been identified through secondary research of publications in top journals since 2015 and through interactions with researchers in the field. Two recent research outputs from each of the focus areas have been identified based on relevance of research in the Indian context and journal of publication.

The range of case studies are quite diverse and present a fair representation of actual research in skin biology in India.

The identified focus areas are:



[7]http://pib.nic.in/newsite/PrintRelease.aspx?relid=158410

PROPERTIES OF THE SKIN

Genotype- Phenotype Study of the Middle Gangetic Plain in India Shows Association of rs2470102 with Skin Pigmentation

Anshuman Mishra, Sheikh Nizammuddin, Chandana Basu Mallick, Sakshi Singh, Satya Prakash, Niyamat Ali Siddiqui, Niraj Rai, S Justin Carlus, Digumarthi V S Sudhakar, Vishnu P Tripathi, Mart Mols, Xana Kim-Howard, Hemlata Dewangan, Abhishek Mishra, Alla G Reddy, Biswajit Roy, Krishna Pandey, Gyaneshwer Chaubey, Pradeep Das, Swapan K Nath, Lalji Singh, Kumarasamy Thangaraj

Skin pigmentation is polygenic in nature and is derived and shaped by various factors. This paper by Mishra et al, (2016) tries to understand the genetic architecture of human skin colour in the Indian sub-continent. The results reveal linkages in the social structure defined and ascribed by the caste system in India and skin pigmentation diversity in the region.

The study conducted with a sample cohort of 1,167 individuals from the Middle Gangetic Plain of the Indian sub-continent reveals the association of rs2470102 single nucleotide polymorphism (SNP) in addition to rs1426654 in contributing to the wide array of skin colour variation in the region. Haplotype analysis of both the SNPs – taken as a '2SNP model' - finds the skin pigmentation variation across population as related to various social categories and associated cultural practices in the region. The study finds evidence that of the total phenotypic variance, 32% of variation in the skin colour is caused by the social structure/ category the sample belongs to and about 6.4% of the variation in skin colour is attributed to the associated SNP. A further phylogeography study of the associated SNP was conducted across 52 diverse populations with a sample space of 1825 individuals across the Indian sub- continent which showed presence of the derived alleles although in varying frequencies across populations.

By establishing a social aspect to the science of skin pigmentation, this study, has given a new dimension to understanding the genetics of skin pigmentation and variation in skin colour not only in the Indian sub-continent region but also globally.

ABOUT THE PAPER

Journal of Investigative Dermatology Volume 137, Issue 3, March 2017, Pages 670–677

Impact Factor (2014): 7.2

Collaboration project funded by CSIR Network Project (EpiHeD-BSC0118), DBT-RA program, 2016 Post-Doc Development Program-Pusan National University, S.Korea, P. R. Foundation (Uttar Pradesh), ICMR-SRF program , and Estonian Personal Grant (PUT-766). European Union Regional Development fund through the Centre of Excellence in Genomics to Estonian Biocentre and University of Tartu and Estonian Institutional Research grant (IUT24-1) also supported the project.

Correspondence: Kumarasamy Thangaraj, CSIR-Centre for Cellular and Molecular Biology, Uppal Road, Hyderabad 500 007, India.

E-mail: thangs@ccmb.res.in

INVESTIGATOR SPEAK

KUMARASAMY THANGARAJ

"The study identified a mutation that has not been reported so far. The advantage of the study is that being conducted on Indian samples, the testing space was large and allowed large stratified samples with numerous diversified skin colour gradients making it a robust and comprehensive study that helps to understand the evolutionary perspective of skin pigmentation and gene mutations."

Sterile Inflammation Enhances ECM Degradation in Integrin β1 KO Embryonic Skin

Ambika S Kurbet, Samarth Hegde, Oindrila Bhattacharjee, Srujan Marepally, Praveen K Vemula, Srikala Raghavan

Infections by pathogens elicit an immune response in the host. The immunological molecular events that gets triggered upon infection, referred to as Pathogen induced molecular patterns (PAMP), has been well studied. However, the molecular events leading to host induced immune response, referred to as Damage induced molecular patterns (DAMP), remains largely unexplored. Such inflammatory responses occurring in the absence of a pathogen are referred to as sterile inflammation.

In this paper, the authors have created an animal model for sterile inflammation by knocking down integrin β1. The results from the model show that loss of Integrin β1 leads to complete disorganization of the basal membrane in the skin. They observe that the inflammatory response is mediated by TGF, upon activation, by integrin β6. They also show that the small molecule inhibitors of TGF β rescues the defects in basal membrane.

This report deciphers the role of integrin β1 in the embryonic skin development. The studies of damage induced sterile inflammation has potential applications in treatment of skin disorders such as skin blistering disease and skin cancer. The mouse model developed in the study is adaptable to study other diseases caused due to sterile inflammation.

ABOUT THE PAPER

Journal of Investigative Dermatology Volume 137, Issue 3, March 2017, Pages 670–677

Impact Factor (2015): 7.8

Collaboration project funded by DBT predoctoral fellowship, CSIR SPM predoctoral fellowship, core funds from inStem supported by the Department of Biotechnology (DBT), American Research Society Research Scholar Grant (122015-RSG-12-053-01-CSM), National Mouse Research Resource (NaMoR) grant (BT/PR5981/MED/31/181/2012; 2013-2016) from the DBT, DBT Ramalingaswami Re-Entry fellowship and Department of Science and Technology (DST) grant (INT/SWISS/SNSFP-51/2015), DST SERB Fast Track Scheme for Young Scientist (SB/FT/CS-198/2013).

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E-mail: srikala@instem@res.in

WOUND HEALING

Porous polymer scaffold for on-site delivery of stem cells – Protects from oxidative stress and potentiates wound tissue repair

Ramasatyaveni Geesala, Nimai Bar, Neha R Dhoke, Pratyay Basak, Amitava Das

Stem cell transplantation is one of the techniques used for chronic wound healing. However, due to oxidative stress in injury site, the function of stem cell transplantation in chronic wound healing is diminished. In this study, the authors have developed a new proof-of-concept porous polyethyleneglycol-polyurethane (PEG-PU) scaffold that acts as a cell delivery vehicle providing penetrability along with reducing oxidative stress in the injury site thereby accelerating tissue repair and wound healing.

The in vitro and in vivo studies done using mouse bone marrow stem cells (BMSC) confirm that PEG-PU is highly porous, biodegradable, thermostable, barostable, cytocompatible and protects wounds from oxidative stress on-site. Transplanting BMSC + PEG-PU showed evidence of overall increase in neo-vascularization by the presence of increased collagen deposition, fibroblast proliferation, leading to enhanced and faster wound repair and tissue closure process as early as 7th day after surgery.

This pre-clinical research has provided a proof-of-concept that can be taken forward for clinical research and evaluation of PEG-UPs suitability as a potential cell delivery vehicle scaffold.

ABOUT THE PAPER

Biomaterials Volume 77, 2016, Pages 1-13

Impact Factor (2015): 8.3

Intra institute collaboration project funded by “CSIR-Mayo Clinic for Innovation and Translational Research, CMPP-07”, CSIR, Ministry of Science and Technology, Government of India, XIIth Five year Plan Project # CSC-0111, CSIR funding for projects CSC-0134 and BSC-0112, UGC-SRF, CSIR-SRF, ICMR-SRF.

Correspondence:

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Email: pratyay@iict.res.in

Amitava Das, Centre for Chemical Biology, CSIR-IICT, Uppal Road, Hyderabad 500 007, India

E-mail: amitavadas@iict.res.in

INVESTIGATOR SPEAK

AMITAVA DAS

"The breakthrough (aspect) of this research (is) that it uses a polymeric biomaterial that is bio-degradable, non-toxic and has anti-oxidative properties to deliver stem cells for scar-less wound healing and tissue re-generation. The material has been patented in both India and US. The research can be taken further for a larger animal model and clinical research."

Co-cultivation of keratinocyte-human mesenchymal stem cell (hMSC) on sericin loaded electrospun nanofibrous composite scaffold (cationic gelatin/hyaluronan/ chondroitin sulfate) stimulates epithelial differentiation in hMSCs: In vitro study

Sirsendu Bhowmick, Dieter Scharnweber, Veena Koul

Scaffold development for regenerating damaged tissues with reduced infections and minimal scarring is a prime research area in tissue engineering and wound healing. An effective scaffold should be able to mimic extracellular matrix (ECM) for it to aid in tissue regeneration as ECM provides mechanical support to cells and also helps to regulate and maintain tissue function. In this study, the effect of sericin loaded electrospun nanofibrous composite scaffold consisting cationic gelatin and selected glycosaminoglycans (GAGs) -mimicking ECM- on keratinocyte-human mesenchymal stem cell (hMSC), has been evaluated in vitro for applications in dermal tissue engineering.

The study shows that sericin loaded electrospun nanofibrous composite scaffolds aids adhesion and rapid growth of fibroblasts, keratinocytes and hMSCs. In vitro results show that 5 days after co-culture of keratinocyte – hMSC on the composite scaffold stimulates epithelial differentiation in hMSCs.

The finding suggests that sericin loaded electrospun nanofibrous composite scaffolds can be used for dermal wound dressing to aid faster wound healing.

ABOUT THE PAPER

Biomaterials Volume 88, 2016, Pages 83-96

Impact Factor (2015): 8.3

Collaboration project between IIT D and Max Bergmann Center of Biomaterials, Germany funded in part by Deutsche Forschungsgemeinschaft (DFG) TRR 67 (A3, A2, Z3), Deutscher Akademischer Austauschdienst (DAAD), Ministry of Human Resource Development, Government of India and Council of Scientific & Industrial Research India (02(0210)/14/EMR-II).

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Email: veenak@iitd.ac.in, veenak_iitd@yahoo.com

ETHNOMEDICAL RESEARCH

Notch1-MAPK Signaling Axis Regulates CD133D Cancer Stem Cell-Mediated Melanoma Growth and Angiogenesis

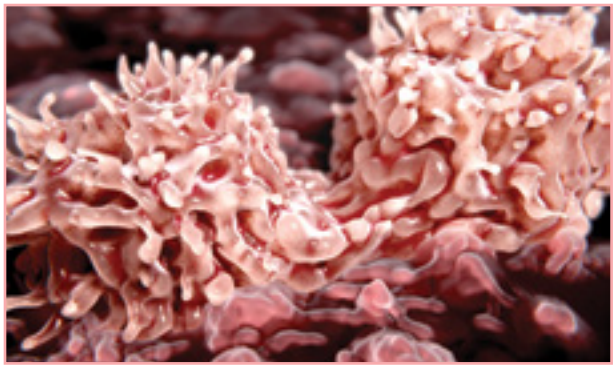
Dhiraj Kumar, Santosh Kumar, Mahadeo Gorain, Deepti Tomar, Harshal S Patil, Nalukurthi N V Radharani, Totakura V S Kumar, Tushar V Patil, Hirekodathakallu V Thulasiram and Gopal C Kundu

Understanding the characteristics of cancer stem cells (CSC) and also the signalling mechanism which triggers them is key to developing treatments and cures to mitigate melanoma. In this study, the authors successfully isolate the melanoma causing cancer stem cell, identify the signalling mechanism that triggers its growth and also suggests a novel ethno sourced drug that inhibits the growth of melanoma.

This research has been successful in isolating and identifying the melanoma causing CSC as CD133+. Notch 1 cell pathway is observed to regulate CSC CD133+ which in turn activates MAPK signalling that leads to melanoma growth, angiogenesis and metastasis.

After having understood the mechanism triggering melanoma, the researchers further probed on the possible cure agents specifically for CSCs in melanoma. They find that a compound Andrographolide derived from Indian herb Andrographis paniculata is effective in inhibiting tumour growth and metastatis in lungs. Tested on mice, it has been observed that the compound not only inhibits tumour by blocking Notch 1 dependent CD133+ and MAPK signalling but also eliminates drug resistant CSCs which are usually the reason for relapses and clears lung metastatis.

Thus, the study suggests that by targeting Notch 1 MAPK signalling and by researching further on the effects of Andrographolide in a human melanoma model can have successful implications in managing melanoma.



ABOUT THE PAPER

Journal of Investigative Dermatology Volume 136, 2016, Pages 2462-2474

Impact Factor (2014): 7.2

Collaboration project funded by the National Centre for Cell Science, Pune, India, University Grants Commission and Council of Scientific and Industrial Research, Government of India

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INVESTIGATOR SPEAK

GOPAL C KUNDU

Our group for the first time demonstrated that Andrographolide, a druggable molecule inhibits Notch1 intracellular domain expression, Notch1 intracellular domain- dependent CD133-mediated mitogen-activated protein kinase and activator protein-1 activation, and epithelial to mesenchymal-specific gene expression, ultimately attenuating melanoma growth and lung metastasis.

ETHNOMEDICAL RESEARCH

Protective Effects of Triphala on Dermal Fibroblasts and Human Keratinocytes

Sandeep R Varma, Thiyagarajan O Sivaprakasam, Abheepsa Mishra, L M Sharath Kumar, N S Prakash, Sunil Prabhu, Shyam Ramakrishnan

Triphala or three fruits is a rasayana formula used widely in Ayurveda. Containing extracts from Emblica officinalis (Indian gooseberry), Terminalia belerica (Bhibitaki), and Terminalia chebula (Haritaki), triphala's medicinal properties are widely explored in Ayurveda. AYUSH, the government department under Ministry of Health and Family Welfare, India has also identified Triphala as a natural medicine. Although many skin products use Triphala, there has not been validation of the same in vitro. Thus, this study aims to test the skin protective effects of Triphala extracts (TE) on human dermal fibroblasts (HDF) and human keratinocytes (HaCaT) cells in vitro.

The results show that TE has anti-oxidant effect on HDF, increases skin structural proteins collagen and elastin and protects skin from DNA damage. This proves the anti-oxidant and skin protection properties of Triphala in vitro. This also lends possibility for further clinical investigation.

ABOUT THE PAPER

PLoS ONE 11(1):e0145921. doi:10.1371/journal.pone.0145921

Impact Factor (2014): 3.2

Industry research funded by The Himalaya Drug Company, India.

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SANDEEP R VARMA

"There are many traditional old literatures available in India on plants and minerals that can bring benefit to skin. However, these do not have scientific evidence. The motive of this research is to take the knowledge from ancient literatures and give it a scientific backing to deliver translational research reaching consumers as useful products."

DISEASES

The matrix protein Fibulin-5 is at the interface of tissue stiffness and inflammation in fibrosis

Manando Nakasaki, Yongsung Hwang, Yun Xie, Sunny Kataria, Rupali Gund, Edries Y Hajam, Rekha Samuel, Renu George, Debashish Danda, Paul M J, Tomoyuki Nakamura, Zhouxin Shen, Steve Briggs, Shyni Varghese, Colin Jamora

Fibrosis is characterised by increased levels of extracellular matrix (ECM) and secretions thereof which in turn affects tissue function. Although many in vitro research show that matrix stiffness contributes to fibrosis, the mechanism that leads the matrix to contribute to fibrosis is unexplored and this is the focal point of this research.

The study done using a transgenic mouse model, establishes the cyclical interplay between matrix stiffness and the subsequent inflammatory response that leads to elevated ECM secretion resulting in fibrosis progression. Evidence from the research shows how loss of Fibulin-5, a protein component of ECM that forms elastic fibres, breaks the vicious cycle leading to fibrosis progression. The research therefore suggests that fibrosis can be managed by targeting Fibulin-5.

The study is the first in vivo evidence on how elastic fibre assembly can alter cytokine expression.

ABOUT THE PAPER

Nature Communications 6:8574 doi: 10.1038/ncomms9574 (2015)

Impact Factor (2015): 11.3

Collaboration project funded by supported by grants from the NIH/NIAMS (Grant 5RO1AR053185-03),

Scleroderma Foundation and core funds from inStem and IFOM.

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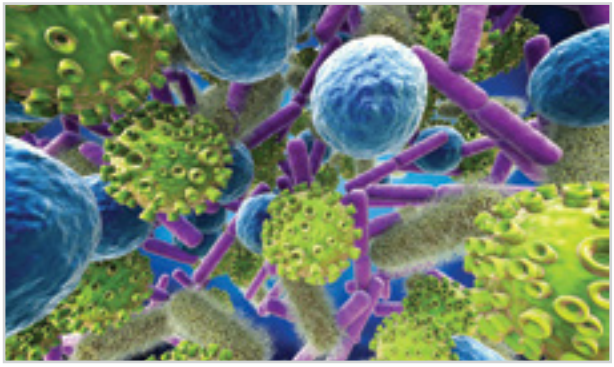
Email: colinj@instem.res.in

COLIN JAMORA

"In this research, we identified a new component that plays a critical role in the development of tissue fibrosis. This protein, fibulin-5, provides us a clue of how inflammation and tissue stiffness conspire to promote the development of this disease. Moreover, identification of new components that promote fibrosis will help us develop therapeutic strategies that are more effective than existing ones."

DISEASES



Microbial community profiling shows dysbiosis in the lesional skin of Vitiligo subjects

Parul Ganju, Sunil Nagpal, M H Mohammed, P Nishal Kumar, Rajesh Pandey, Vivek T Natarajan, Sharmila S Mande, Rajesh S Gokhale

Autoimmune attacks of melanocytes is considered the major factor leading to lesions and skin de-pigmentation in vitiligo subjects. Current treatments focus on reducing the severity of autoimmunity. However, these have not yielded satisfactory results and it disputes the current understanding of vitiligo microbial taxonomy. In this study, the researchers try to understand the cutaneous microbial community profiles of vitiligo subjects comparing the composition of microbes between lesional and non-lesional sites of the subjects and thereby lend clarity to understanding vitiligo.

Diversity of skin microbiome is essential for healthy human skin. As the first study to do a comprehensive analysis of microbes from live vitiligo subjects, the study shows dysbiosis – lower diversity in microbial community- in lesional sites compared to non-lesional sites. Network analysis on microbial community in both the regions shows distinctly different network profiles and number of interactions between the members of the microbial community. The network interaction was higher in non-lesional sites and lower in lesional sites. Actinobacterial species forms the central regulatory node effecting the level of interactions in non-lesional site and species of Firmicutes regulates the interactions in lesional sites.

The findings could help understanding the disease better and could impact and alter the current course of treatment for vitiligo. However, further research is required to establish diagnostic and therapeutic vitiligo interventions.

ABOUT THE PAPER

Scientific Reports 6, 18761; doi: 10.1038/srep18761 (2016)

Impact Factor (2015): 5.2

Collaboration project funded by Council for Scientific and Industrial Research (CSIR), India through grant (TOUCH-BSC0302), “Program support for skin pigmentation and melanocyte-keratinocyte biology” by Department of Biotechnology, India and INSPIRE faculty grant support from the Department of Science and Technology, India

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INVESTIGATOR SPEAK

RAJESH S GOKHALE

This was the first paper in India on skin microbiome. The study looks to compare within, as opposed to across, individuals on how a microbiome acts differently in an affected area vis-a via the unaffected area. A follow up study was conducted on a buffalo model whose results are being used to develop therapies.

APPLICATIONS IN DRUG DELIVERY

Role of non-mulberry silk fibroin in deposition and regulation of extracellular matrix towards accelerated wound healing

Dimple Chouhan, Bijayshree Chakraborty, Samit K Nandi, Biman B Mandal

Wound dressing materials should show properties of wound healing, reduce and eliminate inflammation, infections, repair wounds. In this work, the potential of silk fibroin (SF) from non-mulberry (Antheraea assama and Philosamia ricini) silk variety in wound healing applications is being tested.

In this study, electrospun mats based on non-mulberry SF (NMSF) functionalised with epidermal growth factor (EGF) and ciprofloxacin HCl was developed as a potential aesthetic wound dressing. The result showed that NMSF mats mimic extracellular matrix (ECM) and provide evidence of scar-less aesthetic wound healing. These mats were found to be, among others, biocompatible, highly elastic, have sustained drug release and antibacterial activity. Also, functional mats showed, in vitro, effective delivery of epidermal growth factor as evidenced by proliferation of human dermal fibroblasts and HaCaT cells. In vivo assessment showed evidence of faster wound healing, better wound maturity and enhanced reconstitution of epithelium.

Wounds treated with NMSF mats showed evidence of regulated deposition of collagen, reticulin fibers and mature elastin in ECM. Properties of EGF and NMSF protein aid scar less healing and aesthetic wound repair.

ABOUT THE PAPER

Acta Biomaterialia Volume 48, 2017, Pages 157-174

Impact Factor (2014): 6.0

Collaboration project funded by Department of Biotechnology, DBT (BT/IN/Sweden/38/BBM/2013, BT/505/NE/TBP/2013, BT/548/NE/U-Excel/2014), and Department of Science and Technology, DST (DST/INT/UK/P-110/2014), Government of India

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BIMAN B MANDAL

"This research aimed to develop a wound healing material that accelerates the healing process and also provides scar-less healing. By developing a material based on non-mulberry silk fibroin, we have achieved a model that not only aids faster and scar-less wound healing but is also an affordable and smart model."

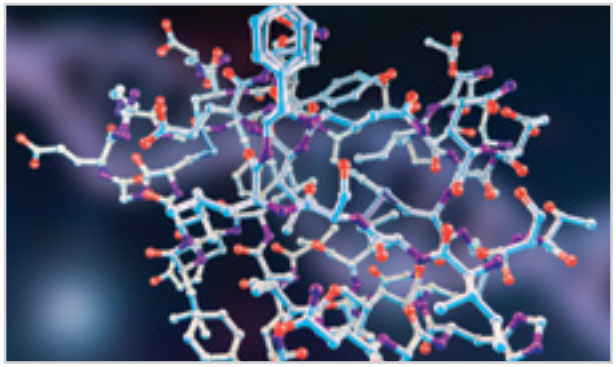
APPLICATIONS IN DRUG DELIVERY

Non-invasive topical delivery of plasmid DNA to the skin using a peptide carrier

Manika Vij, Poornemaa Natarajan, Bijay Ranjan Pattnaik, Shamshad Alam, Nidhi Gupta, Deenan Santhiya, Rajpal Sharma, Archana Singh, Kausar M Ansari, Rajesh S Gokhale, Vivek T Natarajan, Munia Ganguli

Usually, small molecule drugs with high to moderate solubility permeates through skin easily and can be delivered for cutaneous and transdermal treatments non-invasively. Owing to challenges posed by skin layers – stratum corneum and epidermis - large hydrophilic molecules like proteins, nucleic acids etc. have slow, ineffective diffusion and are mostly delivered using harsh and invasive techniques that can compromise on skin integrity and bear side effects. In this study, a cell penetrating peptide carrier Mgpe9's potential for non-invasive topical delivery of plasmid DNA to uncompromised skin is tested.

In vitro and in vivo results show that amphipathic peptide Mgpe9 is non- toxic, easily penetrable, can efficiently break plasmid DNA to stable nanocomplexes and effectively deliver them causing less or no damage to skin structure and integrity. Thus, the study indicates that peptide carrier Mgpe9 can potentially act as an effective non-invasive topical delivery carrier of large hydrophilic molecules like nucleic acids for cutaneous treatments.



ABOUT THE PAPER

Journal of Controlled Release Volume 222, 2016, Pages 159-168

Impact Factor (2014): 7.7

Collaboration project funded by Council of Scientific and Industrial Research (CSIR), New Delhi, India (Network Project TOUCH: BSC0302)

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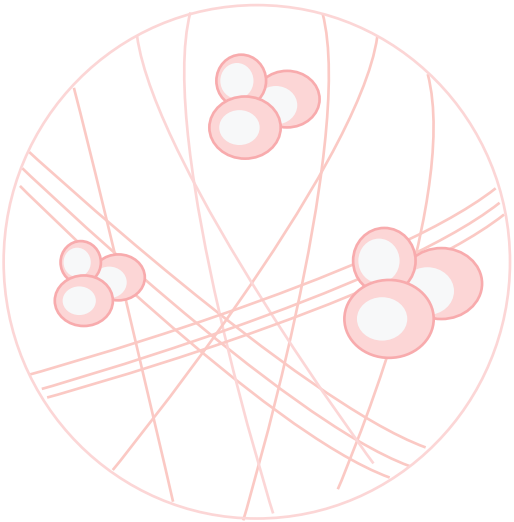
Email: mganguli@igib.res.in; mganguli@igib.in

MUNIA GANGULI

Efficient gene delivery of large molecules into skin is a challenge. This is the first report that uses topical administration of large molecules into skin using non-invasive, non-toxic peptide based method without causing any damage to the skin.

04
FUNDING FOR INDO-SWISS COLLABORATIONS



Funding for science and technology research in India is mainly from governmental organisations including Council for Scientific and Industrial Research (CSIR), Department of Biotechnology (DBT), Department of Science & Technology (DST). The private grants specific for skin research mostly come from partnerships of the Indian Association of Dermatologists, Venereologists and Leprologists (IADVL) with corporates. Funding for Swiss research comes mainly from the Swiss National Science Foundation (SNSF), Commission for Technology and Innovation (CTI), Swiss Development Corporation (SDC) and foundations such as Gebert Ruf and Mercator.

The focus of this section is to identify and list the existing provisional grants that could support Indo-Swiss collaborations in skin research.

1. Public research grants

1.1

Grant: Sinergia Grants

Granting agency: SNSF

Brief: Sinergia promotes the interdisciplinary collaboration of two to four research groups that propose breakthrough research.

Amount / Reward: A maximum amount of CHF 3.2 million may be requested, minimum amount of CHF 50,000.

http://www.snf.ch/en/funding/programmes/sinergia/Pages/default.aspx

1.2

Grant: Indo-Swiss Joint Research Programme (ISJRP)

Granting agency: SNSF (Swiss) and DST (Government of India)

Brief: The next phase of ISJRP will be launched in 2017 for the period of 2017-2020.

2012-2016 focus areas: Translational medical research and renewable energy.

Amount / Reward: A maximum permissible budget for a project is CHF 250,000 at Swiss side and INR 40,00,000 at Indian side.

http://www.snf.ch/en/funding/programmes/bilateral-programmes/india/Pages/default.aspx#Documents

1.3

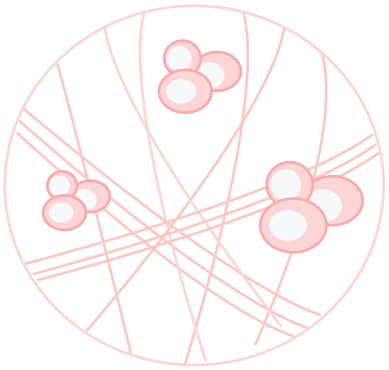
Grant: BRIDGE

Granting agency: SNSF and CTI

Brief: BRIDGE offers new funding opportunities at the intersection of basic research and science-based innovation, thereby supplementing the funding activities of the two organisations.

Amount / Reward: CHF 850,000 for four years for a single applicant or CHF 2.55 million for four years for small consortia (maximum of 3 applicants).

http://bridge.ch/en/



2. Private skin specific grants

2.1

Grant: IADVL – L'Oreal Indian Hair & Skin Research Grant

Granting agency: IADVL and L'Oreal

Brief: To encourage Indian dermatological research in the field of cosmetic science and the physiology of Indian hair and skin. The winners share the grant valued at INR 20,00,000.

Amount / Reward: Upto INR 20,00,000.

http://www.iadvl.org/announcements-5.php

2.2

Grant: The PG Grant Award

Granting agency: IADVL and Galderma

Brief: To encourage and support final year postgraduate students to present their papers, as well as expand their knowledge on dermatology and professional network.

Amount / Reward: A certificate and reward for presentations at DERMACON conference.

http://www.galderma.com/Corporate-Responsibility/Social-responsibility-Education/India-The-PG-Grant-Award

2.3

Grant: IADVL-Special Interest Group (SIG) grants

Granting agency: IADVL

Brief: The grant is aimed at sponsoring research in IADVL's SIG's multicentre studies/research projects.

http://iadvldelhi.com/wp-content/uploads/2016/01/IADVL Constitution-2014.pdf

2.4

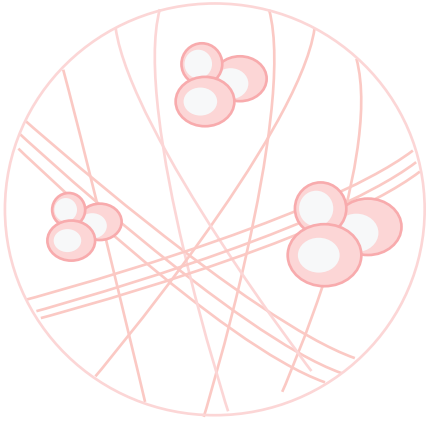
Grant:The AAB research grant

Granting agency: Asian Acne Board and Galderma

Brief: To contribute to the improvement of best practices in the management of acne.

Amount / Reward: USD 10,000

http://www.galderma.com/News/articleType/ArticleView/articleId/92/The-Asian-Acne-Board-and-Galderma-join-forces-to-improve-understanding-and-management-of-acne



05
ASSOCIATIONS AND CONFERENCES

Collaborations in skin biology research is mostly through peer referencing or via the Council of Scientific and Industrial Research (CSIR) network of researchers. There are also some large bodies that support Indian dermatologists and organise dermatology conferences in India. IADVL is one of the most active societies and has created skin specific research grants by interfacing with the industry.

This section provides details of associations, important meetings and conferences conducted in India related to skin research that enable and encourage exchange of ideas in the field.

Association/Society

Indian Association of Dermatologists, Venereologists and Leprologists http://iadvl.org/	1.1
Cosmetic Dermatology Society India http://cosdermindia.in/	1.2
Indian Society for Pediatric Dermatology (ISPD) www.ispedderm.com/	1.3
Pigmentary Disorders Society (PDS) www.pigmentarydisorderssociety.com/	1.4

Conference list for 2017 in India

CONFERENCES	ORGANISER	WEB
Dermacon 2017	IADVL	http://iadvl.org/
Haircon 2017	Association of Hair Restoration Surgeons, India	http://ahrsindia.org/haircon/
Cuticon	IADVL	
Dermazone	IADVL (4 major zonal branches of IADVL)	Contact: drrohitbatra@gmail.com
Dermatopathology CME	Dermatopathology Society of India	http://dermpathindia.org/meetings.html
2nd Acne India Summit		
Asia Pacific Summit on Dermoscopy	Indian Society of Dermoscopy, Onychoscopy & Trichoscopy (ISODOT)	http://www.dermsourceindia.com/
Clinicon 2017	Association of Clinical Dermatalogists of India (ACDI)	http://www.clinicaldermajaipur.com/
World Congress of Cosmetic Dermatology (WCOCD) 2017	International Academy Of Cosmetic Dermatology (IACD) and Association of Cutaneous Surgeons of India ACS(I)	http://www.wcocdbengaluru.com/
4th DAAS Summit (Dermatology and allied specialities summit)		www.daassummit.com
Cosderm India 2017	Cosmetic Dermatology Society India	www.cosdermindia2017.com
Back To Roots II: National Symposium on Clinical Dermatology	IADVL	www.iadvlkarnataka.org
ISPD Annual Conference 2017	Indian Society for Pediatric Dermatology (ISPD)	www.peddermindia.org
2nd Aesthetica Asia 2017	Eastern India Cosmetic Dermatology Research Academy	http://www.aestheticaasia.in/
3rd Pigmentarycon	Pigmentary Disorder Society	www.pigmentarydisorderssociety.com

Source: http://iadvl.org/events.php

06
SKIN RESEARCH ACROSS INDIAN INDUSTRY

ndustry research is demand based often resulting in large scale commercial product development. Startups are a newer phenomenon that aims to conjoin basic biology research and product development to dermatological problems.

Industry research can broadly be classified under two major sectors – Fast-Moving Consumer Goods (FMCG) and Pharma. India is viewed as a huge market in the FMCG sector and according to India Brand Equity Foundation (IBEF) May 2017[8] report, skin care accounts for 5% of the market share in terms of revenue. There has been a recent shift in consumer focus towards organic skincare and the market is estimated to be around USD 81.8 million and growing at a rate of 20-25% per year.

The focus of research in Industry is thus strongly driven by the huge market demand and consumer perception. In the pharma sector, the focus is more on dermatological solutions. Two major players, each in the FMCG and Pharma sector, are discussed below.

COMPANY NAME	L'OREAL[9]
SECTOR	FMCG
RESEARCH CENTRE(S) IN INDIA	MUMBAI AND BANGALORE

RESEARCH FOCUS: In 2013, L'oreal inaugurated its 6th global Research & Innovation (R&I) hub to specifically study Indian skin and hair needs. It has two research centres in the country – a product development centre in Mumbai and Advanced Research centre in Bangalore. The research focus of the product development centre works on commercial FMCG goods like skin care products, colour products and personal hygiene products tailored for Indian demands. The advanced research centre in Bangalore explores and works on phytochemistry, biotechnologies and bioinformatics to provide better solutions to pigmentation disorders. The centre also specifically focuses on Ayurveda.

[8]https://www.ibef.org/download/FMCG-May-2017.pdf

[9]http://www.loreal.com/media/press-releases/2013/jan/l%E2%80%99or%C3%A9al-unveils-new-

COMPANY NAME	UNILEVER[10]
SECTOR	FMCG
RESEARCH CENTRE(S) IN INDIA	BANGALORE

RESEARCH FOCUS: The market leader in skin care with a 54% market share in India, Unilever has one of its six global R&D centres in Bangalore, India which also works on skin care research among others. In skin research, they focus on advanced formulations for face creams and lotions that also deliver UV protection along with exceptional sensory experiences. One of India's most commercially successful skin whitening products, Fair & Lovely, was researched and developed in this facility.

COMPANY NAME	GALDERMA[11]
SECTOR	PHARMA
RESEARCH CENTRE(S) IN INDIA	MUMBAI

RESEARCH FOCUS: Dermatology company headquartered in Switzerland, Galderma established a wholly owned subsidiary Galderma India in 1999 in Mumbai. They work extensively with dermatologists and physicians across India providing treatments for skin conditions such as acne, eczema, seborrheic dermatitis, scabies and skin senescence. Although their R&D facility is based in Canada and France, some of their products are locally manufactured via sub-contracts. The company has partnered with Indian Association of Dermatologists Venereologists and Leprologists (IADVL) to offer scholarships and research grants in dermatology in India.

COMPANY NAME	DR. REDDY'S LABORATORIES[12]
SECTOR	PHARMA
RESEARCH CENTRE(S) IN INDIA	HYDERABAD AND BANGALORE

RESEARCH FOCUS: An Indian MNC in pharma, headquartered in Hyderabad, Dr. Reddy's Laboratories is one of the top 3 pharma companies in India. It has a global presence and has a R&D centre in Hyderabad, Telangana. Their dermatological products cater to vitiligo treatment, dermatology skin care and emollients. Thus, both in FMCG and pharma, it can be seen that the research is driven by market potential and opportunity for commercial success.

[10]research---innovation-center-in-india https://www.unilever.com/about/innovation/our-r-and-d-locations/bangalore-india/

[11]https://www.galderma.in/About-Galderma/Galderma-India-at-a-Glance

[12]http://www.drreddys.com/india/portfolio/therapy-areas/

07
SKIN RESEARCH ACROSS INDIAN STARTUPS

Startups in skin biology are a new addition that look to combine basic research and product development in areas other than cosmetics and skin care. Favourable government policy that propels innovation and a startup culture strengthened by the presence of dedicated bio- incubators and science parks have led to the emergence of unique players in this scenario. Three startup profiles presented here show the varied nature of research in Indian startups.

COMPANY NAME	VYOME BIOSCIENCES[13]
YEAR OF ESTABLISHMENT	2010
RESEARCH CENTRE(S) IN INDIA	NEW DELHI

ABOUT: One of the earliest startups in dermatology research and product development, Vyome is a research and innovation focussed company that is driven by a vision to develop drugs for antibiotics resistant-acne, other pathogens and anti-fungal agents in dermatology. Thus, they focus mainly on product development using new and novel mechanisms.

The startup was co-founded by Dr. Rajesh Gokhale, Professor at National Institute of Immunology and Dr. Shiladitya Sengupta, an Assistant Prof at Harvard Medical School.

COMPANY NAME	AHAMMUNE BIOSCIENCES[14]
YEAR OF ESTABLISHMENT	2016
RESEARCH CENTRE(S) IN INDIA	PUNE, MAHARASHTRA

ABOUT: An innovation based drug-discovery company, Ahammune Biosciences aims to redefine dermatology therapeutics in India. Their main focus currently is to develop a drug for curing vitiligo as present treatments only offer temporary relief.

The firm was co-founded by Dr. Parul Ganju and Dr. Krishnamurthy Natarajan, Professor at School of Life Sciences, Jawaharlal National University.

COMPANY NAME	PANDORUM TECHNOLOGIES[15]
YEAR OF ESTABLISHMENT	2011
RESEARCH CENTRE(S) IN INDIA	BANGALORE, KARNATAKA

ABOUT: Pandorum Technologies is a startup in tissue engineering and regenerative medicine. Housed in the C-CAMP bio-incubator, they design and manufacture 3D human tissues for medical research and therapeutics.

The company was founded by Dr. Tuhin Bhowmick and Dr. Arun Chandru, Indian Institute of Science (IISc) graduates.

[13]http://www.vyome.in/

[14]http://www.ahammune.com/aboutus.html

[15]http://pandorumtechnologies.in/about-us/

08
INDO-SWISS COLLABORATION OPPORTUNITIES

Research collaborations are most commonly pursued with Indian academic institutions through multiple working models. These models are University level and faculty level agreements, and there is an emerging third model, which is at an activity level.

For Swiss universities, it is beneficial to have fewer partners but deeper relationships in India. This can be achieved through 'Activity Level' agreements which are defined with specific milestones and outcomes for both institutions. Agreements at specific activity or focus level also allow for further investments and growth of the initiative owing to its specificity.

For skin research in particular, here are the possibilities

SETTING UP INDO-SWISS RESEARCH COMPETENCE CENTRE

It would be a large-scale collaboration between an Indian research institution and a Swiss university focusing on a particular aspect of skin research, for example, ethno-medical research or drug delivery. Apart from research, training the clinician scientists could be a priority of the centre, an area Indian research is currently lacking in. The Department of Biotechnology of the Government of India is proactive in providing equal funding for such large-scale projects.

JOINT RESEARCH PROJECTS

Developing joint research proposals could be the first step of the Indo-Swiss collaboration on skin research. Biomaterials (for skin grafts) and drug delivery could be the area of collaboration with the most potential. Funding through Swiss National Science Foundation Sinergia grants or Horizon 2020 (with additional EU partners) can be explored.

PHD/ POST-DOC MOBILITY PROGRAM

Researchers at the Swiss university can apply for Swiss National Science Foundation Doc. Mobility (for PhD students) and Postdoc.Mobility programs, which offers them to carry out part of the research work in a different country for the duration of 18 months to two years respectively. In India, DBT-Wellcome fellows can avail a similar opportunity as part of the fellowship and carry out part of their research work in Switzerland.

JOINT PUBLICATION & SHORT VISIT PROGRAMS

Swiss and Indian research groups working on similar fields can always opt for joint paper publication. In that case, short visit programs offered by their respective countries can be helpful. Swiss university faculty can invite an Indian faculty to his/ her lab under SNSF Short Visit Program for up to three months, whereas Indian faculty can invite Swiss university researchers under Visiting Advanced Joint Research (VAJRA) Faculty Scheme for up to three months.

KNOWLEDGE-BASED PARTNERSHIPS

While Switzerland can offer its well-established research protocols & standards, India can definitely offer the large database of cases for skin research. It will be a win-win situation to set-up specific knowledge sharing collaborations thorough a Memorandum of Understanding (MoU).

INFRASTRUCTURE SHARING & CAPACITY BUILDING PARTNERSHIPS

While modern research is progressively more dependent on advanced laboratory facilities, both India and Switzerland have, over the years, built excellent facilities to enable their researchers. Often there is a need to access specific instruments or databank, where a mutual collaboration can be complimentary and could be beneficial for doctoral & post-doctoral researchers. Additionally, a partnership can be explored to train the maintenance staff in the use of advanced facilities.

MARKET VALIDATION PARTNERSHIPS

For applied research, spin-offs from research institutions can explore the possibility to validate their product suitability in each other's market at the prototype stage. While the Indian market itself is attractive for Swiss university spin-offs, validation of their product in Switzerland would be entry point for Indian spin-offs to the European market.

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HOW CAN SWISSNEX INDIA HELP?

Swissnex India can enable introductions for Swiss universities (through emails) to our wide network of academic institutions in India. All Swiss -funded universities and universities of applied sciences can avail our services for free. Similarly, Indian academic institutions can approach us to connect them to relevant Swiss institutions to initiate discussions on possible collaboration.

We also provide support to Swiss academic institutions on the basis of mandates that include

- Organizing 1-2 week programs for visiting delegations to identify potential academic and private research partners
- Supporting organization of summer and winter schools in India
- Organizing networking events and workshops with potential Indian academic and non-academic partners
- Fostering and supporting ongoing collaborations
- Identifying & enabling participation of the faculty at international conferences/ events in India

For more information, write to info@swissnexindia.org

swissnex India

Consulate General of Switzerland