Understanding the Skin Microbiome

Luc AGUILAR
PhD, Advanced Research, Research & Innovation

Magali MOREAU
PhD, Advanced Research, Research & Innovation
GUT MICROBIOME LEADING THE WAY

- From Scientific Communities to Public Awareness
- Growing implications in Human Health

Obesity
Inflammatory bowel disease
Gastric ulcers
Asthma/allergies
Autism
Autoimmune diseases
Cancer
Dental cavities
Depression and anxiety
Diabetes
GUT MICROBIOME LEADING THE WAY

- From Scientific Communities to Public Awareness
- Growing implications in Human Health

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
THE MICROBIOME

« You are not human, you are a walking colony, ... »

J Raes (TED)

> 99% of our gene

> 50-90% of our cells

> 36% of the small molecule in blood transit from the gut microbiome
CHALLENGE OF STUDYING SKIN MICROBIOME

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU

Chen et al. (2018) Nature
MAPPING THE MICROBIOME

- DNA sequencing technologies

**Glossary**

> **α diversity** (Shannon): Species Richness and eveness of sample

> **β diversity** (Bray Curtis): Dissimilarity in the microbial community between samples

Byrd et al. (2018) Nature Reviews Microbiology
SKIN MICROBIOME SHAPED BY BODY SITE & INDIVIDUAL

Influenced by

- Host Physiology
- Lifestyle
- Immune system
- Environment

Byrd et al. (2018) Nature Reviews Microbiology
SKIN MICROBIOME IN BALANCE

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU

Chen et al. (2018) Nature
SKIN MICROBIOME AND DISEASES

- Atopic Dermatitis
  - Loss of Microbe diversity
  - S. aureus in occurrence and severity of flares

- Acne
  - Change of bacterial communities
  - C. acnes phylotypes linked to severity
  - Staph involved with symptoms?

- Dandruff
  - Overload of fungi (M. restricta)
  - Dysbiosis
  - S. epidermidis/ C. acnes

---

Fitz-Gibbon et al., JID, 2013
Hannigan et al., CSHL Persp. In Medicine 2013
Flores G. et al, JDD 2014
Clavaud et al., PlosOne 2013; Exp. Dermatol 2015
Dreno et al. JEADV 2018

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
SKIN MICROBIOME AND DISEASES: EARLY EVIDENCE

- **Psoriasis**
  - Increased diversity
  - Decrease in immunoregulatory bacteria *S. epidermidis* and *C. acnes*
  - Higher colonization *S. aureus*

- **Rosacea**
  - Decrease diversity

---

Chang et al. (2018) Microbiome
Seite et al. (2018) EADV

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
IMMUNE SYSTEM AND SKIN MICROBIOTA: A CONSTANT CROSSTALK

- Homeostatic Immunity
- Inflammation and Dysbiosis

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU

Byrd et al. (2018) Nature Reviews Microbiology
SKIN MICROBIOME AND DISEASES

- Urban exposures and allergies
SKIN MICROBIOME, URBAN LIFESTYLES AND ALLERGIES

- Urban and rural lifestyle
- Environmental microbes on skin linked to allergic symptoms

(in 275 children & teenagers)

Lehtimäki J et al., PNAS 2018

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
SKIN MICROBIOME, URBAN LIFESTYLES AND ALLERGIES

- Urban Exposures of pollutants

(Clinical Study, China, n=200, >10 yrs exposures)
SKIN MICROBIOME, URBAN LIFESTYLES AND ALLERGIES

- Skin microbiome correlates with urban exposures

- Skin Enriched with environmental microbes

Pollutant exposures (PAH level)

LOW

HIGH

Propionibacterium

+20% Minor genera

LOW HIGH

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
FROM DESCRIPTION TO CAUSATION & MECHANISM

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU

Huang YJ et al., (2017) J Allergy Clin Immunol
FROM MICROBIOME KNOWLEDGE TO PRODUCT

- Microbiome-specific **active ingredients**

- Develop **diagnostic tools**
HOW TO MODULATE THE SKIN MICROBIOME?

PREBIOTICS
- Molecules: sugars, fibers promoting growth of beneficial bacteria

PROBIOTICS
- Hundred of strains, undefined composition

CONSORTIUM
- Defined composition of multiple strains with functional intent

STRAINS
- Strain, pure culture +/- synthetic biology

POSTBIOTICS
- Metabolic by-products of microbiome that affect host

ANTIBIOFILM
- Molecules disrupting pathogenic biofilms

PHAGES
- Viruses infecting & killing strains of bacteria

STRAIN SPECIFIC ANTIBIOTICS
- Enzymes produced by phages

Copyright, by courtesy of Luc AGUILAR & Magali MOREAU
Metabolic by-products of microbiome that affect host

> Using Short Chain Fatty Acid to regulate inflammation

Sodium Butyrate (SB) attenuates an ongoing skin hapten-induced contact hypersensitivity

Schwarz et al. (2017) JID
PRE- AND POSTBIOTIC

PREBIOTICS
Molecules, sugars, fibers, promoting growth of beneficial bacteria

POSTBIOTICS
Metabolic by-products of microbiome that affect host

> Foster Growth of beneficial bacteria

> Control /balance the community metabolites

Sucrose

↑ S. epidermidis
↓ Reduce C. acnes

Wang et al. 2016 International Journal of Molecular Science
PHAGES
Viruses infecting & killing strains of bacteria
TRANSPLANTING MICROBES TO TREAT ATOPIC DERMATITIS

PROBIOTICS

Hundred of strains, undefined composition

TRANSPLANT

- S. hominis & epidermidis CoNS transplantation (AMT)
