To investigate hair follicle metabolism and the effect of nutraceutical ingredient in human hair follicles *ex vivo*
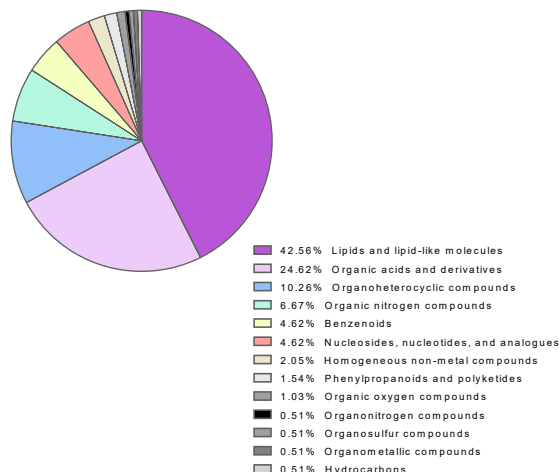
Claim substantiation for NUTRACEUTICALS

Nutraceuticals have been shown to be beneficial for hair growth, and quality, especially in the context of female (FPHL) or male (MPHL) pattern hair loss (Ablon, Dermatol Clin 2021). Metabolomic analysis allows the identification of nutrient and metabolite deficiencies in affected hair follicles. Metabolic analysis and nutrient absorbance assays are now offered using organ culture of healthy or affected hair follicles (Edelkamp et al., Methods Mol Biol 2020).

Metabolomic analysis on freshly collected human hair follicles

### 1. Untargeted metabolomics analysis (UPLC-MS) of healthy terminal hair follicles

Metabolites Super Classes

- 42.56% Lipids and lipid-like molecules
- 24.62% Organic acids and derivatives
- 10.26% Organoheterocyclic compounds
- 6.67% Organic nitrogen compounds
- 4.62% Benzenoids
- 4.62% Nucleosides, nucleotides, and analogues
- 2.05% Homogeneous non-metal compounds
- 1.54% Phenylpropanoids and polyketides
- 1.03% Organic oxygen compounds
- 0.51% Organonitrogen compounds
- 0.51% Organosulfur compounds
- 0.51% Organometallic compounds
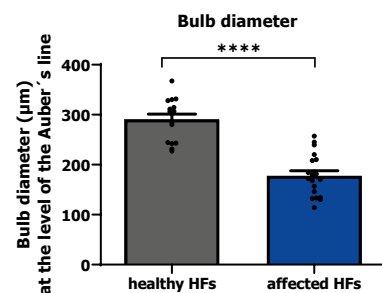- 0.51% Hydrocarbons

Metabolites are down-stream products of metabolism, deriving from natural cell-derived components generated during metabolism but also from nutraceuticals and nutrients.

2. Relative abundance of metabolites is significantly reduced in affected hair follicles from FPHL patients
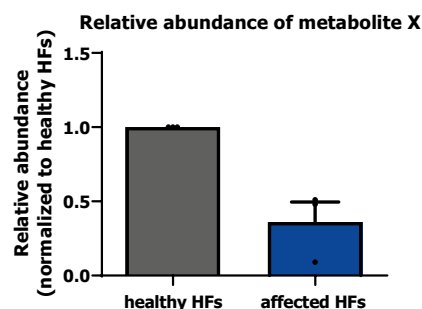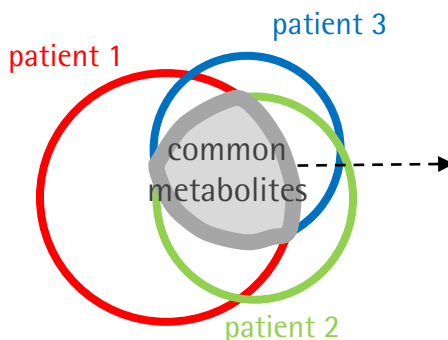
Hair follicles selection

healthy HF   affected HF
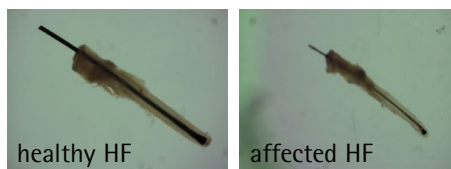
Representative images of a terminal full length HF, and an affected intermediate full length HF from vertex/parietal scalp skin of FPHL patient
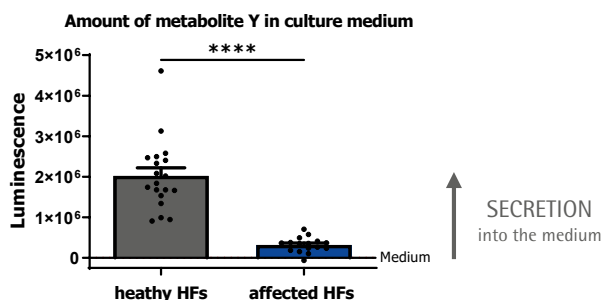

Bulb diameter

Bulb diameter (µm) at the level of the Auber´s line

****

healthy HFs   affected HFs

Pooled data from n=3 donors, mean±SEM, **** $p<0.0001$.

patient 1 — patient 3 — patient 2

common metabolites

Relative abundance of metabolite X

Relative abundance (normalized to healthy HFs)

healthy HFs   affected HFs

Representative example for reduced abundance of a metabolite in diseased HFs. Mean±SEM.

Hair follicle metabolic activity *ex vivo*

### The secretion of metabolite Y is reduced in affected compared to healthy hair follicles *ex vivo*

Amount of metabolite Y in culture medium

Luminescence

****

heathy HFs   affected HFs

SECRETION into the medium

Representative example for reduced secretion of a metabolite in affected HFs. Pooled data from n=4 donors, mean±SEM, **** $p<0.0001$.

Matabolic analysis and nutrient absorbance assays can be combined with efficacy testing for hair growth paramaters such as hair shaft production, and/or anagen maintenance (e.g. Parodi et al., PLOS Biol 2018; Ramot et al., Arch Dermatol Res 2015).

Nutraceutical supplementation *ex vivo*

Ex vivo cultured HFs absorb fluorescent labeled nutraceutical ingredient supplied in the culture medium.

Bulb   Lower HF   Isthmus   Infundibulum
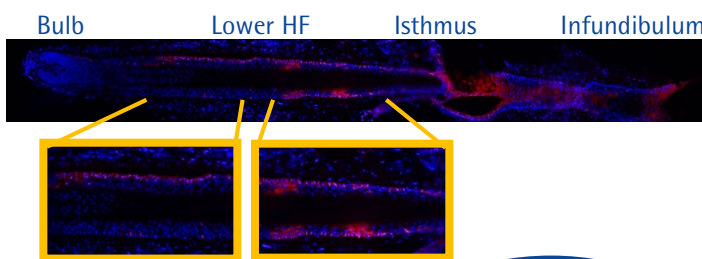
Representative image showing uptake of Texas Red conjugated nutraceutical X into human HF after 1 h incubation *ex vivo*.

Contact us for a customized study:

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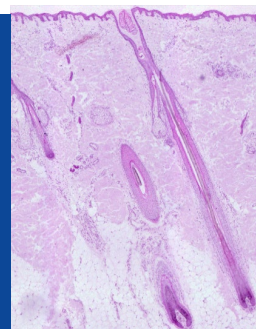Mendelstr. 17, 48149 Muenster, Germany

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