

Triple temperance strategy for scalp and hair care

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Introduction:

Gradual changes in the structure of the scalp and its ability to regenerate occur with aging. Moreover, cumulative effects of environmental factors contribute to a decrease in skin and scalp barrier function and hydration, favoring the entry of irritating compounds and allergens. This results in an **exacerbation of scalp sensitivity**, an **aggravation in epidermal barrier defects**, **disturbances** in the regulation of **immune and inflammatory mechanisms** and additionally a change in the **microbial balance**.

Here we propose a holistic approach for scalp and hair follicle care based on a **temperance strategy** through three key targets: moderating scalp sensitivity by **protecting the epidermal barrier**, **balancing microbiota** and **tempering the oversized immune response**.

Materials & Methods:

> Plant extract selection

At first, plant extracts were screened for their TRPV1-antagonist properties using a fluorometric detection method in transfected cells stimulated by capsaicin. Then, the best plant extract (PE) was studied for its effects on the regulation of the microbial balance and immuno-dependent inflammatory mechanisms.

> Balancing microbiota

The formation of *Staphylococcus epidermidis* biofilm was evaluated using crystal violet staining-based assay and its lipase activity was measured by fluorometric method.

> Tempering oversized immune response

The **inflammatory response of macrophages** induced by inactivated *Cutibacterium acnes* was assessed by quantifying secreted interleukin-8 (IL8).

> Hair follicle care

The capacity of the PE to promote **proliferation** of hair matrix cells was assessed by measuring

- **Ki67** immunofluorescence microscopy on *ex vivo* culture of hair follicles stressed by 50µM of capsaicin.
- **Versican**, highly expressed during the growing anagen phase and involved in dermal matrix assembly and cell adhesion by immunostaining in dermal papilla fibroblasts cultured in pseudo-papillae aggregates stressed by capsaicin at 50µM.

Results & Discussion:

> Balancing microbiota

We observed that the best PE used at different concentration decreased the capsaicin-induced TRPV1 activity (Figure 1A) and used at 0.55% it reduced the *Staphylococcus epidermidis* biofilm formation by 22% (Figure 1B) and fully inhibited its lipase activity (data not shown).

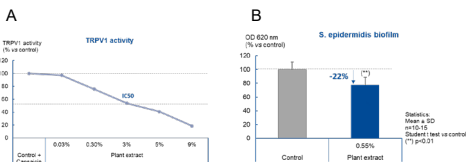


Figure 1: (A) TRPV1 activity and (B) *S. epidermidis* biofilm formation after treatment with the plant extract.

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Results & Discussion:

> Tempering oversized immune response

The **production of pro-inflammatory IL-8** by macrophages activated by *Cutibacterium acnes* was also **decreased by -24%** at 0.4% and up to **-48%** at 0.9% (Figure 2).

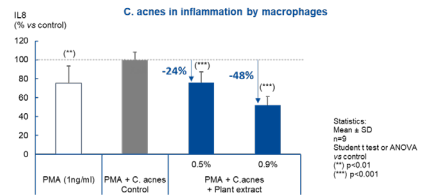


Figure 2: Level of pro-inflammatory cytokine IL-8 expressed by activated macrophages

> Hair follicle care

Finally, we showed that in the presence of capsaicin, both Versican and Ki-67 antigen were decreased in pseudo-dermal papilla models and in hair follicles in culture (Figure 3).

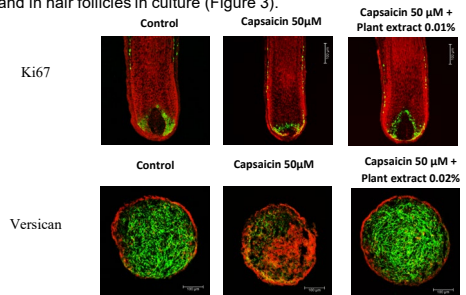


Figure 3: Immunostaining of Ki67 (hair follicle in culture) and Versican (pseudo-dermal papillae model) after treatment with the plant extract in a stress-induced model (capsaicin). Green: Ki67 or Versican; Red: Evans Blue was used as a contrast agent. Scale bar: 100µm

These results suggest that **TRPV1 agonist can impact hair growth cycles**. Interestingly, the treatment with the PE significantly maintained a basal level of Versican and Ki-67 in the stress-induced hair model.

In this present work, we showed that a PE can temper:

- the activation of the heat-sensitive **TRPV1** channel,
- the macrophage-dependent **inflammatory** processes,
- the commensal *S. epidermidis* biofilm formation and lipase activity to **limit microbial dysbiosis**.

The plant extract was also able to **maintain a basal level of Versican and Ki-67** in the stress-induced hair model.

Furthermore, a consumer study demonstrated perceivable benefits of the botanical product on the scalp and hair when formulated in a shampoo and conditioner.

Conclusions:

This study demonstrated that triple temperance strategy using a botanical ingredient is effective in scalp and hair care.

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