

# Avocado perseose, a biomimetic patented active ingredient targeted to the needs of infants' skin

Sophie Leclère-Bienfait, Stéphanie Brédif, Johan Rocheteau, Caroline Baudouin, Alex Saunois and Philippe Msika  
Innovation R&D Direction, Laboratoires Expanscience, Epernon, France

## Introduction

Postnatal life is a time period of active functional maturation and cutaneous adaptation. We have conducted a large research program which enabled us to introduce new fundamental knowledge on infant and children skin. For instance, these *in vivo* and *in vitro* investigations revealed that skin barrier, water handling capacities and some

defense systems develop and get organized during early childhood, and that the stem cells resource is at its maximum just after birth and decreases in the first months of life [1, 2]. Results from this research program were key elements for the development of a biomimetic active ingredient targeted to the needs of infants' skin.

## Development of a biomimetic active ingredient

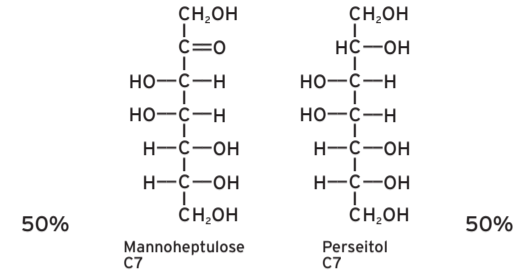


### Avocado perseose is a Biomimetic natural sustainable substance

Avocado perseose is a unique active ingredient obtained from controlled and specific pharmaceutical sustainable supply chains, according an eco-designed process.

This patented natural ingredient, issued from avocado cake, is a concentrated mixture of rare 7-carbon sugars (perseitol and mannoheptulose) whose molecular structure is in total affinity with the skin.

In nature, Avocado perseose is essential to fruit development and in the same way we prove here that it could accompany the development of infants' skin: Avocado perseose is a biomimetic active ingredient reflecting the perfect coherence and dialogue between plant biology and cutaneous biology.

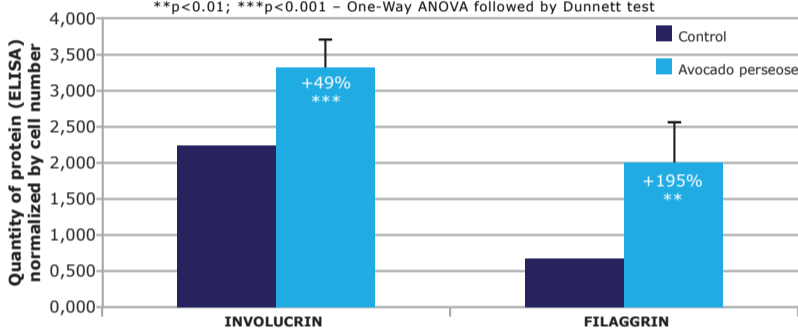


## Patented biological activity: from the surface to the depth of epidermis

### Avocado perseose reinforces skin barrier cohesion and organization at the level of the stratum corneum

Avocado perseose stimulated the expression of proteins essential for the set up and strength of cornified envelope: involucrin and filaggrin (figure 1). Moreover, Avocado perseose stimulated the synthesis of ceramides in human reconstructed epidermis by +32% (data not shown), thus ensuring the permeability of the skin barrier.

Figure 1: Expression of involucrin and filaggrin by NHEK

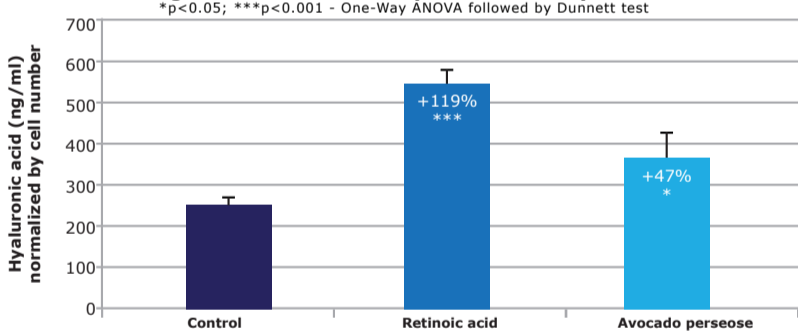


Normal human epidermal keratinocytes (NHEK) were incubated in presence of 0.005% Avocado perseose. The expression levels of involucrin and filaggrin were evaluated by cell-ELISA.

### Avocado perseose maintains epidermal water content

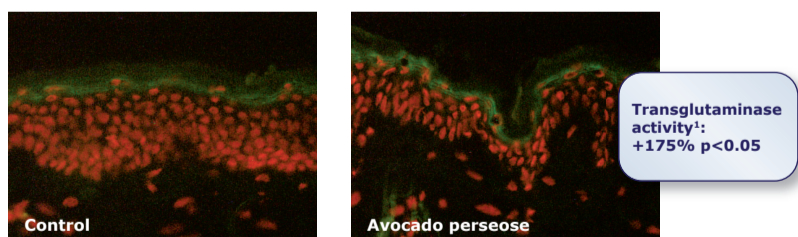
Avocado perseose was able to stimulate the production of hyaluronic acid, water binding molecule, in keratinocytes (figure 2). And, by stimulating an enzyme involved in strengthening skin barrier, transglutaminase 1, in a model mimicking dry skin, Avocado perseose could avoid epidermal water evaporation (figure 3).

Figure 2: Production of hyaluronic acid by NHEK



NHEK were incubated in presence of 0.005% Avocado perseose or 10<sup>-7</sup>M retinoic acid (positive reference for the assay). The quantity of hyaluronic acid produced by keratinocytes was measured by ELISA in the culture medium.

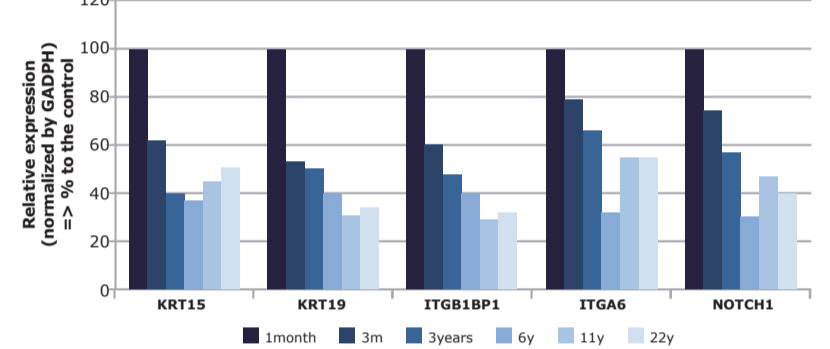
Figure 3: Expression of transglutaminase in human skin explants after barrier disruption (model mimicking dry skin)



Normal human skin explants were delipidated by a mix of organic solvents and then topically treated by Avocado perseose. Membrane transglutaminase was immunostained, the reaction was revealed by FITC (green staining); nuclei were stained by propidium iodide (red staining).

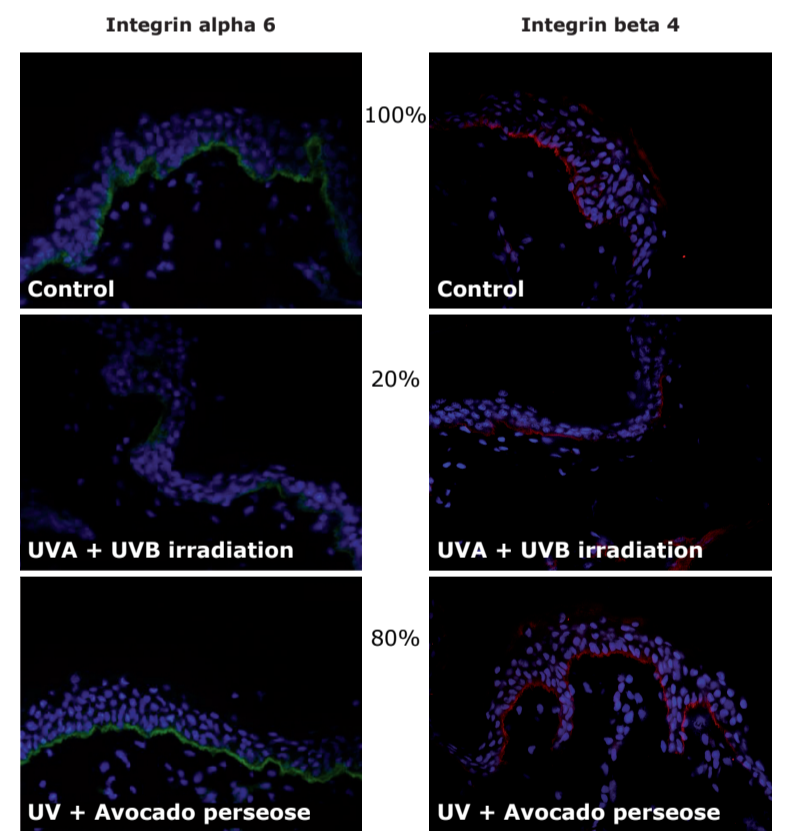
<sup>1</sup> Transglutaminase enzyme activity was evaluated by colorimetric assay in NHEK treated by 0.005% Avocado perseose (data not shown).

Figure 4: Evolution of the expression levels of Stem Cells genes with age in the presence of avocado perseose



NHEK from donors of different ages (1 month, 3 months, 3 years, 6 years, 11 years and adults: 22 years) were incubated in the presence of 0.005% Avocado perseose. The expression of stem cells markers was evaluated by qRT-PCR.

Figure 5: Immunostaining of markers for basal layer Stem Cells



Normal human skin explants were treated with Avocado perseose before and after being irradiated by UVA (10J/cm<sup>2</sup>) and UVB (200 mJ/cm<sup>2</sup>). Integrins alpha 6 and beta 1 were immunostained, the reaction was revealed by FITC for alpha 6 (green staining) or TRITC for beta 1 (red staining); the cell nuclei were stained with DAPI (blue). Staining was quantified by measuring the intensity of fluorescence compared to the number of nuclei.

### Avocado perseose maintains the balance and preserves the potential of epidermal Stem Cells

In a previous study [2], we showed that the expression of genes of stem cells is high after birth and decreases with age. In normal condition, this expression profile was maintained in the presence of Avocado perseose (figure 4), demonstrating that Avocado perseose is well tolerated by cells at any age. However, after UV irradiation, the skin treatment with Avocado perseose avoided the UV-induced downregulation of the two main markers of interfollicular stem cells (basal layer) the alpha6 and beta1 integrin proteins (figure 5).

## Conclusion

Avocado perseose acts for a perfect tolerance and a unique and complete action from the surface to the depth of the skin: it reinforces the skin barrier, maintains moisturization and preserves Stem Cells resource. Among other sugars, only Avocado perseose presented such range of activity and tolerance.

We have shown here that, in the same way it accompanies the fruit development, Avocado perseose is adapted to the regulation and maturation processes taking place from birth until the second year of life. Its incorporation in baby products provides a new vision on skin protection in children.

## References:

- [1] Fluhr JW *et al.* Infant epidermal skin physiology: adaptation after birth. *Br J Dermatol* (2012) 166(3):483-90
- [2] Poster: Baudouin C *et al.* Modeling and genomic signature of age-specific infants and children epidermis: new data and discoveries