

In vivo evaluation of skin volatile organic compounds and squalene peroxidation on stressed and aged skin

Ferreira Yolène¹, Mourel Laura¹, Veitch Alastair², Perrin Armelle¹, Le Mestr Audrey¹, Botto Jean-Marie¹, Imbert Isabelle^{1*}

¹Ashland, Global Skin Research Center, Sophia Antipolis, France – ²Ashland, Global Measurement Science, Bradford, UK

Introduction

Volatile organic compounds (VOCs) are emitted from various natural and chemical sources. The human body also emits various VOCs which represent the footprint of the cellular activity and can thus reveal certain dysregulations of the metabolism. Skin VOCs arise from eccrine, sebaceous and apocrine gland secretions and their interactions with microbiota determine our body odors. Specific skin VOCs such as aldehydes 2-nonenal (Asian skin) and nonanal (Caucasian skin) increase with age. These VOCs derive from lipid peroxidation which increases also with age and oxidative stress[1-2]. In the present study, we evaluated the relationship between lipid peroxidation and VOCs *in vivo*. A botanical extract from *Santalum album* (*S. album*) known for its effects on olfactory receptor OR2AT4 and advanced glycation end products (AGEs), *in vitro* was selected to evaluate at the same time its effect on lipid peroxidation and VOCs as well as its anti-aging impact.

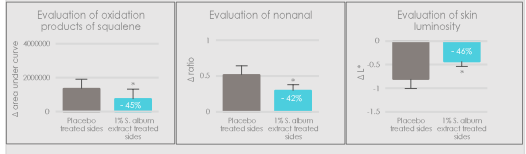
Methods

A double-blind clinical test has been designed to study the variation of nonanal as well as other skin parameters degraded with age and oxidative stress. 25 stressed Caucasian volunteers, aged from 36 to 66 years-old, were enrolled. They applied on the face, for 28 days, twice a day, a cream containing 1% *Santalum album* extract on one side and placebo on the other side. At D0 and D28, the effect of *S. album* extract applications, on skin oxidative stress and skin aging was evaluated.

Results

In vivo evaluation of *S. album* extract effect on oxidative stress:

After one month of application twice a day, the use of the formulated extract was associated with a decrease of squalene peroxidation and nonanal emission compared to placebo.

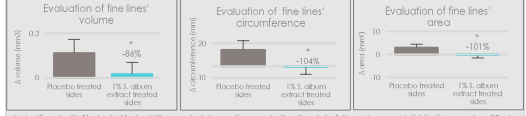


*: significant with Student's t-test or Wilcoxon test depending on whether the data followed a normal distribution or not. n=23 +/- SEM for oxidation products, n=22 +/- SEM for nonanal, n=23 +/- SEM for skin luminosity

The concomitant decreases of oxidation products of squalene and nonanal highlighted that both may be correlated. Therefore, by decreasing skin lipid peroxidation with *S. album* extract, we could minimize the nonanal quantity at the skin surface. In addition to the decrease of lipid peroxidation, the anti-oxidant effect could be highlighted by an enhancement in skin luminosity. After one month of application with the cream containing 1% *S. album* extract, an improvement of 46% of skin luminosity was noticed compared to placebo, supported the anti-oxidant effect of *S. album* extract.

In vivo evaluation of *S. album* extract effect on skin aging:

Fine lines' parameters were first assessed, and a statistical decrease of these latter were noticed after 1% *S. album* extract-containing cream applications compared to placebo. This effect was visible on color pictures showing less visible fine lines and wrinkles on side treated with the formula containing 1% *S. album* extract compared to placebo treated side.



*: significant with Student's t-test or Wilcoxon test depending on whether the data followed a normal distribution or not. n=25 +/- SEM

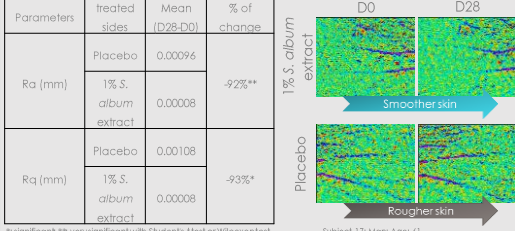
Color pictures of crow's feet area



Subject 28; Woman; Age: 60

In parallel, the skin roughness was carried out by the evaluation of Ra (arithmetic average of the absolute values of the roughness profile ordinates) and Rq (root mean square average of the roughness profile ordinates).

After 1 month of applications with 1% *S. album* extract containing cream a significant decrease of roughness parameters was observed compared to the placebo side. This result could be appreciated on the 3D pictures and color pictures, where the microrelief was less pronounced on 1% *S. album* extract treated side and also on color pictures.



*: significant; **: very significant with Student's t-test or Wilcoxon test depending on whether the data followed a normal distribution or not. n=25

Color pictures of skin smoothness



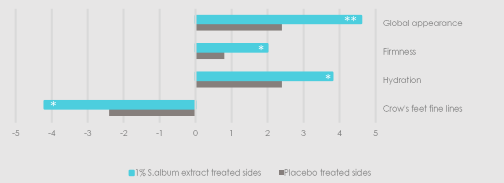
Subject 15; Woman; Age: 36

The evaluation on skin aging of the extract of *S. album* showed a positive impact on visible fine line's parameters but also on skin smoothing demonstrated anti-aging and relaxing effects of the extract.

Volunteer self assessment

To confirm all the results obtained with objective measurements, the volunteers performed a survey at each control visit. They rated higher scores for skin hydration, firmness and less fine lines on the side treated with 1% *S. album* extract, compared to the placebo side.

Volunteer self-assessment



*: significant; **: very significant with Student's t-test or Wilcoxon test depending on whether the data followed a normal distribution or not. n=25

This last result supported all the previous data, showing an ability on *S. album* extract to provide skin with a visible and perceivable smoother and healthier look.

Conclusion

This study pointed out the concomitant decrease of both skin lipid peroxidation level and nonanal emanation level, associated with the application of the formula in stressed population. These diminutions have gone with an improvement in skin luminosity and skin smoothness, highlighted the potential effect of the extract to counteract the effect of aging and oxidative stress.

References

1-Hoze S, Gozu Y, Nakamura S, Kohno Y, Sawano K, Ohta H, Yamazaki K. 2-Nonenal newly found in human body odor tends to increase with aging. *J Invest Dermatol.* 2001 Apr; 116(4):520-4. doi: 10.1046/j.0022-202x.2001.01287.x. PMID: 11286617.
2-Gallagher M, Mysocik C.J, Leyden J.J, Spelman AL, Sun X, Prett G. Analyses of volatile organic compounds from human skin. *Br J Dermatol.* 2008 Sep; 159(4):780-91. doi: 10.1111/j.1365-2133.2008.08748.x. Epub 2008 Jul 14. PMID: 18637798; PMCID: PMC2574753.