

HOW TO ALLEVIATE THE IMPACT OF CALCIUM ON HAIR MECHANICAL PROPERTIES? A NEW SPECIFIC COMBINATION OF ACIDS FOR HAIR CARE

Adrien KAESER¹, Manon CHAUMONTET², Guillaume MARTY², Isaac Eng Ting LEE¹, Yoshiki SHIBUYA¹, Patrick MINOU², Laura FENELON², Nawel BAGHDADLI³
 L'Oréal Research and Innovation, ¹Kawasaki, Japan, ²Saint Ouen, France, ³Aulnay-Sous-Bois, France

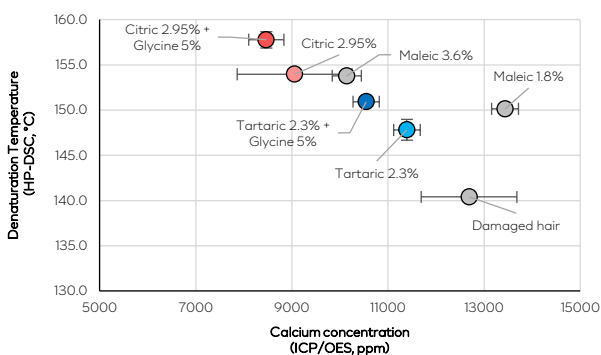
1 CALCIUM DELETERIOUS TO HAIR HEALTHINESS

Human hair tend to accumulate damages through treatment by color and waving services, exposure to water, UV or regular grooming, thus impacting their properties and health. Additionally, it is known that damaged hair is accumulating metal ions, and predominantly calcium ions from tap water,^[1] and this accumulation has been linked by scientists and consumers to different markers of hair lack of quality (rigidity, breakage) and appearance.^[2] In this study, we investigated the impact of small molecules on calcium removal and improving the perception of hair reinforcement.

2 ACTIVES SELECTION & EFFECT ON CALCIUM

HP-DSC & Calcium ions quantification

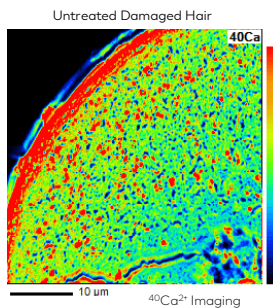
Damaged caucasian hair (2x chemical treatments) were treated 5 times (w/ shampoo washes, tap water) with mixes of actives (pH4)



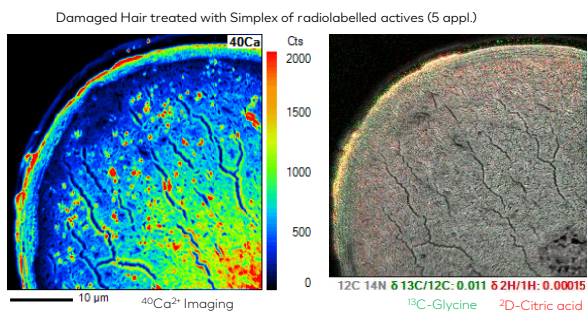
The mixture of Citric acid (2.95%) and Glycine (5%) was selected as the most impactful on denaturation temperature, while significantly decreasing the quantity of calcium ions in the hair fiber.

Nano-SIMS & Actives quantification

Damaged caucasian hair were treated 5 times (w/ shampoo wash) with a simplex solution of radiolabelled actives. Nano-SIMS was conducted on fibers cross section for detection of ¹H, ²D, ¹²C, ¹³C, ⁴⁰Ca.^[3]



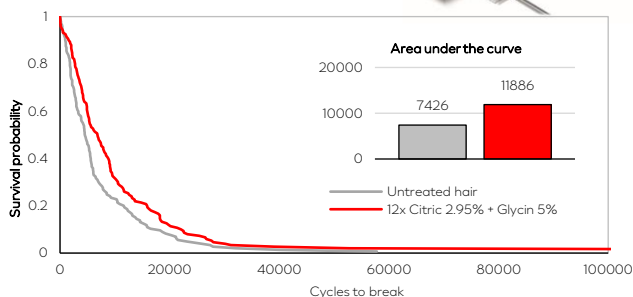
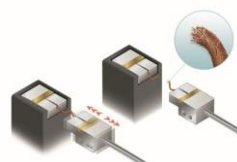
Calcium ions are present predominantly in the cuticle area and as granules in the cortex. Applications of actives is successful in decreasing significantly the calcium ions in the outer part of the hair fiber. Additionally, traces of glycine and citric acids can be imaged in this area of the fiber.



3 EFFECTS ON HAIR PROPERTIES

CYCLIC FATIGUE

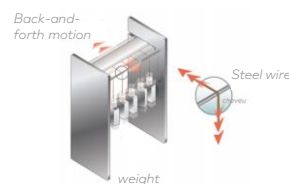
Damaged hair swatches treated 12 times with the simplex solution were extended to the right constant stress, at a constant speed, in a repeated manner until breakage



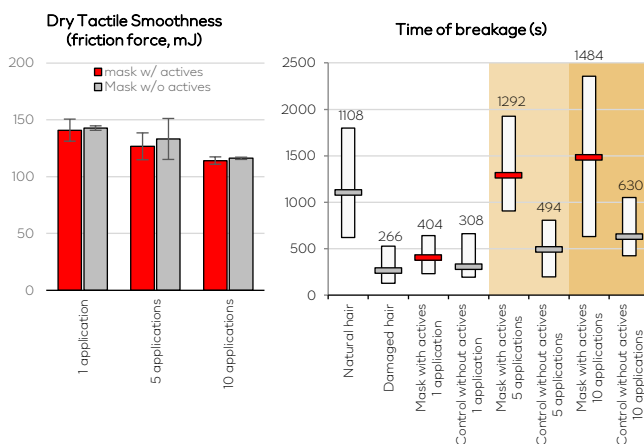
The survival curve shows a significant difference, as illustrated by a statistical increase of the area under the curve for hair treated with the simplex solution, in comparison to untreated hair. This reflects an improvement of the resistance to breakage.

FLEXABRASION

This measures the resistance to breakage when an extended fiber is subjected to repeated stress of flexion and surface abrasion. The more a fiber is damaged, the faster it will break. Flexabrasion is impacted by surface smoothness and internal torsion.^[4]



A mask containing actives (Citric acid 2%, Glycine 1%) was compared in multi-application with a control mask (w/o active) (Shampoo between applications)



While dry smoothness is similar for both masks, an improvement in breakage resistance is observed starting 5 cumulative applications

CONSUMER USAGE

Panelists in Spain (n=30) and China (n=20) with damaged to very damaged hair were asked to use the mask containing actives in their hair care routine twice a week for 1 months.

On top of instant care benefits, panelists have highlighted the progressive benefits:

- Hair strength and less breakage
- Softer fiber
- Repaired and less dried tips



4 CONCLUSION

The combination of citric acid and glycine was successfully shown to modify the properties of damaged hair fibers, from a microscopic level to a perceived macroscopic evaluation of the fiber reinforcement and resistance to breakage. This simple combination of actives which can be obtained from natural sources presents opportunities to prolong healthy hair.

[1] Kempson I. M. et al., Chem. Soc. Rev. 2011, 40 (7), 3915
 [2] Marsh J. M. et al., ACS Appl. BioMater. 2018, 1(4), 1174
 [3] Hallegot P. et al., Appl. Surf. Sci. 2006, 252(19), 6706
 [4] de Oliveira N. F. et al., Cosmetics 2022, 9(1), 1

We wish to thank Christian MAZILIER, Nicolas DAUBRESSE, Clothilde LOUADOUDI, Maxime N DIAYE, Yoan LE POULL, Sophie CHEN