Ingredients

Marshmallow Root: Botanical Ingredient for Hair Protection and Reparation Against Environmental Stress

THE EXPERTS

Marie-Philippine DE LOTH
Marketing Manager, Seqens Personal Care (Porcheville, France)

Agathe LE TIRANT
R&D Engineer, Seqens Personal Care, (Porcheville, France)

Cécile GAVORY
R&D Manager, Seqens Personal Care, (Porcheville, France)

Evolution of the Haircare Market: The Rise of Skinification

During the COVID-19 pandemic and afterwards, consumers have been prioritising self-care and well-being, extending detailed routines to their hair. This holistic approach to haircare, known as *"the skinification of hair"*, is the blending of skincare principles into haircare routines. The haircare market now boasts features like exfoliation, moisturisation, protection, anti-ageing, and overnight care, mirroring advanced skincare regimens. Recognising that hair, much like skin, endures environmental stressors such as pollution and UV rays, the industry is now seeking solutions that shield and actively repair hair fibers. The structural integrity of hair is related to its overall health and appearance, which is a consideration for consumers. Clinical studies underscore the psychological and social impact of hair condition, linking healthy hair to confidence and perceived attractiveness[1].

In line with this trend, Seqens Personal Care has developed an active ingredient derived from organic marshmallow *(Althaea officinalis)* root. This botanical active ingredient acts as a protective and reparative shield for hair, especially in urban environments.

Environmental Aggressors and their Deleterious Impact on Hair

A close look at hair structure reveals that the outer cuticle serves as a protective barrier against external aggressors for the cortex beneath. A healthy cuticle feels soft, enhances hair's shine by reflecting light, and reduces friction between hair shafts. The cortex constitutes the primary keratinised component of the hair shaft and is responsible for its mechanical ▶▶▶

© WF Seydlbast / Adobe Stock

▶▶▶ characteristics, including its strength, elasticity, and colour[2,3].

Hair is constantly exposed to external stressors that can induce oxidative and structural modifications, leading to increased porosity, dryness, and roughness. Such changes weaken the hair, making it more prone to breakage and stiffness. Among these aggressors, ultraviolet radiation (UVR) and airborne particulate matter are particularly damaging. UVR degrades key structural proteins like keratin through free radical formation, impairing hair's mechanical integrity. While UV-B primarily affects the cuticle, UV-A and visible light penetrate deeper, reaching the cortex and amplifying the damage[4,5]. Meanwhile, particulate matter enhances hair surface friction and roughness[6], further dulling the hair and reducing softness. Therefore, it is essential to find effective strategies to shield against UVR and pollutants damages to maintain hair health and aesthetics.

Mucilaginous Plants: The Case for Marshmallow Root

Film-forming agents derived from mucilaginous plants, which produce water-retentive mucilage, represent a promising approach for enhancing hair protection. Mucilage is composed of various heterogeneous polysaccharides and is derived from various plant tissues such as seeds, roots, bulbs or even leaves [7,8]. Its beneficial properties —biocompatibility, non-toxicity, and versatility—have already found applications in food, medicine, and pharmaceuticals such as acting as a film-forming agent and serving for wound care [8,9].

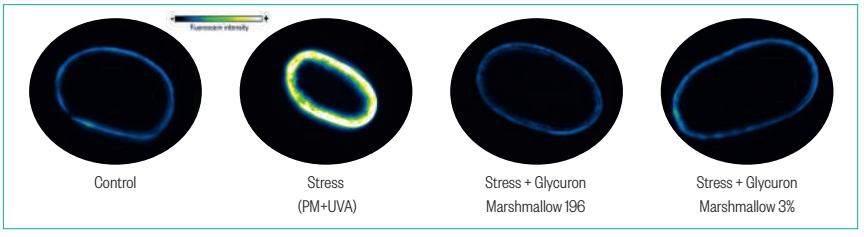
Similar applications are found in marshmallow *(Althaea officinalis)* roots. Containing 5–11% mucilage, they have a long history in traditional medicine for their soothing, wound-healing, and anti-inflammatory effects[10–12]. Extraction of the roots indicates they are rich in sugars and containing polysaccharides such as glucans and arabinogalactans, which have been associated with film-forming and protective properties on skin[13].

Marshmallow Root as a Shield Against Environmental Stressors

Inspired by the mucilage content of marshmallow roots, an extract was developed from *Althaea officinalis* roots. The extract was tested *ex vivo* on blonde hair strands exposed to simulated urban pollution, modelled as a combination of PM10 particulates and high-intensity UV-A radiation. Both rinse-off and leave-on application methods were assessed with *Althaea officinalis* root extract at 1% and 3%.

Three key parameters were measured to evaluate the structural and aesthetic aspects of the hair. First, protein carbonylation levels, a well-established marker of protein oxidation and indicator of structural damage, were detected by fluorescent labelling and quantified using densitometry analysis. Second, hair integrity and porosity were assessed by fluorophore diffusion and penetration using image analysis. Finally, surface roughness was evaluated using fluorescent 3D imaging to visualize cuticle changes and assess hair smoothness.

The effects of *Althaea officinalis* root extract are shown as a percentage of effectiveness. 100% means full protection, bringing the hair back to normal like the control group. 0% means no protection, with results the same as the stressed group.



▲ **Figure 1:** In situ visualization of fluorescein diffusion on cross-sections of the hair shaft with the rinse-off protocol.

Marshmallow root extract protects hair against protein carbonylation

Oxidative damage is especially severe in the cuticle due to its external localization when exposed to environmental stress, leading to increased fragility and porosity[5,14]. According to the stress model applied, levels of carbonylated proteins were observed to be higher following exposure to UV-A and pollutants compared to the unstressed control group.

Marshmallow root extract demonstrated protective effects in the leave-on protocol, significantly reducing cuticle protein oxidation by 18% at 1% and 27% at 3%. Cortex oxidation was reduced by 25% at 1% and 33% at 3%. Similar results were observed under the rinse-off protocol, showing even stronger protection: protein carbonylation in the cuticle decreased by 43% at 1% and 64% at 3%, while oxidation in the cortex was nearly completely prevented, with reductions of 100% and 99%, respectively at 1% and 3%.

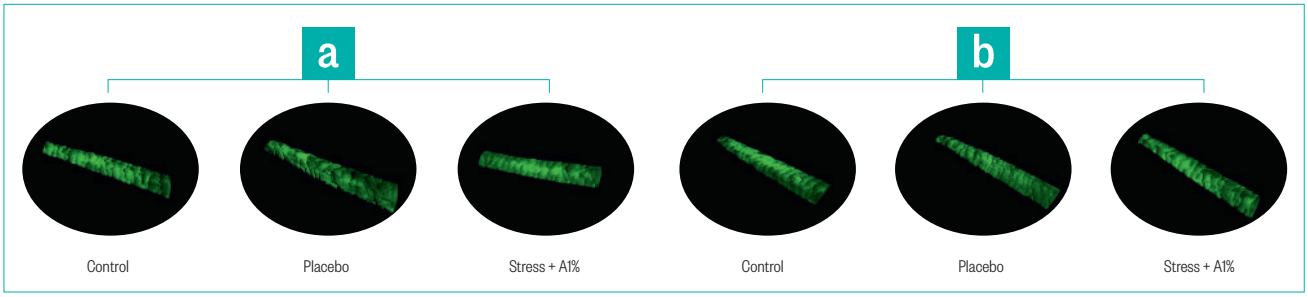
Marshmallow root extract reduces hair porosity

Porosity, hair's ability to retain moisture, is affected by environmental stress and depends on the arrangement of cuticle scales. Widely spaced or raised scales increase porosity, leading to dryness and loss of shine[15].

Application of leave-on treatment containing marshmallow *(Althaea officinalis)* root extract reduced dye penetration by 91% at a 1% concentration and completely prevented it (100% reduction) at 3%. In the rinse-off protocol, both concentrations fully preserved hair structure and hydration by effectively eliminating porosity (Figure 1).

Marshmallow root extract smoothes hair surface roughness

As previously mentioned, hair shine depends on the integrity and



▲ **Figure 2:** Representative images of reconstructed hair segment for each condition with *Althaea officinalis* extract at 1% application. a. leave-on and b. rinse-off

smoothness of the cuticle. Environmental damage, including protein oxidation, causes scales to lift, increasing roughness and dullness[16]. This phenomenon was directly observed on hair strands stressed by urban pollution, using 3D fluorescent imaging, where stressed hair (placebo on Figure 2) showed lifted and disrupted cuticles with rough surfaces.

In contrast, both leave-on and rinse-off treatments with 1% marshmallow extract restored a smooth, shiny appearance with well-aligned cuticle scales (Figure 2).

Conclusion

The pandemic and the rise of the skinification trend have reshaped consumer expectations, driving demand for advanced haircare solutions that go beyond basic cleansing to offer protection against pollution and structural repair. Based on marshmallow *(Althaea officinalis)* root, the extract provides a natural and effective solution for modern haircare needs. Its proven ability to reduce protein oxidation, porosity, and surface roughness, under both rinse-off and leave-on conditions, supports the preservation of hydration, strength, flexibility, and shine. This positions the marshmallow root active ingredient as high-performance urban shield for hair health. ●

References

1. Lemoine-Dessaint A, Jamieson D, Raffin R. Holistic care for healthy hair. South Afr Pharm Cosmet Rev. 2022;49(2):36–7.
2. Sinclair RD. Healthy Hair: What Is it? J Investig Dermatol Symp Proc. 2007;12(2):2–5.
3. Guerra-Tapia A, Gonzalez-Guerra E. Hair Cosmetics: Dyes. Actas Dermo-Sifiliográficas Engl Ed. 2014;105(9):833–9.
4. Lee WS. Photoaggravation of hair aging. Int J Trichology. 2009;1(2):94.
5. Truëb RM. The impact of oxidative stress on hair. Int J Cosmet Sci. 2015;37(S2):25–30.
6. Galliano A, Ye C, Su F, Wang C, Wang Y, Liu C, et al. Particulate matter adheres to human hair exposed to severe aerial pollution: consequences for certain hair surface properties. Int J Cosmet Sci. 2017;39(6):610–6.
7. Dybka-Stępień K, Otlewska A, Góźdź P, Piotrowska M. The Renaissance of Plant Mucilage in Health Promotion and Industrial Applications: A Review. Nutrients. 2021;13(10):3354.
8. Goksen G, Demir D, Dhama K, Kumar M, Shao P, Xie F, et al. Mucilage polysaccharide as a plant secretion: Potential trends in food and biomedical applications. Int J Biol Macromol. 2023;230:123146.
9. Calero MPV, Alvarez AE, Morales EQ, Rojas Salas MF, Chavarría-Rojas M, Redondo GM. A Look at the Role of Mucilage at the Industrial Level. Pharmacogn Commun. 2021;12(1):7–13.
10. Al-Snafi AE. The Pharmaceutical Importance of Althaea officinalis and Althaea rosea: A Review. Int J PharmTech Res. 2013;5(3):1378–85.
11. Ameri A, Heydarirad G, Mahdavi Jafari J, Ghobadi A, Rezaeizadeh H, Choopani R. Medicinal plants contain mucilage used in traditional Persian medicine (TPM). Pharm Biol. 2015;53(4):615–23.
12. Bonaterra GA, Bronischewski K, Hunold P, Schwarzbach H, Heinrich EU, Fink C, et al. Anti-inflammatory and Anti-oxidative Effects of Phytohustil and Root Extract of Althaea officinalis L. on Macrophages in vitro. Front Pharmacol. 2020;11:290.
13. Deters A, Zippel J, Hellenbrand N, Pappai D, Possemeyer C, Hensel A. Aqueous extracts and polysaccharides from Marshmallow roots (Althea officinalis L.): Cellular internalisation and stimulation of cell physiology of human epithelial cells in vitro. J Ethnopharmacol. 2010;127(1):62–9.
14. Cavagnino A, Starck A, Bobier A, Baraibar MA. Protein Carbonylation as a Reliable Read-Out of Urban Pollution Damage/Protection of Hair Fibers. Cosmetics. 2022;9(5):98.
15. Müllner ARM, Pahl R, Brandhuber D, Peterlik H. Porosity at Different Structural Levels in Human and Yak Belly Hair and Its Effect on Hair Dyeing. Molecules. 2020;25(9):2143.
16. Horev L. Exogenous Factors in Hair Disorders. Exog Dermatol. 2006;3(5):237–45.