Theophylline administration to ex vivo human skin shows multiple anti-aging and anti-cytotoxicity effects: Could theophylline be a potential anti-aging cosmeceutical?

Previous studies examining the topical application of theophylline in murine skin showed photodamage-protective properties. However, the effects of theophylline on human skin remains elusive. By using cutting-edge microscopy techniques and ex vivo assays, the research team at Monasterium Laboratory GmbH has investigated the in-depth effect of theophylline administration on human scalp skin. The study was supported by Henkel AG & Co. KGaA, Düsseldorf, Germany and published online on October 21, 2019, in the International Journal of Cosmetic Science. In the pilot study, researchers employed in-house developed and clinically relevant human scalp full thickness skin ex vivo organ culture model and provided the very first insights that theophylline possesses several striking complex skin-protecting properties. Treatment of theophylline on skin samples strongly augmented various molecular factors that regulate anti-aging and extracellular matrix integrity. Such as, our results show an increased expression of collagen I and III, metallothionein-1 (endogenous antioxidant of human skin) and an enhanced structural stability of fibrillin-rich dermal microfibrils after the treatment. In addition, even after the induction of cytotoxic ROS by menadione administration, co-treatment assay with theophylline shows substantial reduction in the expression of aging parameters, suggesting its anti-cytotoxic properties and protective role in oxidative stress.

Furthermore, interestingly the study shows that there is a dose-dependent correlation between theophylline administration and intracutaneously produced endogenous melatonin in human skin ex vivo culture medium. Since melatonin has many beneficial effects (antioxidant, anti-inflammatory, DNA repair and metabolic regulation) on the skin, researchers hypothesize that it could be one of the regulatory pathways by which theophylline exerts its effect on the skin. Additionally, theophylline treatment significantly elevated the expression of keratin 15 (stem cell marker) in the epidermal basal layer. Thus, this study provides the first evidence that theophylline impacts on human skin stem cells, raising the possibility of its stem cell protecting properties.

Taken together, our ex vivo pilot study in human skin shows that theophylline has multiple skin-protecting properties and it would be interesting to elucidate further its topical application as an anti-aging cosmeceutical in pre-clinical and clinical studies. This research also highlights the application of human skin organ culture models for novel pre-clinical tests and screenings currently available at Monasterium Laboratory.

References:

