Secrets of beauty from the ice age

The high Alpine plant Saponaria pumila is a survival specialist. It weathered the last ice age, growing on ice-free mountain peaks, so-called Nunataks, while exposed to constantly low temperatures and high levels of UV radiation. To cope with this harsh environment S.pumila developed adaptive strategies, repair mechanisms and protective compounds. These precious substances are now available for skin care: Mibelle Biochemistry presents PhytoCellTec™ nunatak®

During the last glacial age, which ran from 110,000 BC until 10,000 BC, large parts of the northern hemisphere were covered under a thick sheet of ice. The climatic conditions in the coldest stage of the ice age were very harsh with dramatically decreased temperatures. These conditions presented a challenge and threat not only to man and animals but also to all plant species. During this period over 90% of all terrestrial life vanished from the northern hemisphere; only few organisms were robust and adaptable enough to survive.

A small number of plant species managed to escape the ice by moving to ice-free mountain peaks, so-called Nunataks. In these glacial refuges water could be found in liquid form for the assimilation by plant roots. It should be emphasised, however, that only the most specialised of high alpine species were able to survive on Nunataks. A representative of this family of extremophile plants is Saponaria pumila, a cushion plant only a few centimetres high bearing large pink flowers. In order to survive constantly low temperatures and high UV radiation S.pumila developed efficient repair mechanisms and protective compounds. Could the human skin be protected by the same molecular compounds and mechanisms?

Solar UV radiation causes direct or indirect damage to vital cellular constituents such as DNA, proteins and lipids, thereby affecting a cell's function and viability. Unlike UVB, UVA can penetrate into the lower dermis and generate excessive amounts of reactive oxygen species. The resulting oxidative stress induces senescence in dermal stem cells. These cells are important for the growth and repair of the extracellular matrix, which gives the skin elasticity and tensile strength. Thus, their protection is of great importance.

Protective effects of S.pumila stem cells on human dermal stem cells

S.pumila is a rare, in some alpine regions even protected plant species, and therefore of limited availability as a source of cosmetic actives. However, the PhytoCellTec™ technology developed by Mibelle Biochemistry enables the large-scale cultivation of S.pumila stem cells. Plant stem cells are obtained by injuring germinated sprouts, the healing of the cut surface starts with the formation of a callus. The callus consists of cells that have dedifferentiated to become stem cells. An extract of the S.pumila stem cells was tested for its protective effects on the human skin. For this purpose a novel human dermal stem cell culture was established as an in vitro test system: The activity of dermal stem cells can be assessed based on their characteristic property of growing in three dimensional spherical colonies. Furthermore, sphere size served as an observable indicator of cell viability in this assay. As expected, UV irradiation of cell cultures lowered the cells' ability to form spheres. However, dermal stem cell cultures incubated with S.pumila extract exhibit a 35% higher sphere-forming capacity compared to the control. Moreover, dermal stem cells treated with S.pumila extract reveal a slightly higher proliferation potential as indicated by the higher percentage of large spheres. Interestingly, the ability to form large spheres is even maintained after UV irradiation, whereas the untreated dermal stem cells have lower or limited proliferation potential, they form only small and medium sized spheres.

Pre-treatment of the skin with an S.pumila fortified cream protects against stressful conditions

An *in vivo* study was conducted with the aim of evaluating whether pre-treatment with a basic cream

containing PhytoCellTec™ nunatak® fortifies the skin against stressful conditions during beach holidays. Healthy volunteers applied verum and placebo, one to each side of the face. Skin roughness was evaluated at different time points during the study: after a two-week pre-treatment period (t1), after two weeks' vacation (t2) and again after a recovery phase (t3) (Figure 1). The measurements revealed that the pre-treatment (t1) had no significant influence on skin texture, however after exposure (t2) intense sunlight and saltwater clearly left their mark on the skin texture but only on the placebo-treated side of the face, despite the use of sunscreen by all volunteers. At t2 skin roughness, fine lines and wrinkles were visibly less pronounced on the verum-treated skin area.

Improvement of the extracellular matrix structure

The capacity of PhytoCellTec™ nunatak® to stimulate the regeneration of dermal connective tissue was evaluated by visualising the dermal structure using ultrasonography. An emitted ultrasonic wave generates an echo when it is partly reflected at the boundaries between different tissue layers. A heterogeneous tissue like an intact dermis gives a strong echo (bright colours in the ultrasonographic image Figure 2). Disruption of the dermal architecture, however, leads to weaker reflections and dark bands. Examination of the dermal tissue structure on the forearms of 20 volunteers (average age 53) revealed a so-called subepidermal low echogenic band (SLEB), which is typically found in sun damaged or aged skin. PhytoCellTec™ nunatak® stimulates the regenerative capacity and restorative processes in dermal tissue and improves skin density by 10% with the result that after 28 days of treatment the SLEB is significantly reduced.

Conclusion

Saponaria pumila is one of the few plant species that survived the last ice age on Nunataks. It has evolved unique adaptive strategies to deal with the harsh and unfriendly climatic conditions. This extremophile cushion plant can nowadays be found in crevices on cliffs at altitudes of 2500-3600m. Because of its limited availability Mibelle Biochemistry used its PhytoCellTec technology to produce large volumes of S.pumila stem cells. An extract made of these plant stem cells has shown *in vitro* to protect human dermal stem cells against UV-induced stress. Clinical studies reveal that PhytoCellTec™ nunatak® fortifies the skin against challenging environmental conditions.

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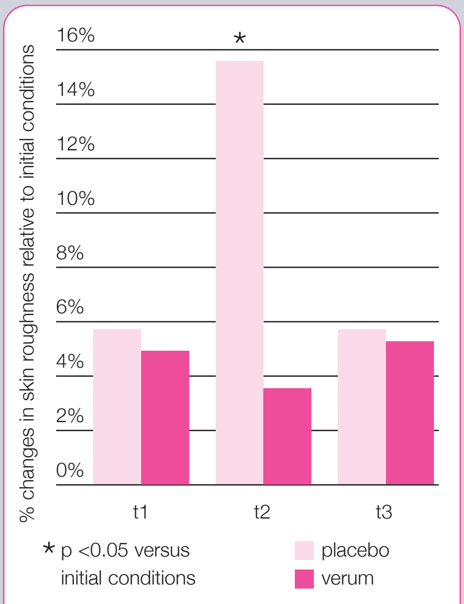

Figure 1: Skin roughness measured at three different time points

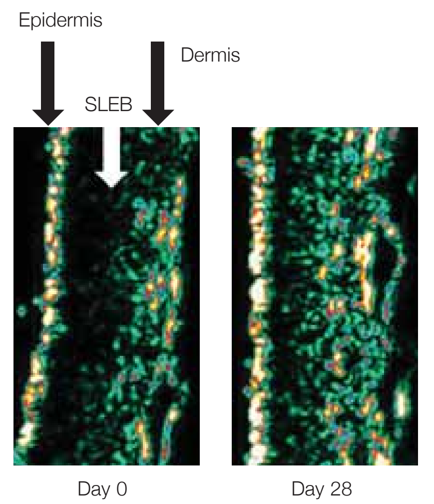

Figure 2: Ultrasonographic images of the forearm of a volunteer before and after treatment. The colour scale of echogenicity is: white – yellow – red – green – blue – black. Light colours indicate higher echogenicity.