

Snow Algae Powder - The Mystery of Red Snow

Algae that survive in Alpine snow

In summer, persisting snow fields on high mountains are sometimes tinged with a red, pink colour. This phenomenon is caused by snow algae. It is a unicellular member of the green algae that changed colour by producing carotenoids for protection against high ultraviolet radiation. Snow algae are extremophile species adapted to survive on Alpine and polar snow fields. The spores contain high amounts of astaxanthin carotenoids.

Sustainable production of snow algae in bio-reactors

A tube photobioreactor has been developed to produce raw material from snow algae. In the initial process, light and aeration was used to grow the green algae for three weeks, doing photosynthesis in order to reach biomass. In the second stage, nutrients were reduced and light strongly increased over a two week period to induce the formation of carotenoids resulting in the red coloured spore form. Snow algae harvested at this stage were homogenized at 1200 bar in a phospholipid solution to open the cells and to form liposomes with encapsulated water- and oil-soluble algae

actives (snow algae extract). The liposomal extract was carefully coated onto maltodextrin in a spray granulation process (Snow Algae Powder).

Stimulation of Klotho activity for caloric restriction mimetic anti-ageing effects

The extremophile snow algae were then tested for anti-ageing effects in cultures of skin cells and also in clinical studies. The algae extract was found to stimulate the longevity gene Klotho and to activate the protein AMPK which is a master switch in cellular energy metabolism.

Klotho, named after a Greek goddess of fate, is a longevity-related gene, discovered in 1997. Mice that are deficient in Klotho display an accelerated ageing phenotype, on the other hand, when overexpressed, the gene extends lifespan by 30%. The Klotho protein mediates its longevity effects by inhibiting the insulin/IGF-1 signaling. Suppression of this signaling pathway is regarded as central mechanism in the calorie restriction-induced longevity phenomenon. In a replicative ageing model with primary human fibroblast cells, the

expression of the Klotho gene was found to be down-regulated in aged cells. Treatment of aged cells with the snow algae extract induced an up-regulation of Klotho expression to a value even beyond that of young cells.

Stimulation of AMPK activity for cellular defense

The AMPK is a cellular sensor for energy which is activated by an increased AMP/ATP ratio indicating low energy. During calorie restriction and after exercise AMPK activity is increased to restore ATP levels. But the role of AMPK is not restricted to the control of the energy metabolism. AMPK was shown to regulate several transcription factors related to cellular defense and protection systems indicating its role as anti-ageing factor. In a cell culture model with primary human keratinocytes, the snow algae extract was found to stimulate activation of AMPK.

In-vivo anti-ageing effects of snow algae powder

Does stimulation of Klotho and AMPK have a real impact on typical skin parameters? In cell culture models with primary human fibroblast cells, treatment with the snow algae extract was found to prevent ageing-induced reduction in collagen production and to protect against the H₂O₂-induced increase in production of matrix metalloproteinases which are enzymes responsible for collagen degradation.

A cream with 3% Snow Algae Powder was tested in a placebo-controlled half face study over three weeks by 20 volunteers.

These 20 volunteers spent the middle week in the harsh winter Alpine climate. Compared to initial conditions, trans epidermal water loss was increased and pigment spots and eye wrinkles were worsened on the placebo-treated half side.

All these issues showed improvement on the side treated with the snow algae.

Rejuvenation effects measured by Multi-Photon Tomography

In another clinical study, multiphoton tomography was used as a novel non-invasive method to analyze the papillary surface area. Near infrared wavelengths are used to build up a tissue contrast based either on auto-fluorescence generated, for example, by elastin and NADH, or based on second harmonic generation induced by collagen structures. The papillary surface, corresponding to the surface of the basal membrane, can be reconstructed using special software and algorithm. Example pictures from a young and old female volunteer show the age-related decline in papillary structures leading to a flattened basal membrane in old skin. A cream with 2% Snow Algae Powder was applied by 5 women aged between 55 and 67 on the inner side of the forearm over two months. The placebo cream was then applied on the other forearm. At the end of the study, the papillary surface was increased by 12.5% compared to initial conditions and by 30.5% compared to placebo, indicating a clear rejuvenation effect. Snow Algae Powder can be regarded as a significant key to skin's longevity.

