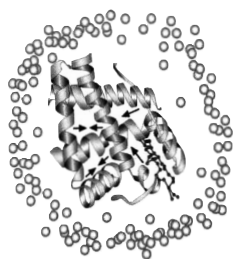


THE SCIENCE SUPPORTING ECTOIN

Ectoin is an innovative, multi-functional natural active substance that has been shown to have an effect in protecting the skin against external aggressors by protecting Langerhans cells, protecting DNA and cells from UV-induced damage, significantly reducing formation of sunburn cells, and retaining moisture in the skin.

Ectoins belong to the family of compatible solutes, also referred to as stress protection substances, and were discovered in extreme halophilic bacteria such as *Halomonas elongata*. The natural environment of these organisms is characterized by high UV-radiation, dryness, extreme temperature, and high salinity. The bacteria protect themselves against damages from these hostile conditions by synthesizing ectoins.^{1,2} These, in turn, stabilize the bacteria's biopolymers such as proteins, nucleic acids, and membranes,^{3,4,5,6} allowing them to function optimally and to thus help the bacteria survive in their inhospitable environments.

Ectoins are amphoteric, organic molecules that are able to bind water and form a large hydrate sheath, i.e., they are excellent water structure formers.² This allows them to protect the biomolecules in their cells against a variety of aggressors such as UV, osmotic stress, heat, dryness, or frost^{4,7}



Protein, active center, compatible solute

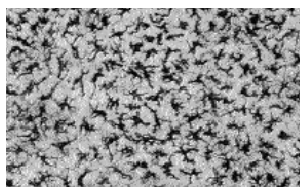
Ectoins are non-toxic, are highly compatible with cell metabolism and are extremely active even at low concentrations. They are readily accepted by cells and are chemically, physically, and biologically stable.

Human skin, when exposed to a variety of environmental hazards, also has to cope with a number of specific stress factors.⁸ UV-radiation, e.g., can result in cell damage (protein, lipid, DNA, membrane) and immunosuppression, and cell membranes can be damaged by pollutants, allergens, or surfactants.

The ingredient ectoin, produced in a patented process in the biotech industry (often referred to as “bacteria milking”), showed great efficacy in improving the biological processes available to counteract environmental aggressors:

IMMUNE SYSTEM PROTECTION

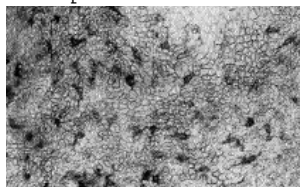
Human skin has its own specific immunological defense system, the skin immune system (SIS). Within the epidermis, it is primarily Langerhans cells that are the key elements of the SIS and are able to correct damages done by damaging environmental influences, pathogens, and transformed skin cells. UV radiation causes Langerhans cell death, thereby diminishing the function of the SIS. Tests have demonstrated the protective effect of ectoin with respect to the number of Langerhans cells; this effect can be seen under the microscope



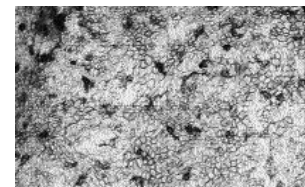
A) Untreated, non-irradiated area of epidermis



B) Untreated, irradiated area of epidermis



C) Placebo-treated, irradiated area of epidermis



D) Ectoin-treated irradiated area of epidermis

Human epidermis. The Langerhans cells have been visualized using ATPase staining. The photographs were taken 48 hours after irradiation of the skin with 1.5 MED (Sun-Simulator Sol 500).

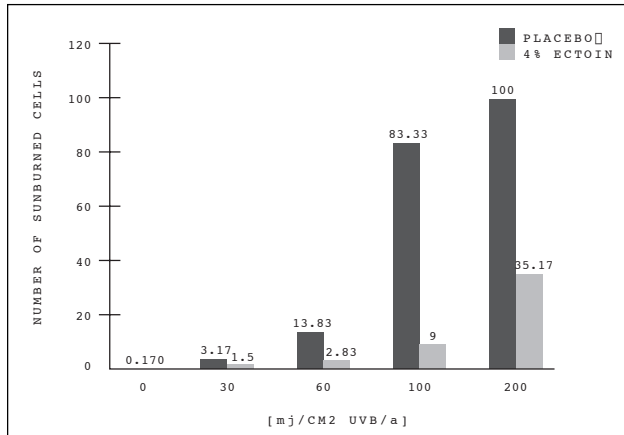
CELL PROTECTION

Tests have shown that ectoin also supports the repair and protective mechanisms of the cells. In cases of external stress such as UV-irradiation, heat, and other physical and chemical stress factors, human skin cells are able to produce so-called stress proteins or Heat Shock Proteins (HSP). These have the particular tasks of recognizing, stabilizing, and helping to metabolize damaged proteins. The more quickly this function is activated, the better the cells can cope with these stress factors and protect themselves early against cell damage. In tests (using proteins of the HSP 70 family) it was shown that cells pre-treated with ectoin were able to synthesize HSP two to three times faster than non-treated cells.

PROTECTION AGAINST UV-INDUCED DAMAGE

When cells are damaged to such an extent that repair is no longer possible, apoptosis (controlled cell death) is initiated. Sun Burn Cells (SBC) are apoptotic keratinocytes, formed in the epidermis as a result of excess UV irradiation. Their existence in human skin indicates severe UV-induced cell damage.

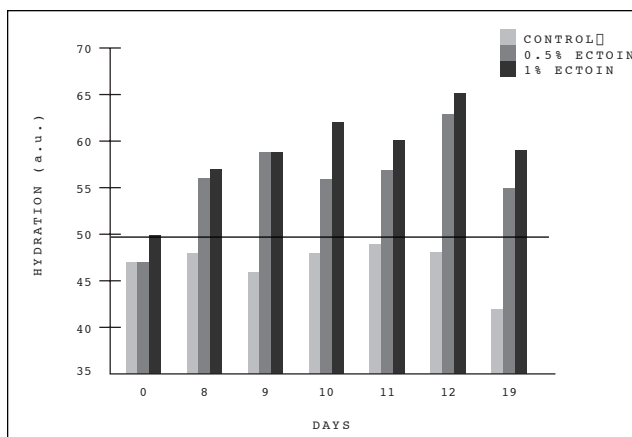
An in vitro study using a skin model, Skinthetic, showed that ectoin significantly reduces the formation of



SBCs under irradiation.

MOISTURE RETENTION

Human skin is equipped with a Skin Lipid System that, together with excretions from the sebaceous glands, serves as a shield against moisture loss and as a barrier against unfavorable outside factors. The very sensitive equilibrium of the substances comprised in the Skin Lipid System can easily be disturbed by external or internal factors and conditions. These can include dryness due to high temperatures or very low temperatures at low humidity, high salt concentrations in the skin due to, e.g., perspiration, surfactants contained in soap, etc. The result can be transepidermal water loss (TEWL) and dry, flaky skin. In tests exposing skin to these conditions, which we encounter on a daily basis, much improved hydration levels were evident when skin had been treated with an



ectoin-enriched formulation.

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