

# DERMASCOPE

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## O<sub>2</sub> – Skin Oxygenation



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Oxygen uptake in the skin has been an attractive cosmetic property for many years. Ingredients that imply oxygenation, energizing, and cellular respiration often speak to addressing the impact of increasing the needs of oxygen for all of skin's metabolic processes. Some products claim to oxygenate skin with breathable formulations, non-ROS oxygenating ingredients, while certain products use free radical peroxides which can damage skin.

### Hypoxia

Hypoxia occurs when the skin is deprived of an adequate oxygen supply; it has been shown that aged or damaged skin is not well-oxygenated. If the availability of oxygen is inadequate for aerobic cellular metabolism, energy is provided by less efficient anaerobic pathways that produce metabolites other than carbon dioxide and water. Deficits in oxygen content diminish the cell reproduction process and new skin cells will not be as healthy. This deficit leads to physiological changes that result in premature aging with a manifestation of fine lines, wrinkles and a dull or sallow complexion.

The cells draw energy from metabolizing carbohydrates, lipids, and proteins in order to synthesize adenosine triphosphate (ATP). ATP is the universal chemical cellular fuel and participates in all intracellular reactions of biosynthesis. These reactions include transport of substances across membranes and exchanges between cells and their environment, while incorporating nutrients and discharge of metabolic wastes.

O<sub>2</sub> → CELL RESPIRATION → ATP SYNTHESIS → ENERGY

### Gas Carrying Mechanism

Upper layers of the skin rely on, and are largely supplied by atmospheric oxygen, which is in the stable O<sub>2</sub> form. This molecular oxygen is vital to support the normal structure and activity of cells. Oxygen promotes metabolic processes within viable cells to produce a higher state of activity. Oxygen consumption is often an indicator of a good metabolic activity.

Perfluorocarbons are unique gas carriers that allow cosmetic ingredients to deliver atmospheric oxygen. Perfluorocarbons are synthetic molecules that are able to store gases such as oxygen. When applied topically, perfluorocarbons draw oxygen to the site facilitated by a process known as passive diffusion. Passive diffusion takes advantage of gasses' affinity to move from areas of greater concentration, to areas

of lesser concentration, until it reaches a state of equilibrium. Oxygenated perfluorocarbons in emulsions are known to increase surface oxygen concentration without the need for a pressure chamber. The gas-carrying capacity of perfluorocarbons is a physical phenomenon and completely reversible through gas diffusion. The mechanism of the gas carrying properties of perfluorocarbons can be compared to the function of respiratory gases in the body, and directly related to the partial pressures of these gases. The oxygen supply to each cell of the body diffuses over a distance of approximately 0.05 millimeters; the uptake of oxygen in the cell is based on active transport mechanism between the cells and the intercellular space. An increase of oxygen supply results in a stronger diffusion gradient, which allows the cells of the epidermis to take up the optimal quantity of oxygen for metabolic processes.

Multiple cosmetic ingredients utilize perfluorocarbons in various beneficial ways. In 2014, Grant Industries launched a methyl perfluorobutyl ether blend in a delivery system for non-ROS oxygen. The gel entraps the oxygen carrying methyl perfluorobutyl ether into an elastomer matrix with an external water phase to manage evaporation in the manufacturing process and upon application of the product. Positive results from in vitro and in vivo testing were conducted.

### Perfluorocarbons and Molecular Weight

Clinical studies of cosmetic preparations have been measured by the moisture content of the skin, skin profile and the oxygen partial pressure of the skin. Perfluorodecalin, a type of perfluorocarbon, in addition to molecular energy, is shown to improve the barrier function of the skin. A linear dose-dependent reduction in fine lines and wrinkles was also found. Other modes of action concerning the different half-lives and variable molecular weights of the combined perfluorocarbons is available in other ingredients that are shown to maximize the acting time in the dermis. Low molecular weight perfluorocar-

bons penetrate the dermis readily, while the higher molecular weight perfluorocarbons penetrate slower, while still maintaining the initial results and further moisturizing the dermis.

### Perfluorocarbons and Delivery Systems

Air Products/ROVI has two ingredients based upon perfluorocarbons with different delivery mechanisms. Cera-some™ Oxygen is based upon a carrier technology utilizing skin-identical ceramides that are believed to be able to deliver molecular oxygen to deeper layers of the skin. The use of this ingredient leads to a greater oxygen content within the skin, relative to untreated skin. The second ingredient, OxyForce, which was launched in 2014, is a cellular active ingredient that can enhance the supply of molecular oxygen to the skin cells. With a delivery of molecular oxygen in a high performance solution, the oxygen partial pressure in skin is increased. In vivo studies showed a positive effect was detected in 95 percent or more of the volunteers for a reduction in the appearance of wrinkle depth.

- At age 30, the loss of oxygen levels in the skin drops by 25 percent.
- At age 40, the loss of oxygen levels in the skin drops by up to 50 percent.
- Oxygen loss to the skin can be even higher in highly polluted environments.
- Oxygen content in skin is reduced with smoking and related risky behaviors.

### O<sub>2</sub> Optimizing, Regulation, Production and Energy

Incorporation of Lonza's Biodynes TRF (Saccharomyces Lysate Extract) demonstrated soothing and anti-irritant properties. The ingredient assists skin in optimizing cellular oxygen and plumping up the skin, by building up moisture content of the skin cells. By contributing to skin rejuvenation properties, the ingredient is indicative of significantly increased oxygen consumption in the fibroblast cells. Cosmetic properties, noted with in vivo studies, demonstrated soothing and anti-irritant properties.

Phytovityl by Solabia is a corn kernel extract that favors the production and storage of energy in skin cells. The ingredient stimulates and restores energy potential to improve cutaneous microrelief. The ingredient was further shown to protect the skin against the free radical aggression and pollution. In vitro and in vivo studies were conducted, offering a global solution in skin aging by reactivating the energy capacities of skin cells with skin protection against radical aggression and pollution.

Gattfosse's Hydrolyzed Soy Protein stimulates cellular metabolism. With short term use, it boosts oxygen consumption and increases the natural energy of the cells. Long term use stimulates cellular renewal for a brighter skin effect. Another Gattfosse product, a stone extract that is rich in magnesium, stimulates the cells metabolic activity, acting both on cellular respiration and on the synthesis of ATP.

SEPPIC'S SEPITONIC™ M3 is a chrono-energizer with multiple minerals (zinc, copper, magnesium). The ingredient

is supported with many studies indicating an optimization of cellular respiration to stimulate energy (ATP) and radical scavenging effect to inhibit the cellular free radical formation produced during respiration process.

Some ingredients focus on atmospheric oxygen while other ingredients function on various principles such as cellular respiration and microcirculation. In aesthetics, procedures such as a massage can stimulate heat in the skin and assist in improving circulation by drawing blood nutrients to the skin that may be hindered due to stress and other factors. By incorporating oxygenating therapies, ingredients, and other materials that improve cellular communication and functionality, an ideal balance can be achieved to counteract aging, and environment factors. High performance products that need extra additional oxygen to achieve activity are also ideal products to combine with oxygenating ingredient properties.

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