# kosmetikos*

*By Steve Herman*

# THERE'S SOD IN YOUR SMEC!

Last month we explained how enzymes are the key to life, consequently making human existence possible. "Great, but what's in it for me?" you ask. Well for one thing, you can put SOD in your SMEC.

As highly trained and sophisticated technical mavens, we are expected to know relevant acronyms[1], as pervasive in cosmetics as in the Pentagon- VOC, AHA, INCI, TEWL, DOPA (my personal favorite) and SOD. SOD, of course, stands for SuperOxide Dismutase. If you really don't know what SMEC is, look at the end of the column-when no one is looking! Anyway, we know that "ase" at the end of a chemical name gives it away as an enzyme. In the case of SOD, it is an enzyme that gobbles up the dreaded superoxide ion.

We are going to look at SOD as the first stop in a brief journey through the skin.

Figure 1 shows our passage from the air/skin interface, through the dead outer surface into the living cells and the intercellular matrix that cements them. These four areas will show how enzymes can promote beneficial effects on the health and appearance of skin.

The environment is harsh on the skin, and active oxygen is a key player in promoting many of these damaging reactions. For example, UVA-generated reactive oxygen can cross-link protein such as collagen. The photoinactivation (great word?) of certain enzymes can functionally impair cells. So what can SOD do? It catalyzes the transformation of superoxide to hydrogen peroxide:

$$2\,O_2^- + 2H^+ \xrightarrow{SOD} O_2 + H_2O_2$$

The reaction naturally occurs without SOD, but the function of an enzyme is to selectively speed reactions—in this case, by a factor of $10^{10}$. Hydrogen peroxide isn't healthy for the skin, but it's a lot better than superoxide. In any event, the skin can deactivate the peroxide with peroxidase, but cosmetic ingredients can accelerate this process. The basic reaction is:

$$2\,H_2O_2 \xrightarrow{\text{peroxidase}} 2\,H_2O + O_2$$

So you can look on the label of a skin treatment product and it says "peroxidase"? Well, not exactly. As one example, Fennel Seed Extract is used as a source of peroxidase. Enzymes are complex botanical products, not chemical compounds easily synthesized in the lab. The commercially available enzymes are typically derived from natural products rich in the desired material, extracted carefully to concentrate the selected enzyme in its active form.

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We have just considered a reaction on the surface of the skin. We now go to the "dead" layer to examine the action of another enzyme. Collagenase, as the name implies, dissolves collagen, and it will help heal wounds. Ah, you cry, a DRUG! Indeed it is a drug. I have a commercial product from Germany marketed by Knoll, the pharmaceutical division of BASF. It is

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*Greek kosmEtikos, skilled in adornment or decorating.

called Iruxol®, and it uses the specific collagenase Clostridiopeptidase A. A few moments on the internet[2] reveals a domestic product, Santyl® ointment.

Three important points pertinent to cosmetics arise from examining these two products. The first is that collegenase can have beneficial effects on the skin. If it can help heal serious wounds, it would likely contribute to soothing less severe dermal trauma. Secondly, collagenase is safe under reasonable use conditions. Just because it is an enzyme that can catalyze reactions at a wild rate, devouring the collagen that holds our skin together, does not mean a small application will eat an entire extremity, much less a whole human body.

The last lesson from these products is that they are wanting in cosmetic elegance. The delivery is via anhydrous ointments, not known for consumer appeal in skin care. Serious stability problems must be solved to get this enzyme, indeed almost any enzyme, into appealing form.

What might collagenase do if it were used as a cosmetic? It could increase cell turnover much like AHA's, possibly without many of the negative effects associated with AHA's. As a wound healer, it might be useful where traditional healers like allantoin are used, such as shaving products. Another glance at the web[3] yields "an enzyme alternative to AHA's," Linked-Peptain™ C. It claims to improve stability and performance by immobilization on polymers.

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On to the "living" skin, we have the intercellular matrix and the cells themselves. Let us first examine what the application of an enzyme could do to improve the matrix. An example is a product derived from soy, Soy Bean (Glycine Soja) Protein, which is produced by Pentapharm[4] in Switzerland. It is a proteinase inhibitor, targeting elastase and tryptase. It thus performs an exactly opposite function of the collagenase we previously considered. It is also active in a lower layer of the skin. Claims for such a product include increased skin moisture, skin elasticity, and noticeable improvement in appearance.

Now the last stop, inside the living cells. The DNA in the cell is constantly being mutated. DNA is abundant in the cells and repairs occur naturally, so the problem is usually under control. Added assault on the system can create problems, and one common source is UV exposure, which triggers a cross-linking of certain side groups, resulting in pyrimidine dimers[5]. The cell recognizes this disrupted pattern and excises the effected section. Since the DNA sits in a broth of its raw materials, the excised area reconstructs into the correct pattern. If excess damage occurs, beyond the ability of the DNA repair enzymes to correct, a signal is given to the body to reject the damaged cell as quickly as possible. That is why sunburned skin peels.

Once again, while the body produces its own defense, a boost in the necessary material, in this case DNA Repair Enzyme, can be considered beneficial. One source for cosmetic use is plankton extract. Plankton spend their entire lives on the surface, or near the surface, of the ocean. The amount of UV exposure encountered by plankton is thus extreme, and consequently they have a high concentration of DNA repair enzymes.

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Highly selective extraction processes have been developed by Yarosh[6], yielding the specific enzyme type T4 Endonuclease. The T4 Endonuclease requires stabilization[7], in this case provided by a liposomal delivery system. The INCI nomenclature for one such product is Plankton Extract and Lecithin. Other sources, such as the milk flora Micrococcus luteus, are viable. The mechanism of DNA repair is such that such a product can stop the cascade of destructive reactions caused by overexposure to the sun.

We have gone from the air to the relatively inert surface of the skin, into the matrix gluing the living dermal cells and into the cells themselves. It has been a relatively quick and non-technical tour, showing in general terms how cosmetic ingredients can help protect the skin from chemicals in the environment and excess UV exposure. Enzymes can perform many of the tasks assigned to established ingredients such as AHA's, hopefully without some of the negative effects.

Ignored herein has been the FDA distinction between drugs and cosmetics. It is the responsibility of formulators and marketers to position innovative products in such a way to provide safe and efficacious products in a state-of-the-art form in a way that does not create legal issues. This line has been walked for many years, and it can be walked in the future with creative applications of enzymes. ■

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SMEC= Sub Micron Emulsion Concentrate