

SCIENCE & INDUSTRY

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The Gift of the Squid

“Good” melanin can be found in squid and cuttlefish.

By Steve Herman

*But it was serious business for the squid,
A sober argument of self-defense,
This clouded ink...
Farewell, fair squid:
Thus, dark to dark.*

— Ronald de Sousa, “Squid in Their Ink”¹

When thinking about the bounty of nature employed by the cosmetic industry, it is easy to overlook the squid and other members of the cephalod family. The fishermen who save the ink sacks from their catch contribute a primary source of melanin for numerous skin and hair products positioned to offer protection from free radicals and the sun. Cuttlefish and octopus join the squid in producing ink rich in melanin.



Melanin is a family of substances rather than a specific molecule. The main types are eumelanins and pheomelanins (Figures 1 and 1A). The core defining structures are linked to polymer or protein chains,

resulting in a wide range of molecular weights. The details of the attachments have not yet been precisely characterized.

Melanins are the pigments that color human skin. Eumelanin is a black-to-dark-brown insoluble material found in human black hair and in the retina of the eye. Sunglasses containing eumelanin are produced to protect eyes

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*Greek kosmEtikos, skilled in adornment or decorating.

deficient in melanin. Pheomelanin ranges in color from reddish-brown to yellow, is alkali-soluble, and is found in red hair. Redheads burn easily in the sun: Pheomelanin is not a desirable cosmetic additive. Thus, there is good melanin (eumelanin) and bad melanin (pheomelanin). Squid and cuttlefish produce good melanin.

FIGURE 1 Eumelanins

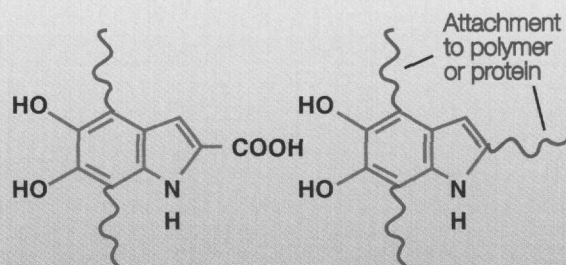
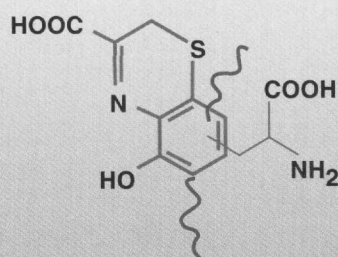


FIGURE 1A Pheomelanins



The difference between the skin color of diverse ethnic groups is related to the volume fraction (f_v) of their melanin. For light-skinned Caucasians, $f_v = 1.3\%$, for well-tanned Caucasians and Mediterraneans, $f_v = 11-16\%$, and for darkly pigmented Africans, $f_v = 18-43\%$. The concentration of melanin, which determines how dark the pigmented epidermis is, has relevance to laser removal of tattoos and hair. An in-depth discussion of the instrumental

(continued on p. 68)

kosmetikos*

(continued from p. 66)

analysis of melanin concentration, using approaches such as the absorption coefficient of melanosomes and the optical depth of the epidermis, can be found in reference 2.

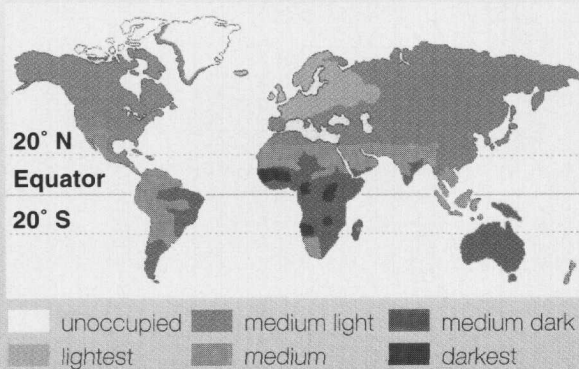
The amount of melanin in different racial groups is related to the intensity of sun exposure in their native region. Population movements have accelerated in the last few

cancer. Melanin is the skin's basic defense against UV-assault, so it is reasonable to expect to find useful applications of eumelanin in sun-protectant lines. Kollias and Baqer found the actual situation a bit more involved. It had previously been assumed that melanin in the skin was responsible for absorbing both visible light and UVB. They found significant protection from melanin in the UVA range (320-400 nm) but little protection from UVB. The results were attributed to the absorption characteristics of melanin at different wavelengths, and implies the degree of skin pigmentation does not correlate to protection against sunlight.

Melanin has been proposed as a hair colorant.⁶ Melanin is a big molecule, which cannot penetrate the hair. Precursors must thus be employed. The same basic premise is used for traditional permanent hair dyes. The materials employed by Brown et al. were Cu II as the dye initiator, and the melanin precursor 5,6-dihydroindole. The range of colors is limited, and the melanin approach cannot lighten hair. The benefit of the melanin precursor technique is improved color stability when the hair is exposed to light.

It is beyond question that melanin, as nature's skin colorant and first line of defense against radiation damage, is a valuable cosmetic ingredient. The applications for skin and hair are still in its infancy. Remember the squid and cuttlefish, and the fishermen gathering their ink sacks, when new and innovative applications for melanin appear. ■

FIGURE 2 Skin Color Distribution 1500



centuries, so current populations often have diverse skin types. Figure 2 shows the distribution of skin color in the year 1500, before significant migration occurred.³ Most dark pigmented people live within 20° of the equator; most light pigmented people live in the northern hemisphere, north of 20° latitude.

Melanins have clear applications in skin-care, sunscreens, and hair-care. Eumelanin is a "caged stable free radical": an inert precursor of an active molecule, activated by exposure to radiation. In simpler terms, the molecule is so big and intertwined that the free radical can be buried in the structure until exposed by a change of state. This allows, for example, eumelanin to protect glucose oxidase from inactivation by free radicals. Synergistic effects are possible, and a combination of 0.08% vitamin E and 0.02% eumelanin prevents the auto-oxidation of linoleic acid five times more effectively than either ingredient alone.

It is well-known that dark pigmented skin is less susceptible to solar damage than light skin, both for short-term effects, such as sunburn, to long-term damage from skin

Thanks to Dr. Miles R. Chedekel of MeL-Co for literature and valuable discussions.

Basic reading

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References

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