ZINC
BIOCHEMICAL FUNCTIONS

Melanin Granules

Zinc is the **main element found bound to melanin, (a dark brown substance) in pigmented cells and tissues of the skin, hair, parts of the eye, and certain nerve cells. Melanin is synthesized and stored inside **melanosomes** (specialized organelles also referred to as melanin granules) of melanocytes that are located in the epidermis and connective tissue of the skin (Borovansky J, 1994). **Melanocytes transport melanin granules to parts of the eye and ear, and to certain nerve cells of the brain**. They also transport melanin to **keratinocytes** (karatin producing cells of the skin) **during wound healing.** Melanocyte activity is influenced by **environmental factors (eg: sun exposure) and the pituitary hormone, alpha-MSH (alpha-melanocyte stimulating hormone)**. Sunlight darkens existing melanin granules, causing increased pigmentation (tanning), and then stimulates more melanin production (via the enzyme, tyrosinase). **This creates a greater layer of zinc-bound melanin granules within the skin to provide increased protection against oxidative damage of the underlying tissues from further exposure to solar radiation**. Dark-skinned individuals have been found to have higher alpha-MSH activity and a greater ability to accumulate melanin in melanocytes compared to fair-skinned individuals under the same conditions. **Dark pigmentation is known to be a strong defense against sun damage and the development of certain skin neoplasms such as melanomas** (Bandyopadhyay D, 2000). Zinc's antioxidant, re-epithelialization, and proliferative regulatory properties within melanin granules help explain this association (Borovansky J, 1994 & 1995). Numerous zinc-containing melanosomes are also found in the **choroid, iris, and retina of the eye, particularly in the retinal pigmented epithelium (RPE) of the retina** (Sarna T, 1992, Head KA, 1999). The delicate **rods and cones** (eye photoreceptors that detect light and color), located adjacent to the RPE, also require high amounts of zinc to provide protection against their oxidative damage and consequent apoptosis (Carmody RJ, 1999, Hirayama Y, 1990). This is true of other cells high in zinc such as those in the prostate, brain, hair, and inner ear (Karis A, 2001, McFadden SL, 1999, Shambaugh GE Jr, 1989).*

Tissue Repair

Inflammation is a necessary stage of the healing process, bringing nutrients to the injured area that stimulate reactions to induce repair (Phillips SJ, 2000). Zinc facilitates tissue repair and re-epithelialization by **stimulating keratinocyte proliferation and migration to the injured area (Tenaud I, 2000, Andrews M, 1999). During inflammation, a large amount of nitric oxide (NO) is produced by white blood cell **proinflammatory cytokines** which can cause tissue damage. Zinc effectively **quenches these NO radicals within keratinocytes** (Yamaoka J, 2000, Uchi H, 2000). It also suppresses oxidative damage and apoptosis of skin cells caused by **ultraviolet radiation** (Takahashi H, 2000). Many tissue healing and sun protection products, such as **Desitin,** contain zinc as their active ingredient. A recent study found topical zinc solutions to significantly **improve healing and outcome** of surgically removed **HPV** lesions (Scirpa P, 1999, Andrews M, 1999).*

Brain Function

Zinc is crucial for proper brain development and maintenance. **It binds to and protects the structure of transcription factor p53 so that it can cause the expression of key genes involved in the embryonic development of the **brain cortex** (Johnson S, 2001). Other zinc-dependent transcription factors activate specific genes that stimulate **nerve development, learning, and memory** (Tamura T, 1996). **Neurons** and **glial cells,** which function in **synaptic neurotransmission,** have high concentrations of zinc, as do the **synaptic vesicles, boutons, and mossy fibers** of the **hippocampus,** an area associated with **memory** (Takeda A, 2000, Frederickson CJ, 2000, Eichenbaum H, 1996). **Serotonin,** a neurohormone that mediates neurotransmission, requires zinc for its synthesis. Serotonin is necessary for the production of **melatonin,** another neurohormone that regulates **sleep, mood, puberty, and ovarian cycles** (Johnson S, 2001).*