OptMSM®

BY Bergstrom® Nutrition

Strengthen Skin Within

Clinically proven bio-available dietary source of sulfur.

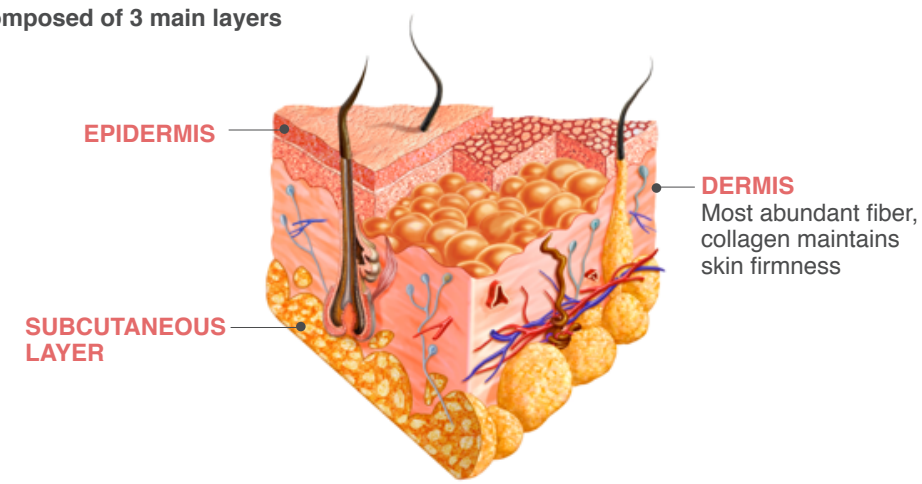
Skin Anatomy

The skin is the most extensive organ of the body, weighing about 15% of the total body weight. Although it appears smooth to the eye, the skin is composed of many grooves and layers. Within its entirety, the skin is compromised of three distinctive layers, the epidermis, the dermis and the hypodermis. Each layer is unique within its cellular makeup and physiological function.

The epidermis (outermost layer) is compromised of keratin which strengthens the skin, and melanin which gives skin its color. The epidermis provides protection against foreign environmental substances. The stratum corneum functions as the main barrier from the external environment.

The dermis is directly below the epidermis and gives skin its strength and support. Unlike the epidermis, the dermis contains nerves, blood vessels and fibroblasts that provide the sensory receptors, deliver nutrients, and maintain the structural foundation of the skin. The most abundant fiber within the dermis is collagen, a protein-based fiber with the primary function of maintaining skin firmness. Elastin fibers combine with collagen to provide the skin with elasticity. The base substance within the dermis is composed of substances such as complex sugars (glycosaminoglycans,) glycoproteins, hyaluronic acid, and chondroitin sulphate. When combined, these substances form a “cementing and gelling” base that binds to water molecules, allows nutrients and oxygen into the tissue, and protects the dermal structural layer. New cells are produced within the dermis and eventually pushed toward the outer layers (the epidermis). (Naylor, 2011; Zohra, 2010).

FIGURE 1. Skin is composed of 3 main layers



Bergstrom® Nutrition

Skin Aging

Skin aging is influenced by many factors including genetics, environmental stressors, hormonal changes, and metabolic processes. Combined, these factors lead to cumulative changes of skin structure, function, and appearance. (Naylor, 2011; Zohra, 2010; Tagami, 2008).

Skin aging is important because of its visual and social impact; it clearly represents the aging process. The skin serves as a protective barrier between the body's internal organs and the environment. Aged skin has a thinner epidermis with flattened dermal ridges, making it less resistant to shearing forces. The complex biochemistry of the dermis is altered with age; and the delicate balance between those enzymes that control renewal and repair of the dermal matrix is also disrupted, contributing to the overall loss of connective tissue (collagen, elastin) and atrophy of the skin. Coupled with a reduced ability of the skin to regenerate and a less efficient protective immune functioning, aging leaves the skin more vulnerable to complete dysfunction (Shashidhar, 2010; Raschke, 2010).

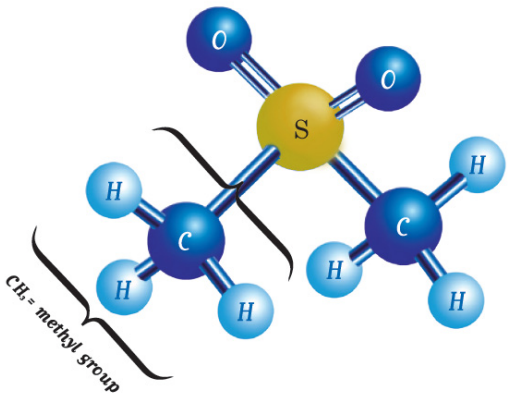
It is proposed that oxidative stress plays a central role in initiating and driving the signaling events that lead to cellular mutations that cause chronic disease (and skin aging). When there is an escalation of endogenous and exogenous oxidative stressors, the surplus of reactive oxygen species (ROS) may have a degenerative effect on the body (and skin). At the cellular level, ROS may denature proteins, alter cell cycles, and influence the release of pro-inflammatory mediators (i.e.: cytokines), which may trigger the induction of some inflammatory skin diseases (Masaki, 2010; Rexbye, 2006; Green, 2001).

OptiMSM® for Healthy Skin, Hair & Nails

Methylsulfonylmethane (MSM), also known as dimethyl sulfone (DMSO2) and methyl sulfone, is an organic sulfur-containing compound that occurs naturally in a variety of fruits, vegetables, grains, and animals including humans. However, processing, heating, storage, and preparation of foods removes essential MSM sulfur. Without sufficient MSM sulfur in the body, unnecessary illness of varying types may result. Research has shown that MSM is helpful in improving joint flexibility, reducing stiffness and swelling, improving circulation and cell vitality, and reducing pain and scar tissue (Babak Nakhostin-Rooh, 2011; Jacob, 2004, 2005; Parcel, 2002; Nat Standard, 2012).

After extensive testing on both human and animal subjects, OptiMSM has proved safe and effective for maintaining joint health, reducing inflammation associated with osteoarthritis, supporting immune and respiratory functions, minimizing post exercise recovery time, and maintaining healthy skin, hair and nails. Sulfur has been used extensively in dermatological remedies for acne, rosacea, psoriasis, dandruff, wound healing, and reducing scar tissue (Parcel, 2002).

MSM is an odorless, water-soluble, white crystalline material that supplies a bio-available form of dietary sulfur, which plays a major role in stabilizing and promoting numerous body functions.



About Bergstrom Nutrition

Bergstrom Nutrition produces the world's only GRAS- designated proprietary and patented forms of MSM (methylsulfonylmethane) in it's GMP-compliant, ISO 9001:2008 registered, FSSC22000:2010 certified production facility, exceeding industry standards for optimal purity and product consistency. The Vancouver, Washington-based company pioneered the use of MSM for human consumption in 1989.

For information on Bergstrom Nutrition call 1.888.733.5676 or visit **bergstromnutrition.com**

OptiMSM®

CLAIM ONE:
OptiMSM® Supports the Structural Integrity of Skin

Collagen is the most plentiful protein in the body; it makes up 70% of the dry weight of human skin and is a highly flexible structure. Vitamin C is essential for the formation of collagen and sulfur active bonds (disulfide bonds) which hold collagen fibers together (Pugliese, 2009; Rock, 2011).

Aging is a natural progression of deterioration and the most visible effect of skin aging occurs when there is a decline in both collagen and glycosaminoglycans, as well as from changes in their chemical structure and 3-dimentional organization (Fisher, 2010). Visibly, skin becomes thinner losing its structural strength and elasticity.

The dermis contains the structural elements of the skin, the connective tissue. Collagen is one protein that is a type of connective tissue that gives the skin its strength. Elastin fibers are another type, which lend to elasticity. Where the dermis and epidermis meet is where connective tissue delivers nutrients from blood vessels to the epidermis. The stronger the connective tissue, the more nutrients reach the skin, giving it a youthful appearance.

Structural deterioration that occurs within skin's connective tissue is due to progressive cross-linking of protein within collagen fibers. Known as the "cross linking theory" the increased cross-linking defragments its natural chemical structure and causes "stiffening" or "folding" (wrinkles) within in the tissue (Fisher, 2009).

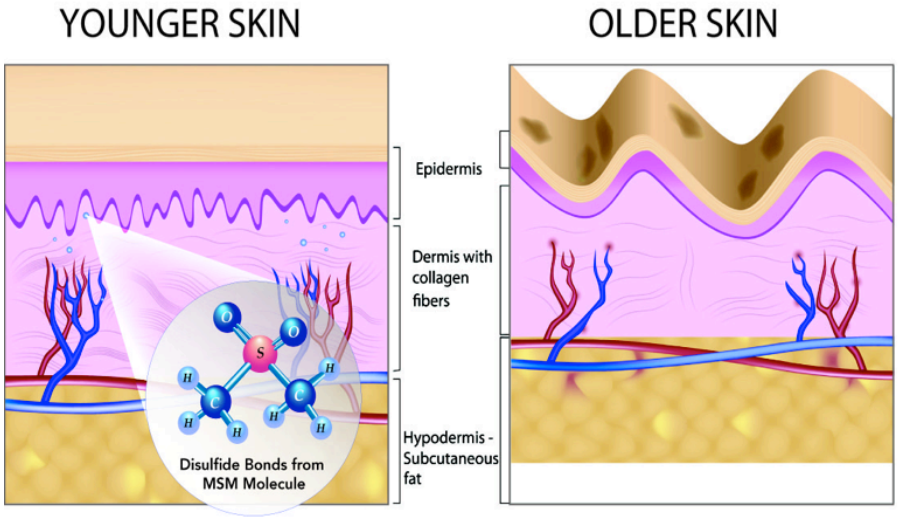


FIGURE 2. Skin wrinkles are formed when collagen stability deteriorates. Disulfide bonds help to maintain strong collagen form and protect against degenerative cross-linking.

OptiMSM® is 34% sulfur by weight and sulfur has long been a valued ingredient in dermatology. Daily oral supplementation of OptiMSM may be an effective way to boost dietary sulfur and contribute to preserving the structural integrity of the skin. As a source of bio-available sulfur (Shujiro Olsuki, et al. 2002) MSM maintains disulfide bonds that hold collagen strands in strong form and sustains the pliancy of connective tissue. Sulfur may contribute to the cross linking of the structural framework of skin tissue (proteoglycans/collagen). By maintaining healthy collagen, "hardening" of the tissue is inhibited allowing for healthy dermal functioning.

CLAIM TWO: OptiMSM® May Downregulate the Damaging Effects of UV Induced Oxidative Stress

Epidemiological and clinical studies have proposed that UVR induced oxidative stress plays a central role in initiating and driving the signaling events that lead to cellular mutations that accelerate skin aging (Taihao, 2009; Masaki, 2010; Nicols, 2010).

Oxidative stress stimulates the production of unstable molecules otherwise known as reactive oxygen species (ROS). ROS are highly reactive molecules that are created as by-products of normal metabolism (intrinsic) and environmental stressors (extrinsic) and are known to permanently damage stable molecules. When there is an escalation in ROS, they are responsible for cellular damage, particularly targeting cells that are rich in unsaturated fatty acids, sensitive to oxidation reactions, and DNA also being a target of severe attacks by ROS. These species can target lipid-rich membranes as well as cellular DNA and proteins to produce an array of toxic effects. Peroxidation of lipid-rich membranes alters their fluidity and their signaling efficiency leading to inflammatory changes and to abnormal cellular responses

UVR effects are complex and involve the interaction with a variety of molecules, including nucleic acids, membrane lipids and proteins. The type and severity of these reactions is dependent upon UV wavelength.

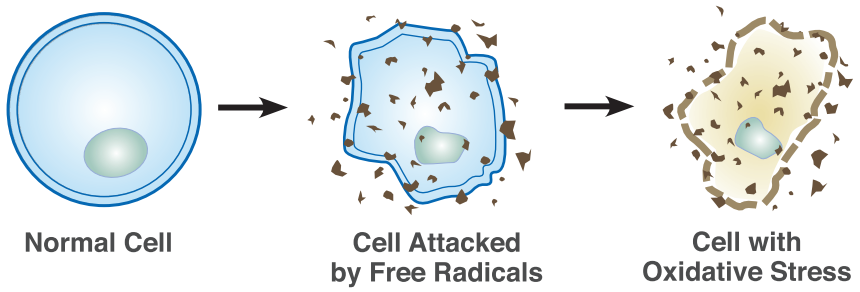
UVB radiation (mid wave) although it only compromises 5% of the total UVR, UVB radiation are absorbed mostly by the DNA and epidermal keratinocytes, as it can cross the whole epidermis layer and penetrate the dermis compartment of human skin. UVB radiation is, therefore, mainly responsible for photo carcinogenesis and can induce both direct and indirect adverse effects including the induction of oxidative stress, DNA damage, and premature aging of the skin.

UVA radiation (long wave) comprises the largest spectrum of total UVR (90–95%) and penetrates deeper into the epidermis and dermis of the skin. In contrast to UVB, UVA does not excite the DNA molecule to the same degree in the skin and it is believed that much of the mutagenic and carcinogenic action of UVA radiation is mediated through the generation of reactive oxygen species. It is the oxidative stress imposed UVA exposure that stimulates arachidonic acid metabolites and histamine which are found in increased amounts in inflammatory skin and are thought to play a key role in the induction of post inflammatory hyper-pigmentation.

Chronic UVA and UVB exposure damages and inhibits turnover of collagen fibrils within the extracellular matrix of the dermis both from releasing damaging ROS and stimulating pro-inflammatory reactions. Following exposure, pro-inflammatory cytokines, NF-kB, matrix metalloproteinases (MMPs) are activated along with the enzyme MMP-1,
an enzyme responsible for cleaving collagen type 1 (primary form of collagen within extracellular matrix of the dermis). It is proposed the elevated levels of MMP-1 (along with other metabolites) are responsible for the degradation of connective tissues (collagen, elastin, fibronectin, laminin) of the extracellular matrix. This damage of tissue leads to accelerated aging and wrinkling within the skin. (Fischer, et al 2009).

Our bodies are equipped with natural defenses against oxidative stress, this system includes endogenous antioxidant enzymes particularly superoxide dismutase, catalase, glutathione reductase, glutathione peroxidase, thioredoxin reductase and NAD(P)H: quinine reductase. Intrinsic non-enzymatic antioxidants include glutathione and Vitamin C in the aqueous phase, and tocopherols and uqbiquinol in the lipid phase. Glutathione S transferases and cytochrome P450 enzymes are also present in skin and are involved in the protection against oxidative stress. Aging impairs our natural ability to ward off damaging ROS and cellular injury may occur under conditions of high oxidative stress (Beani, 2001; Beike, 1987; Emri, 2009; Fisher, 2009; Lima, 2011; Masaki. 2010; Nicolas, 2010; Oresajo, 2010; Steenvoorden. 1997; Verschooten, 2006).

As we age, our ability to produce and effectively ward off oxidative stress may become compromised, potentially making supplementation more beneficial. Recent studies in vivo have shown that certain ingredients have been shown in vivo to stimulate the production of these primary defense antioxidants (Lima, 2011;Pillai, 2005).



- Oxidative stress stimulates a cascade of reactions that may accelerate skin aging
- Immune Dysfunction
- Chronic Inflammation
- Structural Deterioration
- Impaired cellular renewal
- Photo aging

FIGURE 3. As skin is the largest organ of the body and barrier from the environment, it is most susceptible to ROS.

OptiMSM®

OptiMSM® may protect skin from UV induced oxidative stress by:

- **As a bio-available source of sulfur, supporting the production of endogenous antioxidant enzyme Glutathione, a primary scavenger of damaging ROS created from UVR in the skin.**
- **Potentially downregulating pro-inflammatory intermediates NF-kB, cytokines, MMP's (stimulated by ROS) that degrade dermal extracellular matrix, the connective tissue that maintains skin resilience and structure.**

OptiMSM® & Photoprotection

Systemic photoprotection by oral supplementation to support endogenous antioxidant systems is becoming a growing interest in biochemistry research. Supplementation with key antioxidant enzymes, such as glutathione peroxidase, catalase, superoxide dismutase or with non-enzymatic antioxidants is proving effective in animal and human clinical studies (Steenoorden, 1997; Helmut Sies, 2004).

Glutathione is a tripeptide composed of the amino acids cystine, glycine and glutamic acid. It is the major endogenous antioxidant enzyme in the non-lipid portion of cells (most of the cytoplasm). Functions include detoxification of ROS and peroxides, regulation of cell growth and protein function. Accordingly it is one of the three antioxidant enzymes that neutralize damaging ROS generated when skin is exposed to UVR (Steenvoorden, et al., 1997, Béani, 2001, Verschooten L, 2006; Lima, 2011; Oresajo, 2010). Sulfur forms the thioester linkages of the glutathione molecule.

Glutathione is important to maintain a healthy skin defense against oxidative stress induced by UVR (Steenvoorden,1997; Béani, 2001; Verschooten L, 2006;). Similar to intense exercise that creates oxidative stress and a decrease in glutathione levels, the skin when exposed to UVR also experiences an influx of oxidative stress. Although not a direct antioxidant, MSM has been shown in humans to significantly increase plasma glutathione levels (Babak Nakhostine-Roohi, et al., 2011). Supplementation of MSM was shown to prevent GSH depletion following acute bouts of exercise (Marañón, et al., 2008, Babak Nakhostine-Roohi, et al., 2011). As a source of bio-available sulfur, MSM is a precursor in glutathione metabolism (DiSilvestro, R, et al., 2008). OptiMSM was effective in preventing glutathione depletion during activity and increasing plasma glutathione levels post exercise recovery in healthy untrained humans (Babak Nakhostine-Roohi, et al., 2011).

In another study, researchers examined OptiMSM's protective effect against skin damage induced by UVB irradiation in mice. OptiMSM was effective in alleviating post UVB inflammatory response of exposed skin (Hasegawa, et al. 2005). Researchers concluded OptiMSM protected skin from UVR damage by removing damaging ROS and suppressing skin inflammation. It is proposed that MSM's anti-inflammatory effect may be due to its ability to inhibit pro-inflammatory transcription factors NF-kB and cytokine expression that further damage skin homeostasis and accelerate deterioration (Beike, et al., 1987, Burkhard, et al., Kim et al., 2009, Takashi Hasegawa, et al., 2005).

OptiMSM® for Healthy Hair

Sulfur has long been recognized as an important nutrient for healthy hair. Radiolabeled oral dosage MSM has been shown to be incorporated into hair, skin and nails. (Otsuki, 2002). Sulfur is also a building block of keratin, the chief structural constituent of hair and nails

OptiMSM®

References

Atmaca, G. “Antioxidant Effects of Sulfur Containing Amino Acids.” Yonsei Med J (2004): 776-788.

Babak Nakhostin-Rooh., et al. “Effect of chronic supplementation with methylsulfonylmethane on oxidative stress following acute exercise in untrained healthy men.” J of Pharmacy and Pharmacology (2011): 1290–1294.

Beani, JC. Enhancement of endogenous antioxidant defenses: a promising strategy for prevention of skin cancers.” Bull Acad Natl Med. (2001);1507-25.

Beike, et al., “Effects of dimethyl sulfoxide on the oxidative function of human neutrophils.” J of Laboratory and Clinical Med. (1987): 110:91-96.

DiSilvestro, R. “Methylsulfonylmethane (MSM) Intake in Mice Produces Elevated Liver Glutathione and Partially Protects Against Carbon Tetrachloride- Induced Liver Injury.” FASEB Journal (2008): 22:445.8.

Emri, G., et al., “Let the sun shine in: mechanisms and potential for therapeutics in skin photodamage.” Curr Opin Investig Drugs (2007): 390-400.

Fisher, et al. “Collagen fragmentation promotes oxidative stress and elevates matrix metalloproteinase-1 in fibroblasts in aged human skin.” Amer J Pathol (2009) 101-114.

Green, et al. “Factors associated with premature aging (photoaging) before the age of 55: a population based study.” Dermatol (2011): 74-80.

Greul, AK., et al., “Nutritional Protection against skin damage from sunlight.” Ann Rev Nutr (2004): 173-200.

Jacob, et al. “The Safety of OptiMSM: A Clinical Review.” Cardinal Nutrition. (2005): 1-6.

Jacob, S., Appleton, J., “MSM: The Definitive Guide.” Freedom Press. (2004).

Kim, et al., “The Anti-inflammatory Effects of Methylsufonylmethane on Lipopolysaccharide-Induced Inflammatory Responses in Murine Macrophages.” Biol. Pharm. Bull. (2009): 651-656.

Lima, CF., et al. “Curcumin induces heme oxygenase-1 in normal human skin fibroblasts through redox signaling: relevance for anti-aging intervention.” Mol Nutr Food Res (2011): 430-42.

Manley, et al., “The effect of methyl sulphonyl methane supplementation on biomarkers of oxidative stress in sport horses following jumping exercise.” Acta Veterinaria Scandinavica (2008): SO-45.

Masaki, H., et al. “Role of antioxidants in the skin: anti-aging effects.” J Dermatol Sci (2010): 85-90.

Naylor, EC. et al. “Molecular aspects in skin ageing.” Maturitas (2011): Jul; 69(3):249-56.

Natural Standard Comprehensive Database. MSM Monograph. Accessed Mar 2012
http://www.naturalstandard.com/

Nicolas, JA., et al. “Skin photoprotection by natural polyphenols: anti-inflammatory, antioxidant and DNA repair mechanisms.” Arch Dermatol Res (2010): 71-83.

Oresajo, C., et al. “Complementary effects of antioxidants and sunscreens in reducing UV-induced skin damage as demonstrated by skin biomarker expression.” J Cosmet Laser Ther (2010): 157-62.

Otsuki, S., et al. “Elucidation of dimethylsulfone metabolism in rat using a 35S radioisotope tracer method.” Nutr Res (2002): 313-322.

Parcel, S. “Sulfur in Human Nutrition and Applications in Medicine.” Alt Med Rev (2002).

Pulgliese, P. “Vitamin C in Skin Care.” Skin Inc. 2009. http://www.skininc.com/skinscience/physiology/46738787.html accessed March 25th 2012

Raschke, C. et al. “Skin Aging: A Brief Summary of Characteristic Changes.” Textbook of Aging Skiin (2010): 37-43.

Rexbye, et al. “Influence of environmental factors on facial ageing.” Age Ageing (2006): 110-5.

Rock, et al. “Collagen fragments inhibit hyaluron synthesis in skin to ultraviolet B (UVB): new insights into mechanisms of matrix modeling.” J Biol Chem (2011): 18268-76.

Shashidhar, K et. al. “Skin Anatomy and Physiology.” Plastic and Reconstructive Surgery (2010): 161-171.

Steenvoorden DP., et al., “The use of endogenous antioxidants to improve photoprotection.” J Photochem Photobiol B. (1997): 1-10.

Tagami, H.,”Location-related differences in structure and function of the stratum corneum with special emphasis on the facial skin.” Int J Cosmet Sci (2008): 413-34.

Taihao, Quan, et al. “Matrix-Degrading Metalloproteinases in Photoaging.” Journal of Investigative Dermatology Symposium Proceedings (2009) 14, 20–24

Takashi, H,. et al. “Anti-inflammatory Effect of Methysulfonylmethane (MSM) in Mice.” Jpn Pharmacol Ther. (2005): 1314 1290..12

Verschooten L., et al., ‘New strategies of photoprotection.” Photochem Photobiol. (2006): Jul-Aug;82(4):1016-23.

Zohra, Z., et al. “Skin: Structure and Function.” Dermatology in Clinical Practice. (2010): 1-15.