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## FREQUENTLY ASKED QUESTIONS

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**Q:** **What is DMSO?** **A:** Dimethyl sulfoxide (DMSO) was first synthesized in 1866, has been available as a by-product of the paper pulp industry for many years, and is now used chiefly as an industrial solvent. In 1964 Dr. Stanley W. Jacob, et al. first described the remarkable medicinal properties of DMSO. When applied to intact human skin, the compound penetrates rapidly and produces a wide range of pharmacologic actions, including antiinflammation, local analgesia, bacteriostasis, diuresis, cholinesterase inhibition, enhancement of the action of concomitantly administered drugs, influence on collagen, nonspecific enhancement of immunity, vasodilation, and lessening of adhesiveness of blood platelets. As a result the compound has been used widely as a treatment for various conditions, including arthritis, bursitis, acute musculoskeletal trauma, scleroderma, troublesome urogenital disorders, and various postoperative pain syndromes. To date little, if any, local or systemic toxicity has been noted in humans after the administration of DMSO.

**Q:** **How does DMSO work?** **A:** Research suggests the eight primary pharmacologic actions of dimethyl sulfoxide are;

- 1 •Penetrant-carrier. Experiments utilizing the intact urinary bladder of the dog have demonstrated that DMSO enhances the absorption of heparin, insulin, sodium salicylate, Evan's blue dye, sulfadiazine, aminophylline, and ThioTEPA.
- 2 •Local analgesic agent. Dimethylsulfoxide has been shown to penetrate human skin, relieving pain in a variety of conditions. In the laboratory, it blocks conduction in isolated nerves. Conduction returns when the isolated nerve is washed free of dimethyl sulfoxide.
- 3 •Anti-inflammatory adjunct. DMSO has anti-inflammatory activity against the bakers yeast granuloma in guinea pigs.
- 4 •Bacteriostatic agent. DMSO is bacteriostatic in 20 percent concentration against E. coli, Staphylococcus aureus, and Pseudomonas.
- 5 •Diuretic. The intravenous administration of DMSO to dogs produces a transient doubling of urine volume.
- 6 •Tranquilizer. The material has been shown clinically to exert a tranquilizing effect when applied topically.
- 7 •Potentiator of other compounds. Experimental work in the laboratory has shown that DMSO-insulin combinations administered intravenously to dogs give a blood sugar drop that is more profound and of longer duration than when insulin alone is administered.
- 8 •Hydroxyl radical scavenger. DMSO is the most powerful OH free radical scavenger in biology.

**Q:** **Does MSM have the same biological effects as DMSO?** **A:** Research suggests MSM produces many-but not all-of the DMSO effects. The following are considered MSM's most significant actions:

- 1 •It is an analgesic. It relieves pain.
- 2 •It reduces inflammation.
- 3 •It passes through cellular membranes of the body, including the skin.
- 4 •It dilates blood vessels (vasodilation) and increases blood flow.
- 5 •It is a cholinesterase inhibitor. Cholinesterase is an enzyme that stops excessive passage of nerve impulses from one nerve cell to another. Dr Jacob has seen MSM provide swift relief of constipation. By blocking the action of cholinesterase, MSM helps restore normal bowel activity (peristalsis).
- 6 •It reduces muscle spasm. Injury or inflammation commonly cause spasm in a muscle or group of muscles. Spasm involves a sudden contraction, which is followed by pain and interference with function. Spasm can be felt by a physician's touch or measured with electromyography. If you apply MSM gel or cream to an affected area and then feel the muscle again later, or measure it electrically, the muscle is looser, the area less tender. MSM taken orally produces a muscle-relaxing effect.
- 7 •It alters the crosslinking process in collagen, thus reducing scar tissue. Crosslinking is the process in which new structural proteins are knitted to existing healthy tissue at the sites of surgical incisions or traumatic damage in the body.
- 8 •It has antiparasitic properties, particularly for giardia and trichomonas, protozoan parasites that causes diarrhea.
- 9 •It has an immune normalizing effect, as observed in some autoimmune diseases such as rheumatoid arthritis, lupus, and

**Q:** How else does MSM differ from DMSO? **A:** One of the factors that set both DMSO and MSM apart is that they are small molecules. DMSO tips the scales at a molecular weight of 78; MSM, 94. By chemistry standards, they are featherweight molecules. They mimic water in this respect. Water has a very low molecular weight and passes through tissue. DMSO and MSM pass through the skin and into the tissue below. Just like DMSO, MSM is very useful when employed as a topical gel, cream, or lotion to help in the relief of local pain and inflammation. Unlike DMSO, however, MSM cannot transport medication with it.

Another difference between the two compounds is that DMSO is a proven and powerful free-radical scavenger, that is, an antioxidant, whereas MSM's is not a free radical scavenger. Free radicals are unstable molecular fragments that launch an oxidative attack on DNA, cell membranes, enzymes, and proteins, disrupting normal cellular activities and triggering the inflammatory process. Such cumulative oxidative damage is similar to the rusting of metal and contributes to premature aging and the development of serious disease. Every disease known to medical science is associated with an increased activity of free radicals.

**Q:** Is MSM a safe compound? **A:** One of the first things we set out to learn about MSM was its safety. In long-term toxicity trials with laboratory animals we found no toxic effects with oral doses of 8 grams per kilogram (2.2 pounds) of body weight. Most people take from 2 to 8 grams total as a daily supplement. To determine the lethal dose of MSM, or of any substance, we used a standard test known as LD-50. LD stands for lethal dose. The number 50 refers to the amount of the substance required that would result in the death of half the number of laboratory animals used in the test. For MSM, the findings determined that the LD-50 was more than 20 grams for each kilogram of body weight. To put that into perspective, the LD-50 of common table salt you use for cooking is 2.5 to 3 grams per kilogram of weight. MSM thus rates as one of the least toxic substances in biology and medicine. It compares to water, which has an LD-50 rating also greater than 20 grams per kilogram of weight. In follow-up experiments with human volunteers, we found no toxic effects at intake levels of up to 1 gram per kilogram of body weight per day for 30 days. That means about 68 grams for an average 150-pound person. A few patients have taken more than 100 grams orally of MSM daily without any side effects. But these were extremely unusual cases involving very sick patients under Dr. Jacob's personal care. Do not take that much on your own. Please consult your health care professional for details on how much MSM to take.

**Q:** Is MSM a natural compound? **A:** In its natural state MSM is an inconspicuous sulfur molecule found in the atmosphere, in plants, animals, and the human body. Chemically, it consists of two hydrocarbon units (groups of hydrogen and carbon atoms) attached to a unit with one sulfur and two oxygen atoms. The molecule is one-third sulfur by weight. Atmospheric chemists describe the molecule as a minor oxidation product in an oceanic sulfur cycle that begins with marine algae. These ocean organisms, called phytoplankton, release sulfur compounds known as dimethylsulfonium salts. The salts, in turn, are transformed in the ocean water into a volatile compound- dimethylsulfide (DMS)-which escapes as a gas from watery depths and rises into the atmosphere. There, the DMS undergoes photochemical oxidation and is converted to sulfur compounds, mostly sulfates, and, in part, to DMSO<sub>2</sub> (MSM) as well as dimethyl sulfoxide (DMSO), the closest relative of MSM. These compounds are absorbed in tiny droplets called aerosols that float around the atmosphere and are returned to the surface of the ocean with rainwater.

On land, a number of scientific analyses over the years have found MSM present naturally in animal tissue, food, and in the human body. Researchers first discovered the molecule more than fifty years ago in the blood, adrenal glands, and milk of cows. It was also found to be present in horses and rabbits and assumably is there in other species. Later, in a 1982 analysis by the Crown-Zellerbach Company, milk was found to contain between 2 and 6 parts per million of MSM. That may not seem like much but the quantity is higher than the level of some other better-known minerals, such as manganese and selenium. Zinc, by comparison, weighs in at 8.6 parts per million in milk. Coffee contains about 1.5 parts of MSM per million, and tea somewhat less. Green vegetables and other foods have small traces of MSM. MSM's presence in the human body was first reported during the 1960s, when a laboratory analysis of the urine of men, women, and children found that 4 to 11 milligrams of MSM was excreted over a twenty-four-hour period. Then in the late 1980s, a researcher at a major German pharmaceutical company found that MSM is present in human plasma. Plasma is the liquid part of blood. Through a gas chromatography technique, W. Martin of Pharmakin GmbH of Ulm detected a "significant concentration" of MSM among the one hundred samples of plasma he examined. He found the equivalent of about 4 milligrams of MSM in the plasma of an average-size adult. So far, researchers have not adequately been able to explain the presence of MSM other than that it comes from food sources and/or is the result of a natural chain of biochemical reactions. Its precise role is not known.

The studies to date are tantalizing but preliminary. More are needed. Hopefully, this information will promote further research necessary to understand better this unique and natural substance that perpetuates a long sulfur healing tradition.

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