



# Sulfur in human nutrition and applications in medicine.

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## Abstract

Because the role of elemental sulfur in human nutrition has not been studied extensively, it is the purpose of this article to emphasize the importance of this element in humans and discuss the therapeutic applications of sulfur compounds in medicine. Sulfur is the sixth most abundant macromineral in breast milk and the third most abundant mineral based on percentage of total body weight. The sulfur-containing amino acids (SAAs) are methionine, cysteine, cystine, homocysteine, homocystine, and taurine. Dietary SAA analysis and protein supplementation may be indicated for vegan athletes, children, or patients with HIV, because of an increased risk for SAA deficiency in these groups. Methylsulfonylmethane (MSM), a volatile component in the sulfur cycle, is another source of sulfur found in the human diet. Increases in serum sulfate may explain some of the therapeutic effects of MSM, DMSO, and glucosamine sulfate. Organic sulfur, as SAAs, can be used to increase synthesis of S-adenosylmethionine (SAME), glutathione (GSH), taurine, and N-acetylcysteine (NAC). MSM may be effective for the treatment of allergy, pain syndromes, athletic injuries, and bladder disorders. Other sulfur compounds such as SAME, dimethylsulfoxide (DMSO), taurine, glucosamine or chondroitin sulfate, and reduced glutathione may also have clinical applications in the treatment of a number of conditions such as depression, fibromyalgia, arthritis, interstitial cystitis, athletic injuries, congestive heart failure, diabetes, cancer, and AIDS. Dosages, mechanisms of action, and rationales for use are discussed. The low toxicological profiles of these sulfur compounds, combined with promising therapeutic effects, warrant continued human clinical trials.

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## **A multicentered, open-label trial on the safety and efficacy of methylsulfonylmethane in the treatment of seasonal allergic rhinitis.**

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### **Abstract**

**BACKGROUND:** Seasonal allergic rhinitis (SAR) affects more than 23 million Americans annually, and current epidemiologic studies indicate that its prevalence within the United States is increasing. Numerous clinical observations and case studies have led researchers to hypothesize that methylsulfonylmethane (MSM) may help ameliorate the symptoms associated with SAR.

**OBJECTIVE:** The primary goal of this study was to evaluate the efficacy of MSM in the reduction of SAR-associated symptoms. This study also examined possible adverse reactions associated with methylsulfonylmethane supplementation. Finally, this study attempted to elucidate the method of action by which MSM elicits its effect on allergy symptoms.

**DESIGN:** Fifty-five (55) subjects were recruited for the study. All met the criteria for participation in the study. 50 subjects completed the study. Those subjects completing the study consumed 2,600 mg of MSM orally per day for 30 days. Clinical respiratory symptoms and energy levels were evaluated by a Seasonal Allergy Symptom Questionnaire (SASQ) at baseline and on days 7, 14, 21, and 30. Immune and inflammatory reactions were measured by plasma immunoglobulin E (IgE) and C-reactive protein at baseline and on day 30. An additional inflammatory biomarker, plasma histamine, was measured in a subset of subjects (n = 5).

**RESULTS:** Day 7 upper and total respiratory symptoms were reduced significantly from baseline ( $p < 0.01$  and  $p < 0.005$ , respectively). Lower respiratory symptoms were significantly improved from baseline by week 3 ( $p < 0.001$ ). All respiratory improvements were maintained through the 30-day visit. Energy levels increased significantly by day 14 ( $p < 0.0001$ ); this increase continued through day 30. No significant changes were observed in plasma IgE or histamine levels. The results of this study are promising. It would be worthwhile to conduct a larger, randomized, double-blind, placebo-controlled study to establish further if MSM would be a useful agent in the treatment of symptoms associated with SAR.

**CONCLUSION:** The results of this study suggest that MSM supplementation of 2,600 mg/day for 30 days may be efficacious in the reduction of symptoms associated with SAR. Furthermore, few side effects are associated with the use of this compound. Recent acute and subacute chronic toxicologic data on the same source of MSM as used in this study, further validate the safety of this product.

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## **Efficacy of methylsulfonylmethane (MSM) in osteoarthritis pain of the knee: a pilot clinical trial.**

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### **Abstract**

**OBJECTIVE:** Osteoarthritis (OA) is the most common form of arthritis and the second most common cause of long-term disability among middle-aged and older adults in the United States. Methylsulfonylmethane (MSM) is a popular dietary supplement used as a single agent and in combination with other nutrients, and purported to be beneficial for arthritis. However, there is paucity of evidence to support the use of MSM.

**METHODS:** A randomized, double-blind, placebo-controlled trial was conducted. Fifty men and women, 40-76 years of age with knee OA pain were enrolled in an outpatient medical center. Intervention was MSM 3g or placebo twice a day for 12 weeks (6g/day total). Outcomes included the Western Ontario and McMaster University Osteoarthritis Index visual analogue scale (WOMAC), patient and physician global assessments (disease status, response to therapy), and SF-36 (overall health-related quality of life).

**RESULTS:** Compared to placebo, MSM produced significant decreases in WOMAC pain and physical function impairment ( $P<0.05$ ). No notable changes were found in WOMAC stiffness and aggregated total symptoms scores. MSM also produced improvement in performing activities of daily living when compared to placebo on the SF-36 evaluation ( $P<0.05$ ).

**CONCLUSION:** MSM (3g twice a day) improved symptoms of pain and physical function during the short intervention without major adverse events. The benefits and safety of MSM in managing OA and long-term use cannot be confirmed from this pilot trial, but its potential clinical application is examined. Underlying mechanisms of action and need for further investigation of MSM are discussed.

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# The effect of methyl sulphonyl methane supplementation on biomarkers of oxidative stress in sport horses following jumping exercise.

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## Abstract

**BACKGROUND:** Exercise induces changes in several organs and tissues, and this process might be due to oxidative damage caused by free radicals and inflammatory mediators. Methyl Sulphonyl Methane, better known as MSM, is a naturally occurring sulphur compound with well-known antioxidant properties. On the other hand, Vitamin C is important in limiting free radical damage in the aqueous phase of the cell, and cellular vitamin C status may be linked to the mechanisms involved in quenching cellular reactive oxygen species. The aim of this study was to determine if supplementation with MSM and vitamin C could alleviate exercise-induced oxidative stress in horses undergoing jumping competition.

**METHODS:** Twenty four jumping horses involved in competition were used. Horses were given the following three treatment diets: control (without supplementation), MSM 8 mg/kg, and combined supplements (MSM 8 mg/kg + Vit-C 5 mg/kg). EDTA blood samples were collected before exercise, upon arrived to the schooling area (control), and each week after last show. Nitric oxide, carbon monoxide, lipid hydroperoxides and the antioxidant enzymes, glutathione peroxidase, glutathione transferase and glutathione reductase, plasma levels were determined.

**RESULTS:** Competition induced a significant increase in lipid peroxidation, nitric oxide and carbon monoxide. By contrary, reduced glutathione as well as antioxidant enzyme activities, were decreased. MSM administration significantly ameliorated all these exercise-related changes, and this effect was potentiated by Vit C reaching values in some of the parameters similar to those found before competition.

**CONCLUSION:** These results suggest that jumping exercise could induce harmful effects on horses, probably due to an increase in oxidative damage and proinflammatory molecules. In addition, we have demonstrated that MSM could exert some protective effect on oxidative and inflammatory exercise-induced injury.

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