






Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Skin Studies

Skin Studies-Human	Study Title	Study Summary
<p>Schwartz, S et al. (2018)</p> <p>Presented at Integrative Dermatology Symposium October 28th, 2018 at Sacramento, CA.</p> <p>Published abstract and poster presentation</p> <p> Study using</p>	<p>Oral Supplementation of Methylsulfonylmethane (MSM) Improves the Appearance of Skin, Hair, and Nails at Dosages as Low as 1 gram/day</p>	<p>Oral supplementation of OptiMSM at both 1g/day and 3g/day improved multiple outcomes of skin appearance and health, as well as hair and nail growth and health.</p>
<p>Natural Medicine Journal</p> <p>Anthonavage, M. et al. 2015</p> <p> Study using</p>	<p>Effects of Oral Supplementation With Methylsulfonylmethane on Skin Health and Wrinkle Reduction</p>	<p>Two-part study. Part one was a pre-clinical evaluation of gene expression in a 3D skin model. Results supported the design of clinical portion. Part two was a double-blind placebo controlled design. 20 healthy females randomized to take 3g MSM per day or placebo for 16 weeks. Significant improvements in skin appearance and condition were found in the treatment group when evaluated by expert grading, instrumental analysis, and participant self-assessment.</p>

Exercise Recovery Studies

Exercise Recovery Studies-Human	Study Title	Study Summary
<p>Melcher et al. 2017</p> <p>Gazzetta Medica Italiana - Arch per le Sci Mediche 2017, May; 176(5): 271-283</p> <p> Study using</p>	<p>Effects of Methylsulfonylmethane supplementation on oxidative stress, muscle soreness, and performance variables following eccentric exercise</p>	<p>A double-blind placebo controlled study evaluating 3g of MSM/day for 28 days in healthy exercise-trained males. MSM supplementation provides some degree of muscle protection following exercise by reducing muscle soreness by approx 15-20% over placebo and providing faster recovery of isometric quadriceps force. Oxidative stress did not increase following exercise in this model.</p>
<p>Withee E et al. 2017</p> <p>Journal of International Society of Sports Nutrition (2017) 14:24 doi 10.1186/s12970-017-0181-z</p> <p> Study using</p>	<p>Effects of MSM on exercise induced oxidative stress, muscle damage, and pain following a half-marathon: a double blind, randomized, placebo controlled trial</p>	<p>Double blind, placebo controlled study design. 22 healthy adults randomly assigned to take either 3g of MSM per day or placebo for 21 days before running a half marathon. MSM group saw clinically significant reductions in both muscle and joint pain.</p>
<p>van der Merwe, M. et al. 2016</p> <p>Journal of Sports Medicine, vol 2016, Article ID 7498359</p> <p> Study using</p>	<p>The Influence of Methylsulfonylmethane on Inflammation-Associated Cytokine Release before and following Strenuous Exercise."</p>	<p>Double-blind, placebo controlled study. 40 healthy, resistance trained males received 3g MSM or placebo for 28 days before eccentric knee exercise. In-vivo cytokine analysis was performed before and through 72 hours post-exercise. Additional cytokine analysis was performed in-vitro and ex-vivo on whole blood and isolated single blood cells from a subset of subjects, with and without LPS stimulation. Results indicate MSM dampens inflammatory expression following exercise and reduces post-exercise immunosuppression.</p>

This paper is intended to provide scientific and educational information only. It is not intended for use to promote or sell any product. These statements have not been evaluated by the Food and Drug Administration. Consumption of OptiMSM® is not intended for use to diagnose, treat, cure or prevent any disease. OptiMSM® is manufactured by Bergstrom Nutrition.

©2018 Bergstrom Nutrition. All rights reserved. Ver 2.0



Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Peel S. et al. 2015

Presented at American Society for Biomechanics Conference Aug, 2015 At Columbus, OH

Published abstract and poster presentation



The Effects of MSM Supplementation on Knee Kinetics during Running, Muscle Strength, and Muscle Soreness following Eccentric Exercise-Induced Quadriceps Damage

Double-blind, placebo controlled study. 40 healthy resistance-trained men; 3 g/day for 28 days before eccentric knee exercise. Testing occurred before exercise (Baseline) then at 0hr, 24hrs, 48hrs and 72 hrs post exercise. @ 72 hrs Maximum Isometric Force (MIF) normal in MSM group but still 8% below BL for Placebo. Absolute change in muscle soreness during passive knee flexion was smaller in MSM group. Some findings of this study suggest individuals may be able to return to regular training more quickly following knee extensor damage with MSM supplementation.

Kalman D. et al. 2013

FASEB J, 2013, 27:1076.7

Published abstract and poster presentation



A Randomized Double Blind Placebo Controlled Evaluation of MSM for Exercise Induced Discomfort/Pain

Double-blind, placebo controlled study. 24 healthy adult males randomly assigned to receive either treatment or placebo for 14 days. Intervention of 3 grams of MSM per day for the 14 day period resulted in significantly lower (1.55 + 0.82 vs. 3.75 + 2.58 p=0.012) pain/discomfort 2 hours following a leg extension exercise to muscle failure when compared to the placebo group.

Nakhostin-Roohi B. 2013

Iranian J of Pharma Research 2013, 12(4): 845-853

Effect of Single Dose Administration of Methylsulfonylmethane on Oxidative Stress Following Acute Exhaustive Exercise

16 subjects randomly assigned to receive either 100mg/kg BW (6g for a 60kg person) MSM in water or placebo (just water) were subjected to treadmill running until exhaustion. Protein Carbons were lower at 2, and 24 hrs post exercise. Plasma TAC was higher at 24 hrs after exercise. Serum levels of bilirubin and uric acid were significantly lower immediately after exercise in the MSM group. Results suggest a single oral dose of MSM lowers exercise induced oxidative stress in healthy untrained men, but is not adequate to significantly affect reduced glutathione levels.

Barmaki, S. et al. 2012

J. Sports Med Phys Fitness 2012;52:170-4

Effect of MSM Supplementation on Exercise-induced Muscle Damage and Total Antioxidant Capacity

Double-blind, placebo controlled study. 18 subjects; treatment = 50mg/kg BW/day MSM for 10 days before a 14 km run. CK and Bilirubin was significantly reduced in MSM group vs. placebo. TAC significantly increased. MSM decreased muscle damage via antioxidant capacity.

Kalman D. et al. 2012

J. of Int. Society of Sports Nut. 2012, 9:46



Influence of MSM on Markers of Exercise Recovery and Performance and Total Antioxidant Capacity

8 subjects were randomly assigned either 1.5 or 3.0g of MSM per day for 30 days. Leg extension exercise to exhaustion. TEAC increased in a dose-dependant manner. Fatigue and homocysteine decreased in dose dependant manner. MSM may favorably influence selected markers of exercise recovery, especially at 3g/day.


Nakhostin-Roohi et al.2011

Journal of Pharmacy and Pharmacology 2011, 63:1290-1294

Effect of Chronic Supplementation with MSM on Oxidative Stress Following Acute Exercise in Untrained Healthy Men

Double-blind, placebo controlled study. 18 subjects; treatment = 50mg/kg BW/day MSM for 10 days before a 14 km run. Serum MDA, PC, GSSG, GSH, and GSH/GSSG ratio were evaluated. MDA, PC, GSSG were significantly reduced in treatment group vs. placebo and GSH and ratio were increased. MSM decreased oxidative stress following acute exercise.

Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Exercise Studies-Animal	Study Title	Study Summary
<p>Marañón et al. 2006</p> <p>Acta Veterinaria Scandinavica 2008; 50:45 doi:10.1186/1751-0147-50-45</p> <p> Study using</p>	<p>The Effect of MSM Supplementation on Biomarkers of Oxidative Stress in Sport Horses Following Jumping Exercise</p>	<p>24 jumping horses divided into 3 groups; control, MSM@ 8mg/kg BW and combo of 8mg/kg MSM and Vit C 5mg/kg. Blood samples collected before and after exercise. NO, CO, Lipid Hydroperoxides, and Antioxidant enzymes, glutathione peroxidase, glutathione transferase and glutathione reductase measured. Exercise induced significant increase in lipid peroxidation, NO, and CO. Reduced glutathione, and antioxidant enzyme activity was decreased. MSM significantly ameliorated all of these exercise-related changes and the combo of MSM/Vit C potentiated this effect with some of the parameters close to pre-exercise levels.</p>
Joint Support Studies-Human	Study Title	Study Summary
<p>Lubis AMT et al. 2017</p> <p>Acta Med Indones – Indones J Intern Med. Vol 49 Number 2 April 2017</p>	<p>Comparison of Glucosamine-Chondroitin Sulfate with and without MSM in Grade I-II knee osteoarthritis: A double blind randomized controlled trial</p>	<p>Double blind, placebo controlled study evaluated 147 patients with grade I-II knee OA. treated with either 1500mg Gluc 1200mg Chond (n=49), or 1500mg Gluc, 1200mg Chon, 500mg MSM (n=50), or placebo (n=48). GCM showed significant clinical improvement compared with GC and placebo, especially in pain.</p>
<p>Pagonis et al. 2014</p> <p>Int Journal of Orthopaedics 2014 June 23 1(1): 19-24 ISSN2311-5106</p>	<p>The Effect of Methylsulfonylmethane on Osteoarthritic Large Joints and Mobility</p>	<p>Double-blind, placebo controlled study. 100 subjects took MSM 3g twice daily for 26 wks. Statistically significant improvement for MSM group in all WOMAC and SF-36 quality of life scores. No adverse effects reported.</p>
<p>Debbi et al. 2011</p> <p>BMC Comp and Alt Med 2011, 11:50</p>	<p>Efficacy of Methylsulfonylmethane Supplementation on Osteoarthritis of the Knee: A Randomized Controlled Study</p>	<p>Double-blind, 49 subjects, 12 week treatment with 1.125 g of MSM 3X daily. Significant improvement seen in pain and physical function. WOMAC, VAS, KSKS, ALF scales utilized.</p>
<p>Kim et al. 2006</p> <p>OsteoArthritis and Cartilage 2006, 14:286-294</p>	<p>Efficacy of MSM in Osteoarthritis Pain of the Knee: A Pilot Clinical Trial</p>	<p>Double-blind, placebo controlled study. 50 subjects MSM 3g twice daily for 12 wks. Significant reduction for MSM group in WOMAC pain, Urine MDA and Plasma Homocysteine. SF-36 scores indicated improvement in basic performing activities in the treatment group.</p>
<p>Usha and Naidu. 2004</p> <p>Clin Drug Invest 2004, 24:6 353-363</p>	<p>Randomized, Double-Blind, Parallel, Placebo-Controlled Study of Oral Glucosamine, Methylsulfonylmethane and their Combination in Osteoarthritis</p>	<p>118 patients randomized to receive placebo, 500mg Glu, 500mg MSM, or combo of 500mg Glu + 500mg MSM for 12 wks. Glu, MSM and their combination produced analgesic and anti-inflammatory effect. VAS, Lesquene index and consumption of rescue meds measured.</p>

This paper is intended to provide scientific and educational information only. It is not intended for use to promote or sell any product. These statements have not been evaluated by the Food and Drug Administration. Consumption of OptiMSM® is not intended for use to diagnose, treat, cure or prevent any disease. OptiMSM® is manufactured by Bergstrom Nutrition.

©2018 Bergstrom Nutrition. All rights reserved. Ver 2.0



Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Joint Support Studies

Joint Support Studies-Animal	Study Title	Study Summary
Akramas et al. 2019 J Hellenic Vet Med Soc 2019, 70(2), 1561-1572	Methylsulfonylmethane alone or in combination with thiocolchicoside modulate autoimmune disease in rats with adjuvant arthritis	This study evaluated the effects of MSM alone or in combination with thiocolchicoside on AA in the rat. Results show both treatments provided benefits (reduced swelling, reduced IL-17, and histological changes) similar to the drug diclofenac.
Akramas et al. 2017 Turkish J Vet Anim Sci, 2017, 41:748-756	Anti-inflammatory and anti-oxidative effects of herbal preparation EM 1201 in adjuvant arthritic rats	This study investigated effects of 2 herbal formulas in rats with adjuvant arthritis (an RA model) Turmeric, Devils Claw, Milk Thistle with and without MSM were compared with the NSAID Diclofenac. Results show these formulations are promising agents comparable to DF and may provide a safer alternative for the treatment and prevention of arthritis.
Ezaki et al. 2012 J Bone Miner Metab. 2013 Jan;31(1):16-25. doi: 10.1007/s00774-012-0378-9. Epub 2012 Aug 10.	Assessment of Safety and Efficacy of MSM on Bone and Knee Joints in OA Animal Model	This study evaluated cartilage formation in growing rats and cartilage degradation in mice, both are acceptable Human OA models at recommended human dosage of 0.6g/kg BW/day and at 10x & 100X. Intake of MSM for 4 wks did not affect cartilage formation in rat's knee joints. MSM Intake for 13 weeks decreased degeneration of the cartilage on knee joint surface of the mice. 100X dosage significantly decreased organ wt. compared to control.
Hasegawa T, Ueno S, Kumamoto S, Yoshikai Y 2004 Jpn Pharmacol Ther 2004;32(7):421-7.	Suppressive effect of methylsulfonylmethane (MSM) on type II collagen-induced arthritis in DBA/1J mice	Oral administration of OptiMSM® modified immune responses in DBA/1J mice. Arthritic deformation and swelling induced by type II collagen injections (an animal model of rheumatoid arthritis) were significantly diminished in mice drinking MSM compared to controls. Abnormal white blood cell proliferation in lymph nodes was also reduced in mice drinking MSM.
Murav'ev et al. 1991 Patol Fiziol Eksp Ter 1991, 2:37-39	Effect of DMSO and MSM on a Destructive Process in the Joints of Mice with Spontaneous Arthritis	Oral administration of DMSO or its main metabolite MSM lessened the destructive changes in joints of 36 Mrl/Mn/Inr female mice.
Moore et al. 1985 Proceedings of Fed of American Soc. Of Exp Bio 1985, 530: Abstract 692	Diminished Inflammatory Joint Disease in MRL/lpr Mice Ingesting DMSO or MSM	A 3% solution of either DMSO or MSM was administered in drinking water, ad libitum for 3 months. Inflammatory reaction of synovial tissue was found in 95% of control, 82% of DMSO and 71% of MSM. Pannus formation was significantly reduced in MSM vs. placebo.

This paper is intended to provide scientific and educational information only. It is not intended for use to promote or sell any product. These statements have not been evaluated by the Food and Drug Administration. Consumption of OptiMSM® is not intended for use to diagnose, treat, cure or prevent any disease. OptiMSM® is manufactured by Bergstrom Nutrition.

©2018 Bergstrom Nutrition. All rights reserved. Ver 2.0



Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Oxidative Damage Protection Studies

Additional Oxidative Damage Protection Studies-Animal	Study Title	Study Summary
<p>Mdawar et al. 2019 Elixir Pharmacy 128 (2019) 52786-52790</p>	<p>The Protective Effect of Methyl Sulfonyl Methane on Peptic Ulcer Induced by Alendronate</p>	<p>MSM administered before alendronate inducing ulcer showed significant difference leading to the conclusion MSM has a protective effect of peptic ulcer from alendronate.</p>
<p>Amirshahrokhi, K et al. 2017 European J of Pharmacology, 2017, http://dx.doi.org/10.1016/j.ejphar.2017.06.034</p>	<p>Methylsulfonylmethane is effective against gastric mucosal injury</p>	<p>This study evaluated Oral MSM's effect on ethanol/HCL induced gastric injury. Pre-treatment with MSM significantly increased GSH, CAT, and PGE2 and significantly decreased gastric inflammation (NF κB, TNF-α, IL-1β, IL-6, MCP-1) and oxidative damage (MDA, MPO, PC, and NO).</p>
<p>Radwan et al. 2016 J of Biomed and Pharma Res, 2016, 5(3):10-17  Study using</p>	<p>Actions of Taurine, Methylsulfonylmethane and Silymarin Against Acetaminophen-Induced Neuro- and Hepato-Toxicity in Rat</p>	<p>This study evaluated the effects of pretreatment (14 days) with either MSM (400mg/kg/day), taurine, or silymarin on acetaminophen (APAP)-induced liver and brain injury in rats. MSM pretreatment resulted in significant amelioration, over control, of APAP-induced changes in liver enzymes AST and ALT; brain and liver markers of oxidative stress - MDA, GSH, GSSG, NO, and 8-OHdG; and 2 brain monoamines - norepinephrine, and serotonin. MSM significantly outperformed taurine and silymarin pretreatment in liver NO levels and brain 8-OHdG.</p>
<p>Amirshahrokhi, K. et al. 2013 Inflammation. 2013 Oct;36(5):1111-21. doi: 10.1007/s10753-013-9645-8.</p>	<p>Effect of MSM on Paraquat-Induced Acute Lung and Liver Injury in Mice</p>	<p>Mice treated with 500mg/kg/day i.p. for 5 days histological and biochemical examination of lung and liver tissue. Results showed a significant reduction in liver and lung tissue damage and a significant reduction in tissue levels of MDA, MPO and TNF-α. MSM significantly increased level of SOD, CAT and GSH. Findings suggest MSM attenuates PQ-induced pulmonary and hepatic oxidative injury.</p>
<p>Bohlooli et al. 2013 Iran J. of Basic Med Sci, 2013, 16:896-900  Study using</p>	<p>Effect of Methylsulfonylmethane Pretreatment on Acetaminophen Induced Hepato-toxicity in Rats</p>	<p>The study evaluated effect of pretreatment of MSM on acetaminophen-induced liver injury in rats. Dosage of MSM pre-treatment = 100 mg/kg BW for one week. On day 7 rats received acetaminophen @ 850mg/kg to induce liver injury. Blood serum levels of AST and ALT measured 24 hrs post dose. Tissue samples of liver were evaluated for MDA, GSH, SOD and MPO activity. Results show acetaminophen caused a negative impact on all measured biological indices and pre-treatment with MSM significantly attenuated this negative impact.</p>
<p>Kamel et al. 2013 Arch. Pharm. Reas. 2013, doi:10.1007/s12272-013-0110-x</p>	<p>Hepatoprotective Effect of MSM Against Carbon Tetrachloride-Induced Liver Injury in Rats</p>	<p>Pre-treatment with MSM (400mg/kg) before a single dose of CCl4 (2ml/kg, i.p.) inhibited serum ALT and AST activities, decreased liver MDA, TNF-α, IL-6 and Bax/Bcl2 ratio compare to CCl4 group. MSM raised SOD and CAT activity as well as CYP2E1 level in liver tissues. MSM protects liver from CCl4 injury possibly through its antioxidant, anti-inflammatory and anti-apoptotic properties.</p>

This paper is intended to provide scientific and educational information only. It is not intended for use to promote or sell any product. These statements have not been evaluated by the Food and Drug Administration. Consumption of OptiMSM® is not intended for use to diagnose, treat, cure or prevent any disease. OptiMSM® is manufactured by Bergstrom Nutrition.

©2018 Bergstrom Nutrition. All rights reserved. Ver 2.0



Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Mohammadi et al. 2012
Adv in Pharma Sci 2012,
doi:10.1155/2012/507278



Protective Effects of
MSM on Hemodynamics
and Oxidative Stress in
Monocrotaline-Induced
Pulmonary Hypertensive
Rats

MSM administered to rats at 100, 200, and 400 mg/kg/day for 10 days before a single dose of 60 mg/kg, IP, MCT. Blood samples analyzed for CAT, SOD, GPx, GSH and MDA. MSM treatment showed potential protective antioxidant effects by a significant increase in antioxidant enzyme activity and associated reducing agents.

Amirshahrokhi, K. et al.
2011

Tox and App Pharm 2011,
doi 10.1016/j.ta-
ap.2011.03.017

Effect of MSM on
Experimental Colitis in
the Rat

Colitis induced by intra-colonic instillation of 1 ml of 5% acetic acid. Rats treated with MSM at 400mg/kg/day orally for 4 days. Colon evaluated histologically and biochemically. Micro and macroscopic colonic damage was decreased. MDA, MPO, and IL-1 were significantly decreased while GSH levels increased. MSM may have a protective effect in experimental ulcerative colitis.

DeSilvestro et al. 2008
FASEB J, 2008, 22:445.8

Published abstract and
poster presentation



MSM intake in Mice
Produces Elevated Liver
Glutathione and
Partially Protects
against CCl4 -Induced
Liver Damage

MSM administration (5 weeks, 80 mg/100 ml drinking water) produced a statistically significant increase in liver GSH (mean increase of 78%). A similar effect was not seen in lung or skeletal muscle. Also, MSM partially inhibited liver injury after injection of CCl4, which induces liver oxidative stress.

Allergy/Immune Studies

Allergy/Immune Studies	Study Title	Study Summary
<p>Hewlings & Kalman 2018 JMIR Res Protoc, 2018, 7(11): e11139</p>	<p>Evaluating the Impacts of Methylsulfonylmethane on Allergic Rhinitis After a Standard Allergen Challenge: Randomized Double-Blind Exploratory Study</p>	<p>This study evaluated the effects of a single oral dose (12grams) and sub-chronic dosages of 1, 3, or 6 grams of MSM daily for 14 days in response to a standardized allergen challenge in healthy subjects. MSM supplementation significantly alleviated participants symptoms in response to a standardized allergenic challenge.</p>
<p>Godwin, S. et al. 2015 Journal of the International Society of Sports Nutrition</p> <p>Published abstract and poster presentation</p>	<p>MSM enhances LPS- induced inflammatory response after exercise.</p>	<p>Supplementation of MSM blunted the increase in systemic levels of inflammatory cytokines (IL-6 & IL-1β) immediately after exercise. However, Ex vivo incubation of blood from various time points with LPS caused a dramatic increase in inflammatory cytokines after exercise only in the group treated with MSM. Also, a 2-3 fold increase in IL-10 was seen only in the MSM group after LPS stimulation despite lower IL-10 levels before exercise.</p>
<p>Hasegawa T, Ueno S, Kumamoto S 2005</p> <p>Jpn Pharmacol Ther 2005;33(12):1217-1223</p>	<p>Anti-Inflammatory Effect of Methylsulfonylmethane (MSM) in Mice</p>	<p>3 aspects of anti-inflammatory effects of OptiMSM evaluated: 1) Skin damage by UV, 2) Skin inflammation by ovalbumin injection and 3) Itching from histamine. Results: 1) OptiMSM suppressed skin inflammation from UV light. 2) Mice that consumed 2.5% OptiMSM in solution suppressed immediate-phase swelling reaction. 3) Scratching behavior was considerably less in mice following ingestion of 2.5% MSM solution for 1 week before histamine injections. Conclusion: Study confirms MSM is an anti-inflammatory agent, and it mitigates abnormal immune reactions that trigger inflammation.</p>

This paper is intended to provide scientific and educational information only. It is not intended for use to promote or sell any product. These statements have not been evaluated by the Food and Drug Administration. Consumption of OptiMSM® is not intended for use to diagnose, treat, cure or prevent any disease. OptiMSM® is manufactured by Bergstrom Nutrition.

©2018 Bergstrom Nutrition. All rights reserved. Ver 2.0



Published Studies on the Efficacy of MSM (methylsulfonylmethane)

Barrager E, Veltmann JR, Schauss AG, Schiller RN 2002

J Altern Complement Med 2002; 8:167-73.

 Study using

A Multi-Centered, Open Label Trial on the Safety and Efficacy of Methylsulfonylmethane in the Treatment of Seasonal Allergic Rhinitis

50 person study consumed 2600mg/day MSM orally for 30 days. Clinical respiratory symptoms and energy levels evaluated by questionnaire at the beginning and @ days 7, 14, 21, and 30. Immune and inflammatory reactions were also determined by lab tests. After 1 week, frequency of upper respiratory symptoms were significantly improved. At 3 weeks, participants also had significant improvements in lower respiratory symptoms. All respiratory improvements were maintained through day 30. Energy levels improved significantly by day 14, and were maintained through day 30. Minimal side effects reported during trial.

Sulfur Donation Studies-Animal	Study Title	Study Summary
--------------------------------	-------------	---------------

Wong et al. 2018
Nutrients, 2018, 10(19):1-9

 Study using

Small Intestinal Absorption of Methylsulfonylmethane (MSM) and Accumulation of the Sulfur Moiety in Selected Tissues of Mice

This study used radiolabeled S(35) to evaluate the absorption and metabolism of MSM using mice. The study found that MSM is easily and readily absorbed in the small intestine, creating a pool of sulfur available to the body, relieving the bioburden on SAAs. It found that MSM sulfur in incorporated into proteins, likely though post-translational sulfation.

Richmond, V, 1986
Life Sciences 39 (1986): 263-268

Incorporation of methylsulfonylmethane sulfur into guinea pig serum proteins

Guinea pigs were fed MSM with radiolabeled sulfur - S[35]. Cysteine and methionine were found radiolabeled, indicating incorporation of the MSM sulfur into SAAs.

Reviews	Review Title	Review Summary
---------	--------------	----------------

Hewlings & Kalman, 2019
EC Nutrition 14.9 (2019): 785-791

Sulfur in Human Health

Review article of the multiple roles sulfur plays in human health and nutrition, concerns about sufficient intake, and the ways MSM can address those concerns.

Butawan, M 2017
Life Sciences 39 (1986): 263-268

Methylsulfonylmethane: Applications and Safety of a Novel Dietary Supplement

Review article provides an overview of MSM (methylsulfonylmethane) with details regarding its common uses and applications as a dietary supplement as well as safety for consumption.