



OptiMSM®

Boosting Collagen
Formulations:
**The Power of
OptiMSM®**

balchem.com





Beauty From Within Market

When it comes to beauty, consumers today seek holistic solutions

It's not just about superficial beauty; it's about feeling good too. An increasing broad base of consumers are connecting the importance of diet and nutrition to a healthy appearance.

When we nourish our bodies, our skin reflects that care. The desire for glowy, healthy skin drives the demand for nutricosmetics—supplements that enhance beauty from within.

The nutricosmetics market is experiencing a surge. Mordor intelligence data estimates the global nutricosmetics market size at \$8.09 billion in 2023, and expected to reach \$11.91 billion by 2028.

While many ingredients are playing in the beauty from within space, collagen has by far had the highest growth on that market

— some calling it a “collagen boom”. For a while in the late 2010’s, collagen sales were growing as high as 30% year-on-year – and now are cruising at a low-double-digit rate (according to SPINS data).

What formulation options are available to address these consumer trends for beauty from within supplement products? **Collagen and Methylsulfonylmethane (MSM) are two popular options in the nutricosmetics space.** Each represents strong formulation options individually as well as together given their complementary mechanisms of action, and even data suggesting a synergistic benefit. Let’s explore what makes Collagen and MSM a unique pairing that can help deliver excellent beauty from within benefits for your consumer.

\$11.91bn.

Estimated global nutricosmetics market size by 2028

55%

of US women say they have consumed a vitamin, mineral or supplement in the past 12 months to improve their appearance



It's important to think of two main nutritional approaches to supporting skin health:



Provide
nutrients to aid in collagen formation



Support
the body's network of defenses



Nutrition & **Beauty**

Two main nutritional approaches to supporting skin health

Skin is the largest organ in the body, and covers the body's entire external surface ⁽¹⁾.

Skin is made up of multiple layers - namely the epidermis, dermis, and subdermis, each with unique functions that aid the skin's ability to serve as a barrier between us and the outside world. Within the dermis, the deepest layers are made of a dense network of connective tissue, largely made of a protein called collagen. Collagen has both important structural and functional roles, and is inte-

gral for maintaining the physical architecture of the skin. However, collagen can degrade over time, both as a natural part of the aging process but also due to exposure to our environment, including free radicals which may lead to oxidative damage ⁽²⁾. Furthermore, **our diets can play an important role in maintaining healthy collagen and skin**, with nutrients such as vitamin C, sulfur, and even collagen itself delivering important benefits.



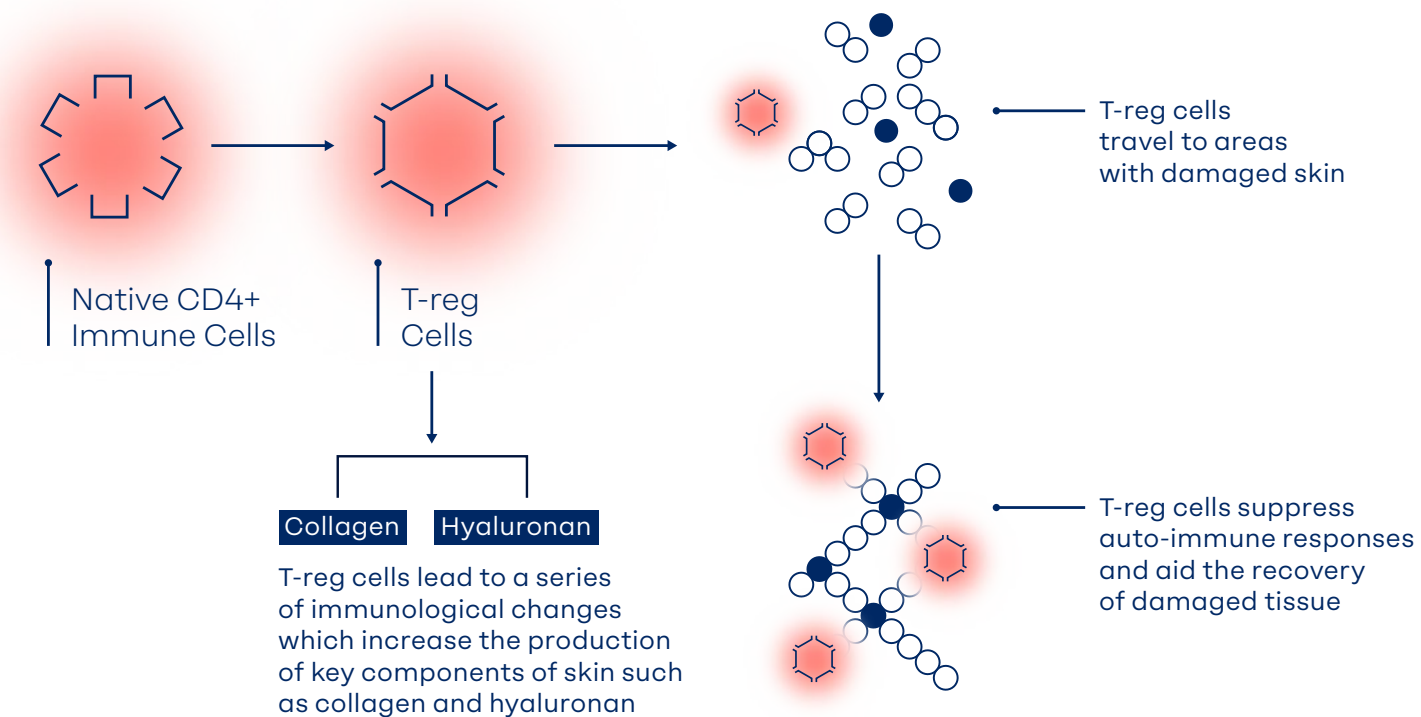
How Does Collagen Supplementation Aid Skin Health?

Collagen supplementation has been studied as a dietary intervention to improve markers of skin health, with the thought being that providing the building blocks of collagen through the diet will stimulate production of collagen within the body. Interestingly, researchers uncovered something a bit more complex. Neither endogenous nor exogenous peptides participate in the protein translation process directly, meaning that collagen fragments could not be involved in protein synthesis directly⁽³⁾. However, collagen fragments may work through a separate mechanism to impact the production of the skin's necessary components.

There appear to be two mechanisms by which collagen supplementation may improve skin health. First, collagen may stimulate the production of components of the extracellular matrix through an immune-mediated mechanism. Specifically, collagen supplementation is believed to lead to the differentiation of naïve CD4+ immune cells into T-reg cells upon exposure, causing the T-reg cells to migrate to peripheral tissues. This allows for interaction with macrophages, which triggers a series of changes that lead to the production of both collagen and hyaluronan, two essential components of skin structure⁽³⁾.

Second, the same T-reg cells that are activated by collagen fragments travel to areas with damaged skin, where they suppress specific autoimmune responses in the skin, allowing for the recovery of damaged tissue⁽³⁾. Put simply, **collagen supplementation works** by both supporting the production of key structural components our skin needs, as well as by supporting the natural defenses of our skin.

Building on this important mechanistic work, there is evidence examining the clinical impact of collagen supplementation on markers of skin health. A recent systematic review & meta-analysis of 26 individuals randomized controlled trials (RCTs) shows that on average, supplementation with hydrolyzed collagen significantly improves two key markers of skin health, namely significantly greater skin hydration and increased skin elasticity. Furthermore, the researchers found that the benefits of collagen supplementation were dependent on the duration of supplementation (>8 weeks showed greater efficacy than supplementation <8 weeks)⁽⁴⁾. Thus, the totality of the evidence supports the use of collagen supplementation to increase markers of skin health, such as skin hydration and skin elasticity.



➔ **Collagen fragments increase the presence of specific immune cells (T-reg cells) which have multiple important roles in skin health:**

- Aid in the synthesis of extracellular matrix components
- Increase skin turnover by induction of specific immune cells



Sulfur: A Critical Nutrient for Skin Health

Controlling Oxidative Stress: Critical for Skin Health

Oxidative stress reflects the imbalance between the presence of reactive oxygen species (ROS) and the body's ability to neutralize them. To combat these ROS, your body relies on a combination of both critical nutrients such as Vitamin C and Vitamin E, but it also has a series of endogenous mechanisms as well. One of these mechanisms is a system known as Glutathione Peroxidase system, a series of enzymatic reactions which work to protect your body from oxidative damage ⁽⁶⁾.

Glutathione sits at the core of this defense network. Glutathione is a tripeptide molecule found in the cytosol of all eukaryotic cells. The structure of glutathione contains a thiol (-SH) group on the cysteine residue in its core, enabling glutathione's critical function. This thiol group enables glutathione to

function as a reducing agent and nucleophilic center, meaning that it is able to donate electrons to neutralize free radicals. In the process, glutathione (GSH) forms a disulfide bond with another glutathione molecule, forming oxidized glutathione (GSSG), in an enzymatic reaction catalyzed by glutathione peroxidase. Once oxidized, GSSG then is converted back into GSH via glutathione reductase, allowing that GSH molecule to again be ready to address any lingering free radicals. **Under normal physiological conditions, nearly 98% of the body's glutathione exists as the reduced form GSH**, underscoring its importance in the defense against ROS. Adequate defense against ROS and oxidative stress is a key aspect of maintaining our health as we age, and this includes helping to maintain healthy skin and connective tissue ⁽⁶⁾.

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This system relies on several nutrients for proper function – such as Vitamin B2, Vitamin B3, and Selenium – but arguably no nutrient is as integral to this system as sulfur. In fact – glutathione was originally named “phylothion”, the Greek expression for “sulfur loving”. While sometimes overlooked in the context of human nutrition, sulfur is actually the third most abundant mineral in the body. It lies at the center of the glutathione system, but it is also a key structural component of the building blocks of skin and hair, including hyaluronic acid, dermatan sulfate, and even collagen itself ⁽⁶⁾.

In our diets, sulfur primarily comes from sulfur containing amino acids, namely methionine and cysteine. Generally speaking, those who consume higher protein foods get more of these important sulfur containing amino acids in their diet, while others such as vegetarians, vegans, or even seniors (age 75y+) get considerably less ⁽⁷⁾.

Given the nutrient gap for sulfur, supplementation becomes an option. The predominant form of sulfur used in the dietary supplement marketplace is that of MSM, a naturally occurring compound composed of sulfur, oxygen, and methyl groups. It acts as an important source of both sulfur and methyl groups in our diet, and has demonstrated benefits for joint health ⁽⁸⁾, exercise recovery ⁽⁹⁾, and skin health ⁽¹⁰⁻¹³⁾. **MSM is bioavailable, as confirmed in both short term ⁽¹⁴⁾ and long-term studies ^(15,16).**

With respect to skin health, given the structural and functional roles that sulfur provides for the skin, **there has been a growing body of research demonstrating the clinical benefits that MSM supplementation can deliver.**

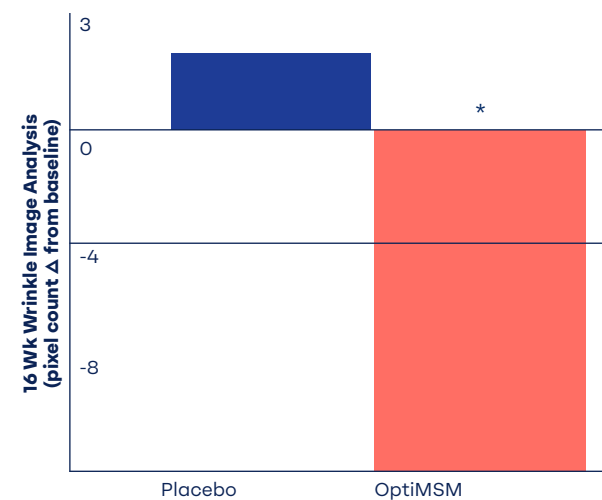
MSM Has **Proven Advantages** for Beauty

In a randomized, double-blind, placebo-controlled clinical trial, Anthonavage et al.⁽¹⁰⁾ sought to assess the effectiveness of MSM (as OptiMSM) on selected markers of skin health, namely skin firmness and the appearance of crow's feet, fine lines, and wrinkles. Women age 35-59y were randomized to receive either 3000 mg/day of OptiMSM or a placebo for 16 weeks, and were assessed both subjectively and objectively for markers of skin health at baseline, 8 weeks, and 16 weeks.

Experts provided visual grading to subjectively measure the appearance of crow's feet lines and wrinkles, as well as skin firm-

ness, and found that OptiMSM supplementation had significantly decreased the appearance of crow's feet, fine lines, and wrinkles compared to baseline, while no such change occurred for those receiving the placebo. As validation, an objective measure of wrinkle severity was performed using Clarity Pro imaging, which again demonstrated that OptiMSM supplementation significantly decreased the appearance of wrinkles vs baseline, unlike those receiving placebo. This study led the authors to conclude that **supplementation with OptiMSM provides benefits for skin health, particularly the appearance of fine lines and wrinkles**⁽¹⁰⁾.

OptiMSM® supplementation **significantly decreases the appearance of wrinkles**



Adapted From: Anthonavage M, et al., Nat Med J 2015; 7(11): 1-10
*Significant difference from baseline, p ≤ 0.05

Author/Publication	Study Design	Study Population	Duration/Dosage	Primary Outcome	Conclusions
Anthonavage M, et al. , Nat Med J 2015; 7(11): 1-10	Randomized, double-blind, placebo-controlled trial	N=20 F, age 35-59 y	16 weeks • Placebo • 3000 mg/day OptiMSM	Skin wrinkles Skin firmness Skin texture	<ul style="list-style-type: none"> • MSM sig ↓ skin wrinkles • MSM sig ↑ skin firmness • MSM sig ↑ skin texture
Guaitolini E, et al. , J Clin Aesthet Dermatol 2019; 12(4): 40-45	Randomized, single-blind, placebo-controlled trial	N=50 F, age 40-65 y with skin chrono aging and/ or photo-aging	60 days • Placebo • Intervention (200 mg HA + 500 mg L-carnosine + 400 mg MSM/day) 4 months • 1000 mg/day OptiMSM • 3000 mg/day OptiMSM	Skin hydration Skin elasticity Sebometry Hair condition assessment Nail condition assessment	<ul style="list-style-type: none"> • Sig ↑ skin hydration • Sig ↑ skin elasticity • Sig ↓ sebaceous secretion • MSM sig ↑ hair condition grading • MSM sig ↑ nail condition grading
Muizzuddin N & Benjamin R. Nat Med J 2019; 11(11): 1-8	Double-blind clinical trial	N=63 F, age 35-59 y	Part I 4 months • Placebo • 3000 mg/day MSM	Parts I & II Facial wrinkles Skin roughness	Part I <ul style="list-style-type: none"> • MSM sig ↓ facial wrinkles • MSM sig ↓ skin roughness • MSM sig ↑ skin elasticity
Muizzuddin N & Benjamin R. Int J Vitam Nutr Res 2022; 92(3-4), 182-191	Double-blind, placebo-controlled trial	Part I: n=20 F, age 35-59 y Part II: n=63 F, age 35-59 y	Part II 4 months • 1000 mg/day MSM • 3000 mg/day MSM		Part II <ul style="list-style-type: none"> • Sig ↓ skin roughness in both groups • Sig ↓ skin wrinkles in both groups • Sig ↑ skin radiance in both groups

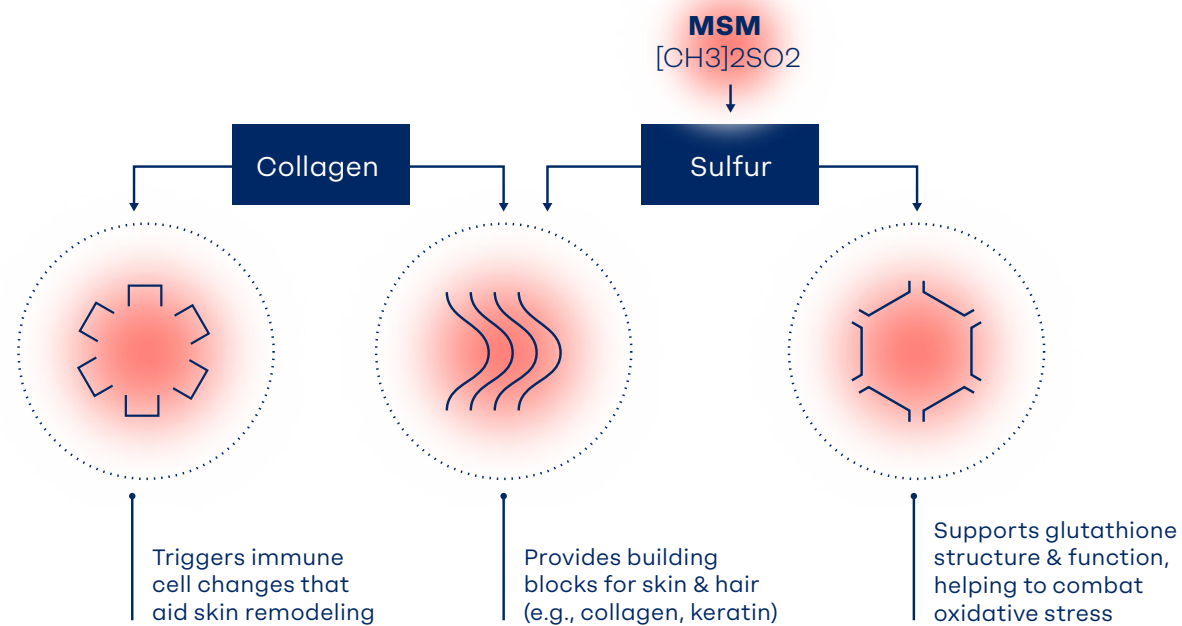
OptiMSM® Supplementation Improves Measures of Skin Health



MSM Acts as a Collagen Booster

Supplemental collagen and sulfur as MSM appear to have overlapping, yet distinct roles in the skin. Through different mechanisms, collagen⁽³⁾ and sulfur⁽⁶⁾ aid in the production of collagen and other critical architectural components of the skin. Both nutrients also support the body's defenses to help preserve healthy collagen in the skin – with collagen aiding in an immune-mediated remodeling of the skin⁽³⁾, and sulfur aiding in antioxidant defense by way of supporting glutathione structure and function⁽⁶⁾. Given these benefits – is there a clinical benefit observed when combining these nutrients together that is not observed when given alone?

Collagen and Sulfur Offer Complementary Mechanisms of Protection



Collagen + Sulfur delivers greater improvements for skin health together than when given alone

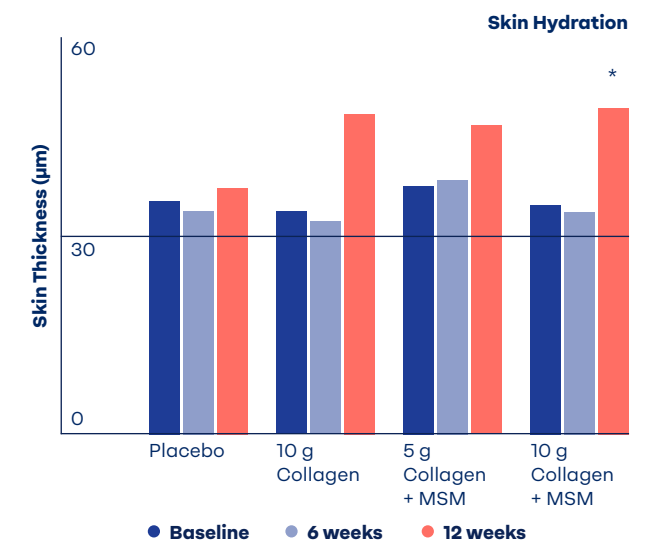
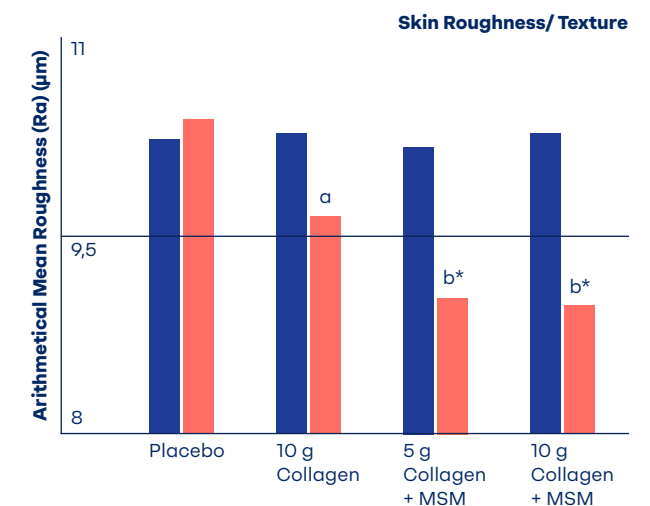
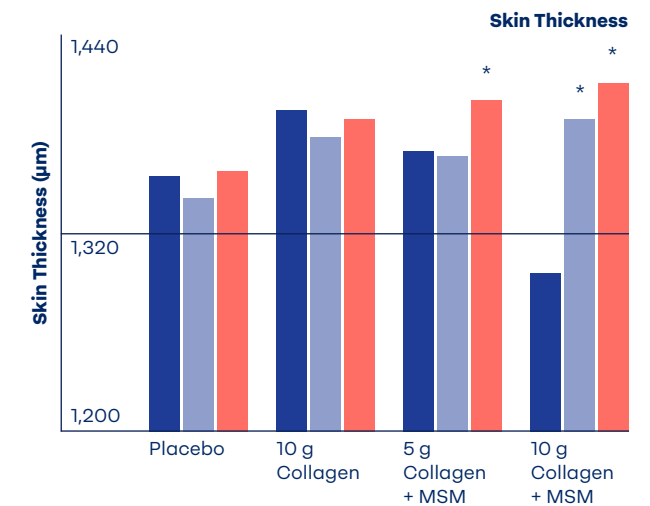
A recent randomized, double-blind, placebo-controlled clinical trial sought to investigate and compare the effects of supplementation of collagen with or without MSM on markers of skin health⁽¹⁷⁾. Women age 40-65y (n=109) were randomized to one of four different treatment groups or a placebo, and were given their test product for 12 weeks. All subjects were tested for various markers of skin health at baseline, 6 weeks, and 12 weeks – including skin density, texture, and wrinkle assessments.

Group	Collagen	Vitamin C	MSM
Placebo	0 g	0 mg	0 g
Collagen High Dose	10 g	80 mg	10 g
Collagen MSM Low Dose	5 g	80 mg	5 g
Collagen MSM High Dose	10 g	80 mg	10 g

By 12 weeks, the groups receiving collagen demonstrated significant improvements in skin density and wrinkle depth compared to both their baseline values and to those receiving placebo, regardless of whether MSM was added. However, some benefits were only observed among those receiving both MSM and collagen – namely improvements in skin thickness and skin hydration. Plus, while supplemental collagen did significantly decrease skin roughness, this effect was significantly greater in the groups receiving both MSM and collagen combined. Based on these data, the research team concluded that the combination of both MSM and collagen provided superior improvements in markers of skin health, namely skin thickness and roughness, compared with collagen supplementation alone.

Adding MSM to collagen leads to significant improvements in multiple aspects of skin health that collagen alone does not provide – including improvements in skin thickness, roughness, and hydration

Collagen and MSM Supplementation Improves Measures of Skin Health



Adapted from: Pogačnik T, et al., J Func Foods 2023; 110: 105838
*Significant difference from baseline and placebo, p < 0.05 | Treatments with different subscripts are significantly different, p < 0.05

Why OptiMSM®?

Maintaining healthy skin is a multi-factorial approach, and nutrition is a critical aspect of this routine. Nutrients such as collagen and MSM help to both support the production of integral components of skin, but also help to support our

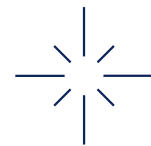
body's defense mechanism to help best support skin health. Collagen and MSM offer complementary mechanisms of protection, both supporting the production of key building blocks of our skin but also support the body's systems to help

defend and rebuild our skin. MSM and collagen offer greater improvements for skin health together than when given alone, and make an excellent pairing for your next skin health formulation.



Unique

The only GRAS
MSM on the market



Purity

99.9% purity through
proprietary 4-stage
distillation process



Quality

Made in the USA

MSM and collagen
make an excellent
pairing **for your
next skin health
formulation**



References:

- 1) Yousef H, Alhaji M, Sharma S. Anatomy, Skin (Integument), Epidermis. [Updated 2022 Nov 14]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470464/>
- 2) Reilly DM, Lozano J. Plast Aesthet Res 2021; 8:2
- 3) Barati M, et al., J Cosmet Dermatol 2020; 19(11): 2820-2829
- 4) Pu SY, et al., Nutrients 2023; 15(9): 2080
- 5) Vaskova Ja, et al., Molecules 2023; 28(3): 1447
- 6) National Academies of Sciences, Engineering, and Medicine. 2005. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington, DC: The National Academies Press
- 7) Nimni ME, et al., Nutr Metab 2007; 4: 24
- 8) Toguchi A, et al., Nutrients 2023; 15: 2995
- 9) Kalman D, et al., FASEB J 2013; 27: 1076.7 (abstract)
- 10) Anthonavage M, et al., Nat Med J 2015; 7(11): 1-10
- 11) Guaitolini E, et al., J Clin Aesthet Dermatol 2019; 12(4): 40-45
- 12) Muizzuddin N & Benjamin R. Nat Med J 2019; 11(11): 1-8
- 13) Muizzuddin N & Benjamin R. Int J Vitam Nutr Res 2022; 92(3-4), 182-191
- 14) Kalman DS & Hewlings SJ. EC Nutrition 12.11 (2018): 6840695
- 15) Bloomer RJ, et al., J Nutr Food Sci 2019; 9:1
- 16) Miller L, et al., Nutrients 2021; 13, 3620
- 17) Pogačnik T, et al., J Func Foods 2023; 110: 105838.

OptiMSM[®]

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our experts**
about OptiMSM[®]
and your next
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HUMAN NUTRITION & HEALTH