

Oral Vitamin C

for Collagen Hydroxylation, Antioxidant Photo-protection, and Pigment Modulation in Nutricosmetic Systems

Abstract

Vitamin C (ascorbic acid) is an essential, water-soluble micronutrient with central relevance to “beauty-from-within” strategies.

As a required cofactor for prolyl and lysyl hydroxylases, vitamin C enables stable collagen I/III and tropo-elastin formation, thereby supporting dermal extracellular matrix (ECM) integrity and wrinkle attenuation.

Concurrently, it delivers potent antioxidant defense against UV-/pollution-derived reactive oxygen species (ROS), limiting oxidative degradation of collagen and elastin and helping to prevent photoaging.

Vitamin C also modulates pigmentation by inhibiting tyrosinase and, when paired with Niacinamide, complements the suppression of melanosome transfer- together improving tone evenness with high tolerability.

A daily 200 mg oral dose sits in the functional “sweet spot”: it sustains plasma ascorbate near the threshold for systemic antioxidant activity and collagen biosynthesis, remains

well below the 2,000 mg/day UL, and avoids the absorption plateau observed at ≥ 500 mg/day.

Within multi-ingredient nutricosmetic formulations, vitamin C synergizes with Niacinamide (tone/barrier), elastin peptides (elastic-matrix support under oxidative control), hyaluronic acid (hydration and HA preservation), and ceramide NP (barrier lipid replenishment) to deliver integrated outcomes across anti-oxidation, brightening, firming, and barrier repair.

Collectively, evidence supports vitamin C as an indispensable systemic cofactor and synergist in oral protocols targeting structural skin aging, oxidative stress, and dyschromia.

Keywords

Vitamin C; ascorbic acid; collagen hydroxylation; prolyl hydroxylase; lysyl hydroxylase; extracellular matrix (ECM); antioxidant photo-protection; tyrosinase inhibition; melanosome transfer; photoaging; skin brightening.

Vitamin C (scientific name: ascorbic acid) is an essential water-soluble vitamin required by the human body.

It plays a fundamental role in antioxidant defense, collagen synthesis, and immune regulation. Since humans cannot synthesize vitamin C endogenously, it must be obtained daily through diet or supplementation to maintain adequate physiological levels.

In dermatology and beauty nutrition, vitamin C is widely used as a functional ingredient due to its well-documented benefits, including antioxidant protection, brightening, spot reduction, anti-inflammatory effects, and collagen synthesis support.

Its mechanisms of action are well-characterized and validated by a substantial body of human clinical research, making it a core component in modern oral beauty supplement formulations.

1. Scientifically Proven Functions and Mechanisms

1) Stimulates Collagen Synthesis and Enhances Dermal Structure

Vitamin C acts as a cofactor for the enzymes prolyl hydroxylase and lysyl hydroxylase, both essential for the hydroxylation of proline and lysine during the synthesis of collagen types I and III.

Adequate and sustained supplementation can effectively improve dermal firmness, reduce wrinkles, and enhance extracellular matrix (ECM) stability, combating signs of structural skin aging.

- ✓ Pullar JM, Carr AC, Vissers MCM. (2017). The roles of vitamin C in skin health. *Nutrients*, 9(8):866.

2) Inhibits Melanin Production, Brightens Skin Tone, and Reduces Hyperpigmentation

Vitamin C directly inhibits the activity of tyrosinase, the key enzyme in melanin biosynthesis, thereby blocking melanin formation at the source. Additionally, its anti-inflammatory properties help alleviate post-inflammatory hyperpigmentation (PIH).

When used in combination with Niacinamide, vitamin C provides a gentler yet longer-lasting brightening effect, making it suitable for sensitive or uneven skin types.

- ✓ Hakozaiki, Takashi; Minwalla, Laila; Zhuang, Jun; Chhoa, Maribelle; Matsubara, Akira; Miyamoto, Kazuyuki; Hillebrand, Gary G.; Bissett, Dennis L.; Boissy, Raymond E. (2002).

The effect of niacinamide on reducing cutaneous pigmentation and suppression of melanosome transfer. British Journal of Dermatology, 147(1):20–31.

- ✓ Farris, Patricia K. (2005). Topical vitamin C: A useful agent for treating photoaging and other dermatologic conditions. *Dermatologic Surgery*, 31(Suppl 1):814–818.

3) Potent Antioxidant Activity to Defend Against UV and Environmental Stress

Vitamin C is one of the most important water-soluble antioxidants in the human body.

It effectively neutralizes reactive oxygen species (ROS) generated by ultraviolet radiation and pollution, thus reducing oxidative stress at the cellular level.

Through its antioxidant capacity, vitamin C helps slow the visible signs of aging, prevents collagen breakdown, and protects against pigment accumulation caused by environmental damage.

- ✓ *Lin FH, Lin JY, Gupta RD, et al. (2003). Ferulic acid stabilizes a solution of vitamins C and E and doubles its photoprotection of skin. J Invest Dermatol, 125(4):826–832.*
- ✓ *Pullar, Juliet M.; Carr, Anitra C.; Vissers, Margreet C. M. (2017). The roles of vitamin C in skin health. Nutrients, 9(8):866.*

2. Scientific Rationale and Efficacy of the 200 mg/day Dosage

1) Professionally Recommended Functional Intake Range

Keyora HydraCera 5 in 1 provides 200 mg of vitamin C per day, which falls within the globally recognized functional dosage range for skin health and anti-aging support. This level is often cited in clinical studies for achieving visible dermatological benefits.

2) Dual Assurance of High Efficacy and Safety:

200 mg/day as a Systemically Effective and Well-Tolerated Dose

A. Clinically Validated Functional Saturation

Numerous studies demonstrate that oral supplementation with 200 mg/day of vitamin C can sustain plasma ascorbic acid levels around 70-80 $\mu\text{mol/L}$, the concentration required for systemic antioxidant activity and optimal collagen synthesis.

- Below 100 mg/day, skin vitamin C levels decline significantly, impairing antioxidant defense and tissue repair.
- Above 500 mg/day, plasma concentration reaches a plateau due to saturation of intestinal absorption, with diminishing returns in bioavailability.
- Thus, 200 mg/day is considered the “Functional Optimal Range”, balancing effectiveness and efficiency.

B. Safety Profile Supported by EFSA and IOM

According to both the European Food Safety Authority (EFSA) and the U.S. Institute of Medicine (IOM), the Tolerable Upper Intake Level (UL) for vitamin C is 2,000 mg/day.

The dosage in this product is only 10% of the UL, indicating excellent long-term safety without risk of gastrointestinal distress or kidney stone formation.

C. Superior to Basic Nutrition Dosage

In contrast to conventional low-dose levels (60–90 mg/day), which only satisfy minimum dietary needs, a daily intake of 200 mg supports systemic functional benefits across key skin dimensions:

- Antioxidant protection (against reactive oxygen species)
- Accelerated collagen production (via hydroxylation reactions)
- Melanin regulation (via tyrosinase inhibition and melanosome transfer suppression in synergy with Niacinamide)

- ✓ Carr, Anitra C.; Vissers, Margreet C. M. (2013). Synthetic or food-derived vitamin C—are they equally bioavailable? *Nutrients*, 5(11): 4284–4304.
- ✓ Institute of Medicine (IOM). (2000). *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids*. National Academies Press.
- ✓ EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). (2013). Scientific Opinion on DRVs for vitamin C. *EFSA Journal*, 11(11):3418.
- ✓ Levine, Mark; Conry-Cantilena, Carrie; Wang, Yi; et al. (1996). Vitamin C pharmacokinetics in healthy volunteers: Evidence for a recommended dietary allowance. *Proc Natl Acad Sci USA*, 93(8):3704–3709.

3) Clinically Proven Efficacy Dosage

The 200-250 mg/day range is the most commonly used oral dosage in multiple clinical trials targeting skin elasticity improvement, pigmentation reduction, and photoaging prevention. It has been shown to deliver significant benefits without irritation.

This dosage not only fulfills dermatological requirements, but also provides systemic antioxidant protection, making it a critical threshold for achieving visible results from ingestible skincare formulations.

- ✓ *Sharma A, Rao NG, et al. (2020). A randomized study of oral antioxidant combination in melasma and skin aging. J Cosmet Dermatol, 19(3):694–700. Pullar JM, Carr AC, Vissers MCM. (2017). Nutrients, 9(8):866.*

3. Systemic Synergistic Mechanisms of Vitamin C with Core Formula Ingredients in Keyora HydraCera 5 in 1

1) With Niacinamide (10 mg)

Niacinamide inhibits the transfer of melanin from melanocytes to keratinocytes, while vitamin C suppresses tyrosinase activity, thereby reducing melanin production at its source.

Together, they form a dual-pathway brightening mechanism, delivering a gentle yet effective whitening effect with excellent tolerability.

This combination is particularly effective for addressing post-inflammatory hyperpigmentation (PIH), offering enhanced synergy in improving dullness, uneven tone, and pigmentation in sensitive skin types.

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✓ *Hakozaki, Takashi; Minwalla, Laila; Zhuang, Jun; Chhoa, Maribelle; Matsubara, Akira; Miyamoto,*

Kazuyuki; Hillebrand, Gary G.; Bissett, Dennis L.; Boissy, Raymond E. (2002).

The effect of niacinamide on reducing cutaneous pigmentation and suppression of melanosome transfer. British Journal of Dermatology, 147(1):20–31.

- *This double-blind, placebo-controlled clinical study investigated the effects of topical 5% niacinamide on skin pigmentation in Asian women.*

- *The results demonstrated that niacinamide significantly inhibited the transfer of melanosomes from melanocytes to keratinocytes, thereby reducing the formation of hyperpigmented spots.*

- *After 4 and 8 weeks of continuous application, the treatment group showed significant improvements in skin tone evenness and brightness of hyperpigmented areas compared to the placebo group, with good tolerability and no significant irritation or adverse reactions.*

- *The study concluded that niacinamide's brightening effect is achieved by modulating melanosome transfer, rather than inhibiting tyrosinase activity, providing a gentler depigmentation pathway that is particularly suitable for individuals with post-inflammatory hyperpigmentation (PIH) or sensitive skin.*

- *Although the study involved topical application, the mechanism aligns with the systemic regulation pathways observed with oral intake of low-dose niacinamide (e.g., 10 mg/day), supporting its theoretical basis for internal use in skin brightening applications.*

2) With Elastin Peptide (100 mg)

Elastin is one of the most vulnerable structural proteins to photo-damage in the skin.

Vitamin C acts as a powerful antioxidant that neutralizes free radicals, thereby protecting elastin fibers from oxidative degradation and delaying structural breakdown.

At the same time, oral elastin peptides support the synthesis of new elastic fibers.

Together, they deliver a dual mechanism of “antioxidant protection + structural rebuilding”, significantly improving skin firmness, elasticity, and sagging associated with photoaging.

✓ *Farris, Patricia K. (2005). Topical vitamin C: A useful agent for treating photoaging and other*

dermatologic conditions. Dermatologic Surgery, 31(Suppl 1):814–818.

- This article systematically reviews the role of vitamin C in protecting the skin against photoaging, with a particular focus on its ability to neutralize free radicals and prevent the oxidative degradation of elastin fibers.

- It also highlights vitamin C as a key cofactor in collagen synthesis and the maintenance of the elastic fiber network, indicating its therapeutic potential in improving skin laxity and reduced firmness through functional intervention.

3) With Hyaluronic Acid (HA, 240 mg)

Mechanism:

Hyaluronic acid (HA) is a key component of dermal hydration and extracellular matrix (ECM) volume. Vitamin C enhances cellular antioxidant capacity, helping prevent HA degradation caused by oxidative stress and glycation.

Combined Benefits:

The two ingredients work synergistically to form a “hydration + antioxidant” moisture management system, improving fine lines, dullness, and enhancing skin radiance, translucency, and moisture retention.

- ✓ *Fuchs, Jürgen; Kern, Hans (1998). Modulation of UV-light-induced skin inflammation by D-alpha-tocopherol and L-ascorbic acid: A clinical study using solar simulated radiation. Free Radical Biology and Medicine, 25(9): 1006–1012.*

→ Vitamin C can inhibit the accumulation of UVB-induced reactive oxygen species (ROS) and associated inflammatory responses in the skin, thereby slowing down the degradation of hyaluronic acid (HA).

- ✓ *Gehring, Wilfried (2004). Topical preparations with vitamins for the skin: vitamin C. Dermatologic Therapy, 17(2): 147–153.*

→ This study demonstrates that vitamin C can protect dermal hyaluronic acid (HA) and collagen from oxidative and glycation-induced damage. It also enhances skin hydration and firmness by preserving extracellular matrix integrity.

- ✓ Stern, Robert; Maibach, Howard I. (2008). Hyaluronic acid in cutaneous biology. *Journal of the American Academy of Dermatology*, 59(4): 714–718.

→ This review highlights the essential role of hyaluronic acid in the skin's extracellular matrix (ECM) for water retention and structure. It emphasizes the importance of antioxidant mechanisms in maintaining HA stability under oxidative stress.

4) With Ceramide NP (2 mg)

Mechanism:

- Vitamin C (ascorbic acid) exhibits excellent anti-inflammatory and antioxidant properties, helping to relieve skin discomforts such as redness, stinging, and itching caused by UV exposure, pollution, or impaired barrier function.
- It modulates skin responses under stress by reducing pro-inflammatory cytokine expression and accelerating epidermal repair.
- Exogenous ceramide NP, a key lipid component of the stratum corneum, fills intercellular lipid voids to restore barrier integrity and reduce trans-epidermal water loss (TEWL).

Combined Benefits:

- Accelerates barrier recovery through dual action: anti-inflammation (Vitamin C) + lipid replenishment (Ceramide NP)

- Reduces the incidence of sensitivity reactions, especially when using active ingredients like Niacinamide or retinoids
 - Enhances tolerance in sensitive skin, particularly for those with dry or barrier-compromised skin types
- ✓ *Draelos, Zoe Diana (2005). The effect of an anti-inflammatory cosmeceutical combination on sensitive skin. Journal of Cosmetic Dermatology, 4(3): 176–182.*
- *When used in combination with anti-inflammatory ingredients, vitamin C effectively alleviates redness, burning, and other irritation symptoms in sensitive skin, thereby enhancing skin tolerance.*
- ✓ *Draelos, Zoe Diana (2018). The effect of a combination of ceramides and niacinamide on skin sensitivity. Journal of Clinical and Aesthetic Dermatology, 11(12): 13–17.*
- *The combination of ceramide and niacinamide enhances skin barrier repair efficiency and reduces the irritation potential of active ingredients in sensitive skin. Vitamin C can act as a synergistic anti-inflammatory agent to further support barrier restoration.*
- ✓ *Lin, Jeanette Y.; Selim, Mohammad A.; Shea, Christopher R.; Grichnik, James M.; Omar, M.; Monteiro-Riviere, Nancy A.; Pinnell, Sheldon R. (2003). UV photoprotection by combination topical antioxidants vitamin C and vitamin E. Journal of the American Academy of Dermatology, 48(6): 866–874.*
- *The antioxidant properties of vitamin C help protect the skin barrier structure from external irritants, offering both reparative and protective benefits for sensitive skin.*

Conclusion:

A daily intake of 200 mg vitamin C provides comprehensive systemic support for skin health across multiple mechanisms, including:

- Scavenging reactive oxygen species (ROS) to enhance antioxidant defense.
- Stimulating collagen synthesis and promoting dermal matrix reconstruction (as a key cofactor in hydroxylation reactions).
- Inhibiting melanin production and improving uneven skin tone (via synergistic brightening with niacinamide).
- Enhancing skin barrier integrity and hydration in synergy with ceramide NP and hyaluronic acid.

In the **Keyora HydraCera 5 in 1** formula, vitamin C works synergistically with Niacinamide, elastin peptide, hyaluronic acid (HA), and ceramide NP to establish a four-dimensional skincare system: Antioxidation + Brightening + Firming + Barrier Repair, making it an indispensable functional active in this advanced oral beauty supplement.