STUDY REPORT

Evaluation of the efficacy and safety of SCH Actives™ Antiox C

Content

Summary

SCH Actives™ Antiox C leverages the power of gold particles to boost the stability, absorption, and efficacy of Vitamin C and Ferulic Acid, delivering a potent anti-aging solution. Acting as precision carriers, gold particles penetrate deeply to enhance skin rejuvenation, hydration, and radiance. Gold's unique ability to stabilize sensitive ingredients prevents degradation, ensuring long-lasting potency and results. This advanced technology offers continuous hydration and anti-aging benefits while being gentle on the skin, making it suitable for all skin types. The result is a premium skincare experience that visibly improves skin texture, elasticity, and overall glow.

FERULIC ACID: Powerful antioxidant. Shields skin from harmful UVA & UVB rays. Stabilizes endogenous Vitamin C. inhibits tyrosine activity and lightens skin.

GOLD: >100 nm safe particles boost bioavailability, ensuring fast and deep skin penetration.

L-ASCORBIC ACID: Release of pure Vitamin C. Powerful antioxidant. Supports fibroblast proliferation and collagen synthesis. Stimulates intracellular ATP synthesis.

Introduction

Skin Aging

Skin aging is a complex biological process driven by both internal factors, like genetics, and external influences such as UV exposure, pollution, and lifestyle habits [1,2]. A key aspect of skin aging is the gradual breakdown of the extracellular matrix (ECM), the supportive network of proteins like collagen and elastin that maintains skin's structure, elasticity, and firmness [3,4]. In younger skin, fibroblasts actively produce and organize ECM components, ensuring a firm and resilient appearance. As we age, however, a range of factors—including UV radiation, environmental pollutants, free radicals, hormonal changes, and lifestyle-related stressors—disrupt this balance, accelerating ECM degradation and leading to visible signs of aging such as fine lines, wrinkles, and sagging skin and pigmentation changes like age spots and uneven skin tone due to prolonged UV exposure [2] (Figure 1). Additionally, the body's natural ability to produce collagen decreases, and after around age 40, collagen breakdown outpaces synthesis, further compromising skin structure [5].

Oxidative stress plays a particularly significant role in skin aging [6]. It arises when the production of free radicals—unstable molecules that damage cells—exceeds the body's natural antioxidant defenses. Normally, the body's own antioxidants, including enzymes and small molecules, help neutralize these free radicals, protecting skin cells and ECM components from damage. However, with age and increased environmental exposure, the body's antioxidant capacity declines, making skin more vulnerable to oxidative stress. This imbalance leads to cellular damage, degrades collagen and elastin fibers, and impairs fibroblast function, accelerating the appearance of wrinkles and loss of elasticity [7].

Supporting the body's natural antioxidant defenses with skincare ingredients like Vitamin C and Ferulic Acid can help counteract this decline. These antioxidants enhance the skin's ability to neutralize free radicals, protect collagen from oxidative damage, and slow the visible signs of aging.

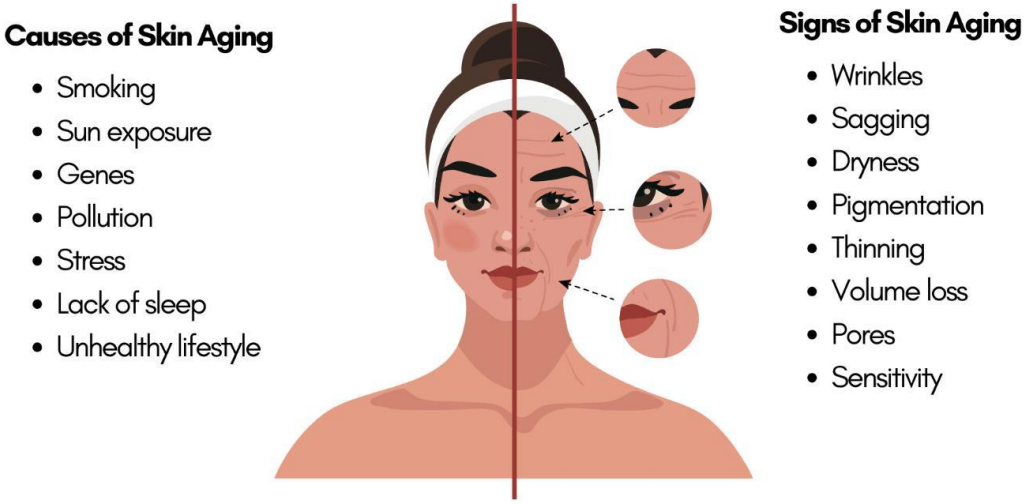

Figure 1. *Causes and signs of skin aging.*

SCH Actives™ Antiox C offers an innovative solution to combat age-related skin changes by supporting the integrity of the extracellular matrix with its powerful actives: Vitamin C and Ferulic Acid. Vitamin C, a powerful antioxidant, enhances collagen production to improve skin firmness and radiance, while Ferulic Acid amplifies this effect by further neutralizing free radicals and reducing oxidative stress [8,9]. This advanced formula also boosts skin hydration, addressing dryness and roughness often associated with aging. Together, Vitamin C and Ferulic Acid help restore collagen balance, preserving a youthful appearance and reducing visible signs of aging.

Molecular Mechanisms of Skin Aging: Oxidative Stress, ROS, and Antioxidants

SCH Actives™ Antiox C targets the fundamental causes of skin aging by addressing oxidative stress and the buildup of reactive oxygen species (ROS) that damage essential structural proteins like collagen and elastin within the extracellular matrix (ECM) [6,7]. In young, healthy skin, fibroblasts maintain an organized ECM, rich in collagen and elastin for firmness and elasticity, along with hyaluronic acid, which supports moisture retention and a plump appearance. However, with age and increased exposure to external stressors like UV radiation, pollution, and metabolic changes, ROS production rises, leading to oxidative damage that accelerates the breakdown of these structural proteins. As a result, the ECM becomes disorganized and fragmented, reducing the skin's ability to retain moisture and maintain its structural integrity (Figure 2). This leads to dryness, sagging, fine lines, and a loss of elasticity (Figure 1).

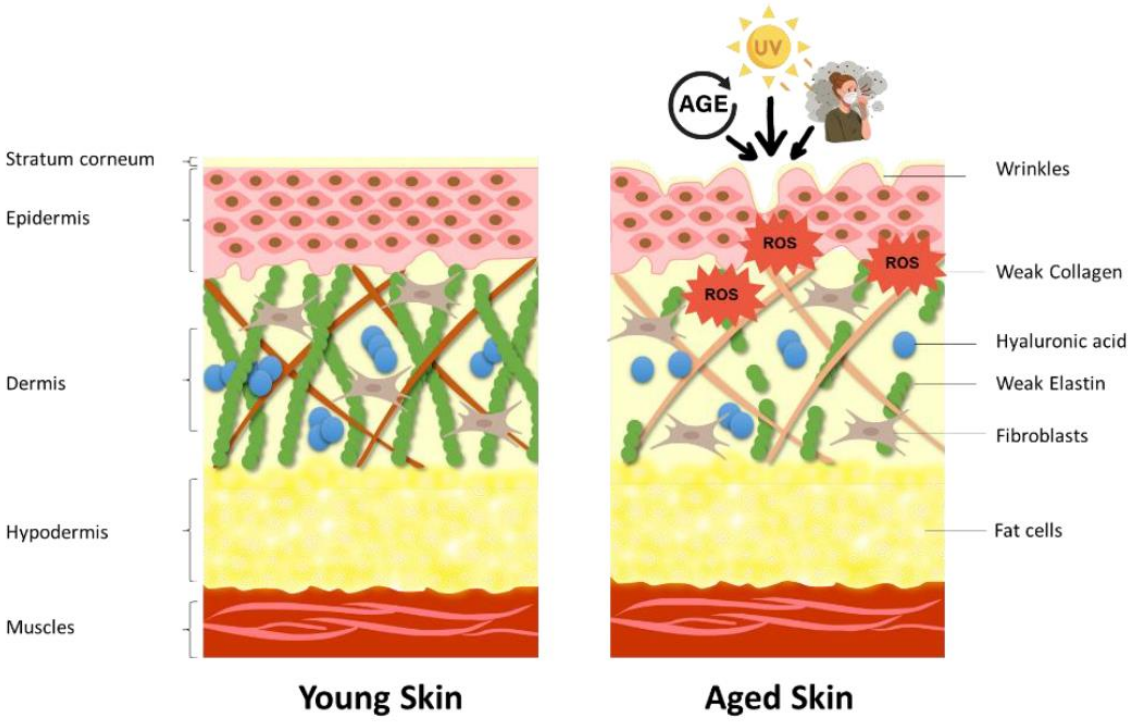

Figure 2. *Illustration of the molecular mechanisms of skin aging, highlighting the degradation of collagen, elastin, and hyaluronic acid in the extracellular matrix (ECM) in aged skin.*

Oxidative stress in the skin, primarily driven by the accumulation of reactive oxygen species (ROS) from environmental and internal sources, gradually overwhelms the body's natural antioxidant defenses. Normally, the skin's own antioxidants—such as glutathione, Vitamin C, and Coenzyme Q10—work together to neutralize these ROS, protecting cellular structures and maintaining the stability of essential proteins like collagen and elastin [10]. However, as ROS levels increase due to factors like UV exposure, pollution, and metabolic processes, these antioxidants are gradually depleted.

When the skin's antioxidant defenses are exhausted, ROS can freely damage cellular components, including lipids, proteins, and DNA, compromising cellular functions and accelerating the breakdown of the extracellular matrix (ECM) [11]. This degradation of the ECM results in weakened skin structure, reduced elasticity, and loss of moisture retention, all of which contribute to the visible signs of aging, such as wrinkles, sagging, and dullness, and uneven skin tone. Without sufficient antioxidant support, the skin becomes more vulnerable to oxidative damage, and its ability to repair and regenerate diminishes over time.

Vitamin C in Cosmetics: Benefits and Disadvantages

Vitamin C, or ascorbic acid, is a cornerstone ingredient in many skincare products due to its powerful antioxidant properties and numerous skin benefits [8,12]. It helps to brighten the complexion, even out skin tone, and reduce the appearance of hyperpigmentation by inhibiting the enzyme tyrosinase, which is involved in melanin production. Additionally, Vitamin C stimulates collagen synthesis, improving skin elasticity and firmness, and provides protection against oxidative stress caused by environmental factors such as UV radiation and pollution[13]. However, while Vitamin C offers numerous advantages, its inclusion in cosmetics presents several challenges. Pure ascorbic acid is notoriously

unstable, degrading quickly when exposed to light, heat, and air, which reduces its efficacy and can cause the product to discolor[14].

Furthermore, pure Vitamin C can be irritating to sensitive skin, particularly at higher concentrations, limiting its use for some individuals.

To address these stability issues, various Vitamin C derivatives have been developed. These derivatives offer a compromise between stability and bioavailability. For example, Magnesium Ascorbyl Phosphate (MAP) is a stable, water-soluble derivative of Vitamin C that is less prone to oxidation. However, it must be enzymatically converted into active ascorbic acid once it penetrates the skin, which can limit its ability to stimulate collagen production effectively. Similarly, Ascorbyl Palmitate is a fat-soluble Vitamin C derivative that can more easily penetrate the skin's lipid layers, but it too requires conversion to ascorbic acid within the skin, which reduces its immediate efficacy [13]. While these derivatives offer enhanced stability, they often have lower bioavailability, meaning they deliver less immediate results compared to pure ascorbic acid.

Gold in Cosmetics: A Game-Changer for Skincare Solutions

Gold has been used in beauty for centuries, symbolizing luxury and opulence, but its benefits go far beyond aesthetics, offering significant skincare advantages. In modern cosmetics, gold is commonly used in the form of colloidal gold or nanoparticles, which are small enough to be easily absorbed by the skin. These particles significantly enhance the efficacy of skincare formulations [15,16], providing a high surface area and strong adsorption energy that allows for effective bonding with active ingredients such as Vitamin C and Ferulic Acid in SCH Actives™ Antiox C. By combining with biological molecules, gold improves the solubility, stability, biodistribution, and effectiveness of these actives [17].

In addition to improving the performance of antioxidants like Vitamin C and Ferulic Acid, gold particles boost skin absorption, hydration, and elasticity while reducing the appearance of fine lines and wrinkles. Drawing from biomedical research, where gold is used for drug delivery and tissue engineering [18], gold’s role in cosmetics optimizes the delivery of essential compounds. This results in a controlled and sustained release of active ingredients, ensuring prolonged effectiveness over time and protection from environmental degradation caused by light, heat, and air.

Gold particles also help calm skin irritation, reduce redness, and shield against oxidative stress, offering an anti-inflammatory effect that benefits overall skin health [19,20]. Moreover, their biocompatibility makes them safe for long-term use, enhancing the stability and performance of advanced skincare formulations like SCH Actives™ Antiox C.

SCH Actives™ Antiox C composition

SCH Actives™ Antiox C is an advanced formulation that harnesses the synergistic benefits of gold particles, Vitamin C, and Ferulic Acid, all carefully selected to address the signs of skin aging. Each ingredient plays a vital role in enhancing the overall effectiveness of the product.

1. **Gold particles:** The gold particles in **SCH Actives™ Antiox C** are approximately 170 nm in size, providing a significant advantage in skin penetration and the delivery of active ingredients. Their small size enables efficient penetration through the skin's outer layers, ensuring that Vitamin C and Ferulic Acid are delivered deep into the dermis, where they can exert their antioxidant and rejuvenating effects. This size also allows for an extended release of these actives, offering sustained hydration and anti-aging benefits.
2. **Vitamin C:** Vitamin C is a powerful antioxidant that stimulates collagen production, brightens skin tone, and reduces the appearance of fine lines and wrinkles. It neutralizes free radicals, preventing oxidative damage to skin cells, and supports skin repair and regeneration. As an essential cofactor for collagen synthesis, Vitamin C plays a crucial role in maintaining skin elasticity and firmness, while enhancing the skin's natural defense mechanisms.
3. **Ferulic Acid:** Ferulic Acid is a potent antioxidant that stabilizes and enhances the efficacy of Vitamin C and other active ingredients. It neutralizes free radicals, inhibits enzymes that catalyze free radical generation, and enhances the activity of scavenger enzymes. Ferulic Acid provides a protective role for key skin structures, including keratinocytes, fibroblasts, collagen, and elastin. It protects the skin from UV-induced damage, reduces inflammation, and inhibits melanogenesis by blocking tyrosinase activity. Additionally, it helps improve skin texture and tone, supporting overall skin health and rejuvenation.

By combining gold particles, Vitamin C, and Ferulic Acid, SCH Actives™ Antiox C offers a comprehensive anti-aging solution. This formulation firms and revitalizes the skin while boosting collagen production, improving elasticity, and reducing wrinkles, providing users with an effective strategy for maintaining youthful and radiant skin.

The Power of Synergy: How Vitamin C, Ferulic Acid and Gold Particles Work Together to Enhance Skincare Efficacy

SCH Actives™ Antiox C combines Vitamin C with Ferulic Acid, a stabilizing antioxidant, to enhance the potency, stability, and shelf life of the formulation [12]. The inclusion of gold particles not only improves penetration but also stabilizes the entire formulation, ensuring that these powerful actives reach the deeper layers of the skin where they are most effective. This advanced delivery system maximizes both the stability and bioavailability of Vitamin C, providing long-lasting anti-aging benefits without compromising product performance or skin comfort. The gold particles, along with Ferulic Acid, help protect the integrity of Vitamin C, preserving its potency and extending its effectiveness, making SCH Actives™ Antiox C an ideal solution for skin rejuvenation and protection.

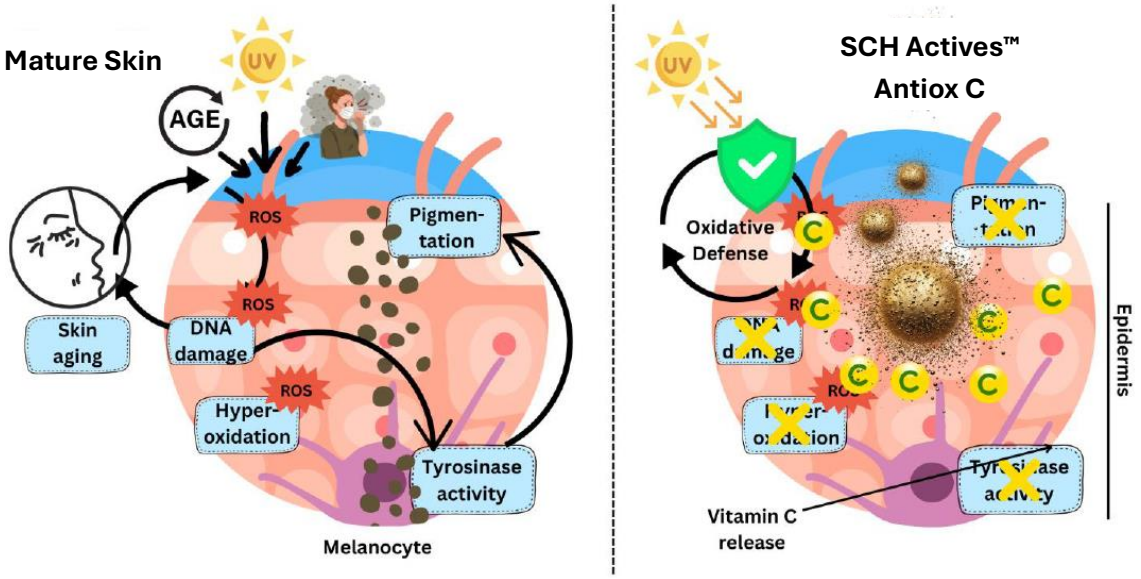

Figure 3. *Schematic illustrating the effects of aging, pollution, and UV exposure on mature skin (left), leading to an increase in reactive oxygen species (ROS). This rise in ROS accelerates molecular processes such as Tyrosinase activity, DNA damage, hyperoxidation, and pigmentation, ultimately enhancing skin aging. On the right, SCH Actives™ Antiox C releases its active ingredients, Vitamin C and Ferulic Acid, upon skin penetration. These antioxidants neutralize ROS and strengthen the skin's oxidative shield, protecting against further aging and promoting a more youthful complexion.*

How does SCH Actives™ Antiox C Counteract the Process of Skin Aging?

This advanced product combines Vitamin C and Ferulic Acid, two well-researched antioxidants, with gold particles to significantly enhance their effectiveness and stability. Gold nanoparticles have become a key innovation in skincare due to their unique properties that improve the delivery and efficacy of active ingredients, ensuring deeper penetration into the skin for maximum results.

Enhanced delivery system: Vitamin C and Ferulic Acid are both potent antioxidants known for their ability to brighten the complexion, stimulate collagen production, and protect the skin from oxidative stress. However, both ingredients can face challenges related to skin penetration and stability. The inclusion of gold particles in SCH Actives™ Antiox C enhances the absorption of these actives, ensuring they reach deeper layers of the skin where they can be most effective. This improved delivery system maximizes their benefits and effectiveness.

Controlled release and stability: One of the key advantages of gold particles in SCH Actives™ Antiox C is their ability to provide controlled, sustained release of Vitamin C and Ferulic Acid upon skin penetration. When the particles penetrate the skin, the lower intracellular pH (more acidic environment) triggers the release of the actives. This pH-responsive mechanism ensures that the ingredients are gradually released, maximizing their effectiveness over time and enhancing skin benefits. This gradual release ensures that both antioxidants remain active in the skin for a prolonged period, enhancing their overall

efficacy. Additionally, the gold particles help protect Vitamin C and Ferulic Acid from environmental degradation caused by light, air, and heat, preserving their potency and stability throughout the product's shelf life.

Antioxidant and anti-Aging benefits: Vitamin C and Ferulic Acid work synergistically to deliver potent antioxidant protection. Vitamin C stimulates collagen synthesis, improving skin elasticity and visibly reducing the appearance of fine lines and wrinkles. Ferulic Acid enhances the stability and efficacy of Vitamin C, while also neutralizing free radicals, inhibiting free radical-generating enzymes, and reducing oxidative stress. Together, they help prevent premature aging, protect the skin's natural structures—including collagen, elastin, and keratinocytes—and promote a brighter, more even complexion.

Improved skin texture and hydration: Vitamin C's ability to improve skin texture and Ferulic Acid's brightening properties are further enhanced by the deep penetration provided by the gold nanoparticles. This results in a smoother, more hydrated skin surface, helping to combat dullness and dryness. The combination of these powerful ingredients leaves the skin revitalized and radiant.

This powerful trio combats oxidative stress, stimulates collagen production, and promotes a youthful, radiant complexion, providing long-lasting anti-aging benefits.

Cosmetic Applications

- Anti-aging
- Prevention of photo-damage induced by UV radiation
- Healing agent
- Hydration and Moisture Retention
- Antioxidant Defense
- Skin brightening
- Anti-pigmentation

Dosage

0,3% SCH Actives™ Antiox C in final formulation.

Objective of the study

The aim of this study was to assess the efficacy and safety of **SCH Actives™ Antiox C**, a skincare formulation that utilizes gold nanoparticles to optimize the delivery of potent anti-aging ingredients, including Vitamin C and Ferulic Acid. The research focused on evaluating the physicochemical properties of **SCH Actives™ Antiox C**, including its stability and the interaction between the gold particles and active ingredients. The study also examined the formulation's effects on skin cell turnover, collagen production, and moisture retention, as well as its overall anti-aging benefits in both in vitro and in vivo models. Additionally, the safety profile and biocompatibility of **SCH Actives™ Antiox C** were evaluated to ensure the formulation is gentle on the skin while providing significant rejuvenation effects. The

collective objectives aimed to confirm the product's ability to deliver sustained hydration, improve skin texture, and enhance anti-aging results.

Materials and Methods

Equipment

Standard laboratory equipment such as analytical balance, centrifuge, pH-meter, rotavapor stirrers, HPLC, authomatic synthesizer and lyophilizer machine were used.

Morphology of SCH Actives™ Antiox C by transmission electron microscopy (TEM)

High resolution transmission electron microscope (HRTEM) of unconjugated and conjugated gold particles Drops of gold particles conjugated to MPM peptides under uranyl acetate staining were deposited over carbon-coated Formvar films on copper grids. To obtain the transmission electron microscopy (HRTEM) results, a field emission gun microscope JEOL 2010F was used, working at 200 kV and with a point-to-point resolution of 0.19 nm.

Particle Size and Size Distribution Analysis of SCH Actives™ Antiox C Using Dynamic Light Scattering (DLS)

The Z-average size and polydispersity index (PDI) of SCH Actives™ Antiox C particles were measured using a Malvern ZetaSizer 2000 (Malvern, UK; software: ZetaSizer 7.03). The analysis was performed using dynamic light scattering (DLS) at a fixed scattering angle of 90° with a 633 nm laser. Measurements were conducted in triplicate to ensure accurate and consistent results.

Antioxidant Activity of SCH Actives™ Antiox C

The ABTS radical scavenging activity was measured based on the modified method of You et al [21]. In this assay, ABTS is converted to its radical form (ABTS•+) by oxidation, and the extent of radical scavenging is determined by measuring the reduction in absorbance at 734 nm after the sample is added, indicating its antioxidant potential. To prepare the ABTS working solution, an equal mixture of ABTS (7 mmol/L) and potassium persulfate (2.45 mmol/L) was incubated in the dark at room temperature (25°C) for 12–16 hours. The working solution was then diluted using phosphate buffer (5 mmol/L, pH 7.4) until the absorbance reached 0.70 ± 0.02 at 734 nm. Samples tested included SCH Actives™ Antiox C particles, and a combination of Vitamin-C and Ferulic Acid in solution. A mixture of Vitamin C and Ferulic Acid was prepared by dissolving Vitamin C in water, while Ferulic Acid was dissolved in Caprylic/Capric Triglyceride (CCT) oil. After both ingredients were fully dissolved in their solvents, they were combined to create a single formulation. The samples were diluted in deionized water to achieve concentrations of 3.125–50 µg/mL. For each assay, 2.5 mL of the sample solution was mixed with 2.5 mL of ABTS working solution and allowed to react at room temperature for 18 minutes. Absorbance was measured at 734 nm using a UV

spectrophotometer, with phosphate buffer used as the blank control. The percentage of ABTS radical scavenging activity was calculated using the equation:

$$ABTS\ radical\ scavenging\ activity\ (\%) = \frac{Acontrol - Asample}{Acontrol} x\ 100$$

where *Acontrol* is the absorbance of the control solution, and *Asample* is the absorbance of the sample.

Stability Assessment of Vitamin C in SCH Actives™ Antiox C

A mixture of Vitamin C and Ferulic Acid was prepared for stability testing: Vitamin C was dissolved in water, while Ferulic Acid was dissolved in Caprylic/Capric Triglyceride (CCT) oil. After both ingredients were fully dissolved in their solvents, they were combined to create a single formulation.

The stability of the free Vitamin C and Ferulic Acid mixture versus **SCH Actives™ Antiox C** was assessed in two formulations: an aqueous solution and an emulsion. Using high-performance liquid chromatography (HPLC) with a UV detector and a C18 reversed-phase column, the degradation profiles of the active ingredients in both formulations of the free mixture and **SCH Actives™ Antiox C** were monitored over a 30-week incubation period at 45°C. This study aimed to evaluate the role of gold particles in **SCH Actives™ Antiox C** in enhancing the stability, bioavailability, and long-term effectiveness of Vitamin C and Ferulic Acid, with a focus on the differences in stability observed between the aqueous and emulsion formulations.

In Vitro Studies

Assessing Oxidative Stress in HaCaT Keratinocytes: UVA Exposure and H2O2 Treatment

Cell Culture

HaCaT keratinocytes were cultured in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10% fetal bovine serum (FBS) and 1% penicillin/streptomycin. Cells were maintained at 37°C in a humidified atmosphere containing 5% CO_2 and sub-cultured when reaching 70-80% confluency.

Induction of ROS by H2O2

HaCaT keratinocytes were divided into three groups for the experiment: Control group 1 (no treatment), Control group 2 (treated with 100 µM H_2O_2 only to induce oxidative stress), and the treatment group (pre-treated with SCH Actives™ Antiox C 0,3% for 24 hours prior to exposure to 100 µM H_2O_2 to evaluate its protective effects). Reactive oxygen species (ROS) levels were determined using the fluorescent probe 2', 7'-dichlorofluorescein diacetate (DCFH-DA).

Cells were pre-loaded with 20 mM DCFH-DA for 30 minutes. After pre-loading, 100 µM H_2O_2 was added to Control group 2 and the treatment group. Following a 2-hour exposure to 100 µM H_2O_2 at 37°C, the cells were lysed using 0,1% Triton X-100. The oxidized product, DCF,

was measured using a fluorescent microplate reader (VICTOR X5, PerkinElmer, USA) at an excitation wavelength of 485 nm and an emission wavelength of 530 nm. Intracellular ROS levels were expressed as fluorescent arbitrary units per µg of protein. The assessment aimed to evaluate the potential protective effects of SCH Actives™ Antiox C in mitigating oxidative stress-induced cellular damage.

Evaluation of Cell Viability, Apoptotic Activity, and Collagen mRNA Expression in Human Dermal Fibroblasts

MTT Assay for Cell Viability in Human Dermal Fibroblasts

To evaluate the effect of UVA exposure and SCH Actives™ Antiox C treatment on cell viability, an MTT assay was performed. After UVA irradiation, cells were incubated for 24 hours. Following this incubation, a solution of MTT reagent (20 µL per 100 µL of culture medium) was added to each well, and the plates were incubated at 37°C for 3 hours. During this incubation, the MTT reagent was metabolized by viable cells into an insoluble formazan product. Afterward, a solubilizing solution was added to dissolve the formazan, and absorbance was measured at 490 nm using a microplate reader to quantify cell viability based on the amount of formazan produced, which is directly proportional to the number of living cells.

Assessment of Collagen-1 mRNA levels by RT-qPCR

Total RNA was extracted from dermal human fibroblasts using the RNeasy Mini Kit (Qiagen, Germantown, MD, USA) according to the manufacturer's protocol. The concentration and purity of the RNA were determined using a NanoDrop 2000 spectrophotometer (Thermo Fisher Scientific). For cDNA synthesis, 1 µg of total RNA was reverse transcribed using the First Strand cDNA Synthesis Kit (Invitrogen, Waltham, MA, USA) according to the manufacturer's instructions.

Quantitative Real-Time PCR (qPCR) Quantitative PCR was performed using SYBR Green Supermix (Bio-Rad, Hercules, CA, USA) on the CFX96 Real-Time PCR Detection System (Bio-Rad). The reaction mixture included 10 µL of SYBR Green Supermix, 1 µL of cDNA template, and 0.5 µM of each forward and reverse primer, with nuclease-free water added to a total volume of 20 µL. The PCR conditions were set as follows: initial denaturation at 95°C for 3 minutes, followed by 40 cycles of denaturation at 95°C for 10 seconds, annealing at 60°C for 30 seconds, and extension at 72°C for 30 seconds.

Primer Sequences The primer sequences used for qPCR were:

COL1A1:

forward, 5'- GATTCCCTGGACCTAAAGGTGC; reverse, 5'- AGCCTCTCCATCTTTGCCAGCA

GAPDH:

forward, 5'-TCGACAGTCAGCCGCATCT; reverse, 5'-TACGACCAAATCCGTTGACTCCGA

Data Analysis The relative expression levels of *COL1A1* were normalized to the housekeeping gene GAPDH using the 2^-ΔΔCt method. Each reaction was performed in

triplicate, and data were expressed as mean ± standard deviation (SD). Statistical significance was determined using one-way ANOVA followed by Tukey's post-hoc test, with p-values < 0.05 considered statistically significant.

Caspase-3 Activity Assay for Apoptotic Evaluation in Human Dermal Fibroblasts

Human dermal fibroblasts were divided into four groups: (1) UVA group (irradiated only), and three pre-treatment groups (2) pre-treated with Vitamin C at concentrations of 15%, (3) with Ferulic Acid at concentrations of 0,5% and (4) with 0,3% SCH Actives™ Antiox C for 24 hours before UVA exposure. For the UVA exposure experiments, cells were irradiated with a total dose of 8 J/cm^2 using UVA broadband lamps (320–420 nm, PUVA 180; Herbert Waldman, Werk für Lichtechnik Schwenningen, Germany). Prior to irradiation, the culture medium was removed, and cells were washed twice with phosphate-buffered saline (PBS). Cells were then overlaid with Hank's Balanced Salt Solution (HBSS), which is phenol-red-free, to prevent any interference with the light during irradiation and to avoid any potential cytotoxic effects associated with phenol red.

After UVA exposure, the HBSS was replaced with fresh DMEM for the pre-treatment groups.

Caspase-3 activity was assessed using a caspase colorimetric protease assay. 24 hours after UVA stimulus, cells were lysed, and the caspase-3 activity was determined by measuring the cleavage of a chromogenic substrate that produces a colorimetric change. The absorbance of the solution was measured using a microplate reader at the appropriate wavelength. The level of caspase-3 activity was used to quantify the extent of apoptosis in dermal fibroblasts after UVA exposure and pre-treatment with SCH Actives™ Antiox C.

Tyrosinase Activity Assay

SK-MEL cells were cultured and harvested for tyrosinase activity measurement. The cells were either left untreated or incubated for 24 hours with 0,3% SCH Actives™ Antiox C. Following incubation, the cells were lysed in a buffer containing 50 mM sodium phosphate (pH 6.8) with 1% Triton X-100, 1 µM phenylmethylsulfonyl fluoride (PMSF), 1 µg/mL aprotinin, and 10 µg/mL leupeptin to inhibit proteases and prevent degradation. The lysates were clarified by centrifugation at 13,000 × g for 15 minutes at 4°C to remove cell debris. For the assay, the clarified supernatants were incubated with L-DOPA (3,4-dihydroxyphenylalanine) in the same 50 mM sodium phosphate buffer (pH 6.8) at 37°C for 3 hours. Tyrosinase activity was then determined by measuring the absorbance at 470 nm, which corresponds to the dopachrome product formed by the enzymatic conversion of L-DOPA. The results were used to evaluate the effect of SCH Actives™ Antiox C treatment on tyrosinase activity in SK-MEL cells.

Quantification of Vitamin C Release from SCH Actives™ Antiox C in Pig Skin Slices Using Franz Diffusion Cells

Pig skin slices were prepared and mounted in Franz diffusion cells, then treated topically with 0,3% **SCH Actives™ Antiox C**. The release of Vitamin C into the lower chamber of the Franz cell was quantified after 20 hours. Following the treatment, the Vitamin C released

into the lower chamber was collected and analyzed by high-performance liquid chromatography (HPLC).

In Vivo Studies

Antioxidant Capacity and Melanin Production after Solar-Simulated Radiation

This study aimed to assess the antioxidant capacity and melanin production following exposure to solar-simulated radiation. Skin was pretreated for 2 hours with vehicle, 0,5% ferulic acid, 15% vitamin C, or 0,3% SCH Actives™ Antiox C. After pretreatment, skin was exposed to solar-simulated radiation for 15 minutes using an **Oriel Solar Simulator 1600W** (Oriel Instruments, Stratford, CT, USA). For SSR, UV wavelengths below 290 nm were filtered out using an optical filter (WG320, Oriel Instruments) to ensure the accurate simulation of solar radiation. Images of selected skin areas were taken before and after radiation exposure using a high-resolution digital camera to assess changes in pigmentation. The images were captured under consistent lighting conditions to ensure accurate visual assessment. A total of 15 healthy female participants aged 27-70 years took part in the study.

Assessment Skin β-Carotenoid Levels After 28-Day Application of 0,3% SCH Actives™ Antiox C Cream vs. Placebo Following Ozone Exposure

To evaluate the antioxidant capacity of **SCH Actives™ Antiox C** in preventing oxidative damage from ozone exposure, β-carotenoid levels were measured in a study involving 20 healthy volunteers aged 35 to 60 years. Participants, who provided informed consent, met inclusion criteria that excluded skin disorders, recent use of topical antioxidants, or exposure to high ozone levels in the preceding month.

In a split-face design, participants applied a placebo or **0,3% SCH Actives™ Antiox C** cream to one side of the face, while the untreated side served as a control. This setup enabled a direct comparison of antioxidant effects between treated and untreated areas. The cream was applied 15 minutes before ozone exposure to allow adequate absorption and activation of the ingredients. Ozone exposure was then administered at a concentration of 1.5 ppm for 30 minutes on both hemifaces, simulating environmental oxidative stress conditions that elevate reactive oxygen species (ROS) production, known contributors to skin aging.

β-carotenoid levels were measured non-invasively using autofluorescence on the cheeks at two time points: immediately before and after ozone exposure, with specific excitation and emission wavelengths tailored to detect β-carotenoids. This approach provided a reliable, real-time measurement of skin antioxidant capacity, reflecting the protective efficacy of **SCH Actives™ Antiox C**. Percentage changes in β-carotenoid levels were calculated as the difference between pre- and post-exposure measurements. This method quantified both the antioxidant potential of β-carotenoids and the role of **SCH Actives™ Antiox C** in shielding skin from oxidative stress.

Firmness and Elasticity Study

The study was conducted on 20 participants to evaluate the effects of **SCH Actives™ Antiox C** on the firmness and elasticity of the facial skin. **SCH Actives™ Antiox C** was applied twice daily for 28 days. The firmness and elasticity of the skin were assessed using a Cutometer Dual MPA 580, which employs special probes to measure skin properties. The principle of the device involves applying negative pressure (450 mbar) to suck in the skin through a 2 mm aperture in the probe for 2 seconds. After the suction phase, the skin is released and allowed to relax for 2 seconds before the process is repeated. Measurements were taken from the cheek area to evaluate the skin's response to treatment.

The tests were conducted in a controlled environment with a constant room temperature of 21°C and air humidity between 40%-60%. Three measurements were performed on each participant at the designated site (crow's feet area), with each measurement taken at a slightly different spot to prevent skin fatigue. The parameters R0, R2, R5, R7, R8, and R9 were evaluated based on the mean of the three measurements.

R0: Assesses skin firmness, representing the skin's immediate reaction to the applied force after suction.

R2, R5, and R7: Parameters related to skin elasticity. The closer the values are to 1 (100%), the more elastic the skin.

- R2: Ratio of complete relaxation to penetration immediately after suction.

- R5: Ratio of the elastic portion of the suction phase to the immediate recovery during the relaxation phase.

- R7: Ratio of the elastic portion of the suction phase to the maximum penetration immediately after suction.

R8: Represents the skin's ability to return to its original state, measured in mm as **Ua**, indicating complete relaxation after the first suction.

R9: Indicates the fatigue effect on the skin after repeated suction. Lower values suggest less fatigue, defined as the difference between the last and first maximum amplitude (R3 - R0).

A sample deformation vs. time curve was used to illustrate the measurement method:

- **Uf:** Penetration immediately after suction.
- **Ua**: Complete relaxation, often divided into two parts: **Ur** (maximum elastic recovery) and the flat viscoelastic part (**Ua - Ur**).
- **Ue**: Immediate elastic deformation.
- **R3**: Last maximum amplitude, used to determine the R9 parameter.

Statistical analysis was performed using **Statistica 13.1 software**, with **Student's t-test** applied to evaluate the significance of results at a confidence level of 0.05.

Results

Results of high-resolution TEM

To analyze the structural features essential for its efficacy in skincare, Transmission Electron Microscopy (TEM) images of **SCH Actives™ Antiox C** illustrate gold particles approximately 170 nm in size. The images reveal that the nanoparticles are spherical and exhibit a uniform distribution throughout the sample (Figure 4). This precise imaging highlights the consistency in particle size and distribution, which is critical for the efficient delivery of active ingredients in skincare formulations. The observed structural characteristics support **SCH Actives™ Antiox C**'s potential for enhanced performance in skincare applications.

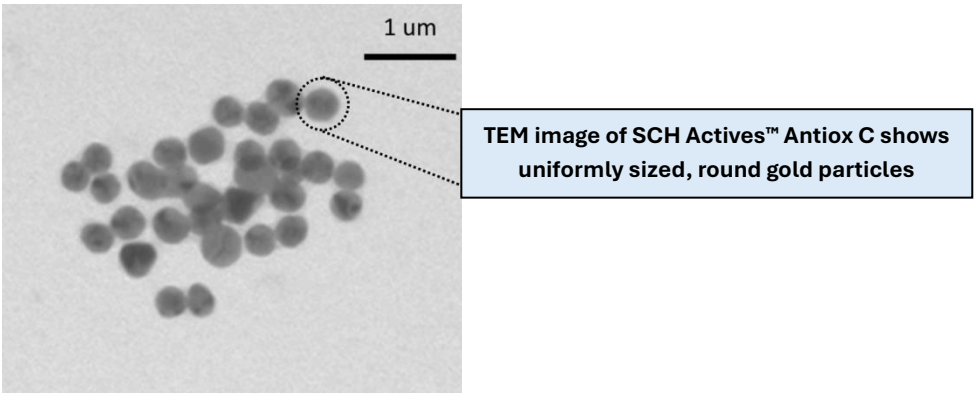

Figure 4. *Transmission Electron Microscopy (TEM) images of SCH Actives™ Antiox C.*

Dynamic Light Scattering Analysis of SCH Actives™ Antiox C: Particle Size and Size Distribution

To quantify **SCH Actives™ Antiox C**'s particle size and size distribution, Dynamic Light Scattering (DLS) analysis was conducted. DLS results indicated that 100% of the particles exhibited a peak size of 170 nm, with a standard deviation of 41 nm and a polydispersity index (PDI) of 0.22, signifying a uniform particle distribution (Figure 5). The DLS data confirm the consistent size and even dispersion of the particles within the **SCH Actives™ Antiox C** sample, highlighting its uniform formulation quality.

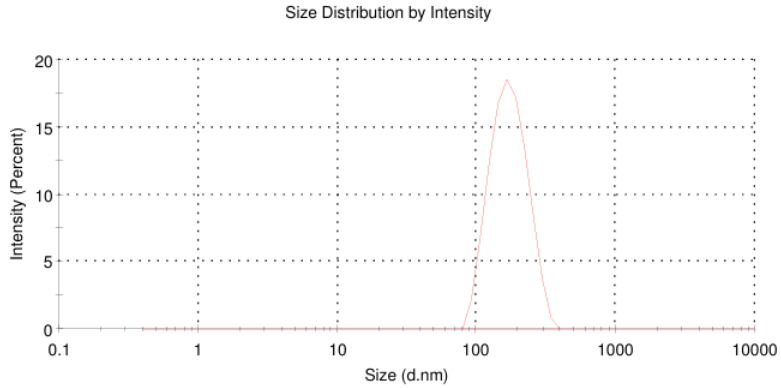

Figure 5. *Dynamic Light Scattering (DLS) analysis of **SCH Actives™ Antiox C** nanoparticles showing a peak size of **170 nm**, with a standard deviation of **41 nm**.*

Long-Term Stability Testing of SCH Actives™ Antiox C

To assess the long-term stability of Vitamin C and Ferulic Acid, **SCH Actives™ Antiox C** was compared to a free mixture of these ingredients over a 30-week period at 45°C in two different environments: an aqueous solution and an emulsion. Testing in both environments is crucial for cosmetics, as formulations vary widely aqueous formulations are common in lighter, water-based products like serums, while emulsions (mixtures of oil and water) are often used in creams and lotions. Stability studies in both types help determine how well the active ingredients retain their effectiveness across various product formats.

Using High-Performance Liquid Chromatography (HPLC), the stability of each formulation was monitored. In the aqueous solution, the free mixture of Vitamin C and Ferulic Acid degraded rapidly, retaining only 16% of its initial content by week 5 and nearly completely degrading by week 20 (0,1%). By contrast, **SCH Actives™ Antiox C** maintained high stability, retaining 97-99% of the initial concentration throughout the 30 weeks. In the emulsion, the free mixture followed a similar degradation pattern, retaining only 27% of the initial concentration by week 5 and completely degrading by week 30. However, **SCH Actives™ Antiox C** in the emulsion retained 97-99% of its initial content over the full period. These results demonstrate the robust stability of **SCH Actives™ Antiox C** in both aqueous and emulsion formulations, supporting its potential to deliver the active ingredients in diverse cosmetic product types while retaining efficacy over time and under heat stress.

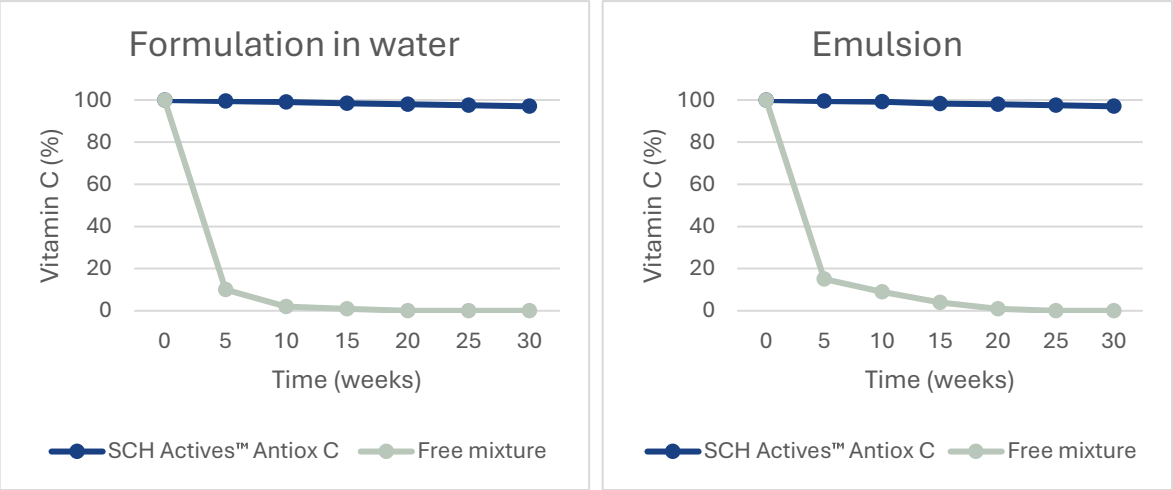

Figure 6. *Stability of Vitamin C in SCH Actives™ Antiox C versus a free mixture of Vitamin C and Ferulic Acid in aqueous and emulsion formulations over 30 weeks at 45°C, measured by HPLC.*

Determination of Antioxidant Activity of SCH Actives™ Antiox C

The antioxidant stability of free Vitamin C and Ferulic Acid versus SCH Actives™ Antiox C was assessed over time using an ABTS radical scavenging assay (Figure 7). Both formulations demonstrated time-dependent changes in scavenging activity, with SCH Actives™ Antiox C consistently showing higher antioxidant stability. At 40 hours, free Vitamin C and Ferulic Acid retained a scavenging rate of 55,9%, whereas SCH Actives™ Antiox C achieved a significantly higher rate of 89,8%. These findings highlight SCH Actives™ Antiox C's superior stability and effectiveness in preserving antioxidant activity over extended periods.

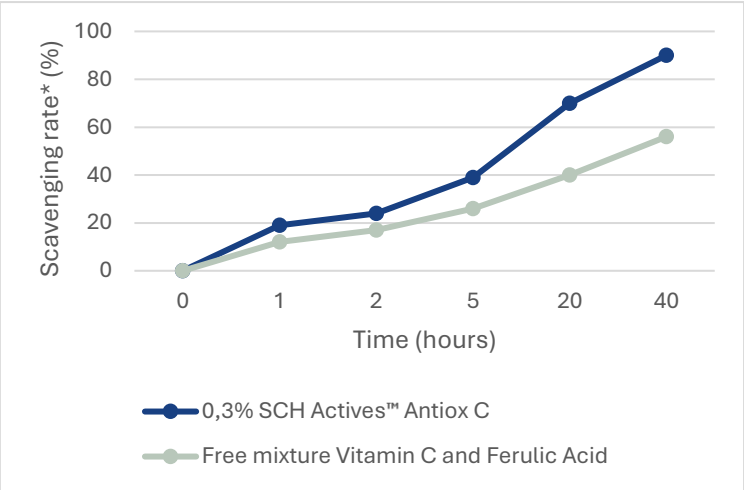

Figure 7. *ABTS radical scavenging rate of a free Vitamin C/Ferulic Acid physical mixture versus SCH Actives™ Antiox C. The mass ratio of Vitamin C to Ferulic Acid in SCH Actives™ Antiox C was equivalent to that in the free physical mixture. *The relative ability to scavenge ABTS radicals generated in an aqueous phase was measured.*

In vitro studies

Assessment of Vitamin C Delivery from SCH Actives™ Antiox C in Pig Skin Using Franz Diffusion Cells

To evaluate the effectiveness of SCH Actives™ Antiox C in enhancing skin delivery of Vitamin C, pig skin slices were mounted in Franz diffusion cells and treated with a 0,3% SCH Actives™ Antiox C formulation. After 20 hours, the percentage of Vitamin C released into the lower chamber was quantified using high-performance liquid chromatography (HPLC). Results showed that SCH Actives™ Antiox C achieved a release of 69% of the initial input (Figure 8). This significant increase highlights the enhanced delivery potential of the stabilized SCH Actives™ Antiox C formulation, suggesting it may improve Vitamin C penetration through the skin more effectively than unformulated actives .

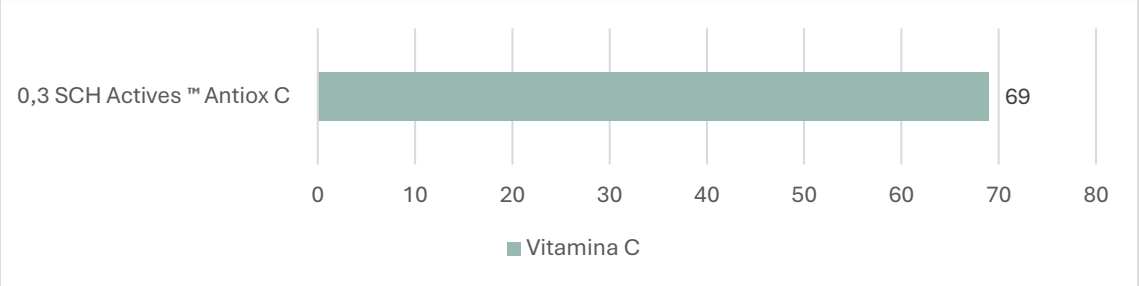

Figure 8. *Vitamin C release potential of SCH Actives™ Antiox C in pig skin assessed by HPLC. The bar represents Vitamin C detected in receptor chamber after 20h by HPLC.*

SCH Actives™ Antiox C inhibits generation of reactive oxidative species (ROS) in keratinocytes exposed to H_2O_2

The next experiment evaluated the protective effect of SCH Actives™ Antiox C against oxidative stress-induced ROS production in HaCaT keratinocytes exposed to H_2O_2. The cells were divided into three groups: an untreated control group, a H_2O_2-treated control group,

and a H_2O_2-treated group pre-treated with 0,3% SCH Actives™ Antiox C for 24 hours. ROS levels were measured using a fluorescent ROS probe, with results expressed in arbitrary fluorescent units. The findings showed a significant increase in ROS production in the H_2O_2-treated control group (mean = 134.4, std = 7.2) compared to the untreated control (mean = 22.3, std = 1.3). However, pre-treatment with 0,3% SCH Actives™ Antiox C reduced ROS levels to 52.9 (std = 12.3), demonstrating that SCH Actives™ Antiox C effectively mitigates oxidative stress and helps protect keratinocytes from excessive ROS production.

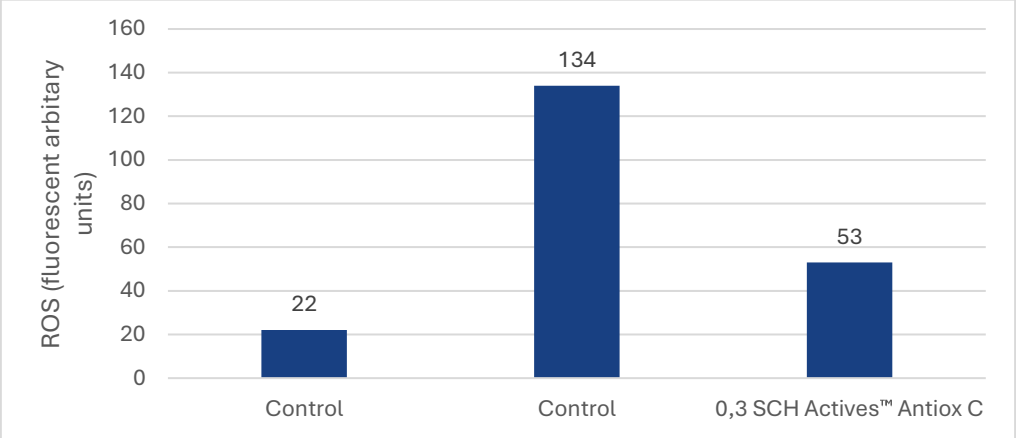

Figure 9. *ROS production in HaCaT cells. Cells were treated as follows: untreated (control), H_2O_2-treated (control + H_2O_2-), or H_2O_2-treated with 0,3% SCH Actives™ Antiox C for 24 hours. SCH Actives™ Antiox C pre-treatment significantly reduced ROS levels compared to the H_2O_2-treated group, demonstrating its protective effect against oxidative stress. *ROS detection by fluorescent probe (DCFH-DA).*

SCH Actives™ Antiox C inhibits generation of reactive oxidative species (ROS) in keratinocytes exposed to H_2O_2

Vitamin C plays a crucial role in collagen synthesis by aiding in the stabilization and cross-linking of collagen fibers, which is vital for maintaining skin structure and elasticity. As we age, collagen production naturally declines, contributing to wrinkles and sagging skin. To investigate how **SCH Actives™ Antiox C**, which contains Vitamin C, affects collagen I synthesis in dermal fibroblasts, the cells were treated with **SCH Actives™ Antiox C** for 24 hours, and the impact on COL1A1 gene expression was assessed. The results revealed that **SCH Actives™ Antiox C** substantially boosted COL1A1 expression, leading to a marked increase in collagen I synthesis (Figure 10). Specifically, qPCR analysis showed a mean fold increase of 2.6 ± 0.25 in COL1A1 expression with **SCH Actives™ Antiox C** treatment, compared to a mean fold increase of 0.98 ± 1.2 in the control group. These findings indicate that **SCH Actives™ Antiox C** nearly doubles the expression of the COL1A1 gene, significantly enhancing collagen I production in the treated cells, which could help mitigate some signs of aging.

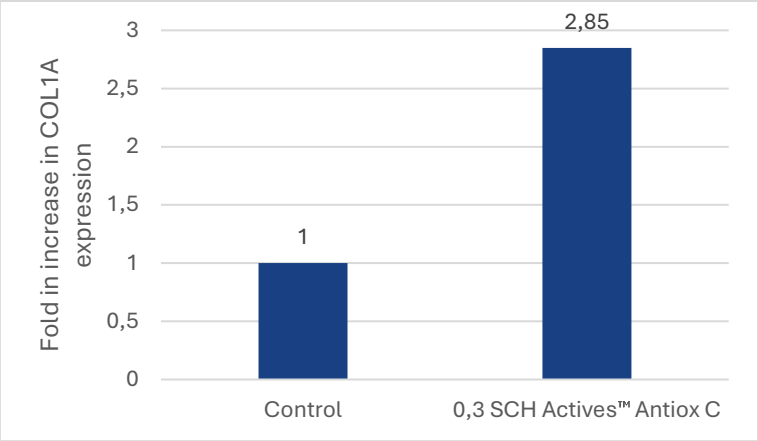

Figure 10. *Effect of SCH Actives™ Antiox C on COL1A1 Expression in Dermal Fibroblasts. Cells treated with 0,3%* ***SCH Actives™ Antiox C*** *for 24 hours showed a significant increase in COL1A1 expression.*

Protective Effect of SCH Actives™ Antiox C on Cell Viability in Human Dermal Fibroblasts Exposed to UVA Radiation

To assess the protective effects of **SCH Actives™ Antiox C** on UVA-induced cell damage, human dermal fibroblasts were pre-treated with 0,3% **SCH Actives™ Antiox C**, 15% Vitamin C, or 0,5% Ferulic Acid for 24 hours prior to UVA exposure (8 J/cm^2). Cell viability was evaluated using the MTT assay, with results expressed relative to the UVA-only group.

The data showed that pre-treatment with **SCH Actives™ Antiox C** significantly increased cell viability to 185% compared to the UVA-only group (Figure 11). Pre-treatment with 15% Vitamin C and 0,5% Ferulic Acid also improved cell viability, reaching 153% and 131% of the UVA-only group, respectively. These findings indicate that **SCH Actives™ Antiox C** provides the most substantial protection against UVA-induced cell damage, followed by Vitamin C and Ferulic Acid.

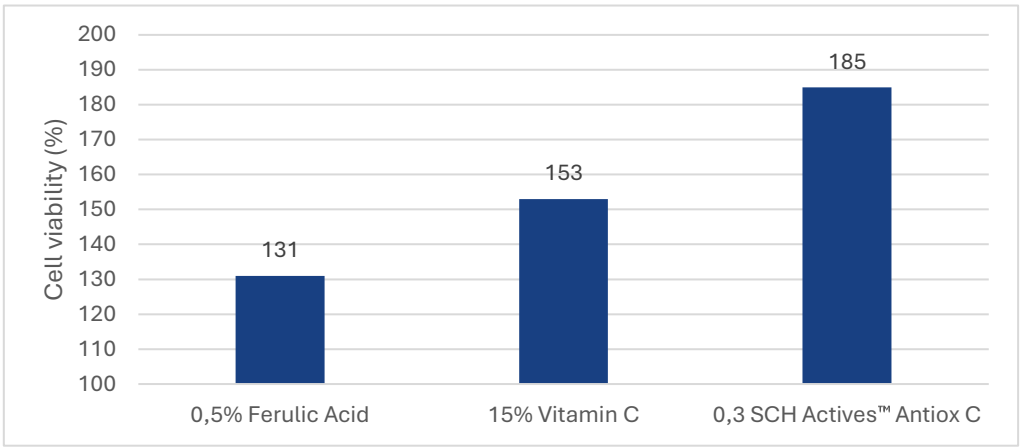

Figure 11. *Cell Viability in UVA-Exposed Human Dermal Fibroblasts Pre-treated with SCH Actives™ Antiox C. Cells were pre-treated with 0,3%* ***SCH Actives™ Antiox C****, 15% Vitamin C, or 0,5% Ferulic Acid for 24 hours before UVA exposure (8 J/cm^2). Cell viability was assessed 24 hours post-irradiation using the MTT assay, where absorbance values are proportional to the number of viable cells.*

Caspase-3 Activity Assay for Apoptotic Evaluation in Human Dermal Fibroblasts

Caspase-3 is a key enzyme involved in the execution phase of apoptosis, and its activity serves as a marker for cell death. The results of the caspase-3 activity assay showed that pre-treatment with **SCH Actives™ Antiox C** significantly reduced apoptotic activity in human dermal fibroblasts exposed to UVA radiation (Figure 12). The caspase-3 activity, which is indicative of apoptosis, was highest in the UVA-only group, and pre-treatment with **SCH Actives™ Antiox C** (0,3%) resulted in a substantial reduction in caspase-3 activity (mean = 3 ± 1). In comparison, pre-treatment with 15% Vitamin C and 0,5% Ferulic Acid reduced caspase-3 activity to a lesser extent, with mean values of 20 ± 6 and 50 ± 7, respectively. These findings indicate that **SCH Actives™ Antiox C** is highly effective in mitigating UVA-induced apoptosis in human dermal fibroblasts.

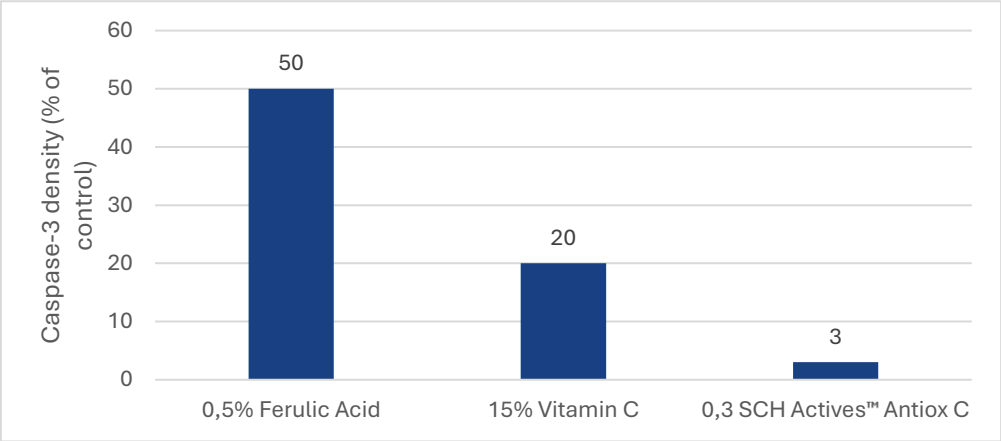

Figure 12. *Caspase-3 Activity in UVA-Exposed Human Dermal Fibroblasts. Caspase-3 activity was measured 24 hours after UVA exposure using a colorimetric assay, where absorbance values are directly proportional to the level of caspase-3 activity, indicating the extent of apoptosis.*

Tyrosinase Activity Assay

Tyrosinase activity is directly related to skin pigmentation and melanogenesis, which plays a role in the skin's response to UV radiation and aging. Overproduction of melanin, often triggered by UV exposure, can lead to the formation of age spots, hyperpigmentation, and uneven skin tone, which are common signs of photoaging. To assess the effect of **SCH Actives™ Antiox C** on tyrosinase activity, SK-MEL cells were incubated with 0,3% **SCH Actives™ Antiox C** for 24 hours, followed by lysis and incubation with L-DOPA to measure enzymatic activity. The results showed that **SCH Actives™ Antiox C** treatment significantly reduced tyrosinase activity, with a mean value of 56 ± 5.6% compared to the control group (100 ± 2%), indicating its ability to inhibit excessive melanin production (Figure 13). This suggests that **SCH Actives™ Antiox C** may help prevent or diminish age-related pigmentation changes and protect the skin from the visible signs of UV-induced damage, promoting a more even and youthful complexion.

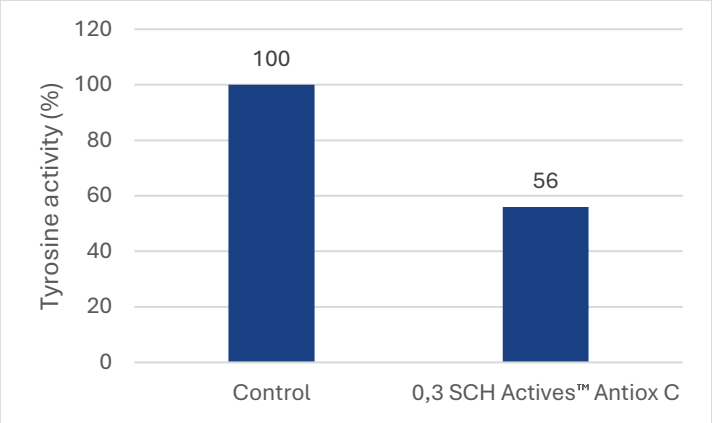

Figure 13. *Effect of SCH Actives™ Antiox C on Tyrosinase Activity in SK-MEL Cells. SK-MEL cells were treated with 0,3%* ***SCH Actives™ Antiox C*** *for 24 hours, and tyrosinase activity was measured using a colorimetric assay.*

In vivo studies

SCH Actives™ Antiox C Reduces Melanin Production and Enhances Skin Radiance After Solar-Simulated Radiation

Skin pretreated with vehicle, 0,5% ferulic acid, 15% vitamin C, or 0,3% SCH Actives™ Antiox C was exposed to solar-simulated radiation in a study involving 15 healthy participants aged 27-70 years. **SCH Actives™ Antiox C** demonstrated a visibly potent effect in reducing melanin production, with significant improvements in skin radiance compared to the other treatments (Figure 14). The results showed a noticeable reduction in skin darkening in the SCH Actives™ Antiox C group, highlighting its potential to inhibit excessive melanin production and protect the skin from UV-induced pigmentation changes.

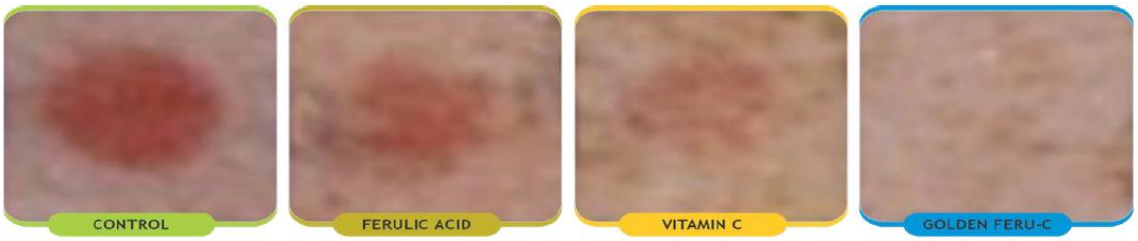

Figure 14. *Visual assessment of melanin production after solar-simulated radiation exposure in 15 participants treated with vehicle, 0,5% ferulic acid, 15% vitamin C, or 0,3% SCH Actives™ Antiox C.*

SCH Actives™ Antiox C Preserves Skin Antioxidant Capacity Against Ozone-Induced Oxidative Stress

The next study evaluated the protective effects of 0,3% SCH Actives™ Antiox C against oxidative damage induced by ozone exposure, a common environmental stressor that accelerates skin aging by generating reactive oxygen species (ROS) and depleting

antioxidants. In 20 healthy volunteers aged 35 to 60 years, β-carotenoid levels, a key biomarker of antioxidant capacity, were measured before and after ozone exposure. Skin was treated with either placebo or SCH Actives™ Antiox C on one hemiface, with the other side serving as a control, and exposed to ozone 15 minutes after application. In placebo-treated areas, β-carotenoid levels dropped significantly after ozone exposure, indicating a loss of antioxidants and oxidative damage (Figure 15). In contrast, pre-treatment with SCH Actives™ Antiox C preserved 81% (±3.2) of baseline β-carotenoid levels, demonstrating a substantial protective effect compared to the placebo, which retained only 45% (±5.1). Control areas maintained baseline levels (100% ±6). These results confirm that SCH Actives™ Antiox C effectively neutralizes ROS generated by ozone and helps preserve the skin's natural antioxidant defenses, protecting it from oxidative stress.

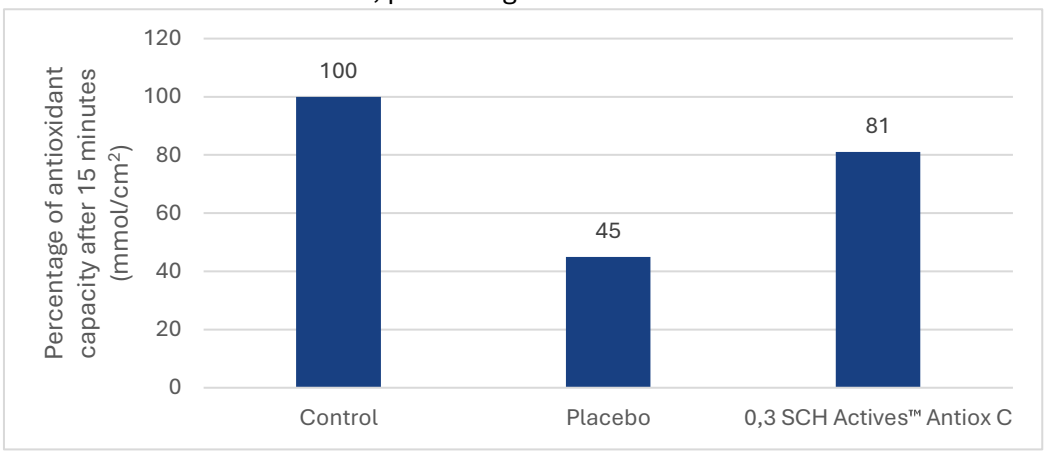

Figure 15: *β-carotenoid levels after ozone exposure in 20 healthy volunteers aged 35 to 60 years. Placebo-treated areas showed significant depletion, while 0,3% SCH Actives™ Antiox C preserved antioxidant levels, demonstrating its protective effect against oxidative stress.*

Significant Reduction in Wrinkle Appearance Following SCH Actives™ Antiox C Treatment

Next, the in vivo efficacy of 0.3 SCH Actives™ Antiox C Cream over a 28-day period with twice-daily application was evaluated, focusing on its impact on wrinkle length, volume and depth, as well as skin firmness and elasticity. After 28 days of applying 0,3% SCH Actives™ Antiox C cream, a noticeable visual improvement was observed, including reduced wrinkles, diminished redness, and less visible pigmentation (Figure 16).

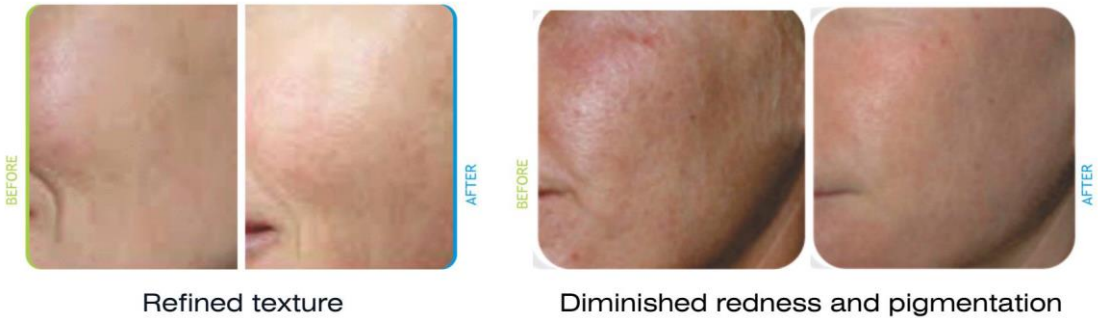

Figure 16: *Before and after images showing visual improvements after 28 days of applying 0,3% SCH Actives™ Antiox C cream. The images demonstrate a reduction in wrinkles, diminished redness, and less visible pigmentation.*

SCH Actives™ Antiox C Cream Significantly Enhances Skin Firmness and Elasticity

Next, the in vivo efficacy of 0,3% SCH Actives™ Antiox C was evaluated over a 28-day period with twice-daily application in a study aimed at assessing its effects on skin quality. Conducted on 20 participants aged 35-70 years, skin firmness and elasticity were measured using the Cutometer Dual MPA 580 for precise, objective data. The results showed that SCH Actives™ Antiox C significantly improved skin firmness by 37% and enhanced elasticity by 39%, highlighting its effectiveness as a powerful anti-aging skincare solution (Figure 17).

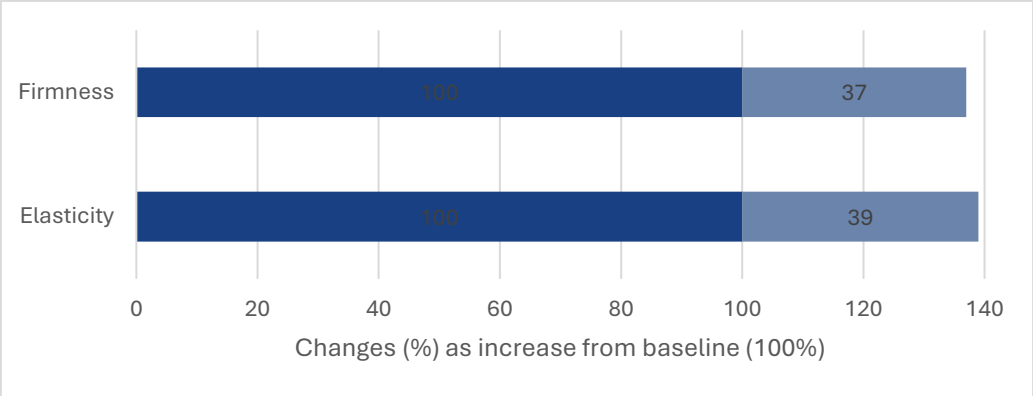

Figure 17: *Results of the firmness and elasticity assessment using a Cutometer Dual MPA 580, showing a 37% increase in firmness and a 39% increase in elasticity after applying 0,3% SCH Actives™ Antiox C Cream for 28 days. Data is presented as percentage change from baseline (before treatment = 100%).*

Average Irritation Index (Xav) Evaluation for SCH Actives™ Antiox C

0,3% SCH Actives™ Antiox C cream was evaluated for its potential to cause skin irritation in a study with 20 participants. Four key indicators—oedema (swelling), erythema (redness), itching, and burning sensation—were monitored at two intervals: 48 hours (T1) and 72 hours (T2) after application (Table 1). No signs of irritation were observed in any participants at either time point. There was no swelling or redness at the application site, and none of the participants reported itching or burning. The absence of irritation across all measures indicates that SCH Actives™ Antiox C has excellent skin tolerance, with an Average Irritation Index (Xav) of 0.

Indicator	48 hours (T1)	72 hours (T2)	Findings
Oedema (Swelling)	No irritation	No irritation	No swelling
Erythema (Redness)	No irritation	No irritation	No redness
Itching	No irritation	No irritation	No itching
Burning Sensation	No irritation	No irritation	No burning sensation
Average Irritation Index Xav	0	0	Excellent skin tolerance

Table 1*: This table summarizes the skin irritation study results for 0,3% SCH Actives™ Antiox C cream across two time points (48 hours and 72 hours).VI. Safety studies performed with the product*

In vitro cytotoxicity performed in keratinocytes incubated with **SCH Actives™ Antiox C** up to 50µg/mL indicated no reduction of cell viability.

SCH Actives™ Antiox C was tested using Ames test showing that the product is non genotoxic.

HetCam test performed with gold **SCH Actives™ Antiox C** (50µg/mL) did not show any sign of ocular irritation.

HRIPT test run in 50 panelists for 30 days indicates the product is totally safe, neither sensitization nor irritation was observed.

Conclusions

Ideal for skincare: TEM images and DLS measurements show uniformly distributed, 170 nm gold particles in SCH Actives™ Antiox C, optimized for skincare performance.

Long-lasting stability: SCH Actives™ Antiox C delivers unparalleled stability, maintaining 97% of its potency for up to 30 weeks in both aqueous and emulsion formulations, ensuring long-lasting efficacy and powerful results in your skincare products, even under heat stress.

Superior antioxidant capacity: SCH Actives™ Antiox C outperformed free Vitamin C and Ferulic Acid in antioxidant stability, retaining 89.8% of its scavenging activity after 40 hours, compared to just 55.9% for the free mixture, demonstrating its superior long-lasting effectiveness in preserving antioxidant power.

Enhanced skin delivery: Achieves 69% Vitamin C release in a Franz cell model after 20 hours.

Oxidative stress protection: Reduces ROS levels by over 50% in keratinocytes, shielding skin cells from oxidative damage.

Collagen boost: Increases collagen I synthesis by 2.6 times, promoting firmer, more youthful skin.

UVA protection: Improves cell viability by (+85%), offering superior protection against UVA-induced damage compared to Vitamin C and Ferulic Acid.

Reduces apoptosis: Decreases UVA-induced caspase-3 activity, protecting skin cells from damage.

Brightens and evens skin tone: Reduces tyrosinase activity by 44%, helping prevent hyperpigmentation and promoting a more even complexion.

Radiance boost: Significantly enhances skin radiance and reduces skin darkening compared to other treatments like Vitamin C and Ferulic Acid.

Ozone protection: Preserves 81% of antioxidant levels (β-carotenoids) after ozone exposure, protecting skin's natural defenses.

Anti-aging effects: Improves skin firmness by 37% and elasticity by 39% after 28 days of use.

Excellent skin tolerance: No irritation observed, with an Average Irritation Index (Xav) of 0, indicating high skin compatibility.

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