The Impact of the Omega-6 : Omega-3 Balance on Skin and Anti-Aging

Scientific Evidence for Dermatology, Aesthetics and Anti-Aging Medicine

Presentation for Dermatologists and Aesthetic Clinics

Based on Systematic Reviews, Clinical Trials and In Vivo/In Vitro Studies

Agenda

The Omega-6:3 Ratio and the Skin

OMEGA-6 (AA) in the Skin

PGE_2 → dermal inflammation, erythema, edema
LTB_4 → cutaneous neutrophil recruitment
TXA_2 → vasoconstriction, dermal hypoxia

Activates NF-κB → ↑ MMPs → collagen degradation
Activates COX-2 → amplifies UV photodamage
OXLAMs → oxidative stress in membranes

↑ Sebum production → inflammatory acne
↑ Altered ceramides → compromised barrier

OMEGA-3 (EPA+DHA) in the Skin

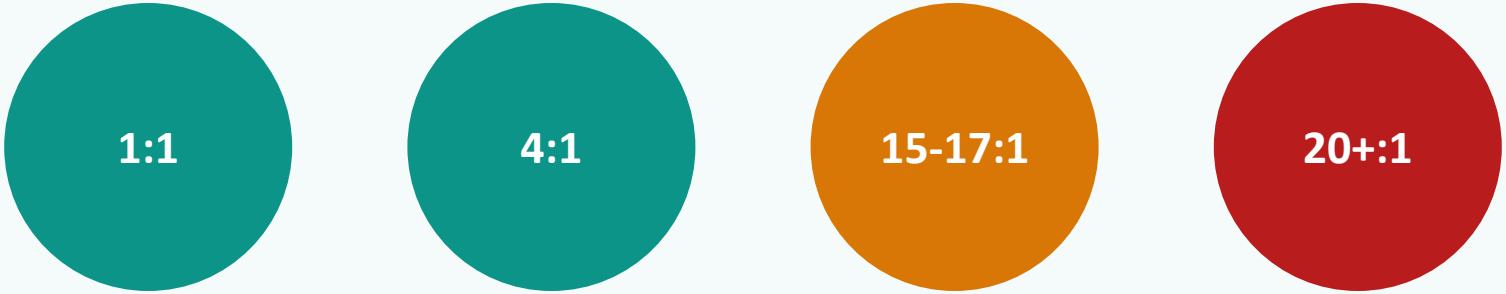
Resolvins → active resolution of cutaneous inflammation
Protectins → protection against UV damage
Maresins → repair and wound healing

Inhibits NF-κB → ↓ MMPs → preserves collagen
Inhibits COX-2 → endogenous photoprotection
↑ Endogenous antioxidants (SOD, GPx)

↓ Sebum production → less acne
↑ Ceramide synthesis → reinforced barrier

The RATIO determines whether the skin ages prematurely or repairs itself — it is the "biochemical switch" between photodamage and photoprotection

The Evolution of the Ratio and Its Impact on the Skin



Dermatological Context

Populations with a low ratio (Japan ~4:1, Okinawa ~1-2:1) present lower incidence of acne, psoriasis and premature skin aging compared to Western populations (15-20:1).

Observational studies confirm: higher intake of vegetables, olive oil and oily fish associated with fewer wrinkles in women >70 years (Purba et al. 2001, JACN). Diet rich in omega-6 (margarine, sugar, processed foods) associated with more photodamage.

The modern dietary revolution — sunflower, soy and corn oils — profoundly altered the biochemical environment of the skin.

RATIO ≥ 15:1

The Pro-Skin Aging Environment

Impact across 5 critical dermatological domains

High Ratio: Photoaging and Collagen Degradation

Photodamage Cascade

UV + High ratio → amplified cascade:

1. UV activates NF-κB and AP-1 in keratinocytes
2. ↑ COX-2 → ↑ PGE_2 → erythema, edema, inflammation
3. ↑ MMP-1 (collagenase) → degrades type I and III collagen
4. ↑ MMP-9 (gelatinase) → degrades basement membrane
5. ↑ ROS → membrane lipid peroxidation
6. ↓ Procollagen → loss of regenerative capacity

AA (omega-6) INCREASED MMP-1 slightly
EPA (omega-3) INHIBITED MMP-1 by 79%
(Kim et al. J Lipid Res 2005)

In Vivo Evidence (Humans)

Kim et al. (2005, J Invest Dermatol):
Topical EPA 2% application in volunteers:
- Reduced UV epidermal thickening by 72%
- Restored procollagen from 18% to 46%
- Attenuated COX-2, MMP-1 and MMP-9

In elderly (≥75 years), 2 weeks of topical EPA:
- ↑ Dermal procollagen
- ↑ Tropoelastin and fibrillin-1
- Anti-aging effect intrinsic AND extrinsic

Purba et al. (2001, JACN, n=453):
Higher omega-3 and vegetable intake = fewer wrinkles in photoexposed areas

EPA inhibited MMP-1 by 79% vs. AA which INCREASED MMP-1 — the ratio determines whether UV destroys or preserves collagen

High Ratio: Skin Barrier, Hydration and TEWL

Compromised Barrier

Pro-inflammatory cytokines (IL-6, TNF-α) alter ceramide metabolism enzyme activity — modifying the ceramide composition of the stratum corneum. Result: damaged lipid barrier → increased TEWL → dry, sensitive and reactive skin.

Dermal Dehydration

UV + chronic inflammation ↓ dermal hyaluronic acid (downregulation of HAS genes). Without active resolution (resolvins), inflammation perpetuates the loss of water retention capacity. Chronically dehydrated skin ages faster.

Cutaneous Sensitization

Excess omega-6 sensitizes keratinocytes to external stimuli — UV, pollution, irritating cosmetics. Patients with a high ratio are more prone to irritant contact dermatitis, rosacea and post-procedure erythema.

Bae & Park, J Derm Treat 2021 | Cho 2019 | Front Nutr 2024 | PMC6117694

High Ratio: Acne, Psoriasis and Atopic Dermatitis

Acne Vulgaris

↑ PGE_2 and LTB_4 → follicular inflammation
↑ IGF-1 and mTOR → hyperseborrhea
Skin microbiome dysbiosis
High ratio amplifies the comedonal inflammatory cascade

Psoriasis

↑ LTB_4 → neutrophilic recruitment in the epidermis
↑ TNF-α, IL-17 → keratinocyte hyperproliferation
Chronically activated NF-κB
Omega-3 proven to reduce PASI score

Atopic Dermatitis

Altered ceramide composition → compromised barrier
↑ TEWL → xerotic and pruritic skin
↑ Cutaneous allergic sensitization
Krill oil ↓ TEWL in AD models in 3-5 weeks

Guertler et al.: 16 weeks of EPA+DHA (800mg DHA + 400mg EPA/day) significantly improved acne severity ($p<0.001$) — objective dermatological assessment with inflammatory and non-inflammatory lesion counts.

High Ratio: Cellular Aging and Telomeres

Chronic Inflammation → Accelerated Aging

The concept of "inflammaging" — chronic low-grade inflammation that accelerates aging — is central in anti-aging dermatology.

An elevated ω-6:ω-3 ratio is one of the main drivers of inflammaging:

- ↑ NF-κB → chronic pro-inflammatory cytokines
- ↑ ROS → mitochondrial oxidative stress
- ↑ MMPs → continuous ECM degradation
- ↓ Resolution → perpetual inflammatory cycle

Result: fibroblasts with senescent phenotype, progressive loss of collagen and elastin, and accelerated skin aging.

Telomeres and Omega-3

Telomeres — the protective caps of chromosomes — shorten with each cell division. Accelerated shortening is a marker of biological aging.

Evidence:
- Higher EPA+DHA levels are associated with longer telomeres (multiple observational studies)
- Recent review: majority of evidence points to EPA/DHA slowing telomere shortening
- Mechanism: ↓ oxidative stress and ↓ chronic inflammation — the two drivers of shortening

Clinical implication: Regulating the ratio may influence biological aging at the DNA level — not just cosmetically.

Omega-3 acts on aging at 3 levels: cutaneous (collagen), cellular (senescence) and genomic (telomeres)

WHAT IF WE REDUCE THE RATIO?

Ratio ≤ 3:1 — Anti-Aging from the Inside Out

Dermal Protection Mechanisms with Ratio ≤3:1

Anti-Photoaging

EPA inhibits MMP-1 by 79% and MMP-9 in UV-irradiated fibroblasts. Restores procollagen and tropoelastin. Documented endogenous photoprotection.

Skin Barrier

EPA/DHA incorporate into the phospholipid membrane of keratinocytes → ↓ TEWL, ↑ hydration, reinforcement of the stratum corneum ceramide barrier.

Dermal Anti-Inflammatory

Resolvins and protectins resolve cutaneous inflammation → ↓ TNF-α, IL-6, PGE_2 → less erythema, edema and post-procedure sensitivity.

Collagen Synthesis

↑ Procollagen type I and III. ↑ Fibrillin-1 and tropoelastin. Effect documented in both young AND aged skin (Kim et al. J Invest Dermatol).

Hyaluronic Acid

Krill oil ↑ HA synthesis in a dose-dependent manner (Front Nutr 2024). Restores HA in UV-damaged skin → better water retention → plumper skin.

Endogenous Antioxidant

↑ SOD, GPx, endogenous catalase. ↓ Membrane lipid peroxidation. ↓ DNA damage (8-OHdG). Mitochondrial protection → healthy cell turnover.

EPA+DHA + Polyphenol Synergy: The Differentiator

The combination of omega-3 with polyphenols is more effective than either one alone

EPA + DHA

Modulate inflammatory pathways (COX, LOX, NF-κB)

Inhibit MMPs
Preserve collagen

Generate resolvins and protectins

Reinforce lipid barrier

+

Polyphenols

Neutralize ROS (direct antioxidants)

Inhibit MMP-1 and MMP-9
Protect DNA

Stimulate fibroblast activity

Improve UV repair

=

SYNERGY

Amplified collagen preservation

Superior epidermal hydration

↓ Cytokines + ↓ ROS simultaneously

Anti-aging from the inside out

Tranchida et al. (2025): Diet rich in EPA/DHA + polyphenols improves collagen preservation and epidermal hydration in photoaging. Eghbali et al. (2021): Co-administration of omega-3 + green tea polyphenols reduced inflammatory cytokines and DNA damage more than either intervention alone. BalanceOil+ combines marine omega-3 with extra-virgin olive oil polyphenols — replicating this synergy.

Clinical Evidence: Documented Results

RCT: Texture, Hydration and Elasticity

n=120 | 12 weeks | EPA+DHA+Vit E

Significant improvement in skin texture, hydration and elasticity. Objective and subjective assessment.

Oyovwi et al. 2025

Acne: Significant Objective Improvement

n=60 | 16 weeks | 800mg DHA + 400mg EPA/day

Acne severity improved ($p<0.001$) with objective count of inflammatory and non-inflammatory lesions. Dose increased after baseline omega-3 assessment.

Guertler et al. (J Cosmet Derm)

In Vivo Photoprotection

Healthy volunteers | Topical EPA 2%

UV epidermal thickening reduced by 72%. Procollagen restored. MMP-1, MMP-9 and COX-2 attenuated. Anti-aging effect in young and aged skin.

Kim et al. J Invest Dermatol 2005

Hydration and Wrinkles

n=31 | 13 weeks | Krill oil 3g/day

Significant improvements in hydration, elasticity and TEWL. Reduction in roughness and increase in smoothness assessed by digital camera.

Front Nutr 2024 | Kim et al. Marine Drugs 2023

Direct Comparison: Ratio ≥15:1 vs. ≤3:1

Domain	Ratio ≥15:1	Ratio ≤3:1
Collagen	MMPs ↑↑ → accelerated degradation	MMPs ↓79% (EPA), ↑ procollagen I/III
Photoaging	UV amplified: COX-2↑, PGE_2↑, ROS↑	Endogenous photoprotection, ↓ erythema, ↓ DNA damage
Skin Barrier	Altered ceramides, TEWL↑, dry skin	Reinforced barrier, TEWL↓, hydration↑
Elasticity	↓ Elastin, ↓ fibrillin-1, sagging skin	↑ Tropoelastin, ↑ fibrillin-1, firmness↑
Hyaluronic Acid	↓ Dermal HA, deep dehydration	↑ Dose-dependent HA synthesis
Acne / Inflam.	PGE_2↑, LTB_4↑, sebum↑, inflammatory lesions	Resolvins↑, ↓ inflammation, ↓ lesions ($p<0.001$)
Telomeres / DNA	Accelerated shortening, senescence	Slowed shortening, DNA protection
Global Aging	Inflammaging → premature aging	Active resolution → healthy aging

Scenario: Same Patient, Two Ratios

Female, 45 years, phototype III, moderate photodamage, wrinkle complaint, dry skin and residual acne

RATIO 18:1

- Degraded collagen (elevated MMPs)
- Deep wrinkles, loss of firmness
- Chronically dehydrated skin (TEWL↑)
- Compromised barrier → sensitivity
- Prolonged post-procedure erythema
- Persistent inflammatory acne
- Limited response to aesthetic treatments
- Accelerated aging (inflammaging)

Treatments act on inflamed skin

RATIO ≤3:1

- Preserved collagen (inhibited MMPs)
- Attenuated wrinkles, improved firmness
- Hydrated skin (HA↑, TEWL↓)
- Reinforced barrier → less reactivity
- Faster post-procedure recovery
- Controlled acne (active resolvins)
- Better response to aesthetic treatments
- Active anti-aging (inflammatory resolution)

Treatments act on prepared skin

The Opportunity for the Aesthetic Clinic

Competitive Differentiation

The clinic that integrates omega-6:3 ratio regulation into its protocol positions itself as a reference in evidence-based aesthetic medicine. It goes beyond topical treatment — addressing the systemic cause of skin aging.

Superior Results

Patients with a regulated ratio (≤3:1) respond better to all treatments: laser, peels, injectables, biostimulators. Prepared skin (without inflammaging) maximizes the ROI of each procedure.

Loyalty and Recurring Revenue

The Measure→Correct→Monitor protocol creates a follow-up cycle every 120 days. The test and supplement generate recurring revenue while improving clinical outcomes.

Protocol: Measure, Correct, Monitor

1. MEASURE

Dried blood fatty acid test (BalanceTest) — determines the patient's ω-6:ω-3 ratio and Omega-3 Index. Allows personalization of the intervention and establishes a measurable baseline before any aesthetic protocol.

2. CORRECT

BalanceOil+ with high-bioavailability EPA+DHA + extra-virgin olive oil polyphenols. Dose adjusted to body weight (~0.15ml/kg). The omega-3 + polyphenol synergy replicates the most effective combination documented in the literature (Tranchida 2025, Eghbali 2021). Complement with reduction of processed oils in the diet.

3. MONITOR

Re-test at 120 days. Target: ratio ≤3:1 and Omega-3 Index ≥8%. Document skin evolution with standardized photographs. The biochemical + visual before/after is the proof of value for the patient and for the clinic.

Scientific References (1/2)

1. Kim HH et al. EPA inhibits UV-induced MMP-1 in dermal fibroblasts. J Lipid Res 2005;46:1712-20.
2. Kim HH, Cho S et al. Photoprotective and anti-aging effects of EPA in human skin in vivo. J Invest Dermatol.
3. Purba MB et al. Skin wrinkling: can food make a difference? JACN 2001;20:71-80.
4. Balić A et al. Omega-3 vs omega-6 PUFAs in the prevention and treatment of skin diseases. IJMS 2020.
5. Tranchida F et al. EPA/DHA and polyphenols in photoaging. 2025.
6. Eghbali S et al. Co-admin omega-3 + green tea polyphenols: reduced cytokines and DNA damage. 2021.
7. Oyovwi MO et al. RCT: EPA+DHA+VitE on skin texture, hydration, elasticity. 2025.
8. Guertler A et al. EPA+DHA supplementation in mild-moderate acne. J Cosmet Derm.
9. Mateu-Arrom L et al. Topical ω-3 PUFAs in skin diseases. J Cosmet Derm 2025. PMC12228025.
10. Huang TH et al. Cosmetic and therapeutic applications of fish oil. PMC6117694.

Scientific References (2/2)

11. Bae JY, Park SN. Omega-3 FAs in skin barrier function. J Derm Treat 2021;32(7):735-42.
12. Cho S. The role of functional foods in cutaneous anti-aging. J Lifestyle Med 2019.
13. Front Nutr 2024. Krill oil and skin anti-aging. doi: 10.3389/fnut.2024.1388155.
14. Kim J et al. Krill oil protective benefits against UV-B photoaging. Marine Drugs 2023;21(9):479.
15. Cosgrove MC et al. Dietary nutrient intakes and skin-aging. Am J Clin Nutr 2007;86:1225-31.
16. Kalogerakou T, Antoniadou I. CoQ10 and omega-3s: mitochondrial stability and elasticity. 2024.
17. Petruk G et al. Antioxidants from natural sources in dermatology. 2018.
18. Linus Pauling Inst. Essential Fatty Acids and Skin Health. Oregon State University.
19. Preprints.org 2025: Enhancing Skin Health Through Omega-3 FAs and Antioxidant-Rich Diets.
20. Simopoulos AP. The importance of omega-6/omega-3 ratio. Biomed Pharmacother 2002.

Conclusion

Regulating the omega-6:omega-3 ratio to ≤3:1 is an evidence-based inside-out anti-aging intervention with the potential to:

- Inhibit MMPs by up to 79% and preserve collagen and elastin
- Reinforce the skin barrier and reduce TEWL
- Increase dermal hydration via hyaluronic acid synthesis
- Reduce cutaneous inflammation (acne, rosacea, atopic dermatitis)
- Protect against photoaging endogenously
- Improve skin response to aesthetic and dermatological treatments

ANTI-AGING STARTS FROM WITHIN — THE FIRST STEP IS TO MEASURE THE RATIO

BalanceTest + BalanceOil+: the combination that transforms supplementation into a measurable intervention every 120 days.