Dietary Supplements and Skin Anti-Ageing: Separating Facts from Fiction

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ABSTRACT

Background: Recently, the global dietary supplement market has experienced a surge, fueled by consumer demand for non-invasive ways to slow or reverse skin ageing. Ageing skin undergoes structural and biochemical changes, which manifest as wrinkles, dryness, and laxity. Ageing of the skin is influenced by intrinsic (genetic) and extrinsic (UV exposure, pollution, lifestyle) factors. Dietary supplements – supplements added to improve the normal diet - improve skin health and potentially slow down visible signs of ageing.

Objective: To critically evaluate clinical evidence supporting the use of popular oral dietary supplements for skin anti-ageing.

Methods: A narrative review of peer-reviewed journal articles was conducted. Databases were searched for randomized controlled trials, cross-sectional analyses, systematic reviews, and meta-analyses assessing oral supplementation with vitamins (C, D, E), carotenoids, collagen peptides, hyaluronic acid, Coenzyme Q10, essential fatty acids, polyphenols, zinc, and selenium on skin ageing parameters. Studies were organized by supplement class, with emphasis on clinical outcomes (wrinkle depth, elasticity, hydration) and mechanisms of action.

Result: Certain supplements demonstrate anti-ageing potential: vitamin C improves radical scavenging and reduces wrinkles; hydrolyzed collagen enhances hydration and elasticity (supported by meta-analyses); hyaluronic acid boosts skin moisture. However, small sample sizes, short study durations, and heterogeneity in supplement formulations limit the strength of the conclusion.

Conclusion: Dietary supplements are adjuncts to holistic skin ageing strategies that incorporate photoprotection, nutrition, and lifestyle, but they are not standalone. Large-scale, long-term randomized trials with standardized formulations and dosing remain a priority for future research.

Keywords: dietary supplements, skin ageing, skin anti-ageing, dermatology

Compléments Alimentaires et Vieillissement Cutané : Démêler le vrai du faux
Titre courant : Compléments Alimentaires et Vieillissement Cutané

Résumé

Contexte : Le marché mondial des compléments alimentaires a récemment connu une forte croissance, alimentée par la demande des consommateurs pour des méthodes non invasives permettant de ralentir ou d'inverser le vieillissement cutané. La peau vieillissante subit des modifications structurelles et biochimiques qui se manifestent par des rides, une sécheresse et un relâchement cutané. Le vieillissement cutané est influencé par des facteurs intrinsèques (génétiques) et extrinsèques (exposition aux UV, pollution, mode de vie). Une supplémentation en nutriments ajoutée à l'alimentation courante pour améliorer la santé de la peau, peuvent potentiellement ralentir les signes visibles du vieillissement.

Objectif : Évaluer de manière critique les preuves cliniques soutenant l'utilisation de compléments alimentaires oraux populaires pour lutter contre le vieillissement cutané.

Méthodes : Une revue narrative d'articles de revues à comité de lecture a été réalisée. Des bases de données ont été consultées afin d'identifier les essais contrôlés randomisés, les analyses transversales, les revues systématiques et les méta-analyses évaluant l'effet d'une supplémentation orale en vitamines (C, D, E), caroténoïdes, peptides de collagène, acide hyaluronique, coenzyme Q10, acides gras essentiels, polyphénols, zinc et sélénium sur les paramètres du vieillissement cutané. Les études ont été classées par type de supplément, en privilégiant les résultats cliniques (profondeur des rides, élasticité, hydratation) et les mécanismes d'action.

Résultats : Certains suppléments alimentaires présentent un potentiel anti-âge : la vitamine C améliore la neutralisation des radicaux libres et atténue les rides ; Des méta-analyses ont confirmé que le collagène hydrolysé améliore l'hydratation et l'élasticité de la peau ; l'acide hyaluronique stimule l'hydratation cutanée. Toutefois, la petite taille des échantillons, la courte durée des études et l'hétérogénéité des formulations limitent la portée de ces conclusions.

Conclusion : Les compléments alimentaires sont des adjuvants aux stratégies globales de lutte contre le vieillissement cutané qui intègrent la photoprotection, la nutrition et l'hygiène de vie, mais ne constituent pas un traitement unique. Les essais randomisés à grande échelle et à long terme, avec des formulations et des dosages standardisés, demeurent une priorité pour les recherches futures.

Mots-clés : Compléments alimentaires, vieillissement cutané, anti-âge cutané, dermatologie

Introduction

The beauty and nutraceutical market has evolved and has sold the illusion of eternal youth, promising age reversal in a bottle – from anti-ageing capsules to collagen powders. Yet the question remains: do these supplements work, or are we buying into promises masked as science? Are the data behind dietary supplements grounded in facts or driven by fiction?

Advances in healthcare have increased longevity, making anti-ageing concepts, including skin anti-ageing, a priority. The skin changes as one approaches the third decade of life.[1] Research on ageing became a prominent focus of biological inquiry approximately 30 years ago.[2]

Ageing is a multifaceted biological process that affects all organs, including the skin, which is one of the most evident indicators of ageing.[2] Skin ageing is a complex, progressive degeneration of the skin and its supporting structures. It involves numerous biological and biochemical changes, as well as secondary structural changes of the skin.[3] Intrinsic factors such as genetics and cellular metabolism, as well as extrinsic factors such as environmental exposure and lifestyle changes, influence skin ageing.[4,5]

Understanding the mechanisms of ageing helps develop strategies that promote healthy ageing and reduce its negative impact on skin appearance and function.[6] Recently, there have been proposals to use several dietary supplements to improve skin appearance.[7] Oral micronutrient supplementation aimed at preventing skin ageing has gained considerable attention, particularly as scientific insights into the underlying pathological mechanisms of ageing continue to emerge.[8]

The global market for dietary supplements was valued at $194.56 billion in 2024, with projections of $211.68 billion in 2025 and $415.63 billion by 2033.9 This growth represents a compound annual growth rate (CAGR) of 8.80% over the forecast period from 2025 to 2033.9 In Nigeria, the vitamins and minerals market is expected to generate $60.29 million in revenue in 2025, with an annual growth rate of 11.21% anticipated.[10]

Dietary supplements are often perceived as natural and safe. A study in southwestern Nigeria found that most respondents (literate women) believe that dietary supplements prevent the ageing process in older women.[11]

This review examines the evidence behind popular dietary supplements used for skin anti-ageing, separating scientific facts from marketing fiction.

Methodology

This narrative review was conducted through a comprehensive literature search of peer-reviewed English-language articles. Electronic databases, including PubMed/MEDLINE, Scopus, and Google Scholar, were searched for relevant studies evaluating dietary supplements for skin ageing and skin health.

Search terms included combinations of keywords such as "dietary supplements," "nutraceuticals," "skin ageing," "photoaging," "collagen supplementation," "antioxidants," "vitamins," "skin elasticity," "wrinkles," and "cosmetic dermatology." Additional articles were identified through manual review of the reference lists of selected publications.

Eligible studies included randomized controlled trials, observational studies, review articles, systematic reviews, and relevant experimental studies that assessed the effects of dietary supplements on clinical, biochemical, or biophysical markers of skin ageing. Articles focusing solely on topical interventions and animal studies without clinical relevance were excluded.

Results

The literature search yielded approximately 77 relevant sources after applying the inclusion and exclusion criteria. The selected studies focused primarily on vitamins, carotenoids, collagen peptides, hyaluronic acid, coenzyme Q10, essential fatty acids, polyphenols, zinc, and selenium. They evaluated outcomes such as wrinkle depth, skin elasticity, hydration, pigmentation, photodamage, antioxidant activity, and safety profiles.

Dietary Supplements

These are products or supplements added to the diet and are distinct from conventional foods.12 Supplements are mostly taken orally and come in many forms, including tablets, capsules, soft gels, gel caps, powders, gummies, bars, and liquids. Supplements improve skin health and promote a youthful appearance.[13]

Popular dietary supplements for skin anti-ageing

Vitamin C

It is an essential vitamin that must be obtained from the diet. It scavenges free radicals and serves as a necessary cofactor in collagen synthesis and stabilization.[14] A narrative review on the role of vitamin C in skin ageing found that vitamin C maintains skin health and combats skin ageing.[15] In a randomized, placebo-controlled clinical trial by Lauer et al., 33 volunteers were supplemented with either vitamin C or a placebo for four weeks.[16] The study measured changes in the skin's radical-scavenging activity in vivo. After four weeks, participants who took 100 mg of vitamin C daily showed a 22% increase in radical-scavenging activity, while those taking 180 mg daily showed a 37% increase. No changes were observed in the placebo group ($p = 0.6$).[16] They found that orally administered vitamin C increases the skin's radical-scavenging activity, and that this effect is enhanced at higher vitamin C doses.[16] However, the small sample size limits the study's statistical power and reduces confidence in the generalizability of the observed effect. While the findings suggest that oral vitamin C may enhance the skin's antioxidant capacity in a dose-dependent manner, larger and longer-term studies are required to confirm these effects and determine their clinical relevance.

Cosgrove et al. found that higher dietary vitamin C intake significantly reduces the likelihood of senile xerosis and a wrinkled appearance. ($p<0.009$).[17] Another review by Brett West showed that oral vitamin C, grape seed extract and citrus bioflavonoids protect the skin from photoaging.[18]

In a cross-sectional observational study conducted in the U.S., Cosgrove et al. examined the association between nutrient intake and skin ageing in 4,025 women aged 40–74 years.[17] They found that higher vitamin C intake was associated with a lower likelihood of a wrinkled appearance [odds ratio (OR) 0.89; 95% CI: 0.82, 0.96] and senile dryness (OR: 0.93; 95% CI: 0.87, 0.99).[17] However,

these findings should be interpreted with caution. As a cross-sectional study, it cannot establish causality or the direction of the association between nutrient intake and skin ageing. Additionally, the data were drawn from NHANES I (1971–1975), and a cohort effect cannot be ruled out.[17] Changes in dietary patterns over the past 30 years may also limit the applicability of the results.[19]

Vitamin E

It is a fat-soluble vitamin which comprises tocopherols and tocotrienols.[20] It is an antioxidant and protects the cellular membrane from lipid peroxidation by free radicals.[21] The antioxidant activity of vitamin E is dependent on the action of other agents – ascorbic acid, vitamin B3, selenium and glutathione.[22]

Almonds contain high levels of vitamin E. Two randomized controlled trials (with sample sizes of 91 and 31 postmenopausal women, respectively) found that women who consumed almonds accounting for 20% of their daily caloric intake showed a significant reduction in wrinkles and facial pigmentation.[23, 24] This suggested that daily consumption of almonds may improve facial wrinkles and reduce skin pigmentation in postmenopausal women.[23,24] These studies were limited by short study durations of 24 weeks and 16 weeks, respectively, and the nature of the study participants - postmenopausal women with sun-sensitive Fitzpatrick skin types I and II. This limits the generalizability of the study's outcomes, especially for younger females, males, and individuals with higher Fitzpatrick skin types.

A systematic review evaluating the effects of tocotrienols on ageing skin, which analyzed 18 articles, suggests that both oral and topical tocotrienol treatments may delay skin ageing by reducing inflammation, decreasing melanin accumulation, and protecting against UV exposure.[25]

Vitamin D

It is a fat-soluble vitamin obtained from the diet and from sunlight exposure.[26] Vitamin D has demonstrated protective effects against both intrinsic and extrinsic skin ageing. Its benefits include stimulating collagen synthesis, modulating oxidative stress and inflammation, repairing UV-induced damage, enhancing epidermal barrier function, and supporting wound healing.[27,28]

A systematic review assessed the role of vitamin D in skin ageing and included 8 articles. They found that vitamin D can delay the ageing process.[29] However, most of the studies in this review were done in culture or model skin – mouse skin.

Vitamins Combinations

Combining several vitamins with other supplements is an effective strategy for skin anti-ageing. Some studies have shown that the combination of Vitamins C and E provides better photoprotection than either alone.[30,31] This synergistic effect is attributed to their complementary mechanisms of action: vitamin E primarily protects cell membranes from lipid peroxidation. In contrast, vitamin C regenerates oxidized vitamin E back to its active form and scavenges aqueous free radicals.[31]

Carotenoids

Carotenoids are a class of more than 700 naturally occurring fat-soluble yellow, orange, red and green pigments produced in fruits and vegetables.[32] They are divided into provitamin A molecules – β-carotene, α-carotene, and β-cryptoxanthin, which can be converted to retinol and non-provitamin A compounds such as xanthophylls like lycopene, lutein and zeaxanthin that cannot be converted to retinol (vitamin A).[33]

Diets rich in β-carotene through nutritional supplementation prevent cellular damage, premature skin ageing, and skin cancer.[33-35] It does this via quenching reactive oxygen species and inhibiting inflammation.

Meinke et al. observed an increase in the skin's radical scavenging activity in 24 healthy volunteers after 8 weeks of vitamin A supplementation.[36] They observed that

supplementation with carotenoid-containing dietary products at physiological concentrations can protect the skin against reactive oxygen species and help prevent premature skin ageing and other radical-associated skin diseases.[36] Milani and Colombo conducted a prospective, 12-week, randomized, parallel-group trial comparing the effectiveness of combined oral vitamin supplementation and topical treatment versus topical treatment alone.[37] Group A received only the topical retinoic acid gel. Group B received a daily oral supplement containing 50,000 IU of vitamin A and 50 mg of vitamin E, along with a 0.02% retinoic acid topical gel applied in the evening.[37]

A total of 60 participants (men and women aged 50 years or older, mean age 60 ± 8 years) with moderate-to-severe facial skin ageing were enrolled. The results showed that the combination of moderate-to-high oral vitamin A (retinol) doses and a topical retinoic acid gel led to significantly greater clinical improvement than topical retinoic acid alone in individuals with moderate-to-severe skin ageing.[37] The study's limitations were that it was an open trial and the lack of an oral placebo in Group A to increase the internal validity of the study.[37] Cho et al found that 30 mg/day of β-carotene supplementation both prevents and repairs photoaging.[8]

Collagen

Collagen is the main protein component of various connective tissues and constitutes 80% of the dry weight of human skin.[50] It provides mechanical support.[50] As we age, our skin quality deteriorates in two main ways: the body produces less collagen, and the blood supply to the skin decreases. These changes result in skin that is less elastic and more prone to developing wrinkles.[38]

Sources of collagen include bovine, porcine, ovine, fish, chicken, duck and rabbit.[39] These collagen sources can be broken down into a group of peptides with low molecular weight (3–6 KDa) called hydrolyzed collagen.[39] Hydrolyzed collagen is used as a food supplement because of its bioavailability.[40] When digested, it is broken down into dipeptides and tripeptides, which are largely deposited in the skin.[41] These dipeptides stimulate the metabolism, migration, and proliferation of fibroblasts and generate increased collagen and hyaluronic acid production.[41]

A systematic review and meta-analysis evaluating the effect of hydrolyzed collagen on skin ageing found that ingestion of hydrolyzed collagen for 90 days is effective in reducing skin ageing, as it reduces wrinkles and improves skin elasticity and hydration.[41] They also noted that hydrolyzed collagen is safe because there were no reports of adverse effects in any of the analyzed studies.[41] The limitations of this study were the large heterogeneity of the studies, mainly due to the composition of the supplements, methods used to verify the results, and different measurement units, making it difficult to compare them in terms of both intervention and outcomes.[41]

Another systematic review and meta-analysis of 26 randomized controlled trials (RCTs) involving 1721 patients also found that hydrolyzed collagen supplementation improves skin hydration and elasticity.[42] In addition, long-term use of collagen yields more favourable effects on skin hydration and elasticity than short-term use. This study had several limitations: heterogeneity in interventions due to differing supplement compositions and measurement units; small sample sizes in some studies (fewer than 40 participants), which may increase the risk of bias; and limited data on participants' lifestyle habits.[42]

Dewi et al., in a systematic review and meta-analysis exploring the impact of oral hydrolyzed collagen on skin rejuvenation, comprising 14 distinct studies and a collective cohort of 967 participants, concluded that the findings are encouraging and support the use of hydrolyzed collagen supplementation for anti-ageing.[43] Their analysis consistently demonstrated substantial improvement in skin moisture levels and elasticity compared to the placebo group. Although the limitations of the systematic review and meta-

analyses were significant heterogeneity across the included studies, due to varying compositions of the supplements used based on the hydrolyzed collagen source, some used products from various fish, while other studies combined hydrolyzed collagen with other ingredients such as vitamins C and E.

Hyaluronic acid

Hyaluronic acid (HA) is a glycosaminoglycan found in many tissues throughout the body, including skin, connective tissue, and eyes.[44,45] It retains large amounts of water, which is important for maintaining skin hydration and elasticity. HA is also a key component of the extracellular matrix, which provides structural support and maintains skin integrity.[45]

A randomized, placebo-controlled, parallel-group clinical study conducted at two centres in Italy and China involving 88 subjects found that oral HA supplementation is effective in reducing skin ageing; however, combining oral HA supplementation with topical HA products yielded better results.[46] Another randomized controlled study confirms these findings, showing that taking hyaluronic acid orally significantly increased skin hydration within 2-8 weeks, irrespective of age.[47] Improvements in skin tone became visible after 4-8 weeks of supplementation, while the skin's outer layer (epidermis) measurably thickened after 12 weeks of continued use.[47] Similar results were seen in other studies.[48,49]

Coenzyme Q10

Coenzyme Q10, Co Q10 or ubiquinone (2,3-dimethoxy-5-methyl-6-decaprenyl-1,4-benzoquinone) is a small, lipophilic structure composed of a benzoquinone ring and an isoprenoid chain and is found universally in cell membranes.[50] It has antioxidant and anti-inflammatory properties.[51,52]

A double-blind randomized controlled trial with 33 participants evaluated oral CoQ10's impact on the skin and found improvements in wrinkles and skin smoothness, but no changes in hydration, dermal thickness, or minimum erythema dose.[53]

Another randomized, double-blind, placebo-controlled study examined the effects of a liquid food supplement, a combination of water-soluble coenzyme Q10 (Q10Vital®) and collagen, on dermal density and other skin parameters compared with placebo.[54] The trial recruited 34 healthy women aged 40–65 years. They received either the test product (n = 17) or the placebo (n = 17) for twelve weeks. The skin parameters were measured at baseline and after 12 weeks of intervention, and the intervention group showed improved dermal density, reduced periorbital wrinkles and total wrinkle score, and improved skin smoothness.[54] However, changes in skin hydration, dermal thickness, transepidermal water loss (TEWL), and viscoelasticity were insignificant with oral CoQ10 supplementation. The study is limited by its short duration. It is not known if this effect is sustainable or reverses with withdrawal of the supplement.

In another randomized, double-blind, placebo-controlled study of 41 women aged between 60 and 76 years, who took either 100mg CoQ10 daily, 200mg CoQ10 daily, or a placebo for 12 weeks, researchers found that oral CoQ10 supplementation improved facial redness, skin lightening, elasticity, epidermal cellular areas, and collagen production.[55] They also noted that it preserved elastic fibres, maintained the antioxidant factor Nrf2, and reduced p53 levels. These benefits were more pronounced at the 200mg daily dose, with no notable side effects or toxicity during the study period. The researchers concluded that oral CoQ10 supports skin health during ageing and should be considered as a supplement for older individuals.[55]

A systematic review on the use of CoQ10 for skin ageing confirms that CoQ10 reduces wrinkles and fine lines, overall signs of photoaging and exhibits anti-inflammatory activity.[56] They also noted that oral CoQ10 supplementation ranges from 15 to 150 mg daily.

Essential fatty acids

Commonly referred to as vitamin F, they are long-chain polyunsaturated fatty acids (PUFAs) that the human body cannot synthesize and must be obtained from the diet.[44] There are 2 major types of essential fatty acids: omega-3 fatty acids (derived from linolenic acid) and omega-6 fatty acids (derived from linoleic acid).[44] Both are found in fish, shellfish, flaxseed oil, hemp oil, chia seeds, canola oil, pumpkin seeds, avocado, salmon, and walnuts.[44]

A survey examined the associations between nutrient intake and skin ageing of 4,025 women aged 40–74 years, and the researchers found that higher linoleic acid intake was associated with a lower likelihood of senile dryness and skin atrophy.[17]

Polyphenols

It is a primary group of phytochemicals found in plant-based foods. They exhibit anti-inflammatory effects, promote cellular repair and have antioxidant properties.[57] In addition, they stimulate collagen production.[58] The anti-ageing effects of polyphenols on the skin have been studied, showing their potential to counteract premature skin ageing.[59] A cross-sectional study in Japan showed that the consumption of polyphenols from green tea or coffee in 244 women is beneficial for reducing photoaging of the skin.[60]

Zinc

Zinc is an important element for skin health, participating in skin morphogenesis, regeneration, and maintenance, and providing protection and defence.[61] Zinc has antioxidant properties.[62] Zinc supplements come in different forms, each with a varying percentage of elemental zinc.[32] There is a paucity of studies that assessed the effect of oral zinc supplementation on skin ageing.

Selenium

Selenium is a trace element present in food sources and available as a dietary supplement.[63] Its benefits include DNA synthesis and repair, protection against ultraviolet radiation, and protection against oxidative stress.[64] Due to its antioxidant effect, it plays a role in skin anti-ageing.[65]

A low-dose selenium supplement protects keratinocyte stem cells from senescence and delays skin ageing.[66] A narrative review examining oral vitamin E and selenium for skin and hair health reported that selenium, when used alongside other antioxidants such as vitamin E, protects the skin from ageing and various diseases.[67]

Potential Adverse Effects of Supplements

The demand for dietary supplements is on the rise, especially for skin anti-ageing. It is cheaper than skin rejuvenation procedures. There is strong evidence that dietary supplements such as vitamins C and E, hydrolyzed collagen, and hyaluronic acid delay skin ageing through antioxidant, anti-inflammatory, and collagen-stimulating effects.[43,49,56,68] A combination of several dietary supplements is more effective at delaying skin anti-ageing than when used individually.

While dietary supplements are perceived as safe for skin health, their safety profile should not be overlooked. Knowledge of their potential adverse effects, drug-supplement interactions and risks of contamination is important for dermatologists. Vitamin E and omega-3 fatty acids may potentiate the effects of anticoagulants and antiplatelet agents.[69,70] Coenzyme Q, which has a structure similar to that of vitamin K, can reduce the efficacy of anticoagulants.[71] Bovine spongiform encephalopathy can occur from contamination of collagen gelatin capsules.[72] A case report of Creutzfeldt-Jakob disease has been reported, and it was suspected to have been acquired from collagen capsules.[73] There are reports of heavy metal contamination of dietary supplements.[74,75] Pesticide residues and pharmacologically active ingredients can be present in dietary supplements.[76]

Clinical Recommendation

Dermatologists and other healthcare professionals should guide patients and take cognizance of their medical history, medications, and allergies. While supplements may be beneficial for anti-ageing, their use should be guided by clinical judgement. Patients should be counselled that their use does not substitute for other anti-ageing strategies such as photoprotection, sleep, exercise, and diet. Unrealistic expectations often stem from marketing hype because their outcomes are gradual.

The risks and benefits of systemic skin-ageing treatments must be carefully weighed, as their purpose is to reverse or slow a natural process rather than treat a specific disease.[77]

Conclusion

It is important to separate scientifically substantiated benefits and marketing claims. The current body of evidence indicates that certain dietary supplements, such as vitamins C, D, and E; carotenoids; collagen; hyaluronic acid; CoQ10; polyphenols; essential fatty acids; zinc; and selenium, have anti-ageing effects on skin ageing parameters.

Aggressive marketing strategies and claims by nutraceutical companies can create unrealistic expectations among consumers, suggesting that supplements alone can delay or completely halt the ageing process. This approach blurs the line between fact and fiction.

Although great enthusiasm for dietary supplements for anti-ageing is driven by consumer marketing, clinicians should take a pragmatic approach and promote healthy skin ageing, which requires a holistic approach.

Separating facts from fiction: dietary supplements serve as adjuncts and not replacements for comprehensive skin care. Holistic care incorporates photoprotection, a balanced diet, and good lifestyle modifications. There is a need for large-scale, long-term randomized trials to strengthen the evidence on optimal dosing, duration of use, long-term safety, sustainability of benefits after discontinuation, and clinically meaningful outcomes, such as wrinkle progression, elasticity, hydration, pigmentation, and photoaging.

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