

Nutraceuticals and skin health: key benefits and protective properties

Nutraceuticals are defined as a food, or part of a food, that provides medical or health benefits, including the prevention and/or treatment of a disease. Kim Pearson covers key considerations when recommending nutraceuticals to aesthetic patients, including the importance of choosing well-researched nutrients, provided in bioavailable forms, at a dose proven to be effective

It is said that true beauty comes from within. The connection between nutrition, skin condition and ageing has been an interesting area of research for scientists and physicians worldwide throughout the centuries (Schagen et al, 2012). In this article, the author will consider the increasing development of nutritional supplements targeted at improving skin health and discuss whether they have valid research behind them to back up their marketing claims.

This article is designed to raise awareness of the potential role for quality micronutrient supplementation in skin health. Nurses who are interested in nutrition can either refer their patients to a qualified nutritionist for a bespoke nutrition supplement programme and dietary recommendations, or seek further training themselves to improve their knowledge of this area.

Nutraceuticals

The term 'nutraceutical', based on 'nutrition' and 'pharmaceutical', was coined by Stephen DeFelice, founder and chairman of the Foundation for Innovation in Medicine (DeFelice, 1995). According to DeFelice (1995), a nutraceutical can be defined as 'a food (or part of a food) that provides medical or health benefits, including the prevention and/or treatment of a disease'. However, the term 'nutraceutical' commonly used in product marketing has no regulatory definition (Kalra, 2003).

One of the fastest growing subsections of the nutraceutical industry is the 'nutricosmetic' market. Nutricosmetics are nutritional supplements that support the structure, function and health of the skin. A report published by Global Industry Analysts in July 2013 stated that the global nutricosmetics market is forecast to reach \$4.24 billion in 2017, with the anti-ageing segment of that market set to be its second largest growth sector (Jackson, 2014).

Nutraceuticals and skin benefits

There are a number of established ways in which specific nutrients have demonstrated efficacy in improving both the health and appearance of the skin. In addition to those nutrients integral to skin health, such as vitamins A, C, E, copper and zinc, specific nutrients can further protect the skin from damage, address common skin concerns and have anti-ageing effects (Piccardi and Manissier, 2009). In this article, the author will discuss nutrients which have been shown to have anti-inflammatory and antioxidant properties, provide protection from sun damage, support healthy skin, collagen synthesis and cell renewal, and promote skin hydration.

Antioxidant protection

Skin is constantly exposed to pro-oxidant environmental stress from numerous sources, including air pollutants, ultraviolet (UV) light and chemical oxidants. Reactive oxygen species have been heavily implicated in skin ageing and age-related skin disorders (Buonocore et al, 2012), meaning there is much emphasis placed on the use of topical antioxidants in anti-ageing skincare regimens. Dietary antioxidant compounds, such as catechins from green tea, anthocyanins from dark berries, bioflavonoids from citrus fruits, carotenoids (e.g. lycopene and lutein from tomatoes), resveratrol from red wine and genistein from soy, also have beneficial effects on skin health and have been shown to help protect the skin from oxidative stress (Nichols and Katiyar, 2010). Overall, the advantage of oral antioxidant supplementation is that the blood delivers nutraceutical bioactive compounds continuously to all skin compartments, i.e. the epidermis, dermis and subcutaneous fat (Buonocore et al, 2012).

Vitamin E

Many studies have demonstrated that vitamin E acts as a highly effective antioxidant with the potential to decrease the frequency and severity of pathological events in the skin (Nachbar and Korting, 1995). To explore the role of oral vitamin E in counteracting oxidative stress, McArdle et al (2004) supplemented healthy subjects with high-dose vitamin E and took biopsies before and after supplementation to assess the increase in skin concentration. Concentration of vitamin E increased from 0.55 ± 0.09 ng/mg to 1.6 ± 0.19 ng/mg protein



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following supplementation, demonstrating that taking oral vitamin E can directly influence concentrations within the skin.

Moreover, malondialdehyde (MDA) is one of the most frequently used indicators of lipid peroxidation (Nielsen et al, 1997) and was measured by researchers following exposure to UV radiation both before and after vitamin E supplementation (McArdle et al, 2004). The researchers concluded that 'vitamin E supplementation significantly decreased the skin malondialdehyde concentration', demonstrating the potential for certain orally-ingested antioxidant nutrients to protect the skin from oxidative stress.

Anti-inflammatory effects

Dietary consumption of some plants and nutritional oils is known to modulate the balance of lipid inflammatory mediators and is therefore valuable in the treatment of inflammatory skin disorders (Boelsma et al, 2001).

Curcumin

Curcumin, a nutrient extracted from turmeric, is known for its anti-inflammatory properties and skin protection. It has been shown to quench free radicals and reduce inflammation through nuclear factor-kappaB (nf-KB) inhibition. Treatment with curcumin has also reduced wound-healing time, improved collagen deposition, and increased fibroblast and vascular density in wounds, thereby enhancing both normal and impaired wound-healing (Thangapazham et al, 2007).

Ginger

Ginger is a well-established anti-inflammatory food with much research supporting its use in inflammatory conditions (Grzanna et al, 2005). A study carried out by Nigam et al (2009) assessed the effects of gingerol, the active constituent of fresh ginger, on human epidermoid carcinoma A431 (skin cancer) cells. Their research found that treatment with gingerol exhibited considerable cytotoxicity, indicated by growth inhibition of A431 cells, mediated by the generation of reactive oxygen species. Although Nigam et al's (2009) findings were not conclusive, the authors claimed these results suggest that gingerol could be 'effectively used for the treatment of skin cancer'.

Photoprotection properties

Research has demonstrated that it is feasible to achieve protection against UV light-induced erythema through the ingestion of specific nutrients (e.g. carotenoids, tocopherols, ascorbate, flavonoids and n-3 fatty acids) (Sies and Stahl, 2004). Micronutrients can act as UV light absorbers and antioxidants, or modulate signalling pathways elicited on UV exposure.

Carotenoids

Carotenoids are antioxidants capable of scavenging reactive oxygen species generated by photooxidative stress (Stahl et al, 2001). For example, supplementation with beta-carotene has

been shown to protect the skin against UV-induced erythema (Stahl et al, 2001). UV-induced erythema is a suitable parameter to assess the photoprotection potential of micronutrient supplementation (Sies and Stahl, 2004). A study by Stahl et al (2001) investigated whether intervention with natural dietary lycopene protects against UV-induced erythema in humans. At week 10, erythema formation was found to be 40% lower in the group that consumed tomato paste compared with controls (Stahl et al, 2001).

Probiotics

Findings from several human trials have suggested that probiotic supplementation might be useful in the management of atopic dermatitis. A randomised double-blind placebo-controlled clinical trial carried out by Guéniche et al (2009) assessed whether the probiotic bacteria *Lactobacillus johnsonii* NCC 533 could modulate the cutaneous immune homeostasis altered by UV exposure in humans. The findings strengthened the assumption that certain probiotics can modulate the skin's immune system and aid the preservation of skin homeostasis. Consequently, the researchers suggested considering probiotics for the prevention of UV-induced damage (Guéniche et al, 2009).

Green tea

Green tea contains catechins—polyphenolic compounds that provide many of the health benefits green tea is known for (Hsu, 2005). Consumption of green tea polyphenols over a 12-week period has been shown to reduce skin-induced erythema by 25%, and have a positive impact on skin elasticity, roughness and scaling in those who were exposed to a minimal erythemal dose of UV radiation. It also acted to increase blood flow and oxygen delivery to the skin (Heinrich et al, 2011).

In support of these findings Rhodes et al (2013) reported that consumption of a low dose of green tea catechins and vitamin C were incorporated in cutaneous tissues to aid in photoprotection (Rhodes et al, 2013).

Grape seed extract

Proanthocyanidins are a class of polyphenols present in grape seed extract. They are recognised for their antioxidant capabilities and ability to scavenge free radicals (Cos et al, 2004). Studies have suggested that the proanthocyanidins in grape seed extract have an ability to shield the skin from UV radiation (Nichols and Katiyar, 2010). A study using hairless mice also found that grape seed proanthocyanidins had potential to protect against photocarcinogenesis (Katiyar, 2008).

Collagen synthesis optimisation

Some nutrients are essential for healthy collagen biosynthesis. Vitamin C is one such essential nutrient—without adequate vitamin C collagen cannot be replaced, resulting in tissue breakdown and eventually leading to symptoms of scurvy (Telang, 2013).

Vitamin C

Vitamin C plays multiple roles in maintaining healthy skin. It is a known potent antioxidant that can be used topically and orally to treat and prevent skin changes associated with ageing (Telang, 2013).

Unlike most other animals, humans do not synthesise vitamin C and therefore the consumption of optimal amounts of vitamin C is essential. However, research shows that the recommended daily allowance (RDA) of vitamin C is lower than the body needs and subsequently it appears difficult to reach an effective dose of vitamin C through food consumption alone. To achieve optimal health, researchers suggest that daily vitamin C supplementation of 1 g per day is required (Deruelle and Baron, 2008).

Vitamin C is also a potent anti-inflammatory nutrient. It inhibits nf-κB, which is responsible for the activation of a number of pro-inflammatory cytokines. Therefore, vitamin C can be used to treat conditions like acne vulgaris and rosacea, while promoting wound healing and preventing post-inflammatory hyperpigmentation (Telang, 2013).

In addition to stimulating qualitative changes in the collagen molecule, it has been proposed that vitamin C influences quantitative collagen synthesis (Telang, 2013). Vitamin C serves as a cofactor for prolyl and lysyl hydroxylase—the enzymes responsible for stabilising and cross-linking the collagen molecules. Another mechanism by which vitamin C influences the collagen synthesis is via stimulation of lipid peroxidation, where the product of this process (MDA) encourages collagen gene expression (Telang, 2013).

Copper

Studies have shown that the synthesis of mature elastin and collagen can be controlled by the availability of copper (Harris et al, 1980). Copper plays critical biochemical roles essential to the maturation and structural integrity of both collagen and elastin (O'Dell, 1981). Dietary copper deficiency impairs crosslink formation and results in gross pathology of connective tissue (O'Dell, 1981).

Skin cell turnover

Vitamin A

Vitamin A is integral to the functioning of healthy skin. It promotes epidermal differentiation, modulates dermal growth factors, regulates sebaceous gland activity, and suppresses androgen formation. These actions are not only essential to skin cell turnover, but also mean that vitamin A is effective in preventing the formation of comedones that cause the most common forms of acne (Ross et al, 2012).

Zinc

Zinc is an essential micronutrient required for the normal function of skin and there is a well-documented association between zinc deficiency and skin pathology (Wilson et al, 2006). More specifically, zinc assists in the proper structure

of proteins and cell membranes, improves wound healing, has anti-inflammatory properties, and protects against UV radiation (Wilson et al, 2006).

Zinc deficiency is a common problem, affecting an estimated one third of the world's population (Gupta et al, 2014). Therefore, daily supplementation may play an important role in optimising the intake of this vital nutrient. The impact of zinc deficiency is particularly evident in the skin as the development of an erythematous rash, scaly plaques and ulcers (Wilson et al, 2006). Wilson et al (2006) cultured keratinocytes to obtain insight into the cellular effects of zinc deficiency and found that keratinocyte cell apoptosis was the earliest detectable cellular change induced by zinc deficiency.

Increased hydration

Collagen

As collagen is a protein found in human muscles, bones, blood vessels and skin, its consumption is proposed to be an effective way to counteract skin ageing. Eight weeks of oral collagen peptide supplementation significantly increased skin hydration and collagen density of the dermis (Asserin et al, 2015). Another 8-week period of collagen hydrolysate supplementation produced significantly higher skin elasticity levels in women aged 35–55 years (Proksch et al, 2014), further supporting the idea that collagen can improve skin health and appearance.

Pycnogenol

Pycnogenol supplementation has been found to increase skin hydration and elasticity (Marini et al, 2012). These effects are most likely owing to the increased synthesis of extracellular matrix molecules such as hyaluronic acid and possibly collagen. Daily supplements of pycnogenol from French maritime pine bark has been shown to boost skin elasticity by 25% and skin hydration by 8% (Marini et al, 2012).

Efficacy of nutraceutical products

Although there are several nutraceutical products on offer, promising to make skin look healthier and younger, unfortunately many of these will not live up to the expectations of those buying into the claims. There are a number of factors to consider when assessing the potential efficacy of any nutraceutical product.

Does the nutrient have adequate, high-quality research behind it?

In some respects, the nutritional supplements industry can be criticised for being under-regulated as products can be manufactured and marketed with very little research to support their insinuated benefits. For example, some research undertaken on rat models showed that collagen drinks can be effective at increasing levels of collagen in the skin (Zague et al, 2011). However, given that collagen is merely a protein, have collagen drinks been proven to demonstrate greater benefits

than other dietary sources of bioavailable protein? Any type of protein that enters the gastrointestinal tract is subject to digestive enzymes that break it down into its constituent amino acids. These amino acids are then distributed throughout the body and reformed into various tissue structures. To the author's knowledge, there has never been a study conducted on human subjects comparing collagen drinks to other well-absorbed and used forms of protein (e.g. a high-quality protein drink such as whey protein isolate). Therefore, in the author's opinion, the jury is still out on whether collagen drinks are a worthy investment for the consumer or demonstrate any advantage over simply optimising dietary protein intake.

What form is the nutrient provided in?

Certain nutrients can be provided in various forms and from different sources, some of which are far more bioavailable and effective at achieving the desired objective than others. For example, vitamin D₃ is more bioavailable and significantly more effective at increasing blood levels of vitamin D than vitamin D₂ (Lehmann et al, 2013). Magnesium citrate has demonstrated greater bioavailability over other forms of magnesium, with magnesium oxide demonstrating no benefit over the placebo (Walker et al, 2003).

How much of the given nutrient is provided?

It is important that the dose of nutrient(s) provided in the supplement are at a level proven to be effective. Although a supplement may claim that it contains beneficial and proven ingredients, when inspecting labels in detail the levels provided can be well below those proven to have a significant impact. This is often the case for two primary reasons. Firstly, high-quality nutrients can be expensive and therefore minimising the amount of nutrients can help a company to keep production costs low. Secondly, many supplements are provided in a tablet or capsule form and there is limited capacity for delivering bulky nutrients. A powder or liquid supplement is less restricted and offers a better delivery system for providing greater doses of nutrients. It is important to inform patients that high-quality nutrients provided in effective doses are indeed expensive and so the best supplements often cost much more to purchase. Supplement brands widely used by nutritionists include BioCare, Solgar, Viridian and Allergy Research.

Will the nutrients reach their destination?

While vitamin C is essential for collagen synthesis and acts as a powerful antioxidant, it is also essential for the growth and repair of tissues in all parts of the body. For example, it is essential for wound healing and for repairing and maintaining bones and teeth. Optimal intake of vitamin C is also essential for maintaining a healthy immune system (Deruelle and Baron, 2008). All nutrients perform multiple roles in the body and, when ingested orally, any nutrient will be distributed throughout the body for various uses. Consequently, it is important that a sufficient dose is ingested to ensure that all

roles of that nutrient can be fulfilled, including its impact on the skin.

Are there inactive ingredients that could have a negative impact on health?

People put their trust in product manufacturers to ensure that the ingredients in supplements are beneficial and work towards achieving the aim of the product claims. Unfortunately, however, this is not always the case. Take the example of 'BeautySweeties' containing 'beauty ingredients' coenzyme Q₁₀, aloe vera and biotin. The name of the product suggests that eating these sweets could enhance beauty, however, on looking at the detailed nutrition information, it contains 76 g sugar per 100 g. This means that around 75% of the product is contributing towards skin glycation (Danby, 2010).

It is always worth scrutinising the ingredients list of a nutrition supplement before suggesting it to clients. Even some of the most well-recognised, respected brands use ingredients that could potentially have negative effects on a person's health. These additional ingredients are unnecessary, potentially harmful to health, and demonstrate the importance of critically analysing a supplement's ingredients rather than simply buying into the promising marketing claims.

Conclusion

Extensive research has demonstrated that high-quality micronutritional supplementation can optimise skin structure and function. Supplementation with vitamins, minerals and phytonutrients offers antioxidant protection, anti-inflammatory effects, photoprotection properties, enhanced collagen synthesis and skin cell turnover optimisation, as well as skin hydration promotion (Arnold et al, 2012). However, overall, a balanced diet associated with oral supplementation of nutraceuticals could represent a globalised approach for improving skin health and beauty (Piccardi and Manissier, 2009).

When recommending supplements to patients, aesthetic nurses should look for the specific nutrients referenced in this article as well as other nutrients with sound scientific data provided in forms and doses proven to be effective. While this article covers nutrients specific to skin health, it does not address the underlying causes of skin conditions or dietary factors that influence skin health. Aesthetic nurses are not trained in nutrition; however, this should not stop them contacting supplement manufacturers and attending training sessions to improve their knowledge in this area. ◀ JAN

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