The use of topically applied vitamins has become a ubiquitous part of clinical skin care. While a part of the skin’s antioxidant system that assists in protecting it from oxidative damage, vitamins A, C, and E have also proven their ability to treat photaging, acne, cutaneous inflammation, and hyperpigmentation (Burgess, 2008). Understanding these vitamins’ unique mechanisms of action and how they work in concert helps the clinician select the appropriate topicals for their patients.

VITAMIN A

Retinoids encompass all members of the vitamin A family, including retinoic acid, its analogues, and derivatives (e.g., retinol, tazarotene, and adapalene). Retinoic acid is the retinoid that interacts directly with the retinoic acid receptors. Topically applied retinaldehyde and retinol effectively bind with cellular retinol binding protein and are then converted to retinoic acid within the skin (Kang, 2005). Retinoids are effective for the treatment of aging skin, as they are responsible for multiple matrix-protecting actions within the skin, including decreasing collagenase and elastase levels (Kang, 2005). In addition, retinol, retinaldehyde, and retinoic acid have demonstrated the ability to stimulate dermal fibroblast production, increase messenger ribonucleic acids (mRNAs) for types I and III collagen, and trigger glycosaminoglycan production when applied topically (Draelos, 2005; Kang, 2005).

In addition to treating skin aging and extracellular matrix (ECM) breakdown, retinoids assist in the reduction of existing skin discoloration and hinder future hyperpigmentation by inhibiting tyrosinase, enhancing cell turnover, and limiting melanosomal phagocytosis (Draelos, 2005; Lotti & Theirs, 2007; Rendon & Gaviria, 2005). For more sensitive skin, similar yet more gradual results to retinoic acid may be achieved with retinol, without the heightened irritant risk commonly associated with retinoic acid (Kang et al., 2005).

VITAMIN C

L-Ascorbic acid is the only topical form of vitamin C that is fully bioavailable to the skin, and it is the only one to provide all of the cutaneous benefits attributed to vitamin C. Topically applied l-ascorbic acid can serve as a primary, secondary, or coantioxidant that effectively quenches reactive oxygen species in the aqueous environment of the skin (Farris, 2005). This antioxidant powerhouse is an important ingredient in the fight against skin aging; it protects the ECM from breakdown, but rather than directly inhibiting the expression of a particular matrix metalloproteinase (MMP) enzyme, vitamin C upregulates levels of the endogenous tissue inhibitor of MMP-1 (Nusgens et al., 2001).

L-Ascorbic acid is also a cofactor for collagen-stabilizing enzymes prolyl and lysyl hydroxylase and activates transcription of and stabilizes procollagen mRNA (Farris, 2005; Nusgens et al., 2001). Although esters such as ascorbyl palmitate and magnesium ascorbyl phosphate are beneficial when administered orally, the acids in the skin are not strong enough to cleave the ester’s covalent bonds to free the L-ascorbic acid. Therefore, L-ascorbic acid is preferred for topical use to maximize collagen production.

Vitamin C is a useful addition to hyperpigmentation treatment plans. This important vitamin is able to convert dopaquinone back to Levo-Dihydroxyphenylalanine during the process of melanogenesis, preventing melanin formation (Badreshia-Bansal & Draelos, 2007;
Rendon & Gaviria, 2005). L-Ascorbic acid’s proven antioxidant, anti-inflammatory, and photoprotective capabilities may also help prevent melanogenesis.

VITAMIN E

Constituents of the vitamin E family include tocopherol, tocotrienols, and tocopheryl acetate, and are effective anti-aging ingredients. Research demonstrates tocopherol’s ability to inhibit the activity of fibroblastic protein kinase C and the production of collagenase (Ricciarelli, Maroni, Ozer, Zingg, & Azzi, 1999). Studies have also found that tocotrienols are capable of decreasing nuclear factor-κB activation, which is responsible for the production of several MMP enzymes (Ahn, Sethi, Krishnan, & Aggarwal, 2007). This reduction of MMP production is important in avoiding the unnecessary breakdown of healthy ECM components. DI-α-tocopherol was proven to prevent the immunosuppression caused by UV radiation, effectively reducing cancer formation (Gensler & Magdaleno, 1991).

INHERENT INSTABILITY

For proven ingredients, even decades of positive study outcomes and visible results do not guarantee that every product containing the proven ingredient will deliver the expected outcomes. Having these important vitamins formulated properly is of the utmost importance to ensure that they provide benefit to the skin. Improved stabilization technologies are newly available for the production of effective and stable vitamin topicals (Burgess, 2008).

Vitamin A is highly susceptible to oxidation and instability in formulation (Guaratini, Gianeti, & Campos, 2006). Because of its sensitivity, it is critical to limit the raw material’s exposure to water, air, and light during formulation, as well as for the duration of the finished product’s expected shelf life. Nitrogen blanket technology is often required during vitamin A product manufacturing to minimize the retinoid raw material’s contact with oxygen. This highly specialized technology is not frequently used in the cosmetic industry. Without its use, the raw material can potentially be partially oxidized—even before packaging. Polymer stabilization systems that protect retinoid raw materials are now more widely available, making it possible to manufacture effective topicals without the use of nitrogen blanket technology.

L-Ascorbic acid (vitamin C) is a water-soluble antioxidant that is also highly susceptible to oxidation (Austria, Semenzato, & Bettero, 1997). Although water-based vitamin C topicals products can be effective, their shelf life typically does not extend past 1 year. This beneficial active’s efficacy can be preserved through the use of anhydrous product bases, by packaging the finished product in opaque materials and by limiting oxygen contact with the finished product through an airless container or nasal-tipped orifice.

While there are always advances to be made in this area of skincare, topical vitamins will continue to be utilized by the clinician as one of the best methods of protection against oxidative damage, external aging factors, acne, inflammation, and hyperpigmentation (Burgess, 2008). The more research that is done will provide only more vehicles to obtain the best results from vitamins A, C, and E for all patients.

REFERENCES


