

# The Essential Role of Vitamins in Cosmetics

T. Bombei, MD, BBA. For years vitamins have been recognized as extremely valuable ingredients in all kinds of cosmetics. Vitamins offer various benefits to the skin as suppression of pigmentation & bruising, stimulation of collagen synthesis, refinement of the skin surface, and antioxidant and anti-inflammatory effects. The antioxidant effect is particularly appreciated since free radicals generated by UV light or pollutants are effectively neutralized and no longer able to damage skin cells. Vitamins can therefore significantly improve the performance of cosmetic and personal care products. The most widely used vitamins in cosmetics are vitamin A, vitamin C, vitamin E and provitamin B5.

## Vitamin A

The primary benefit of vitamin A and its derivatives in cosmetics is their ability to normalize keratinization (horny layers) by regulating skin cell growth and differentiation. This results in decreased roughness and decreased facial wrinkling. Therefore, vitamin A is often called the “skin normalizer” or “rejuvenating agent”. Derivatives of vitamin A used in cosmetics are vitamin A alcohol (retinol), vitamin A esters (retinyl palmitate, retinyl acetate), vitamin A aldehyde (retinal), and tretinoin (all-trans retinoic acid). Tretinoin is the most active form for modulating the skin. For this reason, it is considered a drug by the FDA, available in higher strengths only by prescription. All other forms including retinol, retinyl palmitate, retinyl acetate, and retinal must first be enzymatically converted into the active tretinoin in the skin. These activation steps make these derivatives

The derivatives, however, are more stable and the decreased efficacy can easily be overcome by increasing the dosage.

## Vitamin C

Interest in vitamin C as a cosmetic ingredient is mainly a result of its ability to quench UV-induced free radicals and to regenerate vitamin E, another potent antioxidant. There are three forms commonly used in cosmetics: ascorbyl palmitate, magnesium ascorbyl phosphate, and L-ascorbic acid. Ascorbyl palmitate, a fat-soluble synthetic ester of vitamin C, is stable in cosmetic formulas at neutral pH. L-ascorbic acid is the most active form of vitamin C and has numerous benefits for the skin. L-ascorbic acid is water soluble and must be formulated at low pH to stay active. In clinical studies vitamin C has been found to act as an antioxidant and anti-inflammatory agent. When applied after UV burning, vitamin C reduces redness 50% sooner than untreated areas. Other inflammatory conditions as psoriasis and eczema have also shown clinical improvement with vitamin C. In addition, vitamin C has been found to stimulate collagen synthesis and to reduce dark pigmentation of the skin (e.g. age spots). Thus, vitamin C is also considered an anti-aging ingredient.

## Vitamin E

Because of its ability to quench free radicals the term “protector” has been used to describe the actions of vitamin E. Studies have shown that vitamin E reduces UV-induced erythema, edema, sunburn cell formation, and lipid peroxidation. Clinical improvement in the visible

signs of skin aging has been documented with significant decrease in both skin wrinkling. This may be also be due to the excellent moisturizing effect of vitamin E. While tocopherol is the primary active form of vitamin E, the esters as the vitamin E acetate and sorbate have also been shown to be very active. Esters, however, need first to be converted into the more active form in the skin. It has been reported that vitamin E in combination with vitamin A produces increased storage of vitamin A when applied topically. This sparing action is another valuable benefit of vitamin E. These data validates the popularity of vitamin E as antioxidant, moisturizing and rejuvenating ingredient.

## Provitamin B5

Provitamin B5 or D-panthenol has been used for years in hair care products because it functions as a humectant that increases the water content of hair and improves its elasticity. D-panthenol is inactive but is readily converted to pantothenic acid in the skin. Pantothenic acid is then incorporated as an important component in the energy cycle of the cell. Panthenol can also attract water into the upper layer of the skin and is thus effective as a moisturizer and softener. Moreover, panthenol can promote epithelization thereby enhancing the regeneration of the skin.

## Other Vitamins

Niacinamide (or nicotinamide), a form of vitamin B3 (niacin), has been shown to have anti-inflammatory properties that result in improvement of acne.

Topical 1% vitamin K was found to be effective in speeding the resolution of bruising. A similar formulation combined with retinol has been described effective for under eye circles.

	Vitamin A	Vitamin E	Vitamin C	Provitamin B5
<b>Active Forms</b>	Retinoic acid, retinol, retinal, retinyl palmitate, retinyl acetate	$\alpha$ -tocopherol, $\alpha$ -tocopherol acetate, $\alpha$ -tocopherol sorbate (note: dl-tocopherols = synthetic, d-tocopherols = natural)	L-ascorbic acid, ascorbyl palmitate, magnesium ascorbyl phosphate	D-panthenol, ethyl panthenol
<b>Solubility</b>	Fat-soluble	Fat-soluble	Water-soluble (ascorbyl palmitate is fat-soluble)	Water-soluble
<b>Activity</b>	1 IU retinol = 0.3 $\mu$ g RAE (retinol activity equivalents)	1mg dl- $\alpha$ -tocop. acetate = 1 IU 1mg d- $\alpha$ -tocopherol = 1.5 IU		
<b>Lowest Need of Skin</b>	Approx. 5 IU/inch skin	Approx. 0.03 IU/inch skin	Approx. 0.08 mg/inch skin	Approx. 0.01 mg/inch skin
<b>Usual Concentration in Cosmetics</b>	Retinol & derivat.: 500–10'000 IU/g (= 0.1–2% if solution contains 500'000 IU/g) Retinoic acid: 0.025-0.1 %	10–500 IU/g (corresponds to 10–500 mg/g of dl- $\alpha$ -tocopherol acetate or 7-330 mg/g of d- $\alpha$ -tocopherol)	0.2–4 % (weight %); e.g. 2 g vitamin C / 100g cream (= 2 %)	0.5–3 % (weight %); e.g. 3 g provitamin B5 / 100g cream (= 3 %)
<b>Biological Properties</b>	Improves collagen density, skin elasticity, tone, texture, lines & wrinkles, smoothes skin surface	Protects from oxidant damages, moisturizing, anti-inflammatory, healing & anti-aging effects	Protects from oxidant damages, skin-lightening, anti-inflammatory effects, improves elasticity	Attracts water to hair & skin, moisturizing, regenerating & softening effects