



# WAYNE STATE School of Medicine

## A Review of the Efficacy of Popular Eye Cream Ingredients

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### Abstract:

Every year, there are new products on the market advertised to preserve a youthful appearance and reduce the signs of aging. One classic example is eye cream. Due to the periorbital region’s high susceptibility to damage from external factors, along with its tendency to demonstrate early signs of aging, periorbital skin is a common target for anti-aging therapy. While some of these ingredients have proven efficacious in clinical trials, others have not shown to be clinically significant. Various products contain different combinations, formulations, and doses of these ingredients. This review evaluates the efficacy of popular topical ingredients found in common eye creams, including retinoids, vitamin C, vitamin E, peptides, ceramides, hyaluronic acid and caffeine.

### Introduction

Periorbital skin has a unique physiology, as it is the thinnest and most dynamic of the entire body. It is especially susceptible to damage from sun exposure and other extrinsic factors including smoking, pollution, contact dermatitis, and chronic rubbing due to seasonal allergies.<sup>1</sup>

Eye cream is a topical product that is targeted to address skin concerns unique to this region, including moisturizing and reducing fine lines and wrinkles. Due to the periocular skin’s predilection towards irritation, wrinkles, hyperpigmentation and puffiness, eye cream formulations tend to be thicker and contain more oil than regular facial creams. Additionally, eye creams tend to have a greater amount of active ingredients to target specific complications of the periocular skin, and may reduce concerns such as dark circles, puffiness, and wrinkles.

Dark eye circles are a major periocular skin concern among people of all ages. Hypervascularity, aging, and tear trough depression are all causes of dark undereye circles.<sup>2</sup> Eye creams that contain niacinamide, caffeine, and vitamin E have been shown to decrease periocular hyperpigmentation. In addition, eye creams that contain Vitamin C have been shown to increase under eye brightness.

Another common periocular skin concern is undereye puffiness. There are multiple causes of puffiness including photodamage, fluid accumulation, hollow tear troughs and cheek descent. Eye creams containing active ingredients, such as caffeine, reduce fluid retention, strengthen vasculature and increase skin laxity, which all contribute to decreased puffiness.

Wrinkles are caused by photodamage, squinting, constant movement of the eyes, aging, and chronic rubbing due to seasonal allergies. Popular eye creams including active ingredients like caffeine, retinol, vitamin C, peptides and hyaluronic acid are designed to prevent and reduce wrinkle formation.

### Eye Cream Ingredients

#### Retinoids

Retinoids refer to a class of chemical compounds that are composed of vitamin A, derived from vitamin A, or that have similar structural and functional characteristics to the vitamin.<sup>3</sup> When bound to receptors, retinoids act as important transcription factors that function in the normal maintenance of epidermal differentiation.<sup>3</sup> Multiple studies have been conducted to test the clinical efficacy of topical retinoids in dermatologic products. A study utilizing human skin samples showed that topical 1% retinol inhibits the increase of metalloproteinases and stimulates collagen synthesis in aged, sun-protected, and photoaged skin.<sup>3</sup>

#### Vitamin C

Vitamin C is the most abundant antioxidant available in human skin and is involved in the formation of the skin barrier and collagen in the dermis.<sup>4</sup> L-ascorbic acid is the most biologically active and well-studied form of vitamin C which has been well-established as a cofactor for collagen synthesis.<sup>3</sup> Vitamin C has been utilized in a myriad of under eye creams for its antioxidant, anti-aging, photoprotective and anti-pigmentary effects.<sup>5</sup> A clinical study demonstrated that the topical use of daily 3% vitamin C led to significant increases in dermal papillae.<sup>19</sup> A double-blind randomized trial was conducted to evaluate the clinical effects of 5% vitamin C on photoaged skin over a 6 month period. Compared with placebo, vitamin C led to a clinically apparent improvement in the overall appearance of photodamaged skin as well as a decrease in deep furrows. Another study found that using 20% vitamin C, vitamin E, and raspberry leaf extract led to an improvement in most signs of skin aging, including the periorbital region, namely darkening, smoothness, and wrinkles.<sup>6</sup>

#### Vitamin E

Vitamin E is a lipid-soluble antioxidant that protects cellular membranes from damage by free radical lipid peroxidation.<sup>10</sup> Vitamin E cannot be synthesized by humans; therefore, levels of cutaneous tocopherol is dependent on oral intake and topical delivery. Many over-the-counter anti-aging creams consist of 0.5%-1% vitamin E due to its effective reduction in dark eye circles.<sup>7</sup>

A study concluded that depletion of vitamin E in the human epidermis is a sensitive indicator of environmental oxidative damage.<sup>3</sup> Free radicals cause the disruption of lipids, proteins, nucleic acids, and deplete the stores of endogenous antioxidants.<sup>10</sup> Reactive oxygen species also have the ability to alter the biosynthesis of collagen and glycosaminoglycans in the skin.<sup>23</sup> Vitamin E modulates the damage by acting as a scavenger for these free radicals and lipid peroxyl radicals.<sup>3</sup> Gehring et al. proved topical application of vitamin E resulted in increased stratum corneum hydration and water binding capacity.

#### Peptides

Peptides are short sequences of amino acids that compose the building blocks for proteins. When applied topically, peptides assist in the reversal of the dermal and epidermal signs of aging.<sup>8</sup> This is through the support of dermal fibroblast functions and the stimulation of collagen, elastin, and glycosaminoglycan production.<sup>30</sup> Collagen is the main structural protein in skin.<sup>9</sup> With age, the skin is exposed to various factors which decrease metabolic activities related to collagen content.<sup>9</sup> Increases in dermal collagen are thought to improve signs of aging. Peptides upregulate in vitro collagen production and topical formulations have shown clinical improvement when applied to photodamaged skin.<sup>5</sup>

A 12-week double-blind, placebo controlled, split-face study with moisturizer containing 3 parts/million palmitoyl-KTTKS showed a significant reduction in fine lines and wrinkles.<sup>34</sup> Another study utilizing three peptide derivatives, in a mixed form, resulted in increases in dermal collagen and epidermal protein expression, leading to significant improvement in crow’s feet and other wrinkles.<sup>10</sup>

#### Ceramides

The stratum corneum (SC), the outermost layer of the epidermis, is composed of three lipid components including ceramides, cholesterol and fatty acids.<sup>11</sup> The ceramide component of the SC functions to connect corneocytes, forming a waterproof barrier that protects the skin from dehydration. Ceramides also act as repair agents for the SC.<sup>11</sup> Decreased levels of ceramides often manifests as dry and itchy skin. Topical formulations containing ceramides and pseudoceramide-dominant emulsions are widely used for treatment of skin conditions that involve pruritus and transepidermal water loss (TEWL).<sup>12</sup> Ceramide-containing cream has been demonstrated to significantly increase water content of eyelid skin.<sup>5</sup>

#### Hyaluronic Acid

Hyaluronic acid (HA) is a large non-sulfated glycosaminoglycan found in the extracellular matrix of epithelial and connective tissue. Due to its unique helical coil conformation, HA can trap up to 1000-fold of its weight in water and is essential for maintaining tissue structure and volume.<sup>13</sup> It has an essential role in maintaining the skin’s water reserve, turgor, and moisture.<sup>13</sup> In a study of 76 female subjects (ages 30-60 years) with periocular wrinkles, HA cream was applied twice daily for 60 days. Compared to the placebo group, there was a significant improvement in skin hydration and elasticity in subjects treated with the low-molecular weight HA based cream.

#### Ceffeine

Due to caffeine’s function as a phosphodiesterase (PDE) inhibitor, it can raise intracellular cAMP levels and ultimately suppress various inflammatory pathways. Furthermore, an increase in cAMP stimulates the breakdown of triglycerides into free fatty acids which leads to inhibition of fat accumulation.

Caffeine has also been proven to promote apoptosis of damaged cells. Caffeine’s metabolites have antioxidizing effects against reactive oxygen species. These properties may help reduce wrinkles and protect the skin against free radical damage (ROS).<sup>14</sup> A 2018 study showed that caffeine has protective effects from oxidative stress-induced senescence by activation of A2AR/SIRT3/AMPK-mediated autophagy.<sup>14</sup>

### Discussion

Through the improvement of hydration, elasticity, increases in collagen, and decreases in inflammatory mediators, these ingredients have been proven to affect aspects of the skin. The degree to which these changes lead to improvement in the physical appearance of the skin is not universally proven. While the mechanisms of these topicals on the skin have been tested, large clinical trials are needed to further investigate the comparability of efficacy and the combinations of ingredients within eye cream specifically. This is necessary to clearly establish the efficacy of various eye creams and determine their significance in comparison to other dermatologic products such as facial creams and serums.

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