Eye Area Problems
Puffiness, Bags, Dark Circles and Crow's Feet

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Development of treatment products which address problems of the eye area is growing in interest. Products currently marketed contain an array of natural materials including biofactors, organ extracts, herbal preparations, biological moisturizers and vitamins. The manner in which these ingredients provide benefit to the eye area may not always be easily recognized.

To develop active treatment products that address eye area problems, i.e., puffiness, bags, dark circles and crow's feet, the cosmetic chemist must better understand the biology of the eye area, the effects of aging and chronic sun exposure and how to select ingredients that will provide suitable benefit.

To help both the cosmetic chemist and marketing team to develop eye treatment products, some questions about the eye area that will be addressed are:

- Is the structure and biology of the eye area different from other facial regions?
- Why is the eye area prone to puffiness, bags, dark circles and crow's feet?
- What causes puffiness, bags, dark circles and crow's feet?
- What are the effects of age and the environment on the eye area?
- What are the most logical ingredients for treatment of eye area problems?

Biology of the Eye Area

Eyelid

The most prominent features of the eye area apart from the eyeball are the upper and lower eyelids. These are movable folds of tissue which serve to protect and clean the eyeball. Structural components which make up the eyelids are skin, muscles, connective tissue, fat, glands and blood vessels (see figure 1).

The skin of the eye area is very thin, approximately 0.5 mm thick (about the thickness of an egg shell) compared to the skin in other parts of the body, for example, the sole of the foot, which can be up to 2.0 mm thick. The connective tissue of the eye area is principally made up of collagen, elastin and glycosaminoglycans, but unlike other areas of the face, it is less in quantity and more thinly distributed. The thinness of the skin and connective tissue accounts in part for the high degree of elasticity in the eye area.

Below the epidermis is a sparse distribution of blood capillaries which supply the skin with nutrients and help in the conduction and removal of heat. The vascular system of the eye area is derived from the carotid artery, the same blood vessel that supplies blood to the brain.

Orbital Fat

The eye area fat is a soft filler occupying the space not taken by other eye area structural components. It can be likened to a soft shock absorber, and it also provides an oily surface for muscle gliding. There are three fat pockets in the
lower eyelid and two pockets in the upper lid (figure 2). The pockets are separated by special connective tissue barriers. The left and right eye areas usually have different amounts of fat which contribute to the non-symmetrical nature of bagginess in the same individual.1,3,4

Glands

The eye area is endowed with eccrine and apocrine sweat glands as well as sebaceous glands.1 The eccrine glands are fewer and more diffusely distributed in the eye area than in other body areas. Eccrine glands secrete a water fluid to cool the skin surface.

The apocrine sweat glands of the eye area are referred to as the glands of Moll and are associated with the eyelashes. The purpose of the eyelashes is to protect the surface of the vulnerable cornea from light, dust and other injurious matter.

The sebaceous glands of the eye area are called Meibomian glands. These are unique because they are not associated with hair follicles as are the typical sebaceous glands of other facial regions. The lipid secretion of Meibomian glands makes up the top layer of the tear film. This lipid layer slows tear evaporation and maintains proper eye moisture.1

Muscles

For this review, the important consideration is not the names of the muscles present in the eye area, but what they do. The movements of eye area skin are controlled by the contraction and relaxation of approximately twenty-two facial muscles (figure 3).6 Approximately fourteen muscles are involved in the opening and closing of the eyelids. The main eyelid muscle, the orbicularis oculi, is circularly arranged into three distinct portions around the eye. These three portions are confluent and act in unison.

When all the muscles of the facial area contract, the skin of the forehead, temple and cheek is drawn towards the bridge of the nose and the skin is thrown into folds radiating from the outer corners of the eyes. These folds often become permanent with aging and increased sun damage—the so-called crow’s feet. The contraction and relaxation of the occipitalis and frontalis muscles also cause the skin of the forehead to form transverse wrinkles.1,6,7 Thus, when one smiles, squints, blinks or frowns, the movement of the facial muscles, apart from opening and closing the eyelids, contributes to the formation of crow’s feet and to wrinkles in the eye, cheek and forehead areas.

Orbital Septum

The barrier separating the skin and the orbicularis muscles from the rest of the eyelid components is called the orbital septum. This
barrier is inelastic, varies in thickness from person to person and is perforated by nerves and blood vessels. A weakness in or damage to the orbital septum can result in herniation of the underlying fat layer, leading to a baggy look. When the elastic property of the lower lid decreases, as occurs with aging, the lid droops and the septum becomes lax, allowing for further protrusion of fat and an increase in bag appearance.

**Common Eye Area Problems**

**Puffiness**

A puffy look is usually caused by edema. Edema is the presence of excess fluid in the subcutaneous spaces around the eye. It accumulates usually when one is lying down during sleep and slowly disappears upon waking when the head is higher than the rest of the body. Research indicates that under normal conditions almost all the fluid is held in a gel that fills the spaces between the cells. The gel contains large quantities of mucopolysaccharides, the most abundant of which is hyaluronic acid. The rate and ease of reducing puffiness depends on how quickly the accumulated fluid is removed.

Puffiness of the eye area may also be accentuated by allergies (chemical or environmental) or poor blood circulation which may involve increased capillary pressure and permeability. In females, puffiness may also be accentuated during the menstrual cycle. Periods of depression accompanied by weeping tends to aggravate the degree of puffiness.

Frequent or persistent puffiness could lead to a nutritional deficiency in cells of the eye area. Puffiness increases the space between capillaries and skin cells. Since the rate of diffusion of nutrients from the capillaries is inversely proportional to the distance between the cells and the capillaries, it is essential that this space be maintained at a minimum to prevent damage to these cells.

**Bags**

Even though puffiness and bagginess are sometimes used interchangeably, they are not necessarily the same problem. While puffiness is usually due to the accumulation of excess fluid in the subcutaneous spaces, bagginess is often times due to herniation of orbital fat. Bagginess usually occurs as a result of aging which decreases muscle tone and can affect the integrity of the orbital septum. In individuals with puffiness, the eye area looks swollen but the surface is usually smooth. Individuals with bagginess display a saggy and lumpy look. Bagginess is also more common among older individuals.

**Dark Circles**

Skin color is due to melanin pigment, blood and other plasma constituents. Temperature also influences skin color. For example, when the skin is hot and arterial blood flow rapid, the skin appears red. On the other hand, when the skin is cold, blood flow is sluggish and greater amounts of oxygen are removed for metabolism, causing the skin to have a bluish color. These color differences are exaggerated in the eye area because of the thinness of the skin. Allergy resulting in edema contributes to a darkening of the eye lids, often times producing dark circles. Recurrent swelling around the eye area causes the tissue to become even darker in appearance. Chronic exposure to sunlight, apart from contributing to wrinkles, may further affect blood vessels leading to the escape of fluid into the tissues of the lid area. Though leakage of blood is uncommon among young persons, it is widespread in some older individuals. Hemosiderin, an insoluble storage form of iron, is purported to be a part of the blue/purple pigmentation observed in the eye area. However, deposition of iron into the skin usually occurs only in disease states and should not be considered to be a significant contributor to pigmentation in the eye area.

Dark circles have also been attributed to lack of sleep, fat deposits which can impact a yellow coloration to the eyelid and proliferation of blood
vessels in the eye area. Further, a concave and sunken eye area changes light reflection to create shadows and accentuate dark circles.1,12

Crow's Feet

The eye area, especially the eyelids, has the greatest excess of skin per unit area in the body.1-4 It is known that eye area skin responds to every movement of the facial muscles, resulting in the formation of crow's feet and wrinkles. Physical or chemical injury, excessive rubbing of the thin skin of the eye area, depletion of orbital fat and senile elastosis due to chronic sun exposure can accentuate the formation of crow's feet and wrinkles.21-25 Histologically, wrinkled skin areas show a reduction in collagen and glycosaminoglycans, particularly hyaluronic acid. Elastic tissue is often sparse, fragmented and disorganized which leads to a "crepy" appearance. There is also a decrease in sebaceous gland secretions contributing to skin surface dryness. Decrease in muscle tone, genetic factors and aging can also contribute to the formation of wrinkles.13,22-29

Eye Area Treatment

Puffiness

The problem of eye area puffiness, particularly in the lower lid area, is often associated with a mild irritation. Irritation of the eye area can lead to the release of inflammatory mediators. Histamine and products of arachidonic acid metabolism, prostaglandins, hydroxy-intermediates and leukotrienes contribute to the formation of edema, the probable major cause of puffiness. Thus, agents with anti-inflammatory and dehydrating properties should be used to treat puffiness. Panthenol, taurine and vitamin E,30 as well as comfrey, marigold, chamomile, mallow, ginseng and yarrow are only some of the botanical extracts with an herbal history to document their anti-inflammatory properties.31-35 Active ingredients found in these extracts include the bioflavonoids; quercetin, rutin, apigenin and others; azulene, α-bisabolol, protein-carbohydrate complexes, saponins36 and β-sitosterol.37

Bags

The increasing slackness of eye area skin with age accentuates the baggy look. Formulations which contain ingredients with skin firming properties can help to improve skin tone and reduce the baggy appearance. Botanical extracts such as witch hazel containing up to 9.5 percent tannins and bioflavonoids provide the astringent properties necessary for a noticeable improvement in skin tone. Other plant extracts with astringent properties that might also be used in the eye area include bilberry, blackberry, coltsfoot, elder flower and horsetail.

Horsetail extracts, in particular, act as strong astringents. Horsetail contains aconitic acid, an intermediate in the metabolism of carbohydrates. Reducing equivalents provided by carbohydrate metabolism are used for the formation of cellular energy in the form of ATP. Horsetail also contains an appreciable amount of silicon which is a mineral important in glycosaminoglycan (GAG) synthesis and whose content diminishes with age.38,39 An improvement in GAG synthesis could provide an increase in firmness and elasticity by building dermal volume.

Dark Circles

Dark circles resulting from skin irritation and a weakened blood vessel network can be treated with herbal extracts and certain vitamins. By reducing capillary fragility and strengthening blood vessels to prevent breakage, two of the major contributors to pigmentation under the eye can be controlled.

Vitamin K, also known as phytomenadione and first isolated from alfalfa, is a critical agent in the blood clotting cascade.40 A deficiency in vitamin K would contribute to blood leakage because of the impaired clotting mechanism. Bioflavonoids, hesperetin, quercetin, fisetin and others can decrease capillary fragility in addition to inhibiting the enzymes associated with the formation of inflammatory mediators.41 Because of their many activities, the bioflavonoids impact significant benefit to eye area treatment products.

Vitamin C is another important ingredient that should be incorporated in treatment products. In addition to reported skin lightening properties,42,43 vitamin C has been proposed for use in controlling aging changes in lens tissue.44,45 Vitamin C is an essential cofactor in collagen synthesis and is required for the specific stimulation of messenger RNA for type 1 procollagen, the immediate precursor of mature collagen fibers in skin.46,47 Thus, the importance of vitamin C in the general regulation of skin's structural integrity is quite significant.

Crow's Feet

A lifetime of muscle movement contributes to crow's feet while photoaging accelerates their formation and deepens wrinkling in the eye area.
Today, women can prevent crow's feet and wrinkling by simply using sunscreens. The value of sunscreens goes beyond prevention because they help alleviate the effects of sun damage by allowing skin to naturally repair collagen and elastin networks.\textsuperscript{49-50}

Accelerated repair and reduction of crow's feet can be achieved more readily using retinoidal compounds. Recent studies on animal skin show that topical retinoic acid is active in reversing dermal skin damage caused by chronic UV exposure.\textsuperscript{51-53}

**Authors' Perspective**

Our eyes express our inner feelings. They let others know who we are and what we feel. Eyes reflect our essence, contribute to our social image and greatly affect our sexuality. The condition of the eye area is most important because it enhances beauty—like the setting for a precious gem.

Puffiness, bags, dark circles and crow's feet are the four most disturbing changes that occur in the eye area. Depending upon a person's age, sex, genetics, psychological state and sun exposure, these changes can be either temporary or permanent. Today, treatment and preventive products are possible because of a greater understanding of the uniqueness of the eye area. This review provides a basis for developing effective eye treatment products.

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**References**

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