

Eyes as a mirror of the soul



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ABSTRACT

So many hours in front of screens, little sleep, and increased levels of anxiety have made our eyes more tired. The area around the eyes is thinner and can also suffer from hyperpigmentation, wrinkles, lack of hydration, and sagging. As a result, the cosmetic industry has been suffering an increasing demand for products that help in the rejuvenation of the skin, especially in the periocular region, which over time suffers from the wear and tear of age. Associated with this, the current context of the dermocosmetics market seeks sustainable products given the growing concerns in the socio-environmental sphere. Brazil, in this scenario, due to its biodiversity of the flora, has great importance for the biotechnological growth and in the development of cosmetic products of plant origin, with great potential both in the national and international markets. These natural actives have, among many of their properties, proven to have an effect on the anti-aging process, being a source of antioxidants, thus acting on the ability to promote cell proliferation and be effective against wrinkles. Thus, the importance and interest aroused by the pharmaceutical industry in the search for these natural compounds that bring the importance of the sustainable issue and also in the effectiveness in promoting desired characteristics against aging such as wrinkles, expression lines, bags and dark circles under the eyes is highlighted, ensuring a young and healthy appearance.

Keywords: Sustainable dermocosmetics, Natural products, Rejuvenation.

1 INTRODUCTION

With the increase in life expectancy, there was a greater demand from the population for the prevention of the signs of aging and the improvement of bodily health and well-being. One of the regions that suffer the most from aging is the skin, so the growing concern with its health has led to



the search for products that slow down or minimize this process (MORONE *et al.*, 2019).

There are several factors that can accelerate the aging process, which can be divided into intrinsic and extrinsic, which can act alone or together, affecting the structure of the skin (KRUTMANN *et al.*, 2014). In this context, anti-aging cosmeceuticals are powerful allies to promote skin rejuvenation and slow down or minimize this process (KRUTMANN *et al.*, 2014).

Thus, anti-aging products aim to stimulate cell renewal, especially in the eye region, where the biological wear and tear of the body becomes more visible. Over time, the skin tends to become rough, flaccid, dehydrated and with expression lines, so products with active ingredients that promote antioxidant action, improve local circulation, hydrate and stimulate collagen production are sought (MARTINS, 2020).

Dissatisfaction with the appearance of the face generates a constant search for formulas that minimize the signs of time. As a result, the cosmetics sector has great economic and social importance and has proven to be innovative in winning over consumers and offering products that show good results. Anti-aging products are examples of this, as they bring several benefits and are constantly adapting to serve individuals in a practical and effective way, especially when they contain a sun protection factor, a decisive item in winning over consumers (JESUS *et al.*, 2021).

The eye area is the thinnest and most sensitive region of the face and the one that is most prone to skin aging, so care for this area becomes so important. The skin of the eye area is extremely thin and much thinner than the other regions of the face, so it is more susceptible to external aggressions and facial expressions, being the first place to present signs such as wrinkles and sagging (OLIVEIRA; PAIVA, 2016).

Among the aesthetic changes that affect this region are dysfunctions such as dark circles, wrinkles, flaccidity, edema and fat bags. In view of these changes, there are several treatment suggestions to correct dysfunctions of the periorbital region, such as *peeling*, fillers, and electrotherapies. Therefore, it is necessary that a cosmetic formulation for the treatment of the eye contour has antioxidant, draining, depigmenting, regenerating, decongestant, moisturizing, collagen and elastin stimulating properties and active ingredients that prevent the formation of adipose deposits (OLIVEIRA; PAIVA, 2016).

The growing search for beauty means that more and more brands and product lines that promise changes in appearance are emerging, as a result, studies have sought to make the composition of products more natural, such as the use of plant and biotechnological extracts, making evident the consumer's concern about the origin and quality of the product purchased. allied to a greater environmental concern (SUBRAMANIAN, FIEDLER, 2017; MORONE *et al.*, 2019).



2 SKIN AGING IN THE PERIORBITAL REGION

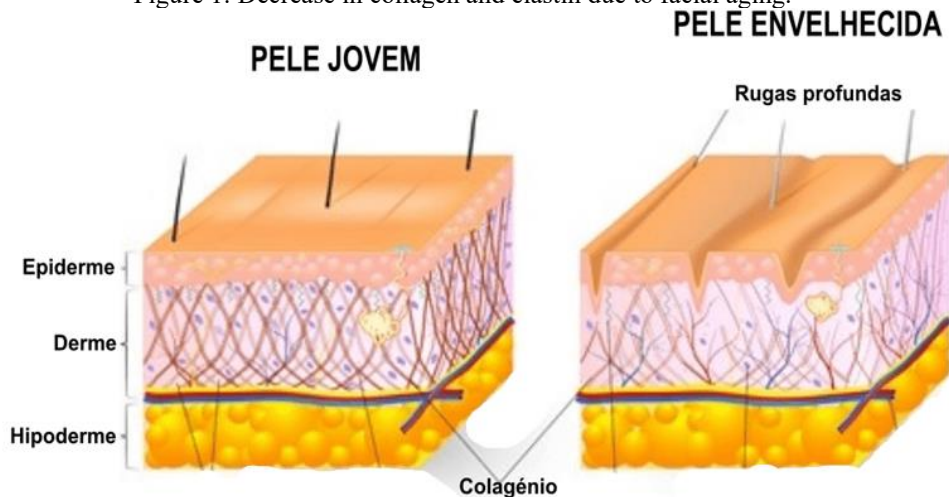
The skin aging process is due to simultaneous modifications, which result in several changes in the appearance of the face. It is a natural and inevitable process, caused by numerous factors that may or may not accelerate this mechanism, which involve structural, cellular and extracellular matrix changes, due to intrinsic and extrinsic factors (BORGES; SCORZA; 2016).

Intrinsic factors are associated with physiological processes, causing an acceleration of cell degeneration, which can be affected by extrinsic factors. The latter are those to which the human being is constantly exposed, and which vary from individual to individual and which accelerate the physiological and cellular degenerative process (BORGES; SCORZA; 2016).

Among the compounds present in this aging process and responsible for the maintenance of the skin are collagen and elastin, which are proteins that are present in large quantities in the body, being responsible for the formation of numerous structures that are indispensable for the human body (ZANGUE; MACHADO-SANTELLI, 2015).

Thus, these proteins act together to maintain the firmness and sustainability of this structure, so that it is possible to ensure the elasticity of the tissues, promoting skin health and preventing premature aging, or even delaying this process in some situations, especially with regard to the face and natural aging, as can be exemplified in the image below (Figure 1) (ZANGUE; MACHADO-SANTELLI, 2015).

Figure 1: Decrease in collagen and elastin due to facial aging.



Source: <https://commons.wikimedia.org/w/index.php?curid=45065840>

In a simplified way, during human aging there are biochemical and structural changes in collagen fibers, reducing synthesis and increasing degradation, as a consequence there is a change in facial volume, loss of elasticity, furrows and expression marks (VASCONCELOS *et al.*, 2020).

Another preponderant factor is the aging of the skin due to oxidative stress, originating from reactive oxygen species (ROS), which cause the peroxidation of fatty acids that constitute the double



lipid layer of the cell membrane, with this, cellular modifications occur that can cause even the death of cells in addition to changes in DNA and cause, for example, the loss of biological functions of proteins, including collagen (DINIZ *et al.*, 2022; MACEDO *et al.*, 2022).

Due to these changes, physical changes in the skin begin to become evident, such as the appearance of wrinkles, decreased elasticity, dryness, change in color, among others (DINIZ *et al.*, 2022; MACEDO *et al.*, 2022).

Among the areas of the skin that suffer the most with age, the periorbital region is one of the first areas to show some signs of aging, such as wrinkles, sagging, and periorbital hyperpigmentation. One of the reasons for this premature aging of this region is due to the eye region being very thin and easily distracted (VASCONCELOS *et al.*, 2020).

To achieve natural and long-lasting rejuvenation, it is important to consider the five distinct layers that make it up, each with specific structures that contribute to the aging appearance. The interaction between bone, ligaments, muscles, and fat should be considered when selecting approaches to restore youthful appearance. To this end, it is important to understand the complex underlying anatomy and the contribution of each structure to the aging of the face, in order to guide the most appropriate rejuvenating therapy (ESTEVEZ; BRANDÃO, 2022).

What happens is that the skin decreases its thickness during the aging process, which gives it translucency and allows a greater visualization of the superficial vascular network, adding a reddish and bluish tone. Sun exposure destroys collagen and elastin fibers, which makes it even thinner, and, in addition, these changes can form "pockets", where the most frequent cause is excessive fluid retention or, in some cases, a hernia prior to the fat in the area. These characteristics give the face an appearance of tiredness, which can be departed from the beauty aspect (SILVA *et al.*, 2021).

The facial skeleton undergoes gradual changes according to aging and promoting the appearance of signs of aging such as wrinkles, muscle decay and adipose tissue. The first region to show clinical signs of bone mass loss is the orbital region, causing adipose tissue to move to deeper compartments of the face. Over time, the action of intrinsic and extrinsic factors promote visible changes in the face, such as the appearance of expression marks and wrinkles, as well as dehydration and the appearance of fatigue on the face (TALBERT *et al.*, 2014).

The piriform sinus, located at the junction of the upper maxilla with the zygomatic arch of the malar region, undergoes resorption and contributes to the formation of a wrinkle typical of aging known as the nasolabial fold. Additionally, the jaw bone also undergoes a resorption process, which reduces the definition of the contour in the lower third of the face (TALBERT *et al.*, 2014).

The anatomical changes promoted by aging occur in different areas of the face. Wrinkles in the glabellar region are caused by the corrugator and procerus muscle, the sagging of the retro orbicularis fat compartment of the o's is caused due to changes in the orbicularis oculi muscle, orbicularis retainer



ligament and frontalis muscle, as well as the underlying bone. On the other hand, the area of the lacrimal ligament and the orbicularis fat compartment of the eyes, which can affect the appearance of the malar mounds (TALBERT *et al.*, 2014).

The nasolabial fold enlarges with aging due to changes in the orbital bone, orbicularis retainer ligament, zygomatic ligament, orbicularis oculi muscle, and superficial musculoaponeurotic system (SYKES *et al.*, 2020).

The eyelid fat pockets are located behind the orbital septum and in front of the eyelid retractors. These fat pockets are surrounded by a thin fibrous fascia, individualizing them into separate compartments. With aging, both the septum and the orbicularis muscle and skin become looser, causing orbital fat to prolapse, making it prominent and ptotic (VILEFORT *et al.*, 2023).

Aging is also due to gravitational forces and facial mimicry that generates facial anatomical changes. Eyebrow aptosis is favored by the action of corrugator muscles, leading to a cutaneous pseudoexcess of the upper eyelid. In an aging face, the skin of the lower eyelid becomes more elongated, exposing herniations of the orbital fat and the inferior orbital margin. The hollowed and elongated lower eyelid combines with a decrease in skin vitality and a deepening of the nasolabial and nasojugal lines resulting in senile physiognomy (VILEFORT *et al.*, 2023).

2.1 CLASSIFICATION OF WRINKLES IN THE PERIORBITAL REGION

Another obvious sign is the formation of wrinkles, which are caused by essential segments of connective tissue, such as collagen and elastin, where the skin suffers a reduction in its natural elastin and with the reduction of connective tissue functions, it then causes layers of fat in the skin, in addition to the lack of oxygenation in the tissues that induces the process of skin dehydration which ends up resulting in wrinkles (TALBERT *et al.*, 2014).

Wrinkles denounce facial aging, being mainly caused by the hyperactivity of the orbicularis muscle of the eyelid. They are classified into three types, as shown in Figure 2 (TAMURA; ODO, 2011).



Source: (TAMURA; ODO, 2011).



Type I wrinkles are wrinkles that present in the outer corner of the eyebrow up to the zygomatic arch, type II wrinkles occur in the outer corner of the eye, extending from the outer corner line of the eye to the zygomatic arch and are characterized by the absence of wrinkles in the upper lateral region. And finally, type III wrinkles are wrinkles that occur exclusively in the outer corner line (TAMURA; ODO, 2011).

These three types of wrinkles may present with the absence or existence of wrinkles on the lower eyelid, according to the following sub-classification: lateral wrinkles, medial wrinkles and medial corner wrinkles (TAMURA; ODO, 2011).

2.2 PERIORBITAL HYPERPIGMENTATION

The eye area is one of the most sensitive and delicate regions of our face, and also one of the areas that shows the first signs of aging, such as fine lines, wrinkles, dark circles and bags. Therefore, it is important to take good care of this region and use specific products.

Periorbital hyperpigmentation, popularly known as "dark circles", is characterized by the darkening of the area in the eye region caused by numerous factors, whether intrinsic or extrinsic. Intrinsic factors are usually predetermined by the individual's genetics, on the other hand, extrinsic factors are associated with numerous factors such as vascularization and excessive pigmentation, sagging of the periorbital skin, tiredness, fatigue, sun exposure, smoking, among many others. In addition, some medications are suspected of triggering the occurrence of dark circles such as non-steroidal anti-inflammatory drugs and chemotherapy drugs (MAC-MARY *et al.*, 2019).

It is a modification that gives the face a tired and aging appearance. And in general, dark circles under the eyes can be classified into four types, as shown in chart 1.



Table 1. Types of dark circles.

Kind	Description	Appearance
Pigmented	Hyperpigmentation of dark circles happens when melanocytes produce too much melanin, darkening the thin skin under the eyes. This type of phenomenon can also happen in other areas of the face, such as melasma.	Infraorbital brown coloration
Vascular	The capillaries in the area become congested, leaving blood visible under the thin skin. Thus, the dark pigments that make up the blood are concentrated in the lower cavity of the eyes and can oxidize, giving the bluish appearance of dark circles.	Blue, pink or purple coloration, and may or may not present periorbital edema.
Structural	The deeper formation of the bones of the face creates a shadow in the eye socket, intensifying the darkening of dark circles. It may be associated with eyelid bags and fat loss.	Structural shadows coming from the surface of the facial anatomical contour.
Mixed	The appearance of the two or three types mentioned above can be subdivided into four subtypes: pigmented-vascular, pigmented-structural, structural vascular, and a combination of the three	Different shades

Cast iron: SARKAR *et al.* (2016)

These spots can be bluish, brown, or red and are related to many conditions such as tiredness, skin aging, ethnic traits, genetic predisposition, circulatory processes, and the activity of melanocytes.

3 TENDENCY TO VEGETABLE

The global demand for natural cosmetics is growing, driven by sustainability and wellness trends, especially the quest for a healthier lifestyle (PERES *et al.*, 2021). This demand for natural products is mainly due to sustainability and wellness trends, along with the demand for conscious consumption that are on the rise in the market (FURMAN *et al.*, 2022).

Driven by the market for natural, organic, and vegan products, consumers are increasingly opting for cosmetics that meet these requirements. Regarding sustainability, advances in cosmetic research reflect a global technological trend focused on natural products and biodiversity related to plants and their derivatives, such as extracts, fixed and essential oils, as sources of raw materials and active ingredients for use in cosmetic products (ZUCCO *et al.*, 2020).

The concept of having healthy habits is increasingly present in the lives of the population and the new generation is looking for alternative products that not only satisfy their desires, but also have a purpose when thought of collectively (FURMAN *et al.*, 2022). Thus, responsible consumption is starting to be part of the agenda of the global cosmetics consumer, who is migrating, to varying degrees, to a more natural beauty experience. This favors brands that combine green attributes with convenience and affordability, and that partner with consumers interested in more responsible cosmetics consumption (PERES *et al.*, 2021).



The expansion of the demand for natural products has reoriented part of the cosmetics industry towards plant-based and biotechnological actives. Among the agents involved in the chain of cosmetics based on natural products, natural raw materials are the ones that play a key role in the development and success of a company in this segment. Therefore, a close look at natural inputs reinforces their importance, as well as highlights the strategic role of Brazilian biodiversity in the sector (ZUCCO *et al.*, 2020).

And when we talk about natural raw materials, it is worth mentioning the immense diversity of plants that exist on our planet, providing natural wealth in the development of various products and contributing to the world scientific, technological, and economic market (FERREIRA NETO *et al.*, 2022). Plants are important sources of biologically active substances, among which the bioprospecting of agents with antioxidant and antimicrobial characteristics has been gaining prominence in the biotechnology industry, in the development of cosmetic products (BELI *et al.*, 2020).

Among the raw materials, coffee has aroused great scientific and industrial interest due to its bioactive properties related to its beans, husk, paste, pulp, and oil (SANTOS *et al.*, 2017; HERMANN *et al.*, 2019; BOGER *et al.*, 2022).

Coffee oil, for example, has been explored for therapeutic and cosmetic purposes, mainly due to its composition having different fatty acids with different properties such as anti-inflammatory, allergy treatment, in addition to acting as a protective barrier on the skin due to its potential to absorb ultraviolet rays that cause serious damage to the skin. In addition, both linoleic acid and palmitic acid are constituents of the stratum corneum, helping to restructure the skin barrier and contributing to the improvement of skin hydration (SANTOS *et al.*, 2017; HERMANN *et al.*, 2019; BOGER *et al.*, 2022).

Coffee extracts have a high content of bioactive compounds with applicability in the development of cosmetic products with high biological activity (SANTOS *et al.*, 2017; HERMANN *et al.*, 2019; BOGER *et al.*, 2022).

The formation of ROS is inevitable, for this reason, to reduce the aggressions caused by free radicals, the antioxidants produced by the body, such as the enzymes superoxide dismutase, glutathione peroxidase and catalase. In addition to our body's natural defense system, antioxidants can be applied exogenously, being provided by cosmetic products, especially those obtained from plant extracts, which have among the antioxidant compounds of different chemical classes that, in addition to fighting premature aging with the inhibition of free radicals, can provide elasticity and firmness to the skin (DINIZ *et al.*, 2022; MACEDO *et al.*, 2022).

In addition to the option mentioned above, the vast biodiversity of the Brazilian flora allows the use of numerous possibilities for the use of cosmetic formulations of various plants. Other examples include the São Caetano melon (*Momordica charantia L.*) and Pennyweed (*Boerhavia diffusa L.*) that help in the prevention of photoaging, the Guadua Bamboo (*Bambuguadua angustifolia K.*) which has



antioxidant and photoprotective properties, turmeric (*Curcuma longa L.*) with the ability to absorb UV rays and Chamomile vulgaris (*Matricaria Chamomilla L.*) which is rich in anti-inflammatory compounds and natural protectors from ultraviolet radiation. In addition, the extract of *Aloe vera* (L.) Burm.f is widely used for skin hydration, among many other examples that can be cited (SARETTA; BRANDÃO, 2021).

4 STRATEGIES IN THE TREATMENT OF THE EYE AREA

There are several benefits offered by products for the eye area, but it is necessary to understand which symptoms are most evident, and then choose the best strategy, such as hydration, reduction of dark circles and puffiness and prevention of the signs of aging.

Regarding hydration, moisturizing ingredients help to keep the skin soft and smooth in eye area creams. This benefit is indispensable for those who want youthful skin, as a lack of hydration can leave the skin dry, which can lead to wrinkles and fine lines.

Many people suffer from dark circles and puffiness in the eye area, whether due to emotional issues, insomnia or hormonal disorders, eye area creams can be good allies to reduce this discomfort.

The eye region is one of the first areas to show signs of aging, and that is why it is important to use technological assets that can delay the appearance of lines and wrinkles, in addition to treating existing ones.

5 BIOTECHNOLOGICAL ASSETS IN THE REVITALIZATION OF THE PERIORBITAL AREA

Biotechnology can be conceptualized as the science that uses technology to produce or alter products for specific purposes, being a science that emerges with the ideal of using biological materials based on new ones and incorporating this technology to obtain more effective products (SANDBERG *et al.*, 2019).

In short, biotechnology develops technologies using living organisms or raw materials developed from them in which it modifies or creates innovative, biotechnological products or services, seeking to develop and/or improve production methods and procedures. Biotechnology extracts from living organisms all the materials necessary to create, transform and modify the environment in which we live through technological processes, whether for agricultural purposes, pharmaceuticals, medicines, food or cosmetics (BARBA; SANTOS, 2020).

In the area of cosmetics, the use of biotechnological resources has advanced in order to originate new or improve existing processes. Thus, raw materials such as functional biopolymers, products obtained by fermentation processes, recombinant DNA technologies and enzymes are used. Biotechnology companies seek to develop new classes of biological products comprising recombinant



proteins, as well as new applications of molecular technologies for the discovery of conventional small molecule drugs, as well as proteins and enzymes used by industries (MCNAMEE *et al.*, 2021).

There are many applications of biotechnology in the area of cosmetics, such as the extraction of enzymes from plants, which act in the capture of free radicals, having antibacterial and exfoliating action, repairing acne-prone skin, preventing premature aging of the skin and many also work in the removal of excess pigmentation from the epithelial tissue. These enzymes can be extracted from papaya (*Carica papaya* L.) as papain, which has healing and exfoliating properties, from pineapple (*Ananas comosus* (L.) Merril.) to bromelain, widely used in cell renewal, skin cleansing, and fighting cellulite (MCNAMEE *et al.*, 2021).

Another biotechnological active ingredient present in the sector is hyaluronic acid, which is purified through the fermentation process using *Streptococcus zooepidemicus* bacteria, has an excellent moisturizing, antioxidant and regenerating action, preventing the early appearance of wrinkles, in addition to also acting on skin elasticity (MCNAMEE *et al.*, 2021).

It is worth mentioning the link between biotechnology and sustainable development, which aims at the production of renewable raw materials of higher quality, food security and various environmental applications for the decontamination of rivers and soils, producing little or no waste and always seeking to use biological processes (LOKKO *et al.*, 2018).

In this sense, in the last decades of the twentieth century and the first decades of the twenty-first century, a series of new products have emerged and the previous ones improved (SAJNA *et al.*, 2015). In addition, this decade was the stage for one of the great technological innovations in the production of cosmetics, which was the insertion of nanotechnology in the chemical formula of cosmetics (CHAUDHRI; JAIN, 2014; VOGEL *et al.*, 2022).

This fact revolutionizes the productive sector and inaugurates a new era in the production of cosmetics, the company L'Oreal being the first to launch the facial cream with vitamin E nanocapsules on the market. JAIN, 2014; VOGEL *et al.*, 2022).

Nanotechnology is based on being able to manipulate and organize atoms and molecules that make up the materials on a nanometric scale, so a nanocosmetic is characterized by a cosmetic that has nanostructured active ingredients in its formulation and presents better performance in terms of better penetration into the innermost layers of the skin, ensuring a more homogeneous distribution of substances and greater stability (VOGEL *et al.*, 2022).

Currently, there are several active ingredients used in cosmetics from biotechnologies and companies have invested heavily in the development of more effective raw materials that present effective results. In addition, there is a concern with sustainable development and the production of natural cosmetics (BIANCHET *et al.*, 2020).



6 SPECIAL EYE CARE

There are several benefits offered by products for the eye area, but it is necessary to understand which symptoms are most evident, and then choose the best care strategy, such as hydration, reduction of dark circles and puffiness and prevention of the signs of aging.

It is necessary that a cosmetic formulation for the treatment of the eye contour has antioxidant, draining, depigmenting, regenerating, decongestant, moisturizing, collagen and elastin stimulating properties and active ingredients that prevent the formation of adipose deposits, which guarantees special care for the eye area (OLIVEIRA; PAIVA, 2016).

7 CONCLUSION

The search for beauty and skin health has become constant and the cosmetics market shows growth potential in the search for continuous improvement in order to develop effective products, with long-lasting effects, economically viable and sustainable from an environmental point of view. It is clear the importance and interest aroused by the pharmaceutical industry in the search for these natural compounds that bring the importance of the sustainable issue and also in the effectiveness in promoting desired characteristics against aging such as wrinkles, expression lines, bags and dark circles, ensuring a young and healthy appearance.



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