CODEX
BEAUTY LABS

Chapter: Biotech Beauty

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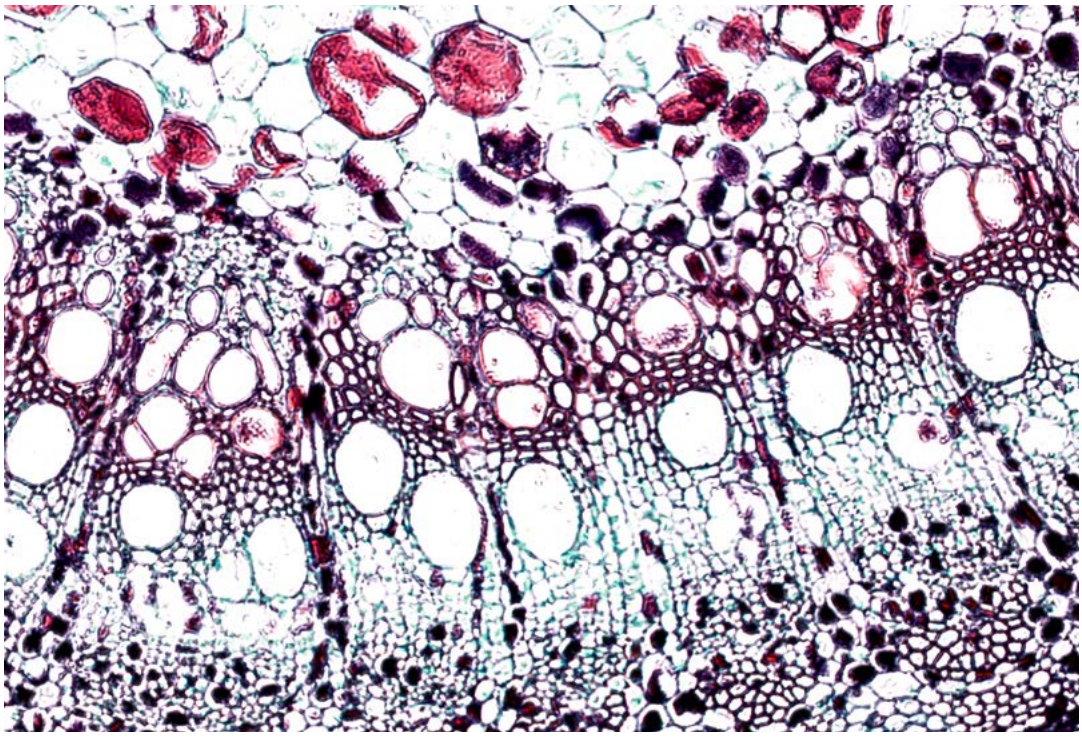
01 An Industry Paradigm Shift

In the clean and natural skincare space, brands are beginning to explore and transition from the use of botanical active ingredients conventionally extracted from plants using solvents and gases to bio fermented versions thereof. The biotech beauty trend synergistically combines science and nature, within a lab environment, to create ingredients that are not only nature-equivalent, but that are consistently cleaner and more potent than their natural plant extract equivalents. By leveraging fermentation microbes as miniature chemical factories or selecting plant cells based on their benefits as expressed in skin cells models, new and unique plant-based active ingredients can be created with specific functional properties meant to address the needs of an individual's skin more safely and efficaciously. Moreover, these ingredient-specific advantages can be realized in a way that avoids negatively impacting nature and the environment, since lab-manufactured active ingredients do not require food-producing farmland, utilize much less water and energy than growing and harvesting plants, and do not require extensive extraction or concentration processes, thereby reducing the ingredient's carbon footprint and waste production. These biotech-derived ingredients are also free of undesirable pesticides and irritants associated with conventionally grown and extracted plant-based ingredients.

The field of genetics, a subspecialty of biotechnology, historically employed by the biotech industry to research biological phenomena such as gene identification, sequencing and expression is now beginning to find utility in the beauty industry. The ability to assess an individual's genetic makeup to determine whether they are genetically predisposed to suffer from certain skin disorders such as eczema and acne because their skin is biologically programmed to be excessively dry or oily is enabling the development of innovative products that target those genes responsible for such disorders.



02 Plant-Cell Active Ingredients

Biotech actives are made in a bioreactor by isolating specific functional plant cells from a natural plant and either just amplifying them (e.g., plant stem cells) or fermenting them with genetically engineered microbes such as bacteria, enzymes and yeast, a process known as bio-fermentation, to create active ingredients that are biologically/naturally equivalent to those found in nature. There are numerous advantages to using biotech-derived actives as compared to conventional plant extracts. For example, the inherent bioactivity/potency of conventional plant extracts depends on various factors including their growing conditions (i.e., composition of the soil in which they are grown, air, water or ground pollution, exposure to sun, shade and rain, time and method of harvest), as well as the particular extraction process (physical pressing, oil, water, or chemical maceration or gas extraction) used to obtain the actives from the physical plant. Any one or all of these factors can impact the potency, purity, concentration, and consequently efficacy, of the active ingredients in a skincare formula. Biotech-derived actives, on the other hand, are made under precise, highly controlled process conditions that yield consistently potent, pure/clean ingredients in large quantities that are safe and highly efficacious.

There are then, of course, the issues of sustainability and environmental impact. Growing and harvesting plants is a very resource-intensive endeavor. In addition to the land and water required to grow plants for use in botanical skincare products, an appreciable amount of CO2-generating energy must also be expended to harvest the plants, transport them, and extract their actives. This is not a very efficient process because most of the plant starting material is discarded and the quantity of active extracted is not very robust. Biotech-derived ingredients, on the other hand, are significantly more sustainable because they do not require nearly as much land, water and energy. This is because the bio-fermentation process employs specific plant cells rather than physical plants as the starting material to create large quantities of highly potent, pure bioactive ingredients. The process is carrier out in a bioreactor where only the necessary supporting raw materials are added (liquids like the growth medium or pH-adjusting bases, and gases like oxygen or CO2 for pH control), and only energy to maintain the required process temperature and agitation is used. The process is tightly controlled in a cleanroom and sterile vessel to maximize the yield of bio-active, which then undergoes a simple purification process for either a secreted product or the plant cell itself. Hence, in contrast to classically extracted plant-based ingredients, the bio-actives obtained from plant cell cultures are easily standardized, reproducibly manufactured, and compliant with strict safety requirements derived from the pharmaceutical industry. More particularly, plant cell extracts are made using well characterized plant cell lines that are free from pathogens, and the bio-process is free from pesticides, industrial chemical pollutants, allergens and other toxic substances. Biotech-based actives are produced under controlled, cleanroom conditions, complying with current good manufacturing practice (cGMP) procedures. In fact, ISO 22716 manufacturing guidelines that apply to skincare formulation manufacturing can easily be applied to ingredient production as well, which would represent a significant step forward for the cosmetics industry.

Yet another advantage that the field of biotechnology offers to the beauty industry is the ability to re-engineer naturally occurring active ingredients in a way which yields more functionally specific results. By genetically tweaking the microbes used in the bio-fermentation process or the plant stem cells, the resultant plant-cell actives can be further optimized to provide greater efficacy and targeted functionality to address specific skin issues more effectively such as aging, inflammation and acne, just to name a few.

03 Genetic Testing

Biotechnology in the form of DNA testing, coupled with the identification of those genes responsible for specific skin factors such as sebum production and inflammation signaling can be used to make informed skincare product, and routine, recommendations for addressing skin-related issues. For example, depending on an individual's genetic makeup, they may be genetically predisposed to suffer from acne, be deficient in skin elasticity and firmness which can lead to the premature aging of their skin, or have a higher than average sensitivity to sun exposure.

Epigenetics is the study of changes in living organisms caused by gene expression modification rather than genetic code alteration. In short, epigenetics focuses on the effect aging and environmental factors have on the expression of genes by the skin. For example, collagen production is controlled by specific genes within the skin. Those genes, however, become less active as a person ages and when their skin is exposed to the harmful factors of the exposome (UV rays and air pollution).

The phenomenon of photoaging occurs when a person's skin begins to develop fine lines and wrinkles caused by years of exposure to the sun's harmful rays. Melanin is a complex pigment that not only imparts color to skin, but also provides photoprotection against UV-A rays at a cellular level, thereby inhibiting photoaging. Hence, the ability to stimulate melanin production by activating skin's pigmentation genes can facilitate enhanced photoprotection and, consequently, lessen skin's susceptibility to photoaging. Photoaging, however, is also dependent on other endogenous factors such as skin's ability to produce antioxidants that neutralize damaging free radicals caused by the sun. The body's ability to produce effective quantities of antioxidants is also dependent on a person's individual genetic traits. The ability to activate antioxidant-producing genes can have a meaningful impact on the photoaging process.

By regulating certain processes that naturally occur within the skin, science can help skin help itself. The question then becomes how does one know which genes need to be activated to address a particular skin-related issue and, equally as important, how can those genes be activated once identified? Here, too, is where biotechnology comes into play.

Geneticists are scientists that study genes in an order to try and ascertain which ones should be targeted for the purpose of improving/enhancing certain biological aspects of life. Once the targeted genes have been identified,

the next step is to determine whether they can be influenced to facilitate biological improvement/enhancement. A person's DNA, which is comprised of genes, is responsible for providing the instructions needed to make proteins that control functions within a cell. The epigenome is comprised of chemical compounds and proteins that can attach themselves to a person's DNA and control a variety of biological actions including gene activation/deactivation. In essence, they serve as a kind of "gene switch" that turns genes on and off. The scientific term for when a gene is turned on is "gene expression" which means that the gene is producing proteins used to control cell function like sebum production.

When epigenomic compounds attach themselves to DNA and modify its function, they are said to have "marked" the genome, a phenomenon known as gene marking. These genetic markers, a.k.a. biomarkers, are what help geneticists understand whether a particular active ingredient can turn a gene "on" so that it can begin to produce proteins that will lead to a desired effect being experienced by the body. The same is true when it comes to turning a gene "off" for the purpose of improving/enhancing one's quality of life. For example, when it comes to acne, the ability to regulate sebum production can lead to a significant improvement in the appearance of one's skin and, in turn, their emotional well-being. Acne is typically caused by the over production of sebum which causes pores to become clogged and infected resulting in the formation of a pimple. If an epigenomic compound, i.e., an active ingredient present in a product could temporarily turn off/deactivate the gene responsible for sebum production, the result would be less pimples being formed. The ability to address acne in this way would be a game changer for those suffering from this skin disorder.

04 Summary

Biotechnology is beginning to play a major role when it comes to the sourcing of nature-equivalent active ingredients that possess a consistent and reproducible level of potency, safety, and sustainability that today's consumers expect from their clean/natural skincare products. The field of genetics, a subspecialty of biotechnology, is also starting to influence the understanding and treatment of various skin disorders. The ability to take a sample of a person's DNA in order to determine whether they are genetically predisposed to suffer from certain skin disorders and how those genes can be turned on/off through the use of a gene switch in the form of an active ingredient, represents the next great frontier in skincare.

At Codex Beauty Labs, biotechnology is a part of our DNA. We have made it our mission to fully utilize biotech-derived active ingredients together with genetic testing tools and methodologies to provide our consumers with products that are not only safe, efficacious, and sustainable, but specifically tailored to address their individualized needs. The best example of Codex's Beauty Labs commitment to this mission is embodied in our patented, 100% biotech-based preservative system found in all our water-containing products. We believe it is important to put our money where our mouth is.

References

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