

Cosmeceuticals *and* Cosmetic Practice

Edited by
PATRICIA K. FARRIS



WILEY Blackwell

Cosmeceuticals and Cosmetic Practice

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Preface

The term cosmeceutical, in the US, is now a household word. It is used in magazine articles, internet postings and is even defined in the dictionary. Cosmeceuticals are a new breed of skin care products that are a hybrid between cosmetics and pharmaceuticals. The term cosmeceutical is not recognized by the Food and Drug Administration so there are no specific criteria set up for products to be included in this category. Today, we use the term cosmeceutical to refer to everything from sunscreens to prescription retinoids and almost everything in between. In fact, even simple moisturizers can technically be called cosmeceuticals as they have beneficial effects on skin physiology. In most cases, however, we reserve the use of the term cosmeceutical to refer to enhanced moisturizers containing active ingredients that provide added benefits to the skin.

The advent of cosmeceuticals represents one of the most important innovations in topical skin care. As a blend between cosmetics and pharmaceuticals, these products provide therapeutic benefits above and beyond simple cosmetics and are highly sought after by consumers. They are readily available, reasonably priced and heavily marketed, making them one of the fastest growing segments of the personal care market. Consumers turn to cosmeceuticals to treat skin aging and a myriad of skin conditions such as acne, melasma and rosacea. They view these products as alternatives to medications and often try cosmeceutical products before seeking professional help. Physicians also value cosmeceuticals for their therapeutic effects. We use them in conjunction with medications to treat skin conditions and to enhance the benefits of in-office procedures.

In view of this demand, it is no surprise that cosmetic and pharmaceutical companies are focused on growing the cosmeceutical marketplace. Most major cosmetic companies have heavily invested in developing cosmeceuticals and many pharmaceutical companies are now joining in. Through basic science research these companies are working to identify potential targets for improving skin health and appearance and develop new active ingredients that can be used as interventions. They create innovative delivery systems allowing for more effective and targeted delivery of actives to the skin. Their efforts are to be commended as they have contributed significantly to the development of more effective skin care products and to

our basic understanding of skin aging, moisturization and the pathogenesis of diseases.

Patients increasingly are looking to their physicians for advice on product selection. They are overwhelmed by the marketing hype that often creates unrealistic expectations and some degree of consumer confusion. They are looking for individualized skin care regimens and want to know what works and what doesn't. The aesthetic physician faces a formidable challenge to be knowledgeable about cosmeceuticals. There are few resources on the subject and the scientific studies conducted by the companies who develop these products are not always readily available. In addition, it seems as if new products and ingredients are marketed almost daily, making it impossible for us to keep up with this rapidly developing market.

This provides the rationale for this textbook. It provides you with the expertise of clinicians, researchers and industry-based cosmetic chemists from around the globe. The book is divided into three parts. Part I provides you with insight into how cosmeceuticals are developed, tested and how these science-driven skin care products are brought to market. Innovations in delivery systems and penetration enhancer will also be discussed.

Part II covers many of the key cosmeceutical ingredients including vitamin antioxidants, botanicals, growth factors, peptides and marine-based ingredients, just to name a few. Some of the newest anti-aging strategies including stem cell modulating compounds, glycation inhibitors, and ion-based anti-aging skin care are also discussed.

In Part III, clinicians who are considered leaders in the field will provide their unique and individual perspective on how cosmeceuticals can be used in clinical practice. Studies supporting the use of cosmeceuticals to treat common conditions such as acne, rosacea, hyperpigmentation, hair loss and striae are reviewed. The use of cosmeceuticals to enhance cosmetic procedures performed in the office setting such as chemical peels and laser treatments complete Part III.

Through our collective efforts, we hope to be able to provide you with a resource that will make it easier to advise your patients on product selection and give you the information you need to incorporate cosmeceuticals into your clinical practice.

I owe my deepest gratitude to my contributors who are among the leading experts in the field of topical skin care and without whom this textbook would never have been possible. I commend them for their deep commitment to professionalism and for their never-ending pursuit to put science behind cosmeceuticals. Finally, I would like to acknowledge Rachel Green and Jeffery B. Henry for all of their efforts and help in preparing this book.

Patricia K. Farris

CHAPTER 1

Cosmeceuticals and Clinical Practice

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Definition and regulatory issues

The term cosmeceutical was coined by Albert Kligman, M.D., in 1993, referring to skin care products that are a blend of cosmetics and pharmaceuticals. This term is engrained in medical literature, the lay press, and is commonly used by consumers. There is an implied medical nature as a result of “ceutical” and an expectation of medicinal-like properties. Today cosmeceutical is generally used to refer to skin care products that contain active ingredients that are beneficial to improving skin’s appearance and promoting healthy skin.

Cosmeceutical is not a legal term nor is it acknowledged by the Food and Drug Administration (FDA). The Federal Food, Drug and Cosmetic Act (FD&C Act) categorizes products as cosmetics or drugs according to their intended use. Cosmetics are defined as “articles intended to be rubbed, poured, sprinkled, or sprayed on, introduced into, or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness, or altering the appearance.” Cosmetic products include moisturizers, nail polish, lipstick, eye and facial make-up, shampoo, hair color and toothpaste. This is in contrast to a drug that is defined as “an article intended for the use in diagnosis, cure, mitigation, prevention or treatment of disease,” including those intended to “affect the structure or any function of the body of man or any other animals.” While the FD&C Act does not recognize the term cosmeceutical, it acknowledges that products can be both cosmetics and drugs if they have two intended uses. For example, a dandruff shampoo that is intended to clean hair and treat dandruff makes it both a cosmetic and drug. A moisturizing sunscreen that is intended to moisturize skin and protect it from sun exposure is also considered a cosmetic and drug.

It is ironic that most cosmeceuticals in the marketplace today enjoy cosmetic status in spite of the fact they contain active ingredients designed

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to treat, mitigate or improve skin conditions. Carefully crafted marketing and advertising campaigns avoid making any type of drug claims and limited testing prevents these ingredients from being viewed as drugs. Cosmetic status is preferred by the companies who develop and market cosmeceuticals since there is a less rigorous pre-approval process required and no new drug application (NDA) necessary. This allows companies to develop and test cosmeceuticals with far less cost than drugs and moves them quickly into the marketplace at a price point that is affordable for consumers. Recent reports suggest the FDA is considering stricter regulation over cosmeceutical skin care products but the specifics are yet to be determined.

The cosmeceutical marketplace

In spite of a lackluster economy, cosmeceutical products are maintaining a strong, significant presence in the beauty marketplace. This is due by and large to the fact that Baby Boomers, who are now in their fifties and sixties, are showing a continued interest in health and beauty products. Anti-aging products remain as top performers with consistently high increases in revenue over the past several years. Cosmeceutical sales were projected to increase 7.4% in 2012, with global sales reaching US\$9.4 billion. While US cosmeceutical sales remain strong, emerging markets such as China and Brazil are expected to have significant impact on global sales. In an attempt to keep up with this demand, ingredient and end-product manufacturers are focusing their efforts on developing innovative technologies that give them unique positioning in the marketplace. Many of the latest ingredients are a blend between science and nature, making actives from botanical and marine sources among the most highly sought after in the industry.

Consumers now view cosmeceuticals as effective treatment options for a variety of skin conditions. Scientifically based marketing campaigns, celebrity and physician endorsements lend credibility to these products in the eyes of consumers. Cosmeceuticals are readily available and reasonably priced, making them an alternative to visiting a doctor and buying medications. For this reason, it is no surprise that many patients who visit our offices have tried cosmeceuticals prior to seeking cosmetic treatments. Cosmeceuticals for treating aging skin, rosacea, eczema, scars and cellulite are widely available. High end department stores promote a medical-like atmosphere going so far as to use sales persons in white coats to sell cosmeceuticals. This blurring between medicine and the mass market is unique to this category of products. And finally, there are dermatologists and plastic surgeons who market their own cosmeceutical lines. Physician lines are sold in department stores, mass retail outlets, on infomercials and home shopping channels. These lines have been widely accepted

by consumers who view physician lines as more scientifically based. The success of these lines makes physicians major players in shaping the cosmeceuticals marketplace.

Cosmeceuticals in cosmetic practice

Physicians practicing aesthetic medicine have also played a role in expanding the use of cosmeceuticals. Cosmeceuticals are now a regular part of our treatment armamentarium and are used in addition to medications and procedures to improve patient outcomes. Anti-aging cosmeceuticals are among the most frequently recommended by physicians who utilize them as an integral part of a comprehensive skin rejuvenation program. Moisturizers and serums containing ingredients like vitamin C, niacinamide, retinol, peptides, growth factors and botanicals can all be used in this regard. In addition, patients undergoing cosmetic procedures such as laser resurfacing and chemical peels may be given cosmeceuticals to “prime” the skin for procedures, encourage healing and reduce complications after.

Cosmeceuticals are also recommended for patients with acne, rosacea, eczema and other skin conditions where they are commonly used in combination with prescription medications. For example, moisturizers containing anti-inflammatory botanical ingredients may be used in conjunction with prescription medications for treating rosacea. Cosmeceuticals containing soy can be used to provide added skin lightening benefits when paired with hydroquinone. This shift in treatment paradigms has placed the use of cosmeceuticals within the purview of medical practice. Now more than ever, it is imperative that physicians understand the science behind cosmeceuticals. Patients are inundated with commercial information obtained from sometimes less than reliable sources such as consumer advertising, blogs and internet websites. They turn to their physician to provide credible advice on which products to choose and which products are worth the money. Therefore, it is our responsibility to review the scientific data and clinical studies and to steer patients away from products that are not adequately tested nor have proven benefits. This can be difficult since in the realm of cosmeceuticals, well-designed clinical trials are often lacking. Thus evaluating new products and keeping informed on the rapidly changing cosmeceutical marketplace remain an ongoing challenge for physicians.

Skin care regimens based on science

It takes time and skill to develop individualized skin care regimens for patients. Physicians must fully evaluate a patient’s skin type, assess the degree of photodamage and take into account any pre-existing skin

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conditions in order to design an appropriate regimen. It is important to consider if the patient has oily, dry or sensitive skin or if there are any pre-existing skin conditions like seborrhea, eczema, acne, and rosacea. Lifestyle considerations such as hobbies, sporting activities and occupation also play a role. A basic skin care regimen required to maintain skin health and beauty is made up of a cleanser, moisturizer and sunscreen. Toners, astringents and eye creams may also be included although these products are not considered essential. In general, regimens for cosmetic patients should include daytime products that protect the skin and nighttime products that will repair skin damage.

Cleansers are designed to remove dirt, make-up, sebum and pollutants from the skin and should be used morning and evening. Currently there are a wide variety of cleansers available, making it easy to recommend products that are appropriate for all patients. Mild cleansing products include synthetic detergent bars; these are also called syndets and lipid-free cleansers. These products have a pH that is closer to that of the skin (5.5–7) and clean the skin with little to no irritation. Syndet bars and lipid-free cleanser can be used on patients with most skin types and are especially helpful for those with dry or sensitive skin. Patients with pre-existing conditions such as eczema, rosacea and photoaging have a compromised barrier function, making gentle cleansing even more important.

Astringents and toners are used to remove any residual oils that are left on the skin after the cleansing process. Originally these products were designed to remove soap residue but today they are used primarily by patients who use cleansing creams or by those who have oily skin. Astringents and toners should be avoided in those with dry sensitive skin or in patients with a compromised barrier function. In these patients, astringents and toners may exacerbate dryness and cause burning and stinging.

Moisturizers are an essential component of a basic skin care regimen as they are necessary to hydrate the skin and to maintain barrier function. Proper moisturization can mitigate symptoms of dry skin, including itching, and improves the skin's appearance. Moisturizers are especially important for patients with conditions like rosacea and eczema where the barrier function is already compromised. Patients with oily skin and acne must also be given moisturizers since many medications used to treat acne have significant drying effects.

Photoprotection is the final essential component of the skin care regimen. Moisturizers containing sunscreens are appropriate for daily use and can be applied under make-up. Although many of these moisturizers offer good protection against ultraviolet A and ultraviolet B rays, they may not be the best choice for outdoor activities. Gel or spray-on sunscreens that are water-resistant are usually preferred by outdoor enthusiasts. Sunscreens should be selected based on skin type and personal preference.

Office dispensing

Physician-dispensed cosmeceuticals are sold in the vast majority of aesthetic practices. In 2011, dispensing lines generated US\$302.9 million in sales compared to US\$425 million sold in spas and salons, according to market research provided by Kline & Company. Healthcare and insurance companies frequently deny coverage for prescribed topical medications, making office dispensing a value added service for patients. As an extension to in-office dispensing, many physicians offer products for on-line purchase, making continuity easier for patients. Office-dispensed cosmeceuticals often contain higher concentrations of active ingredients than those available at mass market, making them more beneficial but also potentially more problematic. Nurses and estheticians can be helpful in instructing patients on proper product use and in providing information on how to treat complications should they arise.

While most patients view office dispensing as a value-added service, the dispensing physician must exercise extreme caution to keep the patient's best interest ahead of financial gain. Ethical conflicts occur when physicians are overly promotional, putting undue pressure on patients to buy products. It is important to dispense only products that have scientific validity, are clinically tested, and reasonably priced. Be familiar with retail alternatives should patients choose to purchase elsewhere. Private labeling has become increasingly popular with dispensing physicians and care should be taken to ensure that these products are not misrepresented as being physician developed or invented.

Efficacy and safety

Consumers seek products that are safe and effective. They prefer products that are fragrance-free, hypoallergenic, paraben-free, natural and green. They want products that are not animal-tested, favoring those with human clinical testing behind them. Responding to this demand, leading cosmetic companies are performing more extensive clinical testing than in years past although many studies do not meet rigorous scientific standards. Recently several major consumer companies have tested cosmeceuticals against leading prescription products. In these studies, achieving parity with prescription products bodes well with educated consumers and makes for strong marketing claims.

In spite of their long term safety profile, some consumers continue to have concerns about the safety of cosmeceuticals. Questions about the safety of nanoparticles, potential sensitizers and alleged carcinogens force many to seek natural and organic options. Natural cosmeceuticals refer to

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those with natural ingredients and are not necessarily organic. Examples of natural ingredients include aloe vera, vitamin C, soy and oatmeal. In order for a skin care product to be called organic, it must meet the new standards set by the U.S. Department of Agriculture agency in 2005. Organic skin care products must contain at least 95% organic ingredients, meaning that they were obtained from plants that were grown following organic farming guidelines. Organic crops must be grown without pesticides, hormones and chemical products, and may not plant genetically modified crops. They must also avoid any contamination during the processing of organic products. There is no scientific evidence to confirm that organic skin care products are safer or more beneficial than conventional products.

There are several excellent sources for consumers on product safety. The Cosmetic Toiletries and Fragrance Association (CTFA), now called the Personal Care Products Council, remains a trusted source on product safety. The Cosmetic Ingredient Review (CIR), a subsidiary of the Personal Care Products Council, reviews individual ingredients and determines their safety based on studies and data that are available. Information from both of these agencies is readily available on their websites and provides a valuable resource for both physicians and consumers.

Conclusion

Cosmeceuticals are now an integral part of the practice of aesthetic medicine. Physicians and their staff must be knowledgeable in order to advise patients on proper product selection and best practices. This unique category of products gives patients access to cosmetics containing beneficially active ingredients that can be used to improve the skin's appearance and treat dermatological diseases. As physicians we need to be vigilant to ensure that products recommended or sold by us are fully tested to ensure both safety and efficacy.

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PART I

Development,
Formulation and
Evaluation of
Cosmeceuticals

CHAPTER 2

Bench to Beauty Counter: Development of Cosmeceuticals

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Introduction

The development of cosmeceuticals is a complex process which involves multiple disciplines to achieve a safe, effective product that is acceptable to the consumer. Cosmeceuticals pass through many stages in the course of their development, from idea generation to final market launch. These steps are identified in Figure 2.1 and briefly outlined below.

The starting point is consumer insights and market research. This research is critical to understand consumer needs and the drivers of consumer behavior, well beyond what the consumers are able to articulate themselves. Market analysis reveals the potential demand for a new cosmeceutical product, a number of concepts are drafted to encompass the cornerstones of the idea, and the requirements profile is developed. By translating these findings into precise dermatological, chemical and physical terms, the product development team evaluates potential ingredients and product forms to create the first prototypes.

Important product characteristics of the prototype(s) are compared to the most accepted consumer product concept, and optimized for any necessary adaptations. To bring a final formulation to a fully marketable product requires a battery of stability, skin compatibility, and claim substantiation tests and the manufacturing of the final formulation.

Foundation for the development process

In-depth skin knowledge: prerequisite to cosmeceutical development

The development of cosmeceuticals is based on a deep knowledge of the skin, its biology, its chemistry, its mechanics, and how to treat various

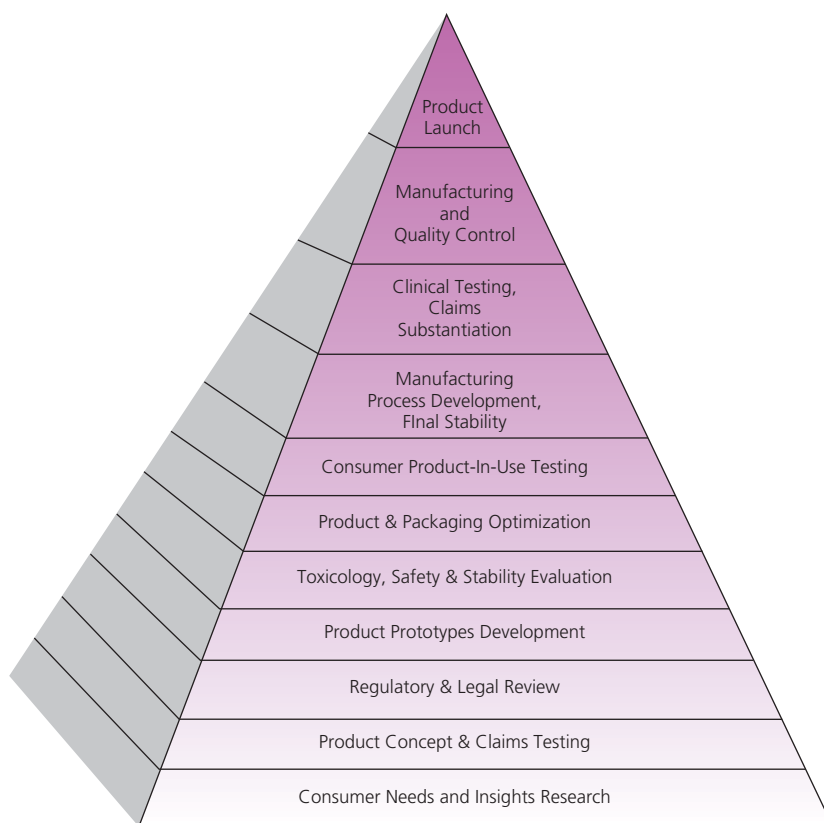


Figure 2.1 Concept to product launch process.

skin problems. Consumer characterization is an essential part of this process and covers a wide range of parameters. Skin type classification is a good starting point, with dry, oily, normal, or combination of dry and oily, as common types. Complex mechanisms influence the skin type, such as gender, age, hormonal status, and ethnic background. Skin changes over time and elderly people quite often experience very dry skin conditions. Similarly, hormonal changes, particularly in women during different stages of life, such as menopause, need to be taken into account. Ethnic background is also important, as different skin phototypes show varying sensitivity to UV light, resulting in different degrees of sunburn, tanning or photoaging, which can thus indirectly impact the efficacy of active ingredients. Finally, climate (temperature, humidity, seasonal changes), food and lifestyle have a profound, long-term influence on the skin.

From consumer insights to product idea

The changing landscape of consumer insights, leading to new product ideas, is exemplified by the sunscreen category. Originally, the predominant

product forms were lotions and creams. Due to the market demand for higher SPF levels, product formulations required a higher usage of sunscreen actives, resulting in products that were often sticky, oily and unpleasant to use. The industry challenge was to launch sunscreens with both excellent protection properties and pleasant aesthetics. Existing low viscosity sunscreen lotions were perceived by consumers to have a better skin feel than the higher viscosity products. This consumer insight opened the door to a novel technology which led to the development of sprayable lotions. Although the UV filters were still the same, completely new formula bases and customized packaging had to be developed. Currently, these sprayable sunscreen products are well established, cosmetically elegant, and preferred by many consumers. This highlights the importance of translating consumer insights into an aesthetically pleasing and effective product technology.

Regulatory and legal considerations

When developing a product, there are many regulatory considerations that must be taken into account, including product composition, category (based on intended use), claims and labeling, and manufacturing. The US Food and Drug Administration (FDA) has jurisdiction over the safety, efficacy, and quality of cosmetics, drugs [Rx and OTC (Over the Counter)], medical devices and food. The Federal Trade Commission (FTC) regulates truth in advertising and marketing, and oversees business practices to protect the consumer from fraud and deception.

Cosmetics and drugs marketed in the USA must comply with the Food, Drug and Cosmetic (FDC) Act and the regulations codified in Title 21, Code of Federal Regulations. Color additives are regulated by the 1960 Color Additive Amendment to the FDC Act, and must be approved by the FDA for their specific usage.

A product's category (as cosmetic or drug) is defined by the claimed or intended uses, and in some cases, the product composition. The FDC Act defines cosmetics as

articles intended to be rubbed, poured, sprinkled or sprayed on or introduced into or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance and articles intended for use as a component of any such articles, except that such term shall not include soap.

Drugs are defined as “articles intended for use in the diagnosis, treatment, or prevention of disease in man...and articles intended to affect the structure or any function of the body of man.”

OTC drugs have a structural and/or functional effect on the skin. The FDA has determined that the consumer is capable of diagnosing their need, and can safely treat their condition with these drugs without the direction of a physician. The FDA has published monographs

that stipulate the rules and requirements for the manufacture and marketing of many OTC drug categories (e.g. Skin Protectant, Sunscreens, Acne, External Analgesics, etc.). These documents define approved active ingredients and their percentages, labeling requirements (indications, warnings, directions) and allowable claims. The regulatory requirements related to drugs are more extensive than those for cosmetics.

The differentiation of a cosmetic and a drug based on a structure/function effect was legally established in 1938 (FDC Act). Since that time, the knowledge of skin physiology and the effects of topical formulations has greatly progressed. Dr. Albert Kligman first popularized the term “cosmeceutical” in recognition of the impact that some cosmetic products may have on the skin structure and/or skin function. However, the FDA does not recognize “cosmeceuticals” and continues to regulate based on the 1938 definition.

The FDA has far-reaching authority: they can act against false, deceptive or misleading claims on labeling, deceptive packaging, adulterated and/or misbranded products, and product safety and quality issues; they can request that a company voluntarily recall drugs and cosmetic products due to concerns over safety; they can embargo imported products, and they have the authority to conduct periodic audits to monitor compliance with US statutes.

The FTC regulates the advertising of products, including claims made on websites, and those of spokespersons and testimonials included in various sponsored media channels. This regulatory body also monitors unfair competition methods, and unfair or deceptive practices affecting the consumers, and has the authority to levy fines.

Patents and trademarks

Patent protection is a basic right mentioned in the US Constitution and plays an important role in business success, serving as a strategic tool. In the USA, a patent is granted by the US Patent and Trademark Office (USPTO), and provides a means by which inventors can exclude others from using the invention described in the claims in the granted patent for a period of 20 years. Patents comprise a major part of a company’s intellectual property (IP), which can be licensed and sold, and increase a company’s overall value.

Patents play an integral role in the product development process and need to be carefully considered before the development process moves forward. Conducting extensive patent searches to gauge the patent landscape is critical to prevent a patent infringement lawsuit. Thus, “right to market” and “freedom to operate” are key goals for product manufacturers.

Trademarks are signs, symbols or specific indicators used to uniquely identify products or services. Registered trademarks, indicated by the ® symbol, are also approved and issued by the USPTO. The TM symbol

represents a mark for which an application is pending; however, it is not yet approved and registered.

The science of formulation chemistry: product prototypes development

Actives and topical formulation bases

Many cosmetic manufacturers have extensive research programs dedicated to identifying, testing and selecting efficacious ingredients that impart a broad spectrum of skin benefits. Careful selection of active ingredients is critical to the overall product design. To fully leverage the efficacy of these actives, an appropriate formula base needs to be constructed. Actives and inactive ingredients in the formula are closely linked so that the development of a suitable base is just as important as the proper selection of the actives. This is a complicated balancing act, for many actives are difficult to incorporate into a base formula. Not only do they have to be stable in the base over a defined shelf life, but once applied on the skin, the actives need to be easily released from the formula matrix to stay on the skin surface or penetrate into the skin, depending on their function. In-depth knowledge of the human skin barrier is essential to understanding how physicochemical properties of the active can impact percutaneous absorption.

By utilizing modern delivery systems, such as microencapsulation or solubilization techniques, bioavailability and efficacy of the active can be optimized. Examples are liposomes, cyclodextrins, solid lipid nanoparticles and micro/nanoemulsions.

Some active ingredients also have the potential to irritate the skin, if not properly formulated. These undesirable side effects can lead to skin incompatibilities (e.g. redness or burning sensation), and should be minimized.

A comprehensive formulation strategy encompasses the collective knowledge of an interdisciplinary team to leverage proven methodologies, established know-how, as well as state-of-the art technology. The starting point is a technological SWOT (strength, weakness, opportunity, threat) analysis of the active with regard to the desired beneficial action on the skin. This well-known business analysis tool can help identify favorable and unfavorable factors to guide the creation of an outstanding product. For example, an oxygen-sensitive active could exhibit very good efficacy in pristine form (strength), but is rapidly degraded by oxygen (weakness). Antioxidants and an oxygen impermeable package could be used to mitigate this weakness.

The success of a cosmeceutical depends on its ability to improve a dermatological condition and is dependent on consumer compliance.

Appealing aesthetics or sophisticated textures impact how the consumer perceives the product and promotes reapplication rate, an essential factor to achieving the desired efficacy. The final product characteristics, such as color, texture, appearance, odor, viscosity and skin feel are therefore all important to the quality and consumer acceptance of a final product.

Inactive ingredients and product forms

The inactive ingredients in topical formulations have versatile functions, influencing the sensory properties of the product, their fundamental skin-care properties, as well as the delivery of actives. They can be combined in different ways to achieve a variety of forms, ranging from aqueous hydrogels to water-free oils or powders, aerosols, foams, suspensions, and other colloidal systems. The most important colloidal systems for cosmeceuticals are emulsions with two predominant types: oil-in-water emulsions (o/w), where oil droplets are finely dispersed in water (water determines the main properties), and water-in-oil emulsions (w/o), where water droplets are finely dispersed in oil (oil determines the main properties).

If not properly stabilized, the incompatible phases (e.g. oil and water) of thermodynamically unstable emulsions start to separate during storage. However, when an *emulsifier* is added to the system, the droplets remain dispersed, and a stable emulsion is obtained. Typically, non-ionic or anionic emulsifiers are the stabilizers of choice. However, certain emulsion systems can be very complex (e.g. supramolecular gel structures or multi-phase systems).

Besides emulsifiers, different groups of *polymers* are employed as stabilizers or thickeners. Examples are xanthan gum, a high molecular weight polysaccharide produced by microbial fermentation, and polyacrylic acid cross-linked at different levels.

Another diverse ingredient class is *lipids*. Representatives of this class are: solid, semi-solid and liquid hydrocarbons, natural oils and waxes, fatty acid esters, partially hydrogenated or modified triglycerides, derivatives of fatty acids or fatty alcohols, and silicones. Lipids are not only important solubilizers for lipophilic actives, but also have an immediate impact on the skin feel during and after product application. The optimal combination of lipids is crucial to creating a formulation with attractive sensory properties.

Additional important *additives* in cosmeceutical products are preservatives to protect against microbial spoilage of the product, antioxidants to stabilize ingredients susceptible to oxidation, chelating agents to capture traces of certain metal ions to stop pro-oxidative effects of metal ions and prevent discolorations, and organic acids and bases to regulate the pH. Fragrances provide a pleasant scent and colors are added to enhance the product aesthetics.