Skin Care Products: What do they promise, what do they deliver

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Skin care products: What do they promise, what do they deliver

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Abstract The industry offers a vast armamentarium of skin care products to clean, soothe, restore, reinforce, protect and to treat our skin and hence to keep it in "good condition". Skin care products are readily available and their promotions with fanciful claims are omnipresent. The promotions are based on effects, evoked by actives that are delivered through vehicles that rely on specific technologies. Due to the fact, that these products are in direct contact to the target tissue, their vehicle and ingredients are able to profoundly modulate the characteristics of the skin and some of its functions. This makes products for the skin absolute unique and versatile delivery systems. This paper discusses the concept of skin care and skin protection, the choice of skin care products, their vehicles, their functionality and their regulatory status.

1. Introduction

Our skin reflects our origin, lifestyle, age and state of health. Skin color, tone and evenness, pigmentation, as well as skin surface characteristics are signs of our skin's health. The cosmetic and pharmaceutical industry offers a vast armamentarium of skin care products and procedures to clean, soothe, restore, reinforce, protect and to treat our skin and hence to keep it in "good condition" [1,2]. Skin care products are readily available in daily life and they play a major role in health and nursing care. The promotion of skin care products including their claims are often based on an *effect* (e.g., moisturizing, antioxidant), evoked by an *active* (e.g., urea, tocopherol) that is delivered through a *vehicle* (e.g., lotion) that relies on a *specific technology* (e.g., nanotechnology). In addition *"without" claims* (e.g., without parabens) often accompany nowadays promotions.

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Some of the effects, actives, vehicles and technologies have become well-known. The pharmacologic, immunologic or metabolic effect of *medicinal products* — e.g., to treat hand eczema or acne — is assigned to an active pharmaceutical ingredient (API), e.g., corticosteroids, retinoids. It is common knowledge that the vehicle housing the API plays a crucial role in delivering the API to its target site. Unfortunately many assign the vehicle effect to its entirety (e.g., ointment, cream, gel) and not to the sum of ingredients forming the vehicle that remains on the skin after application (see section *Metamorphosis of the Vehicle*). Skin care products rarely house APIs but rather so-called *actives* or *cosmetic actives*. These products are classified in some specific cases as *medical devices* but in a majority as *cosmetics*. In all these cases, too, the vehicle plays a crucial role in unleashing an effect on the skin. This is due to the fact, that the target tissue is directly treated and the vehicle and their ingredients are able to profoundly modulate the characteristics of the skin and some of its functions. This makes products for the skin absolute unique and versatile pharmaceutical and cosmetic delivery systems.

Against this background we discuss the concept of skin care and skin protection, the choice of skin care products and their vehicles, their functionality and their regulatory status.

2. Concept of skin care and skin protection

The concept of skin care is not well defined. It is a kind of umbrella term covering cleansing, perfuming, changing appearance, changing body odor, protecting and keeping the skin in "good condition". In the last decades our perception of skin care has broadened and soothing of skin symptoms/conditions, and improvement and restoration of the skin's barrier function and integrity have been added. Today, modern skin care includes *cleansing*, *soothing*, *restoring*, *reinforcing* and *protecting*. With increasing age the emphasis on skin care is changing [3,4]. The importance of soothing, restoring, reinforcing increases and cleansing should be executed with particular care. The character of skin care shifts from more *cosmetic* objectives — smooth, healthy looking skin — to more *therapeutic and preventive* objectives — soothing, restoring, reinforcing and protecting stressed skin. Even though skin care and skin protection plays an important role throughout lifetime the *noxes* and the *skin areas in primary need of care and protection* also change. In younger years environmental noxes (e.g., UV radiation) are of primary importance whereas in advanced years age-related noxes (e.g., prolonged exposure to various sources of moisture, including urine or feces, perspiration, wound exudate, and their contents) become more important. Subsequently the skin areas in need of care and protection also change — initially skin areas (e.g., face, arms, legs) exposed to the the external environment and later enclosed skin areas (e.g., skin folds, perianal, perigenital skin, groin, feet) become the vulnerable zones (hot spots) [5,6]. Ageing per se changes the skin structure and function across the life course increasing its susceptibility to numerous clinical relevant skin problems (e.g. xerosis cutis) [7]. Skin diseases (e.g., bacterial/fungal infections), accumulating effects of systemic diseases (e.g., diabetes mellitus, renal insufficiency) or pharmacotherapies (e.g., cancer therapies) also necessitate special skin care.

3. Skin care procedures and skin care products

The information on skin care procedures is plentiful but little scientifically documented and the number of products available for cleansing, soothing, restoring, reinforcing and protecting is of an almost infinite variety. Nonetheless their functionalities may be described as

- Removal of dirt, sebum, microorganisms, exfoliated corneocytes and other non-wanted substances from the skin
- Reduction of unpleasant skin symptoms (e.g., pruritus, burning, odor)
- Restoration of (subclinically) damaged skin (e.g., dry and inflamed skin)
- Reinforcement of undamaged but vulnerable skin (e.g., skin surface pH balance, germ reduction)
- Protection of damaged, undamaged and vulnerable skin from various noxes
- Providing a pleasant skin feel (well-being).

The functionality of the skin care products ranges from mono-functional, e.g., protecting barrier creams to poly-functional, e.g., soothing and restoring cleansers. They unfold their functionality as leave-on products (e.g., moisturizing or skin barrier products), or as rinse-off products (e.g., cleansers). Skin care procedures — washing/

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drying and the application of leave-on products — should be as benign as possible. The unduly removal of natural skin component (e.g., lipids), prolonged exposure to water (e.g., long-term immersion in full-baths), a (repeated) disruption of the physiological skin surface pH, and excessive and/or prolonged occlusion of the skin should be avoided.

Skin care delivered to improve, e.g., the outcome of an eczema therapy or to reduce, e.g., the adverse effects of a cancer therapy are often termed as adjuvant skin care. Nonetheless, adjuvant or the above described classic preventive skin care pursues the similar goals.

4. The choice of vehicle

There is an overwhelming range of skin care products on the market with a multitude of promises and application recommendations. The latter often includes recommendations regarding the *choice of vehicle*. However, these recommendations are unfortunately often founded on faulty science. One reason is the absence of a clear and persuasive terminology for vehicles. Current recommendations rarely differentiate between vehicle *effects* (moisturizers, emollients, humectants, etc.) and vehicle formats (ointments, creams/lotions, gels etc.), e.g., "a moisturizer is a cream for application on face and body". From many recommendations suspicion may arise that the essence of the vehicle is not fully understood, e.g., "… unlike lotions, which do not maintain moisture in the skin, cream moisturizers donate moisture and aid in retention of moisture on the skin surface …" [8]. The terms "moisturizer" and "emollient" are often used interchangeably, despite the fact that they describe different mechanisms. Conceptually a moisturizer adds moisture to the tissue whereas an emollient softens a tissue and makes it flexible. Both, moisturizers and emollients may, or may not have softening and moisturizing effects.

4.1. The concept of vehicles

Without going into physicochemical details one may define a vehicle as a mixture of a series of ingredients that forms a three dimensionla matrix or format, e.g., ointment or cream, etc. The physicochemical character of the ingredients chosen and the manufacturing process determine the final format of the vehicle — the three dimensional matrix. E.g., when two immiscible liquid phases, each may contain several ingredients, are mixed and stabilized an emulsion results. In pharmaceutics and cosmetics the emulsion is termed as a cream or a lotion. Creams are semisolid whereas lotions are more liquid. The difference between these two forms is primarily viscosity. Depending on the ingredients (emulsifiers) chosen to stabilize the emulsions, the emulsion may become an oil in water (o/w) or a water in oil (w/o) emulsion (Fig. 1).

4.2. The metamorphosis of the vehicle: the primary and secondary vehicle

In the case of an oil in water (o/w) emulsion the lipophilic (inner) phase is dispersed in the hydrophilic (outer) phase. In the case of a water in oil (w/o) emulsion the hydrophilic (inner) phase is dispersed in the lipophilic (outer) phase. It is easy to imagine that the sensory character of the emulsion on the skin may be very different. Due to evaporation of water the oil in water emulsion may convey the immediate impression of "cooling". A considerable number of ingredients that are used in many current topical formulations are volatile, e.g., water, alcohol and even propylenglycol. Once applied to the skin, the evaporation of volatile ingredients may dramatically change the character of the vehicle once applied to the skin. This phenomenon is termed as *metamorphosis of the vehicle* (Fig. 2) [9].

This phenomenon becomes often recognizable as the visual aspect of the skin surface is changing. It gives the false impression to both consumers and

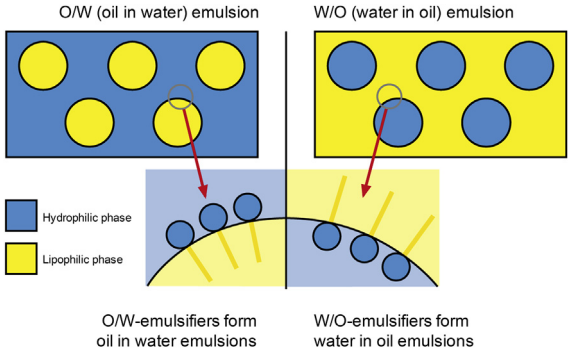

Fig. 1 Depending on the ingredients (emulsifier) chosen to stabilize the emulsions, the emulsion may become an oil in water (o/w) or a water in oil (w/o) emulsion. Semisolid emulsions are termed as *creams* whereas more liquid emulsions are termed as *lotions*. The difference between these two formats is primarily viscosity. It is also easy to imagine that the sensory character of the o/w and the w/o emulsions on the skin may be very different. Due to evaporation of water the o/w emulsion may convey the immediate impression of "cooling".

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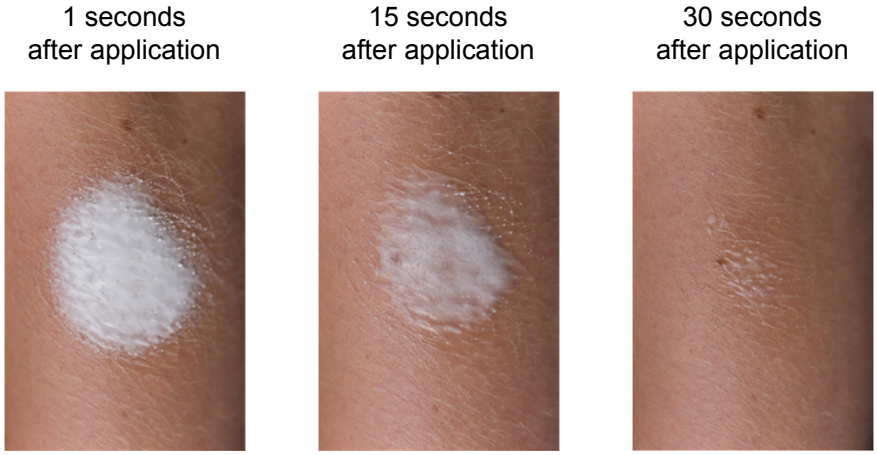

Fig. 2 In clinical situations, most topical vehicles (structural matrix and ingredients) undergo considerable changes after they are removed from the primary container and are applied onto the skin. The fast breaking foam spray is a distinctive example for the *metamorphosis of the vehicle*. This phenomenon tempts both consumers and professionals to believe that the product is well absorbed, even though only volatile ingredients are evaporating. Relevant penetration into and permeation through skin (absorption) of any ingredient may demand more time than for the metamorphosis of the vehicle [9].

professionals that the product is well absorbed, even though only volatile ingredients are evaporating. Absorption into or through the skin of any ingredients — active or inert — demands much more time.

As a consequence one may differentiate between two types of vehicles — the *primary vehicle* in the tube, bottle or jar and the *secondary vehicle* that forms after application on the skin. The latter has lost all or significant amounts of its volatile ingredients. In addition the original three-dimensional matrix may have completely changed. The primary vehicle is responsible for the application sensation whereas the secondary vehicle is responsible of the subsequent skin feel and long-term effect.

4.3. The polarity (hydrophilicity vs. lipophilicity) and viscosity of vehicles

The properties of ingredients — hydrophilic (solubility in water) or lipophilic (solubility in oil) — chosen to formulate the vehicle, determine its final character. This means — theoretically and practically — that for most of the vehicles (e.g., ointments, creams/lotions, gels and pastes) a hydrophilic and a lipophilic form exist, e.g., hydro- vs. lipolotion or hydrogel vs. oleogel. From a practical point of view, it is important to note, that lipophilic formulations are often less effectively removed from the skin than hydrophilic formulations. In the case of stressed skin topical formulation must be easily removable and an appropriate cleansing product/procedure has to be chosen. Viscosity is another important product feature that should be considered. Low viscosity products are preferably used on larger skin areas, whereas high viscosity products are used on smaller areas. As a consequence for the future one may expand previous criteria of vehicle choice (ointment, cream/lotion, gel, paste) and also use polarity (hydrophilic vs. lipophilic) and viscosity (low vs. high). Hydrophilic vehicles are more suitable for moist and lipophilic vehicle are more suitable for dry skin conditions. Low viscosity vehicles are more suitable for larger whereas high viscosity vehicles are more suitable for smaller skin areas (Fig. 3) [9].

For daily practice, healthcare professionals, patients and consumers may put more emphasis on polarity and viscosity of the vehicle rather than the vehicle format. As these features are rarely mentioned on the product labeling or in the accompanying information only own previous experience or recommendations from third parties may help to choose the adequate product of preference. Another option is to rely on the functionalities claimed on the product.

5. Product functionality

5.1. Cleansing products

Skin cleansing includes washing, showering and bathing. It removes dirt, sebum, microorganisms

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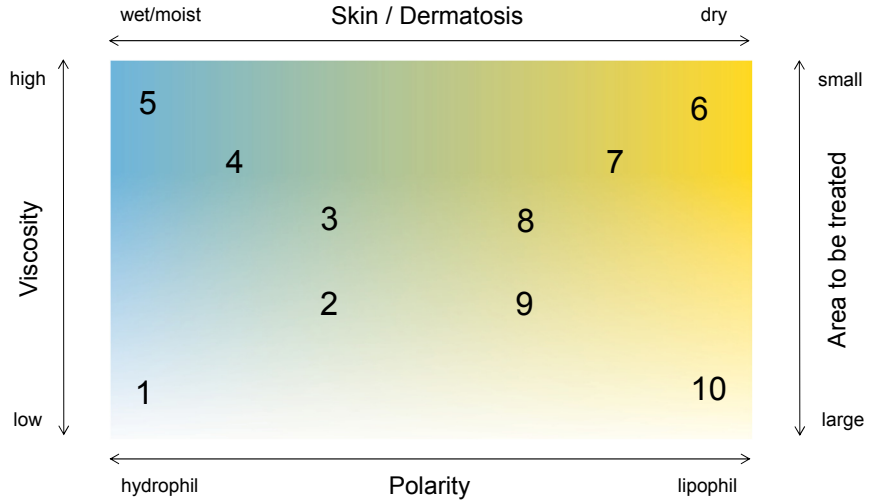

Fig. 3 From a theoretically and practical point of view polarity (hydrophilic vs. lipophilic) (x-axis bottom) and viscosity (low vs. high) (y-axis left) are relevant vehicle features to consider when choosing a product. Hydrophilic vehicles are more suitable for wet/moist and lipophilic vehicles are more suitable for dry skin conditions (x-axis top). Low viscosity vehicles are more suitable for larger whereas high viscosity vehicles are more suitable for smaller skin areas (y-axis right). Typical vehicles are: ☆ (1) aqueous solution; • (2) o/w- or hydrolotion; ÷ (3) o/w-cream; ≠ (4) hydrogel, hydrophilic ointment; ≡ (5) cross-linked hyaluronic acid gel (cubed water); ≈ (6) lip stick; ⋯ (7) lipogel, lipophilic ointment; | (8) w/o-cream; — (9) w/o- or lipolotion; ⌟ (10) oil [10].

and exfoliated stratum corneum cells from the skin. Cleansers are products that are used as such, added to the washing water or are part of wipes to remove debris from the skin in an emulsified form. The key cleansing ingredients are the "surfactants" — a term derived from the words "surface" and "active" — that lower the surface tension on the skin and hence remove the debris. "Syndet" is another portmanteau word created by combining the words "synthetic" and "detergent". Soaps were the first surfactants people used for cleansing. They are made by reacting fatty acids with a base (e.g., sodium hydroxide) — a process that is called saponification. All the terms are often used as linguistic synonyms even though the physicochemical difference between the classic soap and syndets/detergents is distinctive. Traditional soaps have a pH of 9 to 10 whereas syndets/detergents show a pH of 5 to 6 [11]. The latter pH is preferable for the skin and it was shown that the artificial reduction of the skin surface pH promotes the skin integrity in aged and compromised skin e.g. [12]. Depending on the emulsifying capability of the surfactants, they may disturb or disrupt the skin barrier and hence aggravate unfavorable skin conditions [13,14]. Cleansers may contain antimicrobials (e.g., benzalkonium chloride or iodine) or humectants (e.g., glycerin) or occlusives (e.g., paraffin) to compensate cleansing-induced damage. Because cleansers are rinse-off products the effectiveness of antimicrobial additives has been questioned [15]. The effect of other additives may also be questioned because significant amounts are lost during cleansing. Acidic cleansers with "mild" surfactants (non-ionic/silicone-based surfactants) — minimal disturbance/disruption and yet high rinsibility — are generally recommended to cleanse vulnerable skin [2,6]. There may be situations in clinical practice, in which the exposure to water and cleansers must be restricted to a minimum, e.g., severe xerosis cutis [16].

5.2. Soothing, restoring, reinforcing products

Even though there are linguistic differences between the terms soothing, restoring, and reinforcing, it is difficult to subcategorize products accordingly. The soothing character of a product can rarely be awarded to a single substance in the product. Products restoring the skin (e.g., moisturization) will most likely soothe the skin (e.g., pruritus). Reinforcing products will create or support natural and healthy skin conditions (e.g., acidic skin pH, limit bacterial/fungal growth).

5.3. Protecting products

"Barrier cream" is the colloquial term for topical products that are placed as physical barriers between the skin and contaminants that may harm the skin. "Barrier creams" may also be intended as products that may restore damaged skin. In this sense, any moisturizing or emollient product can

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also be considered as potential skin barrier improvers [17]. Unfortunately, the terms are used vaguely — both in guidelines and scientific papers. Furthermore "cream" is just one possible vehicle format of such products — other forms such as ointments, pastes, sprays or foams also exist. To avoid linguistic misunderstandings one may differentiate between "barrier products" and "barrier repair products" (see also restoring products). The first is defined as a product that provides primarily a barrier against noxious agents, the latter is defined as a product with the clear intention to restore and reinforce the skin. However, barrier products obviously do not work only based on a physical shielding of the skin; they may also alter the biochemistry of the potential irritant [18]. Barrier products cannot simultaneously provide a barrier against all noxious agents. It is generally believed that more lipophilic formulations are effective against hydrophilic solutions of irritants, and hydrophilic formulations are more effective against lipophilic materials. Even though studies have shown effects of barrier products in age-associated skin conditions (prevention of superficial pressure ulcers and incontinence-associated dermatitis) their general benefits are still debated [2]. Functionality is an adequate mean to describe a skin care product and alleviate the product choice. However, the industry is prone to exaggerated embellishments of the product functionality and reliable choices are often difficult.

6. The vehicle and the actives

A vehicle is something that carries, delivers, transports etc. A vehicle for topical application may carry, transport or deliver APIs or cosmetic actives. While often expected, the effect of most skin care products cannot be assigned to one single "active" ingredient. The following example may illustrate this fact. A skin care lotion may contain glycerin, dimethicon and/or paraffin. They are concurrently integral part of the vehicle and active ingredient. Glycerin (hydrophilic ingredient) termed as *humectant* attracts water from the environment and from within the skin once penetrated into the stratum corneum. Dimethicone and/or paraffin (lipophilic ingredients) are termed as *occlusives* keep the moist within the skin by decreasing transepidermal water loss of the skin through occlusion. These ingredients formulated into emulsions (moisturizing creams or lotions) serve concurrently as vehicle ingredients and as actives.

The range of generic and branded actives that is offered worldwide is overwhelming. Examples are allantoin, ascorbyl palmitate or ubiquinone (CoQ10) etc. for generic actives and Soothex® (soothing action for sensitive or over-reactive skin types) or Yogurtene® Balance (probiotic efficacy; promotes beneficial bacteria) etc. for branded actives. Unfortunately the claim substantiation is often poor and do not comply with current scientific standards.

7. Regulatory issues

Skin care products can theoretically be assigned to three different regulatory classes — medicinal products, medical device and cosmetics. For medicinal products and medical devices a health promise is allowed whereas for cosmetics a health promise is prohibited. The health promise refers to the preventive and/or therapeutic purpose of the medicinal product or the medical device. They achieve their principal intended action in or on the human body by pharmacological, immunological or metabolic means (medicinal products) or by non-pharmacological, non-immunological or non-metabolic means (medical device), respectively. Cosmetics are meant to clean, to perfume, to change appearance, to correct body odor, to protect and to keep in good condition [1]. Currently the majority of skin care products are cosmetics. For medicinal products and medical devices the indication are clearly labeled, e.g., xerosis cutis or pruritus. In cosmetic products claims often describe their functionalities and may be as simple as "soothe signs of dry skin" but may also be more fanciful like "Multi-Ingredient Anti-Aging Moisturizer Designed to Improve the Appearance of Facial Skin" [19]. It is important to note, that while the boundaries of the three regulatory classes seem well defined, there are many examples to demonstrate that these boundaries are not as well defined as one may assume. For instance identical products are marketed as cosmetics or medicinal products in different European countries. Occasionally, you will find that regulatory bodies will question promotional claims and require commercial suppliers to provide additional substantiation or change the products' claim. To increase professional credibility and reputation some commercial organizations promote their products as cosmeceuticals and more recently started to conduct clinical trials with their cosmetic products [20,21]. It is obvious that the label "clinical proven" has a promoting and valorizing effect. However, it does not change the regulatory status of the product and the permitted claims. A well-known example ingredient is Aloe vera

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incorporated in many topical formulations. The authors of a recent Cochrane Review on the effect of Aloe vera topical agents or Aloe vera dressings as treatments for acute and chronic wounds came to the conclusion that there is currently insufficient clinical trial evidence available [22]. This was primarily due to the lack of high quality trials with adequate methodology. Currently, this judgment also applies to many of the "active" cosmetic ingredients and their supposed effects.

This regulatory situation is unknown to most of the consumers and healthcare professionals. They have to trust the current regulations on cosmetic products and quality standards used by the manufacturer.

8. Concluding remarks

Today a vast armamentarium of skin care products to clean, soothe, restore, reinforce, protect and to treat our skin and hence to keep it in "good condition" is available. Skin care products are characterized by effects, evoked by actives that are delivered through vehicles that rely on specific technologies. Due to the fact, that these products are in direct contact with the target tissue, the vehicle ingredients are able to profoundly modulate the characteristics of the skin including causing adverse effects. This means that professional healthcare practitioners have a substantial responsibility for skin health while delivering skin care [23]. Essential for any effect are the **vehicles** and the **actives**. It is suggested when choosing a skin care product, that other criteria than just the classic vehicle terminology (ointment, cream/lotion, gel, etc.) should be considered. It is proposed to include polarity (hydrophilicity vs. lipophilicity) and viscosity of the vehicles to better address the actual skin condition/situation. It should also be pointed out, that vehicles containing volatile ingredients would profoundly change their character once applied to the skin. The residue of a vehicle after application (secondary vehicle) determines the vehicle ingredient dependent effects on the skin. An incredibly large amount of generic and branded actives are offered to enhance topical skin care. However the scientific data to support these effects and the concomitant claims are often vague and do not comply with current scientific standards. Current recommendations are often based on personal experience, opinions or at best on consensus documents rather than on scientific data retrieved from controlled clinical trials. Today most skin care products are classified as cosmetics. Despite the fact that no health claims are allowed for skin care products classified as cosmetics this product category is successfully promoted in the skin care business.

Conflicts of interest

There are no conflicts of interest.

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