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**REVIEW ARTICLE**

# EVALUATION OF MULTIFUNCTIONALITY IN COSMETICS

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## Abstract

In recent years, developments in the field of cosmetic ingredients especially use of natural sources and carriers systems and the manufacturing methods resulted as an improvement in the effect and stability of cosmetics, and thus the performance and component-based multi-functionalities of cosmetic products. Those have partially contributed to the condition-dependent functionality, developments in the field of marketing, monitoring of expectations and their reflection on marketing and the creation of new ideas in the field of claim-driven multi-functionality. Multi-functionality in cosmetic products can be evaluated in four groups. These are performance-based multi-functionality, component-based multi-functionality, conditional multi-functionality and claim-driven multi-functionality. In the first two groups, performance related to formulation and manufacturing comes to the fore, while in the last two, safety becomes important and those are briefly given in this review.

**Keywords:** Claim, efficacy, legislation, multifunctional cosmetics, performance tests, safety.

## INTRODUCTION

Legislations and the scope of cosmetics have some differences according to countries. Mainly the European, American and the Asian cosmetic legislations have differences in terms of borderline products. According to the European legislation, cosmetics generally means any substance or mixture intended to be placed in contact with the external parts of the human body (epidermis, hair system, nails, lips and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view exclusively or mainly to cleaning them, perfuming them, changing their appearance, protecting them, keeping them in good condition or correcting body odors. In addition, according to the EU cosmetic legislation, cosmetic substance means a chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition[1]. In general, cosmetic products have borderlines with medicines, medical devices, biocidal products, toys, textiles and nutrition products[2].

Through the diversity of definition and scope, there are various classes and expressions attributed to cosmetics even in the legislations or the literature. Of these expressions, some of which can be found in global scientific articles are; cosmeceuticals, dermocosmetics, functional cosmetics, dermatocosmetics, active cosmetics, etc. The first three are generally widespread in the America, the Europe and the Far East, of which only "functional cosmetics" is included in South Korean legislation[1,3,4]. Products under such expressions in the world in general; related to the aesthetic appearance, are considered as products that can be on the border of cosmetics and medicines or medical devices. Cosmeceuticals can be defined as substances

and products that are claimed to have biological activity, achieve the desired cosmetic result with a physiological effect, act upon the structure and functions of the cutaneous and cutaneous related parts positively[5,6]. Such products can be sold over the counter-OTC in many countries. Dermocosmetics are considered as products related to the aesthetic appearance of the skin, which can be on the border of cosmetics and medicines such as skin care products, eliminates superficial skin problems and improves skin appearance and health. Dermocosmetics is a category of products that have or are claimed to have a therapeutic effect, such as cosmeceuticals[7].

The Korean Cosmetic Products Act divides cosmetic products into the following three categories[4] and between those quasi-drugs and functional cosmetics are subjected to premarket license of competent authority.

- General cosmetics
- Functional cosmetics
- Quasi-drugs

On the other hand, the conditions required for a product to be accepted as cosmetic within the scope of EU cosmetic legislation can be indicated as;

- The intended use of the product is within the scope of cosmetic application and it is not intended to be used by ingestion, inhalation, injection or insertion into the body.
- If there is an apparatus intended to be used within the scope of its application, it is not intended to impair the integrity or function of the skin (for example, micro-needle instruments).
- Does not contain any prohibited ingredients due to its content.
- If there is a limited component in its content it does not exceed the allowed limits, and also used for defined conditions.
- Within the scope of formula features; the structure of the formula does not give the formula and/or its components a feature or activity that will exclude the cosmetic function.
- In case of a carrier or applicator material is needed in the application of the formula to the human body; this material does not have negative reflections on the effect and stability of the product. The material is expected to meet the requirements of the legislation and/or standard of which it is subjected (e.g. textiles carrying or delivering cosmetics).
- The effect of the product and /or its mechanism of action; should not for an illness diagnosis, prevention and/or treatment, should not for any purpose of correcting, regulating or changing a physiological function.
- Its need to be within the scope of cosmetic legislation, not within the scope of medicine, medical device or biocidal legislation, and not contain a health claim.
- The perception created within the scope of its presentation; not to give the product the image that it has property that are exceeding/unsuitable for the cosmetic legislation other than cosmetic product.

Development in the field of cosmetic ingredients such as using carrier systems combined with raw materials and natural sources, the performance and the component-based multi-functionalities and partially the condition-dependent multi-functionality of cosmetics have been generated. Moreover, developments in the field of marketing and the monitoring of expectations and their reflection on marketing has led to develop of new creations in the field of claim-driven multi-functionality[8-10].

**Multifunctional Cosmetics**

In case of a cosmetic product covers more than one purpose in line with the intended use of the products, it becomes multi-functional. From this point of view, the multi-functional criteria of cosmetic products can be evaluated under four headings, and those are[8-10];

i. Performance-based multi-functionality
ii. Component-based multi-functionality
iii. Conditional multi-functionality (multi-functionality dependent on the condition)
iv. Claim-driven multi-functionality

**Performance-based multi-functionality**

In performance-based multi-functionality, at least two separate functions must be present in the product and the following examples are included in this group[9-12];

- Two-in-one shampoos that offer both cleaning and easy combing functions.
- Foundations that change skin appearance moisturize the skin and protect from UV rays.
- UV filter, moisturizing lipsticks or lip balms.
- Nourishing hair gel with UV filters.

**Component-based multi-functionality**

In case of component-based multi-functionality, a component has more than one function. Examples of this type are odor components with odoring and product protection (preservation) functions. The aluminum salts, which have ability to control the number of microorganisms that cause odor, also reduce wetness and they are used in antiperspirants. Some examples of component-based multi-functionality in cosmetics are presented below[9,13-19] :

- Fragrance ingredients with scent and product protection (preservation) functions.
- Aluminum salts that control the number of microorganisms that cause odor, reduce wetness, and are used in antiperspirants by reducing sweating.
- Most botanical extracts are cosmetic ingredients with multiple functions.
- Green tea extract is an ingredient with anti-inflammatory, anti-microbial and anti-oxidant properties.
- Rose oil and derivatives are ingredients with antioxidant, antimicrobial, improve skin barrier function, fragrance and skin softening properties.

**Conditional multi-functionality**

It is possible for a conditional multifunctional property to be used in more than one situation. Eyelash mascara can be used as hair mascara, lipstick can be used as blush and blush can be used as eye shadow (in condition to meet the safety principles for all intended use). In this type of multifunctionality, besides the purpose for which the product is prepared, it provides

the safety principles for other usage purposes and these uses are taken into account in the evaluation. Examples for this group are given below:

- The ability to use eyelash mascara as hair mascara.
- The ability to use a lipstick as blush.
- The ability to use naturally sourced dyes such as henna for skin and hair coloring.

**Claim-driven multi-functionality**

In the claim-driven multifunctionality, it is decisive that the effects of the product are included in the claims besides the main purpose. As an example of this type, it can be stated that the claims for a shampoo with a cleansing function include issues such as cleaning, refreshing and scenting the hair. In the claim-driven multi-functionality, besides the main purpose of the product, its effects are included in the claims. Examples of this group are given below:

- The claims for a shampoo with a cleansing function include the expressions of cleaning, refreshing and scenting the hair.
- In the claims for the hair conditioner, it softens the hair, provides easy combing, prevents the hair strands from tangling, and enhances the appearance and scents.
- The claims for a nail polish with a coloring function include the expressions that it allows the nails to grow easily, prevents them from breaking, and hardens them.
- The claims for the sun protection skin lotion include the expressions of anti-aging, helping to prevent sun spots and provides moisturizing.

Having more than one purpose with the same product can provide ease of use and economic advantage that encourage the cosmetic industry to make more effort for giving their products multi-functionality in various ways.

**Critical Factors and Steps in Designing Multifunctional Cosmetic Products**

In designing a multifunctional cosmetic product, at first, the type of multi-functionality must be decided and the steps that follow must be shaped based on this. Two approaches can be followed to bring multi-functional properties to cosmetic products. The first of these is a multi-functional cosmetic product in a single primary package, and this feature can be obtained directly from the cosmetic formula or by a function brought by the packaging in addition to the formula. For example, the packaging head of a cuticle removing formula has the function of mechanically repelling the cuticle.

In addition to the eyelash mascara formulation, the mascara brush has a function that simulates physical activity due to the presence of a vibrating motor. The other is to provide multi-functionality with the cosmetic product set. For example, it is the case of having a hair care mask or cream to be applied after the dyeing process in the hair dye set. Some of the cosmetic products in the primary packaging are in the status of multifunctional cosmetic products in line with the formulation components. For example, some shaving foam formulations provide lubricity, moisturizing and anti-redness properties. Among the critical factors to give multi-functional properties to such cosmetic products are compatibility, stability and proof of functionality. In addition, these cosmetic products must meet the basic aesthetic features in terms of user expectations. It is important that the process should be guided/completed by conducting performance tests and stability tests during the formulation development process[17, 20, 21]. In case of the performance-based multi-functionality and component-based multi-functionality in cosmetic products, evaluation parameters and methods need to target the formulation and the manufacturing of the product. In case of condition-dependent multi-functionality and claim-based multi-functionality, evaluation parameter is directed to the toxicological assessment (safety evaluation) of the product. In the claim-based multi-functionality, product is fully evaluated on the basis of marketing methods, and all the properties of the product, which are not planned and arising from the nature of the formulation, are transferred to the claims.

In the design of multifunctional cosmetic products, a systematic should be established with the following steps and technical information should be compiled, evaluated and documented according to the nature of each step, making the determinations for the expectation of the consumer with measurement-based methods or reference sources will allow it to be shaped correctly.

- Identifying and evaluation of the type of multifunctionality.
- Evaluation of consumer habits and expectations.

After the type of multifunctionality is determined below listed main steps need to proceed;

- Formulation development in component or formulation-oriented multifunctionality (performance-based multifunctionality, component-based multifunctionality), evaluation of packaging selection and compatibility, scale-up work after tests and evaluations to prove functionality, good manufacturing practices and processing quality subjects.
- The third type, conditional multi-functionality; A safety assessment is required for a new function within the scope of the new properties defined for an existing product.
- In the fourth type, claim-based multifunctionality; Functionality in which the inherently existing properties of an existing formulation or product are transformed into a claim to provide the main purpose, and for this purpose, testing the existing product, determining the properties that can be claimed by means of sensory tests and shaping it with consumer expectations at this point.
- Determination of marketing methodology and strategy.

In the design of multifunctional cosmetic products below listed factors need to be considered at the beginning and need to be planned at the pre-formulation stage of the product[1-3,10,22,23] that are presented in Figure 1. The scientific studies on multifunctional cosmetics have raised in recent years.

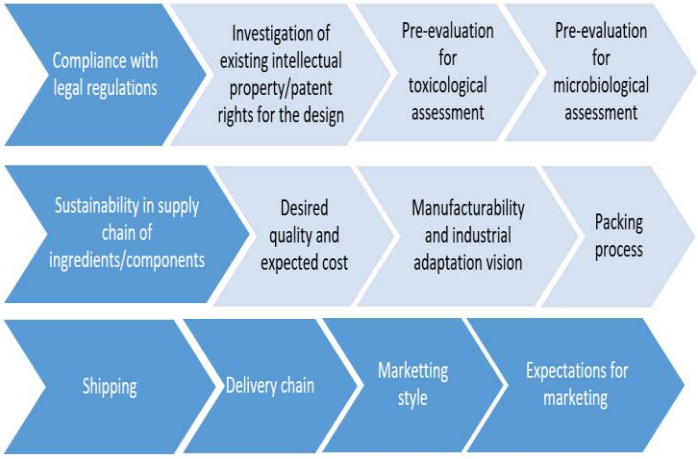


**Figure 1: Factors need to be considering in the design and marketing of a product.**

The search for improving the performance of cosmetics has driven to the development of multifunctional cosmetic formulations containing different active substances. Especially creams combined with minerals, vitamins and herbal compounds have aimed to gain antioxidant and protective effects, which improve the appearance of skin and provides anti-aging effects. It is seen that widely use of UV filters both organic and inorganic filters (inorganic $TiO_2$ and organic octo-krylene, ethylhexyl methoxycinnamate, benzophe-none), vitamin and derivatives such as tocopheryl acetate, retinyl palmitate, etc. and plant extracts such as *Phorphyra umbilicalis*, *Ginkgo biloba* has gain attention[24,25]. In some other studies functional cosmetics have been developed by using herbal bio surfactants to stabilize, the vitamin C added to creams or the active ingredients in anti-dandruff shampoos[26]. Inoue *et al.*, have designed a multifunctional cosmetic product by taking advantage of the moisturizing and whitening effects of water-soluble elastin[27]. The widespread use of nanomaterials has also come through in the field of cosmetics. For example, nanosuspensions have been added to skin-protective and anti-aging cosmetic products to gain functionality[28].

## CONCLUSION

In conclusion, the fact that some cosmetic products can be used for more than one purpose provides easy to use and an economic advantage that encourages more effort to produce new and different multifunctional products.

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## AUTHOR'S CONTRIBUTION

**ALGIN YAPAR E:** study design, writing original draft. **ŞAHİNER A:** literature survey. **KARA BA:** critical review. **TUNA YILDIRIM S:** methodology, formal analysis. **HALAT E:** visualization, editing. **BALA R:** critical review. **SINDHU RK:** editing. The final manuscript was read and approved by all authors.

## DATA AVAILABILITY

The data and material are available from the corresponding author on reasonable request.

## CONFLICT OF INTEREST

No conflict of interest associated with this work.

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