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Review on Cosmeceuticals

Vivek Dhar Dwivedi[1], Mr. Sujeet Pratap Singh[2], Mr. Pramod Mishra[3], Dr. Tarkeshwar P. Shukla[4]
S.C.P.M College of Pharmacy, Lucknow Road Haripur Gonda

Abstract: ***Cosmeceuticals are cosmetic products containing biologically active ingredients intended to provide benefits beyond basic cleansing, beautification, and moisturization. They are widely used in skincare, haircare, and anti-ageing preparations because of their potential to improve skin appearance, maintain skin hydration, reduce visible signs of ageing, and protect against environmental damage. Common cosmeceutical ingredients include retinoids, alpha-hydroxy acids, vitamin C, niacinamide, peptides, antioxidants, botanical extracts, and sunscreens. These ingredients act through various mechanisms, including exfoliation, antioxidant activity, stimulation of collagen production, and enhancement of the skin barrier. The growing demand for safe, effective, and multifunctional personal-care products has increased interest in cosmeceutical research and formulation development. However, limitations such as ingredient instability, skin irritation, variable product efficacy, and differences in regulatory classification remain important concerns. This review summarizes the definition, classification, major active ingredients, mechanisms of action, applications, advantages, limitations, and future prospects of cosmeceuticals.***
Keywords: Cosmeceuticals, skincare, active ingredients, antioxidants, anti-ageing, botanical extracts, formulation development.

I. INTRODUCTION

The term *cosmeceutical* combines the words “cosmetic” and “pharmaceutical.” It is commonly used to describe cosmetic products containing biologically active substances that may produce beneficial effects on the skin or hair. These products occupy a position between conventional cosmetics and medicinal products in consumer perception, although the term does not represent a separate legal category in many countries. Conventional cosmetics primarily cleanse, beautify, perfume, or protect the external appearance of the body. Cosmeceuticals are designed to provide additional benefits, such as improving skin texture, reducing the appearance of fine lines, supporting the skin barrier, and reducing uneven pigmentation. The increasing prevalence of skin concerns, environmental pollution, ultraviolet radiation exposure, and interest in preventive skincare has contributed to the development of cosmeceutical formulations. Advances in dermatological research, biotechnology, nanotechnology, and drug-delivery systems have further expanded their applications.

II. DEFINITION AND CONCEPT OF COSMECEUTICALS

Cosmeceuticals are generally defined as cosmetic preparations containing active ingredients intended to improve the appearance and condition of skin, hair, or nails through specific biological or physicochemical effects.

The term was popularized by dermatologist Albert M. Kligman. However, cosmeceuticals are not universally recognized as a distinct regulatory category. Their classification depends on their composition, intended use, claims, and applicable national regulations. A product marketed for moisturization or improving appearance may be regulated as a cosmetic, whereas a product claiming to treat or prevent a disease may fall under drug or medicinal-product regulations.

III. CLASSIFICATION OF COSMECEUTICALS

Cosmeceuticals can be classified according to their intended application.

1) Skin-care cosmeceuticals: These products include moisturizers, anti-ageing creams, skin-brightening preparations, exfoliating products, antioxidant serums, and sunscreen formulations. They aim to maintain hydration, improve texture, and reduce visible skin imperfections.

2) Hair-care cosmeceuticals: Hair-care products include anti-dandruff shampoos, conditioners, scalp-care preparations, hair-strengthening products, and formulations intended to improve hair appearance. Their effects depend on the ingredients and the specific claims made.

3) Nail-care cosmeceuticals: These include nail conditioners, cuticle moisturizers, and products intended to improve nail appearance and reduce brittleness.

4) Lip-care cosmeceuticals: Lip balms and protective lip preparations contain emollients, occlusive agents, antioxidants, and sometimes ultraviolet filters to support lip hydration and protection.

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5) Sun-protection products: Sunscreens contain approved ultraviolet filters that help protect the skin from ultraviolet radiation when used as directed. They play an important role in preventing sunburn and reducing cumulative ultraviolet damage.

IV. MAJOR ACTIVE INGREDIENTS USED IN COSMECEUTICALS

The effectiveness of a cosmeceutical depends on its active ingredients, concentration, stability, formulation, and ability to reach the intended site of action.

Active ingredient	Major function	Common application
Retinoids	Promote epidermal renewal and improve the appearance of fine lines	Anti-ageing products
Vitamin C	Antioxidant activity and support of collagen synthesis	Serums and brightening products
Niacinamide	Supports the skin barrier and helps improve uneven skin tone	Moisturizers and serums
Alpha-hydroxy acids (AHAs)	Exfoliation and improvement of skin texture	Peels and exfoliating creams
Hyaluronic acid	Binds water and improves skin hydration	Moisturizers and serums
Peptides	Certain peptides may influence skin appearance and signalling pathways	Anti-ageing products
Ceramides	Help maintain the skin barrier and reduce moisture loss	Barrier-repair moisturizers
Botanical extracts	May provide antioxidant, soothing, or conditioning effects	Creams, lotions, and serums
Sunscreen filters	Absorb, reflect, or scatter ultraviolet radiation, depending on the filter	Sun-protection products
Salicylic acid	Helps exfoliate and unclog pores	Products for acne-prone skin

A. Retinoids

Retinoids, including retinol, are widely used in anti-ageing skincare. They influence epidermal turnover and may improve the appearance of fine lines, uneven texture, and certain forms of pigmentation. However, irritation, dryness, and redness can occur, particularly when treatment is introduced too quickly.

B. Antioxidants

Vitamin C, vitamin E, and selected botanical compounds are used to help protect formulations and skin from oxidative stress. Vitamin C also contributes to collagen synthesis. Its formulation can be challenging because some forms are sensitive to light, oxygen, and unsuitable pH conditions.

C. Alpha-hydroxy acids

Glycolic acid and lactic acid are examples of alpha-hydroxy acids. They promote exfoliation by reducing cohesion between surface skin cells. Their performance and tolerability depend on concentration, pH, formulation, and frequency of use.

D. Niacinamide

Niacinamide, a form of vitamin B3, supports the skin barrier and may help improve uneven pigmentation, redness, and the appearance of enlarged pores. It is incorporated into many moisturizers and facial serums.

E. Hyaluronic acid and ceramides

Hyaluronic acid acts as a humectant, helping attract and retain water, while ceramides support the skin's natural lipid barrier. Both ingredients are commonly used in moisturizing and barrier-supporting formulations.

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F. Botanical ingredients

Plant-derived ingredients such as aloe vera, green tea extract, licorice extract, and chamomile are used for their potential soothing, antioxidant, or conditioning properties. Their efficacy varies with plant species, extraction method, composition, concentration, and product stability. Natural origin does not automatically guarantee safety or effectiveness.

V. MECHANISMS OF ACTION

Cosmeceutical ingredients act through several mechanisms:

1) Moisturization: Humectants attract water, emollients soften the skin, and occlusive agents reduce water loss.
2) Antioxidant activity: Selected compounds help neutralize reactive species and limit oxidative damage under appropriate conditions.
3) Exfoliation: AHAs and salicylic acid promote the removal of surface cells or help unclog pores.
4) Support of collagen-related processes: Retinoids and vitamin C may influence processes associated with collagen production and skin structure.
5) Skin-barrier support: Ceramides, niacinamide, and suitable moisturizers help maintain the skin barrier.
6) Photoprotection: Sunscreen filters reduce ultraviolet exposure when an appropriate product is applied adequately and reapplied as directed.
7) Improvement of skin tone: Ingredients such as niacinamide and selected pigment-targeting agents may help reduce the appearance of uneven pigmentation.

The extent of these effects depends on the ingredient, concentration, formulation, duration of use, and individual skin characteristics.

VI. FORMULATION DEVELOPMENT OF COSMECEUTICALS

Formulation development is an important step in producing stable, safe, and effective cosmeceutical products. The principal stages include:

1) Selection of active ingredients: Ingredients are selected according to the intended benefit, scientific evidence, compatibility, safety profile, and applicable regulations.
2) Selection of dosage form: Common dosage forms include creams, lotions, gels, serums, cleansers, shampoos, masks, and emulsions. The selection depends on the intended site of application, sensory properties, ingredient solubility, and consumer preference.
3) Selection of excipients: Excipients such as emulsifiers, preservatives, humectants, emollients, thickeners, antioxidants, and pH-adjusting agents improve product stability, appearance, texture, and usability.
4) Stability testing: Stability studies assess changes in colour, odour, pH, viscosity, phase separation, and active-ingredient content under appropriate storage conditions. Packaging compatibility and microbial quality should also be evaluated.
5) Safety and efficacy evaluation: Depending on the product and applicable requirements, evaluation may include irritation and sensitization testing, microbiological assessment, ingredient-content analysis, and controlled studies of product performance. Claims should be supported by appropriate evidence.

VII. APPLICATIONS OF COSMECEUTICALS

Cosmeceuticals are used for several personal-care purposes:

- Anti-ageing: To improve the appearance of fine lines, wrinkles, and uneven texture.
- Skin hydration: To reduce dryness and support the skin barrier.
- Uneven pigmentation: To improve the appearance of dark spots and irregular skin tone.
- Acne-prone skin: To support cleansing and exfoliation with suitable ingredients.
- Sun protection: To reduce ultraviolet exposure and associated skin damage.
- Hair and scalp care: To improve conditioning, reduce visible flaking with appropriate products, and maintain hair appearance.
- Sensitive-skin care: To support hydration and barrier function through suitably formulated products.

Cosmeceuticals may help manage cosmetic concerns but should not be considered substitutes for medical diagnosis or treatment of skin diseases.

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VIII. ADVANTAGES OF COSMECEUTICALS

The main advantages include:

1) They provide targeted benefits beyond basic cleansing and beautification.
2) They offer a wide range of formulations for different skin and hair concerns.
3) They may support skin hydration, barrier function, and protection against environmental exposure.
4) They are available in various dosage forms suitable for different preferences.
5) Evidence-based active ingredients can provide measurable improvements in selected cosmetic outcomes.
6) Advances in formulation technology may improve ingredient stability, delivery, and user acceptability.

IX. LIMITATIONS AND SAFETY CONCERNS

Despite their benefits, cosmeceuticals have several limitations. Some active ingredients may cause irritation, dryness, redness, allergic reactions, or photosensitivity. The effectiveness of products can vary because of differences in ingredient concentration, formulation quality, storage, and individual response. Stability is another challenge, particularly for light-sensitive or oxidation-prone ingredients. Marketing claims may sometimes exceed the available scientific evidence, and the term “cosmeceutical” itself does not guarantee regulatory approval or clinical effectiveness. Consumers should select products appropriate for their skin type, follow directions for use, and introduce potentially irritating ingredients gradually. Sunscreen use is important when a product increases sensitivity to sunlight. Persistent irritation or significant skin problems require professional advice.

X. REGULATORY CONSIDERATIONS

Cosmeceutical regulation varies across countries. In many jurisdictions, the term “cosmeceutical” has no independent legal definition. Regulatory status is generally determined by the product's ingredients, intended purpose, claims, and mode of action.

Manufacturers must comply with applicable requirements relating to product safety, ingredient restrictions, labelling, manufacturing quality, and substantiation of claims. In India, cosmetic products are subject to the relevant provisions of the Drugs and Cosmetics Act and the Cosmetics Rules, 2020, as applicable. Products intended to treat disease may be regulated differently depending on their claims and composition.

XI. FUTURE PERSPECTIVES

The future of cosmeceuticals is expected to involve evidence-based botanical ingredients, biotechnology-derived actives, personalized skincare, sustainable packaging, and advanced delivery systems. Liposomes, nanoemulsions, and other carrier systems are being investigated to improve the stability, delivery, or performance of selected ingredients.

Artificial intelligence and digital skin assessment may support more personalized product selection. However, novel technologies require appropriate evaluation of safety, stability, effectiveness, environmental impact, and regulatory compliance. Future development should prioritize reproducible research, transparent labelling, responsible marketing, and clinically meaningful outcomes.

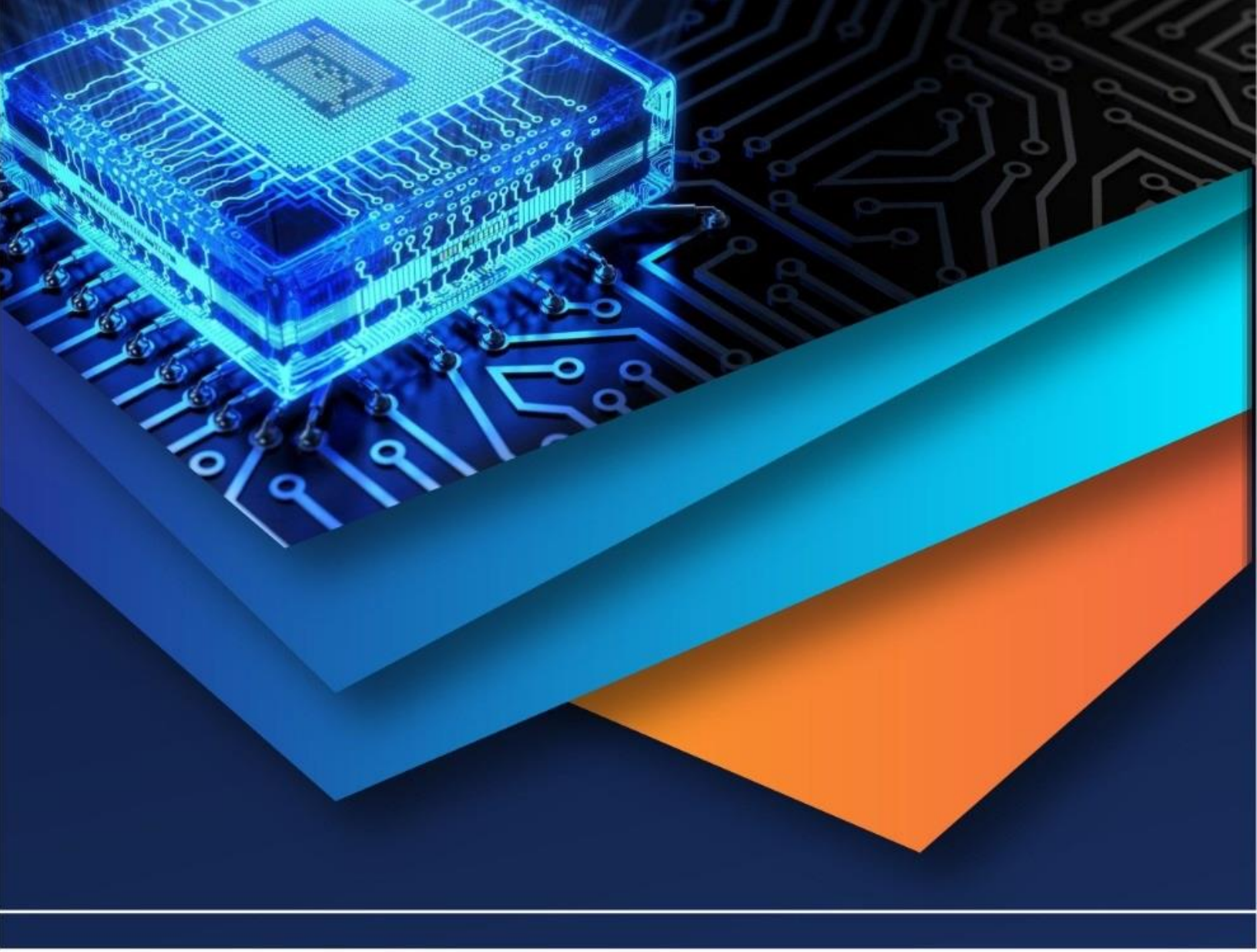
XII. CONCLUSION

Cosmeceuticals represent an important area of cosmetic science and pharmaceutical formulation. Products containing retinoids, antioxidants, niacinamide, hyaluronic acid, ceramides, exfoliating agents, and botanical extracts may provide benefits for hydration, skin texture, uneven pigmentation, and visible signs of ageing. Their effectiveness depends on appropriate ingredient selection, formulation quality, stability, safety, and scientific evidence. Although cosmeceuticals offer promising applications in skincare and haircare, they should not replace medical treatment when a disease is present. Further research and robust product evaluation are necessary to establish their benefits and support safe, evidence-based use.

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