Journal of Advanced Pharmacy and Drug Development
www.japdd.com

Review Article

Herbal Remedies For Skin Aging: Insights Into Anti-Aging Cream Formulations

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Received on: 25 August 2025
Revised on: 20 September 2025
Accepted on: 28 September 2025

DOI:
https://doi.org/10.64842/7pm6d350

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Abstract

Aging represents a complex biological phenomenon characterized by the progressive deterioration of physiological functions, resulting in heightened susceptibility to chronic diseases and diminished quality of life. Key mechanisms underlying this process include oxidative stress, chronic inflammation, telomere shortening, mitochondrial dysfunction, and declining collagen biosynthesis. This review examines the current landscape of anti-aging formulations that incorporate natural bioactive compounds with established antioxidant, anti-inflammatory, and collagen-enhancing properties. We analyze the therapeutic potential of various phytoconstituents, including polyphenols, flavonoids, vitamins C and E, retinoids, peptides, and botanical extracts, which function synergistically to neutralize reactive oxygen species, protect dermal cells, facilitate cellular repair mechanisms, and promote extracellular matrix regeneration. The review also discusses the incorporation of adaptogenic herbs and nutraceuticals that restore cellular homeostasis and counteract age-related metabolic decline. Through comprehensive analysis of existing literature, we demonstrate that multi-targeted anti-aging approaches offer synergistic benefits by reducing oxidative damage, preventing dermal aging, improving skin elasticity, and supporting systemic longevity pathways. This review concludes that evidence-based, holistic anti-aging formulations may provide safe, effective, and sustainable interventions for mitigating premature aging and promoting healthy longevity

Keywords: Anti-ageing, Herbal, Moisturizing, Skin Brightening, Anti-wrinkle.

Introduction:

The skin, comprising approximately 20 square feet in total area, is the largest organ of the human body. It serves essential protective functions against pathogens and environmental hazards, assists in body temperature regulation, and mediates sensory perceptions such as touch, heat, and cold [1,2].

Physiology of the skin:

Epidermis: The epidermis is the outermost layer of the skin, consisting of stratified keratinized squamous epithelium. Its thickness varies across different regions, being most pronounced on the palms of the hands and soles of the feet. While the epidermis lacks blood vessels and nerve endings, its deeper layers are sustained by interstitial fluids from the dermis, which provide essential oxygen and nutrients and facilitate lymphatic drainage.

Dermis: Located beneath the epidermis, the dermis

is a resilient and flexible layer formed from connective tissue that contains a matrix of collagen and elastic fibers. Overstretching the skin may rupture elastic fibers, resulting in permanent stretch marks often observed in conditions such as pregnancy and obesity. Collagen fibers, the predominant cellular component, play a crucial role in binding water and conferring tensile strength to the skin; as the capacity of these fibers declines with age, wrinkles develop. The deepest region of the dermis is underlain by areolar tissue and variable amounts of adipose tissue. Fibroblasts, macrophages, and mast cells are among the principal cells within this layer.

Sebaceous (subcutaneous) glands: These glands are composed of secretory epithelial cells originating from the same tissues as hair follicles. They release sebum, an oily substance, into the hair follicles, and are distributed throughout the skin except on the palms of the hands and soles of the feet [3].

Functions of the Skin [4-8]:

Protection: The skin acts as a physical barrier against pathogens and environmental insults, defending the body from both chemical and mechanical injury. Langerhans cells, present within the skin, play an essential role in the adaptive immune response.

Sensation: Embedded sensory nerve endings enable the skin to detect a range of stimuli, including heat, cold, touch, pressure, vibration, and tissue damage, thereby contributing to the body's sensory perception system.

Thermoregulation: The skin possesses a vascular network that exceeds its metabolic needs, enabling regulation of heat loss via mechanisms such as radiation, convection, and conduction. Vasodilation increases blood flow and heat dissipation, whereas vasoconstriction decreases perfusion to conserve body heat.

Prevention of Evaporation: The skin's surface acts as a dry, semipermeable barrier, significantly minimizing fluid loss. When this barrier is compromised, as seen in severe burns, excessive fluid loss can occur.

Structural Organization: The outermost layer is composed of skin cells, pigments, and structural proteins. The mid-layer houses sweat glands, hair follicles, blood vessels, and adipose tissue, and supplies nutrients to the epidermis. The innermost layer contains additional skin cells, nerves, hair follicles, blood vessels, and sebaceous glands. Each skin layer incorporates connective tissue—collagen fibers provide support, while elastin fibers supply flexibility and strength.

Anti-aging Cosmeceuticals and Skin Physiology [9]:

Anti-aging creams represent moisturizer-based cosmeceutical formulations designed to diminish visible signs of skin aging and enhance youthful appearance. Skin aging results from continuous cellular degradation processes affecting DNA and protein integrity. This aging phenomenon is categorized into two distinct types: intrinsic (chronological) aging and photoaging, each exhibiting unique histological and clinical

characteristics.

Intrinsic aging represents a universal, time-dependent process characterized by alterations in skin's physiological functions. As aging progresses, keratinocytes lose their capacity to maintain a functional stratum corneum, while neutral lipid synthesis rates decline, resulting in dry, pallid skin with visible wrinkles. Conversely, photoaging occurs due to excessive ultraviolet radiation exposure, manifesting as dry, sallow skin with deep furrows and fine wrinkles caused by disruption of dermal and epidermal structures associated with solar elastosis and helodermatid [10].

Plant-based therapeutics have demonstrated significant potential as complementary therapeutic interventions. Cosmetic formulations serve dual purposes: enhancing aesthetic appearance and providing protection against endogenous and environmental hazards. Regular cosmetic use promotes external beauty while supporting long-term skin health by reducing the incidence of dermatological conditions. Skincare products contain natural or synthetic components that enhance skin health, texture, and structural integrity through mechanisms including hydration maintenance, collagen preservation, and photoprotection.

The cosmeceutical market, particularly herbal-based products, is experiencing rapid expansion. These formulations effectively address various skin concerns including hyperpigmentation, wrinkles, aging, and textural irregularities. Olive oil, rich in vitamin A, functions as a potent antioxidant that decelerates aging processes. Vitamin C plays a crucial role in collagen biosynthesis, a protein essential for maintaining skin elasticity and preventing wrinkle formation. Research demonstrates that antioxidant compounds operate synergistically as a "protective network," wherein multiple antioxidant species collaborate to neutralize free radicals and reactive oxygen species while protecting each other from oxidative damage [11].

Polyherbal cosmetic formulations have gained widespread recognition across diverse populations for their efficacy in managing various skin characteristics. The crude extracts of selected botanical ingredients investigated in this study have demonstrated therapeutic benefits for numerous dermatological conditions.

The pursuit of anti-aging interventions has persisted throughout human history, evolving significantly through scientific advancement. Contemporary understanding of underlying mechanisms, particularly inflammatory processes, has led to innovative treatments incorporating ingredients such as retinoids and bioactive eggshell membrane components. Traditional civilizations have long recognized the therapeutic potential of botanical compounds, establishing herbal medicine as a cornerstone of anti-aging practices. This historical foundation has facilitated the development of modern anti-aging formulations [12].

Benefits of Anti-Aging Formulations:

- Enhanced skin hydration and firmness
- Improved skin radiance and luminosity

- Increased self-confidence and psychological well-being
- Positive impact on overall health and wellness
- Prevention of age spots and hyperpigmentation
- Cost-effective alternative to invasive dermatological procedures

Advantages of Anti-Aging Products:

- Youthful appearance restoration
- Wrinkle reduction and prevention
- Enhanced self-esteem
- Protection against skin flaking and dryness
- Promotion of holistic health benefits

Limitations:

Multiple daily applications may be required to achieve optimal anti-aging and skin-brightening effects. However, discontinuation of product use typically results in gradual return to baseline skin appearance. Potential adverse effects include cutaneous irritation, erythema, burning sensations, or allergic dermatitis. Dermatological professionals recommend initiating anti-aging regimens after age 24, as this represents the appropriate developmental stage for implementing comprehensive skincare protocols [13].

Guidelines:

Anti-aging formulations are designed to moisturize, brighten, firm, and lift sagging skin, with particular efficacy in the periorbital and cervical regions. Quality formulations are typically formulated without artificial colorants, fragrances, or parabens. The moisturizing properties of these preparations provide beneficial effects for both male and female skin types [14].

Various Herbs Used in Herbal Anti-Aging Creams [15-20]:

Papaya

Carica papaya is highly valued in skincare for its enzyme papain, which is known for properties such as skin lightening, reducing unwanted hair, exfoliating dead skin, and aiding in the repair of aging skin.

Biological Source: "*Carica papaya*"

Family: *Caricaceae*

Chemical Constituents: Papain, pantothenic acid, folate, magnesium, potassium; also rich in vitamins C, A, and E

Uses: Possesses antioxidant activity, helps prevent and treat acne, diminishes dark spots and wrinkles, improves skin texture, reduces pigmentation, and removes tanning.

Amla

Known as amla or amalaki, *Phyllanthus emblica Linn* is recognized for its abundant antioxidants and high vitamin C content. It promotes skin health by toning, reducing signs of aging, and imparting a natural glow.

Biological Source: "*Phyllanthus emblica Linn*"

Family: *Phyllanthaceae*

Chemical Constituents: Ellagic acid, gallic acid, emblicanin A and B, phyllembein, quercetin, ascorbic acid

Uses: Collagen-boosting effects improve skin firmness and smoothness, while regular consumption of amla juice elevates vitamin C and enhances

collagen production, giving skin a youthful appearance.

Olive Oil

Olive oil, sourced from Olea europaea, is rich in vitamins, healthy fats, and antioxidants, all contributing to improved skin health.

Biological Source: "*Olea europaea*"

Family: *Oleaceae*

Chemical Constituents: Monounsaturated fatty acids, polyphenols, vitamins

Uses: Provides antioxidant, anti-inflammatory, and skin-nourishing benefits; moisturizes and softens skin, protects against UV-induced damage, reduces inflammation, and supports wound healing.

Tulsi (Holy Basil)

Ocimum sanctum is celebrated for preventing signs of aging and maintaining skin health.

Biological Source: "*Ocimum sanctum*"

Family: *Lamiaceae*

Chemical Constituents: Methyl cinnamate, linalool, β-elemene, camphor

Uses: Combines antibacterial and anti-inflammatory effects; cleanses pores, removes excess oil and impurities, and soothes irritations associated with acne [16–17].

Ashwagandha

Withania somnifera is renowned for its anti-aging potential, supporting skin elasticity while cleansing, moisturizing, and calming the skin.

Biological Source: "*Withania somnifera*"

Family: *Solanaceae*

Chemical Constituents: Withanolides, saponins, alkaloids

Uses: Displays antioxidant, anti-inflammatory, immunomodulatory, and neuroprotective effects; enhances skin regeneration and wound healing [18–19].

Ginger

Zingiber officinale offers potent antioxidants beneficial for combatting skin aging.

Biological Source: "*Zingiber officinale"*

Family: *Zingiberaceae*

Chemical Constituents: Gingerols, shogaols, zingiberene, zingiberol, camphene

Uses: Antioxidant, anti-inflammatory, antimicrobial, analgesic, anti-aging, and supportive of skin health.

Cinnamon

Cinnamomum zeylanicum helps protect skin structure by inhibiting collagen degradation and loss of elasticity.

Biological Source: "*Cinnamomum zeylanicum*"

Family: *Lauraceae*

Chemical Constituents: Cinnamaldehyde, cinnamate, cinnamic acid, essential oils

Uses: Improves skin plumpness, addresses eczema, alleviates acne, delays aging symptoms, soothes dry skin, and enhances complexion.

Turmeric

Curcuma longa provides antibacterial and anti-inflammatory properties, reducing facial wrinkles and fine lines.

Biological Source: "*Curcuma longa*"

Family: *Zingiberaceae*

Chemical Constituents: Volatile oils, curcuminoids, curcumin

Uses: Employed for skin brightening, glowing complexion, acne treatment, lightening dark circles, and preventing early aging signs.

Green Tea

Camellia sinensis is a popular ingredient in anti-aging formulations owing to its high antioxidant capacity.

Biological Source: "*Camellia sinensis*"

Family: *Theaceae*

Chemical Constituents: Vitamins (B, C & E), enzymes, peptides, sugars, caffeine, theophylline, chlorophyll, carotenoids

Uses: Catechins provide anti-aging benefits and help prevent skin redness.

Aloe Vera

Aloe barbadensis is valued for its moisturizing properties and its ability to stimulate collagen and elastin synthesis for firmer, more elastic skin.

Biological Source: *"Aloe barbadensis"*

Family: *Liliaceae*

Chemical Constituents: Vitamins A, C, E, B1, B2, B6, B12, aloin, anthranol, emodin

Uses: Displays anti-aging, antifungal, antioxidant, wound healing, anti-inflammatory, and moisturizing effects.

Evaluation of Anti-Aging Cream:

Organoleptic Evaluation:

The cream's physical characteristics including colour, odour, appearance, and homogeneity are assessed visually to determine organoleptic properties after storage.

Homogeneity:

Homogeneity can be evaluated by visually inspecting the cream after formulation. A small quantity will be pressed between the thumb and index finger to assess consistency and uniformity.

pH Measurement:

A calibrated pH meter can be used for this test. Approximately 1 g of cream dissolved in 50 ml of distilled water, and the suspension's pH should be measured at ideal temperature [22].

Spreadability:

To determine Spreadability, the cream should be sandwiched between two standard glass slides (area spanning 7.5 cm). A 100 g weight can be placed on top to form an even layer, then remove the excess cream it is scraped off. The setup can be arranged so that only the upper slide is free to move when a 20 g weight is attached. The time required for the upper slide to travel 7.5 cm is recorded, and the experiment can be repeated three times to obtain the mean value. Spreadability (S) is calculated using:

$$S = M \times L/T$$

Where S = Spreadability, M = mass tied to upper slide (20 g), L = length moved (7.5 cm), and T = time taken (seconds) [23].

Irritancy Test:

A 1 cm^2 area on the dorsal surface is marked, and cream is applied. Any irritation, redness, or swelling is monitored and recorded at regular intervals over 24 hours [20].

Viscosity:

Viscosity is measured using a Brookfield viscometer with spindle no. 7 at 100 rpm [21].

Dilution Test:

This assesses emulsion type: an oil-in-water (O/W) emulsion mixes with water but separates with oil, while a water-in-oil (W/O) emulsion mixes with oil but separates with water. This assesses emulsion type: an oil-in-water (O/W) emulsion mixes with water but separates with oil, whereas a water-in-oil (W/O) emulsion mixes with oil but separates with water [21].

Stability Studies:

Stability testing follows ICH guidelines. Cream samples are stored in bottles under controlled conditions: 30 ± 2 °C/65 ± 5% RH and 40 ± 2 °C/75 ± 5% RH for two months. Physical properties and viscosity are analyzed at the conclusion of the study [24].

Evaluation Parameters for Herbal Anti-aging Cream [25]

Parameter	Method	Significance
pH Measurement	Digital pH meter; cream mixed with distilled water; average of three readings	Ensures compatibility with skin pH; determines stability
Irritancy Test	Applied to a marked skin area; monitored for redness/swelling over 24h	Assesses safety; identifies potential skin irritancy
Spreadability	Cream between slides; pressed with weight; time to slide apart measured	Evaluates ease of application and distribution
Viscosity	Measured with Brookfield viscometer at set speed (e.g., 100 rpm)	Assesses flow properties and consistency for application
Dilution Test	Cream mixed with water/oil; observed for mixing or separation	Identifies emulsion type; determines stability and compatibility

Conclusion:

Continuous exposure of human skin to ultraviolet radiation leads to a range of pathobiological alterations, including irregular pigmentation, increased wrinkle formation, diminished elasticity, dryness, and surface roughness. Herbal formulations have emerged as effective interventions to mitigate these visible signs of aging and promote skin health. This comprehensive review focused on select herbs of notable therapeutic efficacy, emphasizing their active chemical constituents and mechanisms of action against cutaneous aging. Despite the vast diversity of botanical resources, the scope was limited to those demonstrating the most significant benefits for skin aging. Future research may uncover additional herbs exhibiting secondary anti-aging effects and expand the repertoire of botanical agents with potential dermatological and medical

applications.

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How to cite this article:
Shalini BV, Rakshitha C, Yogesha JS, Monisha MR. Herbal remedies for skin aging: insights into anti-aging cream formulations. *J Adv Pharm Drug Dev.* 2025;1(1):46–54. doi:10.64842/7pm6d350