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Exploring Innovative Treatments for Skin Tanning: Current Options and Future Directions

Arshiya Sheikh¹, Deepanshu Gupta², Khushboo Sahu¹, Mitali Sahu², Suchita Wamankar^{2*}, Shobha Sahu¹¹Rungta Institute of Pharmaceutical Sciences and Research, Kurud-Kohka, Bhilai, Chhattisgarh-490024, India.²Rungta Institute of Pharmaceutical Sciences, Kurud-Kohka, Bhilai, Chhattisgarh-490024, India.

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ABSTRACT: Tanning occurs when skin becomes darker or suntanned due to sun exposure. Sunburn is an immediate effect of excessive sun exposure, followed by the development of a tan. The skin responds by producing more melanin, the pigment responsible for skin colour, to protect itself from further damage. Melanin acts as a shield for skin cells, protecting them from harmful ultraviolet (UV) radiation. For melanin to provide protection, melanosomes (organelles containing melanin) must be transferred to squamous cells, where they protect the skin's surface. Melanocytes, the cells producing melanin, synthesize and transfer this pigment through specific proteins involved in melanin production and transport. UV radiation can cause DNA mutations, increasing the risk of skin cancer. When UV exposure intensifies, melanin production increases, and more melanosomes are transferred to squamous cells to enhance protection. Various skin-tanning products are available on the market, including herbal and synthetic formulations designed to darken the skin or enhance its pigmentation. While many herbal ingredients are used, some have harmful properties and should be used in limited quantities to ensure safety. The goal of this review focus on developing more effective, affordable, and accessible treatments with minimal side effects. Collaborative efforts between dermatologists, cosmetic scientists, and pharmaceutical companies will drive innovation in skin tanning treatments, ensuring better skin health and cosmetic satisfaction.

Corresponding author:

Ms. Suchita Wamankar
Associate Professor
Rungta Institute of Pharmaceutical Sciences,
Kohka, Bhilai, Chhattisgarh, India.
Tel: +91-9893477847
E. Mail ID: suchitawamankar@gmail.com

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INTRODUCTION:

The Skin is the enormous part of the human body, considering for around 15 % of the complete body weight. It presents many essential roles, such as protecting the layers against physical, chemical and biological effects [29]. The Skin's barrier property illustrates its important protecting and equilibrium role. This enables humans to survive in environments with variable temperatures, fluctuating water content, and the presence of environmental hazards such as chemicals, bacteria, allergens, fungi, and radiation. The Skin can be

injured in various situation, including burns. Understanding how these, injuries affect the skin’s physiological functions, such as fluid loss, is crucial [1]. Skin is used as our body’s initial tip of junction with the exterior world. Generally, skin differentiated into two types, which is hairy and glabrous. Hairy skin contains pilosebaceous unit but there are no encapsulated sensory organs. Glabrous skin found on the fist and bottoms of the feet, with the absence of pilosebaceous unit yet has a wide epidermis and confine sensorium in the derma [1]. The goal of this review focus on developing more effective, affordable, and accessible treatments with minimal side effects. Research into understanding the molecular mechanisms of skin pigmentation and the role of environmental factors will be critical. Collaborative efforts between dermatologists, cosmetic scientists, and pharmaceutical companies will drive innovation in skin tanning treatments, ensuring better skin health and cosmetic satisfaction.

SKIN:

Skin is the monstrous part of the human body. Skin is basically comprised into two coverings Epidermis and Dermis. Epidermis is the utmost covering of the skin and serves as the point of contact with the environment. The epidermis allows hurdle and shielding. The epidermis covering of skin mainly composed of protein keratin, a water unsolvable structure of protein. The Dermis is attached to underline structure through a subcutaneous tissue, the hypodermis, which is nevermore totally consider bit of the skin. It come up with support as well as flexibility [1,2].



Fig 1. Different types of skin classified according to Fitzpatrick.

Skin type:

The Fitzpatrick ranking is the universally used technique for skin paradigm, based on an individual propensity to sunburn and capacity to tan. In 1975, Fitzpatrick proposed a ranking order locate on an individual’s nationality and prone to sunburn and tan [3]. It is a personality inventory that is builds on inherent tendency, which reacts to sun revelation and tanning characteristic.

Table 1. The Fitzpatrick ranking on different skin classes [4].

Skin Class	Example	Effect on skin
Class 1	Blanched light skin	Always blazes, never tans
Class 2	Light skin	Blazes easily, but minimum tans
Class 3	Medium light skin	sometimes blazes, tans slowly
Class 4	Moderate dusky Skin	Blazes at a minimum range, tans easily
Class 5	Dusky Skin	Hardly blazes, tans easily
Class 6	Dark dusky skin	Never blazes

Skin Tanning:

Tanning is the process in which skin color becomes darken or suntanned. The result of the sunlight is the sunburn followed by the evolution of tan. The skin response to this exposure is to give rise to more melanin, the dyes that provides its color to the skin [4]. UV radiations play a chief role in the evolution of tan over the skin, which in severe condition further develops in the form of skin cancer [5]. Tanning happen as a reaction to UVR-persuade destruction of the skin and can be set out to restrict the quantity of ensuing destruction caused by subsequent continued UVR exposure [6]. A variety of products has been marketed to look on the perceived need. Tanning preparations generally involve oils, sunscreens, creams, gels, lotions containing UV-B chemicals with lower SPF to facilitate tanning without burning [7,1]. Obtaining a tanned skin, each by sunbathing, sun bed use, or a mixture of one as well as the other is an advantageous impartial for many people. Tanning generally differentiates into 3 types that are Immediate Tanning, Delayed Tanning, and True Tanning [8,1].

Mechanism of Tanning:

UV radiation stimulates pigmentation in human skin, which gives rise to production of melanin. In contemplation of Melanin to do its task melanosomes

require to be transfer to squamous cells where, melanocytes want protection. Interior of the squamous cells, melanosomes form a cover throughout the cell nucleus. The melanin in the core of the melanosomes soak up the UV light vitality driving out of sunlight reducing the total of Ultraviolet illumination. UV radiation cause alteration to DNA, which can cause cancer. When UV light radiation enlarges melanin manufacturing also enlarges and more melanosomes are render up to squamous cells. Almost all people can modify prominent revelation to sun by turnout up melanin manufacturing and tanning. Melanocytes demonstrate definite proteins participating in the alloy and dumping of biopolymer melanin in melanosomes. Few of these proteins, are TYR(tyrosinase), TYR1 (tyrosinase-related protein 1), DCT (tyrosinase-related protein 2)MART1(melanoma antigens recognized by T-cells) are enzymes, and others e.g.; Pmel17/silver (gp100) are organizational constituent of melanosomes improve from 0 to 7 d following UV revelation, but the melanin content of the skin increases moderately ^{19,27}.

Mechanism of Sunless Tanning:

Sunless or self-tanning lotions contain dihydroxyacetone (DHA) that darkens the skin by a chemical reaction ^{25,26}. The place of activity of DHA in the skin is cornified layer ¹⁰. Dihydroxyacetone (DHA) is a chemical medium that binds the amino workstations of epidermis amino acids and proteins ¹¹. It is affirmed that dihydroxyacetone protects in case of long wave UVA and visible radiation where by DHA provide a medium sunscreen protection factor (SPF) ¹².

Table 2. Various skin products and its ingredients ¹⁴⁻¹⁸.

Products	Ingredients	Purpose
Peel-off face gel mask	Coffee and turmeric	Tan removal from skin
Soap	Kojic acid	Tan removal from skin
Lotion	Coffee	Tan removal from skin and as antioxidant
Self-tanning lotion	Dihydroxyacetone-ne	Tan removal from skin
Sunscreen	<i>Curcuma longa</i> L, <i>Aloe vera</i> , <i>Alpina galangal</i> Wild.	Tan removal from skin

Skin color in different regions:

Several genetic studies on integral skin color have suggested that saturation genes are important factors in human skin saturation. People living in areas with indestructible UVR have dark facultative skin color (e.g.; Africans and Tibetans), which can protect against UVR damage ^{13,24}.

Treatments:

Various treatments have been introduced using Tanning beds, sun bathing, indoor tanning beds, synthetic ingredients, herbal ingredients are as follows.

- Tanning bed provision are omnipresent in contemporary community and could constitute a new appropriate method to prevail UV revelation when office light therapy is not attainable ¹⁹.
- The use of UVR revelation in the formation of sunbathing or the work of solarium beds ²⁰.
- Catastrophic melanin acts to safeguard in case of the harmful outcome of UVR, as well as photo aging and carcinoma evolution ^{21,28}.

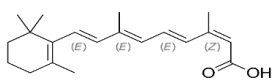
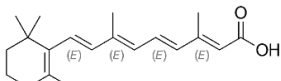
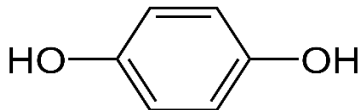
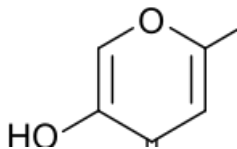
Herbs commonly used in skin tanning:

Different types of herbs have been used since centuries in the treatment of skin related issues to improve the skin appearance and to shield the dermis from harmful UV rays. A UV ray can cause wide range of skin diseases such as sunburns, wrinkles, cancer, premature aging. Herbs are the materials, which can be nontoxic and have antioxidant properties, which gives skin a soothing effect due its composition. Varieties of herbs have been using since ages for the skin appearance.

Table 3. Herbs and their constituents ²².

Common name	Latin name	Chemical constituents
Aloe vera	<i>Aloe Barbidensis</i>	Barbaloin, aloe emodin
Turmeric	<i>Curcuma longa</i> linn	Curcumin, curcuminoid
Lemon	<i>Citrus lamonis burm</i>	Limonene, citric acid, geranyl acetate
Sandal wood	<i>Santalum album</i> linn	Sesquiterpene alcohol
Papaya	<i>Carica papaya</i>	Papain, prunasin
Camphor	<i>Cinnamomum camp-hora</i> ness	Cinnamaldehyde, eugenol, camphor, and cadinene
Ginseng	<i>Panax ginseng</i> Mayer	Ginsenoside, glycoside, panaxoside

Table 4. Substances widely used in the skin tanning ^[23].

Substance	Chemical structure	Uses
Retinoids	<p>Tretinoin</p>  <p>Isoretinoin</p> 	<ul style="list-style-type: none"> ➤ Obstruct with melanosomes transmit. ➤ Enlarge squamous cells movement. ➤ Impede tyrosinase translation. ➤ Used to tend melanosomes.
Hydroquinone		<ul style="list-style-type: none"> ➤ Used to treat hypermelanosomes. ➤ Used solitary or incorporation with tretinoin to inhibit sun or hormone persuade melisma. ➤ Authorised in warpaint since 2001.
Kojic acid		<ul style="list-style-type: none"> ➤ Hetrocyclic copper (II) ions, required cofactors for tyrosinase activity. ➤ Highly unstable upon exposure to sunlight. ➤ Restrict the polymerization of 5,6-dihydroxyindole (DHI) and 5,6-dihydroxyindole-2-carboxylic acid DHICA.

Synthetic constituents widely used in the treatment of tanning:

There are many synthetic ingredients were used in the formation of different products involved in the therapy of derma issues and to protect the derma from harmful UV rays which can cause several of diseases. Some of the common and most widely used ingredients are such as kojic acid, hydroquinone, Retinoids, etc.

CONCLUSION:

A Review of potential therapies for tanning in skin focuses on the mechanisms, skin products, treatment, potential benefits, and emerging tanning therapies. Tanning therapies are intended to propose safe, effective and controlled cosmetic preparation to protect the skin from harmful UV radiations. Several agents that that can either promote or reduce melanin production have been explored. Precision medicine approaches targeting individual skin type could offer more modify and safer solutions for managing tanning or pigmentation changes.

ABBREVIATIONS:

UV - Ultraviolet, DHA - Dihydroxyacetone, TYR - Tyrosinase, TYR1 - Tyrosinase related protein 1, DCT - Tyrosinase related protein 2, MART1 - Melanoma antigens recognized by T cells, DHI - 5,6-dihydroxyindole, DHICA - 5,6-dihydroxyindole-2-carboxylic acid.

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