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 ORIGINAL ARTICLE

Sunless Tanners in Dermatology: A Review of Ingredients, Efficacy, and Safety Profiles

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ABSTRACT

Background: Sunless tanners offer a safer alternative to ultraviolet (UV)-based tanning but may cause adverse skin reactions, including irritant and allergic contact dermatitis. This study examines the composition, efficacy, safety, and reported side effects of commonly used sunless tanning products.

Methods: The top 50 sunless tanners on Amazon's Best Sellers list (March 2025) were reviewed. After excluding bundles, applicators, and non-self-tanning cosmetics, 37 products were included. Ingredient lists were analyzed, and customer reviews were screened for reports of skin reactions using predefined keywords.

Results: All products contained dihydroxyacetone (DHA), 38% included erythrulose, 11% contained melanin, and 5% included tyrosine derivatives. Only one product (3%) also contained sunscreen. On average, 1.96% of customer reviews mentioned skin reactions.

Discussion: DHA remains the predominant active ingredient, with erythrulose, melanin, and tyrosine derivatives used less frequently. Emerging or less common agents such as troxerutin, melanotan, and melanoidins raise safety and regulatory concerns. Reported adverse effects include contact dermatitis and pigmentary changes, which may complicate dermatologic assessments.

Conclusion: While sunless tanners provide a UV-free tanning option, dermatologists should educate patients on ingredient safety, potential adverse effects, and proper application techniques. Given their minimal UV protection, patients should be advised to continue regular sunscreen use.

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INTRODUCTION

Sunless tanners offer an alternative to traditional tanning methods that involve exposure to ultraviolet (UV) radiation. Dermatologists have long advised patients to avoid excess exposure to UV radiation due to its well-documented association with an increased risk of skin cancer and photoaging.[1] Yet, many patients still desire to have a darkened or tanned complexion. To meet this demand, a variety of products commonly referred to as sunless or self-tanners have been developed to darken the skin without the harmful effects of UV radiation. According to a Market Research Report by Fortune Business Insights, the sunless tanner market was valued at 1.04 billion United States Dollars (USD) in 2022 and is expected to grow to 1.7 billion USD by 2030.[2] While sunless tanners are generally considered safer than UV-based tanning, they are not without risks, including allergic and irritant contact dermatitis, among other dermatologic conditions.[3,4]

In this article, we aim to provide dermatologists with practical, up-to-date information to better counsel patients seeking sunless tanning options. To inform our review, we analyzed ingredient lists and consumer-reported reactions from top-selling sunless tanning products on Amazon.com to identify which ingredients patients are most likely to encounter. We then examined the mechanisms of action, efficacy, and adverse effects of both widely used and emerging tanning agents, along with best practices for optimizing cosmetic outcomes and minimizing skin-related complications.

MATERIALS AND METHODS

To better understand which sunless tanning ingredients patients are most likely to encounter, we conducted an ingredient and review analysis of the top-selling sunless tanning products on Amazon.com as of March 2025.[5] Amazon's Best Sellers list was used as a proxy for consumer popularity and product usage patterns. A total of 50 products were screened, with 13 excluded as bundles, applicators, or non-self-tanning cosmetics. For each included product, ingredient lists and customer reviews were collected and analyzed. Ingredient lists were examined for self-tanning agents previously reported as commonly used in sunless tanners, as described by Martini.[6] Customer reviews were screened for mention of skin reactions using the keywords: "allergic," "allergy," "hives," "rash," and "reaction." Reviews containing these terms were subsequently assessed to ensure proper context.

RESULTS

Of the products analyzed, all (n=37) contained dihydroxyacetone (DHA), 38% (n=14) contained erythrulose, 11% (n=4) contained melanin, and 5% (n=2) contained tyrosine/tyrosine derivative.

TABLE 1.

Ingredient List and Customer Review Analysis of Best-Selling Sunless Tanning Products

Amazon Best Sellers List Ranking	Brand	Product Name	Ingredients	Number of Consumer Reviews	Number of Reported Skin Reaction Reviews*	% of Reported Consumer Skin Reactions*
1	Bondi Sands	Self Tanning Foam	Dihydroxyacetone	5883	91	1.55%
2	Beauty by Earth	Self Tanner Tanning Lotion	Dihydroxyacetone	8640	380	4.40%
3	Beauty by Earth	Self Tanner Tanning Drops	Dihydroxyacetone, Erythrulose, N-Acetyl-L-Tyrosine	1727	43	2.49%
4	b.tan	Ultra Dark Self Tanner Mousse	Dihydroxyacetone, Melanin	8035	149	1.85%
5	Jergens	Natural Glow	Dihydroxyacetone	3548	94	2.65%
6	b.tan	Violet Self Tanner	Dihydroxyacetone	2878	47	1.63%
7	Coco & Eve	Sunny Honey Bali Bronzing Self Tanner Mousse	Dihydroxyacetone, Erythrulose	2452	60	2.45%
8	b.tan	Clear Self Tan Gel	Dihydroxyacetone	1798	13	0.72%
9	Beauty by Earth	Self Tanner Mousse	Dihydroxyacetone	2005	65	3.24%
10	Jergens	Natural Glow Instant Sun Body Mousse	Dihydroxyacetone, Erythrulose	3848	46	1.20%
13	Coco & Eve	Antioxidant Face Tanning Micromist	Dihydroxyacetone, Erythrulose	562	56	9.96%
14	St. Tropez	Self Tan Purity Face Mist	Dihydroxyacetone	939	24	2.56%
15	Jergens	Natural Glow Wet Skin Moisturizer	Dihydroxyacetone, Erythrulose	1616	38	2.35%
17	St. Tropez	Self Tan Express Mousse	Dihydroxyacetone, Melanin	2580	47	1.82%
18	L'Oreal Paris	Sublime Bronze Self Tanning Towelettes	Dihydroxyacetone	1434	10	0.70%
19	Isle of Paradise	Self Tanning Drops	Dihydroxyacetone, Erythrulose	1261	26	2.06%
20	Loving Tan	2 HR Express Mousse - Dark	Dihydroxyacetone, Erythrulose	742	9	1.21%
22	Peta Jane	Medium Tanning Mousse	Dihydroxyacetone	312	2	0.64%
24	Loving Tan	Deluxe Bronzing Mousse	Dihydroxyacetone, Erythrulose	748	14	1.87%
25	L'Oreal Paris	Sublime Bronze Self Tanning Facial Drops	Dihydroxyacetone	977	12	1.23%
26	L'Oreal Paris	Sublime Bronze Self Tanning Mist	Dihydroxyacetone	1202	11	0.92%
27	St. Tropez	Self Tan Classic Bronzer Mousse Foam	Dihydroxyacetone	3736	140	3.75%
29	St. Moriz	Professional Instant Self Tanning Mousse	Dihydroxyacetone	2515	23	0.91%
30	Bondi Sands	1-Hour Express Self Tanning Foam	Dihydroxyacetone, Erythrulose	317	0	0.00%
31	Peta Jane	Tanning Mist	Dihydroxyacetone, Erythrulose	115	4	3.48%
33	Body Drench	QuickTan Instant Self Tanner	Dihydroxyacetone, Erythrulose	1557	16	1.03%
34	L'Oreal Paris	Sublime Bronze Tinted Self Tanning Lotion	Dihydroxyacetone	1595	29	1.82%
35	+Lux Unfiltered	Self-Tanning Cream	Dihydroxyacetone	329	5	1.52%
36	Skinny Tan	Body Glow	Dihydroxyacetone	343	6	1.75%
37	Loving Tan	2 HR Express Mousse - Medium	Dihydroxyacetone, Erythrulose	382	5	1.31%
39	Norvell	Premium Sunless Tanning Solution-Venetian	Dihydroxyacetone	817	5	0.61%
40	TAN-LUXE	The Gradual Tan Lotion	Dihydroxyacetone, Erythrulose, Melanin	363	8	2.20%
45	The Sicilian	Double Dark Bronzing Blend	Dihydroxyacetone, Melanin, Methylsilanol Acetyltyrosine, Oleoyl Tyrosine	790	6	0.76%
47	Ten Physics	True Color Sunless Tanner	Dihydroxyacetone	3408	29	0.85%
48	L'Oreal Paris	Sublime Bronze Self Tanning Water Mousse	Dihydroxyacetone	1010	15	1.49%
49	+Lux Unfiltered	N 12 Bronzing Face Drops	Dihydroxyacetone, Erythrulose	207	5	2.42%
50	Norvell	Venetian Sunless Self Tanner Mousse	Dihydroxyacetone	729	7	0.96%
			Average	1930	42	1.96%

*Search terms for reported reactions included: allergic, allergy, hives, rash, and reaction

Only one (3%) of the products also included a sunscreen component. On average, products had 1930 customer reviews, with 1.96% of reviews reporting skin reactions (Table 1).

DISCUSSION

Our analysis clearly demonstrates that DHA is the most common ingredient in sunless tanners, with erythrulose, melanin, and tyrosine/tyrosine derivatives being less frequently used. The following discussion examines the mechanisms of action, efficacy, and adverse effects of these agents, as well as other notable tanning agents, including troxerutin, melanotan, and melanoidins. This list includes agents that, while not necessarily present in the top 50 Amazon bestsellers, are important for dermatologists to be familiar with when advising patients on safe and effective methods to achieve a tanned appearance while minimizing UV exposure (Table 2). Additionally, we discuss best practices for optimizing cosmetic outcomes when using sunless tanners.

Dihydroxyacetone

Dihydroxyacetone (DHA) is a three-carbon sugar that reacts with amino acids such as glycine, alanine, leucine, and valine in a non-enzymatic glycation process known as the Maillard reaction. This reaction results in the formation of brown-colored complexes within the stratum corneum, producing a tanned appearance.[7] DHA is approved by the United States Food and Drug Administration (FDA) for topical use in creams and lotions as a sunless tanner. However, its use in tanning booths and airbrush applications is not FDA-approved due to the potential for exposure to non-skin surfaces, including the eyes and mucous membranes.[8]

Clinical research has explored both the photoprotective effects and safety profile of DHA. One study compared DHA alone to DHA combined with naphthoquinone in a population of minimally pigmented patients over two consecutive years. During the first year, patients applied a DHA solution nightly, while in the second year, they applied DHA, waited 15 minutes, and subsequently applied naphthoquinone. The combined application provided a sun protection factor (SPF) of 18, whereas DHA alone provided an SPF of 3–4.[9,10] Concerns regarding potential carcinogenic activity have been raised due to the formation of free radicals during the Maillard reaction. However, this risk is thought to be negligible, as the free radicals are confined to the nonviable keratin layer.[9] Another clinical trial assessed the potential interference of DHA with vitiligo treatment when used as camouflage. The study found that DHA improved patient quality of life without adversely affecting vitiligo.[11]

TABLE 2.

Sunless Tanning Ingredients: Mechanisms, Efficacy, Safety, and Potential Adverse Effects

Ingredient	Mechanism of Action	Route of Administration	Efficacy	Safety Profile	Possible Side Effects	SPF
Dihydroxyacetone (DHA)	Maillard reaction forms a brown-colored complex in the stratum corneum	Topical Creams, Lotions, and Sprays	Most efficacious and contained in 100% of top-purchased sunless tanning products on Amazon.	FDA approval for skin. No FDA approval for spray due to absorption through mucous membranes.	chromonychia, contact dermatitis, pseudochromhidrosis, xanthotrichia	3 - 4
Erythrulose	Maillard reaction forms a brown-colored complex in the stratum corneum	Topical Creams, Lotions, and Sprays	Great outcomes when used in conjunction with DHA to create a more even, longer-lasting tan.	No FDA regulation as a cosmetic. Considered safe.	Possible skin, eye, and respiratory irritation in strong concentrations.	--
Troxerutin	Antioxidant	Topical Creams, Lotions, and Gels	Poor tanning efficacy and works adjunctively as an antioxidant	Approved as an oral drug in several countries.	Possible cardiac toxicity at extremely high doses far above what is found in topicals.	--
Tyrosine and Derivatives	Precursor to melanin. Involved in the rate-limiting step	Topical Creams, Lotions, and Sprays. Oral Pill Form	Unlikely to be of benefit in producing tanned skin.	Not FDA approved. FDA warns against oral tyrosine supplementation.	No established side effects, as studies on long-term supplementation are limited.	--
Melanotan	Alpha-melanocyte-stimulating hormone analog	Subcutaneous injection, oral pill, and nasal spray	Shown to have an increased half-life and is 100-fold more effective in tanning than native alpha-melanocyte stimulating hormone.	Not FDA approved. Heavily warned against by the FDA and various other international health agencies.	Renal infarction, systemic toxicity, rhabdomyolysis, priapism, melanoma, and eruptive nevi and lentiginosis.	--
Melanin	No known reaction with the skin. Simply used as a colorant	Topical Creams, Lotions, and Sprays	Unlikely to be of benefit in producing tanned skin aside from providing a superficial coloration tint.	The FDA has no information regarding melanin being used in tanning agents.	No established side effects.	1.5-2
Melanoidins	End product of Maillard reaction. As a stand-alone ingredient, it acts as a coloring agen	Topical Creams, Lotions, and Sprays	As a stand-alone ingredient, it is unlikely to be of benefit in producing tanned skin aside from providing a superficial coloration tint.	The FDA has no information regarding melanoidins being used in tanning agents.	No established side effects.	--

Although DHA is generally considered safe for external use, adverse events have been reported. Case reports describe reactions such as orange chromonychia, contact dermatitis, pseudochromhidrosis, and xanthotrichia.[3,4,12,13] The incidence of these adverse effects has not been well characterized. Additionally, DHA use has been associated with alterations in the appearance of pigmented lesions. One study suggested that DHA can cause follicular pigmentation, which may resemble lentigo maligna under dermoscopy, potentially leading to unnecessary biopsies.[14] Another report indicated that DHA-induced changes in pigmented lesions could raise suspicion for melanoma if a history of sunless tanning is not elicited.[15]

Erythrulose

Erythrulose is a keto-sugar that functions similarly to DHA, participating in the Maillard reaction to produce a dark pigment within the stratum corneum.[16] However, erythrulose alone does not produce the same intensity of pigmentation as DHA. When combined with DHA, erythrulose has been shown to enhance tanning outcomes by creating a more homogenous, natural-looking, and longer-lasting tan due to improved pigment distribution within the stratum corneum.[6] It is suggested that this combination also results in a more natural tone compared to DHA alone.

Although erythrulose is generally considered safe for cosmetic use, it is classified as a potential skin, eye, and respiratory irritant.[17] It is important to note that erythrulose is a cosmetic ingredient and is not regulated as a drug by the United States FDA. As of now, DHA remains the only sunless tanning agent formally approved by the FDA for use as a sunless tanner.[18]

Troxerutin

Troxerutin is a flavonoid that does not impart color to the skin but serves as an adjunct ingredient in sunless tanning products due to its antioxidant and anti-inflammatory properties.[19] When combined with dihydroxyacetone (DHA), troxerutin has been reported to enhance the quality and longevity of the tan, contributing to a softer skin texture and a more uniform complexion.[6] Although troxerutin shows potential benefits in improving the appearance and feel of sunless tans, data on its efficacy, specifically as a sunless tanning additive, remains limited. Beyond its cosmetic applications, troxerutin has shown promise in improving chronic venous insufficiency.[20]

Research has also explored the photoprotective effects of troxerutin. An in vitro study using HaCaT keratinocyte cells evaluated its ability to protect against UVB-induced damage.[21] The study determined that troxerutin exhibited low toxicity at concentrations up to 20 μM. Pre-treatment of cells with 0–10 μM of troxerutin prior to exposure to 50 mJ/cm^2 of UVB radiation demonstrated protective effects, including improved cell viability, reduced cell death, attenuation of UVB-induced growth arrest, preservation of cell migration capacity, and enhanced DNA repair activity. While no specific sun protection factor (SPF) rating has been established, these findings suggest that troxerutin may offer photoprotective properties. Further investigation by the same research group indicated that these protective effects may be mediated by the modulation of microRNA expression.[22]

Tyrosine and Tyrosine Derivatives

The inclusion of tyrosine in self-tanning products is based on its role as a precursor in melanin biosynthesis. Melanogenesis begins with the enzymatic conversion of L-tyrosine to L-DOPA by tyrosine hydroxylase, a rate-limiting step in melanin production.[23] The rationale behind adding tyrosine to topical self-tanners is that an increased supply of this precursor might enhance melanin synthesis.[24] However, no clinical or biochemical evidence currently supports the efficacy of topical tyrosine in enhancing tanning outcomes.

Under normal physiological conditions, the conversion of L-tyrosine to L-DOPA is believed to operate near saturation, suggesting that excess tyrosine would not significantly influence melanogenesis.[25] Despite this, tyrosine supplements continue to be marketed for enhancing sunless tanning, although no studies substantiate their efficacy. Moreover, the United States FDA has classified these supplements as potentially harmful due to the lack of safety data.[24]

Currently, no established adverse effects are associated with tyrosine supplementation. However, isolated reports have described potential adverse effects, such as altered saccadic eye movements in patients with schizophrenia following tyrosine intake.[25] Long-term safety data on tyrosine supplementation remain limited, warranting further investigation.

Melanotan

Melanotan-I (MT-I) and Melanotan-II (MT-II) are synthetic analogs of α-melanocyte-stimulating hormone (α-MSH), a peptide that regulates skin pigmentation through melanocortin receptor activation on melanocytes.[26] MT-I and MT-II exhibit increased stability and potency compared to endogenous α-MSH, with studies suggesting they are approximately 100-fold more effective at inducing melanogenesis, leading to excess melanin pigment production.[27]

MT-I and MT-II are readily available for illicit purchase online, often in injectable, oral, or nasal spray formulations.[28] Due to concerns over their safety, the FDA and international health agencies have issued warnings regarding their unregulated production and potential adverse effects.[29] Reported complications, though rare, include renal infarction, systemic toxicity, rhabdomyolysis, priapism, melanoma, eruptive nevi, and lentiginosis.[30–35] MT-II is frequently associated with amplified side effects in comparison

to MT-I, as its high lipophilicity enables it to cross the blood-brain barrier.[28]

The cosmetic effects of MT-I and MT-II may also interfere with dermatologic assessment, as artificially induced pigmentation can obscure the evaluation of pigmented lesions. One study suggested that sunless tanning induced by these peptides could complicate melanoma detection if a history of use is not obtained.[36]

The original formulation of Melanotan-I is now being referred to as afamelanotide by the pharmaceutical industry as they seek to distance themselves from the illicitly sold compounds claiming to be Melanotan.[28] Afamelanotide has been extensively studied for the treatment of erythropoietic protoporphyria (EPP). Being administered as a rice-sized, bioabsorbable, subcutaneous implant, afamelanotide has been shown to be effective at reducing the number of phototoxic reactions, increasing the duration of pain-free time after sun exposure, and increasing the quality of life in patients with EPP.[28] Unlike its illicit counterparts, afamelanotide is FDA-approved for preventing phototoxicity in adult EPP patients.[37]

Melanin

Melanin is a naturally occurring pigment synthesized in response to UV radiation as part of the skin's photoprotective mechanism, conveying an SPF of 1.5-2.[23,38] Increased production of melanin leads to the tanning of skin pigment. The inclusion of melanin in self-tanning products is aimed at increasing said melanin concentration, thus leading to a tanning of the skin. Topical application of melanin has demonstrated significant darkening of pigment and ultimate UV protection in "redhaired" Mc1r-deficient mice.[39] However, topical application of melanin to human skin has not demonstrated these same findings. It is proposed that the increased protection of the human epidermis does not allow penetration of topical melanin, as was seen in mice.

Recent research has explored small-molecule inhibition of salt-inducible kinases (SIK) as a novel approach to stimulating melanogenesis.[39] SIK inhibition has been shown to upregulate the melanocyte-inducing transcription factor (MITF), which regulates key pigment enzymes. Specifically, the SIK inhibitors YKL-06-061 and YKL-06-062 increased MITF expression and promoted melanosome transfer in human skin explants. While these inhibitors have not yet been tested for topical self-tanning applications, their ability to enhance melanin production suggests a potential role in improving the efficacy of topical melanin formulations. Theoretically, combining SIK inhibitors with topical melanin could enhance melanin deposition within the epidermis, overcoming current limitations and leading to more effective pigmentation. However, further studies are needed to evaluate the safety, efficacy, and potential oncogenic risks associated with MITF modulation.

Melanin is also commonly used as a pigment in cosmetic and food industries, reinforcing its potential role in self-tanning formulations.[40] Notably, the FDA has not provided specific guidance on the use of melanin as an ingredient in self-tanners.

Melanoidins

Melanoidins are brown polymeric pigments formed through the Maillard reaction, which also contributes to the pigmentation effects of DHA and erythrulose.[9] These pigments accumulate within the stratum corneum, imparting a temporary tanned appearance that fades with corneocyte desquamation.[7,9]

Despite their superficial similarity to melanin, melanoidins are structurally and functionally distinct.[9] Melanin is synthesized within melanocytes and deposited in the basal epidermis, whereas melanoidins are exogenous pigments that remain confined to the stratum corneum. Furthermore, unlike melanin, melanoidins do not confer significant UV protection.[9]

Melanoidins are widely used as coloring agents in the food and cosmetic industries.[41–44] When applied topically, they are generally well tolerated, with no reported toxicity.[6] However, no studies have specifically evaluated their long-term effects in self-tanning products.[45] Additionally, the FDA has not issued formal guidance on melanoidins in cosmetic formulations.

Cosmetic Considerations in Sunless Tanners

While sunless tanners effectively darken the skin, they have notable cosmetic limitations. Increased pigmentation can occur in areas with a thicker stratum corneum, such as the palms, soles, elbows, knees, and ankles, often leading to uneven or exaggerated coloration. Streaking may also occur if the product is applied unevenly or inadequately blended.[46]

To optimize cosmetic outcomes, best practices have been developed for proper skin preparation before application.[46] Best practices include cleansing, exfoliating, and thoroughly drying the skin to ensure an even distribution of the tanning agent. Application should be sparing in areas of thickened stratum corneum to prevent excessive darkening. To avoid unintended staining of the palms and knuckles, patients are advised to wash their hands immediately after application or use an applicator glove for more controlled distribution.

CONCLUSION

Sunless tanners provide a popular alternative to traditional tanning through UV exposure, offering a safer option for individuals seeking a darker complexion. While DHA remains the primary active ingredient, the inclusion of additional ingredients can influence both the efficacy and final tone, leading to a wide range of outcomes across different formulations.[16] Given the variation in individual preferences, determining an "optimal" sunless tanning formulation remains challenging.

Dermatologists play a key role in educating patients about sunless tanners, including their ingredients, potential risks, and best practices for safe and effective use. Recognizing the potential impact of these products on pigmented lesions is particularly important, as they may alter lesion appearance and raise concerns for malignancy. Awareness of patient use can help distinguish benign changes from true pathology, reducing unnecessary interventions.

Patients should be informed of potential side effects, such as contact dermatitis, and advised to discontinue use if adverse reactions occur.[3,4] Importantly, sunless tanners provide minimal UV protection, necessitating continued sunscreen use to prevent UV-induced skin damage.

Ultimately, sunless tanners remain a safe and effective option for achieving a tanned appearance without UV exposure. By guiding patients in their use, dermatologists can help optimize cosmetic results while minimizing risks and promoting overall skin health and safety.

DISCLOSURES

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