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IJPNaCS International Journal of Pharmaceuticals, Nutraceuticals and Cosmetic Science
e-ISSN: 2682-8146

International Journal of Pharmaceuticals, Nutraceuticals and Cosmetic Science
9(1) 2026, 1-15

International Journal of Pharmaceuticals, Nutraceuticals and Cosmetic Science

Science behind natural skin whitening: A review on local Malaysian skin whitening products Ethereal Lumi Radiance Series and their ingredients for safety, mechanisms and synergistic efficacy

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ARTICLE INFO

Article history:
Received 09 September 2025
Revised 05 January 2026
Accepted 23 February 2026
Online first
Published 30 March 2026

Keywords:
Natural whitening
Melanin,
ECOCERT,
COSMOS,
e'thereal

DOI:
10.24191/IJPNaCS.v9i1.01

ABSTRACT

The global demand for skin whitening products is largely driven by cultural preferences for lighter skin tones. The over-the-counter skin lightening products, such as creams, serums and moisturisers are designed to inhibit melanin production, which ultimately reduces hyperpigmentation, scars and uneven skin tone. These products consist of ingredients derived either from natural, semi-synthetic or synthetic sources, each of which impacts safety and efficacy differently. Synthetic agents like hydroquinone and mercury-based compounds were historically prevalent; however, growing awareness of their adverse effects has spurred a shift toward natural alternatives. With rising consumer demand for safe and sustainable solutions, the skincare trend now favours natural and evidence-based ingredients over harsh synthetic chemicals. This paper aims to investigate the scientific basis of plant-derived skin whitening ingredients, based on Malaysia's emerging *e*'thereal Lumi Radiance product line as a case study. It is Malaysia-developed product. It was conceived, designed and engineered through a strategic collaboration between the Johor-based R&D team and local education institutes. This review paper aims to investigate the mechanisms of action, clinical evidence and synergistic effects of key botanicals such as *Glycyrrhiza glabra* and *Oryza sativa.* The study also focuses on Malaysia's evolving regulatory framework, emphasising the significance of COSMOS and ECOCERT certifications in guaranteeing product safety and sustainability. Our research indicates that while natural whitening agents offer promising alternatives, standardised clinical validation and stricter regulatory oversight remain imperative for ensuring consumer safety.

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1. INTRODUCTION

The global Skin Lightening Products (SLPs) Market size is projected to grow from USD 9.26 billion in 2022 to around USD 16.27 billion by 2032 at a Compound Annual Growth Rate (CAGR) of 5.8% (Fortune Business Insights, 2022). Rising awareness of skin health and desire for flawless and even-toned skin prompt SLPs Market to experience a surge in demand. The current SLPs Market offers a variety of creams, moisturisers and serums formulated to reduce discolouration, hyperpigmentation, and scarring to promote an even skin tone. These products function by inhibiting the production of melanin, the pigment responsible for the skin's natural colour. In addition, many of these products incorporate antioxidants and ultraviolet (UV) filters that prevent further skin damage. Ultimately, it is believed that SLPs can enhance confidence and self-esteem by enabling people to feel more at ease in their own natural skin tone (Qeyam et al., 2025; Regencia et al., 2024).

Over recent years, significant innovations incorporating multi-active formulations have emerged in the SLPs Market. The innovations have moved beyond single ingredients to synergistic complexes that target multiple pathways of melanogenesis (tyrosinase inhibition, antioxidant protection, MITF signalling, melanosome transfer). For instance, the incorporation of natural and organic constituents such as liquorice root (*Glycyrrhiza glabra*), vitamin C and kojic acid is a significant development. These ingredients effectively inhibit melanin production and are skin-friendly. Moreover, there has been an increased focus on products containing multiple active ingredients, such as retinol and glycolic acid, which enhance product efficacy through synergy (Kang et al., 2021; Michalak et al., 2021; Sarkar et al., 2013). Multiple sectors including cosmetics, healthcare, and entertainment have invested heavily in SLP development. Numerous companies devote substantial resources to the development and marketing of beauty and cosmetics products, a leading industry. These products are widely utilised by the healthcare industry to treat a variety of skin conditions, including melasma and hyperpigmentation. In addition, the entertainment industry uses these products to achieve flawless, even-toned skin for stage and screen performances (Pollock et al., 2021). The use of SLPs raises some ethical concerns, particularly SLP products can reinforce the discriminatory belief that lighter skin is more beautiful, successful or of higher status. When unblemished skin is promoted as the ideal, these biases can affect self-esteem, social opportunities and even employment and marriage prospects in many societies. Nonetheless, it is crucial to recognise that these products are not inherently harmful and are safe to the users. Companies must practice transparency, clarity and accountability by providing comprehensive information about product constituents, potential adverse effects and proper usage instructions (Thappa & Malathi, 2013).

In Malaysia, this trend is particularly pronounced, with local brands springing up that integrate plant-based and traditional ingredients into their formulations to meet consumer demand for safer and more sustainable options (Hu et al., 2020; Nordin et al., 2021; Ridzuan et al., 2021). However, the lack of robust scientific evidence supports has raised concerns among consumers toward some of these ingredients. As such, a thorough understanding of skin whitening mechanisms is essential for product formulation that delivers optimal results without compromising safety. This review explores the scientific basis of natural skin whitening through literature synthesis, with a focus on E'thereal Lumi Radiance Series, a Malaysian whitening product line. Key considerations include its active ingredients, safety profile, mechanisms of action and synergistic effects. Additionally, this article examines regulatory standards and consumer safety within the Malaysian market, particularly in relation to the role played by Cosmetic Organic and Natural Standard (COSMOS) and ECOCERT certifications.

https://doi.org/10.24191/IJPNaCS.v9i1.01

2. METHODOLOGY

A structured review was conducted to access thoroughly the evidence regarding skin whitening products and active ingredients in skincare products. The primary question guiding this review was: What are the established mechanisms, efficacy and safety of the *e'*thereal Lumi Radiance Series? A literature search was carried out across PubMed, Scopus, Google Scholar and Web of Science for peer-reviewed articles published from the year 2000 to the present, by using a combination of keywords: 4-n-Butylresorcinol, melanin, skin whitening, COSMO, ECOCERT. The studies identified were screened based on their titles and abstracts, followed by a review of the full texts. Essential data, including study design, formulations and results, were extracted and narratively synthesised into thematic sections focusing on melanin formation, mechanisms and pathways that inhibit melanogenesis. However, potential limitations of this review include the possibility of publication bias, variability in study methodologies and the continuously evolving field of cosmetic science.

3. FORMATION AND ACCUMULATION OF MELANIN

Melanin production is a complex physiological response to environmental stressors such as UV radiation, pollutants and free radical species (ROS) as well as intrinsic factors. The process of melanin formation and accumulation caused by UV exposure is depicted in Fig. 1. When the skin is continuously exposed to UV radiation, the tyrosinase enzyme in the basal melanocytes is activated (Lee et al., 2022). Melanocytes are complex cells rich in mitochondria, which is the Golgi apparatus, ribosomes and other organelles distributed throughout the skin cells of the body. Once melanocytes mature in the basal layer, they develop elongated dendritic structures that connect with keratinocytes, forming the epidermal melanin unit. Melanocytes transfer melanin to the basal layer of the skin via these dendritic structures. Through the proliferation of the stratum corneum, melanin eventually migrates to the skin's surface and is shed along with the exfoliation of the stratum corneum (Schlessinger et al., 2025; Shi et al., 2022).

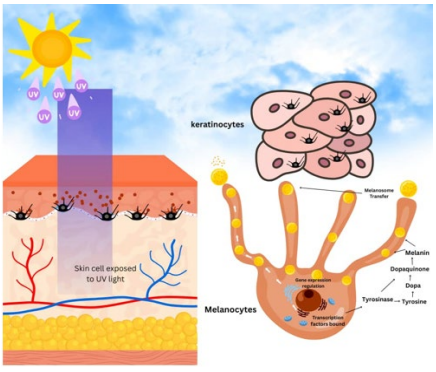

Fig. 1. Melanin **FORMATION** induced by UV exposure and activation of melanocytes (Salinas-Santander et al., 2018).

Air pollutants, mental stress and other endogenous or exogenous environmental factors can also trigger keratinocytes to release reactive oxygen species (ROS) (Bocheva et al., 2023; Dijkhoff et al., 2020) stimulating peripheral nerves to secrete cytokines such as interleukin and prostaglandin. Thus, initiating inflammatory responses. Eventually, this cascade stimulates the pituitary gland to secrete -melanocyte-stimulating hormone (-MSH), which activates tyrosinase (Lee et al., 2018).

3.1 **Major pathways in melanogenesis**

In general, the cellular regulation of melanogenesis through MITF (Microphthalmia-associated transcription factor) is a complex process which integrates the principal signalling pathways. Each pathway contributes to melanocyte survival, proliferation and pigment production. Together, these pathways converge on the MITF transcription factor, upregulating tyrosinase (TYR) and tyrosinase-related protein (TRP-1/2) expression and driving melanin synthesis and transport (D'Mello et al., 2016; Gelmi et al., 2022; Lee et al., 2018; Vibert et al., 2017)

3.1.1 Wnt/β-catenin: Wingless-related integration site signalling pathway

The Wnt/β-catenin pathway regulates melanocyte development and MITF expression through a cascade initiated by Wnt-Frizzled binding, which inhibits GSK-3β and stabilises β-catenin. Nuclear β-catenin then partners with Lymphoid Enhancer-binding Factor (LEF) to activate MITF transcription, while cooperating with SOX10 and interacting with the Ras/MAPK pathway (via MITF Ser73 phosphorylation) to fine-tune melanogenesis. This integrated mechanism ensures controlled pigmentation and melanocyte function (Abrahamian & Grimm, 2021; Vibert et al., 2017).

3.1.2 SCF/c-KIT: Stem Cell Factor-Mediated Melanocyte Proliferation / Endothelin-1-Driven MAPK Activation

SCF binds to the c-KIT receptor, activating MAPK/ERK and PI3K/AKT signals to promote melanocyte survival, proliferation and MITF stabilisation (Gelmi et al., 2022). Mutations in the c-KIT gene, on the other hand, can lead to piebaldism, a condition characterised by congenital depigmentation (Hegde et al., 2023; Hyter et al., 2013). Endothelin-1 (EDN-1) from keratinocytes binds to endothelin receptor B (EDNRB) in melanocytes. It activates MAPK/ERK to enhance MITF activity and tyrosinase expression, which links paracrine signalling to melanin synthesis (Maddaleno et al., 2021).

3.1.3 DAG/PKC: Stress-Responsive Diacylglycerol Pathway

Stress-induced diacylglycerol (DAG) activates protein kinase C (PKC), which directly phosphorylates tyrosinase and may modulate MITF through p38 MAPK or NF-B, contributing to hyperpigmentation disorders like melasma (Horrell et al., 2016; Lv et al., 2020).

3.1.4 α-MSH/MC1R: UV-Induced cAMP/PKA Signaling

In the -MSH/MC1R pathway, ultraviolet (UV) radiation triggers -MSH release, which binds to MC1R and activates cAMP/PKA signals to upregulate MITF and stimulate eumelanin production; loss-of-function MC1R variants are associated with fair skin and red hair due to reduced UV protection (Swope & Abdel-Malek, 2018).

https://doi.org/10.24191/IJPNaCS.v9i1.01

3.1.5 Phases of Melanin Production

Endothelin-1 (EDN1) and stem cell factor (SCF) are the most critical factors leading to melanin production and pigment deposition. These factors induce melanogenesis through (MITF) expression and activation, which in turn induces the expression of pigment-related genes, such as TYR, TRP-1, TRP-2, and premelanosome protein (PMEL). At this level, melanocytes undergo a four-phase melanin production process, as follows: (Cichorek et al., 2013; Hirobe et al., 2010; Horrell et al., 2016; Lee et al., 2022; Maddaleno et al., 2021; Solano, 2014; Swope & Abdel-Malek, 2018; Wu et al., 2001)

Phase I At this stage, vesicles have just formed and appear as transparent spheres without melanin. They produce glycoproteins such as Pmel17 and MART1. MITF then initiates the next stage of melanin synthesis.

Phase II The synthesis of melanin occurs through two main pathways:

- Eumelanin Pathway: Tyrosine is converted by tyrosinase into L-DOPA, then further into DOPAquinone. From here, it can proceed via TYRP-2 and TYRP-1 to form eumelanin, resulting in darker skin tones. Alternatively, DOPAquinone may convert directly into DHI, also leading to eumelanin.
- Pheomelanin Pathway: If glutathione or cysteine is present, DOPAquinone is diverted to form pheomelanin, which produces reddish skin tones.

Higher eumelanin levels lead to darker pigmentation, while increased pheomelanin results in a more reddish hue.

Phase III Melanin production continues, appearing as brown spherical structures. This phase involves the presence of tyrosinase, TYRP-1, and TYRP-2.

Phase IV At this phase, melanin is fully matured and appears as intensely black spheres. Tyrosinase is no longer present; thus, inhibitors at this stage are ineffective. Once melanin synthesis is complete, it begins migrating to the dendrites of melanocytes. Inside the dendrites, two transport mechanisms, Rab27a and myosin, facilitate melanin transfer by forming a pathway between the cytoplasm and melanosomes, enabling efficient delivery to keratinocytes. Hence, inhibiting tyrosinase activity and targeting EDN1 and SCF is a highly effective approach to suppressing melanin synthesis. Understanding these mechanisms has led to therapeutic and cosmetic strategies such as MC1R agonists for photoprotection, tyrosinase inhibitors for hyperpigmentation, and c-KIT-targeted approaches in vitiligo treatment.

3.2 Multi-pathway targeted inhibition of melanogenesis and the synergistic effects of Actience™ Light, BRIGHT Oléoactif® and FISION® GlowPlex in Lumi Radiance Series

Traditional single-pathway inhibitors have limitations across various stages of melanin production—namely production, maturation, transfer, and degradation—and are influenced by multiple signals (such as UV exposure, hormones, and inflammation) that converge on melanogenesis through distinct upstream pathways. Ultimately, these limitations necessitate the adoption of multi-target intervention strategies. Targeting tyrosinase alone is insufficient for long-term depigmentation, which has prompted the development of the whitening active 4-n-butylresorcinol. It is found in Actience™ Light and acts competitively to inhibit tyrosinase (TYR) activity and TRP-1, blocking eumelanin production (Huh et al., 2010; Kolbe et al., 2013). BRIGHT Oléoactif® is formulated with glabridin (90% TYR inhibition rate) and

https://doi.org/10.24191/IJPNaCS.v9i1.01

-oryzanol to achieve a "synthesis-transport-metabolism" quadruple blockade (Chen et al., 2016; Hallstar Beauty, 2022). Whereas FISION® GlowPlex is a combination of nicotinamide (inhibits melanosome transfer), pea peptide (inhibits TYR), and quinoa extract (antioxidant + promotes metabolism) for synergistic effects (Errante et al., 2024; Hakozaki et al., 2002; Han et al., 2022; Jun et al., 2012). All three active ingredients block melanogenesis at multiple pathways as depicted in Fig. 2.

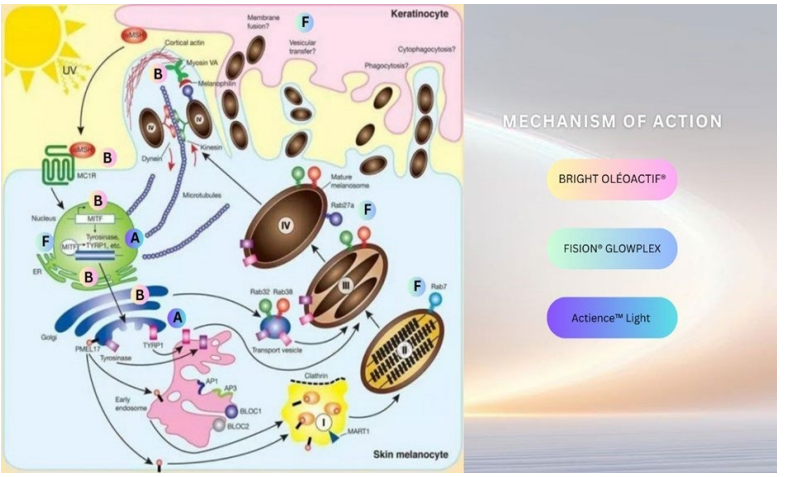

Fig. 2. Schematic diagram of the melanogenesis pathway and comprehensive pathway-blocking mechanisms and synergistic effects of (A) Actience™ Light, (B) BRIGHT Oléoactif® and (F) FISION® GlowPlex.

In the nucleus, Actience^{TM}Light contains active whitening agent 4-n-Butylresorcinol which plays the strongest role in the tyrosinase inhibition pathway. The specific mechanisms target tyrosinase (the key enzyme in melanin production), converting tyrosine to DOPA and then dopaquinone. 4-n-Butylresorcinol inhibits tyrosinase by mimicking its natural substrate (L- tyrosine) and competitively binding to the enzyme's active site. Specifically, its phenolic hydroxyl group and alkyl chain interact with the two copper ions (Cu^{2+}) in tyrosinase's active centre. Eventually, these block substrate binding, inhibiting enzymatic catalysis and reducing melanin synthesis. The tyrosinase-catalysed oxidation of L-DOPA to L-DOPA-quinone was monitored using assay-ingredient 3-methyl-2-benzothiazolinhydrazone (MBTH), which reacts with the quinone to form a stable pink-red dye. The rate of dye formation (measured at 490 nm) in the presence of different inhibitor concentrations is used to calculate the IC_{50} value. It has been reported that its half-maximal inhibitory concentration (IC_{50}) is 21 µmol/L, making it 24 times more potent than kojic acid (IC_{50} = 500 µmol/L) and over 500 times more potent than arbutin (IC_{50} > 1 mM) (Kolbe et al., 2013; Pillaiyar et al., 2017).

An in vitro study shows remarkable inhibitory effectiveness against isolated tyrosinase, but the results do not fully represent its use in real-life situations. The reported IC_{50} of 21 µmol/L, found in a purified enzyme setup using MBTH to capture the quinone product, offers an artificial view that might not reflect its behaviour in living cells. The assay did not take into account physiological challenges, such as whether the compound is capable of penetrating human skin and entering melanocytes while remaining stable, enough to arrive at its target within melanosomes. While initial in vitro studies indicated that 4-n-Butylresorcinol was an effective tyrosinase inhibitor, these results were appropriately acknowledged as merely a promising chemical foundation. This initial potential indeed spurred the comprehensive investigations that ensued. Further research validated its effectiveness in human melanocyte cultures by

decreasing melanin production and demonstrated favourable skin absorption. These findings facilitated its advancement as a principal cosmetic and clinical depigmenting agent. It is now a well-recognised component in topical formulations aimed at addressing skin pigmentation conditions such as melasma, with its safety and biological efficacy corroborated by numerous clinical trials (Huh et al., 2010; Shamanna et al., 2016)—a direct transition from laboratory to clinical application that substantiates the original in vitro discovery.

In addition to its effect on tyrosinase, 4-n-butylresorcinol also inhibits TRP-1, an auxiliary enzyme in melanin synthesis (Huh et al., 2010; Kolbe et al., 2013; Shamanna et al., 2016). TRP-1 catalyses the oxidation of 5,6-dihydroxyindole-2-carboxylic acid (DHICA) into indole-5,6-quinone, a critical step in eumelanin production. 4-n-butylresorcinol binds to TRP-1's hydrophobic pocket, disrupting its function. By targeting both TYR and TRP-1, it reduces eumelanin synthesis at multiple stages, avoiding the limitations of single-pathway inhibitors.

At present, numerous ingredients in the existing market affect tyrosinase activity, which is essential for melanin synthesis, but there are only a few compounds that inhibit TRP-1 activity, which is crucial for melanin stabilisation. TRP-1 (or TYRP1) works alongside tyrosinase in melanin production; primarily, it stabilises and darkens melanin. Subsequently, it causes more persistent pigmentation. Therefore, TRP-1 inhibitors are essential for deeper and longer-lasting pigmentation effects. Unlike hydroquinone, the 4-n-butylresorcinol compound is believed to inhibit selectively melanogenesis without damaging melanocytes. This makes it a safer long-term option. Due to its non-cytotoxic nature, its frequent use alongside potent antioxidants makes it part of a holistic strategy for managing hyperpigmentation and the associated oxidative stress in melanocytes, which may provide benefit in post-inflammatory hyperpigmentation (PIH)—typically a condition more treatment-resistant due to dermal inflammation (Kim et al., 2012; Rai et al., 2025).

Meanwhile, as UV exposure begins (refer to Fig. 4), BRIGHT Oléoactif® works comprehensively to combat pigmentation through quadruple-blocking action: (1) Source inhibition by suppressing tyrosinase and endothelin-1 (ET-1) to prevent melanocyte stimulation in the nucleus. (2) Blocked melanocyte differentiation and melanin synthesis while directly inhibiting tyrosinase activity, which controls pigmentation at its earliest stage. (3) Inhibition of melanosome transfer to prevent pigment deposition. (4) Termination via anti-inflammatory and antioxidant effects to accelerate pigmentation metabolism (Hallstar Beauty, 2022). Key active ingredients include liquorice root (*Glycyrrhiza glabra*) extract, which competitively inhibits tyrosinase by binding to its copper-ion centre, blocking tyrosine's oxidation into DOPAquinone. Rice bran (*Oryza sativa*) extract contains -oryzanol to neutralise UV-induced ROS and reduce oxidative stress (Asadollahi et al., 2024; Zhang et al., 2025). Plant-derived phytochemical compounds are well known for their therapeutic properties. Marshmallow root, rich in mucilage polysaccharides and flavonoids, soothes irritation, reduces redness and calms the inflammatory cascade. This removes the main signal that stimulates melanocytes to overproduce melanin (Rezaei et al., 2015). Rapeseed oil (particularly high-oleic or canola oil) is rich in vitamin E (tocopherols) and other antioxidants. These compounds neutralise free radicals, protecting melanocytes and surrounding keratinocytes from oxidative damage, resulting in a more stable microenvironment. This multi-action approach effectively controls pigmentation from initial triggers through synthesis, transfer and oxidation for complete

https://doi.org/10.24191/IJPNaCS.v9i1.01

brightening benefits. The natural formulation works synergistically to provide safe yet potent results suitable for sensitive skin.

FISION® GlowPlex is an innovative triple-action formula that achieves highly effective skin brightening through three synergistic blockades of melanin pathways. Its multi-action mechanism works by: (1) directly inhibiting tyrosinase activity to block the initial step of melanin synthesis (tyrosine to dopaquinone conversion). Pea peptides competitively bind to tyrosinase's copper active site, effectively blocking the conversion of tyrosine to dopaquinone. (2) Interrupting melanosome transfer from melanocytes to the keratinocyte layer to reduce epidermal pigment deposition. Niacinamide's ability to disrupt PAR-2-mediated melanosome transport from melanocytes to keratinocytes prevents epidermal pigmentation. (3) Neutralising free radicals to minimise UV-induced oxidative stress while accelerating cellular turnover to promote the shedding of pigmented dead skin cells (TRI-K Industries, 2021). The formula accelerates melanin clearance through a dual approach where quinoa polyphenols provide potent antioxidant protection against free radicals, while quinoa polysaccharides promote cellular turnover to enhance the shedding of pigmented cells. The multi-targeted strategy ensures comprehensive brightening effects while supporting skin renewal and antioxidant defence (Fig. 3).

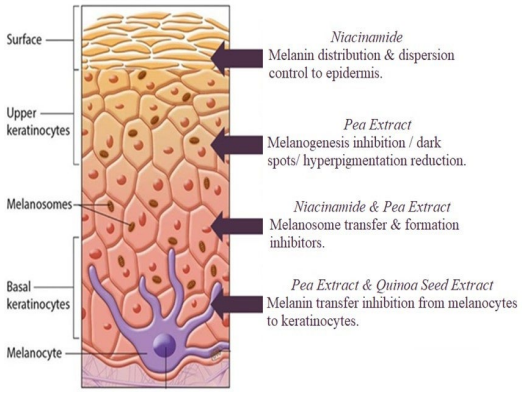

Fig. 3. FISION® GlowPlex: A multi-target approach for comprehensive brightening by addressing pigmentation at manifold stages from signal inhibition to melanin synthesis, transfer and oxidation (TRI-K Industries, 2021).

In short, the *e*'thereal Lumi Radiance collection by a Malaysian brand targets multiple nodes of the melanogenesis pathway and every critical stage of pigmentation development:

i. UV-Induced Signal Blockade: Intercepts melanocyte activation signals triggered by UV exposure at the source.

ii. MITF Inhibition & Tyrosinase Suppression: Targets the MITF pathway to reduce tyrosinase production and directly inhibits tyrosinase's catalytic activity, disrupting all four key melanin synthesis stages.

iii. Melanosome Transfer Interception: Blocks melanosome transport to keratinocytes, preventing visible pigmentation.

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iv. Pigment Clearance & Exfoliation: Enhances skin turnover to shed pigmented keratinocytes, accelerating melanin removal.

This end-to-end approach may contribute to a broad spectrum of brightening effects which function from prevention to correction for a radiant and more even-toned skin.

4. PRODUCT SAFETY: COSMOS AND ECOCERT CERTIFICATION

The belief that natural ingredients are inherently safer or more effective than synthetic ones lack strong scientific support. While plant and mineral-derived substances are often seen as harmless, their safety depends on various factors (ECOCERT Group, 2026; COSMOS-standard AISBL, 2025):

- Chemical Complexity: Natural extracts contain hundreds of constituents, some of which may exhibit toxicity, allergenicity or unintended pharmacological activity. For instance, botanical extracts in cosmetics (e.g., tea tree oil, fragrance blends) are common contact allergens to some individuals (de Groot & Schmidt, 2016; Simpson et al., 2004).
- Dose-Response Relationships: Even biologically compatible compounds such as essential oils and alkaloids can provoke adverse effects at inappropriate concentrations. The high dosage of citrus oils in leave-on products can make the skin susceptible to phototoxicity when exposed to UV light. This response primarily results from compounds known as furocoumarins, which become activated by UV radiation and inflict harm on skin cells (Mioduszewski & Beecker, 2015).
- Contaminant Risks: Pesticide residues, heavy metals and microbial contamination may persist in raw materials without stringent purification (Ajayi et al., 2024; Rubin & Brod, 2019).

Thus, the label “natural” does not guarantee safety as it depends on purification methods, concentration used and toxicological evaluation. Comprehensive evaluation and preclinical testing are essential for all ingredients, and certification from an independent authority is crucial to ensure product safety and effectiveness.

Cosmetic Organic and Natural Standard (COSMOS) is the leading certification system recognised globally for organic and natural cosmetics. Developed collaboratively by five prominent European certification organisations—BDIH from Germany, Cosmebio and ECOCERT from France, ICEA from Italy and the Soil Association from the UK—COSMOS establishes a comprehensive international framework for certification in the cosmetics industry. This initiative ensures uniformity in the standards applied to natural and organic cosmetic products across the globe.

Specifically for skincare raw material ingredients, the ECOCERT certification system implements a comprehensive three-tier verification process for skincare ingredients, ensuring their integrity and safety. Firstly, it assesses sustainability by aligning with the United Nations Sustainable Development Goals (SDGs), promoting environmentally responsible practices. Secondly, it evaluates purity by adhering to the ISO 16128 international standard, which governs Natural and Natural-Derived Ingredients. Lastly, the system ensures non-toxicity through rigorous toxicological assessments that comply with Organisation for Economic Co-operation and Development (OECD) standards, thereby guaranteeing that the ingredients are safe for consumer use. This meticulous certification process ultimately fosters the development of skincare formulations that are not only effective but also safe and sustainable.

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A comprehensive scientific evaluation framework is utilised to assess ecological impact, traceability and biochemical efficacy. This includes Life Cycle Assessments that monitor the carbon footprint from raw material cultivation to product disposal, compliance with Restricted Substance Lists per EU regulations (EC No 1223/2009) and validation of biological efficacy through in vitro testing, reflecting a zero-tolerance policy on animal testing. To ensure supply chain transparency, certified ingredients undergo rigorous audits, allowing traceability from raw material sources to retail outlets. Independent testing is performed by laboratories accredited by the International Laboratory Accreditation Cooperation (ILAC), ensuring the validity of safety and efficacy data, such as skin irritation tests conducted in ILAC-MRA accredited labs. Compliance is dynamic, with annual updates to certifications to align with regulatory changes and international sustainability standards. In return, this commitment to market value offers consumers three assurances: (1) all environmental claims are data-backed, (2) each product batch is traceable via a certification number, and (3) supplier social responsibility assessment reports are publicly accessible, ensuring ethical transparency.

The key ingredient in *e*'thereal Lumi Radiance Emulsion, BRIGHT Oléoactif®, is notable not only for its effectiveness but also for its dedication to sustainability and organic integrity. Certified organic by COSMOS, this exceptional component boasts an impressive 84% organic content, ensuring compliance with rigorous standards for purity and environmental stewardship (Fig. 4(a)). This high level of organic materials demonstrates a commitment to leveraging the benefits of nature while reducing reliance on synthetic additives. By integrating BRIGHT Oléoactif® into its formulation, Lumi Radiance Emulsion not only boosts the skin's radiance but also responds to the increasing consumer demand for products that are both potent and eco-friendly.

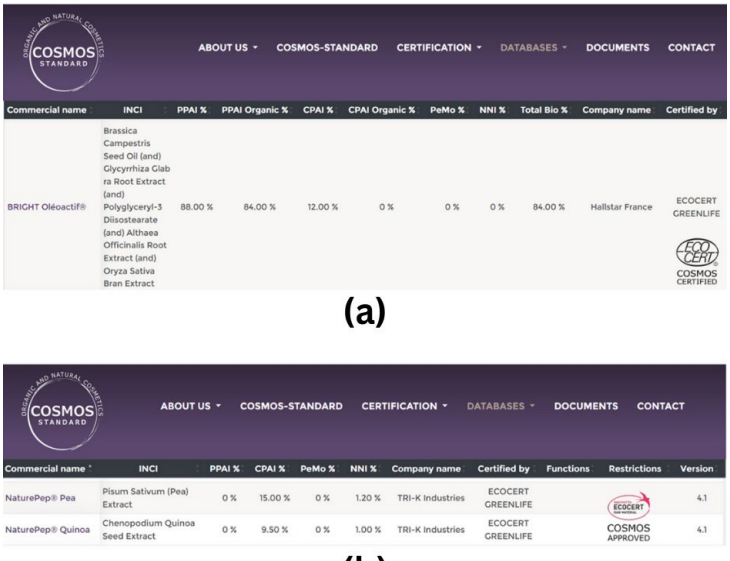

Fig. 4. COSMOS database search on (a) BRIGHT Oléoactif® and (b) Fision® GlowPlex (COSMOS-standard AISBL, 2025).

The *e*'thereal Lumi Radiance serum stands out in the skincare industry with its innovative formulation featuring Fision® GlowPlex, a blend of two COSMOS-approved ingredients: NaturePep® pea extract and

NaturePep® quinoa extract (Fig. 4(b)). NaturePep® pea extract is rich in peptides and antioxidants that nourish the skin and enhance radiance, while NaturePep® quinoa extract provides essential amino acids and vitamins for hydration and elasticity. Together, these ingredients in Fision® GlowPlex significantly brighten, rejuvenate, and restore the skin's natural glow. This thoughtfully curated combination highlights the serum's commitment to high-quality, sustainable ingredients and its effectiveness in addressing common skin concerns, making it a vital addition to any skincare routine.

In addition, the whitening active in *e*'thereal Lumi Radiance Night Booster, Actience™ Light (4-n-butylresorcinol), demonstrates superior efficacy in inhibiting TRP-1 and tyrosinase, along with satisfactory photostability, safety, effectiveness and tolerability. This effectiveness is also reflected in the increasing number of approved patents for cosmetic formulations containing this compound (Resende et al., 2022). A record of 14 patents was granted in 2021 for depigmenting cream compositions featuring 4-n-butylresorcinol. In comparison, several current whitening agents exhibit limitations, including potential side effects such as contact dermatitis, allergic reactions or heightened skin sensitivity.

As a local Malaysian product, the *e*'thereal Lumi Radiance series is registered with the National Pharmaceutical Regulatory Agency (NPRA), under the Ministry of Health Malaysia, which is the primary body responsible for regulating cosmetic products. The NPRA plays a crucial role in safeguarding consumers' interests and protecting market efficiency. Typically, prior to marketing, a local Product Notification Holder is required to submit product information through the Cosmetic Notification Portal to receive a Notification Number, which must be displayed on the product label. The regulations, primarily governed by the Control of Drugs and Cosmetics Regulations 1984, mandate adherence to ingredient lists (both positive and negative), a safety assessment conducted by a qualified assessor, the upkeep of a Product Information File, compliance with Good Manufacturing Practice (GMP), and bilingual labelling. The NPRA also implements post-market surveillance by conducting monitoring, testing, and imposing penalties for non-compliance, thereby ensuring consumer safety without the necessity of pre-market approval. Overall, adhering to NPRA regulations constitutes the essential minimum requirement for legal market entry in Malaysia, while voluntary international certifications such as COSMOS and ECOCERT signify a brand's dedication to elevated standards in safety, organic sourcing, and sustainable development. Collectively, they establish a "dual assurance" that fosters consumer trust.

5. CONCLUSION

Consumers are progressively seeking depigmenting cosmetic options due to the considerable effect of skin pigment irregularities on their quality of life. However, it is essential to prioritise product safety above aesthetic appeal, particularly in markets where unregulated products remain prevalent. This review highlights how brands such as *e*'thereal have adopted multi-pathway, plant-based actives to address pigmentation concerns while aligning with global safety and sustainability standards. Each product in the *e*'thereal Lumi Radiance series is meticulously formulated with a blend of natural ingredients and scientifically backed compounds designed to target hyperpigmentation while nourishing the skin. By prioritising both efficacy and safety, *e*'thereal aims to empower consumers to embrace their natural beauty without compromising their health. This holistic approach not only addresses the aesthetic concerns associated with uneven skin tone but also fosters a deeper understanding of skin care as an integral part of overall well-being. Future research should focus on optimising formulations and improving bioactive ingredient delivery systems, such as nanotechnology and sustained-release mechanisms. Given Malaysia's

https://doi.org/10.24191/IJPNaCS.v9i1.01

abundance of natural herbal resources, the integration of herbaceous and traditional herbs into skincare applications can yield promising results.

ACKNOWLEDGEMENTS/FUNDING

We thank the *e*'thereal brand owner, Maxconnection Sdn. Bhd. and Gracemedic Sdn. Bhd. for supporting this work.

CONFLICT OF INTEREST STATEMENT

The authors declared that they have no conflicts of interest to disclose.

AUTHORS' CONTRIBUTIONS

Celine Lee Xin Yi: Conceptualisation, Investigation, Data collection, Writing-original draft; **Lim Kai Ling:** Conceptualisation, Investigation, Data collection, Writing-original draft; **Aisyah Rehan:** Data Analysis, Writing–review & edit; **Tan Kian Meng:** Correspondence, Methodology and Data Analysis, Writing–review & edit.

REFERENCES

Abrahamian, C., & Grimm, C. (2021). Endolysosomal cation channels and MITF in melanocytes and melanoma. *Biomolecules, 11*(7), 1021. https://doi.org/10.3390/biom11071021

Ajayi, S. A., Olaniyi, O. O., Oladoyinbo, T. O., Ajayi, N. D., & Olaniyi, F. G. (2024). Sustainable sourcing of organic skincare ingredients. *Asian Journal of Advanced Research and Reports, 18*(1), 65–91. https://doi.org/10.9734/ajarr/2024/v18i1598

Asadollahi, L., Abbaspour-Ravasjani, S., Kim, K. A., Maghsoodi, M., Hamishehkar, H., Kosari-Nasab, M., & Cho, J. Y. (2024). Rice stem cells as skin whitening ingredients. *Foods, 13*(17), 2803. https://doi.org/10.3390/foods13172803

Bocheva, G., Slominski, R. M., & Slominski, A. T. (2023). Environmental air pollutants affecting skin functions with systemic implications. *International Journal of Molecular Sciences, 24*(13), 10502. https://doi.org/10.3390/ijms241310502

Chen, J., Yu, X., & Huang, Y. (2016). Inhibitory mechanisms of glabridin on tyrosinase. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 168*, 111–117. https://doi.org/10.1016/j.saa.2016.06.008

Cichorek, M., Wachulska, M., Stasiewicz, A., & Tymińska, A. (2013). Skin melanocytes: Biology and development. *Advances in Dermatology and Allergology, 30*(1), 30–41. https://doi.org/10.5114/pdia.2013.33376

COSMOS-standard AISBL. (2025). *COSMOS-standard documents*. https://www.cosmos-standard.org/en/documents/

de Groot, A. C., & Schmidt, E. (2016). Tea tree oil: Contact allergy and chemical composition. *Contact Dermatitis, 75*(3), 129–143. https://doi.org/10.1111/cod.12591

Dijkhoff, I. M., Drasler, B., Karakocak, B. B., Petri-Fink, A., Valacchi, G., Eeman, M., & Rothen-Rutishauser, B. (2020). Impact of airborne particulate matter on skin: A systematic review from epidemiology to in vitro studies. *Particle and Fibre Toxicology, 17*(1), 35. https://doi.org/10.1186/s12989-020-00366-y

D'Mello, S., Finlay, G., Baguley, B., & Askarian-Amiri, M. (2016). Signalling pathways in melanogenesis.

International Journal of Molecular Sciences, 17(7), 1144. https://doi.org/10.3390/ijms17071144

ECOCERT Group. (2026). *COSMOS-standard: Natural and organic cosmetics*. https://www.ecocert.com/en/certification-detail/natural-and-organic-cosmetics-cosmos

Errante, F., Sforzi, L., Supuran, C. T., Papini, A. M., & Rovero, P. (2024). Peptide and peptidomimetic tyrosinase inhibitors. In *The Enzymes* (Vol. 54, pp. 135–189). Academic Press. https://doi.org/10.1016/bs.enz.2024.06.005

Fortune Business Insights. (2022). *Skin lightening products market size, share & report, 2022-2032*. https://www.fortunebusinessinsights.com/skin-lightening-products-market-110570

Gelmi, M. C., Houtzagers, L. E., Strub, T., Krossa, I., & Jager, M. J. (2022). MITF in normal melanocytes, cutaneous and uveal melanoma: A delicate balance. *International Journal of Molecular Sciences, 23*(11), 6001. https://doi.org/10.3390/ijms23116001

Hakozaki, T., Minwalla, L., Zhuang, J., Chhoa, M., Matsubara, A., Miyamoto, K., & Boissy, R. E. (2002). Effect of niacinamide on reducing cutaneous pigmentation. *British Journal of Dermatology, 147*(1), 20–31. https://doi.org/10.1046/j.1365-2133.2002.04834.x

Hallstar Beauty. (2022). *BRIGHT OLÉOACTIF®*. https://www.hallstarbeauty.com/webfoo/wp-content/uploads/Active-Naturals-BRIGHT-English.pdf

Han, C., Lin, B., Huang, X., Mao, Z., Kong, X., Fang, L., & Zheng, J. (2022). Quinoa husk peptides reduce melanin content. *iScience, 26*(1), 105721. https://doi.org/10.1016/j.isci.2022.105721

Hegde, S., Srinivas, S., & Nanjundappa, N. (2023). KIT gene mutation causing piebaldism associated with multiple café-au-lait-like macules and freckling. *Indian Dermatology Online Journal, 14*(2), 240–242. https://doi.org/10.4103/idoj.idoj_368_22

Hirobe, T., Shinpo, T., Higuchi, K., & Sano, T. (2010). Life cycle of human melanocytes regulated by endothelin-1 and stem cell factor. *Journal of Dermatological Science, 57*(2), 123–131. https://doi.org/10.1016/j.jdermsci.2009.11.006

Horrell, E. M. W., Boulanger, M. C., & D'Orazio, J. A. (2016). Melanocortin 1 receptor: Structure, function, and regulation. *Frontiers in Genetics, 7*, 95. https://doi.org/10.3389/fgene.2016.00095

Hu, Y., Zeng, H., Huang, J., Jiang, L., Chen, J., & Zeng, Q. (2020). Traditional Asian herbs in skin whitening: The current development and limitations. *Frontiers in Pharmacology, 11*, 982. https://doi.org/10.3389/fphar.2020.0982

Huh, S. Y., Shin, J. W., Na, J. I., Huh, C. H., Youn, S. W., & Park, K. C. (2010). Efficacy and safety of 4-N-butylresorcinol 0.1% cream for melasma. *Annals of Dermatology, 22*(1), 21–27. https://doi.org/10.5021/ad.2010.22.1.21

Hyter, S., Coleman, D. J., Ganguli-Indra, G., Merrill, G. F., Ma, S., Yanagisawa, M., & Indra, A. K. (2013). Endothelin-1 is a transcriptional target of p53 in epidermal keratinocytes and regulates UV-induced melanocyte homeostasis. *Pigment Cell & Melanoma Research, 26*(2), 247–258. https://doi.org/10.1111/pcmr.12063

Jun, H. J., Lee, J. H., Cho, B. R., Seo, W. D., Kang, H. W., Kim, D. W., & Lee, S. J. (2012). Dual inhibition of γ-oryzanol on cellular melanogenesis. *Journal of Natural Products, 75*(10), 1706–1711. https://doi.org/10.1021/np300250m

Kang, M. H., Jang, G. Y., Ji, Y. J., Lee, J. H., Choi, S. J., Hyun, T. K., & Kim, H. S. (2021). Antioxidant and anti-melanogenic activities of heat-treated licorice (Wongam, *Glycyrrhiza glabra* × *G. uralensis*) extract. *Current Issues in Molecular Biology, 43*(2), 1171–1187. https://doi.org/10.3390/cimb43020083

Kim, S. Y., Park, K. C., Kwon, S. B., & Kim, D. S. (2012). Hypopigmentary effects of 4-n-butylresorcinol and resveratrol. *Die Pharmazie, 67*(6), 542–546. https://doi.org/10.1691/ph.2012.1660

Kolbe, L., Mann, T., Gerwat, W., Batzer, J., Ahlheit, S., Scherner, C., & Wenck, H. (2013). 4-n-butylresorcinol as a tyrosinase inhibitor. *Journal of the European Academy of Dermatology and Venereology, 27*(Suppl 1), 19–23.

https://doi.org/10.1111/jdv.12051

Lee, D. H., Ahn, S. S., Kim, J. B., Lim, Y., Lee, Y. H., & Shin, S. Y. (2018). Downregulation of α-MSH-induced activation of the Pax3-MITF-tyrosinase axis by sorghum ethanolic extract in B16F10 melanoma cells. *International Journal of Molecular Sciences, 19*(6), 1640. https://doi.org/10.3390/ijms19061640

Lee, K. W., Kim, M., Lee, S. H., & Kim, K. D. (2022). The function of autophagy as a regulator of melanin homeostasis. *Cells, 11*(13), 2085. https://doi.org/10.3390/cells11132085

Lee, U., Ko, J., Kim, S., Lee, P., An, Y., Yun, H., & Oh, J. H. (2022). Light-triggered in situ biosynthesis of artificial melanin for skin protection. *Advanced Science, 9*(7), 2103503. https://doi.org/10.1002/advs.202103503

Lv, J., Jiang, S., Yang, Y., Zhang, X., Gao, R., Cao, Y., & Liu, J. (2020). FGIN-1-27 inhibits melanogenesis by regulating PKA/CREB, PKC-β, and MAPK pathways. *Frontiers in Pharmacology, 11*, 602889. https://doi.org/10.3389/fphar.2020.602889

Lv, J., Meng, D., Zhang, H., Xu, W., An, X., Yin, C., & Wang, Y. (2025). Apigenin promotes melanogenesis via c-KIT/Raf-1/MAPK/CREB pathway. *Frontiers in Pharmacology, 16*, 1572878. https://doi.org/10.3389/fphar.2025.1572878

Maddaleno, A. S., Camargo, J., Mitjans, M., & Vinardell, M. P. (2021). Melanogenesis and melasma treatment. *Cosmetics, 8*(3), 82. https://doi.org/10.3390/cosmetics8030082

Michalak, M., Pierzak, M., Kręcisz, B., & Suliga, E. (2021). Bioactive compounds for skin health: A review. *Nutrients, 13*(1), 203. https://doi.org/10.3390/nu13010203

Mioduszewski, M., & Beecker, J. (2015). Phytophotodermatitis from making sangria. *CMAJ, 187*(10), 756. https://doi.org/10.1503/cmaj.140942

Mun, Y., Kim, W., & Shin, D. (2023). Melanocortin 1 receptor (MC1R): Pharmacological and therapeutic aspects. *International Journal of Molecular Sciences, 24*(15), 12152. https://doi.org/10.3390/ijms241512152

Nordin, F. N. M., Aziz, A., Zakaria, Z., & Radzi, C. W. J. W. M. (2021). A systematic review on the skin whitening products and their ingredients for safety, health risk, and the halal status. *Journal of Cosmetic Dermatology, 20*(4), 1050–1060. https://doi.org/10.1111/jocd.13691

Pillaiyar, T., Manickam, M., & Namasivayam, V. (2017). Skin whitening agents: Medicinal chemistry perspective. *Journal of Enzyme Inhibition and Medicinal Chemistry, 32*(1), 403–425. https://doi.org/10.1080/14756366.2016.1256882

Pollock, S., Taylor, S., Oyerinde, O., Nurmohamed, S., Dlova, N., Sarkar, R., & Galadari, H. (2021). The dark side of skin lightening: An international collaboration and review of a public health issue affecting dermatology. *International Journal of Women's Dermatology, 7*(2), 158–164. https://doi.org/10.1016/j.ijwd.2020.09.006

Qeyam, H., Al-Shami, R., Al-Rusan, A., & Alnaimat, M. (2025). Knowledge, perceptions, and practices of skin-lightening products among female medical students: A cross-sectional study. *Journal of Cosmetic Dermatology, 24*(8). https://doi.org/10.1111/jocd.70380

Rai, A., Nisar, T., Garg, R., & Goyal, R. (2025). Advancements in hyperpigmentation treatment. *World Journal of Pharmaceutical Research, 14*(4), 642–649. https://doi.org/10.20959/wjpr20258-36303

Regencia, Z. J. G., Gouin, J. P., Ladia, M. A. J., Montoya, J. C., Gamalo, M., & Baja, E. S. (2024). Skin-lightening products (SLPs) and levels of depression, anxiety, and stress among Filipino emerging adults: A cross-sectional study. *Journal of Public Health and Emergency, 8*, 4. https://doi.org/10.21037/jphe-23-156

Resende, D. I., Ferreira, M. S., Lobo, J. M., Sousa, E., & Almeida, I. F. (2022). Skin depigmenting agents in anti-aging cosmetics. *Applied Sciences, 12*(2), 775. https://doi.org/10.3390/app12020775

Rezaei, M., Dadgar, Z., Noori-Zadeh, A., Mesbah-Namin, S. A., Pakzad, I., & Davodian, E. (2015). Antibacterial and wound healing activity of *Althaea officinalis*. *Avicenna Journal of Phytomedicine, 5*(5), 418–427.

Ridzuan, P. M., Kummara, N. M., Islah, M. H., Velayuthan, J., Alawi, N. A. A. A., & Ridzuan, A. R. (2021). Review

on aesthetic & cosmetic industries in Malaysia - a way forward. *International Journal of Academic Research in Business and Social Sciences, 11*(12). https://doi.org/10.6007/IJARBSS/v11-i6/9939

Rubin, C. B., & Brod, B. (2019). Natural does not mean safe. *JAMA Dermatology, 155*(12), 1344–1345. https://doi.org/10.1001/jamadermatol.2019.2724

Salinas-Santander, M., Trevino, V., De La Rosa-Moreno, E., Verduzco-Garza, B., Sanchez-Domínguez, C., Cantu-Salinas, C., & Ortiz-Lopez, R. (2018). CAPN3, DCT, MLANA and TYRP1 are overexpressed in skin of vitiligo vulgaris Mexican patients. *Experimental and Therapeutic Medicine, 15*(6), 5219–5226. https://doi.org/10.3892/etm.2018.5764

Sarkar, R., Arora, P., & Garg, K. V. (2013). Cosmeceuticals for hyperpigmentation: What is available? *Journal of Cutaneous and Aesthetic Surgery, 6*(1), 4–11. https://doi.org/10.4103/0974-2077.110089

Schlessinger, D. I., Rahimi, N., & Schlessinger, J. (2025). Biochemistry, melanin. In *StatPearls*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459156/

Shah, S. A., Saeed, A., Irshad, M., Babar, M. E., Hussain, T., Wajid, A., & Ahmad, I. (2018). Oculocutaneous albinism in Pakistan: A review. *Journal of Cancer Science & Therapy, 10*(9). https://doi.org/10.4172/1948-5956.1000552

Shamanna, M., Mohan, M., Gowda, A., Kumar, B. C. S., Shree, S., Gangaboraiah, B., & Sudarsanam, S. (2016). Assessment of efficacy and safety of 4-n-butylresorcinol 0.3% cream. *Clinical, Cosmetic and Investigational Dermatology, 9*, 21–30. https://doi.org/10.2147/CCID.S89451

Shi, J., Guo, Y., Wang, H., Xiao, Y., Liu, W., & Lyu, L. (2022). The ubiquitin-proteasome system in melanin metabolism. *Journal of Cosmetic Dermatology, 21*(12), 6661–6668. https://doi.org/10.1111/jocd.15433

Simpson, E. L., Law, S. V., & Storrs, F. J. (2004). Prevalence of botanical extract allergy. *Dermatitis, 15*(2), 67–72. https://doi.org/10.2310/6620.2004.04009

Solano, F. (2014). Melanins: Skin pigments and much more. *New Journal of Science, 2014*, 498276. https://doi.org/10.1155/2014/498276

Swope, V. B., & Abdel-Malek, Z. A. (2018). MC1R: Front and center in eumelanin and DNA repair. *International Journal of Molecular Sciences, 19*(9), 2667. https://doi.org/10.3390/ijms19092667

Thappa, D., & Malathi, M. (2013). Systemic skin whitening/lightening agents: What is the evidence? *Indian Journal of Dermatology, Venereology and Leprology, 79*(6), 842–846. https://doi.org/10.4103/0378-6323.120752

TRI-K Industries. (2021). *FISION® GLOWPLEX: Reveal your inner radiance*. https://www.terchemicals.com/fileadmin/Newsletter/News_2021/Newsletter_FGP_21/Sell_Sheet_Fision_GlowPlex.pdf

Vibert, L., Aquino, G., Gehring, I., Subkankulova, T., Schilling, T. F., Rocco, A., & Kelsh, R. N. (2017). An ongoing role for Wnt signalling in differentiating melanocytes in vivo. *Pigment Cell & Melanoma Research, 30*(2), 219–232. https://doi.org/10.1111/pcmr.12568

Wu, X., Rao, K., Bowers, M. B., Copeland, N. G., Jenkins, N. A., & Hammer, J. A. (2001). Rab27a enables myosin Va-dependent melanosome capture. *Journal of Cell Science, 114*(6), 1091–1100. https://doi.org/10.1242/jcs.114.6.1091

Zhang, T., Zuo, H. L., Liu, Y., Huang, H. Y., Li, S. F., Li, J., & Wang, X. (2025). Pigmented rice bran mitigates UV-induced pigmentation. *Cosmetics, 12*(2), 51. https://doi.org/10.3390/cosmetics12020051