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INPLASY

Curcuma bioactives and curcuminoid analogues in melanogenesis: A scoping review of experimental and clinical evidence

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ADMINISTRATIVE INFORMATION

Support - UMREG026-2024.

Review stage at the time of initial registration - Data analysis.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 November 2026 and was last updated on 13 November 2026.

INTRODUCTION

Review question / Objective This review asks what evidence supports modulation of melanogenesis by Curcuma bioactives and related curcuminoid analogues, and how activity, safety and mechanistic findings vary across models. We used a scoping approach to map the available literature rather than calculate a pooled treatment effect. The synthesis emphasizes the identity of the test material, the outcome measured and the limits of translation, with the aim of identifying which experimental findings warrant further pharmacognostic investigation.

Background Hyperpigmentation results from excessive or uneven melanin accumulation in the skin. Melanin is synthesized in melanocytes, packaged into melanosomes and transferred to neighboring keratinocytes. Dysregulated pigmentation underlies conditions such as melasma, post-inflammatory hyperpigmentation and solar lentigines, which can affect quality of life. Ultraviolet (UV) exposure, inflammation, hormonal changes and oxidative stress can influence melanogenesis. Management includes topical agents and procedures, although response, tolerability and recurrence vary across conditions and treatments. This has sustained interest in natural products that affect pigment production, provided their biological activity and safety can be distinguished from nonspecific effects.

Curcuma species have a history of medicinal and topical use in systems including Ayurveda and Jamu. Their rhizomes contain curcuminoids, notably curcumin (CUR), demethoxycurcumin (DMC) and bisdemethoxycurcumin (BDMC), which has diverse bioactivities.

Although several experimental studies have reported effects on tyrosinase activity, melanin production, and melanogenesis-related signalling, the evidence is distributed across different materials and experimental models. Differences in chemical composition, assay conditions, experimental systems, and safety assessments make direct comparisons difficult.

A scoping review is therefore useful to systematically map the available evidence, characterize the investigated materials and biological outcomes, identify reported mechanisms and safety observations, and highlight gaps requiring further investigation.

Rationale Although Curcuma-derived materials and curcuminoid analogues have been investigated for their potential anti-melanogenic activities, the available evidence encompasses heterogeneous materials and a range of biochemical, cellular, animal, and clinical models. The reported findings vary in terms of experimental conditions, outcome measurements, and safety observations.
A comprehensive mapping of this literature is needed to clarify the extent and nature of the available evidence, distinguish findings from different experimental models, and identify limitations affecting the interpretation and translation of the reported activities.
This scoping review therefore provides an evidence map of Curcuma bioactives and related curcuminoid analogues in melanogenesis, with particular attention to pigmentation-related activity, molecular mechanisms, safety, and future research priorities.

METHODS

Strategy of data synthesis SciFinder-n, Web of Science and Scopus were searched through 25 April 2026. The search combined terms for Curcuma and curcuminoids with terms related to skin, pigmentation, melanogenesis, tyrosinase, formulation and toxicity. The initial search was broad enough to retrieve skin-related research, after which records were screened for pigmentation-related eligibility.

Eligibility criteria Studies were included if they met the following criteria: (i) original research articles comprising cell-free biochemical, cellular, in vivo, or clinical studies. (ii) investigations centered on Curcuma-derived targets, encompassing crude fractions, isolated polyphenols, or their synthetic structural analogues, irrespective of delivery vehicle or formulation vehicle status. (iii) evaluation of outcomes related to depigmentation or melanogenesis, such as melanin reduction, skin lightening, inhibition of melanogenesis, or tyrosinase activity. (iv) qualitative, semi-quantitative, and quantitative data relevant to pigmentation were considered eligible.
Literature records were excluded if they: (i) were review articles, conference abstracts, editorials, letters, book chapters, or other non-original publications. (ii) non-relevant target matter lacking Curcuma genus derivatives or their structural analogues. (iii) did not assess outcomes related to pigmentation, melanogenesis, or tyrosinase activity. (iv) displayed insufficient methodological detail or extractable outcome data.

Source of evidence screening and selection All retrieved records were exported to Microsoft Excel for deduplication.
Two reviewers (Q. Li and S. N. Sulaiman) independently screened titles and abstracts of records relevant to skin-related activities. Disagreements were resolved through discussion or consultation with a third reviewer (A. Zahari).
Full-text articles were independently assessed for eligibility by Q. Li and S. N. Sulaiman. Unresolved disagreements were adjudicated by S. Y. Liew.

Data management Q. Li and S. N. Sulaiman independently extracted and cross-checked data and unresolved discrepancies were reviewed by M. A. Othman. Extracted data included first author, geographical origin, publication year, material sources, experimental model and assays, pigmentation related outcomes, cytotoxicity or other safety observations, and mechanistic findings.

Language restriction The preliminary screening was limited to English-language publications.

Country(ies) involved Malaysia.

Keywords Curcuma; curcuminoids; melanogenesis; tyrosinase; pharmacognosy; scoping review.

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