Open Access Review Article

September-October 2026, Vol. 02 (5), 01-11

INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH AND MEDICINAL PLANTS

(An International Peer Reviewed Journal)

Comparative Evaluation of Pharmacognostic Characteristics, Phytochemical Composition, and Antioxidant Potential of *Cosmos sulphureus* Cav. and *Calendula officinalis* L.: A Critical Narrative Review on Flower Colour and Quality Standardisation

Vashvi Kumar Sahu* and Revendra Parganiha

[1]Kamla Institute of Pharmaceutical Sciences (KIPS), Shri Shankaracharya Professional University (SSPU), Junwani, Bhilai – 490020, Chhattisgarh, India

ARTICLE INFO:

Received: 13th Sept. 2026; **Received** in revised form: 20th Sept. 2026; **Accepted:** 25th Oct. 2026; **Available online:** 30th Oct. 2026.

Keywords: Cosmos sulphureus, Calendula officinalis, Pharmacognosy, Flower colour, Total Phenolic content, Total flavonoid content, DPPH radical scavenging, Phytochemical standardisation.

DOI: https://doi.org/10.61280/m6kvm371

***Corresponding Author:** Vashvi Kumar Sahu

Email: vashvikumar@sspubhilai.ac.in

ABSTRACT

Background: *Cosmos sulphureus* Cav. and *Calendula officinalis* L. belong to the family Asteraceae and are characterised by conspicuous yellow-to-orange inflorescences and notable phytochemical and antioxidant properties. However, the extent to which flower colour predicts phenolic composition, flavonoid abundance, and radical-scavenging activity remains uncertain. ***Objectives:*** This critical narrative review examines the comparative pharmacognostic characteristics, major phytochemical constituents, and evidence concerning colour-associated variation in total phenolic content (TPC), total flavonoid content (TFC), and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical-scavenging activity.

Methods: Relevant botanical reviews, primary investigations, and analytical-method publications were examined through targeted literature searches of accessible scholarly resources.

Key Findings: Published research on *C. sulphureus* identifies chlorogenic acid, caffeic acid, rutin, and quercetin in investigated extracts alongside demonstrable antioxidant activity [4]. In *C. officinalis*, flavonoids, phenolic acids, carotenoids, and triterpenoid constituents contribute to a complex phytochemical profile [1,3]. A study of 20 *C. officinalis* cultivars reported total flavonoid contents ranging from 0.21% to 0.68%, without establishing a conclusive relationship between floret colour and flavonoid abundance [6]. Methodological discrepancies—including variations in plant material, extraction conditions, calibration standards, and assay procedures—severely restrict quantitative comparisons between published studies, and direct, standardised comparisons of colour-defined morphs remain insufficient for both species.

Copyright: © Author 2026 by the Author. *International Journal of Pharmaceutical Research and Medicinal Plants* Published by **Informative Journals** (Jadoun Science Publishing Group India). This article is an open access article distributed under the terms and conditions of the CC BY-NC-ND 4.0 International License (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Conclusions: Future investigations must combine authenticated botanical material, instrumental colour assessment, pigment profiling,validated spectrophotometric assays, and chromatographic characterisation to establish reproducible relationships between floral pigmentation, phytochemical composition, and antioxidant potential.

1. INTRODUCTION

Medicinal and aromatic plants constitute vital sources of structurally diverse natural products used in traditional medicine, pharmaceutical research, cosmetics, and functional foods. Their quality depends heavily on botanical identity, genotype, environmental conditions, developmental stage, harvesting practices, processing, storage, and chemical composition. Pharmacognostic evaluation is therefore fundamental to the authentication and standardisation of plant materials, particularly when intended for clinical or commercial applications [2,5].

The family Asteraceae includes numerous species valued for their ornamental, medicinal, nutritional, and industrial properties. Among these, *Cosmos sulphureus* Cav. and *Calendula officinalis* L. are notable for their vibrant yellow-to-orange inflorescences. Although both species have attracted considerable interest as sources of natural colorants and bioactive constituents, they differ significantly in morphology, traditional applications, and the extent of their phytochemical documentation.

Cosmos sulphureus, commonly known as sulphur cosmos, is an annual herb native to Mexico and widely cultivated as an ornamental plant. Its flowers have increasingly been investigated as potential sources of natural colorants and antioxidant compounds. Ortega-Medrano et al. [4] investigated ethanolic and methanolic extracts of its leaves and flowers, identifying phenolic compounds, flavonoids, and tannins alongside measurable antioxidant activity. High-performance thin-layer chromatography (HPTLC) indicated the presence of chlorogenic acid, caffeic acid, rutin, and quercetin in the investigated material. These findings support further exploration of the species' phytochemical diversity, although extract composition cannot be assumed to remain consistent across distinct populations, plant organs, or extraction protocols.

Calendula officinalis, commonly known as pot marigold, is an established medicinal and ornamental species with extensive applications in traditional medicine and botanical preparations. Its phytochemical profile comprises flavonoids, phenolic acids, carotenoids, triterpenoids, and diverse secondary metabolites [1,3]. Sahu and Soni [3] have specifically examined the phytochemical profiling, antioxidant potential, pharmacognostic characteristics, and biotechnological significance of this species, providing a robust framework for integrating botanical authentication with chemical characterisation. Preethi et al. [7] similarly investigated the in vitro and in vivo antioxidant potential of *C. officinalis* flower extracts.

While flower colour serves as a potentially useful phenotypic marker for selecting plant material, its reliability as an indicator of phytochemical quality requires critical scrutiny. Yellow and orange pigmentation generally reflects the abundance and composition of carotenoids and accessory pigments. However, phenolic acids and flavonoids comprise chemically diverse groups whose biosynthesis and accumulation are governed by complex environmental, developmental, and genetic interactions. Consequently, visible floral colour cannot be automatically interpreted as a quantitative proxy for total phenolic content (TPC), total flavonoid content (TFC), or overall antioxidant capacity.

Direct empirical evidence from *C. officinalis* illustrates this distinction clearly. Raal and Kirsipuu [6] investigated the inflorescences of 20 cultivars originating from eight European countries and cultivated under uniform conditions in Estonia. They reported total flavonoid contents ranging from 0.21% to 0.68% but found no conclusive correlation between total flavonoid content and floret colour. This demonstrates that substantial chemical variation can occur within a species independently of visible floral pigmentation.

While TPC is commonly estimated using the Folin–Ciocalteu assay, TFC is frequently assessed via aluminium-complexation or related spectrophotometric methods, and DPPH assays quantify the capacity of

an extract to reduce a stable free radical [8-10]. These methods are valuable screening tools; however, they measure distinct analytical endpoints and are highly sensitive to solvent composition, calibration standards, reaction kinetics, matrix interferences, and sample coloration. Cross-study comparisons must account for these methodological discrepancies rather than treating reported values as directly equivalent.

Despite the individual phytochemical data available for both species, a consistent comparative framework linking pharmacognostic traits, floral colour, TPC, TFC, and DPPH activity remains absent. To address this gap, the objectives of this critical review are to: (i) compare the botanical and pharmacognostic characteristics of *C. sulphureus* and *C. officinalis*; (ii) summarise their reported phenolic, flavonoid, and pigment constituents; (iii) critically evaluate the evidence concerning colour-associated variation in TPC, TFC, and DPPH activity; (iv) examine the methodological factors that restrict cross-study comparisons; and (v) identify key research priorities for establishing reproducible pharmacognostic and phytochemical quality standards.

2. MATERIALS AND METHODS

2.1. Review Design

This article was prepared as a critical narrative review utilising a targeted literature search strategy. It synthesises published evidence regarding the pharmacognostic characteristics, phytochemical composition, floral pigmentation, and antioxidant properties of *C. sulphureus* and *C. officinalis*. It was not designed as an original experimental investigation or a formally registered systematic review.

2.2. Literature Search Strategy

Accessible scholarly databases—including PubMed, PubMed Central, major publisher platforms, and relevant bibliographic records—were queried to identify peer-reviewed publications. Search terms combined the scientific names of both species with keywords spanning pharmacognosy, microscopy, phytochemistry, flower colour, carotenoids, phenolic compounds, flavonoids, total phenolic content, total flavonoid content, DPPH, antioxidant activity, extraction protocols, and standardisation.

Representative search strings included:

- “Cosmos sulphureus AND phenolic content AND antioxidant activity”
- “Calendula officinalis AND total flavonoid content AND flower colour”
- “Calendula officinalis AND pharmacognostic evaluation”
- “Asteraceae flower colour AND carotenoids AND flavonoids”
- “Folin–Ciocalteu assay AND total phenolic content”
- “DPPH radical scavenging AND plant extract AND assay limitations”

Primary research articles were prioritised for species-specific quantitative data, while botanical reviews and methodological papers were utilised to contextualize pharmacognostic characteristics and analytical limitations. The review also incorporated the published work of Sahu and Soni [3] due to its direct relevance to the pharmacognostic and phytochemical assessment of *C. officinalis*.

2.3. Eligibility and Evidence Selection

Publications were deemed eligible if they provided substantive data on botanical identity, macroscopic or microscopic morphology, phytochemical profiles, floral pigmentation, TPC, TFC, or antioxidant activity for either target species. Methodological studies were included when they clarified the interpretation of spectrophotometric assays or radical-scavenging measurements. Research involving related Asteraceae taxa was consulted exclusively to illustrate general biological or analytical principles and was not treated as direct evidence for *C. sulphureus* or *C. officinalis*. The search was targeted rather than exhaustive.

2.4. Evidence Extraction and Comparative Assessment

Literature data were categorised into five core domains: botanical authentication/pharmacognosy, phytochemical composition, pigment-associated floral colour, spectrophotometric TPC/TFC measurements, and DPPH radical-scavenging activity. Particular attention was paid to plant organs, cultivars/populations, extraction solvents, analytical methods, reference standards, and reporting units.

2.5. Interpretation of Phytochemical and Antioxidant Assays

To ensure rigorous interpretation, TPC values were evaluated based on the specific assay protocol and reporting basis used in each source. Results expressed as gallic acid equivalents per gram of dry extract were strictly distinguished from values reported per gram of dried plant material or fresh weight. TFC measurements were evaluated in light of specific calibration standards and analytical procedures. DPPH outcomes were interpreted according to their respective assay endpoints (percentage inhibition vs. IC_{50}).

2.6. Data Synthesis and Statistical Considerations

Findings were synthesised qualitatively. Given the profound heterogeneity among available studies regarding biological materials, extraction protocols, calibration standards, reporting units, and assay endpoints, no pooled effect sizes, meta-analyses, or novel statistical tests were performed. Ethical approval was not applicable as no primary human or animal experiments were conducted.

3. RESULTS

3.1. Overview of the Available Evidence

Existing literature confirms that both species accumulate secondary metabolites of considerable interest to natural-product research [3,4]. Primary investigations by Ortega-Medrano et al. [4] provide valuable quantitative and chromatographic baseline data for *C. sulphureus*. Evidence concerning *C. officinalis* encompasses cultivar-level assessments of flavonoid content, targeted antioxidant evaluations, and broader pharmacognostic overviews [1,3,6,7].

As outlined below in Table 1 (ordered newest-first), the current literature lacks standardised, direct head-to-head comparisons of yellow and orange colour morphs across both species, meaning reported variations in TPC, TFC, or DPPH activity cannot be attributed to floral pigmentation alone.

Table 1: Principal publications informing the comparative review.

Reference	Scope	Contribution to the review
[3] Sahu and Soni (2026)	*C. officinalis*	Pharmacognostic, phytochemical, antioxidant, and biotechnological perspective
[9] Munteanu and Apetrei (2021)	Analytical methodology	Review of chemical and cell-based antioxidant assays
[4] Ortega-Medrano et al. (2023)	*C. sulphureus* leaves and flowers	Phytochemical screening, quantitative measurements, HPTLC, and antioxidant assays
[6] Raal and Kirsipuu (2011)	Twenty *C. officinalis* cultivars	Cultivar-associated variation in total flavonoid content and evaluation of floret colour
[7] Preethi et al. (2006)	*C. officinalis* flower extract	In vitro and in vivo antioxidant investigation
[1] Arora et al. (2013)	*Calendula* genus	Botanical, pharmacognostic, phytochemical, and pharmacological overview

[8] Blois (1958)	Analytical methodology	Stable-free-radical method for evaluating antioxidant activity
[10] Singleton and Rossi (1965)	Analytical methodology	Folin–Ciocalteu colorimetric determination of phenolic substances

3.2. Comparative Botanical and Pharmacognostic Characteristics

Both species belong to the Asteraceae family and bear capitula, but differences in growth habit, foliage, and floral morphology support their distinct taxonomic classifications [1,4]. *Cosmos sulphureus* is an annual herb featuring characteristically divided leaves and yellow-to-orange capitula. *Calendula officinalis* generally possesses oblong to lanceolate leaves and capitula composed of peripheral ligulate florets and central tubular florets [1,3,4].

Visual reference morphologies for both targeted taxa are displayed below in Figure 1 and Figure 2.



Figure 1. *Calendula officinalis* L. showing the capitulum inflorescence and ray and disc florets. Original field photograph captured using a smartphone in Bhilai, Chhattisgarh, India. Plant identification was based on visible morphological characteristics; formal authentication using herbarium voucher specimens was not performed. The image is presented as an illustrative field observation rather than an authenticated voucher specimen (author-captured photograph).

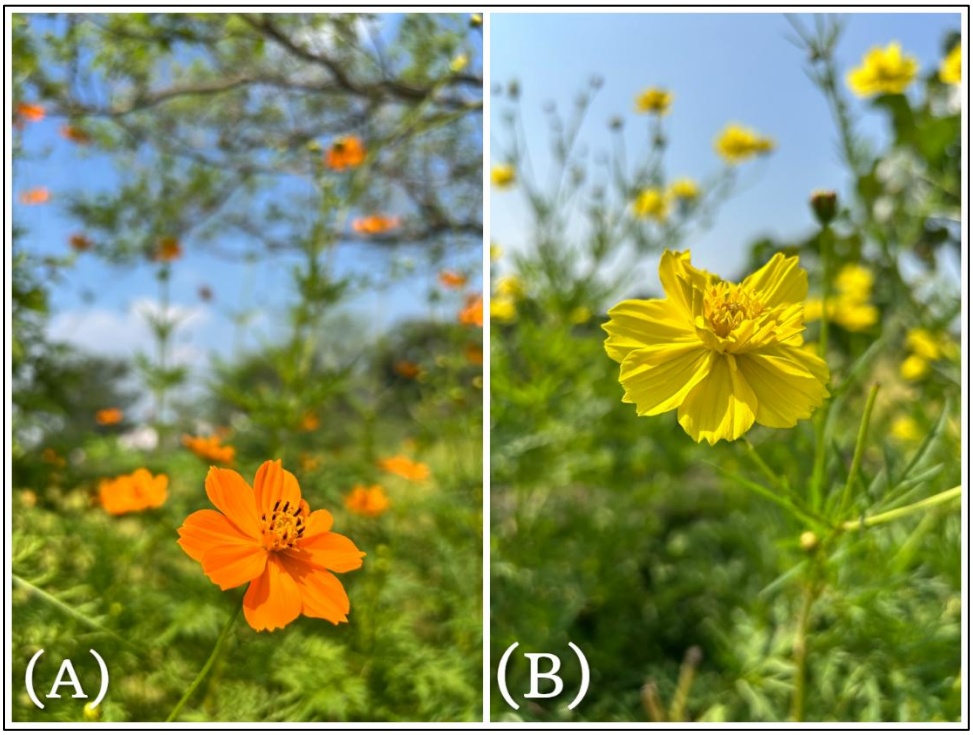


Figure 2. Field photographs of *Cosmos sulphureus* Cav. showing orange- and yellow-flowered morphotypes. (A) Orange-flowered morphotype photographed in Purai village, Durg tehsil and district, Chhattisgarh, India. (B) Yellow-flowered morphotype photographed in Belhari village, Gunderdehi region, Chhattisgarh, India. Photographs were captured using a smartphone. Plant identification was based on visible morphological characteristics; formal authentication using herbarium voucher specimens was not performed. The images are presented as illustrative field observations rather than authenticated voucher specimens (author-captured photographs).

Macroscopic traits are supplemented by microscopic and physicochemical parameters to ensure reliable identification, as summarized in Table 2.

Table 2: Comparative pharmacognostic characteristics.

Character	Cosmos sulphureus Cav.	Calendula officinalis L.
Family	Asteraceae	Asteraceae
Growth habit	Annual herb, often relatively tall	Annual herb, generally more compact
Leaf morphology	Commonly divided or pinnatisect	Commonly oblong to lanceolate
Inflorescence	Capitulum with yellow-to-orange floral structures	Capitulum with peripheral ligulate and central tubular florets
Common floral colours	Yellow, golden-yellow, orange	Yellow to orange, with cultivar-dependent variation
Reported chemical groups	Phenolic acids, flavonoids, tannins, terpenoids, and other metabolites	Flavonoids, phenolic acids, carotenoids, triterpenoids, and other metabolites
Authentication priorities	Leaf and capitulum morphology, authenticated reference specimens, chemical fingerprinting	Leaf and floret morphology, authenticated reference specimens, chemical fingerprinting
Important source of variability	Population, plant organ, and extraction solvent	Cultivar, cultivation conditions, floral tissue, and extraction method

3.2.1. Microscopic and Physicochemical Evaluation

Microscopy complements macroscopic identification by revealing epidermal structures, stomata, trichomes, pollen, and floral tissue anatomy. Physicochemical parameters, including moisture content, total ash, acid-insoluble ash, and extractive values, further aid in evaluating crude drug quality. Furthermore, chromatographic fingerprinting—such as HPTLC applied to *C. sulphureus* [4]—provides an additional safeguard for chemical consistency.

3.3. Phytochemical Composition of *Cosmos sulphureus*

Ortega-Medrano et al. [4] examined ethanolic and methanolic extracts of leaves and flowers from three *C. sulphureus* populations, detecting phenolic compounds, flavonoids, tannins, and terpenoids. HPTLC confirmed the presence of chlorogenic acid, caffeic acid, rutin, and quercetin. Reported TPC values spanned from 40.74 to 124.11 mg gallic acid equivalents per gram of dry extract [4].

3.4. Phytochemical Composition of *Calendula officinalis*

The chemical profile of *C. officinalis* encompasses flavonoids, phenolic acids, carotenoids, triterpenoids, and diverse secondary metabolites [1,3]. Carotenoids contribute heavily to visible yellow-to-orange pigmentation, whereas flavonoids and phenolic acids drive antioxidant behaviour [3]. Raal and Kirsipuu [6] evaluated 20 cultivars and reported total flavonoid contents between 0.21% and 0.68%, concluding that cultivar and growth conditions dictate flavonoid yield independently of floret colour.

3.5. Colour-Associated Variation in Phytochemical Content

While visible colour reflects pigment composition, its relationship with overall polyphenol or flavonoid content remains complex and non-linear. As detailed across Table 3, evidence linking specific colour variations directly to quantitative phytochemistry remains sparse for both taxa.

Table 3: Evidence concerning colour-associated phytochemical variation.

Parameter	Evidence in C. sulphureus	Evidence in C. officinalis	Interpretation
Floral pigmentation	Yellow-to-orange pigmentation; direct colour-morph chemistry insufficiently characterised	Yellow-to-orange pigmentation with cultivar-associated variation	Colour is a phenotype, not a quantitative assay
Carotenoids	Further quantitative pigment profiling needed for direct comparison	Recognised constituents associated with floral pigmentation	Pigment profiling is necessary to explain visible colour
TPC	Variation among populations, organs, and extracts reported [4]	Phenolic compounds established, but values depend heavily on study design [1,3,7]	No direct cross-species ranking is justified
TFC	Flavonoids identified and quantified in extracts [4]	Cultivar-associated variation reported without a conclusive colour relationship [6]	Colour alone is not a validated proxy for TFC
DPPH activity	Activity reported in extracts [4]	Activity reported in flower extracts [7]	Results cannot be ranked reliably without comparable assay conditions

Colour–chemistry association	Controlled morph-specific evidence is insufficient	A cultivar study found no conclusive colour–TFC relationship [6]	A major research gap remains

3.6. Total Phenolic Content

The Folin–Ciocalteu procedure remains a standard screening tool, measuring electron-transfer reactions to produce a colorimetric response relative to a standard [10]. However, because the reagent reacts with diverse non-phenolic reducing species, TPC values must be viewed as operational estimates rather than absolute molecular measurements [9,11].

3.7. Total Flavonoid Content

Spectrophotometric assays relying on aluminium complexation vary across reaction conditions and calibration standards. Consequently, values obtained via disparate protocols cannot be treated as directly interchangeable. Direct chromatographic quantification remains essential for accurate profiling.

3.8. DPPH Radical-Scavenging Activity

The DPPH assay measures free-radical reduction capacity [8]. Both *C. sulphureus* and *C. officinalis* extracts exhibit demonstrable radical-scavenging activity [4,7]. However, intrinsic sample coloration, solvent interferences, and reaction kinetics demand careful blank corrections and standardized concentration-response evaluation [8,9].

3.9. Principal Evidence Gaps

1. Direct comparison of authenticated plant materials under matched cultivation and extraction conditions;
2. Replicated assessments of predefined colour morphs within each species;
3. Simultaneous measurement of TPC, TFC, DPPH activity, and individual chromatographic markers;
4. Quantitative carotenoid analysis to separate pigment-associated colour from polyphenol-associated activity;
5. Validation of micro-morphological and physicochemical quality markers;
6. Harmonised reporting of extraction yields, moisture content, assay conditions, and dry-weight bases;
7. Rigorous statistical evaluation of instrumental colour parameters against chemical profiles.

4. DISCUSSION

4.1. Comparative Pharmacognostic Significance

Establishing botanical identity through a multi-parameter approach—incorporating macroscopic evaluation, microscopy, physicochemical limits, and chromatographic fingerprinting—is crucial before undertaking any comparative phytochemical work. The integration of HPTLC screening with quantitative assays exemplifies a robust model for crude drug standardisation [1,3,4].

4.2. Flower Colour as a Phytochemical Indicator

The assumption that flower colour reliably predicts phytochemical yield is challenged by botanical and biochemical reality. While carotenoids dictate visual appearance, phenolic compounds follow independent biosynthetic pathways driven by ecological and genetic factors. The absence of a clear colour-to-flavonoid correlation in *C. officinalis* cultivars [6] strongly discourages relying solely on visual phenotype for industrial or pharmaceutical selection.

4.3. Interpretation of TPC and TFC

The variation in TPC reported for *C. sulphureus* demonstrates that sample origin and extraction conditions heavily influence measured phenolic content [4]. Because the Folin–Ciocalteu and aluminium-complexation assays suffer from structural selectivity limits and matrix interferences, spectrophotometric results must be interpreted as method-dependent estimates and reinforced by chromatographic profiling [9,11].

4.4. Relationship Between Phenolic Composition and DPPH Activity

Phenolic acids and flavonoids contribute to antioxidant activity via electron or hydrogen-atom transfer, a property dictated by hydroxylation patterns and molecular conjugation. Consequently, higher TPC does not guarantee proportionally superior DPPH scavenging. Sample blanks and rigorous controls are also vital to isolate true antioxidant activity from intrinsic pigment absorbance in coloured extracts [8,9].

4.5. Methodological Sources of Variation

Discrepancies across published literature stem from multiple operational variables: biological material (genotype, organ, developmental stage), extraction procedures (solvent, temperature, duration), calibration standards (gallic acid, quercetin, rutin), reporting basis (fresh vs. dry mass), assay conditions, and post-harvest handling. Because of these widespread methodological differences, ranking species or morphs directly by juxtaposing numbers from disparate studies is scientifically invalid [9,11].

4.6. Implications for Quality Control and Applications

Applications should dictate selection criteria: phenolic-rich extracts require validated TPC and chromatography; flavonoid-focused uses require specific individual quantification; and natural colorant development depends primarily on carotenoid profiling and instrumental colourimetry. A comprehensive quality-control framework must integrate botanical, macroscopic, microscopic, chemical, and functional testing [3].

4.7. Strengths and Limitations of the Review

This review successfully integrates pharmacognostic identification, pigment chemistry, and assay interpretation into a cohesive comparative framework. Its primary limitation lies in the scarcity of direct, head-to-head, colour-controlled studies in the existing literature, coupled with targeted rather than exhaustive search methodologies.

5. CONCLUSION

The available literature confirms that *Cosmos sulphureus* Cav. and *Calendula officinalis* L. possess distinct pharmacognostic traits and accumulate valuable phytochemicals with demonstrable antioxidant activity [1,3,4,6,7]. However, empirical evidence—particularly demonstrated across *C. officinalis* cultivars—proves that visible flower colour does not reliably predict total flavonoid abundance or phenolic yield [6]. At present, neither flower colour nor heterogeneous published data can establish a definitive superiority in TPC, TFC, or DPPH activity between these species or their colour morphs. Future research must combine authenticated botanical material, instrumental colour measurement, carotenoid profiling, validated assays, and chromatographic separation to determine whether floral phenotype can ever serve as a dependable quality marker.

6. ACKNOWLEDGEMENTS

The authors sincerely acknowledge the support, guidance, and encouragement received throughout the course of this research work. They express their heartfelt gratitude to their parents for their unwavering support, motivation, and encouragement, which have been invaluable throughout their academic journey.

The authors are grateful to Kamla Institute of Pharmaceutical Sciences (KIPS), Shri Shankaracharya Professional University (SSPU), Bhilai, for providing the necessary institutional facilities, resources, and support required to conduct and complete this research successfully.

Furthermore, Mr. Vashvi Kumar Sahu (Author) would like to express his sincere gratitude to his research guide, Dr. Revendra Parganiha, Professor, Kamla Institute of Pharmaceutical Sciences (KIPS), Shri Shankaracharya Professional University (SSPU), Bhilai, for his valuable guidance, continuous encouragement, constructive suggestions, and academic support throughout the research work. His expertise, motivation, and insightful feedback have played a significant role in the successful completion of this study.

Finally, the authors extend their sincere appreciation to everyone who directly or indirectly contributed to the successful completion of this research work.

7. ETHICS AND OTHER DECLARATIONS

Ethics Statement/Ethical Approval

Not applicable. This article is a narrative review of previously published literature and does not involve human participants, human biological samples, or experimental animals.

Data Availability Statement

Not applicable. This review does not generate or analyse any new experimental datasets. The information and evidence discussed in this manuscript were obtained from previously published literature and publicly available botanical resources.

Informed Consent Statement

Not applicable, as this review does not involve human participants.

Conflict of Interest

The authors declare that they have no conflict of interest.

Funding

The authors declare that no financial support or external funding was received for the research, authorship, or publication of this article.

Author Contributions

Mr. Vashvi Kumar Sahu: Conceptualization, preparation of the original draft, writing, and editing of the manuscript. **Dr. Revendra Parganiha:** Supervision, technical guidance, and critical review of the manuscript. All authors have read and approved the final version of the manuscript for submission.

REFERENCES:

1. Arora, D; Rani, A and Sharma, A (2013), "A review on phytochemistry and ethnopharmacological aspects of genus *Calendula*", *Pharmacognosy Reviews*, Vol. 7 (14), 179–187. DOI: https://doi.org/10.4103/0973-7847.120520.
2. Evans, WC (2009), *Trease and Evans Pharmacognosy*, 16th edition, Saunders Elsevier, Edinburgh, UK, 59-72.
3. Sahu, VK and Soni, V (2026), "Phytochemical Profiling And Antioxidant Potential Of *Calendula Officinalis*: A Pharmacognostic And Biotechnological Perspective", *J. PhytoPharm. Adv. Chem.*, Vol. 1 (3), 168–177. DOI: https://doi.org/10.66220/3zancg55.
4. Ortega-Medrano, RJ; Ceja-Torres, LF; Vázquez-Sánchez, M; Martínez-Ávila, GCG and Medina-Medrano, JR (2023), "Characterization of *Cosmos sulphureus* Cav. (Asteraceae): Phytochemical

Screening, Antioxidant Activity and Chromatography Analysis", *Plants*, Vol. 12 (4), Article 896. DOI: https://doi.org/10.3390/plants12040896.

5. Heinrich, M; Barnes, J; Gibbons, S and Williamson, EM (2012), *Fundamentals of Pharmacognosy and Phytotherapy*, 2nd edition, Churchill Livingstone Elsevier, Edinburgh, UK, 112-120.
6. Raal, A and Kirsipuu, K (2011), "Total flavonoid content in varieties of *Calendula officinalis* L. originating from different countries and cultivated in Estonia", *Natural Product Research*, Vol. 25 (6), 658–662. DOI: https://doi.org/10.1080/14786419.2010.528417.
7. Preethi, KC; Kuttan, G and Kuttan, R (2006), "Antioxidant potential of an extract of *Calendula officinalis* flowers in vitro and in vivo", *Pharmaceutical Biology*, Vol. 44 (9), 691–697. DOI: https://doi.org/10.1080/13880200601009149.
8. Blois, MS (1958), "Antioxidant determinations by the use of a stable free radical", *Nature*, Vol. 181 (4617), 1199–1200. DOI: https://doi.org/10.1038/1811199a0.
9. Munteanu, IG and Apetrei, C (2021), "Analytical methods used in determining antioxidant activity: A review", *International Journal of Molecular Sciences*, Vol. 22 (7), Article 3380. DOI: https://doi.org/10.3390/ijms22073380.
10. Singleton, VL and Rossi, JA (1965), "Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents", *American Journal of Enology and Viticulture*, Vol. 16 (3), 144–158. DOI: https://doi.org/10.5344/ajev.1965.16.3.144.
11. Raposo, F et al. (2024), "A comprehensive and critical review of the unstandardized Folin–Ciocalteu assay to determine the total content of polyphenols: The conundrum of the experimental factors and method validation", *Talanta*, Vol. 272, Article 125771. DOI: https://doi.org/10.1016/j.talanta.2024.125771.

How to cite this article: Vashvi Kumar Sahu, Revendra Parganiha, Comparative Evaluation of Pharmacognostic Characteristics, Phytochemical Composition, and Antioxidant Potential of Cosmos sulphureus Cav. and Calendula officinalis L.: A Critical Narrative Review on Flower Colour and Quality Standardisation (2026). *International Journal of Pharmaceutical Research and Medicinal Plants*, *2*(5), i-11, https://doi.org/10.61280/m6kvm371

Published by:
Informative Journals
Jadoun Science Publishing Group India