



Original Research

## Profiling Fatty Acid-Rich Extracts from *Sterculia oblonga*: Implications for Skin Care and Antioxidant Formulations

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ARTICLE INFO	ABSTRACT
<p><b>Keywords:</b>  <i>Sterculia oblonga</i>,            Fatty acids,            GC-MS profiling,            n-Hexane extract,            Cosmeceuticals,            Natural antioxidants</p>	<p>The increasing demand for plant-derived lipophilic compounds in the cosmetic and therapeutic industries has intensified the search for novel bioresources from underexplored botanical sources. In this study, the n-hexane extract of <i>Sterculia oblonga</i> stem bark was analyzed using Gas Chromatography–Mass Spectrometry (GC–MS) to profile its chemical constituents. A total of 25 compounds were identified, with a predominance of saturated and monounsaturated fatty acids. Major components included cis-vaccenic acid (20.72%), palmitic acid (15.90%), oleic acid (10.76%), and their corresponding esters. Other constituents, such as aldehydes and long-chain thiols were also present, contributing to potential biological activity. The abundance of skin-conditioning fatty acids and oxidative stress-modulating lipids highlights the extract’s potential in the formulation of antioxidant-rich skin care products. These findings not only underscore the cosmeceutical relevance of <i>S. oblonga</i> but also support its sustainable utilization in natural product development.</p>

### INTRODUCTION

The surge in interest toward plant-based cosmetic actives has led to extensive research into underutilized tropical flora for novel bioactive constituents [1]. This trend is driven by increasing consumer awareness of the potential health hazards posed by synthetic ingredients and a global shift toward sustainable, eco-friendly alternatives. Botanicals are valued for their complex mixture of metabolites, which offer multifunctional benefits including moisturization, anti-aging, photoprotection, and antioxidant activity [2].

Among these botanicals, *Sterculia oblonga*, a lesser-known species within the Malvaceae family, has garnered attention due to its traditional applications in ethnomedicine, such as in the treatment of inflammation and infections [3]. However, scientific exploration of its phytochemical composition remains limited. Previous studies have largely focused on polar solvent extracts (e.g., ethanol, methanol, and ethyl acetate), revealing the presence of flavonoids, alkaloids, and phenolics. These studies, while valuable, provide an incomplete picture of the plant's full bioactive spectrum.

Non-polar solvents like n-hexane are particularly effective in extracting lipophilic compounds such as fatty acids, esters,

hydrocarbons, and long-chain aldehydes [4]. These compounds play essential roles in skin barrier function, hydration, and protection from oxidative damage. As such, the n-hexane fraction of plant extracts is of high interest for the development of natural skincare products, emollients, and antioxidant formulations [5].

Despite the potential of *S. oblonga* in this domain, no previous GC-MS-based profiling of its n-hexane bark extract has been reported. Understanding the lipophilic constituents of this plant may not only uncover novel bioactives but also contribute to the valorization of an underutilized species in cosmeceutical science. This study aims to fill this critical knowledge gap by identifying and characterizing the fatty acid-rich components of the n-hexane extract of *S. oblonga* stem bark and evaluating their potential implications for skin care and antioxidant applications.

### MATERIALS AND METHODS

#### Sample Collection and Preparation

The stem bark of *Sterculia oblonga* was harvested, air-dried, and pulverized. The dried powder was subjected to maceration in n-hexane for 72 hours. The extract was filtered and concentrated under reduced pressure.

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### GC-MS Analysis

The concentrated n-hexane extract was analyzed using an Agilent GC-MS system with a DB-5MS column. The oven temperature was programmed from 50°C to 300°C at a rate of 10°C/min. The mass spectra were recorded and interpreted using the NIST14.L mass spectral library.

### RESULTS AND DISCUSSION

The n-hexane extract of *Sterculia oblonga* stem bark exhibited a chemically diverse array of lipophilic constituents, encompassing saturated and unsaturated fatty acids, esters, long-chain alcohols, and a few semi-polar bioactives. This

composition reflects the extract's richness in hydrophobic compounds with potential cosmeceutical and therapeutic applications. The coexistence of emollient fatty acids and functional alcohols underscores its relevance for skin-conditioning and antioxidant-based formulations. The Total Ion Chromatogram (TIC) of the n-hexane extract, as obtained through GC-MS analysis, is presented in Figure 1, highlighting the major peaks corresponding to identified compounds. The retention times, compound names, and their respective peak areas are summarized in Table 1.

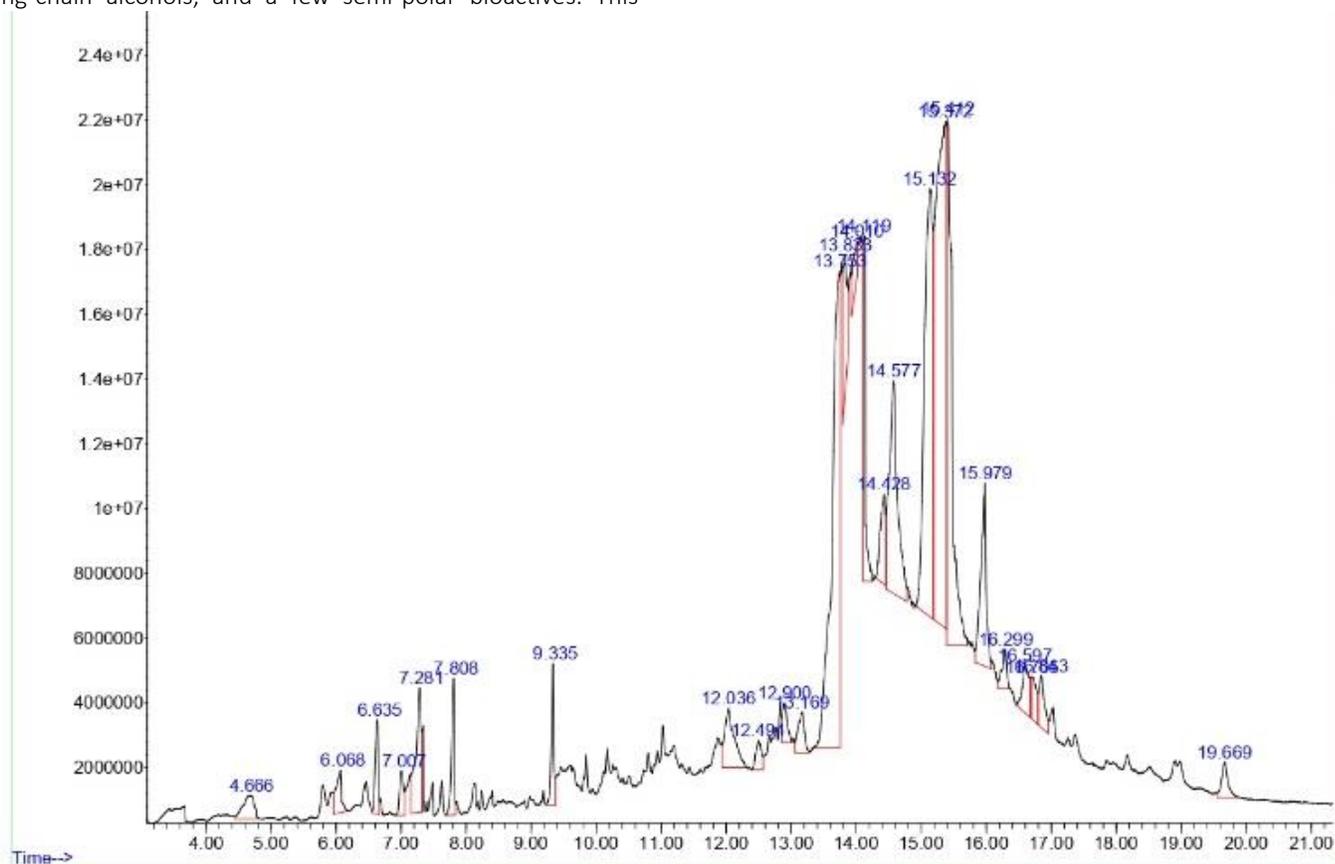


Figure 1. GC-MS total ion chromatogram (TIC) showing the separation of lipophilic compounds present in the n-hexane extract of *Sterculia oblonga* stem bark. Retention times correspond to fatty acids, esters, aldehydes, and thiol-containing constituents identified in the extract.

**Cosmeceutical and Therapeutic Relevance** The fatty acid composition of the n-hexane extract of *Sterculia oblonga* points to significant potential for cosmeceutical applications, particularly in skin hydration and barrier restoration [6-7]. Fatty acids such as oleic acid (9-octadecenoic acid) and palmitic acid (n-hexadecanoic acid), both identified in substantial proportions in the extract, are widely recognized for their emollient and moisturizing properties [8-9]. Oleic acid, a monounsaturated fatty acid, is known to enhance the permeability of the stratum corneum, allowing for improved delivery of active ingredients in topical formulations [10]. Palmitic acid, a major saturated fatty acid found in human

sebum, plays a crucial role in maintaining the skin barrier's integrity and preventing transepidermal water loss, making it valuable in the formulation of creams and lotions designed to combat dryness and support skin repair [11].

In addition to these common fatty acids, the detection of cis-vaccenic acid, one of the most abundant unsaturated fatty acids in the extract, further underscores the therapeutic promise of *S. oblonga* bark. Cis-vaccenic acid has been reported in scientific literature to possess anti-inflammatory properties [12-13], potentially contributing to the mitigation of skin irritation and redness when applied topically. This characteristic makes the extract especially relevant for

formulations aimed at soothing sensitive skin, alleviating inflammatory skin conditions, and providing relief from environmental stressors such as pollution and UV exposure.

Its presence complements the actions of other fatty acids, offering a broader spectrum of dermal benefits.

Table 1: Phytochemical constituents identified in the n-hexane extract of *Sterculia oblonga* stem bark by GC-MS

Peak No.	RT (min)	Compound Identified	Area %	Phytochemical Class
1	4.666	Cyclohexene, 1-methyl-	1.06	Hydrocarbon (Cyclic Alkene)
2	6.068	Octanoic acid	0.93	Fatty Acid
3	6.635	2-Decenal, (Z)-	1.12	Aldehyde
4	7.007	Cyclohexene, 1-ethyl-	0.73	Hydrocarbon (Cyclic Alkene)
5	7.281	2,4-Octadienal, (E,E)-	2.79	Aldehyde
6	7.808	(E)-Tetradec-2-enal	1.46	Aldehyde
7	9.335	Nonanoic acid, 9-oxo-, ethyl ester	1.34	Fatty Acid Ester
8	12.036	tert-Hexadecanethiol	2.23	Thiol
9	12.494	Aspidospermidin-17-ol, 1-acetyl-, etc.	0.65	Alkaloid/Alcohol
10	12.900	1-Hexadecanol, 2-methyl-	0.72	Fatty Alcohol
11	13.169	Hexadecanoic acid, methyl ester	1.02	Fatty Acid Ester
12	13.753	n-Hexadecanoic acid	15.90	Saturated Fatty Acid
13	13.833	Pentadecanoic acid	2.37	Saturated Fatty Acid
14	14.010	n-Hexadecanoic acid	0.86	Saturated Fatty Acid
15	14.119	n-Hexadecanoic acid	3.26	Saturated Fatty Acid
16	14.428	cis-Vaccenic acid	1.84	Unsaturated Fatty Acid
17	14.577	n-Hexadecanoic acid	6.97	Saturated Fatty Acid
18	15.132	9-Octadecenoic acid, methyl ester	14.58	Fatty Acid Ester
19	15.372	cis-Vaccenic acid	20.72	Unsaturated Fatty Acid
20	15.412	Oleic acid / 9-Octadecenoic acid	10.76	Unsaturated Fatty Acid
21	15.979	cis-10-Nonadecenoic acid	3.86	Unsaturated Fatty Acid
22	16.299	cis-13-Eicosenoic acid	0.73	Unsaturated Fatty Acid
23	16.597	Oleic acid	1.30	Unsaturated Fatty Acid
24	16.705	6-Octadecenoic acid, (Z)-	0.81	Unsaturated Fatty Acid
25	16.843	9-Tetradecenal, (Z)-	1.11	Aldehyde

N/B: A total of 25 compounds were identified, dominated by saturated and monounsaturated fatty acids. Notable constituents included: cis-Vaccenic acid (20.72%); Palmitic acid (15.90%); Oleic acid (10.76%); Methyl oleate (14.58%); Pentadecanoic acid, hexadecanol, and aldehydes (varied percentages). These compounds are well-known for their emollient, antioxidant, and barrier-repair properties, making them highly suitable for skin care formulations.

Beyond fatty acids, the extract also contains minor but noteworthy quantities of aldehydes and thiol-containing compounds. These constituents, although present at lower concentrations, may play supportive roles in enhancing the preservative and sensory attributes of cosmetic and therapeutic products. Aldehydes such as 2-decenal and octadienal are known for their mild antimicrobial activity and their contribution to fragrance profiles, potentially imparting a pleasant scent to formulations without the need for synthetic additives. Similarly, thiol derivatives like tert-hexadecanethiol could exhibit protective properties against oxidative degradation in formulations, thereby extending shelf life and stability [14].

The combined chemical profile of the n-hexane extract of *Sterculia oblonga* therefore, positions it as a promising multi-functional ingredient for natural skin care and therapeutic formulations. The synergistic action of fatty acids, esters, aldehydes, and thiol compounds supports its potential use not only as an active cosmeceutical agent but also as a bio-based

excipient that can enhance the efficacy, stability, and sensory appeal of topical products. Such natural extracts align well with current trends favoring clean-label, plant-based, and sustainably sourced ingredients in the cosmetic and personal care industries.

**Comparative Implications** The phytochemical profile of the n-hexane extract of *Sterculia oblonga* stem bark presents a sharp contrast to that of the ethanol extract previously reported by Nkom *et al.* [15]. The n-hexane extract, as revealed by GC-MS analysis, is predominantly composed of long-chain saturated and unsaturated fatty acids, fatty acid esters, aldehydes, alcohols, and thiol derivatives. This lipid-rich matrix highlights the non-polar character of the extract, which is especially suited for delivering skin-conditioning, emollient, and barrier-reinforcing functions in topical formulations. Key constituents such as palmitic acid, oleic acid, and cis-vaccenic acid dominate the profile, positioning this extract as a potential active ingredient in products aimed at moisturizing and protecting the skin.

In contrast, the ethanol extract of *S. oblonga* reported by Nkom et al. [15] was characterized by a more polar phytochemical spectrum. Their study identified a significant presence of phenolic compounds, flavonoids, and alkaloid derivatives, along with various heterocyclic compounds. These polar constituents are renowned for their antioxidant, antimicrobial, and anti-inflammatory properties, suggesting a biomedical relevance oriented more toward oxidative stress mitigation and infection control. The ethanol extract's profile therefore emphasizes biological defense mechanisms, whereas the n-hexane extract focuses on lipid replenishment and skin barrier support.

Importantly, the comparison between the n-hexane and ethanol extracts of *S. oblonga* underscores the complementary nature of these phytochemical profiles. The n-hexane extract contributes essential lipophilic bioactives that can restore and maintain skin integrity, reduce transepidermal water loss, and provide emollient effects. Meanwhile, the ethanol extract offers bioactives that can combat oxidative damage and microbial invasion. This duality reinforces the potential for integrated formulations that harness both extracts to deliver broad-spectrum skin and therapeutic benefits, combining structural support with biological protection.

Such findings align with modern cosmeceutical and therapeutic trends that favor multi-component, plant-based formulations designed to provide holistic care. The study of *S. oblonga* across different solvent systems illustrates the importance of extraction strategy in unlocking a plant's full bioactive potential. Leveraging both non-polar and polar extracts could open new pathways for the development of advanced skin care and biomedical products that meet the rising demand for natural, multifunctional, and sustainable ingredients.

## CONCLUSION

The n-hexane extract of *Sterculia oblonga* bark contains a diverse range of fatty acids and lipophilic bioactives with promising skin-conditioning and antioxidant properties. These findings lay the groundwork for the development of natural cosmeceutical formulations and highlight the potential of *S. oblonga* as a sustainable source of plant-based cosmetic actives.

## CONFLICT OF INTEREST

The author declares no conflict of interest.

## REFERENCES

1. Aware CB, Patil DN, Suryawanshi SS, Mali PR, Rane MR, Gurav RG, Jadhav JP. Natural bioactive products as promising therapeutics: A review of natural product-based drug development. *South African Journal of Botany*. 2022 Dec 1;151:512-28.
2. Shubayr N. Phytochemicals properties of herbal extracts for ultraviolet protection and skin health: A narrative review. *Journal of Radiation Research and Applied Sciences*. 2023 Dec 1;16(4):100729.
3. Singh AB, Singh PD, Vanlalmalsawmropuia H, Kumar S, Khanduri VP, Kumar KS. Traditional uses and pharmacological activities of *Sterculia villosa Roxb.*-an underutilized tree of south east Asia. *Ethnobotany Research and Applications*. 2024 Jun 19;27:1-23.
4. Teixeira FS, Pimentel LL, Vidigal SS, Costa PT, Pintado ME, Rodríguez-Alcalá LM. Suitability of solvent-assisted extraction for recovery of lipophilic phytochemicals in sugarcane straw and bagasse. *Foods*. 2022 Sep 1;11(17):2661.
5. Singh S, Dodiya TR, Singh S, Dodiya R. Topical wound healing, antimicrobial and antioxidant potential of *Mimosa pudica Linn* root extracted using n-hexane followed by methanol, fortified in ointment base. *International Journal of Pharmaceutical Sciences and Nanotechnology*. 2021 Oct;14(3):5472-80.
6. Wang L, Yan YC, Hao YM, Zhuo XX, Duan HT, Zhang Q, Wang LN, Qiu F. A Review on the Phytochemistry and Pharmacology of the Genus *Sterculia*. *Chemistry & Biodiversity*. 2024 Aug;21(8):e202400963.
7. Khoosal ST. *An Investigation Into the Chemical Composition of Various Seed Oils for Application in Cosmetic Products* (Master's thesis, University of the Witwatersrand, Johannesburg (South Africa)).
8. Acid L. Final report on the safety assessment of oleic acid, laurie acid, palmitic acid, myristic acid, and stearic acid. *Journal of the American College of Toxicology*. 1987;6:321-401.
9. Obeta PO, Ogbonna J, Okoro EE, Anthony J. Evaluation of Physicochemical and Spectroscopic Properties of *Delonix regia*, *Jatropha curcas* and *Hura crepitans* Oil Extracts. *Direct Research Journal of Engineering and Information Technology*. 2025 Jun 5;13(1):49-62.
10. Mittal A, Sara UV, Ali A, Aqil M. Status of fatty acids as skin penetration enhancers-a review. *Current drug delivery*. 2009 Jul 1;6(3):274-9.
11. Lodén M. Role of topical emollients and moisturizers in the treatment of dry skin barrier disorders. *American journal of clinical dermatology*. 2003 Nov;4:771-88.
12. Ogbuagu AS, Nwali IU, Ezem SN, Onyema CT, Okonkwo CP. Chromatographic, infrared spectral and anti-inflammatory studies of ethyl acetate and methanol extract of the seed of *D. edulis*. *Journal of Chemical Society of Nigeria*. 2021 Jun 28;46(3).
13. Rhuada OM, Okoko OD, Ayoola GA. Anti-inflammatory activity of the fruit extracts of *Carpolobia lutea* G. DON

- (Polygalaceae). *West African Journal of Pharmacy*. 2019;30(1):54-63.
14. Kumar N, Sharma S. Pharmacology, ethnopharmacology, and phytochemistry of medicinally active *Moringa oleifera*: A review. *The Natural Products Journal*. 2023 Dec 1;13(8):13-41.
  15. Nkom PY, Asuquo EO, Bebiaundeye LA, Ukam EE. GC-MS Evaluation of stem bark extract of *Sterculia oblonga* for biomedical potentials. *Journal World Health WHJ*. 2024 Jun 26;5(1):16-21.