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Original Article

Quality Evaluation and GC-MS Profiling of Surya Paki Stree Kutaja Taila

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ABSTRACT

Background: Sneha Kalpana is an important Ayurvedic pharmaceutical preparation designed to incorporate both lipid-soluble and water-soluble components into a lipid medium. Among its preparation methods, Surya Paka involves exposure of the ingredients to sunlight for processing. This inflammation and immune imbalance. Stree Kutaja Taila, prepared through Surya Paka, is widely used in clinical practice for the management of various skin disorders. However, classical references regarding this preparation are limited, and scientific studies evaluating its standardization are scarce**. Materials and Methods:** The present study aimed to prepare Stree Kutaja Taila using the Surya Paka method and evaluate its physicochemical parameters. In addition, Gas Chromatography-Mass Spectrometry (GC-MS) analysis was carried out to identify the chemical constituents present in the formulation and to generate scientific evidence supporting its therapeutic potential. **Results:** GC-MS analysis revealed the presence of several bioactive compounds, including tetra decanoic acid derivatives, trioxolane derivatives, and dodecanoic acid esters. **Conclusion:** These compounds are reported to possess anti-inflammatory and immunomodulatory properties, suggesting the potential therapeutic role of Stree Kutaja Taila in managing inflammatory and autoimmune conditions.

Keywords: Gas chromatography, Physicochemical, Stree Kutaja taila, Surya Paka.

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INTRODUCTION

In Ayurveda, Sneha Kalpana is the processing of Sneha Dravya Such as taila, Ghrita, Vasa and Majja to change into the form that the body will accept. As Sneha Kalpana is being prepared by Kalka Dravya, Sneha Dravya and Drava Dravya these components are utilized in the recommended amount and when prepared in accordance with the standard operating Sneha Dravya seems to be therapeutically active when certain steps are taken (Sharangadhara, 2016).

Lipid soluble material is extracted into Sneha Using Sneha Dravya as medium, additionally as Drava Dravya or liquid substance are also employed as a component for making medical ghee or taila the water-soluble component can also be removed from it, *Narikela taila* or *Tila taila* are the primary base utilized to prepare the taila used for external application. There are numerous references to taila, which are specially addresses under Kushtha Adhikaran in various Samhita's, a traditional ayurvedic text (Sen, 2017).

Taila is typically produced using The Agni Siddha Process. A few tailas are made utilizing The Surya Paki method (With Sunlight). However, there is no Reference to the typical preparation process for the Surya Paka.

Review on (Stree Kutaja) *Wrightia tinctoria*

Wrightia tinctoria R. Br (Family: Apocynanceae) commonly called *Shweta Indrajao* or *Danta pala* is a well- documented medicinal plant widely used in Indian traditional systems of medicine. The plant Exhibits characteristic grey bark and milky latex with leaves and seeds containing a spectrum of bioactive constituents. *Wrightia tinctoria* has been the subject of numerous pharmacological investigations, which have shown anti-inflammatory, antibacterial, antifungal, antioxidant and hepatoprotective, wound healing and ant psoriatic properties (Hari *et al.*, 2021). Macroscopic evaluation of Stree Kuataja Swarasa revealed that it was dark greenish in colour, with a smooth texture and characteristic odour. Physicochemical Study

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revealed acceptable values for Specific Gravity (1.109), pH (5.52) with total solids value (0.938) Indicating good Stability, purity and suitability of the oil base for topical application. Alkaloids, flavonoids, Tannins, proteins, carbohydrates, saponin and cardiac glycosides are also show positive results in phytochemical screening.

Review of Surya Paka

Surya Paka is a method in which taila and Aushada Dravya are exposed to sunlight for a certain amount of time until all the active ingredients of drug get dissolve in the taila. Surya Paka aims to prepare volatile, thermo-labile and rasoushadis at lower temperature. Surya Paka Sneha is mostly applied externally to treat a variety of skin conditions since it efficiently absorbs ultraviolet radiation from the sun. The UV radiation from the sun is divided into UVA and UVB rays. UVB rays are very useful for treating skin diseases because of their deeper penetration which improves skin shedding and regrowth. This Action helps in reducing inflammation of the skin. There are only few references of Surya Paka Sneha mentioned in classics like Bhaishajya Ratnavali, Bharat Bhaishajya Ratnakar, Gada Nigraha, Vangasena, Chakardatta, Shahasrayoga etc., (Kumar *et al.*, 2016).

MATERIALS AND METHODS

Preparation of oil

Stree Kutaja (*Wrightia tinctoria*) fresh leaves were gathered and carefully cleaned to get rid of unnecessary material to enable efficient extraction, the leaves were then finely cut into small pieces. Fresh coconut oil (*Narikela Taila*) was added to a sanitized stainless-steel container. In order to ensure adequate dispersion of the plant material, the chopped leaves were mixed into the oil in 2:1 ratio (coconut oil: Stree Kutaja *patra*)

Every day, the vessel was exposed to direct sunshine for around 8 hr. To improve the infusion process and to promote uniform extraction of phytoconstituents into the oil. The procedure was continued for 3 days.

On the 4th day, the infused oil was filtered through a clean muslin cloth to remove residual leaf material. The filtered oil was then transferred into an airtight container and stored under appropriate conditions for preservation.

Study conduction

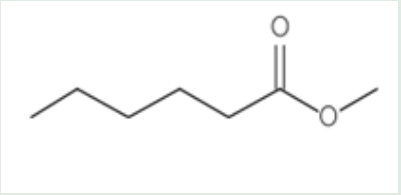
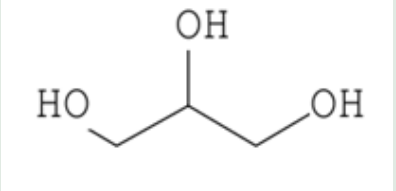
The physiochemical parameters were analysed in AYUSH approved ASU Drug Testing laboratory, Central research facility of KAHER'S Shri BMK Ayurveda Mahavidyalaya, Belagavi.

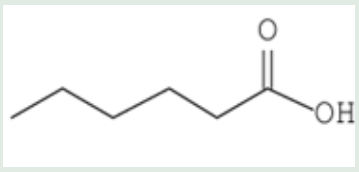
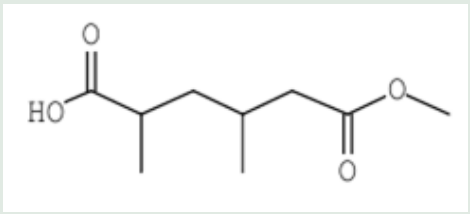
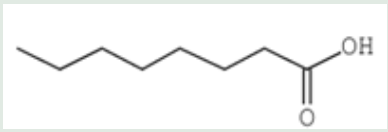
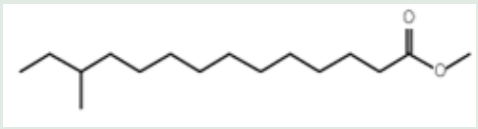
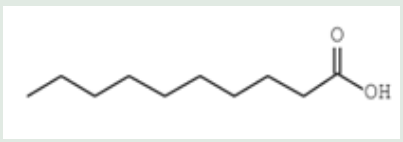
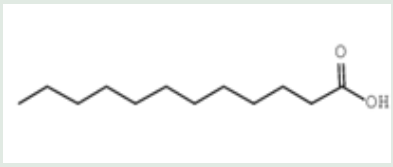
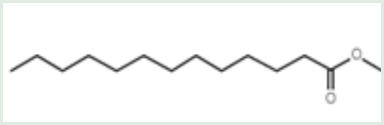
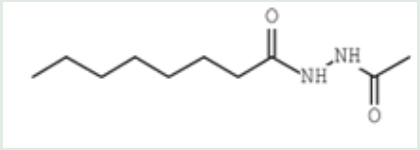
The Gas Chromatography/Mass Spectrometry (GC/MS) Analysis was conducted by Amrith Labs, Nisargam Private Limited, Shimoga, Karnataka.

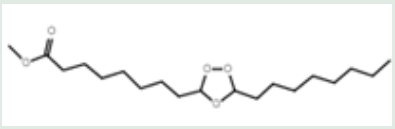
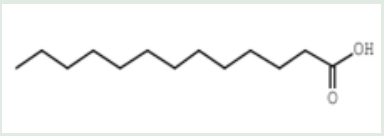
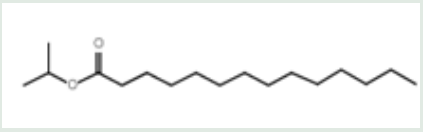
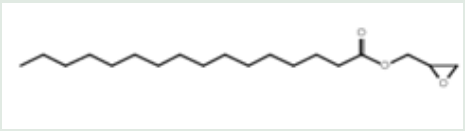
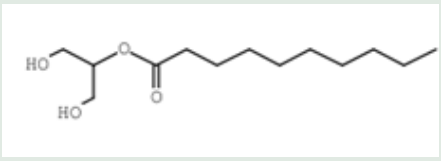
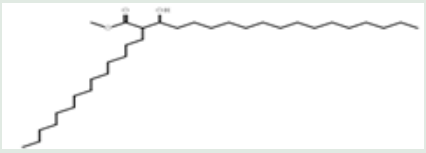
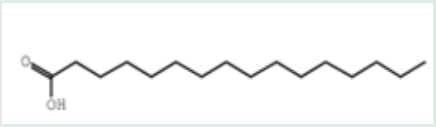
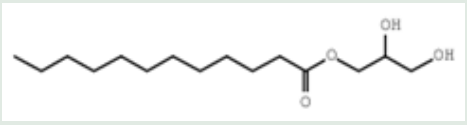
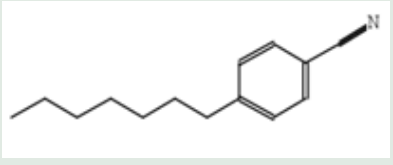
Procedure: Both qualitative and Quantitative analyses of Stree Kutaja taila were conducted using Gas Chromatography -Mass spectrometry (GC-MS). Whereas Mass Spectrometer uses mass-to-charge (m/z) ratio to identify analytes uses retention time to separate components, an instrument called Shimadzu GC-MS QP-2010SE was used for the investigation

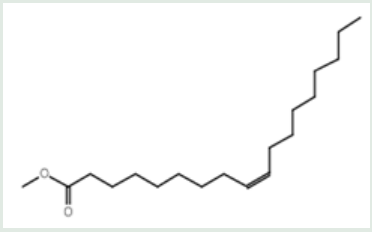
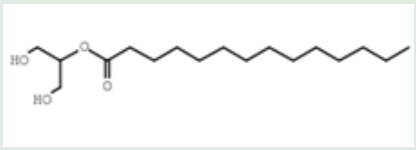
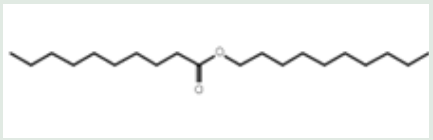
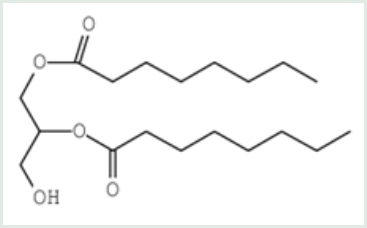
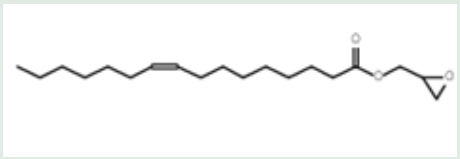
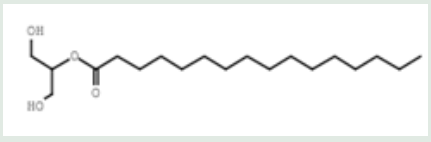
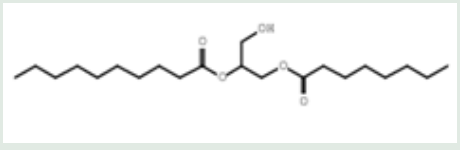
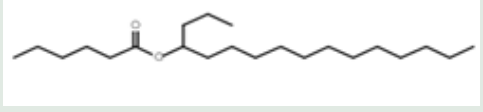
Stree Kutaja taila was prepared in GMP Certified KLE Ayurveda Pharmacy. For sample preparation. 1ml of oil was extracted with 10 ml of acetone and 1 µL of the extract was injected into the GC-MS system. The carrier gas was helium. Split mode (10:1) injection was carried out at 280°C. After being kept at 80°C for 2 min, the oven temperature was raised to 200°C at 10°C/min held for 5 min and then to 280°C at 5°C/min held for 3 min. Temperature of 200°C and 280°C were established for the ion source and contact, respectively.

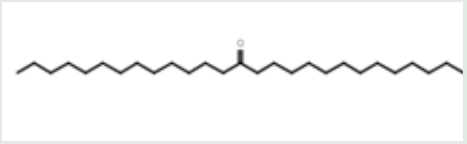
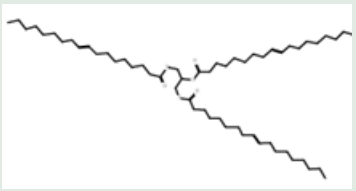
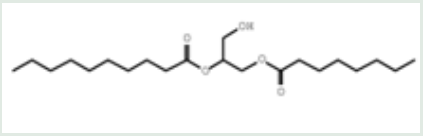
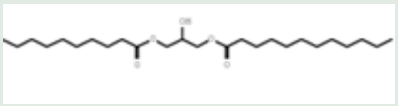
Table 1: Phytoconstituents identified in GC/MS Analysis.

Sl. No.	Name of the compound	Retention Time	Area %	Structure
1.	Hexanoic Acid, methyl ester	5.410	1.00	 Figure no.1
2.	Glycerine	6.480	0.70	 Figure no.2

Sl. No.	Name of the compound	Retention Time	Area %	Structure
3.	Hexanoic Acid	6.592	0.80	 Figure no.3
4.	2,4-Dimethylhexanedioic acid, 6-methyl ester	8.457	4.79	 Figure no.4
5.	Octanoic acid	9.095	1.54	 Figure no.5
6.	Tetra decanoic acid, 12-methyl-, methyl ester	11.515	19.62	 Figure no.6
7.	n-Decanoic acid	12.552	0.44	 Figure no.7
8.	Dodecanoic acid	15.937	3.32	 Figure no.8
9.	Tridecanoic acid, methyl ester	15.434	0.13	 Figure no.9
10.	Octanoic hydrazide, Ac derivative	17.006	0.68	 Figure no.10

Sl. No.	Name of the compound	Retention Time	Area %	Structure
11.	1,2,4-Trioxolane-2-octanoic acid, 5-octyl-, methyl ester	17.253	10.72	 Figure no.11
12.	Tridecanoic acid	17.499	1.15	 Figure no.12
13.	Isopropyl myristate	17.851	0.17	 Figure no.13
14.	Glycidyl palmitate	18.268	0.73	 Figure no.14
15.	Decanoic acid, 2-hydroxy-1-(hydroxymethyl) ethyl ester	18.325	0.64	 Figure no.15
16.	Octadecanoic acid, 3-hydroxy-2-tetradecyl- methyl ester	18.462	6.51	 Figure no.16
17.	n-Hexadecanoic acid	18.651	0.17	 Figure no.17
18.	Dodecanoic acid, 2,3-dihydroxypropyl ester	19.393	15.32	 Figure no.18
19.	p-Heptylbenzonitrile	20.418	0.08	 Figure no.19

Sl. No.	Name of the compound	Retention Time	Area %	Structure
20.	9-Octadecenoic acid (Z)-, methyl ester	20.485	3.07	 Figure no.20
21.	Tetra decanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	20.589	2.89	 Figure no.21
22.	Decanoic acid, decyl ester	20.918	0.18	 Figure no.22
23.	Octanoic acid, 1-(hydroxymethyl)-1,2-ethanediyl ester	21.011	0.11	 Figure no.23
24.	Glycidyl palmitoleate	21.886	0.71	 Figure no .24
25.	Hexadecenoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	22.256	0.68	 Figure no.25
26.	1-Hydroxy-3-(octanoyloxy) propan-2-yl decanoate	22.608	0.11	 Figure no .26
27.	Hexanoic acid, 4-hexadecyl ester	22.688	0.28	 Figure no .27

Sl. No.	Name of the compound	Retention Time	Area %	Structure
28.	14-Heptacosanone	24.089	0.14	 Figure no .28
29.	9-Octadecenoic acid, 1,2,3-propanetriyl ester,	24.489	0.25	 Figure no .29
30.	1-Hydroxy-3-(octanoyloxy) propan-2-yl decanoate	25.226	4.12	 Figure no .30
31.	1-Decanoyl-3-dodecanoylglycerol	29.134	2.69	 Figure no .31

With an event time of 0.30 sec and a total run time of 33 min, mass spectra were captured in scan mode over range of 35-500 m/z.

RESULTS

The organoleptic evaluation of Stree Kutaja taila revealed that the formulation was in taila form exhibiting a dark purple colour with a characteristic odour.

The physiochemical analysis revealed a moisture content of 7.63%. The specific gravity of the sample at 40°C was found to be 0.917. the saponification value was observed to be 279.194, while the iodine value was recorded as 9.413. The acid value of the formulation was 9.422 the refractive indexed measured at 40°C was 1.464 (Table 1).

DISCUSSION

Analytical analysis of Stree Kutaja *taila* offers valuable information about the formulation purity stability and potential therapeutic effect. The lipid base's composition and the addition of active ingredient are reflected in the reflected in measured physiochemical properties. A specific gravity that is comparable to that of common medicinal oils indicated that the contents were processes correctly and dispersed uniformly. The presence of fatty and dissolved components which affect absorption and spreadable when applied topically is indicated by the refractive index. The saponification value shows a significant amount of fatty acid esters and glycerides which are crucial for preserving skin hydration and aiding in the epidermal barrier's recovery. In the chronic skin disorders, the presence of unsaturated fatty acids may improve penetration and therapeutic efficacy as indicated by the iodine value. The oils stability and the amount of free fatty acids are shown by the acid value within acceptable bounds indicate low rancidity and therapeutic appropriate processing and a lower possibility of microbiological contamination, the moisture content also stayed within the acceptable bounds.

GC-MS profiling identified a number of ester compounds and physiological active fatty acid derivatives. It has been observed that derivatives of tetra decanoic and dodecanoic acids have antibacterial and anti-inflammatory properties, which could help lessens the microbial load and inflammatory changes in skin that is afflicted. Derivatives of trioxolane have anti-inflammatory properties that may help in lessen irritation and redness. It is also well known that octadecanoic acid derivatives and associated long chain fatty acids have anti-fungal and anti-oxidant qualities which aid in lowering oxidative stress and promoting tissue repair (Table 2).

Overall, the combined presence of anti-microbial, anti-inflammatory, anti-oxidant and emollient components suggest multifactorial mode of action supporting the therapeutic

Table 2: Biological activity of identified compound in Stree Kutaja taila.

Sl. No.	Name of compound	Area %	Biological action
1	Tetradecanoic acid, 12-methyl-, methyl ester	19.64	Anti-microbial property (Demisie *et al.*, 2024).
2	Dodecanoic acid, 2,3-dihydroxypropyl ester	15.32	Anti-Fungal (Hawar *et al.*, 2023).
3	1,2,4-Trioxolane-2-octanoic acid, 5	10.72	Anti-inflammatory (Jatoth *et al.*, 2025).
4	Octadecanoic acid, 3-hydroxy-2-tetradecyl-, methyl ester,	6.51	Antifungal (Deng *et al.*, 2019).
5	2,4-Dimethylhexanedioic acid, 6-methyl ester	4.79	Antibacterial, and antioxidant activities (Jinoni *et al.*, 2024).
6	1-Hydroxy-3-(octanoyloxy) propan-2-yl decanoate	4.12	Emulsifying and anti-microbial (Zhang *et al.*, 2018).
7	9-Octadecenoic acid (Z)-, methyl ester	3.07	Anti -oxidant property (Zahid *et al.*, 2018).

potential of Stree Kutaja taila in the inflammatory, autoimmune related and chronic skin disorders.

CONCLUSION

Stree Kutaja tail's analytical assessment revealed bioactive substances with antibacterial, anti-inflammatory and antioxidant activity in addition to acceptable physicochemical features. These results help standardize this conventionally used formulation and offer scientific support for its therapeutic applications in inflammatory and immune related skin conditions.

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ABBREVIATIONS

GMP: Good Manufacturing Practice; **ASU:** Ayurveda, Siddha and Unani; **AYUSH:** Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy; **UV:** Ultraviolet; **m/z:** mass-to-charge ratio; **UVA:** Ultraviolet A; **UVB:** Ultraviolet B.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

Stree Kutaja Taila was prepared using the Surya Paka method and evaluated through physicochemical analysis and GC-MS profiling to generate scientific evidence for its composition. The analysis identified bioactive compounds with reported anti-inflammatory and immunomodulatory properties, suggesting its potential role in managing inflammatory and autoimmune conditions.

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