

# The GCMS, antioxidant, and anti-inflammatory activity of the Ayurveda oil, *Arukaladi tailam*

## Research Article

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## Abstract

*Ayurvedic tailams* have a long history of use and efficacy. They have been used for centuries, with many individuals reporting positive results in managing and improving their health. *Ayurvedic tailams* typically have fewer side effects compared to synthetic medications, making them a preferred choice for individuals seeking natural remedies and can be applied both externally (for massage) and, in some cases, internally (for specific therapies). This versatility allows for a wide range of applications and health benefits. The current study focuses on the GC MS analysis of *Arukaladi tailam*, an oil composition used in Ayurveda to treat jaundice when administered topically. Before being subjected to the GC MS analysis, the product was appropriately prepared after being purchased from a reputable Ayurvedic dealer in Chennai, India. The IC<sub>50</sub> value of the DPPH assay was found to be 744.7391 μl/ml and FRAP reveals that the *tailam* had good reducing power. Further the anti-inflammatory of the *tailam* exhibited 14.2% of haemolysis at 1000 μl/ml and inhibited protein denaturation by 63.74% with an IC<sub>50</sub> value of 789.4013 μl/ml. The presence of biomolecules as shown in the GC MS profile are 2-Fluoro-6-trifluoromethylbenzoic acid, 2-tetradecyl ester, Tridecanol, 2-ethyl-2-methyl-, etc. These chemicals could help the medication work better to treat jaundice.

**Keywords:** *Arukaladi tailam*, GC MS, Antioxidant, Anti-inflammatory, *Ayurveda tailam*.

## Introduction

*Arukaladi tailam* is traditional ayurvedic herbal oil used for various medicinal and therapeutic purposes. It is primarily known for its application in ayurvedic head massages and is often used to promote hair and scalp health. The main ingredients of *Arukaladi tailam* typically include a base of sesame oil or coconut oil, combined with various herbs and natural substances. It is imperative to learn the molecular mechanism of alternative medicine, such as Ayurveda, Siddha, and Unani, so that they can be evaluated for their medicinal efficacy via molecular medicines. *Arukaladi tailam* is an ayurvedic oil formulation which is applied on the head to cure jaundice. Key benefits and uses of *Arukaladi tailam* includes improvement of blood circulation, reduces dandruff, promotes hair growth, reduces inflammation, provides a cooling, refreshing and stress-relieving

experience. In traditional Ayurvedic medicine, *Arukaladi tailam* may be recommended for conditions such as alopecia, hair loss, and certain skin disorders. It is believed to balance the doshas and promote overall well-being.

This oil is made from the following ingredients. Water decoction of *Bhringaraj* (*Ecliptaalba*(L.) Hassk.), *Amrutha* (*Tinospora cordifolia* (Willd.) Hook.F. and Thoms.), *Gojihwa* (*Onosma bracteatum*(Wall.)), *Durva* (*Cynodon dactylon* (L.) Pers), *Sakralatha* (*Cardiospermum helicacabum*(Linn.)), *Kadalikhanda* (*Musa paradisiaca* (Linn.)) shoot and *Swarasa* (Juice of *Musa paradisiaca* stem). The decoction is infused in sesame oils and filtered to get this oil. This oil finds its reference in *Sahasrayoga Tailayoga Prakarana* (7), an Ayurvedic treatise. There are many reports of the medicinal roles of all the plants used in this oil.

*Eclipta alba* or *Bhringaraj* is known to have many medicinal roles in the treatment of GI track disorders, pulmonary disorders (including asthma), pyretics, hair loss and greying of hair, hepatic disorders (including jaundice), dermal issues, splenomegaly, and cuts and wounds (26). *Onosma bracteatum* Wall, known as *Gojihva* in Ayurveda. It is an important ingredient in several Unani and Ayurvedic formulations which is used to improve

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memory and immunity(27). *Cynodon dactylon* is a common herb, known as Durva grass in Ayurveda, is used traditionally to treat various ailments such as anasarca, cancer, convulsions, cough, cramps, dropsy, dysentery, epilepsy, headache, internal bleeding, high blood pressure, hysteria, measles, rubella, snakebite, sores, stones, tumours, UTI disorders, warts, and wounds (28).

*Cardiopsermum helicacabum* is known as *Karṇasphoṭa* in Ayurveda. The root of it is officially included in Ayurvedic Pharmacopoeia for its therapeutic uses such as *jvara* (fever), *kustha* (leprosy), *pandu* (Diabetes), *kṣaya* (Tuberculosis) and *sandhivata* (arthritis) etc. Raza et al, 2013 have reviewed the beneficial and remedial aspects of this plant (29). *Musa paradisiaca* Linn is the common banana fruit plant which has been in use as food and medicine since time immemorial. It has medicinal roles such as diabetes, cancer, hypertension, atherosclerosis, ulcers, and urolithiasis as anti-toxin (30).

This approach is to enquire and find a suitable alternative to molecular medicines which have its own short and long negative effects. Some work of this regard has been done and this work is one more step in this direction (1-25). The present study deals with the GC MS analysis of one Ayurveda oil, *Arukaladi tailam*, to know the various bio-compounds present in it.

## Materials and methods

The *Arukaladi tailam* medication was purchased from a typical Ayurvedic dealer in Chennai, India. In a separating funnel, 50 ml of *Arukaladi tailam* were collected and extracted with ethyl acetate. The recovered material was charged to have GC-MS patterns using normal processes after being filtered and concentrated in a water bath at a low temperature.

### GCMS

For 10 seconds, a vortex stirrer was used to forcefully agitate the fluid. Analyses performed utilising gas chromatography was used to identify the clear extract, then 100 micro lit sample Dissolved in 1 ml of suitable solvents. Gas chromatography (Agilent: GC: (G3440A) 7890A. MS: 7000 Triple Quad GCMS,) was equipped with Mass spectrometry detector.

### Antioxidant Activity

Using the 1,1-diphenyl-2-picryl hydrazyl (DPPH) method, the *Arukaladitailam's* ability to scavenge free radicals was evaluated. This test was conducted in accordance with the procedure laid forth by Baliyan et al., 2022 (33), in which 100 L of different *tailam* concentrations were introduced to a test tube containing 3 mL of DPPH working and incubated for 30 mins in the dark. 100 mL of leaf extract was mixed with solutions, and the absorbance was measured at 517 nm. The percentage of inhibition and the IC<sub>50</sub> value were assessed using the O.D. values.

The FRAP assay was carried out according to the protocol used by Rajurkar et al., 2011 (34). This study is to evaluate the sample's ability to reduce ferric iron is based on the transformation of the colourless Fe<sup>3+</sup>-TPTZ complex into the blue Fe<sup>2+</sup>-tripirydyltriazine complex under the influence of low pH-active antioxidants. The change in absorbance at 593 nm is used to track this process.

### Anti-inflammatory activity

The anti-inflammatory activity was conducted as formulated by Anyasor et al., 2019 (32). Two types of assays were conducted which include anti-inflammatory activity against HRBC and inhibition of protein denaturation using BSA. The anti-inflammatory activity against HRBC is to check the compatibility of human RBC against the *Arukaladi tailam* formulation where PBS was used as negative control and distilled water was used as positive control. The settling down of RBC at the end of the experiment marks the compatibility while the red coloured supernatant represents the toxicity of the sample to human RBC.

The efficacy of the *tailam* sample to prevent heat-induced BSA denaturation was tested at various concentrations (200, 400, 600, 800, and 10,000 L/mL) in comparison to the reference drug diclofenac sodium. The reaction mixtures were preheated to 70 °C for 5 minutes after being incubated at 37 °C for 20 minutes. After cooling, a UV-visible spectrophotometer was used to quantify turbidity at 660 nm. The % inhibition of BSA denaturation and the IC<sub>50</sub> value were computed using the O.D. values.

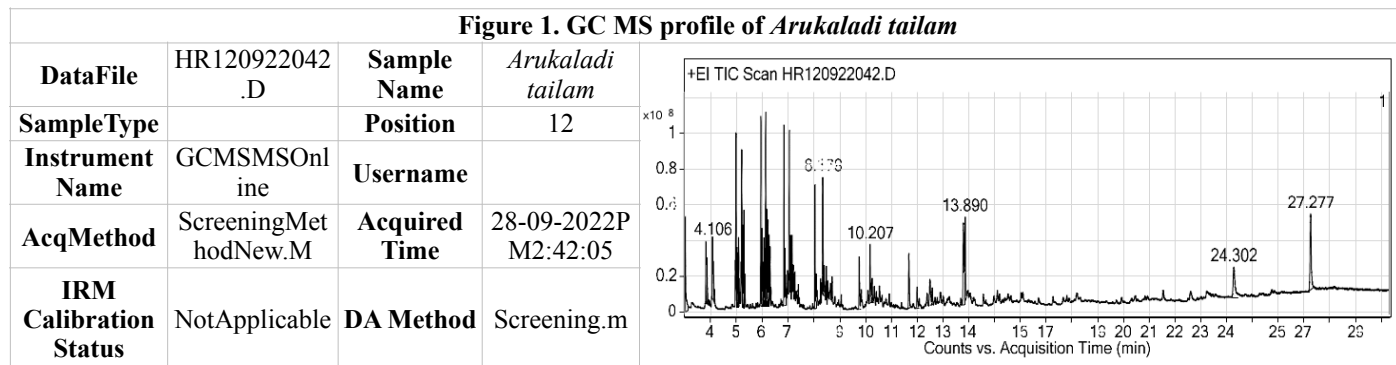
## Results

*Arukaladitailam's* GC MS graphs are shown in Figure 1 and include information on the number of peaks, their retention periods, etc. Table 1 displays the molecular masses, peak areas, and therapeutic uses based on *Arukaladitailam's* GC MS profile. As shown in Table 1, the identification of metabolites was accomplished through comparison of retention time and fragmentation pattern with mass spectra in the NIST spectral library maintained by the computer software (version 1.10 beta, Shimadzu) of the GC-MS as well as prospective pharmaceutical roles of each biomolecule in accordance with Dr. Duke's Phytochemical and Ethnobotanical Data Base (National Agriculture Library, USA) and others (31).

From Figure 1 and Table 1 the presence of biomolecules as shown in the GC MS profile (Table 1) such as 2-Fluoro-6-trifluoro methyl benzoic acid, 2-tetradecyl ester, Tridecanol, 2-ethyl-2-methyl-, Sulfurous acid, 2-ethylhexylpentadecylester, Dodecane, 1-iodo-, 15-Hydroxypentadecanoic acid, cis-13-Octadecenoic acid, cis-13-Octadecenoic acid etc. have far reaching medicinal properties which support the role of *Arukaladi tailam*. The molecule Dodecane, 1-iodo-, has a role of inhibiting Iodothyronine deiodinase enzyme thus helping the thyroid to maintain Thyroxin production. Another molecule Beta. -Sitosterol has Beta

blocking role which could have an impact on the liver function helping in supporting cure of jaundice.

**Figure 1. GC MS profile of Arukaladi tailam**



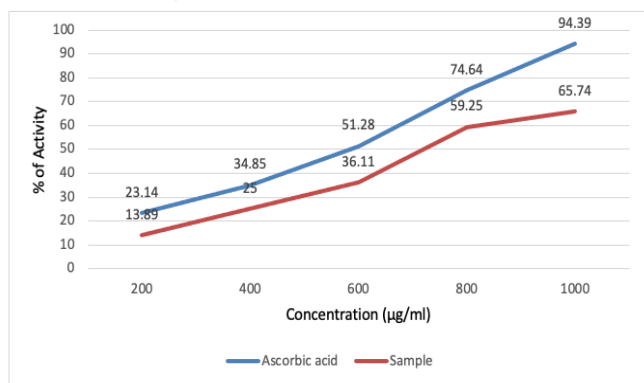
**Table 1: Details of GC MS profile of Arukaladi tailam**

Ret. Time	Compound Name	Mol. Formula	Mol. Wt.	% Peak area	Possible Medicinal Role
3.054	3-Pentanone	C5H10O	86.13	6.072	Not known
3.854	Nonane,4,5-dimethyl-	C11H24	156.31	3.649	Not known
5.009	Nonane,2,2,4,4,6,8,8-heptamethyl-	C16H34	226.44	13.996	Not known
5.229	Hexadecane	C16H34	226.44	5.985	Not known
6.098	2-Fluoro-6-trifluoromethylbenzoic acid,2-tetradecyl ester	C22H32F4O2	404.48	2.417	Acidifier, Arachidonic acid deterrent, promotes Aromatic Amino acid decarboxylase activity, suppresses production of uric acid
6.168	Tridecanol,2-ethyl-2-methyl-	C16H34O	242.44	9.843	Restrains Catechol o methyl Transferase level, methyl donor, methyl guanidine inhibitor
6.249	Sulfurous acid,2-ethylhexylpentadecylester	C23H48O3S	404.70	3.272	Acidifier, Arachidonic acid Inhibitor, Increases Aromatic Amino acid decarboxylase activity, suppresses production of uric acid
6.87	Hexadecane,2,6,10,14-tetramethyl-	C20H42	282.50	6.906	Not known
8.129	Heneicosane	C21H44	295.60	3.406	Not known
8.379	Dodecane,1-iodo-	C12H25I	296.23	9.266	Iodothyronine deiodinase inhibitor
11.716	15-Hydroxypentadecanoic acid	C15H30O3	258.40	4.286	Acidifier, restrains Arachidonic acid, promotes Aromatic Amino acid decarboxylase activity, deters production of uric acid
13.826	9,12-Octadecadienoic acid(Z,Z)-	C18H32O2	280.44	7.524	Not known
13.89	cis-13-Octadecenoic acid	C18H34O2	282.46	8.091	Acidifier, Arachidonic acid Inhibitor, promotes Aromatic Amino acid decarboxylase activity, deters production of uric acid
24.302	Beta-Sitosterol	C29H50O	414.7	5.207	17 beta hydroxysteroid dehydrogenase deterrent, Anti amyloid beta, Anti TGF beta, Beta receptor agonist, Beta-adrenergic receptor blocker, beta-galactosidase deterrent, ER beta binding agent
27.277	3-(2-Ethyl-piperidin-1-ylmethyl)-8a-methyl-5-methylene-decahydro-naphtho(2,3-b] furan-2-one	C22H35NO2	345.52	10.078	Not known

**Antioxidant activity**

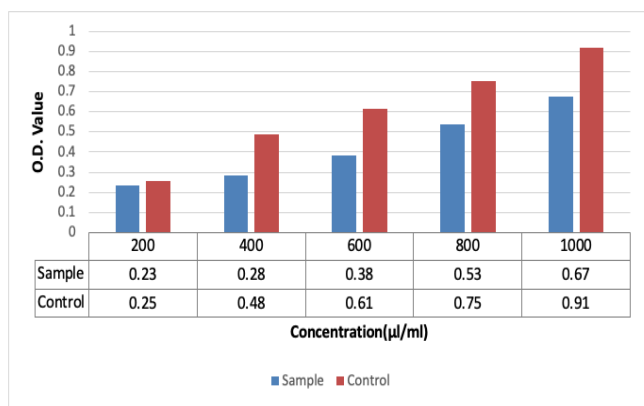
**DPPH activity**

**Figure 1: DPPH antioxidant activity of the tailam**



**FRAP Assay:**

**Figure 2: FRAP antioxidant activity of the tailam**



The antioxidant activity of the sample explains the nature of the herbal formulation to reduce oxidative stress on the cells. DPPH plays an important role to evaluate the free radical scavenging power and FRAP assay determines the reducing power of Fe<sup>3+</sup> ions. The IC<sub>50</sub> value of DPPH activity of the sample was calculated to be 744.74 µl/ml (Fig. 1). The FRAP activity was also fair compared to the standard which remarks the plants efficient antioxidant power (Fig. 2).

**Anti-inflammatory Activity**

**Table 2: Anti-inflammatory Activity of the tailam**

Concentration (µl/ml)	Negative Control (PBS)	Sample of RBC lysis (%)	Positive Control (Distilled Water)
200	0%	3.03	100%
400		6.21	
600		9.63	
800		10.24	
1000		14.2	

The assay is done to test the compatibility of the sample (*Arukaladi tailam*) with the HRBC (human red blood cells). Phosphate buffer saline taken as negative control exhibited the maximum compatibility to HRBC showing no haemolysis while distilled water was considered as 100% of haemolysis (Table 2).

**Heat-Induced BSA denaturation**

**Table 3: Heat-Induced BSA denaturation activity of the tailam**

Concentration (µl/ml)	% of Inhibition of Denaturation	
	Sample	Diclofenac Sodium
200	12.84	11.24
400	27.12	18.08
600	38.16	23.48
800	50.37	36.48
1000	63.74	45.6
<b>IC<sub>50</sub> Value</b>	789.40µl/ml	1127.52µg/ml

This assay is conducted to test the ability of the sample to prevent the denaturation of standard BSA. The drug diclofenac sodium, an anti-inflammatory drug was used as a control where the sample was observed to effectively inhibit protein denaturation. IC<sub>50</sub> values of the sample and the standard drug were 789.40µl/ml and 1127.52µg/ml respectively.

**Discussion**

According to the present study the GCMS reports the major bioactive phytochemical compounds were identified to be beta sitosterol which plays a role as 17-β-hydroxysteroid dehydrogenase deterrent, Beta-adrenergic receptor blocker, β-galactosidase deterrent, ER beta binding agent and 15-Hydroxypentadecanoic acid which acts as an acidifier, restrains arachidonic acid, promotes aromatic amino acid decarboxylase activity, deters production of uric acid. Further this *tailam* also exhibits good antioxidant activity compared to standard drug with an IC<sub>50</sub> value of 744.74 µl/ml for DPPH assay. The *tailam* is also found to be compatible with HRBC showing only 14.2% hemolysis activity for 1000µl/ml. This sample had a fair heat induced protein denaturation assay with an IC<sub>50</sub> value of 789.40µl/ml while the standard drug diclofenac had IC<sub>50</sub> value as 1127.52µg/ml. The various tests conducted on this *tailam* essentially shows that *Arukaladi tailam* formulation is a good hepato-protectant, makes scalp healthier, antioxidant and an anti-inflammatory agent.

Thaila (Tailam), an oil formulation containing herbal mixtures as a medication, is a very helpful type of Ayurvedic medicine. During preparation, its efficacy can be boosted by adding particular substances in accordance with the needs of the drug type. Various herb water decoctions steeped in sesame oil to create this herbal oil. As a result, this oil includes both water and oil-soluble phytoactive elements of medicinal plants. *Sesamum indicum* seed oil infused with a water decoction made from leaves of *Eclipta alba*, *Tinospora cordifolia*, *Onosma bracteatum*, *Cynodon dactylon*, *Cardiospermum halicacabum*, and *Musa paradisiaca* (stem). This oil is applied on the head, which is said to relieve liver problems like jaundice and improve *pitta* and *khaba* which are the energy of digestion or metabolism and the energy of lubrication and structure respectively.

The oil from the seeds of *Sesamum indicum* which is the base ingredient of the tailam contains a number of photochemical compounds with several biological roles. For instance, Sesamin has beneficial anti-oxidant qualities, lowers cholesterol, controls lipid metabolism, stabilises blood pressure, and has anti-tumour actions (37). Sesamin is mostly metabolised by cytochrome P-450 in the body. Sesamin is excreted by bile, urine, and faeces, and its metabolites are mostly eliminated through metabolism in bodily fluids and tissues as glucosinolates and sulfate-conjugated forms (39). Under heating conditions, sesamol increases the antioxidant capabilities of oils and fats (38). Sesamol has potent antioxidant and antibacterial effects. Sesaminol has strong heat stability and antioxidant capabilities.

The plant *Eclipta alba* Hassk (Asteraceae) is well recognised for its therapeutic properties in complementary medicine systems including Ayurveda, Unani, Siddha, Homoeopathy, Chinese, etc. According to reports, *Eclipta alba* has hepatoprotective, antibacterial, anti-inflammatory, analgesic, immunomodulatory, antiviral, and hair-growth and blackening promoter properties. Wedelolactone is a significant chemical source, and demethylwedelolactone has antihepatotoxic properties. Dasyscyphin C, which has antiviral and anticancer properties, eclalbatin, a potent antioxidant, ecliptalbine, and verazine, each of which has the capacity to reduce lipid levels (40).

*Tinospora cordifolia*'s many qualities, which were first mentioned in ancient Ayurvedic writings, are now being studied in the modern day using a "reverse pharmacological" method. Many substances resemble tinocordifolin. Tinosporidine, Cordifol, Cordifellone,  $\beta$ -sitosterol,  $\delta$ -sitosterol, 20  $\beta$ -Hydroxy ecdysone in this plant are said to have prospective medicinal value reported by studies that encompass agonistic activity against diabetes, allergy, inflammation, fever, arthritis, stress, oxidation, and so on. It also has notable activity against plasmodial infections, leprosy, and malaria. It improves liver health and has immuno-modulatory and anti-neoplastic characteristics (41). Further, *Onosma bracteatum*, *Cynodon dactylon*, *Cardiospermum halicacabum*, and *Musa paradisiaca* the other constituent are said to possess anti-oxidant, hepatoprotective, anti-inflammatory, anti-microbial etc. which adds further medicinal value to this formulation.

From Figure 1 and Table 1 the presence of biomolecules as shown in the GC MS profile (Table 1) such as 2-Fluoro-6-trifluoromethylbenzoic acid, 2-tetradecyl ester, Tridecanol, 2-ethyl-2-methyl-, Sulphurous acid, 2-ethylhexylpentadecylester, Dodecane, 1-iodo-, 15-Hydroxypentadecanoic acid, cis-13-Octadecenoic acid, cis-13-Octadecenoic acid etc. have far reaching medicinal properties which support the role of *Arukaladi tailam*. The molecule Dodecane, 1-iodo-, has a role of inhibiting Idothyronine deiodinase enzyme thus helping the thyroid to maintain thyroxin production. Another molecule Beta-Sitosterol has Beta blocking role which could have an impact on the liver function helping in supporting cure of jaundice. According to National Cancer Institute (NIH), Beta-

Sitosterol reduces the amount of cholesterol absorbed from the food, beta-sitosterol and may aid in lowering blood cholesterol levels. Additionally, it could destroy or significantly delay the development of some cancer cells. It is a specific kind of phytosterol.

*Arukaladi tailam* is a part of traditional Ayurvedic medicine. It may be recommended for conditions like alopecia and certain skin disorders. Ayurvedic practitioners may prescribe it to balance the *doshas*. While generally considered safe and natural, it's important to recognise that individual reactions to *Arukaladi tailam* may vary. If used for medicinal purposes, consulting with an Ayurvedic practitioner or healthcare professional is advisable to determine the most appropriate application and dosage for specific health concerns.

It's essential to note that while *Arukaladi tailam* is considered safe and natural, individual reactions may vary. If you plan to use it for medicinal purposes, it's advisable to consult with an Ayurvedic practitioner or healthcare professional to determine the most suitable application and dosage for your specific needs.

## Conclusion

The presence of Idothyronine deiodinase inhibitor, namely, Dodecane, 1-iodo- and beta sitosterol in the GC MS profile of *Arukaladi tailam* indicate that this oil could be acting as a hormone regulator which in turn helps in healthy scalp and liver. Further the oil has good antioxidant activity, compatible to HRBC and protects protein denaturation. Thus, the herbal formulation of *Arukaladi tailam* is a good hepatoprotectant, makes scalp healthier, antioxidant and an anti-inflammatory agent. In summary, *Arukaladi tailam* is versatile Ayurvedic oil with a range of applications, primarily related to hair and scalp health. Its cooling and soothing properties make it a popular choice for those looking to maintain healthy hair and promote overall well-being.

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