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(RESEARCH ARTICLE)

Standardization and Phytochemical Profiling of *Arimedadi tailam*: An Ayurvedic Approach to Oral Health

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Abstract

Introduction: *Arimedadi tailam*, a classical Ayurvedic oil from Sahasrayogam, is prepared with sesame oil and over 40 herbs, including *Khadira, Arimeda*, and *Triphala*. Used traditionally for oral disorders like toothache and gum inflammation through Gandusha and Kavala, it shows modern relevance for its antimicrobial, anti-inflammatory, and antioxidant properties.

Materials and Methods: *Arimedadi tailam* was evaluated as per classical guidelines using organoleptic assessment (color, odor, consistency), physicochemical analysis (acid value, saponification value, iodine value, specific gravity, moisture), phytochemical screening of chloroform extracts, and GC-MS analysis of hexane extracts.

Results: The oil exhibited a yellowish-red color, viscous consistency, and characteristic odor. Physicochemical parameters met API standards. Phytochemical screening confirmed carbohydrates, glycosides, steroids, phenols, alkaloids, and quinones. GC-MS identified isoborneol (63.69%), linoleic acid (6.46%), γ-sitosterol (4.84%), and vitamin E (0.86%), with antimicrobial, anti-inflammatory, and antioxidant effects.

Conclusion: This study validates *Arimedadi tailam*'s therapeutic potential, supporting its standardization for oral health management and bridging Ayurvedic tradition with modern science for global acceptance.

Keywords: *Arimedadi tailam*; Sneha Kalpana; Ayurvedic Medicated Oil; Oral Health; Phytochemical Analysis; Gas Chromatography-Mass Spectrometry (GC-MS)

1. Introduction

Ayurveda, one of the oldest systems of medicine originating from India, emphasizes holistic health through the use of natural herbs, minerals, and specialized formulations to prevent and treat diseases. Among its diverse pharmaceutical preparations, Sneha Kalpana (medicated oils and *ghees*) holds a significant place due to their enhanced bioavailability, prolonged shelf life, and ability to extract both lipid- and water-soluble active principles from raw materials.[1] These formulations are prepared through meticulous processes involving decoctions, pastes, and base oils, ensuring therapeutic efficacy for various ailments, including those related to oral health.

Arimedadi tailam, is a classical Ayurvedic medicated oil formulation described in the ancient text Sahasrayogam.[2] It is prepared following the traditional Sneha Kalpana method, incorporating a blend of over 40 herbal ingredients, with sesame oil (Tila Tailam) as the base. Key components include *Khadira (Acacia catechu), Arimeda (Acacia leucophloea),* and various other botanicals such as Triphala (a combination of Haritaki, Vibhitaki, and Amalaki), spices like *Twak (Cinnamomum verum),* and aromatic substances like Karpoora (Cinnamomum camphora). Traditionally, *Arimedadi*

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tailam is indicated for oral disorders (Mukharoga), including toothache (Dantashoola), gum inflammation, bleeding gums, bad breath (Mukhadurgandha), and strengthening teeth and gums. It is primarily used in procedures like Gandusha (oil gargling or oil pulling) and Kavala (swishing), which are integral to Ayurvedic Dinacharya (daily regimen) for maintaining oral hygiene and preventing periodontal diseases.[3]

In contemporary practice, oil pulling with *Arimedadi tailam* has gained attention for its potential antimicrobial, anti-inflammatory, and antioxidant properties, which align with modern oral care needs. Clinical studies have demonstrated its efficacy as an adjunct in managing plaque-induced gingivitis, showing significant reductions in gingival index and bleeding scores comparable to conventional agents like chlorhexidine gluconate.[4] These benefits are attributed to the synergistic action of its phytochemical constituents, such as flavonoids, terpenoids, and phenolic compounds, which exhibit bioactive effects against oral pathogens.

Despite its traditional acclaim, the standardization and scientific validation of *Arimedadi tailam* remain crucial in the modern era to ensure quality, safety, and reproducibility amid variations in raw material sourcing and preparation methods. Analytical studies employing organoleptic evaluation, physicochemical parameters (e.g., acid value, saponification value), preliminary phytochemical screening, and advanced techniques like Gas Chromatography-Mass Spectrometry (GC-MS) are essential for identifying bioactive compounds, confirming authenticity, and correlating traditional claims with empirical evidence.[5] Such investigations not only bridge the gap between ancient wisdom and contemporary science but also facilitate regulatory compliance and global acceptance of Ayurvedic formulations.

The present study aims to conduct a comprehensive analytical evaluation of *Arimedadi tailam* prepared as per classical guidelines. This includes organoleptic assessment, physicochemical analysis, preliminary phytochemical screening of chloroform extracts, and GC-MS profiling of hexane extracts to identify key compounds and their potential pharmacological actions. By elucidating the chemical profile, this research contributes to the standardization of *Arimedadi tailam*, supporting its role in evidence-based Ayurvedic practice for oral health management.

2. Materials and Methods

2.1. Collection of Raw Materials

Raw materials were procured from verified suppliers in Kerala, India, with strict adherence to quality and purity standards in accordance with API guidelines.

2.2. Preparation of *Arimedadi thailam*

The *Arimedadi thailam* was prepared following the classical Sneha Kalpana method.The list of ingredients,it's botanical name, parts used and used form are shown in Table no 1.

Table 1 Composition of *Arimedadi thailam*

Sl.No	Sanskrit Name	Botanical Name	Part	Form
1	Khadira	*Acacia catechu*	Ht.Wd.	Dct.
2	Arimeda	*Acacia leucophloea*	St.Bk.	Dct.
3	Ushira	*Vetiveria zizanioides*	Rt.	Pdr.
4	Ambu (Hrivera)	*Coleus vettiveroides*	Rt.	Pdr.
5	Pathanga	*Caesalpinia sappan*	Ht.Wd.	Pdr.
6	Gairika	Red ochre(iron oxide -Fe_2O_3)	As Such	Pdr.
7	Chandana	*Santalum album*	Ht.Wd.	Pdr.
8	Raktha Chandana	*Pterocarpus santalinus*	Ht.Wd.	Pdr.
9	Lodhra	*Symplocos racemosa*	St.Bk.	Pdr.
10	Prapoundarika	*Saccharum officinarum*	Rt.	Pdr.
11	Yashtimadhu	*Glycyrrhiza glabra*	Rt.	Pdr

12	Laksha	*Laccifer lacca*	Gl.	Pdr.
13	Rasanjana (Daruharidra)	*Coscinium fenestratum*	St.Ext.	Pdr.
14	Sauviranjana	Antimony trisulfide (Sb_2S_3)	As Such	Pdr.
15	Dhataki	*Woodfordia fruticosa*	Fl.	Pdr.
16	Katphala	*Myrica esculenta*	St.Bk.	Pdr.
17	Haridra	*Curcuma longa*	Rz.	Pdr.
18	Daruharidra	*Coscinium fenestratum*	St.	Pdr.
19	Harithaki	*Terminalia chebula*	Fr.Rd.	Pdr.
20	Vibhithaki	*Terminalia bellirica*	Fr.Rd.	Pdr.
21	Amalaki	*Emblica officinalis*	Fr.Rd.	Pdr.
22	Twak	*Cinnamomum verum*	St.Bk.	Pdr.
23	Ela	*Elettaria cardamomum*	Fr.	Pdr.
24	Pathra	*Cinnamomum tamala*	Lf.	Pdr.
25	Nagakesara	*Mesua ferrea*	Stmn.	Pdr.
26	Jongaka (Agaru)	*Aquilaria agallocha*	Ht.Wd.	Pdr.
27	Mustha	*Cyperus rotundus*	Rz.	Pdr.
28	Majishta	*Rubia cordifolia*	Rt.	Pdr.
29	Nyagrodha	*Ficus benghalensis*	Ar.	Pdr.
30	Yavasaka	*Tragia involucrata*	Wh.Pl.	Pdr.
31	Jatamansi	*Nardostachys jatamansi*	Rt.	Pdr.
32	Padmaka	*Prunus cerasoides*	Ht.Wd.	Pdr.
33	Elavaluka	*Prunus avium*	St.Bk.	Pdr.
34	Samanga	*Mimosa pudica*	Wh.Pl.	Pdr.
35	Jathiphala	*Myristica fragrans*	Sd.	Pdr.
36	Jathipathra	*Myristica fragrans*	Ar.	Pdr.
37	Lavanga	*Syzygium aromaticum*	Fl.Bd.	Pdr.
38	Kankola	*Piper cubeba*	Fr.	Pdr.
39	Karpoora	*Cinnamomum camphora*	Ext.	Pdr.
40	Thila Thailam	Sesame oil	As Such	

2.3. Preparation Process

2.3.1. Organoleptic Analysis

The color, odor, and consistency were evaluated in compliance with the standards outlined in the Ayurvedic Pharmacopoeia of India (API).[6]

2.3.2. Physicochemical Analysis

Specific gravity, refractive index, acid value, saponification value, iodine value, and moisture content were determined in accordance with the standards prescribed in the Ayurvedic Pharmacopoeia of India (API).[6]

2.3.3. Preliminary Phytochemical Analysis

Carbohydrates, proteins, glycosides, steroids, flavonoids, phenols, saponins, alkaloids, and terpenoids [7]were qualitatively analyzed in the chloroform extract of *Arimedadi thailam* using standard phytochemical tests.

2.3.4. Gas Chromatography-Mass Spectrometry (GC-MS) Analysis

Hexane extracts were subjected to GC–MS analysis using a DB-5MS column. The oven temperature was programmed to increase from 60 °C to 280 °C at a rate of 10 °C/min, and compound identification was performed by comparison with the NIST database.[8]

3. Results

3.1. Organoleptic Analysis

Primary evaluation is based on its colour, odour and consistency. These observations were tabulated in Table no.2

Table 2 Organoleptic analysis of *Arimedadi thailam*

No	Characters	Results
1	Colour	Yellowish Red
2	Odour	Characteristic
3	consistency	Liquid (oil)

3.2. Physicochemical Analysis

The results of the physicochemical analysis of *Arimedadi thailam* are provided in Table no. 3.

Table 3 Physicochemical analysis of *Arimedadi thailam*

No	Parameters	Results
	Rancidity	Negative
	Moisture %	NMT 0.5%
	Refractive index.	1.468-1.472
	Saponification value	NMT 225
	Acid value	NMT 6
	Iodine value	103-120
	Specific gravity	0.910-0.920

3.3. Phytochemical Analysis

The chloroform extract revealed the presence of key bioactive compounds, as shown in Table 4.

Table 4 Phytochemical Analysis of *Arimedadi thailam*

Sl No:	Organic Phytochemical constituents	Name of the test conducted	*Arimedadi thailam*s (Chloroform Extract)
1	Carbohydrate	Molisch's test	+
2	Sugar	Benedict's test	_
3	Reducing Sugar	Fehling's test	+
4	Ketose	Seliwanoff's test	_

5	Protein	Biuret test	_
6	Starch	K I test	+
7	Glycoside	Salkowski test	+
8	Steroid		+
9	Terpenoid		_
10	Flavonoid	Alkaline reagent	_
11	Phenol	Phenol reagent test	+
12	Saponin	Foam test	_
13	Alkaloid	Wagner's reagent	+
14	Tannin	Ferric chloride test	_
15	Coumarin	NaOH test	_
16	Aminoacids	Ninhydrin test	_
17	Quinone	H_2SO_4 test	+

3.4. GC-MS Analysis

The GC-MS analysis identified bioactive compounds, with their retention times, area percentages, and pharmacological actions presented in Table 5 and illustrated in Fig. 1.

Table 5 GC-MS Analysis of *Arimedadi thailam*

Sl. No.	**Constituent**	**Chemical formula**	**Retention Time**	**Area %**	**Action**
1.	Isoborneol	$C_{10}H_{18}O$	13.76	63.69%	Antimicrobial Properties[9], Anti- Viral[10] Anti-inflammatory Properties
2.	Linoleic acid	$C_{18}H_{32}O_2$.	30.3	6.46%	Anti oxidant Properties [11]
3.	Stigmastan-3,5-diene	$C_{29}H_{48}$	37.58	4.52%	Anti-inflammatory Properties[12] Antimicrobial Properties Anti oxidant Properties
4.	Vitamin E	$C_{29}H_{50}O_2$	38.31	0.86%	Antioxidant [13] and Immune-modulatory[14] mechanisms
5.	D-asarinin	$C_{20}H_{18}O_6$	38.93	1.18%	Anti-inflammatory Properties[15]
6.	Campesterol	$C_{28}H_{48}O$	39.53	1.64%	Anti-inflammatory Properties[12]
7.	γ-Sitosterol	$C_{29}H_{50}O$	40.68	4.84%	Anti-inflammatory Properties[16] Anti oxidant Properties[17]

8.	9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester	$C_{21}H_{40}O_4$	33.07	0.91%	Antimicrobial Properties[18]
9.	Camphor	$C_{10}H_{16}O$	13.31	4.64%	Anti-inflammatory Properties[19] Antimicrobial Properties
10.	Ergost-5-en-3-ol, acetate	$C_{30}H_{50}O_2$	37.24	2.28%	Anti-inflammatory Properties[20]
11.	Stigmasta-5,22-dien-3-ol, acetate	$C_{31}H_{50}O_2$	37.46	1.46%	Anti-inflammatory Properties Anti oxidant Properties[21]
12.	Squalene	$C_{21}H_{40}O_4$	35.63	0.78%	Antioxidant Properties[22]

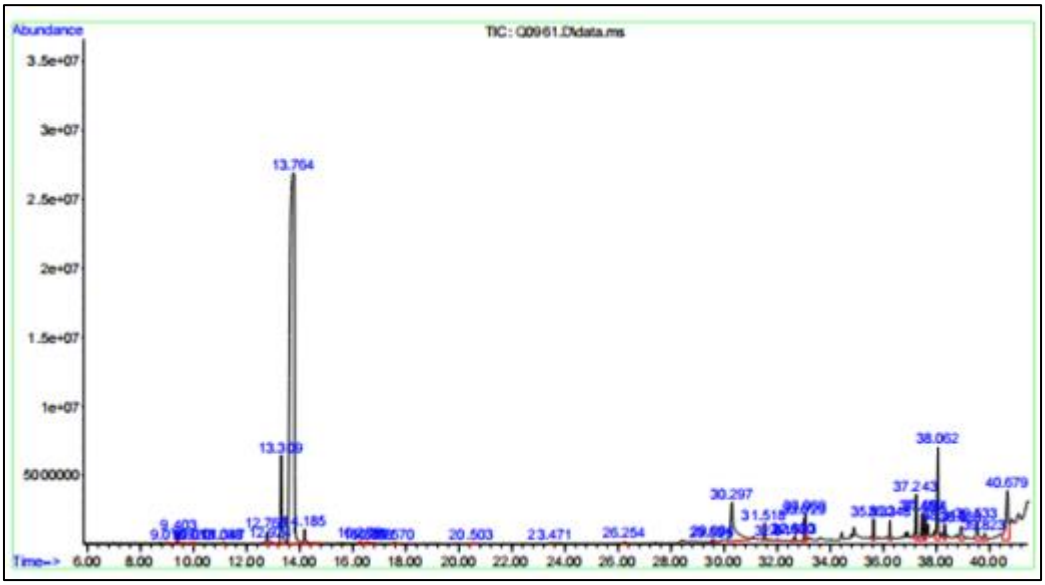

Figure 1 GC-MS Chromatogram of *Arimedadi thailam*

4. Discussion

The analytical evaluation of *Arimedadi tailam* provides significant insights into its chemical composition and therapeutic potential, effectively bridging traditional Ayurvedic knowledge with modern scientific validation. The organoleptic characteristics—yellowish-red color, characteristic odor, and viscous consistency—align with the expected properties of a sesame oil-based Sneha Kalpana formulation, confirming adherence to classical preparation methods outlined in Sahasrayogam. The physicochemical parameters, including a low acid value (NMT 6) and specific gravity (0.910–0.920), indicate high stability and quality, meeting API standards. These attributes ensure the formulation's suitability for prolonged storage and therapeutic use, critical for its application in oral health practices like Gandusha and Kavala.

Preliminary phytochemical screening of chloroform extracts revealed a diverse array of bioactive constituents, including carbohydrates, reducing sugars, glycosides, steroids, phenols, alkaloids, and quinones. These compounds likely contribute to the formulation's multifaceted therapeutic effects, such as antimicrobial activity against oral pathogens and anti-inflammatory properties for managing conditions like gingivitis. Notably, the absence of certain compounds like flavonoids and tannins in the chloroform extract suggests that these may be present in other fractions or require different extraction methods, warranting further investigation.

The GC-MS analysis of hexane extracts provided a detailed chemical profile, identifying key bioactive compounds such as isoborneol (63.69%), linoleic acid (6.46%), γ-sitosterol (4.84%), vitamin E (0.86%), and camphor (4.64%). Isoborneol, the most abundant compound, is well-documented for its antimicrobial properties, particularly against oral pathogens like *Streptococcus mutans*, and its anti-inflammatory effects, which support the traditional use of *Arimedadi tailam* for treating oral infections and inflammation. Linoleic acid, a polyunsaturated fatty acid, and γ-sitosterol, a phytosterol, contribute antioxidant and anti-inflammatory activities, enhancing the formulation's efficacy in reducing gingival index and bleeding scores, as observed in clinical studies comparing it to chlorhexidine gluconate[4]. Vitamin E and squalene (0.78%) further bolster tissue repair and immune modulation, critical for periodontal health. Camphor, another significant constituent, exhibits both antimicrobial and anti-inflammatory properties, potentially enhancing the oil's efficacy in oral hygiene practices by reducing microbial load and soothing inflamed tissues. The presence of minor compounds like D-asarinin (1.18%) and campesterol (1.64%) adds to the anti-inflammatory spectrum, while stigmastan-3,5-diene (4.52%) and ergost-5-en-3-ol, acetate (2.28%) contribute to the formulation's antioxidant and antimicrobial effects. The high area percentage of isoborneol suggests it is a primary driver of the formulation's bioactivity, but the synergistic interactions among these compounds likely amplify the overall therapeutic impact, a hallmark of polyherbal Ayurvedic formulations.

The GC-MS results also highlight the importance of the Sneha Kalpana preparation method, which facilitates the extraction of both lipid-soluble and volatile compounds, as evidenced by the presence of terpenoids like isoborneol and camphor. However, the variability in peak intensities and area percentages (e.g., isoborneol's dominance at 63.69%) may reflect differences in raw material quality or processing conditions, underscoring the need for standardized sourcing and preparation protocols. Comparing these findings with existing literature, the identified compounds align with those reported in studies of individual herbs like Khadira and Triphala, reinforcing the formulation's pharmacological basis. For instance, the antioxidant properties of vitamin E and squalene corroborate studies on sesame oil-based formulations, while isoborneol's antiviral and antimicrobial effects, as noted in prior research, support its role in combating oral pathogens.

The synergy of these phytochemicals explains the efficacy of *Arimedadi tailam* in managing Mukharoga, corroborating traditional claims with empirical evidence. However, variations in raw material quality, sourcing, and preparation techniques could affect reproducibility, highlighting the need for standardized protocols. The study's findings also underscore the importance of advanced analytical techniques like GC-MS in validating Ayurvedic formulations, facilitating regulatory compliance and global acceptance. Future research should focus on clinical trials to further substantiate these findings and explore the formulation's efficacy against specific oral pathogens, as well as its potential in broader dental applications.

5. Conclusion

This comprehensive analytical study of *Arimedadi tailam* confirms its chemical composition and therapeutic potential, reinforcing its role as a valuable Ayurvedic formulation for oral health management. The organoleptic, physicochemical, and phytochemical analyses validate the quality and stability of the formulation, prepared as per classical Sneha Kalpana guidelines. GC-MS profiling identified bioactive compounds like isoborneol, linoleic acid, and γ-sitosterol, which underpin the formulation's antimicrobial, anti-inflammatory, and antioxidant properties, aligning with its traditional indications for Mukharoga. These findings bridge the gap between Ayurvedic wisdom and modern science, providing a foundation for standardization and evidence-based practice. *Arimedadi tailam* emerges as a promising adjunct in oral care, with potential for broader application pending further clinical validation. This research contributes to the scientific acceptance of Ayurvedic formulations, paving the way for their integration into contemporary healthcare systems.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Sharma PV. *Dravyaguna Vijnana*. Vol. 1–3. Varanasi: Chaukhamba Bharati Academy; 2006.

[2] Krishnan Vaidyan KV, Sivaraman Nair R. *Sahasrayogam*. Alappuzha: Vidyarambham Publishers; 1994.

[3] Rautray S, Subramanian P, Arumugham IM. Role of traditional Ayurvedic oils in the management of oral diseases. *AYU*. 2011;32(3):409–13.

[4] Asokan S, Emmadi P, Chamundeswari R. Effect of oil pulling on plaque-induced gingivitis: a randomized, controlled, triple-blind study. *Indian J Dent Res*. 2009;20(1):47–51.

[5] Rajkumar R, Joy J, Kuttan R. GC–MS analysis of bioactive components in selected Ayurvedic medicated oils. *Int J Pharm Sci Res*. 2012;3(12):4781–7.

[6] Anonymous. The Ayurvedic Pharmacopoeia of India. Government of India, Ministry of Health and Family Welfare, New Delhi. 2008;1(6).

[7] Joy A, Francis S. Comparative Pharmacognostic and Phytochemical Analysis of Three Market Samples of Rasna: Pluchea lanceolata, Alpinia officinarum, and Alpinia calcarata. Journal of Ayurveda and Integrated Medical Sciences. 2024;9(12):81-90.

[8] . Sparkman OD, Penton Z, Kitson FG. Gas Chromatography and Mass Spectrometry: A Practical Guide. 2nd ed. California: Academic Press, 2011.

[9] E Silva, A. T. M., Pereira, V. V., Takahashi, J. A., Silva, R. R., & Duarte, L. P. (2018). Microwave-assisted synthesis of borneol esters and their antimicrobial activity. Natural Product Research, 32(14), 1714–1720.

[10] Armaka, M., Papanikolaou, E., Sivropoulou, A., & Arsenakis, M. (1999). Antiviral properties of isoborneol, a potent inhibitor of herpes simplex virus type 1. Antiviral Research, 43(2), 79–92. https://doi.org/10.1016/S0166-3542(99)00036-4

[11] Ramadan, M. F., & Moersel, J. T. (2006). Screening of the antiradical action of vegetable oils. Journal of Food Composition and Analysis, 19(8), 838–842.

[12] Navarro, A., De Las Heras, B., & Villar, A. (2001). Anti-inflammatory and immunomodulating properties of a sterol fraction from Sideritis foetens. Biological & Pharmaceutical Bulletin, 24(5), 470–473. https://doi.org/10.1248/bpb.24.470

[13] Traber, M. G., & Atkinson, J. (2007). Vitamin E, antioxidant and nothing more. Free Radical Biology and Medicine, 43(1), 4–15. https://doi.org/10.1016/j.freeradbiomed.2007.03.024

[14] Meydani, S. N., Han, S. N., & Wu, D. (2005). Vitamin E and immune response in the aged: Molecular mechanisms and clinical implications. Immunological Reviews, 205(1), 269–284. https://doi.org/10.1111/j.0105-2896.2005.00274.x

[15] Lee HB, Kim EK, Park SJ, Bang SG, Kim TG, Chung DW. Isolation and anti-inflammatory effect of astragalin synthesized by enzymatic hydrolysis of tea seed extract. J Sci Food Agric. 2011 Oct;91(13):2315-21. doi: 10.1002/jsfa.4457. Epub 2011 May 12. PMID: 21567414.

[16] Loizou, S., Lekakis, I., Chrousos, G. P., & Moutsatsou, P. (2010). β-Sitosterol exhibits anti-inflammatory activity in human aortic endothelial cells. Molecular Nutrition & Food Research, 54(4), 551–558. https://doi.org/10.1002/mnfr.200900012

[17] Vivancos, M., & Moreno, J. J. (2005). β-Sitosterol modulates antioxidant enzyme response in RAW 264.7 macrophages. Free Radical Biology and Medicine, 39(1), 91–97. https://doi.org/10.1016/j.freeradbiomed.2005.02.025

[18] McGaw, L. J., Jäger, A. K., & van Staden, J. (2002). Antibacterial effects of fatty acids and related compounds from plants. South African Journal of Botany, 68(4), 417–423. https://doi.org/10.1016/S0254-6299(15)30367-7

[19] Lee, H. J., Hyun, E. A., Yoon, W. J., et al. (2006). In vitro anti-inflammatory and anti-oxidative effects of Cinnamomum camphora extracts. Journal of Ethnopharmacology, 103(2), 208–216. https://doi.org/10.1016/j.jep.2005.08.009

[20] Yasukawa, K., Akihisa, T., Kanno, H., et al. (1996). Inhibitory effects of sterols isolated from Chlorella vulgaris on 12-O-tetradecanoylphorbol-13-acetate-induced inflammation in mouse skin. Biological & Pharmaceutical Bulletin, 19(4), 573–576. https://doi.org/10.1248/bpb.19.573

[21] Yoshida, Y., & Niki, E. (2003). Antioxidant effects of phytosterols and their derivatives. Journal of Nutritional Science and Vitaminology, 49(4), 277–280. https://doi.org/10.3177/jnsv.49.277

[22] Huang, Z. R., Lin, Y. K., & Fang, J. Y. (2009). Biological and pharmacological activities of squalene and related compounds: Potential uses in cosmetic dermatology. Molecules, 14(1), 540–554. https://doi.org/10.3390/molecules14010540