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REVIEW ARTICLE

The Secret Garden of Skin Health: A Mini Review of *Centella asiatica* and *Salvia Rosmarinus.*

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Abstract

Amidst increasing demands for skin care solutions, extensive research has been devoted to exploring the properties of natural ingredients, particularly *Centella asiatica* and *Salvia rosmarinus*. *Centella asiatica* is known for its high content of triterpenoids and flavonoids, which provide multiple benefits for the skin, including soothing sensitive skin, reducing inflammation, and improving skin hydration. On the other hand, *Salvia rosmarinus* contains antioxidant metabolites and has emerged as a potent antioxidant, anti-inflammatory, and antimicrobial agent, helping to protect skin from redness and premature ageing. This review employed a systematic approach, involving meticulous research articles and a selection of narrative reviews based on specific inclusion criteria. Databases such as Web of Science, Scopus, Google Scholar, and Research Gate were utilized for this mini-review. A bibliometric analysis was also employed using Bibliometrix software, providing insight into literature trends. Phytochemical analyses shed light on the active compounds in *Centella asiatica* and *Salvia rosmarinus*, offering a comprehensive understanding of their roles in promoting skin health, such as collagen synthesis and skin rejuvenation. Furthermore, pharmacological studies supported the efficacy of these compounds in wound healing, inflammation reduction, and UV damage prevention. The bibliometric analysis underscored a global interest in this field, highlighting top institutions, journals, and highly cited articles. Emerging trends, such as “autophagy” and “composites” in *Centella asiatica* and “enhancement” and “product” in *Salvia rosmarinus*, indicate evolving research directions. This mini-review consolidates existing knowledge, emphasising the potential of these natural ingredients to meet the ever-evolving demands within the skincare industry.
Keywords: *bibliometric, Centella asiatica, pharmacology, phytochemical, Salvia rosmarinus.*

Introduction

The skincare industry has witnessed a surge in demand due to increasing awareness regarding personal grooming and rising consumer demand for specific skincare solutions. The industry includes various cosmetic products such as creams, lotions, sunscreen, and baby skincare products. According to Fortune Business Insights, the global skincare industry was valued at 133.90 billion USD in 2018 and is projected to reach 200.25 billion USD by 2026 [1]. Among the myriad ingredients available in the market, *Centella asiatica* and *Salvia rosmarinus* have emerged as pivotal ingredients in promoting skin health due to their unique properties [2,3].

*Centella asiatic*a (*C. asiatica*), also known as Indian pennywort, gotu kola, or brahmi, is a medicinal herb with a rich history of use in traditional medicine systems such as Ayurveda, Chinese medicine, and Indonesian medicine for thousands of years [4,5]. *C. asiatica* can soothe sensitive skin, alleviate inflammation, and enhance hydration [6,7]. It also treats eczema, rosacea, and acne [8–10]. This plant is rich in active compounds, including saponins, phenolic acid, triterpenoids, and flavonoids, which contribute to its antibacterial, anti-ageing, anti-inflammatory, and antioxidant activities [6,7]. Studies have shown that *C. asiatica* promotes tissue regeneration and stimulates fibroblast proliferation and collagen synthesis [11,12]. The market size of *C. asiatica* was valued at USD 401 million in 2023 and is anticipated to reach USD 581 million by 2030 [3].

Salvia rosmarinus (*S. rosmarinus,* previously known as *Rosmarinus officinalis*), commonly known as rosemary, is an evergreen herb native to the Mediterranean region. It belongs to the mint family, and shares close botanical ties with other herbs like oregano, lavender, basil, and thyme [13,14]. *S. rosmarinus*, enriched with terpenoids, flavonoids, phenolic acids, and alkaloids, significantly contributes to skin health. It acts as a natural antioxidant, protecting the skin from free radicals that lead to premature ageing, and offers numerous benefits for maintaining healthy skin. [15,16]. Its anti-inflammatory properties can also alleviate redness associated with skin conditions such as eczema [17]. *S. rosmarinus* also serves as a comprehensive solution for skin irritation, featuring potent antibacterial properties that combat acne-causing bacteria and prevent them from infiltrating pores [18,19]. Additionally, *S. rosmarinus* acts as a natural astringent by controlling oil and reducing the appearance of large pores. The market size of *S. rosmarinus* is anticipated to reach 1.323 million USD by 2032, a notable increase from 829 million USD in 2022 [2].

This paper aims to comprehensively review the phytochemicals found in *C. asiatica* and *S. rosmarinus*, exploring their potential impact on skin health. It also examines the pharmacological properties of these phytochemicals and their effects on promoting and enhancing skin health. The literature trends of *C. asiatica* and *S. rosmarinus* on skin health were also analysed using a bibliometric approach.

Methodology

This review collects information on *C. asiatica* and *S. rosmarinus* through specific inclusion criteria, encompassing research articles and narrative reviews that delve into both plants' phytochemicals and pharmacological properties. The scope of the review incorporates studies conducted through both *in-vitro* and *in-vivo* approaches. Specifically, it explores into four prominent phytochemicals and five pharmacological attributes of *C. asiatica* and *S. rosmarinus*, focusing on their effects on skin health. Article searches were systematically conducted, and data were sourced from various databases, such as Web of Science (WOS), Scopus, Google Scholar, and Research Gate. The bibliometric approach was also employed using the keywords in Figure 1. The WOS database was employed in this analysis as it is widely used for research publications and citations, providing balanced, selective, and complete coverage [20].

Bibliometrix was also used to identify the most used keywords and emerging trends in *C. asiatica* and *S. rosmarinus* in skin health [21].

Results and discussion

Phytochemical properties of Centella asiatica and S. rosmarinus

C. asiatica contains various phytochemicals, including saponins, phenolic acids, triterpenoids, and flavonoids, all contributing to its potential benefits for skin health [5,7]. Among these phytochemicals present in *C. asiatica*, four key active compounds are commonly isolated and extracted for their positive effects on the skin: asiaticoside, madecassoside, asiatic acid, and madecassic acid (Figure 2 a-d). Asiaticoside and madecassoside belong to the group of pentacyclic triterpene glycosides, classified explicitly as saponins [12,22]. On the other hand, asiatic acid and madecassic acid are categorised as aglycones or sapogenins, representing the non-sugar moiety of the saponins [23]. These four triterpene saponins mentioned above are significant secondary metabolites produced through the isoprenoid pathway. The synthesis involves the creation of aglycones combined with a hydrophilic sugar chain (glycone, asiaticoside, and madecassoside) [13]. This combination is responsible for the biological activity exhibited by these saponins, contributing to their potential to enhance skin health.

The four active compounds mentioned above offer multiple benefits for skin health, including anti-ageing, wound healing, hydration, antibacterial, and anti-inflammatory [4,8,24]. These metabolites possess potent antioxidant properties crucial for shielding the skin against free radicals and UV-induced skin damage [25]. Additionally, they promote collagen production, speeding up wound healing and diminishing signs of ageing [23]. As effective hydrating agents, these compounds assist in retaining skin moisture and repairing the skin barrier [8]. Moreover, their antibacterial properties contribute to suppressing the growth of acne-causing bacteria, thereby reducing the likelihood of breakouts [8]. The anti-inflammatory benefits of these components are also crucial in calming skin irritation [10]. Additionally, they also have the potential to prevent hyperpigmentation and suppress hypertrophic scarring [12].

S. rosmarinus also contains various active compounds beneficial for skin health, including terpenoids, flavonoids, phenolic acids, and alkaloids [13,14]. These compounds have antioxidant, anti-inflammatory, and antimicrobial properties that can help protect the skin from free radicals, environmental stressors, and acne [16,26]. *S. rosmarinus* is also a natural astringent that can help tighten and tone the skin and scalp, making it a good choice for those who want to improve the appearance of dull skin or hair [14,18]. In addition, *S. rosmarinus* can help improve skin elasticity and promote better hydration. [16]. Four main active ingredients that improve skin health are carnosic acid, carnosol, caffeic acid, and rosmarinic acid (Figure 3).

Carnosic acid is a natural benzendiol abietane diterpene rich in antioxidants [27,28]. This lipophilic antioxidant has been found to inhibit lipid peroxidation, which can help protect the skin from oxidative stress and damage [29]. Its high reactive affinity to free radicals allows it to oxidise and prevent damage easily [29]. Carnosol is a derivative of carnosic acid containing a lactone ring, and it can inhibit the activity of enzymes that break down collagen and elastin, which can help prevent the signs of ageing and improve skin texture [28,30]. Carnosol also has anti-inflammatory effects that can help reduce inflammation and skin redness [14].

Caffeic acid is a polyphenol known for its potent antioxidant and anti-inflammatory properties [31]. However, caffeic acid is less extensively studied than rosmarinic acid, a caffeic acid derivative, due to its lower abundance than rosmarinic acid [26,31]. Rosmarinic acid is known for its antioxidant and anti-inflammatory effects [17]. It also calms the skin, making skin problems more tolerable during the healing process [13,32].

Additionally, rosmarinic acid has been shown to stimulate collagen type I synthesis in skin fibroblasts, improving skin texture and appearance [15,26]. It also enhances skin barrier function by activating sodium proton exchanger I, which helps maintain a healthy skin barrier and normal pH levels. [17].

Pharmacological properties of Centella asiatica and S. rosmarinus

In the current literature, various studies (*in vitro* and *in vivo*) have investigated the efficacy of *C. asiatica* and *S. rosmarinus* in improving skin health. In a clinical trial, the effect of a 0.05% w/w ECa 233 (*C. asiatica* extract containing 51% madecassoside and 38% asiaticoside) gel on wound healing after laser resurfacing treatment was examined [33]. Thirty individuals with acne scars underwent laser resurfacing treatment, with one-half of the face treated with ECa 233 and the other half with a placebo gel. The ECa 233-treated side showed superior improvements in skin erythema, crusting, and overall wound appearance compared to the placebo treated side. [33].

Another study investigated the effect of madecassoside in *C. asiatica* on inflammation caused by *Propionibacterium acne* and skin hydration [8]. The study highlighted that madecassoside significantly inhibited pro-inflammatory cytokine interleukin-1 beta (IL-1β), toll-like receptor 2 (TLR2), and nuclear translocation of nuclear factor kappa B (NF-κB) in *P. acnes*-stimulated THP-1 human monocytic cells. Furthermore, this study also used two cell lines, HaCaT keratinocytes and human dermal fibroblasts, to assess the effect of madecassoside on hydration levels. The results showed increased of hyaluronic synthase genes (HAS1, HAS 2, and HAS3) and key moisturising factors (hyaluronic acid, aquaporin-3, loricrin, and involucrin) in these cells. This indicates that madecassoside can improve hydration and moisturising levels in skin cells [8].

Since *C. asiatica* has wound-healing properties, a study by Hou et al. (2016) utilised asiaticoside and madecassoside to accelerate burn wound healing in Sprague-Dawley rats [22]. The compounds promoted wound healing in Sprague-Dawley rats compared to the vaseline (control) group. The proposed mechanism behind the wound healing involves promoting collagen synthesis and upregulation the transforming growth factor beta (TGF-β) signalling pathway by promoting SMAD3 gene phosphorylation and SMAD4 binding for enhanced repair [22].

In evaluating *S. rosmarinus* efficacy for skin health, a study by Takayama and co-researchers used a hydroethanolic extract of *Rosmarinus officinalis* (ROe)-loaded emulgel to prevent UVB-related skin damage [32]. The study found that ROe exhibited effective scavenging activity, reducing oxidative damage. The ROe also reduced oedema formation, myeloperoxidase activity, and glutathione depletion, maintaining the skin's ferric-reducing and ABTS scavenging abilities after UVB exposure.

Another study focused on using carnosol, typically found in *S. rosmarinus*, to reduce UVB-induced skin inflammation in HR1 mice [30]. The study found that topical application of carnosol (0.05 $\mu g/cm^2$) effectively inhibited erythema, inflammatory responses, and epidermal thickening. Carnosol also reduced the level of immunoglobulin-E and interleukin-1β in blood serum. Additionally, it inhibited the expression of inducible nitric oxide synthase (iNOS) and inflammation marker cyclooxygenase-2 (COX-2) in the mice. Carnosol also downregulated the activation of the signal transducer and activator of transcription 3 (STAT3), a transcription factor regulating the inflammatory gene expression [30].

Khezri et al. (2019) employed rosemary essential oil in nanostructured lipid carriers (REO-NLCs) to improve *in-vitro*-infected wound healing in mouse models [15]. The study found that REO-NLCs exhibited significant antibacterial activity against *Staphylococcus epidermidis, Staphylococcus. aureus, Listeria monocytogenes, Escherichia coli and Pseudomonas aeruginosa.*

The REO-NLC also positively affected the healing process by improving wound contraction and promoting cell proliferation. Other studies related to the effects of *C. asiatica* and *S. rosmarinus* on skin health can be seen in Table 1.

Bibliometric analysis of Centella asiatica and S. rosmarinus on skin health

The WOS database (Figure 4) identified approximately 5,271 articles related to *C. asiatica* and skin health, spanning 1975 to 2023. The initial two articles on this topic were indexed in WOS in 1975. In the earlier years, the number of papers remained in the single and double digits, not exceeding 100 papers per year. However, a noticeable shift occurred from 2008 onwards, with the publication trend consistently reaching triple digits annually, peaking in 2022 with 495 articles. The number of citations received annually also experienced a significant increase, starting from zero in 1975 to 12,580 citations in 2023.

For *S. rosmarinus* and skin health, approximately 9871 articles were identified, with the first three articles indexed in WOS in 1975. From 1976, the number of papers related to this topic remained in the single digits until 1985, when it reached double digits with ten articles. Subsequently, starting from 2000, the publication trend consistently reached triple digits annually, reaching a peak in 2022 with 860 articles. Similar to *C. asiatica*, the number of citations received yearly for *S. rosmarinus* and skin health experienced a substantial rise, growing from zero in 1975 to 28,661 citations in 2023.

Figure 5 illustrates the ranking of countries based on the number of publications on the related topics of *C. asiatica* and *S. rosmarinus* for skin health research. The number of articles is depicted on a colour gradient, ranging from pale blue (indicating the lowest number of publications) to dark blue (indicating the highest number of publications). For *C. asiatica* and skin health, approximately 125 countries were involved in producing articles, with the United States of America (USA) leading the way with 1094 publications. China and India followed closely, with 805 and 506 articles, respectively. Approximately 29 countries produced over 50 articles, contributing to 88.5% of the total publications. For *S. rosmarinus* and skin health, 133 countries were involved in research production, and the USA also took the lead with 1683 articles. Spain and China followed with 885 and 750 articles, respectively. A total of 45 countries produced more than 50 articles, contributing to 92.0% of the total publications.

Tables 2 and 3 show the top ten institutions, fields, and journals related to *C. asiatica* and *S. rosmarinus* for skin health. The most productive institution that publishes *C. asiatica* for skin health is the University of California, USA, with 87 articles, followed by the Council of Scientific Industrial Research, India, and Universiti Putra Malaysia, Malaysia, with 76 and 66 articles, respectively. Most papers on this topic fall under dermatology, with 1015 articles, showcasing the primary focus on the skin health aspects of *C. asiatica*. This is followed by pharmacology and pharmacy, and biochemistry and molecular biology, with 768 and 421 articles, respectively. The leading journal in this area is the Journal of Cosmetic Dermatology, with 97 articles, followed by Molecules and Contact Dermatitis, with 74 and 72 articles, respectively.

For *S. rosmarinus* and skin health, the most productive institution is the Egyptian Knowledge Bank, Egypt, with 255 articles, followed by the Consejo Superior de Investigaciones Cientificas, Spain, and the University of California, USA, with 233 and 127 articles, respectively. Most papers related to this topic belong to the food science and technology field, with 2,455 articles reflecting the common use of *S. rosmarinus* in culinary applications. This is followed by dermatology and applied chemistry, with 1002 and 917 articles, respectively. The leading journal in this area is Industrial Crops and Products, with 143 articles, followed by the Journal of Cosmetic Dermatology and Contact Dermatitis, with 132 and 93 articles, respectively.

The most cited article for *C. asiatica* is "*In Vitro* and *In Vivo* Wound Healing Activity of Asiaticoside Isolated from *Centella asiatica*" by Shukla et al. (1999) [24]. This article reports the therapeutic benefits of asiaticoside in promoting wound healing through increased collagen production and hydroxyproline content, leading to improved wound healing. While for *S. rosmarinus*, the most cited article is by Bozin et al. (2007) entitled "Antimicrobial and Antioxidant Properties of Rosemary and Sage (*Rosmarinus officinalis* L. and *Salvia officinalis* L., Lamiaceae) Essential Oils" [34]. This article analysed the essential oils of rosemary and sage, revealing significant antimicrobial activity against various bacterial strains and fungi, with notable effects on *Escherichia coli, Salmonella typhi, Salmonella enteritidis, Shigella sonei, Candida albicans*, and dermatomycetes. The rest of the top five most cited articles for each *C. asiatica* and *S. rosmarinus* for skin health can be seen in Table 4.

Table 5 provides the top ten keywords in studies related to *C. asiatica* and *S. rosmarinus* for skin health. The most commonly used keyword for *C. asiatica* is "*in-vitro*," while for *S. rosmarinus*, it is simply "rosemary.". Figure 6 illustrates the trending keyword topics in studies related to *C. asiatica* and *S. rosmarinus* for skin health for the past ten years. The topics that have been trending for *C. asiatica* in recent years (2023) are autophagy and composites. The keyword "autophagy" emerged in recent years, probably due to a compound in *C. asiatica*, madecassoside, which has been shown to activate autophagy in human melanocytes under oxidative stress [35]. The keyword "composites" has emerged recently since some studies have combined *C. asiatica* with other natural skincare ingredients to enhance skin health. For *S. rosmarinus*, recent keyword trends are "enhancement" and "product," likely indicative of developments in research and technology facilitating the enhancement of rosemary properties in skincare products.

Conclusion

In conclusion, *C. asiatica* and *S. rosmarinus* have good properties and activities that improve skin health. *C. asiatica*, enriched with triterpenoids and flavonoids, demonstrates anti-ageing, antibacterial, and anti-inflammatory properties, promoting collagen synthesis and skin hydration. While *S. rosmarinus* contains metabolites such as carnosic acid and rosmarinic acid, it can help protect skin from free radical damage, preventing inflammation and premature skin ageing. Pharmacological studies also validate these plants' efficacy in wound healing, reducing inflammation, and preventing UV damage. Bibliometric analyses reveal an increasing global research interest in improving skin health using *C. asiatica* and *S. rosmarinus*. The top institutions, journals, and highly cited articles underscore the scientific community's focus on *C. asiatica* and *S. rosmarinus* for skin health. Emerging trends, such as autophagy and composites in *C. asiatica* and enhancement and product in *S. rosmarinus*, reflect ongoing research directions. Future research should focus more on clinical trials with specific dosage concentrations and their mechanisms of action and explore the synergistic effect of combining *C. asiatica* and *S. rosmarinus* for enhanced benefits. Overall, these natural ingredients exhibit promising potential in skincare, aligning with the rising consumer demand for safe and effective solutions in the evolving landscape of skin health.

Conflict of Interest:
The authors have no conflict of interest to declare.

Authors' contribution:
M. A. A. M.: Software, Formal analysis, Methodology, Writing - Original Draft; M. F. Z: Formal analysis, Writing - Review & Editing; W. I. W. I.: Writing - Review & Editing; P. M. R.: Writing - Review & Editing, Project administration

Table 1. Studies related to *C. asiatica* and *S. romarinus* effects on skin health.

Compound	Extract type	Treatment	Results	Ref
Centella asiatica extract	Ethanolic leave extract	DNCB-Induced Atopic Dermatitis HaCaT keratinocyte cells and BALB/c mice treated with C*entella asiatica*.	*Centella asiatica* extract inhibits inflammatory cytokine expression in HaCaT cells and reduces mast cell infiltration in mice.	[36]
	Unspecified	Women treated with *Centella asiatica* after microneedling therapy system.	*Centella asiatica* and microneedling therapy system improved facial skin condition.	[37]
	Ethanolic whole plant extract	Hydrogen peroxide-induced senescence human dermal fibroblast cells.	The extracts prevent the repression of DNA replication and mitosis-related gene expression to avoid premature senescence.	[38]
	Ethanolic callus extract	Hydrogen peroxide-induced human dermal fibroblast cells.	Callus extract has promising antioxidant and anti-skin-ageing activities.	[25]
	Titrated extract of *C. asiatica* (TECA)	Ultraviolet B (UVB) damage in human keratinocyte cells.	*Centella asiatica* protects against UVB-induced damage in human keratinocytes.	[39]
Salvia rosmarinus or Rosmarinus officinalis extract	Ethanolic leave extract	Skin bacteria; *Staphylococcus aureus, S. oralis, Pseudomonas aeruginosa*, and *Escherichia coli*	The topical formulation using *Rosmarinus officinalis* extract showed promising antimicrobial activity towards tested bacteria.	[40]
	Alcoholic leave extract	Aryl hydrocarbon receptor (AhR) in human keratinocytes.	*Rosmarinus officinalis* L. leaf extracts and their metabolites inhibit AhR activation (responsible for inflammatory skin conditions and skin cancer).	[41]
	Oil (not specified plant part)	Wistar albino rats with skin flaps.	*Rosmarinus officinalis* extract improved the survival of skin flaps by increasing blood circulation.	[42]
	Hydroalcoholic leave extract	Human melanoma cells (A375)	Rosemary extract reduced the proliferation of melanoma cells and showed down-regulation of proteins crucial for cellular homeostasis.	[43]
	Alcoholic leave extract	*Propionibacterium acnes*- stimulated monocytic THP-1 cells and ICR mice	Rosemary extract suppresses *P. acnes*-induced inflammation by inhibiting pro-inflammatory cytokines through TLR2-mediated NF-jB signalling.	[44]

Table 2. Top ten institutions, fields, and journals related to *Centella asiatica* and skin health.

Top Institution	PC	Top Field	PC	Top Journal	PC
University of California, USA	87	Dermatology	1015	Journal of Cosmetic Dermatology	97
Council of Scientific Industrial Research, India	76	Pharmacology & Pharmacy	768	Molecules	74
Universiti Putra Malaysia, Malaysia	66	Biochemistry and Molecular Biology	421	Contact Dermatitis	72
University of Ohio, USA	64	Medicinal Chemistry	361	Journal of Drugs in Dermatology	72
Chulalongkorn University, Thailand	55	Nursing	348	Journal of Ethnopharmacology	62
Free University of Berlin, Germany	55	Plant Sciences	330	International Journal of Cosmetic Science	58
Charite - Universitatsmedizin Berlin, Germany	51	Multidisciplinary Chemistry	286	Industrial Crops and Products	49
Harvard University, USA	51	Applied Chemistry	261	International Journal of Molecular Sciences	47
Humboldt University of Berlin, Germany	51	Food Science and Technology	258	Journal of Wound Ostomy and Continence Nursing	45
China Pharmaceutical University, China	50	Paediatrics	251	Journal of Cosmetic Science	43

PC: publication count

Table 3. Top ten institutions, fields, and journals related to *S. romarinus* and skin health.

Top Institution	PC	Top Field	PC	Top Journal	PC
Egyptian Knowledge Bank, Egypt	255	Food Science and Technology	2455	Industrial Crops and Products	143
Consejo Superior de Investigaciones Cientificas, Spain	233	Dermatology	1002	Molecules	132
University of California, USA	127	Applied Chemistry	917	Journal of Cosmetic Dermatology	93
Centre National de la Recherche Scientifique, France	110	Pharmacology & Pharmacy	698	Contact Dermatitis	74
Islamic Azad University, Iran	108	Biochemistry Molecular Biology	628	Journal of Drugs in Dermatology	73
Universidade de Sao Paulo, Brazil	92	Plant Sciences	588	Antioxidants	66
Universite de Carthage, Tunisia	82	Multidisciplinary Chemistry	526	Journal of Ethnopharmacology	58
University of Ohio, USA	81	Nutrition Dietetics	442	International Journal of Cosmetic Science	56
University Of Zaragoza, Spain	79	Medicinal Chemistry	434	International Journal of Molecular Sciences	54
University of Copenhagen, Denmark	76	Nursing	357	Plant	54

PC: publication count

Table 4. Top five most cited articles related to *Centella asiatica* and *S. romarinus* for skin health.

Compound	Article	CC	Ref
Centella asiatica	*In vitro* and *in vivo* Wound Healing Activity of Asiaticoside Isolated from *Centella asiatica*	140	[11]
	Determination of Biologically Active Constituents in *Centella asiatica*	112	[12]
	Triterpenes from *Centella asiatica* Stimulate Extracellular Matrix Accumulation in Rat Experimental Wounds	97	[13]
	Effect of Different Extracts of *Centella asiatica* on Cognition and Markers of Oxidative Stress in Rats	92	[14]
	Triterpene Composition and Bioactivities of *Centella asiatica*	89	[15]
Salvia rosmarinus or Rosmarinus officinalis	Antimicrobial and Antioxidant Properties of Rosemary and Sage (*Rosmarinus officinalis* L. and *Salvia officinalis* L., Lamiaceae) Essential Oils	243	[16]
	Antioxidative Activity and Phenolic Composition of Pilot-plant and Commercial Extracts of Sage and Rosemary	242	[17]
	Antioxidant and Pro-oxidant Properties of Active Rosemary Constituents: Carnosol and Carnosic Acid	230	[18]
	Antioxidant Activities of Rosemary (*Rosmarinus Officinalis* L.) Extract, Blackseed (*Nigella sativa* L.) Essential Oil, Carnosic Acid, Rosmarinic Acid and Sesamol	214	[19]
	Antioxidant Activity of a Rosemary Extract and Its Constituents, Carnosic Acid, Carnosol, and Rosmarinic Acid, in Bulk Oil and Oil-in-Water Emulsion	207	[20]

CC: Citation count

Table 5. Top ten most used keywords in studies related to *C. asiatica* and *S. romarinus* for skin health.

Centella asiatica	**Frequency**	**Rosemary**	**Frequency**
In-vitro	307	Rosemary	956
Centella asiatica	295	Antioxidant	710
Expression	285	Chemical composition	621
Oxidative stress	280	Antioxidant activity	578
Skin	270	*Rosmarinus officinalis*	578
Acid	238	Extracts	570
Management	202	Acid	478
Antioxidant	191	Antimicrobial activity	460
Apoptosis	153	Quality	435
Activation	147	In-vitro	422

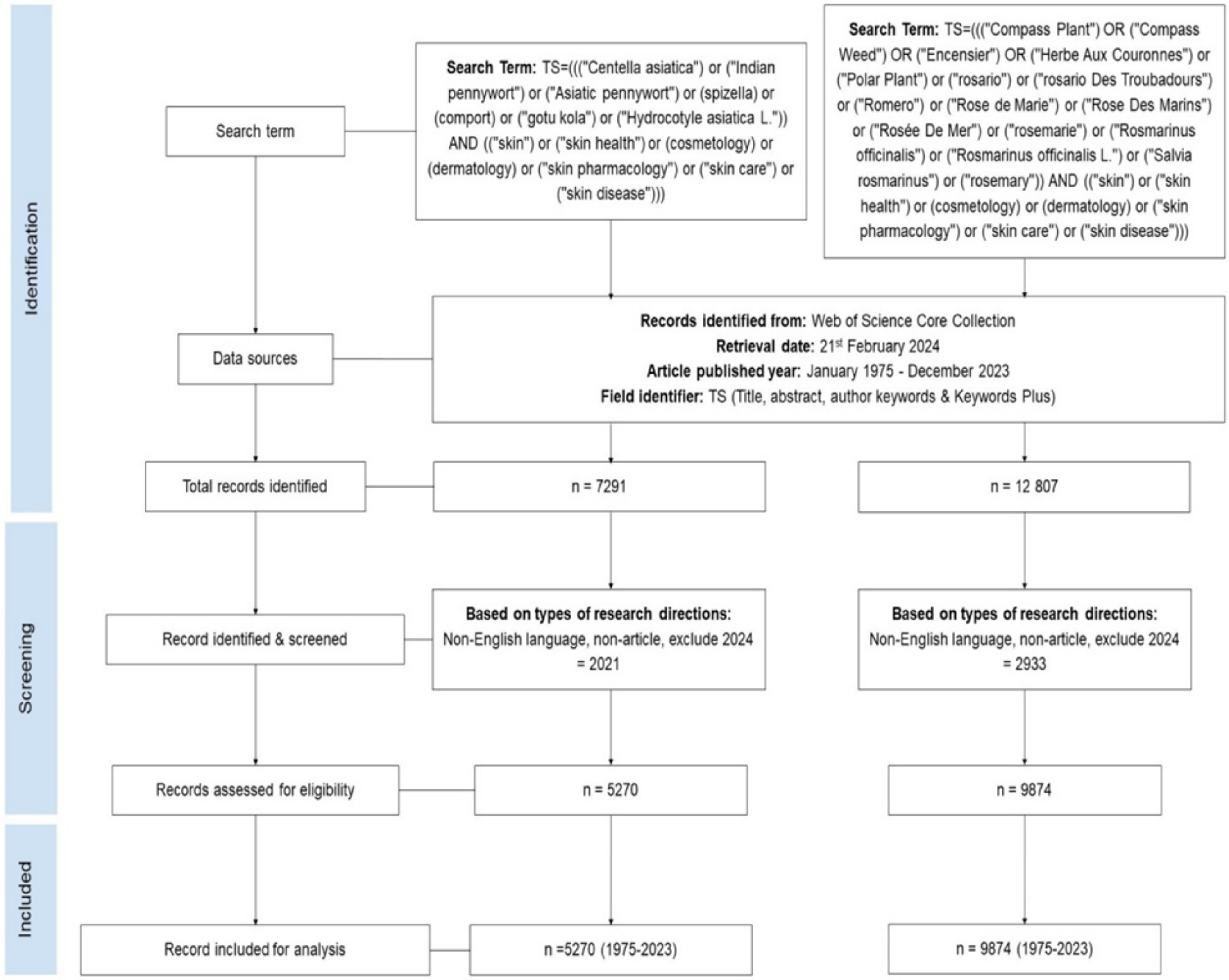

Figure 1. Flowchart of bibliometrics analysis.

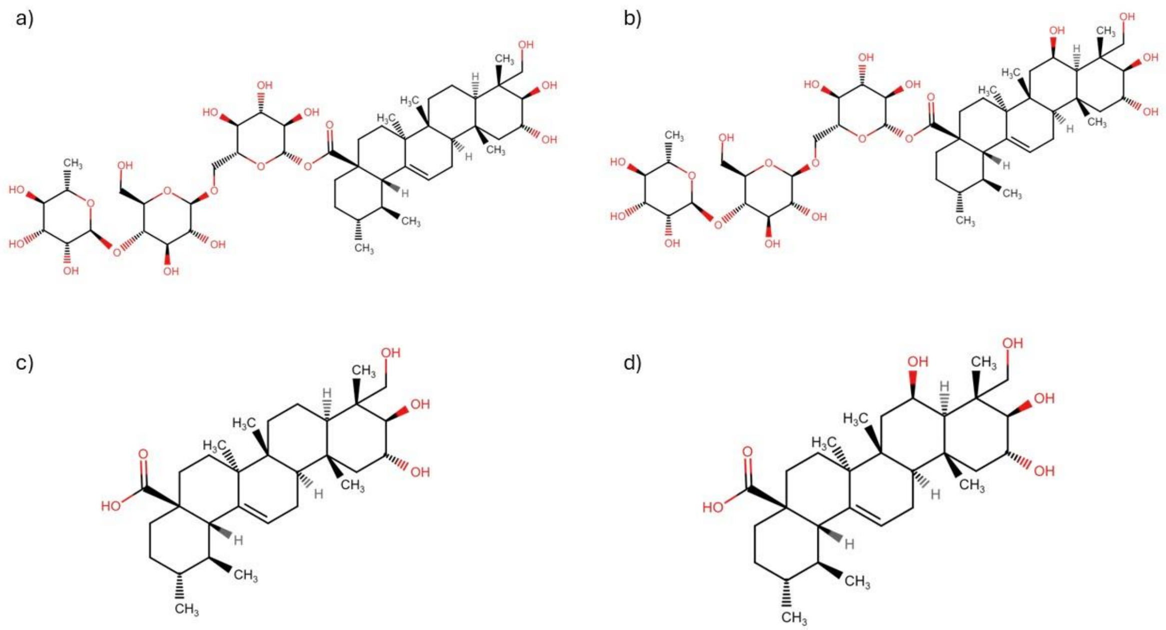

Figure 2. Chemical structure of a) asiaticoside, b) madecassoside, c) asiatic acid, and d) madecassic acid which represent prominent triterpene saponins metabolites in *C. asiatica*.

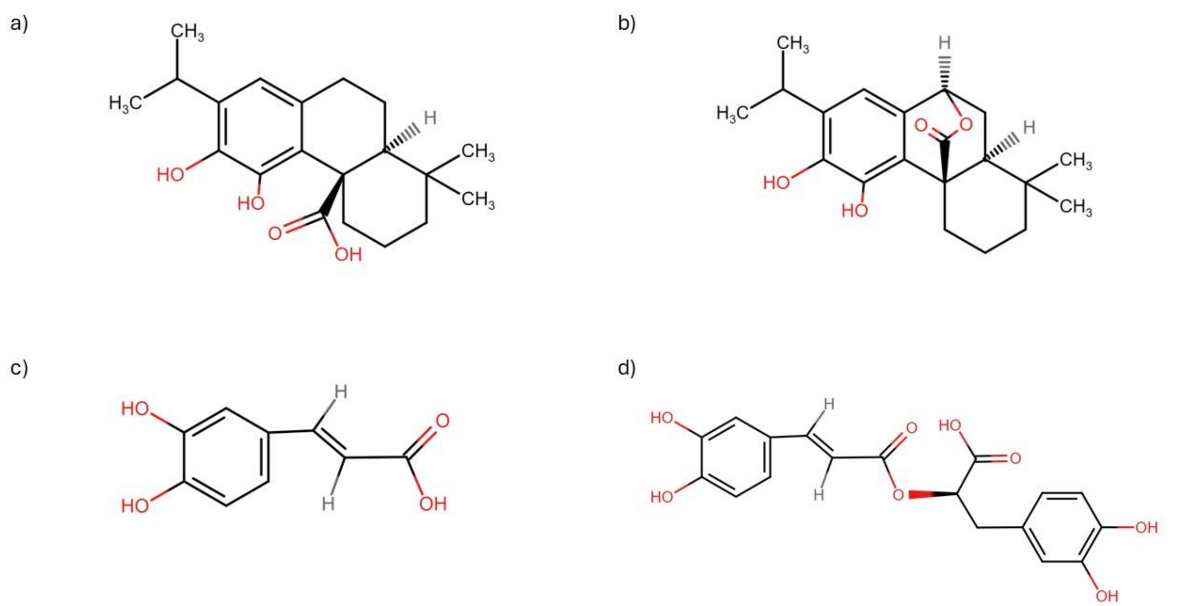

Figure 3. Chemical structure of a) carnosic acid, b) carnosol, c) rosmarinic acid, and d) caffeic acid which represent prominent phenolic compounds in *S. rosmarinus*.

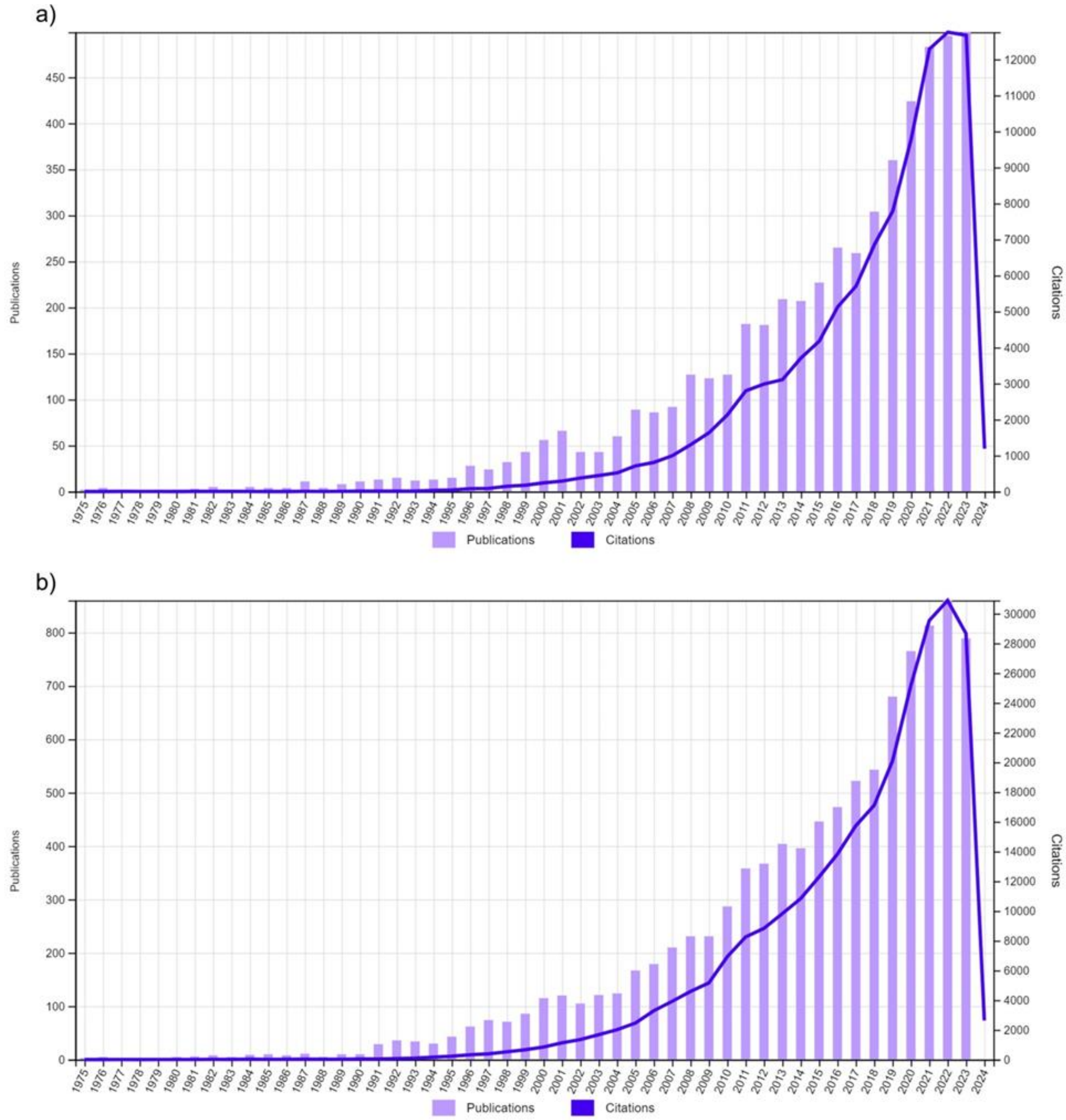

Figure 4. Publication number on a) *Centella asiatica* and b) *S. romarinus* for skin health from 1975 until 2023 and citation count.

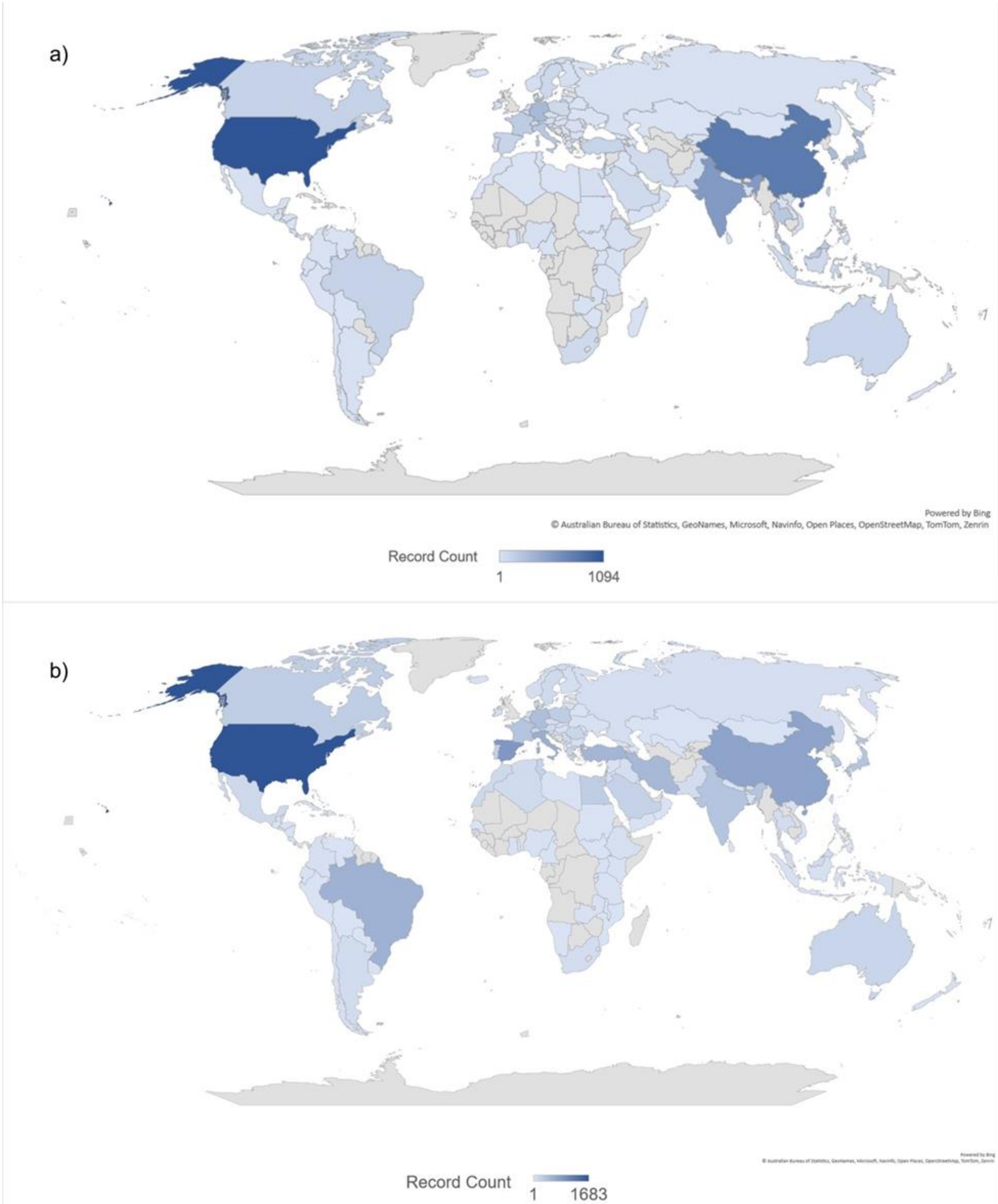

Figure 5. The total number of published articles related to a) *Centella asiatica* and b) *S. romarinus* for skin health.

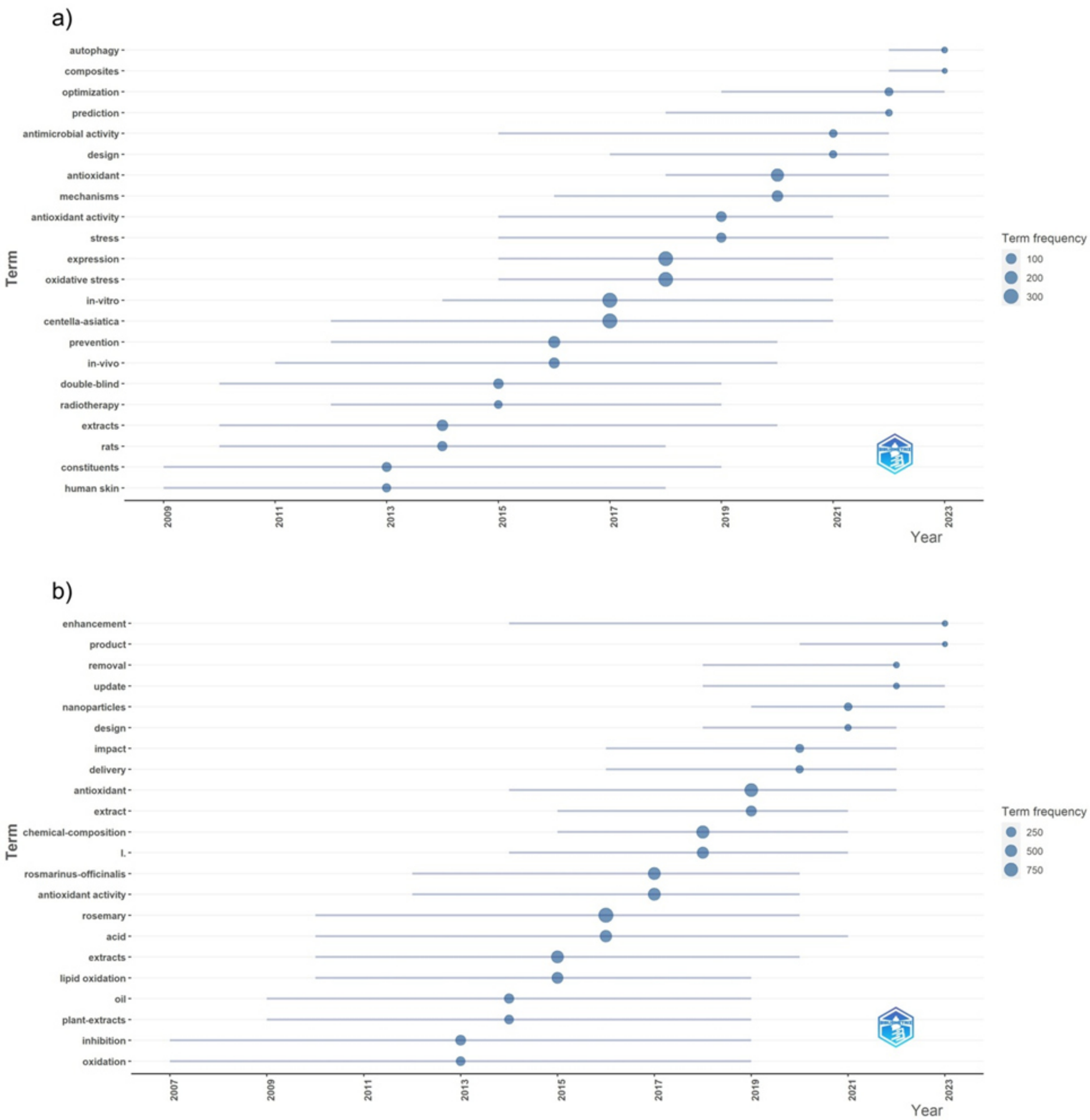

Figure 6. Trending keyword topics for the past ten years in studies related to *Centella asiatica* and *S. romarinus* for skin health.

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