

Supplementary Materials

Systematic Review of Usnic Acid Extraction from Wild-Grown Lichen Biomass

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Table S1. PRISMA 2020 checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	YES (title)
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	YES (abstract)
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	YES (introduction)
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	YES (introduction)
METHODS			

Section and Topic	Item #	Checklist item	Location where item is reported
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	YES (Methods: Section 2.1 Eligibility Criteria)
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	YES (Methods: Section 2.2 Literature Search)
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	YES (Methods: Section 2.2 Literature Search)
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	YES (Methods: Section 2.2 Literature Search; Figure 1 (PRISMA flow diagram))
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	YES (Methods: Section 2.3 Data collection and data items)
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	YES (Methods: Section 2.3 Data collection and data items)
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	YES (Methods: Section 2.3 Data collection and data items)
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	NO (Not performed due to the methodological nature of the review)
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	YES (Methods: Section 2.3 Data collection and data items)

Section and Topic	Item #	Checklist item	Location where item is reported
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	YES (Methods: Section 2.4 Data synthesis)
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	YES (Methods: Section 2.3 Data collection and data items)
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	YES (Methods: Section 2.4 Data synthesis; Table 1)
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	YES (Methods: Section 2.4 Data synthesis)
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	YES (Methods: Section 2.4 Data synthesis)
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	NO (Not performed due to the descriptive nature of the review.)
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NO (Not assessed due to descriptive, non-comparative nature of the review)
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	NO (Not performed.)
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	YES (Methods: Section 2.2; Figure 1 (PRISMA flow diagram))
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	YES (Location: Section 2.1 Eligibility Criteria; Section 2.2 Literature Search)
Study characteristics	17	Cite each included study and present its characteristics.	Section 3.0 Results; Tables 1, 2, and 3; Sections 3.1–3.4
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	NO (Not performed due to the descriptive nature of the review; no comparative or clinical outcomes were assessed.)

Section and Topic	Item #	Checklist item	Location where item is reported
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	YES (Sections 3.1–3.4; Tables 1, 2, and 3)
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	YES (Sections 3.1–3.4; Tables 1, 2, and 3)
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	NO (No meta-analysis performed; data presented descriptively only.)
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Partial (Sections 3.1–3.4)
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	NO (No sensitivity analyses were conducted.)
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Not assessed due to descriptive nature of the review; no comparative or clinical outcomes were evaluated.
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	NO (Not assessed due to descriptive nature of the review; no comparative or clinical outcomes were evaluated.)
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	PARTIAL (Limited discussion; only conclusions provided.)
	23b	Discuss any limitations of the evidence included in the review.	NO
	23c	Discuss any limitations of the review processes used.	NO
	23d	Discuss implications of the results for practice, policy, and future research.	PARTIAL
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	registered in the Open Science Framework (OSF); https://osf.io/7awc2/overview
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	https://osf.io/7awc2/overview

Section and Topic	Item #	Checklist item	Location where item is reported
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	NO
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	No funding.
Competing interests	26	Declare any competing interests of review authors.	No competing interests.
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	A list of excluded studies with reasons for exclusion is provided in the Supplementary Materials. Other data collection forms, extracted data, and analytic code are not publicly available.

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Table S2. Summary of study selection: included and excluded records

Studies included			
Lp.	Title	DOI	Authors
1	Optimizing the extraction of polyphenols from different edible lichens using response surface methodology and the determination of their mineral and antibacterial properties	10.3390/foods14152562	Ozkan et al.
2	Phytochemical characterization of phenolic compounds by liquid chromatography-time of flight mass spectrometry and biological activities of <i>Peltigera neckeri</i> , <i>Peltigera canina</i> and <i>Peltigera ponojensis</i> from Türkiye	10.1016/j.eujim.2025.102444	Tüzün et al.
3	Quantitation of usnic acid from three <i>Usnea</i> species, its commercial formulations using high-performance thin-layer chromatography-mass spectrometry (HPTLC-MS) and their metabolite profiling using UPLC-QToF-MSE	10.1093/jaoacint/qsae074	Tatapudi et al.

4	<i>In vitro</i> and <i>in vivo</i> evaluation of the trypanocidal activity of the acetone extract of lichen <i>Usnea steineri</i> and its chemical constituents	10.1080/14786419.2025.2469307	Ferreira et al.
5	Eumitrin L: a new xanthone dimer from the lichen <i>Usnea baileyi</i>	10.1080/14786419.2025.2528973	Phan et al.
6	Identification and determination of usnic acid and fatty acid from various lichen species in Arequipa, Peru, as well as antibacterial and antioxidant capacity	10.1016/j.heliyon.2024.e39703	Carrasco et al.
7	Enhanced accumulation of biologically active compounds in lichens with potential functional food applications	10.1016/j.foodchem.2024.140286	Baczewska et al.
8	GC-MS profiling and pharmacological potential of <i>Physconia venusta</i> (Ach.) Poelt	10.4274/tjps.galenos.2023.91126	Zeghina et al.
9	Cytotoxic of usnic acid isolated from <i>Ramalina</i> sp	10.11594/jtls.14.02.14	Darmawan et al.
10	<i>Usnea aurantiaco-atra</i> (Jacq) Bory: Metabolites and biological activities	10.3390/molecules28217317	Vega-Bello et al.
11	Quantitative variation of usnic acid in response to elevation and microsite conditions in <i>Usnea amblyoclada</i> : chemometric modeling for predicting the effects of climate change	10.1007/s11557-023-01904-6	Díaz et al.
12	Methodological aspects of green extraction of usnic acid using natural deep eutectic solvents	10.3390/molecules28145321	Kulinowska et al.
13	Unravelling novel phytochemicals and anticholinesterase activity in Irish <i>Cladonia portentosa</i>	10.3390/molecules28104145	Nagar et al.
14	A sustainable application for the extraction of lichen metabolites from <i>Usnea cornuta</i> : nontargeted metabolomics and antioxidant activity	10.1080/14786419.2022.2116703	Castañeta et al.
15	<i>In vitro</i> anticancer activity of mucoadhesive oral films loaded with <i>Usnea barbata</i> (L.) F. H. Wigg dry acetone extract, with potential applications in oral squamous cell carcinoma complementary therapy	10.3390/antiox11101934	Popovici et al.
16	The evaluation of antioxidant and anti-inflammatory activities of <i>Parmotrema hypotropia</i> lichen extract	10.21608/EJCHEM.2022.109501.5016	Tartouga et al.
17	Antibiotic and nematocidal metabolites from two lichen species collected on the Island of Lampedusa (Sicily)	10.3390/ijms23158471	Zorrilla et al.

18	Antimelanoma potential of <i>Cladonia mitis</i> acetone extracts – comparative <i>in vitro</i> studies in relation to usnic acid content	10.1002/cbdv.202200408	Grudzińska et al.
19	Phenolic secondary metabolites and antiradical and antibacterial activities of different extracts of <i>Usnea barbata</i> (L.) Weber Ex F.H.Wigg from Călimani Mountains, Romania	10.3390/ph15070829	Popovici et al.
20	Phytochemical analysis, antioxidant, antimicrobial, and cytotoxic activity of different extracts of <i>Xanthoparmelia stenophylla</i> lichen from Stara Planina, Serbia	10.3390/plants11131624	Kocovic et al.
21	Bioassay-guided isolation of antimycobacterial substances from the traditionally used lichen <i>Cladonia pyxidata</i> (L.) Hoffm.	10.1007/s13205-022-03159-6	Thuan et al.
22	Antioxidant, cytotoxic, and rheological properties of canola oil extract of <i>Usnea barbata</i> (L.) Weber Ex F.H. Wigg from Călimani Mountains, Romania	10.3390/plants11070854	Popovici et al.
23	Lichen-derived compounds and extracts as biologically active substances with anticancer and neuroprotective properties	10.3390/ph14121293	Studzińska-Sroka et al.
24	Compositional variation of atranorin-related components of lichen <i>Myelochroa leucotylica</i> dependent on extraction solvent and their quantitative analysis by qHNMR	10.1002/pca.3048	Ojha et al.
25	Usnic acid and <i>Usnea barbata</i> (L.) F.H. wigg. dry extracts promote apoptosis and DNA damage in human blood cells through enhancing ROS levels	10.3390/antiox10081171	Popovici et al.
26	Antioxidant and cytotoxic activities of <i>Usnea barbata</i> (L.) f.h. wigg. dry extracts in different solvents	10.3390/plants10050909	Popovici et al.
27	Microwave-assisted extraction and HPLC-UV-CD determination of (S)-usnic acid in <i>Cladonia foliacea</i>	10.3390/molecules26020455	Cavalloro et al.
28	Supercritical carbon dioxide extraction of <i>Usnea longissima</i> (L.) Ach.: Optimization by Box-Behnken design (BBD)	10.3906/kim-2102-66	DİNÇER et al.
29	Evaluation of pharmaceutical potential and phytochemical analysis of selected traditional lichen species	10.31925/FARMACIA.2021.6.12	Tas et al.
30	Optimizing supercritical fluid extraction of usnic acid from the lichen species <i>Usnea subfloridana</i>	10.1134/S1990793120070040	Boitsova et al.
31	Specialized metabolites of the United States lichen <i>Niebla homalea</i> and their antiproliferative activities	10.1016/j.phytochem.2020.112521	Zhang et al.

32	Unraveling the pharmacological potential of lichen extracts in the context of cancer and inflammation with a broad screening approach	10.3389/fphar.2020.01322	Ingelfinger et al.
33	Optimization of usnic acid extraction conditions using fractional factorial design	10.1017/S0024282920000316	Galanty et al.
34	Characterization of sunflower oil extracts from the lichen <i>Usnea barbata</i>	10.3390/metabo10090353	Basiouni et al.
35	Chemical constituents of chloroform extract from the lichen <i>Ramalina peruviana</i> Arch (Ramalinaceae)	10.1002/vjch.201900172	Linh et al.
36	Investigation of chemical constituents and cytotoxic activity of the lichen <i>Usnea undulata</i>	10.1002/vjch.2019000130	Tram et al.
37	A facile <i>in vivo</i> procedure to analyze metabolic pathways in intact lichens	10.1111/nph.15968	Kuhn et al.
38	Phytochemical and pharmacological studies on four Indonesian epiphytic medicinal plants: <i>Drynaria rigidula</i> , <i>Hydnophytum formicarum</i> , <i>Usnea misaminensis</i> , and <i>Calymperes schmidtii</i>	10.1177/1934578X19856792	Nugraha et al.
39	Studies on preparation and UHPLC analysis of the <i>Usnea barbata</i> (L) F.H.Wigg dry acetone extract	10.37358/rc.70.19.11.7645	Popovici et al.
40	Identification of anti- <i>Helicobacter pylori</i> compounds from <i>Usnea undulata</i>	10.1177/1934578X19864212	Do et al.
41	Molecules comprehensive analysis of secondary metabolites in <i>Usnea longissima</i> (lichenized Ascomycetes, Parmeliaceae) using UPLC-ESI-QTOF-MS/MS and pro-apoptotic activity of barbatic acid	10.3390/molecules24122270	Divya Reddy et al.
42	<i>Cladonia uncialis</i> as a valuable raw material of biosynthetic compounds against clinical strains of bacteria and fungi	10.18388/ABP.2019_2891	Studzińska-Sroka et al.
43	Simultaneous determination of usnic, diffractaic, evernic and barbatic acids in rat plasma by ultra-high-performance liquid chromatography–quadrupole exactive Orbitrap mass spectrometry and its application to pharmacokinetic studies	10.1002/bmc.4123	Wang et al.
44	Supercritical fluid extraction of usnic acid from lichen of <i>Cladonia</i> genus	10.1134/S1990793117080024	Brovko et al.

45	Sensitive analysis of bioactive secondary metabolites in lichen species using liquid chromatography–mass spectrometry	10.1016/j.jpba.2017.07.016	Musharraf et al.
46	Specialized metabolites of the lichen <i>Vulpicida pinastri</i> act as photoprotective agents	10.3390/molecules22071162	Legouin et al.
47	Extraction, solubility and antimicrobial activity of (-) usnic acid in ethanol, a pharmaceutically relevant solvent	10.1177/1934578x1701200725	Ahmad et al.
48	Elevational trends in usnic acid concentration of lichen <i>Parmelia flexilis</i> in relation to temperature and precipitation	10.3390/cli5020040	Neupane et al.
49	Lichen secondary metabolites affect growth of <i>Physcomitrella patens</i> by allelopathy	10.1007/s00709-016-1022-7	Goga et al.
50	Effect of milling on physicochemical properties of usnic acid isolated from <i>Usnea</i> sp.	10.13005/ojc/330641	Zaini et al.
51	Constituents of <i>Ramalina capitata</i> (Ach.) Nyl. extracts	10.1080/14786419.2016.1272112	Zrnzević et al.
52	Usnic acid derivatives with cytotoxic and antifungal activities from the lichen <i>Usnea longissima</i>	10.1021/acs.jnatprod.6b00109	Yu et al.
53	Evaluation of anticancer and antioxidant activity of a commercially available CO ₂ supercritical extract of old man's beard (<i>Usnea barbata</i>)	10.1371/journal.pone.0146342	Zugic et al.
54	Optimisation and establishment of separation conditions of organic acids from <i>Usnea longissima</i> Ach. by pH-zone-refining counter-current chromatography: Discussion of the elutropic sequence	10.1016/j.chroma.2015.12.016	Sun et al.
55	Biological activities of four <i>Parmotrema</i> species of Malaysian origin and their chemical constituents	10.7324/JAPS.2016.60806	Rajan et al.
56	<i>In vitro</i> antimicrobial activity of extracts and compounds isolated from <i>Cladonia uncialis</i>	10.1080/14786419.2015.1005616	Studzińska-Sroka et al.
57	<i>Ramalina</i> lichens and their major metabolites as possible natural antioxidant and antimicrobial agents	10.1111/jfbc.12142	Şahin et al.
58	Development and characterization of a novel Swarna-based herbo-metallic colloidal nano-formulation-inhibitor of <i>Streptococcus mutans</i> quorum sensing	10.1039/c4ra11939h	Singh et al.
59	A new depside from <i>Usnea aciculifera</i> growing in Vietnam	10.1177/1934578x1400900831	Truong et al.

60	Pretreatment of natural materials used for supercritical fluid extraction of commercial phytopharmaceuticals	10.1002/ceat.201300715	Ivanovic et al.
61	Chemical composition of <i>Hypogymnia physodes</i> lichen and biological activities of some its major metabolites	10.1007/s00044-013-0644-y	Ranković et al.
62	Characterization of three depside compounds from a Western Ghat lichen <i>Parmelia erumpens</i> Kurok with special reference to antimicrobial and anticancer activity	10.1039/c4ra04137b	Aravind et al.
63	Usnic acid derivatives from <i>Leprocaulon microscopicum</i>	10.1016/J.PHYTOL.2012.10.009	Millot et al.
64	Biological activities of <i>Toninia candida</i> and <i>Usnea barbata</i> together with their norstictic acid and usnic acid constituents	10.3390/ijms131114707	Ranković et al.
65	Antimicrobial activity of usnic acid on <i>Squamarina lentigera</i> lichen species	10.5505/TurkHijyen.2012.74436	Cansaran-Duman et al.
66	SFE as a superior technique for isolation of extracts with strong antibacterial activities from lichen <i>Usnea barbata</i> L.	10.1016/j.supflu.2012.07.018	Zizovic et al.
67	Chemical composition of three <i>Parmelia</i> lichens and antioxidant, antimicrobial and cytotoxic activities of some their major metabolites	10.1016/j.phymed.2012.07.012	Manojlović et al.
68	A new depsidone and antibacterial activities of compounds from <i>Usnea undulata</i> Stirton	10.1080/10286020.2011.622720	Sultana et al.
69	HPLC isolation of antioxidant constituents from <i>Xanthoparmelia</i> spp.	10.1016/j.jpba.2010.04.013	Amo de Paz et al.
70	Analysis of salazinic, norstictic, and usnic acids in <i>Xanthoparmelia chlorochroa</i> by ultra-performance liquid chromatography/tandem mass spectrometry	10.1093/jaoac/93.4.1137	Dailey et al.
71	Usimines A-C, bioactive usnic acid derivatives from the antarctic lichen <i>Stereocaulon alpinum</i>	10.1021/np070464b	Seo et al.
72	A new antifungal and antiprotozoal depside from the Andean lichen <i>Protousnea poeppigii</i>	10.1002/ptr.2321	Schmeda-Hirschmann et al.
73	Quantitative determination of secondary metabolites in <i>Cladina stellaris</i> and other lichens by micellar electrokinetic chromatography	10.1016/j.chroma.2007.12.035	Falk et al.
74	Anti-tuberculosis compounds from two Bolivian medicinal plants, <i>Senecio mathewsii</i> and <i>Usnea florida</i>	10.1177/1934578x0800300901	Hong et al.

75	HPLC analysis of usnic acid in some <i>Ramalina</i> species from Anatolia and investigation of their antimicrobial activities	10.1080/13880200601028503	Cansaran et al.
76	UV triggers the synthesis of the widely distributed secondary lichen compound usnic acid	10.1007/s11557-006-0514-9	McEvoy et al.
77	Determination of usnic acid in some <i>Rhizoplaca</i> species from middle Anatolia and their antimicrobial activities	10.1515/znc-2006-1-209	Cansaran et al.
78	Identification and quantitation of usnic acid from the lichen <i>Usnea</i> species of Anatolia and antimicrobial activity	10.1515/znc-2006-11-1202	Cansaran et al.
79	The evaluation of plants from turkey for <i>in vitro</i> antimycobacterial activity	10.1080/13880200590903372	Tosun et al.
80	Identification and quantitation of allelochemicals from the lichen <i>Lethariella canariensis</i> : Phytotoxicity and antioxidative activity	10.1023/A:1025682318001	Toledo Marante et al.
81	¹ H and ¹³ C-NMR and biological activity investigations of four lichen-derived compounds	10.1002/(SICI)1099-1565(199909/10)10:5<279::AID-PCA464>3.0.CO;2-3	König et al.
82	Alectosarmentin, a new antimicrobial dibenzofuranoid lactol from the lichen, <i>Alectoria sarmentosa</i>	10.1021/np50109a009	Gollapudi et al.
83	Crystal structure of usnic acid sodium salt 2 1/2 hydrate	10.1007/BF01195444	Ribár et al.
84	Chemical constituents of the lichen <i>Cladina macaronesica</i>	10.1515/znc-1991-1-203	González et al.
85	l-Usnic acid: Tumor inhibitor isolated from lichens	10.1007/BF01944592	Morris Kupchan et al.
86	Method of isolation of usnic acid from <i>Ramalina reticulata</i>	10.1021/ja01160a118	Stark et al.
87	Characterization of bioactive compounds from Romanian <i>Cetraria islandica</i> (L) Ach	10.37358/rc.19.6.7302	Patriche et al.
88	<i>In situ</i> DART-MS as a versatile and rapid dereplication tool in lichenology: Chemical fingerprinting of <i>Ophioparma ventosa</i>	10.1002/pca.2635	Le Pogam et al.
89	Aromatic metabolites of lichens of the family Parmeliaceae. I. Depsidones	10.1007/BF00579953	Krivoshchekova et al.
90	Stenosporic acid, a new depside in <i>Ramalina stenospora</i>	10.1016/S0031-9422(00)85190-0	Culberson et al.
91	Screening of anti-HIV-1 activity of North American plants. Anti-HIV-1 activities of plant extracts, and active components of <i>Lethalia vulpina</i> (L.) Hue.	EID: 2-s2.0-0032444603	Nakanishi et al.
92	Some constituents of the lichen <i>Ramalina siliquosa</i>	10.1016/S0031-9422(00)86273-1	Culberson et al.

93	Quantification of usnic acid in <i>Usnea florida</i> by densitometric high performance thin layer chromatography	10.1080/01483919108049626	Polónia et al.
94	Cytotoxic activity of compounds from the lichen: <i>Cladonia convoluta</i>	10.1055/s-2004-827240	Bézivin et al.
95	UV-B induces usnic acid in reindeer lichens	10.1017/S0024282906005883	Nybakken et al.
96	Antiproliferative effects on tumour cells and promotion of keratinocyte wound healing by different lichen compounds	10.1055/s-0029-1185329	Burlando et al.
97	Larvicidal activity of <i>Cladonia substellata</i> extract and usnic acid against <i>Aedes aegypti</i> and <i>Artemia salina</i>	EID: 2-s2.0-70449589527	Bomfim et al.
98	Antimicrobial activities of the lichens <i>Hypogymnia vittata</i> , <i>Hypogymnia physodes</i> and <i>Hypogymnia tubulosa</i> and HPLC analysis of their usnic acid content	EID: 2-s2.0-77955888470	Cansaran-Duman et al.
99	Cellular mechanisms of the anticancer effects of the lichen compound usnic acid	10.1055/s-0029-1240851	Einarsdóttir et al.
100	Determination of usnic and perlatolic acids and identification of olivetoric acids in Northern reindeer lichen (<i>Cladonia stellaris</i>) extracts	10.1017/S002428291000037X	Smeds et al.
101	Insecticidal effect of <i>Usnea longissima</i> (Parmeliaceae) extract against <i>Sitophilus granarius</i> (Coleoptera: Curculionidae)	EID: 2-s2.0-84858320610	Yildirim et al.
102	Uncommon chlorinated xanthone and other antibacterial compounds from the lichen <i>Cladonia incrassata</i>	10.1055/s-0034-1382827	Dieu et al.
103	Reindeer lichen (<i>Cladonia stellaris</i>) from a Norwegian mountain region as a sustainable source of usnic acid	EID: 2-s2.0-84935511252	Rahman et al.
104	Antioxidant and antimicrobial potential, and HPLC analysis of stictic and usnic acids of three <i>Usnea</i> species from Uludag mountain (Bursa, Turkey)	EID: 2-s2.0-84973640205	Oran et al.
105	Determination of the content in usnic acid and polyphenols from the extracts of <i>Usnea barbata</i> L. And the evaluation of their antioxidant activity	EID: 2-s2.0-85046120451	Popovici et al.
106	Antibacterial properties of usnic acid against vibriosis	EID: 2-s2.0-85088102296	Bachtiar et al.
107	Antibacterial activity and stability of methanol extract from <i>Thamnia subuliformis</i> in vitro	10.13386/j.issn1002-0306.2021050011	Ren et al.

108	In-vitro antifungal and antibacterial activity of the ethanolic extract of <i>Usnea laevis</i> against <i>Candida albicans</i> , <i>Staphylococcus aureus</i> and <i>Pseudomonas aeruginosa</i>	10.20453/RMH.V31I3.3806	Jaramillo-Ordoñez et al.
109	Insecticidal activity of lichens against the maize weevil, <i>Sitophilus zeamais</i> Motschulsky (coleoptera: Curculionidae)	EID: 2-s2.0-84872443169	Yildirim et al.
110	Research for the lichen <i>Usnea barbata</i> metabolites	10.1515/znc-2017-0177	Bazarnova et al.
111	Influence of different pre-treatment methods on isolation of extracts with strong antibacterial activity from lichen <i>Usnea barbata</i> using carbon dioxide as a solvent	10.1016/j.supflu.2013.01.005	Ivanovic et al.
112	Nature of light-absorbing pigments from Brazilian lichens identified by Raman spectroscopy	10.1016/j.vibspec.2018.08.007	Fernandes et al.
113	Isolation of (+) usnic acid from Sudanese drug <i>Usnea molliuscula</i>	10.1055/s-0028-1097780	Kheir et al.
114	Antimycobacterial activity of acetone extract and isolated metabolites from folklore medicinal lichen <i>Usnea laevis</i> Nyl. against drug-sensitive and multidrug-resistant tuberculosis strains	10.1016/j.jep.2021.114641	Tatipamula et al.
115	Chemical composition and <i>in vitro</i> antibacterial activity of three lichen species (<i>Usnea</i> sp., <i>Thamnolia vermicularis</i> subsp. <i>solida</i> and <i>Ramalina asperula</i>) collected from the Jauja and Huaral provinces-Peru	10.15446/rcciquifa.v52n3.110402	Carrasco et al.
116	Studies on screening the effective components of <i>Cladonia alpestris</i> and its correlation with pharmacological effects	EID: 2-s2.0-0037317135	Zhang et al.
117	Chemical constituents from <i>Usnea longgisima</i> , a traditional mongolian medicine	10.4268/cjcmm20131318	Laxinamu et al.
Records excluded			
Review			
Lp.	Title	DOI	Authors
1	A review of the potential of lichen substances as antifungal agents: the effects of extracts and lichen secondary metabolites on <i>Fusarium</i> fungi	10.1007/s00203-022-03104-4	Furmanek et al.
2	Insecticidal and antiprotozoal properties of lichen secondary metabolites on insect vectors and their transmitted protozoal diseases to humans – review	10.3390/d13080342	Muhoro et al.

3	A review on phytochemicals from some medicinal plants of Bangladesh	10.6000/1927-5951.2011.01.01.14	Kaisar et al.
4	Bioactive lichen metabolites: alpine habitats as an untapped source- review antimicrobial, anti-inflammatory, antiproliferative and antioxidant activities properties	10.1007/s11101-010-9201-1	Boustie et al.
5	Insecticidal efficacy of lichens and their metabolites-A mini review	10.7324/JAPS.2018.81020	Sachin et al.
6	Acute liver failure caused by 'fat burners' and dietary supplements: A case report and literature review	10.1155/2011/174978	Krishna et al.
7	Chemical composition of lichens and their medical applications – review	10.1007/s11094-009-0183-5	Podterob et al.
8	A review of natural products with antileishmanial activity	10.1016/j.phymed.2003.10.006	Rocha et al.
9	Pharmaceutically relevant metabolites from lichens (mini-review)	10.1007/s002530100684	Müller et al.
10	Lichens as a repository of bioactive compounds: an open window for green therapy against diverse cancers	10.1016/j.semcancer.2021.05.028	Dar et al.
11	The Genus <i>Cetraria</i> s. str. – A review of its botany, phytochemistry, traditional uses and pharmacology	10.3390/molecules27154990	Sánchez et al.
12	Emerging antifungal targets and strategies	10.3390/ijms23052756	Ivanov et al.
13	A review of anti-cancer and related properties of lichen-extracts and metabolites	10.2174/1871520621666210322094647	Tripathi et al.
14	A roadmap to UV-protective natural resources: classification, characteristics, and applications	10.1039/d1qm00741f	Santhra Krishnan et al.
15	Lichen: A comprehensive review on lichens as a natural sources exploring nutritional and biopharmaceutical benefits	10.23751/pn.v23i3.9833	Gautam et al.
16	<i>Usnea</i> sp.: Antimicrobial potential, bioactive compounds, ethnopharmacological uses and other pharmacological properties; a review article	10.1016/j.jep.2020.113656	Sepahvand et al.
17	Chemical and biological investigations on mangrove associated lichens (Manglicolous lichens) from India: A review	10.36468/pharmaceutical-sciences.764	Tatipamula et al.
18	Pharmacologic activities of plant-derived natural products on respiratory diseases and inflammations	10.1155/2021/1636816	Timalsina et al.

19	A review on pharmacological, anti-oxidant activities and phytochemical constituents of a novel lichen <i>Parmotrema</i> species	10.1080/22311866.2021.1916596	Saha et al.
20	Contribution of cyanotoxins to the ecotoxicological role of lichens	10.3390/toxins13050321	Ivanov et al.
21	Acute liver failure secondary to drug-induced liver injury	10.1016/j.cld.2019.09.005	Chayanupatkul et al.
22	Lichens in genus <i>Parmelia</i> : an overview and their application	10.2174/1389201021666200406105212	Gandhi et al.
23	Fragrances: contact allergy and other adverse effects	10.1097/DER.0000000000000463	De Groot et al.
24	Antifungal activity of lichen compounds against dermatophytes: a review	10.1111/jam.14209	Furmanek et al.
25	Aspects of nanomaterials in wound healing	10.2174/1567201815666180918110134	Chakrabarti et al.
26	Recent progress and future perspectives of antibiofilm drugs immobilized on nanomaterials	10.2174/1389201019666180828090052	Khan et al.
27	Liver toxicity related to herbs and dietary supplements: Online table of case reports. Part 2 of 5 series	10.1016/j.fct.2016.07.001	Brown et al.
28	Potential of lichen compounds as antidiabetic agents with antioxidative properties: a review	10.1155/2017/2079697	Thadhani et al.
29	Hepatotoxicity by dietary supplements: a tabular listing and clinical characteristics	10.3390/ijms17040537	García-Cortés et al.
30	Liver injury due to herbal and dietary supplements: A review of individual ingredients	10.1002/cld.541	Zheng et al.
31	The genus <i>Usnea</i> : A potent phytomedicine with multifarious ethnobotany, phytochemistry and pharmacology	10.1039/c5ra24205c	Prateeksha et al.
32	Chemistry and biological activity of <i>Ramalina</i> lichenized fungi	10.3390/molecules20058952	Moreira et al.
33	Parmeliaceae family: Phytochemistry, pharmacological potential and phylogenetic features	10.1039/c4ra09104c	Gómez-Serranillos et al.
34	Liver injury induced by herbal complementary and alternative medicine	10.1016/j.cld.2013.07.006	Navarro et al.
35	Lichens: A promising source of antibiotic and anticancer drugs	10.1007/s11101-013-9283-7	Shrestha et al.
36	<i>Candida</i> species: Current epidemiology, pathogenicity, biofilm formation, natural antifungal products and new therapeutic options	10.1099/jmm.0.045054-0	Sardi et al.
37	Biopharmaceutical potential of lichens	10.3109/13880209.2011.633089	Zambare et al.
38	Review of liver injury associated with dietary supplements	10.1111/j.1478-3231.2010.02439.x	Stickel et al.

39	Anthelmintic and antioxidant efficacy of two macrolichens of Ramalinaceae	EID: 2-s2.0-77953472683	Praveen Kumar et al.
40	Hepatotoxic herbs: Will injury mechanisms guide treatment strategies?	10.1007/s11894-009-0046-y	Frazier et al.
41	Lichen extracts as raw materials in perfumery. Part 1: Oakmoss	10.1002/ffj.1916	Joulain et al.
42	Review of usnic acid and <i>Usnea barbata</i> toxicity	10.1080/10590500802533392	Guo et al.
43	Hepatotoxic slimming aids and other herbal hepatotoxins	10.1111/j.1440-1746.2008.05310.x	Chitturi et al.
44	Can claims, misleading information, and manufacturing issues regarding dietary supplements be improved in the United States?	10.1124/jpet.105.085712	Gibson et al.
45	Drug-induced liver disease 2004	10.1097/01.mog.0000160043.10804.60	Lazerow et al.
46	Lipoxygenase inhibitors from natural plant sources. Part 1: Medicinal plants with inhibitory activity on arachidonate 5-lipoxygenase and 5-lipoxygenase/cyclooxygenase	10.1002/ptr.1603	Schneider et al.
47	Anti-inflammatory activity of plants	EID: 2-s2.0-0037221206	Okoli et al.
48	Hepatotoxicity of usnic acid and underlying mechanisms	10.1080/26896583.2024.2366737	Chen et al.
49	Targeting CD8+ T cells with natural products for tumor therapy: Revealing insights into the mechanisms	10.1016/j.phymed.2024.155608	Wang et al.
50	The dual effect of endoplasmic reticulum stress in digestive system tumors and intervention of Chinese botanical drug extracts: a review	10.3389/fphar.2024.1339146	Zhang et al.
51	Moroccan antihypertensive plants and their mechanisms of action	10.2174/0118715303272284231126145853	Amtaghri et al.
52	From immune checkpoints to therapies: understanding immune checkpoint regulation and the influence of natural products and traditional medicine on immune checkpoint and immunotherapy in lung cancer	10.3389/fimmu.2024.1340307	Zhou et al.
53	Nutritional and health-promoting effects of lichens used in food applications	10.1007/s13668-023-00489-6	Thakur et al.
54	Anti-yeast potential of lichen-extracted substances – an analytical review	10.1016/j.sajb.2023.08.018	Furmanek et al.

55	Lichen and its microbiome as an untapped source of anti-biofilm compounds	10.1002/cbdv.202401557	Millot et al.
56	Prospects for the search and development of new original pharmaceutical substances – derivatives of usnic acid extracted from lichens (Review)	10.20969/VSKM.2023.16(4).97-103	Ilya et al.
57	Special issue on plant and marine-derived natural product research in drug discovery: strengths and perspective	10.3390/ph15101249	Duarte et al.
58	Usnic acid	10.1016/S0031-9422(02)00383-7	Ingólfssdóttir et al.
59	Harnessing natural antifouling agents for enhancing water and wastewater treatment membranes	10.1016/j.seppur.2024.130254	Raj Kandel et al.
60	Miscellaneous naturally derived anticancer agents	10.2174/1574885518666230330162748	Punniyakotti et al.
61	NTP technical report on the toxicity studies of <i>Usnea</i> lichens containing (+/-)-usnic acid (CASRN 125-46-2) administered in feed to F344/N Nctr rats and B6C3F1/Nctr mice	EID: 2-s2.0-85146849691	Leakey et al.
Not available			
Lp.	Title	DOI	Authors
1	Photolability of secondary compounds in some lichen species	EID: 2-s2.0-0034918430	Begora et al.
2	Green synthesis of silver nanoparticles using <i>Parmelia perlata</i>	EID: 2-s2.0-84955597305	Uthreshwaranath et al.
3	Contributions to the complex study of some lichens- <i>Usnea</i> genus. Pharmacological studies on <i>Usnea barbata</i> and <i>Usnea hirta</i> species.	EID: 2-s2.0-0027538929	Dobrescu et al.
4	Effect of cultured and natural thallus, and symbionts extracts of <i>Usnea articulata</i> on skin wound healing in wistar rat	EID: 2-s2.0-84905824940	Valadbeigi et al.
5	Studies on chemical constituents from herbs of <i>Usnea longissima</i>	EID: 2-s2.0-67449097146	Feng et al.
6	Effect of <i>Cladonia alpestris</i> on <i>Trichomonas vaginalis</i> in vitro	EID: 2-s2.0-0029174245	Wu et al.
7	Brins shrimp lethality bioassay of six lichens constituents	EID: 2-s2.0-0028016365	Ding et al.
8	New study of antimicrobial activity and identification of lichenical substances of some lichens from south Spain	EID: 2-s2.0-0026269827	Rowe et al.
9	Antimicrobic activity of usnic acid for aerobic and anaerobic bacteria	EID: 2-s2.0-0024936250	Liberman et al.
10	Identification and quantitative determination of usnic acid in drug and galenic preparations	EID: 2-s2.0-17344388003	Fischer et al.

11	The effect of tigecycline-usnic acid combination on tigecycline-non-susceptible <i>Acinetobacter baumannii</i> clinical isolates and the role of usnic acid as an adjuvant efflux pump inhibitor	10.21608/mid.2024.279500.1866	Fahmy et al.	
Cultured lichen, plant, fungi material, book chapter, UA concentration in dust				
Lp.	Title	DOI	Authors	Comment
1	Antioxidant and antibacterial properties of some cultured lichens	10.1016/j.biortech.2007.01.031	Behera et al.	Cultured lichen
2	Forestry workers	10.1007/978-3-319-68617-2_153	Haeberle et al.	Book Chapter
3	Kombucha tea: A promising fermented functional beverage (Book Chapter)	10.1016/B978-0-12-815271-3.00010-5	Sinir et al.	Book chapter
4	Bioactive specialized metabolites of <i>Trochila</i> sp., an endophytic fungus of <i>Lilium carnolicum</i>	10.1016/j.phytochem.2025.114684	Mostafa Alilou et al.	plant
5	<i>In vitro</i> , <i>in vivo</i> and in silico anticancer activity and toxicity of usnic acid extracted from the mycobiont culture of <i>Usnea baileyi</i>	10.1007/s00210-024-03584-9	Murugan et al.	Cultured lichen
6	A comparative metabolomics analysis of Açaí (<i>Euterpe oleracea</i> Mart.) fruit, food powder, and botanical dietary supplement extract	10.1002/pca.3416	Heck et al.	plant
7	Lichen as a raw material in perfumery and cosmetic Industries	10.1002/9781394190706.ch17	Alom et al.	Book Chapter
8	Antioxidant properties of lichen	10.1002/9781394190706.ch12	Rasul et al.	Book Chapter
9	Depside and depsidone synthesis in lichenized fungi comes into focus through a genome-wide comparison of the olivetoric acid and physodic acid chemotypes of <i>Pseudevernia furfuracea</i>	10.3390/biom11101445	Singh et al.	Fungi
10	Screening of phytocompounds, molecular docking studies, and <i>in vivo</i> anti-inflammatory activity of heartwood aqueous extract of <i>Pterocarpus santalinus</i> L.f.	10.4103/2221-1691.303604	Vasudevan et al.	plant
11	A cyclic lipodepsipeptide, a spirolactone, and a chromanone from the marine fungus <i>Verruculina enalia</i> (Kohlm.) Kohlm. & Volkm.-Kohlm. BCC 22226	10.1016/j.tet.2020.131497	Bunyapaiboonsri et al.	fungi
12	Evaluating the inhibitory effect of eight compounds from <i>Daphne papyracea</i> against the NS3/4A protease of hepatitis C virus	10.1080/14786419.2018.1519825	Wei et al.	plant
13	Bioactive constituents, vitamin analysis, antioxidant capacity and α -glucosidase inhibition of <i>Canna indica</i> L. rhizome extracts	10.1016/j.fbio.2020.100544	Ayusman et al	plant

14	<i>In vitro</i> anti-pancreatic cancer activity of HPLC-derived fractions from <i>Helicteres hirsuta</i> Lour. stem	10.1007/s11033-019-05180-0	Pham et al.	plant
15	Mycousfurans A and B, antibacterial usnic acid congeners from the fungus <i>Mycosphaerella</i> sp., isolated from a marine sediment	10.3390/md17070422	Lee et al.	fungi
16	Chemical and biological studies on <i>Cichorium intybus</i> L.	10.1080/14786419.2017.1343319	Satmbekova et al.	plant
17	Type I NR-PKS gene characterization of the cultured lichen mycobiont <i>Xanthoparmelia substrigosa</i> (Ascomycota)	10.1007/978-81-322-2235-4_5	Hametner et al.	cultured lichen mycobiont
18	Antioxidative and cardiovascular-protective activities of metabolite usnic acid and psoromic acid produced by lichen species <i>Usnea complanata</i> under submerged fermentation	10.3109/13880209.2012.654396	Behera et al.	Cultured lichen
19	Studies on nutritional requirement for the culture of lichen <i>Ramalina nervulosa</i> and <i>Ramalina pacifica</i> to enhance the production of antioxidant metabolites	10.1007/s12223-012-0100-2	Verma et al.	Cultured lichen
20	Production of Anti- <i>Helicobacter pylori</i> metabolite by the lichen-Forming fungus <i>Nephromopsis pallescens</i>	10.1007/s12275-011-0289-9	Luo et al.	fungi
21	Bioactivity of secondary metabolites and thallus extracts from lichen fungi	10.1007/s10267-011-0118-3	Kowalski et al.	fungi
22	Protoplast isolation from cultured lichen <i>Usnea ghattensis</i> , their fusion with protoplasts of <i>Aspergillus nidulans</i> , fusant regeneration and production of usnic acid	10.1007/s12223-009-0058-x	Behera et al.	Cultured lichen
23	Experimental studies on the growth and usnic acid production in "lichen" <i>Usnea ghattensis</i> <i>in vitro</i>	10.1016/j.micres.2005.08.006	Behera et al.	Cultured lichen
24	Alysinol - A new triterpene from <i>Alysicarpus monolifer</i>	10.1080/10575630290034258	Riaz et al.	plant
25	Phytochemical profiling and bioactivity assessment of <i>Entada scandens</i> stem extract: insights into its antioxidant, antimicrobial, and anticancer activities	10.1002/cbdv.202500771	Wasupalli et al.	plant
26	Corrigendum to "Identification and determination of usnic acid and fatty acid from various lichen species in arequipa, Peru, as well as antibacterial and antioxidant capacity" (Heliyon, (2024), 10, 21, (e39703), (S2405844024157349), 10.1016/j.heliyon.2024.e39703)	10.1016/j.heliyon.2025.e43917	Carrasco et al.	Corrigendum

27	Microbiological and toxicological hazards in sewage treatment plant bioaerosol and dust	10.3390/toxins13100691	Szulc et al.	UA concentration in dust
28	Fungal metabolite isolated from <i>Mycosphaerella nawae</i> AM20 and its protective role in cerebral ischemia	10.1016/j.jksus.2022.102061	Ismail et al.	Fungi
29	Bioactivities of ethanol extracts from <i>Rosa macrophylla</i> and their material basis	10.3969/j.issn.1674-7895.2024.03.10	Li et al.	plant
30	Study on Chemical Constituents in <i>Thamnolia Subuliformis</i> (Ehrh.) W.Culb. by UHPLC-Q-Exactive Focus-MS/MS	10.13748/j.cnki.issn1007-7693.20223535	Li et al.	Qualitative analysis
31	Experimental studies on the physiology of the phycobiont and mycobiont <i>Ramalina ecklonii</i> By	10.1111/j.1399-3054.1966.tb07071.x	Fox et al.	Cultured lichen symbionts
32	Action of <i>Parmelia caperata</i> extracts on smooth muscle organs	EID: 2-s2.0-0017199271	Correia Da Silva et al.	Pharmacodynamic study
33	Photosensitivity and allergy to aromatic lichen acids, Compositae oleoresins and other plant substances	10.1111/j.1600-0536.1980.tb03907.x	Thune et al.	Clinical allergy study
34	Photosensitivity and allergy to aromatic lichen acids, Compositae oleoresins and other plant substances	10.1111/j.1600-0536.1980.tb03907.x	Thune et al.	Clinical allergy study (duplicate)
35	Lichen picker's dermatitis (<i>Cladonia alpestris</i> (L) Rab.)	10.1111/j.1600-0536.1981.tb03951.x	Salo et al.	Clinical dermatitis study
36	The sensitizing capacity of atranorin	10.1111/j.1600-0536.1984.tb00965.x	Sandberg et al.	Allergenicity study
37	An investigation of the allergenic constituents of <i>Cladonia stellaris</i> (Opiz) Pous & Vežda ('silver moss', 'reindeer moss' or 'reindeer lichen')	10.1111/j.1600-0536.1993.tb03344.x	Hausen et al.	Allergenicity study
38	Allergic contact dermatitis from sunflower (<i>Helianthus annuum</i>) with cross-sensitivity to arnica	10.1111/j.1600-0536.1993.tb03384.x	Machet et al.	Allergenicity study
39	Mobility of lichen compounds from <i>Cladonia mitis</i> in arctic soils	10.1097/00010694-198407000-00007	Dawson et al.	Environmental/soil chemistry study
40	Applications of negative fast atom bombardment and MS/MS to screening of lichen compounds	10.1016/0031-9422(90)83052-3	Holzmann et al.	Analytical MS screening; no extraction
41	Herbs and liver injury: A clinical perspective	10.1016/j.cgh.2013.07.030	Rossi et al.	Clinical study
42	Isolation and <i>in vitro</i> cultivation of lichen algae and their antimicrobial properties	EID: 2-s2.0-0026998369	Harmala et al.	Cultured lichen
43	Airborne allergic contact dermatitis from Compositae	EID: 2-s2.0-0030423942	Stingeni et al.	Clinical study

44	The 39th Annual Meeting of the Association for Herbal Research, Saarbrücken (conference paper)	EID: 2-s2.0-0025878569	Adam et al.	Conference paper
45	Effects of culture conditions on dibenzofuran production by cultured mycobionts of lichens (conference paper)	EID: 2-s2.0-0030658856	Kon et al.	Cultured lichen
46	Prevalence of botanical extract allergy in patients with contact dermatitis	10.2310/6620.2004.04009	Simpson et al.	Allergenicity study
47	Fulminant liver failure due to usnic acid for weight loss	10.1111/j.1572-0241.2004.04165.x	Durazo et al.	Clinical case report
48	Liquid-liquid extraction of cinchona alkaloids by using some metal complexes of optically pure usnic acids	10.1016/S0003-2670(00)84667-X	Tsurubou et al.	Metal chelation
49	Optimization of culture conditions for lichen <i>Usnea ghattensis</i> G. Awasthi to increase biomass and antioxidant metabolite production	EID: 2-s2.0-69049104550	Behera et al.	Cultured lichen
50	Herbal and dietary supplement hepatotoxicity	10.1055/s-0029-1240006	Navarro et al.	Clinical study
51	Biology of <i>Alysicarpus monilifer</i> (L.) DC.: An important medicinal plant – letter	10.5958/0975-6892.2015.00036.2	Gholami et al.	plant
52	Chemical diversity and antiviral potential in the pantropical <i>Diospyros</i> genus	10.1016/j.fitote.2016.04.017	Peyrat et al.	plant
53	Clinical features and outcomes of complementary and alternative medicine induced acute liver failure and injury	10.1038/ajg.2016.114	Hillman et al.	Clinical study
54	A cytotoxic pyranonaphthoquinone from cultured lichen mycobionts of <i>Haematomma</i> sp	10.3987/COM-17-13704	Takenaka et al.	Cultured lichen
55	Phytochemical and biological evaluation of metabolites produced by alginate-immobilized bionts isolated from the lichen <i>Cladonia substellata</i> vain	10.1016/j.fitote.2018.10.001	Santiago et al.	Cultured lichen
56	Two new usnic acid derivatives from the endophytic fungus <i>Mycosphaerella</i> sp.	10.1515/znc-2017-0162	de Oliveira et al.	Fungi
57	Pharmacological studies of isolated compounds from <i>Ahatoda vasica</i> and <i>Calotropis procera</i> as an antioxidant and antimicrobial bioactive sources	EID: 2-s2.0-85050151388	Ahmed et al.	plant
58	1st International Symposium on Green Materials and Technology, ISGMT 2018	EID: 2-s2.0-85072960581	-	Conference paper
59	Patch testing to plants: sensitisation associated with exposure to plants, essential oils and botanicals in cosmetics	EID: 2-s2.0-85108596653	Murphy et al.	Clinical study

60	Assessment of skin photoallergy risk in cosmetics containing herbal extract ingredients	10.1159/000515470	Pan et al.	Clinical study
61	Graphical Abstract TOC	10.1016/S1773-2247(22)00151-4	-	
62	α -glucosidase inhibition kinetics and molecular docking studies with the bioactive constituents from <i>Canna indica</i> L. rhizome extract	10.14233/ajchem.2020.22727	Swain et al.	plant
63	Detection of endolichenic fungi producing antifungal compound	10.4014/kjmb.1201.01001	Kim et al.	Cultured lichen
64	[Chemical constituents from rhizome of <i>Daphne papyracea</i> var. <i>crassiuscula</i>].	EID: 2-s2.0-84874448567	Wei et al.	plant
65	Hepatotoxicity induced by herbs and medicines used to induce weight loss	10.1157/13125592	Herrera et al.	Clinical study
66	Study on efficacy of preparation with usnic acid and zinc sulphate for episiotomy care	EID: 2-s2.0-0034909770	Oliva et al.	Clinical study
67	A new Dibenzofuran, isostrepsilic acid, produced by cultured mycobiont of the lichenized ascomycete <i>Usnea orientalis</i>	EID: 2-s2.0-0002496130	Kon et al.	Cultured lichen
Full-text articles excluded:				
Not related to the area of the interest; no extraction protocol, UA was purchased, UA synthesized, ...				
Lp.	Title	DOI	Authors	Comment
1	Purification and properties of a new enzyme from <i>Evernia prunastri</i> , which reduces L-usnic Acid	10.1515/znc-1981-1-208	Estévez et al.	No extraction protocol
2	Screening of tissue cultures and thalli of lichens and some of their active constituents for inhibition of tumor promoter-induced <i>Epstein-Barr</i> virus activation	10.1248/cpb.43.1388	Yamamoto et al.	No extraction protocol
3	Severe hepatotoxicity associated with the use of weight loss diet supplements containing ma huang 46 usnic acid [2]	10.1016/j.jhep.2004.06.028	Neff et al.	No extraction protocol
4	Liking lichens	10.1016/S1473-3099(05)70200-0	Dixon et al.	Note - No extraction protocol
5	Allergic contact dermatitis from a natural deodorant: A report of 4 cases associated with lichen acid mix allergy	10.1016/j.jaad.2004.12.043	Sheu et al.	No extraction protocol
6	Lichens – Photophysical studies of potential new sunscreens	10.1016/j.jphotobiol.2008.12.008	Boehm et al.	No extraction protocol

7	Identification and compatibility of the major active principles in some new natural origin antiseptics - extraction as described previously, not available article	10.1134/S0036024409090350	Nikolić et al.	No extraction protocol
8	Anti-mutagenic lichen extract has double-edged effect on azoxymethane-induced colorectal oncogenesis in C57BL/6J mice	10.3109/15376510903521232	He et al.	No extraction protocol
9	Redox characterization of usnic acid and its cytotoxic effect on human neuron-like cells (SH-SY5Y)	10.1016/j.tiv.2011.12.003	Rabelo et al.	UA was purchased
10	Significance of natural product interactions in oncology - commentary	10.1177/1534735412467368	Block et al.	No extraction protocol
11	Anti-biofilm performance of three natural products against initial bacterial attachment	10.3390/ijms141121757	Salta et al.	No extraction protocol
12	Reversed-polarity capillary zone electrophoretic analysis of usnic acid	10.1002/1522-2683(200108)22:13<2755::AID-ELPS2755>3.0.CO;2-6	Kreft et al.	No extraction protocol
13	Computational studies on sirtuins from <i>Trypanosoma cruzi</i> : structures, conformations and interactions with phytochemicals	10.1371/journal.pntd.0002689	Sacconnay et al.	No extraction protocol
14	Development of Fe-based bulk metallic glasses as potential biomaterials	10.1016/j.msec.2015.03.041	Li et al.	No extraction protocol
15	Design and characterization of antimicrobial usnic acid loaded-core/shell magnetic nanoparticles	10.1016/j.msec.2015.03.044	Taresco et al.	No extraction protocol
16	Construction of a multiplex promoter reporter platform to monitor <i>Staphylococcus aureus</i> virulence gene expression and the identification of usnic acid as a potent suppressor of psm gene expression	10.3389/fmicb.2016.01344	Gao et al.	No extraction protocol
17	Effect of plant secondary metabolites on susceptibility of insects to entomopathogenic microorganisms	10.1134/S1995425517030052	Duisembecov et al.	No exact extraction protocol
18	The inherent matrix properties of lichen metabolites in matrix-assisted laser desorption ionization time-of-flight mass spectrometry	10.1002/rcm.7980	Le Pogam et al.	No extraction protocol
19	Biogenic fabrication and characterization of silver nanoparticles using aqueous-ethanolic extract of lichen (<i>Usnea longissima</i>) and their antimicrobial activity – without characteristic of extraction process	10.1186/s40824-018-0135-9	Siddiqi et al.	No extraction protocol

20	Nutrivigilance: A new activity in the field of dietary supplements	10.31925/farmacia.2019.3.24	Morgovan et al.	No extraction protocol
21	Mechanism of action of an old antibiotic revisited: Role of calcium ions in protonophoric activity of usnic acid	10.1016/j.bbabbio.2019.01.005	Antonenko et al.	UA synthesized
22	Bioadhesive polymeric films based on usnic acid for burn wound treatment: Antibacterial and cytotoxicity studies	10.1016/j.colsurfb.2019.03.001	Pagano et al.	UA was purchased
23	Synergistic effect between usnic acid and Polymyxin B against resistant clinical isolates of <i>Pseudomonas aeruginosa</i>	10.1155/2020/9852145	Da Costa Júnior et al.	UA was purchased
24	(+)-usnic acid induces ROS-dependent apoptosis via inhibition of mitochondria respiratory chain complexes and Nrf2 expression in lung squamous cell carcinoma	10.3390/ijms21030876	Qi et al.	UA was purchased
25	Usnic acid treatment changes the composition of mycobacterium tuberculosis cell envelope and alters bacterial redox status	10.1128/mSystems.00097-21	Sieniawska et al.	UA was purchased
26	Phenolic compounds disrupt spike-mediated receptor-binding and entry of SARS-CoV-2 pseudo-virions	10.1371/journal.pone.0253489	Goc et al.	UA was purchased
27	The RP-HPLC method for analysis of usnic acid as potential marker of herbal drugs-based formulations containing <i>Usnea barbata</i>	10.2298/JSC201216045T	Tadić et al.	Not from wild-grown lichen
28	Anti-inflammatory potential of compounds isolated from Tunisian lichens species	10.1002/cbdv.202200134	Mendili et al.	(isousnic acid)
29	Design, characterization, and anticancer and antimicrobial activities of mucoadhesive oral patches loaded with <i>Usnea barbata</i> (L.) F. H. Wigg ethanol extract F-UBE-HPMC	10.3390/antiox11091801	Popovici et al.	No extraction protocol
30	Formulation and development of bioadhesive oral films containing <i>Usnea barbata</i> (L.) F.H.Wigg dry ethanol extract (F-UBE-HPC) with antimicrobial and anticancer properties for potential use in oral cancer complementary therapy	10.3390/pharmaceutics14091808	Popovici et al.	No extraction protocol
31	<i>In silico</i> exploration of leads from lichen-derived salazinic acid, sekikaic acid and usnic acid targeting HER2 in breast cancer	10.29356/jmcs.v69i4.2175	Roney et al.	No extraction protocol
32	Integrated stress response activation induced by usnic acid alleviates BCL-2 inhibitor ABT-199 resistance in acute myeloid leukemia	10.1016/j.jare.2024.10.003	Wu et al.	UA was purchased

33	Bioprospecting secondary compounds from <i>Usnea Longissima</i> -short communication	10.1007/s40009-023-01240-z	Arif et al.	inconsistent quantification
34	Secondary metabolites from Australian lichens <i>Ramalina celastri</i> and <i>Stereocaulon ramulosum</i> affect growth and metabolism of photobiont <i>Asterochloris erici</i> through allelopathy	10.3390/molecules29194620	Bačkor et al.	No extraction protocol
35	Biomaterial improves the stability of perovskite solar cells by passivating defects and inhibiting ion migration	10.1021/acsami.4c06285	Liu et al.	UA was purchased
36	Green extraction of depsidones and depsides from <i>Hypogymnia physodes</i> (L.) Nyl. using natural deep eutectic solvents	10.3390/ijms25105500	Baczewska et al.	Not quantification of UA
37	Usnic acid derivatives inhibit DNA repair enzymes tyrosyl-DNA phosphodiesterases 1 and 2 and act as potential anticancer agents	10.3390/genes14101931	Zakharenko et al.	No extraction protocol
38	The role of plant extracts in the repair of <i>Rattus norvegicus</i> mandibular alveolar bone in a periodontitis model	10.31788/RJC.2023.1638159	Lestari et al.	No extraction protocol
39	Usnic acid alleviates pulmonary fibrosis <i>in vitro</i> and <i>in vivo</i> by inhibiting the ZNF70-mediated Wnt/ β -catenin signaling pathway	10.1016/j.intimp.2025.115725	Han et al.	No extraction protocol
40	Unraveling usnic acid: a comparison of biosynthetic gene clusters between two reindeer lichen (<i>Cladonia rangiferina</i> and <i>C. uncialis</i>)	10.1016/j.funbio.2022.08.007	Egbert et al.	No extraction protocol/ no quantification
41	Elemental analysis and <i>in vitro</i> evaluation of antibacterial and antifungal activities of <i>Usnea barbata</i> (L.) Weber ex F.H. Wigg from Călimani Mountains, Romania	10.3390/plants11010032	Popovici et al.	No extraction protocol/ no UA quantification
42	Phytochemical characterization and pharmacological properties of lichen extracts from cetrarioid clade by multivariate analysis and molecular docking	10.1155/2022/5218248	Ureña-Vacas et al.	UA was purchased
43	Identification of photodegraded derivatives of usnic acid with improved toxicity profile and UVA/UVB protection in normal human L02 hepatocytes and epidermal melanocytes	10.1016/j.jphotobiol.2020.111814	Kwong et al.	derivatives of usnic acid
44	Antibacterial activity of the lichens <i>Usnea Florida</i> and <i>Flavoparmelia caperata</i> (Parmeliaceae) – short communication, methodology not described	10.1080/14786419.2018.1561678	Dieu et al.	No extraction protocol
45	First report of dye yielding potential and compounds of lichens; a cultural heritage of Himalayan communities, Pakistan	10.30848/PJB2019-1(15)	Shaheen et al.	Extraction of dyes

46	Hazards of hindsight - Monitoring the safety of nutritional supplements	10.1056/NEJMp1315559	Cohen et al.	No extraction protocol
47	CAM safety	10.1177/0884533612460872	Mullin et al.	No extraction protocol
48	Prooxidant and antioxidant behaviour of usnic acid from lichens under UVB-light irradiation – Studies on human cells	10.1016/j.jphotobiol.2010.06.017	Kohlhardt-Floehr et al.	No extraction protocol
49	<i>Usnea barbata</i> extract prevents ultraviolet-B induced prostaglandin E2 synthesis and COX-2 expression in HaCaT keratinocytes	10.1016/j.jphotobiol.2007.08.002	Engel et al.	UA was purchased
50	Screening of plant extracts for antimicrobial activity against bacteria and yeasts with dermatological relevance	10.1016/j.phymed.2006.12.013	Weckesser et al.	Extracts were purchased
51	Quantitative determination of usnic acid in usnea lichen and its products by reversed-phase liquid chromatography with photodiode array detector	10.1093/jaoac/88.5.1265	Ji et al.	UA in dietary supplements
52	Copper toxicity to five <i>Parmelia</i> lichens <i>in vitro</i>	10.1016/S0098-8472(02)00087-4	Cabral et al.	No extraction protocol
53	Comparative <i>in vitro</i> analysis of the biological potential of <i>Usnea florida</i> (L.) Weber ex F.H. Wigg., <i>Usnea intermedia</i> (A. Massal.) Jatta, and <i>Usnea lapponica</i> vain and quantification of usnic acid	10.56042/ijtk.v23i6.3586	Kocakaya et al.	inconsistent quantification
54	Analyzing the impact of <i>Ramalina digitellata</i> , <i>R. fastigiata</i> , <i>R. fraxinea</i> , and <i>R. polymorpha</i> 's usnic acid concentration on antioxidant, DNA-protective, antimicrobial, and cytotoxic properties	10.1002/cbdv.202200816	Kiliç Yayla et al.	inconsistent quantification
55	Antibacterial potencial of 12 lichen species	10.1590/0001-3765202120191194	Micheletti et al.	No extraction protocol
56	Low molecular weight non-peptidyl antimalarial leads: Lichen metabolite, usnic acid and its analogues	10.1080/10406638.2021.1920985	Susithra et al.	No lichen specified
57	Antimicrobial activity of some lichen extracts	10.1007/s11094-022-02557-7	Nekhoroshev et al.	inconsistent quantification
58	Reflexions sur la valeur chimiotaxonomique des substances lichéniques a basses concentrations: Le cas de l'acide usnique chez <i>Evernia prunastri</i> (L.) Ach.	10.1016/S0031-9422(00)86165-8	Ramaut et al.	No extraction protocol

59	Raman spectroscopy of hot desert, high altitude epilithic lichens	10.1039/b501585e	Villar et al.	No extraction protocol
60	The effect of <i>Alectoria sarmentosa</i> , <i>Bryoria fuscescens</i> , and <i>Bryoria fremontii</i> extracts and usnic acid on the growth of <i>Gremmeniella abietina</i> in vitro	10.1139/b96-044	Kaitera et al.	UA was purchased
61	Constituents from <i>Lethariella cladonioides</i>	10.1016/S0367-326X(01)00287-8	Jiang et al.	No extraction protocol
62	In vitro study of the inhibitory activity of usnic acid on dental plaque biofilm	EID: 2-s2.0-77954974037	Chifiriuc et al.	No extraction protocol
63	Lichen extracts	10.2310/6620.2008.08033	Schalock et al.	No extraction protocol
64	Phyto-vesicles: Conduit between conventional and novel drug delivery system	10.1016/S2221-1691(12)60485-7	Mishra et al.	No extraction protocol
65	Antimicrobial and antibiofilm activity of secondary metabolites of lichens against methicillin-resistant <i>Staphylococcus aureus</i> strains from cystic fibrosis patients	10.2217/fmb.12.142	Pompilio et al.	No extraction protocol
66	Determination of usnic acid responsive mirnas in breast cancer cell lines	10.2174/1871520618666181112120142	Kiliç et al.	UA was purchased
67	Determination of dysregulated mirna expression levels by qrt-pcr after the application of usnic acid to breast cancer	10.2174/1871520619666190923163552	Tanman et al.	No extraction protocol
68	PORIMIN: The key to (+)-Usnic acid-induced liver toxicity and oncotic cell death in normal human L02 liver cells	10.1016/j.jep.2021.113873	Kwong et al.	UA was purchased
69	Alkoxy glycerol enhanced activity of Oxyresveratrol in Alzheimer's disease by rescuing Tau protein	10.1016/j.neulet.2021.135981	Lakshmi et al.	UA was purchased
70	Cytotoxic activities of extracts and isolated compounds of some potential sumatran medicinal plants against MCF-7 and HSC-3 cell lines – usnic acid previously isolated	10.5614/j.math.fund.sci.2019.51.3.2	Andania et al.	No extraction protocol
71	Investigation of antiepileptic potentials of usnic acid and some lichen species on the behavioral and biochemical levels in pentylenetetrazole-induced kindling model of epilepsy	10.29228/jrp.816	Berköz et al.	UA was purchased
72	Effects of usnic acid on the oxygen exchange properties of mesophyll cell protoplasts from <i>Commelina communis</i> L.	10.1016/S0176-1617(11)80171-9	Vavasseur et al.	UA was purchased

73	Smooth muscle relaxant activities of compounds isolated from Malaysian medicinal plants on rat aorta and guinea-pig ileum	10.1002/ptr.2650090803	Mustafa et al.	No extraction protocol
74	Biological evaluation and phytochemical profiling of some lichen species	10.1556/066.2019.48.4.7	Tas et al.	Unspecified solvent
75	Usnic acid inhibits proliferation and migration through atm mediated DNA damage response in RKO colorectal cancer cell	10.2174/1389201021666201002155955	Wu et al.	No extraction protocol
76	A versatile and automatic on-line screening method: Transverse diffusion of laminar flow profiles-based capillary electrophoresis for exploring PTP1B inhibitors in natural products	10.1016/j.chroma.2024.46560	Gao et al.	No extraction protocol
Studies did not report quantitative analysis of usnic acid				
Lp.	Title	DOI	Authors	
1	Characterization and antimicrobial activity of usnic acid from tropical lichens collected from Doi Suthep Pui, Thailand	10.34044/j.anres.2025.59.2.08	Tilapho et al.	
2	Phytochemical composition and antitumor activity of a new arctic lichen <i>Anamylopsora pakistanica</i>	10.1080/14786419.2024.2365444	Đukić et al.	
3	Phytochemical characterization and bioactivity evaluation of Himalayan lichen <i>Usnea lapponica</i> Vain.: antioxidant, antibacterial, and antibiofilm effects	10.1080/14786419.2025.2580437	Manojlović et al.	
4	Potential of <i>Cladonia foliacea</i> extract as an oral toxic insecticide against adult <i>Anopheles gambiae</i> , malaria vector in western Kenya	10.1556/034.66.2024.3-4.7	Muhoro A.M. et al.	
5	Electrospun nanofibers for localized drug release of a neuroprotective natural extract of <i>Usnea ghattensis</i>	10.1016/j.ejpb.2024.114552	de la Cabeza Fernández et al.	
6	Evaluating the impact of <i>Xanthoparmelia conspersa</i> extracts on signaling in HeLa cells and exploring their diverse biological activities	10.1038/s41598-024-73599-y	Łaska et al.	
7	Comparative study on the antimicrobial activities and metabolic profiles of five <i>Usnea</i> species from the Philippines	10.3390/jof9111117	De la Cruz et al.	
8	Ultrastructural, energy-dispersive X-ray spectroscopy, chemical study and LC-DAD-QToF chemical characterization of <i>Cetraria islandica</i> (L.) Ach	10.3390/molecules28114493	Manassov et al.	
9	Antioxidant activity of usnic acid compound from methanol extract of lichen <i>Usnea</i> sp.	10.5650/jos.ess22315	Maulidiyah et al.	

10	Therapeutic effect of <i>Parmotrema tinctorum</i> against complete Freund's adjuvant-induced arthritis in rats and identification of novel Isophthalic ester derivative	10.1016/j.biopha.2019.108646	Syed Zameer Ahmed et al.
11	The preparation of hyaluronic acid nanoparticles from <i>Aspicilia</i> lichens using Bifidobacteria for help in the treatment of diabetes in rats <i>in vivo</i>	10.1002/ptr.5889	Esmaeili et al.
12	Antimicrobial and antioxidant activity of <i>Evernia prunastri</i> extracts and their isolates	10.1007/s11274-021-03099-y	Shcherbakova et al.
13	Phytochemical constituents, antioxidant and antistaphylococcal activities of <i>Evernia prunastri</i> (L.) Ach., <i>Pseudevernia furfuracea</i> (L.) Zopf. and <i>Ramalina farinacea</i> (L.) Ach. from Morocco	10.1007/s00203-021-02288-5	Aoussar et al.
14	Analytics on antimicrobial activity of lichen extract	10.22207/JPAM.15.2.21	Yadav et al.
15	Antioxidant activity-guided isolation of usnic acid and diffractaic acid compounds from lichen genus <i>Usnea</i> sp.	10.7324/JAPS.2021.110210	Maulidiyah et al.
16	Determination of chemical composition and antimicrobial, anti-oxidant and cytotoxic activities of lichens <i>Parmelia conspersa</i> and <i>Parmelia perlata</i>	10.1007/s11694-020-00672-1	Manojlović et al.
17	Larvicidal activity of <i>Ramalina usnea</i> lichen against <i>Aedes aegypti</i>	10.1016/j.bjp.2016.03.006	Moreira et al.
18	Phytochemical analysis, cytotoxic, antioxidant, and antibacterial activities of lichens	10.1155/2020/8104538	Aoussar et al.
19	Structure and chemical analysis of major specialized metabolites produced by the lichen <i>Evernia prunastri</i>	10.1002/cbdv.201900465	Staples et al.
20	Usnic acid potassium salt: Evaluation of the acute toxicity and antinociceptive effect in murine model	10.3390/molecules24112042	Araújo et al.
21	Extracts of five <i>Cladonia</i> lichens as sources of biologically active compounds	10.31925/farmacia.2018.4.13	Kosanić et al.
22	DNA barcoding and LC-MS metabolite profiling of the lichen-forming genus <i>Melanelia</i> : Specimen identification and discrimination focusing on Icelandic taxa	10.1371/journal.pone.0178012	Xu et al.
23	<i>In vitro</i> antimicrobial activity of the organic extract of <i>Cladonia substellata</i> Vainio and usnic acid against <i>Staphylococcus</i> spp. obtained from cats and dogs	10.1590/S0100-736X2017000400011	Moura et al.

24	Phytochemical study and antioxidant, antimicrobial and anti-cancer activities of <i>Melanelia subaurifera</i> and <i>Melanelia fuliginosa</i> lichens	10.1007/s13197-016-2255-3	Ristić et al.
25	Lichen secondary metabolites in <i>Umbilicaria antarctica</i> evaluated by acetone rinsing	10.5817/CPR2016-2-17	Martic et al.
26	Rapid identification of lichen compounds based on the structure-fragmentation relationship using ESI-MS/MS analysis	10.1039/c5ay01091h	Musharraf et al.
27	Neuroprotective activity and cytotoxic potential of two Parmeliaceae lichens: Identification of active compounds	10.1016/j.phymed.2015.06.005	Fernández-Moriano et al.
28	Chemotaxonomic fingerprinting of Chilean lichens through MALDI and electrospray ionization mass spectrometry	10.1590/S1516-8913201400185	Santos et al.
29	Usnic acid potassium salt: An alternative for the control of <i>Bi-omphalaria glabrata</i> (Say, 1818)	10.1371/journal.pone.0111102	Martins et al.
30	Antibacterial and antioxidant activity of lichen species <i>Ramalina roesleri</i> (short communication)	10.1080/14786419.2013.811410	Sisodia et al.
31	Antimicrobial property of extracts of Indian lichen against human pathogenic bacteria	10.1155/2013/709348	Srivastava et al.
32	Lichenic extracts and metabolites as UV filters	10.1016/j.jphotobiol.2013.01.009	Lohezic-Le Devehat et al.
33	Characterisation of phenols and antioxidant and hypolipidaemic activities of <i>Lethariella cladonioides</i>	10.1002/jsfa.4601	Wei et al.
34	Chemical composition, antioxidant, and antimicrobial activities of lichen <i>Umbilicaria cylindrica</i> (L.) delise (Umbilicariaceae)	10.1155/2012/452431	Manojlovic et al.
35	Molecular structural studies of lichen substances with antimicrobial, antiproliferative, and cytotoxic effects from <i>Parmelia subrudecta</i>	10.1080/10826068.2010.525432	Ivanova et al.
36	Antibacterial activities of ramalin, usnic acid and its three derivatives isolated from the Antarctic lichen <i>Ramalina terebrata</i>	10.1515/znc-2010-1-206	Paudel et al.
37	Antibacterial and antifungal activities of some phenolic metabolites isolated from the lichenized ascomycete <i>Ramalina lacera</i>	10.1177/1934578x0800300226	Hanuš et al.
38	Evaluation of the antimicrobial activity of the acetone extract of the lichen <i>Ramalina farinacea</i> and its (+)-usnic acid, norstictic acid, and protocetraric acid constituents	10.1515/znc-2004-5-617	Tay et al.

39	Phytochemical combinations of lichen <i>Evernia prunastri</i> (L.) Ach. reduce drug resistance to temozolomide but not to paclitaxel <i>in vitro</i>	10.3389/fphar.2025.1633978	Shcherbakova et al.
40	Anti-liver cancer therapeutic targets and safety of usenamine A in experimental liver cancer	10.1093/jpp/rgae096	Xiaoqiong et al.
41	Biological activities of <i>Usnea lethariiformis</i> lichen extracts and UHPLC-ESI-QTOF-MS analysis of their secondary metabolites	10.3389/fphar.2024.1508835	Piñeiro et al.
42	Cytotoxic, anti-proliferative, and apoptotic evaluation of <i>Ramalina sinensis</i> (Ascomycota, Lecanoromycetes), lichenized fungus on oral squamous cell carcinoma cell line; in-vitro study	10.1186/s12906-023-04118-1	Koopaie et al.
43	Inhibition of autophagy increases cell death in HeLa cells through usnic acid isolated from lichens	10.3390/plants12030519	Kumari et al.
44	Lichen extracts from cetrarioid clade provide neuroprotection against hydrogen peroxide-induced oxidative stress	10.3390/molecules27196520	Ureña-Vacas et al.
45	Evaluation of antimicrobial properties of lichen substances against plant pathogens	10.5423/PPJ.OA.12.2021.0176	Paguirigan et al.
46	Phylogenetic studies and metabolite analysis of <i>Sticta</i> species from Colombia and Chile by ultra-high performance liquid chromatography–high-resolution Q-Orbitrap mass spectrometry	10.3390/metabo12020156	Albornoz et al.
47	<i>In vitro</i> anticancer activity and oxidative stress biomarkers status determined by <i>Usnea barbata</i> (L.) f.h. Wigg. dry extracts	10.3390/antiox10071141	Popovici et al.
48	Effect of ethyl acetate extract of <i>Usnea longissima</i> o esophagogastric adenocarcinoma in rats	10.1590/s0102-8650201900300000005	Mammadov et al.
49	Toxicity of usnic acid from <i>Cladonia substellata</i> (Lichen) to embryos and adults of <i>Biomphalaria glabrata</i>	10.1016/j.actatropica.2017.11.007	Araújo et al.
50	Activity of the lichen <i>Usnea steineri</i> and its major metabolites against gram-positive, multidrug-resistant bacteria	10.1177/1934578x1601100419	Tozatti et al.
51	Inhibitory activity of (+)-usnic acid against non-small cell lung cancer cell motility	10.1371/journal.pone.0146575	Yang et al.
52	Evaluation of <i>Parmotrema reticulatum</i> taylor for antibacterial and antiinflammatory activities	10.4103/0250-474X.180241	Jain et al.

53	Antibacterial and antioxidant activity of lichens: <i>Usnea rubroincta</i> , <i>Ramalina dumeticola</i> , <i>Cladonia verticillata</i> and their chemical constituents	10.17576/mjas-2016-2001-01	Gunasekaran et al.
54	Anticancer activities of selected species of North American lichen extracts	10.1002/ptr.5233	Shrestha et al.
55	Lichen secondary metabolites in <i>Flavocetraria cucullata</i> exhibit anti-cancer effects on human cancer cells through the induction of apoptosis and suppression of tumorigenic potentials	10.1371/journal.pone.0111575	Nguyen et al.
56	Antioxidant, antimicrobial and antiproliferative activities of five lichen species	10.3390/ijms12085428	Mitrović et al.
57	Optimal defense: Snails avoid reproductive parts of the lichen <i>Lobaria scrobiculata</i> due to internal defense allocation	10.1890/09-1829.1	Asplund et al.
58	Pharmacological properties of lichen <i>Cladonia clathrata</i>	10.3109/13880200903273914	Da Costa Silva et al.
59	Antimycobacterial activity of lichen substances	10.1016/j.phymed.2009.07.018	Honda et al.
60	Antifungal activity of lichen extracts and lichenic acids	10.1023/B:BICO.0000009378.31023.ba	Halama et al.
61	The antimicrobial activity of extracts of the lichen <i>Cladonia foliacea</i> and its (-)-usnic acid, atranorin, and fumarprotocetraric acid constituents	10.1515/znc-2004-3-423	Yilmaz et al.
62	Protection against UVB irradiation by natural filters extracted from lichens	10.1016/S1011-1344(02)00362-7	Rancan et al.
63	Effect of cyclic amp and acridine orange on the enzymatic reduction of usnic acid in the lichen <i>Usnea aurantiaco-atra</i> (jacq.) Bory	10.5586/asbp.1995.038	Vicente et al.
64	Evaluation of the cytotoxic activity of the <i>Usnea Barbata</i> (L.) F. H. Wigg Dry Extract	10.3390/molecules25081865	Popovici et al.
65	DFT and molecular docking research on the effects of lichen metabolites	10.1016/j.molliq.2024.126660	Kocakaya et al.
66	Chemical composition and antioxidant activity of lichen <i>Toninia candida</i>	10.1590/S0102-695X2011005000184	Manojlovic et al.
67	Chemistry of two new leprarioid lichens from Sri Lanka	10.4038/jnsfstr.v34i2.2086	Kathirgamanathar et al.
68	Study of the composition and properties of secondary metabolites of the lichen <i>Usnea Barbata</i> (Quantitative data reported per extract volume only)	10.14258/jcprm.2018011966	Lyskova et al.

69	Production of bioactive metabolites from lichen <i>Cladonia substel-lata</i> Vainio	10.1590/S0102-33062006000200003	Ribeiro et al.
70	Antimicrobial activity of phenols actives from the liquen <i>Rama-lina solediosa</i> (B. de Lesd.) Laundron	10.1590/S0102-33062004000400022	Falcão et al.
71	Studies on the northeast Anatolian lichens <i>Lobaria scrobiculata</i> and <i>L. pulmonaria</i>	10.3797/scipharm.aut-00-29	Zeybek et al.
72	Quelques aspects des propriétés d'un lichen, le letharia vulpina (L.) hue, en biologie végétale expérimentale: I. Action sur la ger-mination du blé et le développement de l'ail	10.1080/00378941.1976.10835691	Dauriac et al.
73	Analysis of <i>Usnea fasciata</i> crude extracts with antineoplastic activ-ity	EID: 2-s2.0-0028625642	Pereira et al.
74	Potential allelochemicals from the lichen <i>Cladonia foliacea</i> and their <i>in vitro</i> effects on the development of mosses	EID: 2-s2.0-0002402727	Giordano et al.
75	Antimicrobial, antiviral and cytotoxic activity of New Zealand li-chens	10.1006/lich.1999.0241	Perry et al.
76	Usnic acid and diffractaic acid as analgesic and antipyretic com-ponents of <i>Usnea diffracta</i>	10.1055/s-2006-958027	Okuyama et al.
77	Photoinhibition in lichens depends on cortical characteristics and hydration	10.1017/S0024282904014045	Gauslaa et al.
78	Intermediate reactive oxygen and nitrogen from macrophages in-duced by Brazilian lichens	10.1016/j.fitote.2004.04.002	Santos et al.
79	Antimicrobial activity and phytochemical studies of some lichens from south of Spain	10.1016/j.fitote.2005.12.001	Saenz et al.
80	Larvicidal and wormicidal efficacy of methanolic extracts of five macrolichens collected from Bhadra wildlife sanctuary	EID: 2-s2.0-84865365449	Vinayaka et al.
81	Insecticidal efficacy of <i>Ramalina hossei</i> H. Magn & G. Awasthi and <i>Ramalina conduplicans</i> Vain-Macrolichens from Bhadra wildlife sanctuary, Karnataka	EID: 2-s2.0-81455135250	Praveen Kumar et al.
82	<i>Evernia prunastri</i> and <i>Pseudoevernia furfuraceae</i> lichens and their major metabolites as antioxidant, antimicrobial and anticancer agents	10.1016/j.fct.2012.11.034	Kosanić et al.
83	Antimicrobial and antioxidant activities of a macrolichen <i>Usnea pictoides</i> G. Awasthi (Parmeliaceae)	10.7324/JAPS.2013.3827	Pavithra et al.

84	Phytochemical screening and <i>in-vitro</i> antioxidant activities of <i>Colubrina asiatica</i> Brong	EID: 2-s2.0-8490754144	Nivas et al.
85	<i>In situ</i> isolation and characterization of nano-usnic acid for medical applications	EID: 2-s2.0-8490388008	Mariawilliam et al.
86	Biological activities and chemical composition of lichens from Serbia	EID: 2-s2.0-84919631929	Kosanić et al.
87	Contribution to the knowledge of the chemical composition and biological activity of the lichens <i>Cladonia foliacea</i> Huds. (wild.) and <i>Hypogymnia physodes</i> (L.)	EID: 2-s2.0-85018394040	Mitrovic et al.
88	Evaluation of the sunscreen lichen substances usnic acid and atranorin	EID: 2-s2.0-84945177803	Varol et al.
89	Antioxidant and cytoprotective potentials of Parmeliaceae lichens and identification of active compounds	EID: 2-s2.0-84941921493	Fernández-Moriano et al.
90	Efficacy of extracts of some lichens for potential antibacterial activity	EID: 2-s2.0-84921452811	Abuiraq et al.
91	Biopharmaceutical potential of two <i>Ramalina</i> lichens and their metabolites	10.2174/1389201017666160401144825	Ristić et al.
92	GC-MS analysis and biological activities of medicinally important lichen: <i>Parmelia perlata</i>	EID: 2-s2.0-85018201476	Pratibha et al.
93	Amylase inhibitory activity of some macrolichens in Mazandaran province, Iran	EID: 2-s2.0-85006483222	Valadbeigi et al.
94	Protective effects of lichen metabolites evernic and usnic acids against redox impairment-mediated cytotoxicity in central nervous system-like cells	10.1016/j.fct.2017.04.030	Fernández-Moriano et al.
95	Are atranols the only skin sensitizers in oakmoss? A systematic investigation using non-animal methods	10.1016/j.tiv.2020.105053	Avonto et al.
96	Combination therapy for bacterial pathogens: Naturally derived anti-microbial drugs combined with <i>Ulva lactuca</i> extract	10.2174/1871526521666210823164842	Bamunuarachchi et al.
97	An assessment of proximate composition, antioxidant activities and LC/MS-based phytochemical profiling of some lichen species collected from the Western Ghats of southern part of India	EID: 2-s2.0-85124342316	Muthu et al.
98	Can lichen secondary compounds impact upon the pathogenic soil fungi <i>Fusarium oxysporum</i> and <i>F. Avenaceum</i> ?	EID: 2-s2.0-85117862466	Tekiela et al.

99	Antibacterial activity of lichen <i>Usnea rubrotincta</i> , <i>Ramalina dumeticola</i> , and <i>Cladonia verticillata</i> (conference paper)	10.1063/1.4931293	Gunasekaran et al.
100	Differential sensitivity of four <i>Lobaria</i> lichens to copper <i>in vitro</i>	10.1002/etc.5620211128	Cabral et al.
101	Droplet counter-current chromatography in the separation of phenolic substances from <i>Neuropogon aurantiaco-ater</i>	EID: 2-s2.0-18244431466	Pozzebon et al.
102	The metal complexes of natural compounds, usnic acid and naringenin immobilized on mesoporous silica: solid phase extraction and oxidative catalytic properties	EID: 2-s2.0-85121842426	Uruş et al.
103	Evaluation of biological properties and isolation of metabolites of lichens of Parmeliaceae family from Himalayan region of Nepal	10.26538/tjnpr/v3i8.3	Ranjit et al.
104	Toxicological effects of <i>Cladonia substellata</i> (lichen) a new possibility environmentally safe for control <i>Biomphalaria glabrata</i> and against the infectious agent of schistosomiasis	10.1016/j.sajb.2025.02.040	Da Rocha et al.
105	Depside and depsidone-rich hydroalcoholic extract, resourced from the lichen <i>Parmelinella wallichiana</i> (Taylor) Elix & Hale selectively restricts non-small cell lung cancer by modulating p53, FOXO1 and PALLADIN genes	10.1016/j.fitote.2024.106211	Saha et al.
106	Visualizing usnic acid with anisaldehyde reagent	10.1017/S002428292400015X	McCune et al.