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Review Article

Cordyceps sinensis and Influenceable Articles on it

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ABSTRACT

Cordyceps Sinensis, known as *winter worm and summer grass*. This review summarized the overview of *C. sinensis*; chemical constituents and its biological studies. Further the bibliometric analysis performed which will help to broaden the knowledge and understanding of its research, topics, and growing trends. The search term "*Cordyceps sinensis*" was typed in google scholar and the appeared articles (total 1,134 articles) are selected, having citations more than 100 are 40 articles. Further evaluated according to the journal, year of publication, manuscript type, and first author. To make it more comprehensive the articles having more than 10 citations in the year 2017-18, at least 1 citation in 2019, and all articles of the year 2020 were also presented separately. The average number of citations among the top 40 manuscripts was 189, ranging from the highest 636 to lowest is 102 citations. The maximum number of articles in the top 40 were published in the Biological and Pharmaceutical Bulletin (n=5) and Life sciences (n=5), followed by the Phytomedicine (n=3). The highest cited paper is by Zhu JS, "the scientific rediscovery of an ancient Chinese herbal medicine: *Cordyceps sinensis* Part I", published in 1998 with total citation 636. The most prevalent theme in the title is a polysaccharide (n=13) followed by antioxidant (n =4). Most of the research is performed by Chinese researchers. This bibliometric analysis identified the most influential articles in the field of *C. sinensis* research and discussed the overview on it.

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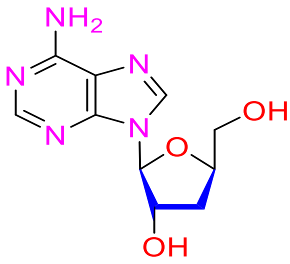
GRAPHICAL ABSTRACT


Cordycepine


Cordyceps sinensis

1. Introduction

The medicinal fungi with genus Cordyceps belong to Pyrenomycetes, Hypocereals, Ascomycota, and Clavicipitaceae.[1] The macrofungi Cordyceps is a specific character because of its parasitic nature on the larva and the pupae of insects. Cordyceps is a pleomorphic fungus and distributed all over the world especially abundant in humid temperate and the tropical region. *C. sinensis* is popularly known as winter worm and summer grass and this is the most popular tonic herbs in Ayurveda, traditional, Chinese medicine and other ethnic communities from centuries-long. So far over 400 different species are identified in genus Cordyceps [1].

C. sinensis is abundantly available in Nepal's mountain and many Nepalese communities residing to these areas wildly collect and sell it to build their economic resources.[2] Different pictures of *C. sinensis* and people collecting it naturally is shown in **Fig. 1a**, the enlarged image of *C. sinensis* showing different parts is shown in **Fig. 1b**, and the lifecycle is shown in **Fig. 1c.** Its various ethnomedicinal values are identified and the uses vary to different communities. Mostly its biological potency attracts today's researchers to do scientific findings of its chemical constituents. Till now various compounds are identified from it like ergosterol, adenosine, mannitol, polysaccharide, and the most popular cordycepin. Along with it, various biological potencies are tested like anti-inflammatory, neuroprotective, hepatoprotective, antitumor, antioxidant, antibacterial, and antiapoptotic properties [1].

As our ongoing effort to write review articles[3-9] and bibliometric analysis[3, 4], we report it. Some articles about bibliometric analysis in other fields like bladder cancer[10], emergency abdominal surgery[11], and other fields have been published but to this particular relating to the *C. Sinensis* none have been published yet. So this bibliometric analysis aims to identify the key research topic in this subject, the research theme along with most eminent and highly influential articles that will help to broaden our knowledge and understanding for further interest in this subject.

2. Chemical constituents of *C. sinensis*

Review article about the properties of *C. sinensis* reported by Chen and coworker in 2013.[12] The Liu and coworkers described in detail about the chemical constituents of *C. sinensis* with their corresponding pharmacological actions up to 2014.[1] Below is the summarized form on it.

2.1 Nucleosides

This is a major chemical constituent present in *C. sinensis* and used a core marker to determine the quality of cordyceps. As the nucleoside is widely popular in drug development and also using for a long time as an antiviral, and anticancer agents. So far more than 10 nucleoside and such related chemical compounds have been isolated from *C. sinensis* including adenosine, adenine, cystidine, inosine, eridine, cytosine, thymidine, guanine, guanosine, uracil and hypoxanthine. The nucleosides and nucleotides present in *C. sinensis* can easily convert reciprocally. The development of UPLC method makes it easy for the determination of various nucleosides and analytes present in cultured *C. sinensis*.[1, 13] The chemical structure of nucleosides is shown on **Fig. 1.**

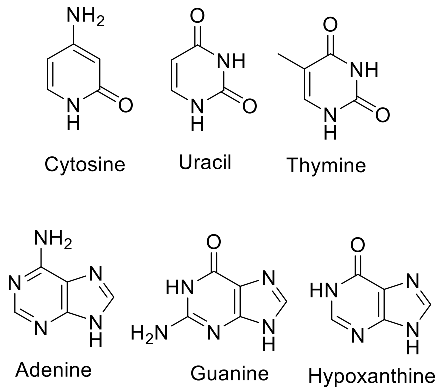


Fig.1. Structure of six Nucleosides

Fig. 1a. Different pictures of *C. sinensis* and the people collecting it naturally.

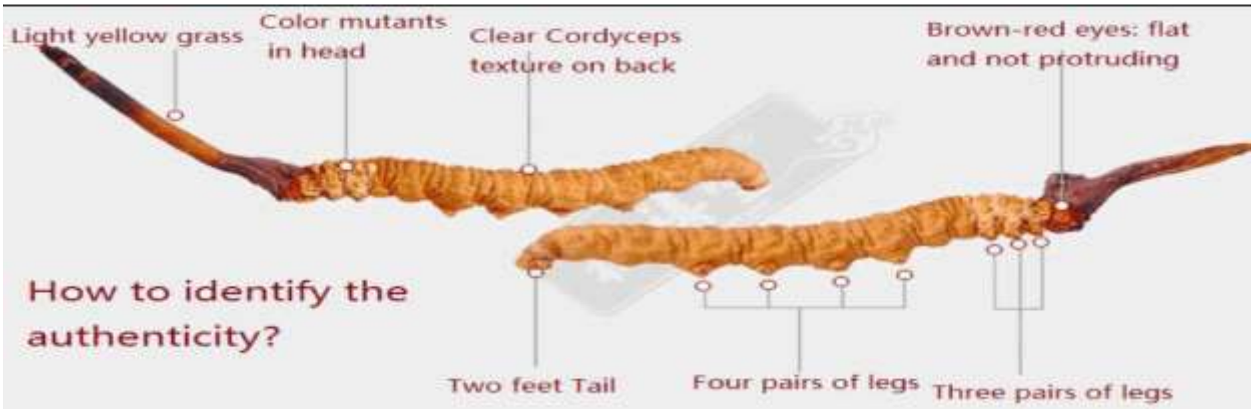


Fig.1b. Yarshagumba enlarged image showing different parts.
[Source:http://yarsagumbanepal.blogspot.com/2017/11/what-are-cordyceps-sinensis-yarsagumba.html?m=1]

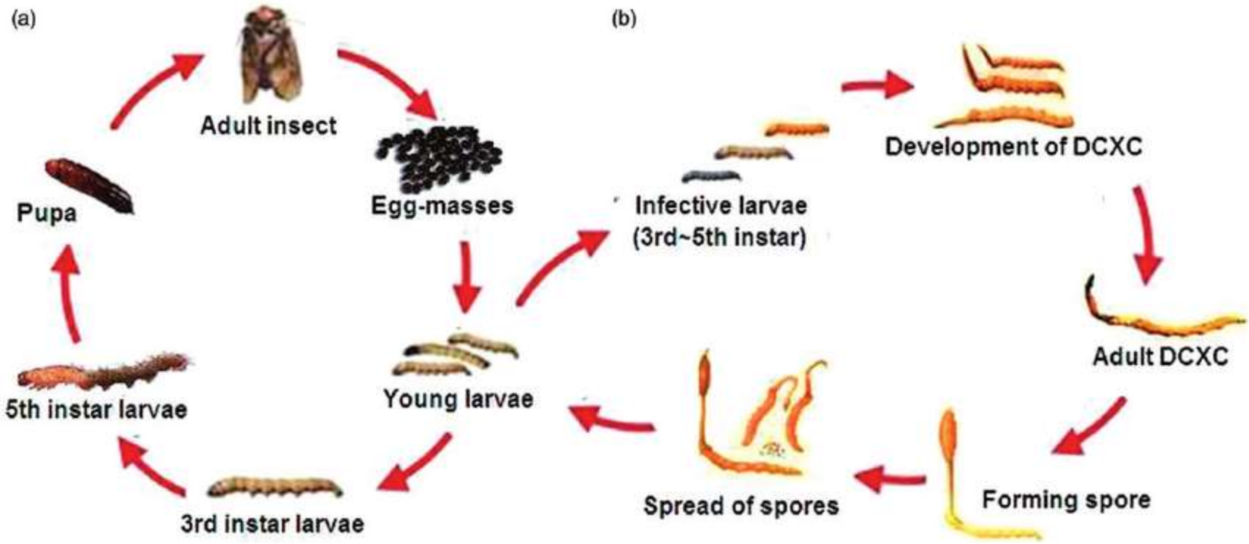


Fig.1c. The life cycle of the insect of the genus *Hepialus* [a] and the development process of the DCXC [b]. [Reproduced from**:** *Crit Rev Biotechnol, 2014; 34[3]: 233–243.*]

2.1.1 Cordycepin

Cordycepin [**Fig.2-a**] was first time isolated from *C. militaris* in early 1950[14] and the structure was assigned as 3'-deoxyadenosine, due to its limited availability only in natural *C. sinensis* makes more difficult to detect in a cultured one.[1] The cordycepin category compounds show diverse significant therapeutic potential via various intracellular targets like apoptosis and nucleic acid. The various molecular mechanism of cordycepin to shows pharmacological potential has been studied by Tuli *et al.*[15] Due to the similarity of cordycepin with adenosine it also involves in other molecular processes in cells.[1] The role of cordycepin for prevention of injury in focal cerebral ischemic/reperfusion [I/R] was studied by Wang *et al*, suggests its neuroprotective action via the antioxidant and the anti-inflammatory activity, so this could be a good candidate for research in various I/R-related heart disease like myocardial infarction.[1, 16] The analgesic activity tested in mice through neurolysin inhibition assay, hot-plate test, abdominal constriction induced by acetic acid shows its potential analgesic potential. Moreover, cordycepin possesses a broad spectrum of biocidal activities like antiviral, antibacterial, and insecticidal.[1]

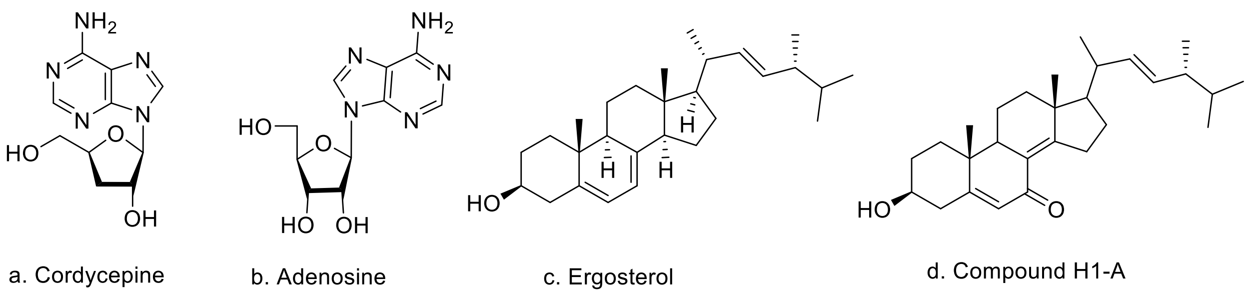


Fig.2. Chemical constituents in *C. sinensis*

2.1.2 Adenosine

The structure of adenosine is shown in **Fig. 2-b**. This is a major nucleoside in *C. sinensis* and in general, this played a crucial role in many biochemical processes. With comparison to the naturally available *C. sinensis*, the adenosine is more in cultured one but in *C. militaris* it's opposite. Several other analogs of adenosine are identified from *C. sinensis* like 2'3'-dideoxyadenosine, 2'-deoxyadenosine, cordycepin triphosphate, and the 3'- amino-3'-deoxyadenosine.[17]

Li and Yang explained three different kinds of methods to extract adenosine from cordyceps namely boiling water extraction, organic solvent pressurized liquid extraction, and the water extraction at ambient temperature.[18] In their study, they conclude the enzymes present on natural *C. sinensis* decompose adenosine and it is affected by extracting time duration. Its role in signal transduction and energy transfer in cells and having a broader spectrum of preventing tissue damage, cytoprotective action, role in preventing chronic heart failure, anticonvulsant property, and anti-inflammatory property, etc.

2.1.3 Nucleobases

Six nucleobases [adenine, thymine, cytosine, guanine, hypoxanthine, and uracil] identified in cultured and naturally grown *C. sinensis* are shown in **Fig. 1**. Fan *et al* discovered a reliable effective methods for the quantitative determination of these mentioned bioavailable nucleosides via acid hydrolysis followed by HPLC with diode array detection.[19]

2.1.4 Nucleotides

The IP-RP-LCMS [ion-pairing reversed-phase liquid chromatography-mass spectrometry] methods developed by Yang *et al* isolated three different nucleotides as adenosine-5'-monophosphate [AMP], uridine-5'-monophosphate [UMP], and guanosine-5'-monophosphate [GMP]. These nucleotides are involved in a various pharmacological activity like influencing the metabolism of fatty acids, enhancing the immunity, increase absorption of iron from the gut and plays a role to maintain the ruptured gastrointestinal injuries, etc.[20] The GMP, AMP, and UMP nucleotides can undergo degradation to give guanosine, adenosine, and uridine, respectively. Mostly the nucleotides play a great role in promoting the human immunity and some other function like promoting blood circulation, decrease urethral inflammation, enhance memory activity and brain function.[1]

2.2 Polysaccharides

The amount of Polysaccharide is 3-8% by total weight in *C. sinensis*. This includes both the intracellular and the extracellular polysaccharide. Various scientific finding revealed its therapeutic potential including antiviral, antitumor, antioxidant, hypoglycemic and hypocholesterolemia etc. Sasaki *et al* study suggest if the fungal polysaccharide molecular weight is more than 16,000 then, it shows antitumor activity.[21] These polysaccharides are a major contributor to the pharmacological action. The qualitative and quantitative determination of 10 different monosaccharides beyond 16,000 molecular weight as ribose, mannose, rhamnose, xylose, galactose, fructose, glucose, mannitol, arabinose, and sorbose from 13 different cultured and natural *C. sinensis* has been performed. Due to the excessive harvest of these species, it becomes endangered species so the supply is limited which makes limited to do various biological activity test but the cultured one also have these pharmacological potencies. This further divided into Exopolysaccharide fraction [EPSF], Acid polysaccharide [APS], CPS-1. A water-soluble polysaccharide named CPS-1, CPS-2 a *C. sinensis* polysaccharide, and some other Polysaccharides [1].

2.3 Other chemical constituents

Sterols [[ergosterol [**Fig 2-c**], compound H1-A [**Fig 2-d**]], protein [CSDNase, CSP], an amino acid and polypeptide [cordymin, cordycedipeptide A, cordyceamides A and B, tryptophan], etc [1].

3. Methods

The search engine, Google Scholar was used, typed "*Cordyceps Sinensis"* and chosen articles with the word specifically in the title of the article only, the patents are included but the citation excluded and searched the article by using custom range screened from the beginning and the articles started appearing from 1923 AD. Then the whole screening performed from the appeared citation to the particular articles i.e. the articles having more than 100 citations were selected and further evaluated according to the journal, year of publication, manuscript type, and the first author [**Table 1**]. Further to make it more comprehensive the article has more than 10 citations in the year 2017-18, at least 1 citation in 2019, and all articles of the year 2020 were also searched separately and are presented here in **Tables 3, 4,** and **5** respectively. The top 40 articles are further categorized based on their published journals [**Table 2**]. Moreover, the certain time range is searched and the year range versus published paper are presented in **Fig. 3**.

Table 1. The top research in *C. sinensis* having more than 100 citations. The rank is based on highest to lowest citations.

Rank	Manuscript [first author, title, journal and year]	Citations
1	Zhu JS, The scientific rediscovery of an ancient Chinese herbal medicine: *Cordyceps sinensis* Part I. The Journal of alternative and complementary medicine. 1998.	663
2	Bok JW, Antitumor sterols from the mycelia of *Cordyceps sinensis*. Phytochemistry. 1999.	491
3	Zhu JS, The scientific rediscovery of a precious ancient Chinese herbal regimen: *Cordyceps sinensis* Part II. The Journal of Alternative and Complementary Medicine. 1998.	342
4	Li SP, Quality control of *Cordyceps sinensis*, a valued traditional Chinese medicine. Journal of pharmaceutical and biomedical analysis. 2006.	295
5	Li SP, A polysaccharide isolated from *Cordyceps sinensis*, a traditional Chinese medicine, protects PC12 cells against hydrogen peroxide-induced injury. Life sciences. 2003.	288
6	Chen YJ, Effect of *Cordyceps sinensis* on the proliferation and differentiation of human leukemic U937 cells. Life sciences. 1997.	281
7	Kiho T, Polysaccharides in fungi. XXXVI. Hypoglycemic activity of a polysaccharide [CS-F30] from the cultural mycelium of *Cordyceps sinensis* and its effect on glucose metabolism in mouse liver. Biological and Pharmaceutical Bulletin. 1996.	218
8	Kuo YC, *Cordyceps sinensis* as an immunomodulatory agent. The American journal of Chinese medicine. 1996.	217
9	Li SP, Anti-oxidation activity of different types of natural *Cordyceps sinensis* and cultured Cordyceps mycelia. Phytomedicine. 2001.	209
10	Kiho T, Structural features and hypoglycemic activity of a polysaccharide [CS-F10] from the cultured mycelium of *Cordyceps sinensis*. Biological and Pharmaceutical Bulletin. 1999.	204
11	KIHO T, Polysaccharides in fungi. XXXII. Hypoglycemic activity and chemical properties of a polysaccharide from the cultural mycelium of *Cordyceps sinensis*. Biological and Pharmaceutical Bulletin. 1993.	199
12	Winkler D. Yartsa Gunbu [*Cordyceps sinensis*] and the fungal commodification of Tibet's rural economy. Economic botany. 2008.	196
13	Leung PH, Chemical properties and antioxidant activity of exopolysaccharides from mycelial culture of *Cordyceps sinensis* fungus Cs-HK1. Food Chemistry. 2009.	190
14	Chiou WF, Protein constituent contributes to the hypotensive and vasorelaxant activities of	187

	Cordyceps sinensis. Life Sciences. 2000.	
15	Hsu TH, A comparison of the chemical composition and bioactive ingredients of the Chinese medicinal mushroom DongChongXiaCao, its counterfeit and mimic, and fermented mycelium of *Cordyceps sinensis*. Food chemistry. 2002.	185
16	Yamaguchi Y, Antioxidant activity of the extracts from fruiting bodies of cultured *Cordyceps sinensis*. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2000.	185
17	Buenz EJ, The traditional Chinese medicine *Cordyceps sinensis* and its effects on apoptotic homeostasis. Journal of Ethnopharmacology. 2005.	182
18	Kuo YC, Growth inhibitors against tumor cells in *Cordyceps sinensis* other than cordycepin and polysaccharides. Cancer investigation. 1994.	164
19	Koh JH, Hypocholesterolemic effect of hot-water extract from mycelia of *Cordyceps sinensis*. Biological and Pharmaceutical Bulletin. 2003.	162
20	Wang BJ, Free radical scavenging and apoptotic effects of *Cordyceps sinensis* fractionated by supercritical carbon dioxide. Food and Chemical Toxicology. 2005.	158
21	Yu HM, Comparison of protective effects between cultured *Cordyceps militaris* and natural *Cordyceps sinensis* against oxidative damage. Journal of Agricultural and Food Chemistry. 2006.	153
22	Dong CH, Application of Box-Behnken design in optimisation for polysaccharides extraction from cultured mycelium of *Cordyceps sinensis*. Food and bioproducts processing. 2009.	153
23	Li SP, Determination of nucleosides in natural *Cordyceps sinensis* and cultured *Cordyceps mycelia* by capillary electrophoresis. Electrophoresis. 2001.	147
24	Koh JH, Activation of macrophages and the intestinal immune system by an orally administered decoction from cultured mycelia of *Cordyceps sinensis*. Bioscience, biotechnology, and biochemistry. 2002.	145
25	Chen W, Effects of the acid polysaccharide fraction isolated from a cultivated *Cordyceps sinensis* on macrophages in vitro. Cellular Immunology. 2010.	144
26	Kuo YC, Regulation of bronchoalveolar lavage fluids cell function by the immunomodulatory agents from *Cordyceps sinensis*. Life Sciences. 2001.	144
27	Chen YQ, Determination of the anamorph of *Cordyceps sinensis* inferred from the analysis of the ribosomal DNA internal transcribed spacers and 5.8 S rDNA. Biochemical systematics and ecology. 2001.	143
28	Ji DB, Antiaging effect of *Cordyceps sinensis* extract. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2009.	131
29	Kim HO, A comparative study on the production of exopolysaccharides between two entomopathogenic fungi *Cordyceps militaris* and *Cordyceps sinensis* in submerged mycelial cultures. Journal of applied microbiology. 2005.	126
30	Koh JH, Antifatigue and antistress effect of the hot-water fraction from mycelia of *Cordyceps sinensis*. Biological and Pharmaceutical Bulletin. 2003.	126
31	Huang LF, Simultaneous separation and determination of active components in *Cordyceps sinensis* and *Cordyceps militarris* by LC/ESI-MS. Journal of Pharmaceutical and Biomedical Analysis. 2003.	125
32	Nakamura K, Inhibitory effect of *Cordyceps sinensis* on spontaneous liver metastasis of Lewis lung carcinoma and B16 melanoma cells in syngeneic mice. The Japanese Journal of Pharmacology. 1999.	123
33	Zhang G, Hypoglycemic activity of the fungi *Cordyceps militaris*, *Cordyceps sinensis*, *Tricholoma mongolicum*, and *Omphalia lapidescens* in streptozotocin-induced diabetic rats. Applied	115

	microbiology and biotechnology. 2006.	
34	Dong CH, Nutritional requirements of mycelial growth of *Cordyceps sinensis* in submerged culture. Journal of Applied Microbiology. 2005.	114
35	Li SP, The fruiting body and its caterpillar host of *Cordyceps sinensis* show close resemblance in main constituents and anti-oxidation activity. Phytomedicine. 2002.	114
36	Yan JK, Recent advances in *Cordyceps sinensis* polysaccharides: Mycelial fermentation, isolation, structure, and bioactivities: A review. Journal of Functional Foods. 2014.	112
37	Wu JY, Inhibitory effects of ethyl acetate extract of *Cordyceps sinensis* mycelium on various cancer cells in culture and B16 melanoma in C57BL/6 mice. Phytomedicine. 2007.	111
38	Liu ZY, Molecular evidence for the anamorph—teleomorph connection in *Cordyceps sinensis*. Mycological Research. 2001.	108
39	Chen J, Morphological and genetic characterization of a cultivated *Cordyceps sinensis* fungus and its polysaccharide component possessing antioxidant property in H22 tumor-bearing mice. Life Sciences. 2006.	108
40	Nakamura K, Anticancer and antimetastatic effects of cordycepin, an active component of *Cordyceps sinensis*. Journal of pharmacological sciences. 2015.	102

Table 2. Publication distribution of top 40 articles by Journals

Journals Name	**Published articles**
American journal of Chinese medicine	1
Applied microbiology and biotechnology	1
Biochemical systematics and ecology	1
Biological and Pharmaceutical Bulletin	5
Bioscience, biotechnology, and biochemistry	1
Cancer investigation	1
Cellular Immunology	1
Economic botany	1
Electrophoresis	1
Food and bioproducts processing	1
Food and Chemical Toxicology	1
Food Chemistry	2
Journal of Agricultural and Food Chemistry	1
Journal of alternative and complementary medicine	2
Journal of applied microbiology	2
Journal of Ethnopharmacology	1
Journal of Functional Foods	1
Journal of pharmaceutical and biomedical analysis	1
Journal of Pharmaceutical and Biomedical Analysis	1
Journal of pharmacological sciences	1
Life sciences	5
Mycological Research	1
Phytochemistry	1
Phytomedicine	3
Phytotherapy Research	2
The Japanese Journal of Pharmacology	1

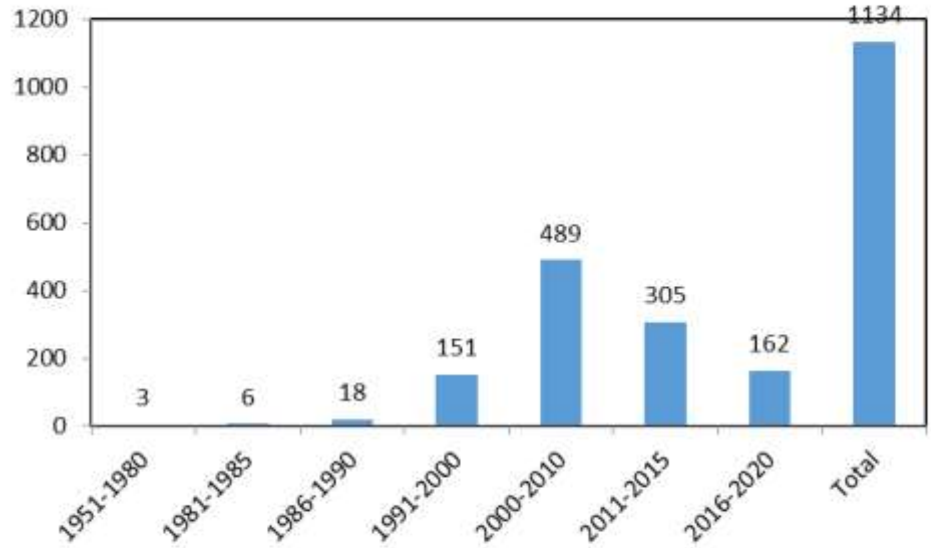


Fig. 3. The number of articles published by year.

In the year 2017 and 2018 total of 79 articles published and the article having more than 10 citations are listed in the **Table. 3**

Table 3. Articles published in the year 2017 and 2018 having more than 10 citations.

Rank	Manuscript [first author, title, journal and year]	Citations
1	Wang J, Structural characterization and immunostimulatory activity of a glucan from natural *Cordyceps sinensis*. Food Hydrocolloids. 2017.	35
2	Xiao Y, Construction of a *Cordyceps sinensis* exopolysaccharide-conjugated selenium nanoparticles and enhancement of their antioxidant activities. International journal of biological macromolecules. 2017.	29
3	Chen YC, Functional study of *Cordyceps sinensis* and cordycepin in male reproduction: A review. journal of food and drug analysis. 2017.	19
4	Cai H, Extracts of **Cordyceps sinensis** inhibit breast cancer cell metastasis via down-regulation of metastasis-related cytokines expression. Journal of Ethnopharmacology. 2018.	16
5	Song AX, Bifidogenic effects of *Cordyceps sinensis* fungal exopolysaccharide and konjac glucomannan after ultrasound and acid degradation. International journal of biological macromolecules. 2018.	15
6	Wang J, Comparison of structural features and antioxidant activity of polysaccharides from natural and cultured *Cordyceps sinensis*. Food science and biotechnology. 2017.	14
7	Du C, Identification of Chinese medicinal fungus *Cordyceps sinensis* by depth-profiling mid-infrared photoacoustic spectroscopy. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy. 2017.	12
8	Fan ST, Protective properties of combined fungal polysaccharides from *Cordyceps sinensis* and Ganoderma atrum on colon immune dysfunction. International journal of biological macromolecules. 2018.	12

In the year 2019, only about 27 articles published. **Table 4** shows the list of articles published in 2019 and has at least 1 citation.

Table 4. Article published in 2019 and has at least 1 citation.

Rank	Manuscript [first author, title, journal and year]	Citations
1	Li XH, Isochromanes from Aspergillus fumigatus, an endophytic fungus from *Cordyceps sinensis*. Natural product research. 2019.	12
2	Chen S, Polysaccharide from natural *Cordyceps sinensis* ameliorated intestinal injury and enhanced antioxidant activity in immunosuppressed mice. Food Hydrocolloids. 2019.	11
3	Ying M, Cultured *Cordyceps sinensis* polysaccharides attenuate cyclophosphamide-induced intestinal barrier injury in mice. Journal of Functional Foods. 2019.	3
4	Yu X, Effectiveness and Safety of Oral *Cordyceps sinensis* on Stable COPD of GOLD Stages 2–3: Systematic Review and Meta-Analysis. Evidence-Based Complementary and Alternative Medicine. 2019.	3
5	Fu S, Protective effect of *Cordyceps sinensis* extract on lipopolysaccharide-induced acute lung injury in mice. Bioscience reports. 2019.	2
6	Su NW, Cordycepin, isolated from medicinal fungus *Cordyceps sinensis*, enhances radiosensitivity of oral cancer associated with modulation of DNA damage repair. Food and Chemical Toxicology. 2019.	2
7	Li Y, Arsenic species in *Cordyceps sinensis* and its potential health risks. Frontiers in pharmacology. 2019.	1
8	Liu W, The components data of fuzheng huayu extracts, *Cordyceps sinensis* mycelia polysaccharide, gypenosides and amygdalin. Data in brief. 2019.	1
9	Tiamyom K, The Effects of *Cordyceps sinensis* [Berk.] Sacc. and *Gymnema inodorum* [Lour.] Decne. Extracts on Adipogenesis and Lipase Activity In Vitro. Evidence-Based Complementary and Alternative Medicine. 2019.	1

In the year 2020 [up to June 28] only about 16 researches are published. To understand the recent growth trends the list of all the articles are presented in **Table 5.**

Table 5. Article published in year 2020 [up to June 28]

SN	Manuscript [first author, title, journal and year]
1	Guo DL, Three new α-pyrone derivatives induced by chemical epigenetic manipulation of Penicillium herquei, an endophytic fungus isolated from *Cordyceps sinensis*. Natural Product Research. 2020.
2	Tian Y, Rapid freezing using atomized liquid nitrogen spray followed by frozen storage below glass transition temperature for *Cordyceps sinensis* preservation: Quality attributes and storage stability. LWT. 2020.
3	Ying M, Cultured *Cordyceps sinensis* polysaccharides modulate intestinal mucosal immunity and gut microbiota in cyclophosphamide-treated mice. Carbohydrate Polymers. 2020.
4	Li LQ, Anti-inflammation activity of exopolysaccharides produced by a medicinal fungus *Cordyceps sinensis* Cs-HK1 in cell and animal models. International Journal of Biological Macromolecules. 2020.
5	Sun YD, The effect of *Cordyceps Sinensis* in the prognosis on patients receiving chemotherapy with malignant tumors: A systematic review and meta-analysis. TMR Cancer. 2020.

6	Samarasinghe K, Therapeutic Properties and Anti-Lipidemic Activity of *Cordyceps sinensis*. InApolipoproteins, Triglycerides and Cholesterol 2020.
7	Nxumalo W, Can Cordyceps cicadae be used as an alternative to *Cordyceps militaris* and *Cordyceps sinensis*?–A review. Journal of Ethnopharmacology. 2020.
8	Li J, Extracts of *Cordyceps sinensis* inhibit breast cancer growth through promoting M1 macrophage polarization via NF-κB pathway activation. Journal of Ethnopharmacology. 2020.
9	He P, *Cordyceps sinensis* attenuates HBx-induced cell apoptosis in HK-2 cells through suppressing the PI3K/Akt pathway. International Journal of Molecular Medicine. 2020.
10	Yang SX, Water extracts of *Cordyceps sinensis* inhibits proliferation and metastasis via regulating cell cycle and matrix metalloproteinases in melanoma. Life Research. 2020.
11	Qi W, *Cordyceps sinensis* polysaccharide inhibits colon cancer cells growth by inducing apoptosis and autophagy flux blockage via mTOR signaling. Carbohydrate Polymers. 2020.
12	Bai X, The protective effect of *Cordyceps sinensis* extract on cerebral ischemic injury via modulating the mitochondrial respiratory chain and inhibiting the mitochondrial apoptotic pathway. Biomedicine & Pharmacotherapy. 2020.
13	Chen L, Polysaccharides isolated from *Cordyceps sinensis* contribute to the progression of NASH by modifying the gut microbiota in mice fed a high-fat diet. Plos one. 2020.
14	Li F, Biotransformation of ginsenoside Rb1 with wild *Cordyceps sinensis* and Ascomycota sp. and its antihyperlipidemic effects on the diet-induced cholesterol of zebrafish. Journal of Food Biochemistry. 2020.
15	Zhong X, 1H NMR spectroscopy-based metabolic profiling of *Ophiocordyceps sinensis* and *Cordyceps militaris* in water-boiled and 50% ethanol-soaked extracts. Journal of Pharmaceutical and Biomedical Analysis. 2020.
16	Ji Y, Comparison of bioactive constituents and effects on gut microbiota by in vitro fermentation between *Ophicordyceps sinensis* and *Cordyceps militaris*. Journal of Functional Foods. 2020.

CONCLUSION

C. sinensis is a valuable macro fungus having enormous pharmacological activities via different chemical constituents present on it. Most of them have a key role to regulate our immune system and prevents disease through strengthening our defense mechanism. Several compounds like adenosine, cordyglucans, EPSF, cordycepin, and saponins present in it have antiviral, antitumor activity. Further identification will lead to the finding of new chemical constituents and the diverse pharmacological roles. To date, scientists can explain some pharmacological property and the constituents present in it but still a major mystery about it is hidden for us to explore. This review highlights on overview on *C. sinensis,* chemical constituents and biological studies. Further the bibliometric analysis identified the most influential articles in the field of *C. sinensis* research and provide a potent useful guide to authors, future researchers, that what kinds of manuscript constitute a highly citable publication in this particular subject.

Authors contribution

DRJ designed the study and wrote the first draft of manuscript, NA involved in the literature review and correction of the manuscript.

Conflict of Interests

The authors declare no conflict of interest.

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