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THE HEALTH BENEFITS OF CORDYCEPS MILITARIS MUSHROOM-A REVIEW

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Abstract

Cordyceps mushroom is considered one of the fungal species of therapeutic importance, as it has been used in Asian countries for a long time to achieve long lives and lasting health. Accordingly, researchers have conducted many different studies about its metabolic activities in vitro and in vivo, and there has been great controversy as to whether it is a nutritional substance. It is complementary to maintaining health and is a therapeutic substance that carries broad medical specifications. Accordingly, The *Cordyceps* industry has experienced tremendous growth, with hundreds of products being introduced into the global market.

Keywords: *Cordyceps, fungi, Traditional medicine.*

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Introduction

The *Cordyceps* fungus grows on caterpillar larvae and has been used in traditional Chinese medicine since ancient times to treat coughs, fatigue, weakness in the body after a serious illness, or weak sexual desire (1).

Cordyceps is derived from the Latin cord, meaning "club", and ceps, meaning "head". (2). The fruiting bodies of these fungi usually germinate from the heads of the larval and adult stages of many different insect species. *Cordyceps* is an insectivorous fungus that affects many insect orders and different life stages. It is included in the Ascomycetes, Ophiocordycipitaceae and Hypocreales, which have gained a golden reputation in safe and beneficial traditional medicine through the use of many species of the same genus for more than 2,000 years, and have also been used in the ancient book Ben-Cao-Cong-Xin (New Compilation of Materia Medica), which is as old as 1757 years AD . , and 'Ben Cao Gang Mu Shi Yi', written by Xueming Zhao in 1765 AD. Cordyceps is also known as 'Dong Chong Xia Cao', which means 'Worm in winter and grass in summer' in China . (3,4,5).

Sedges are considered among the grasses that cover large areas of grassland and constitute 80-90% of the total grassland under the Alps. These plants are an environment and a home for the ghostly moth Cordyceps sinensis. (**6**).

Cordyceps is considered one of the largest genera, with more than 500 species joining it. Cordyceps sinensis, Cordyceps sopulifera, Cordyceps cycadicola, Cordyceps liangchanensis, Cordyceps ophioglucides, and Cordyceps militaris are all species of Cordyceps that were cultivated for their medicinal benefits. (**7**). (Winter worm and summer grass) is a term in Chinese for a fungus of the type C. sinensis, which is considered one of the most famous types of Cordyceps. It is also known as Dongzhongxiakao and is considered one of the most famous medicinal mushrooms and one of the traditional treatments used by the Chinese people. C. militaris is a type of fungus known as the orange caterpillar fungus because it attacks the larvae of insects belonging to the Hepialidae family. It has a chemical composition and has biological roles and medical activities that are not different from C. sinensis. (8).Figure(1).

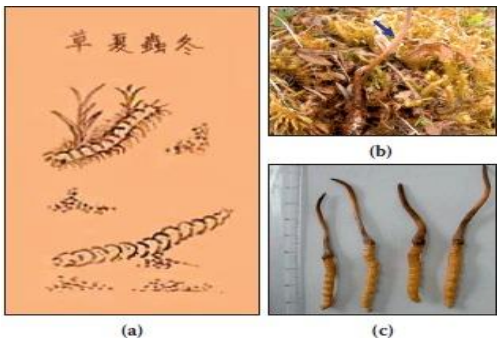

Figure (1) illustrated (a) *Cordyceps sinensis*, (b) The arrowhead in the image points to *Cordyceps* sinensis in the soil (c) Collect as raw material.

Cordyceps Ecology

Insect larvae are the main food of Cordyceps species, and occasionally parasitize adult insects. Cockroaches, ants, bees and black beetles are part of the insect repertoire that Cordyceps grows on, and possibly other arthropods and the fungus Elaphomyces Nees. There is medicinal value to many of its species, but only a few are cultivated. Cordyceps sinensis... Cordyceps militaris is considered the most famous species in China, where it is sold in huge markets(9).

Cordyceps Natural Products .

Cordyceps contains proteins, nucleosides, and sterols, as well as vitamins and amino acids such vitamin E, K, and soluble vitamins (B12, B1, B1), and various polysaccharides, oligosaccharides, monosaccharides, and disaccharides. (10,11).

Cultivation and Growing of *Cordyceps*

Cordyceps' natural fruiting bodies are extremely rare and costly to obtain. Furthermore, native populations of essential Cordyceps species are quickly declining owing to overcollection. (**12**), It is obvious that more effort needs to be placed on growing Cordyceps in vitro in an artificial medium. Considering all the recognized species of Cordyceps, the success rate in culturing them in an artificial medium is quite low. Medicinal species of Cordyceps that are noteworthy include Cordyceps militaris, Cordyceps sinensis, artificial O. sinensis, and artificial Cordyceps militaris. The strain CS-4 (Paecilomyces hepiali Chen.) was found in 1982 and was one of the first Cordyceps strains to be used commercially. The toxicity, biological activity, and chemical makeup of this strain were thoroughly investigated through a series of clinical trials. The natural growth cycle of cordyceps was shortened from five to two years with the use of large-scale fruiting techniques .The host larvae, use this technique Thitarodes (Hepialus), were bred and Approximately one hundred larvae were deposited into plastic receptacles the size of shoe boxes with lids. The grassland soil in the containers was rich in planted roots as well as tubers and roots from the larvae's natural diet. Two years later, *C. sinensis* spores were added, and roughly 10% of the larvae developed stromata as a result of the Cordyceps infection. (13). Arora *et al.* (14) obtained a viable culture of Cordyceps sinensis under submerged conditions at 15° C and pH of 6. They employed a variety of carbon and nitrogen sources, as well as supplementary materials like vitamins and minerals, in their research on *C. sinensis* growth on Sabouraud's dextrose with yeast extract broth medium (15). Seema S. and colleagues' study found that sucrose was the most efficient carbon source and that yeast extract and beef extract were the two different sources of nitrogen. The conidia were subjected to the physical stress of freezing shock, which allowed the researchers to harvest a significant number of them. (**16**). Moreover, the inclusion of calcium and zinc chloride as macro- and micronutrients, as well as folic acid, significantly increased production. At 9-13°C for 40-60 days, using sterile rice media , then lowering the temperature

to 4° C to promote growth and 13° C for 40 days to produce the fruiting bodies, was one of the most significant artificial methods for *C. sinensis* culture. Although the growth of Cordyceps mycelium is dependent on a number of factors, including temperature, pH, and other environmental factors, potato dextrose agar was discovered to be the most effective medium after a variety of media were tested at 20-25°C and a pH range of 8.5-9.5(**17**). Complete artificial culture is accomplished by injecting cultured strains into grown larvae. After that, the larvae are housed for a year or two while being watched over. After then, *C. sinensis* may be harvested. Conversely, seminatural farming harvests *C. sinensis* from the areas where it has been released after letting infected larvae live unhindered for three to five years in their natural habitats. *Cordyceps militaris* is significantly simpler to culture than *C. sinensis* in both solid and broth media utilizing various Carbon and Nitrogen sources since it can complete its life cycle when cultured in vitro(**18**). Various culture techniques, including surface and submerged cultivation, were employed to produce Cordyceps. Lately, *C. militaris* mycelium has been cultivated on sophisticated artificial medium. This usually takes 35 to 70 days, and the length of this depends on a number of cultivation factors, including the amount of medium used and the size and form of the container used for the culture process. *C. militaris* stroma is cultured in vitro using insects, and then the stroma is grown in the lab on various organic substrates. Rice and other cereals have frequently been combined with certain organic substrates to produce *C. militaris* stromata commercially. (19). The researchers considered that corn grains, soybeans, corn, distinct corn, and cotton seed coats are other substrates that have proven successful in agriculture, and the substrate that is currently being employed is a blend of brown rice, silkworm cocoons, and soybeans. Compared to chemical media, these materials are excellent food sources for *C. militaris* because they require comparatively less nitrogen for growing , and this is evidence of its higher productivity when using grains in culture compared to using insects. Researchers have also shown that the triamine citric acid and the hormone colchicine, 2, 4-D, enhance the production of *C. militaris* stroma (**20**). Additionally, potassium, calcium, and magnesium salts at 0.1 g/l can boost fruiting body production. Mycelia may also be grown in submerged culture to produce physiologically active chemicals. *C. militaris* culture has advanced, resulting in a high stromata yield and cordycepin concentration. Furthermore, fruiting body production was studied utilizing three generations of multi-ascospore isolates and their progeny strains, and it was found that the F1 progeny strains produced a higher number of fruiting bodies (21). utilizing a range of media (22).

***Cordyceps* Improve Athletic Performance**

Cordyceps mushrooms are thought to enhance oxygen utilization, increase blood flow, and act as an antioxidant. Accordingly, the use of nutritional supplements containing this mushroom has become popular among athletes, and one research study showed the effect of a mushroom containing a mixture of the *Cordyceps militaris* plant on high-intensity exercise after a period of 1 week to less than a month (23).

Cordyceps Benefit Heart Health

The most important bioactive component of cordyceps it cordycepin, has been shown in a review of studies conducted in 2020 to lower the production of triglycerides, In animal , total cholesterol and low-density lipoprotein (LDL) cholesterol (24).

Cordyceps may help with heart health by regulating blood fat levels and contribute to the treatment of irregular heartbeats. Hyperlipidemia, or high blood fat levels, is a significant risk factor for heart disease (25).

Cordyceps has been shown to be helpful in normalizing heart rate in individuals with arrhythmia, according to a 2022 evaluation of nineteen studies including 1,805 patients (26)

Cordyceps Help Manage Diabetes

Diabetes is a common disease and a major cause of death, as it is considered the eighth cause of death in the United States of America (27). *Cordyceps militaris* may contribute to improving glucose metabolism and thus reducing the level of sugar in the blood, increasing the body's efficiency in processing sugar, and protecting the body from nerve damage caused by the Diabetes (28).

Cordyceps Reduce Inflammation

Inflammation is a natural condition that occurs during injury or infection and is considered one of the necessary parts of the body's healing, but when it turns into chronic inflammation that lasts for long periods, perhaps for several years, it may cause more chronic diseases. Conditions such as heart disease or immune diseases such as rheumatoid arthritis, diabetes, asthma, depression, and some types of cancer, and the death rate due to inflammation is linked to more than half of the deaths in the world (**29**).

In a 2020 study, researcher Tan L and his colleagues found that cordycepin has the ability to protect the body from chronic inflammation, as it regulates specific pathways associated with inflammation and may protect against viral infections by preventing viral DNA replication and may enhance the body's immunity (**30**).

The Anti-Aging Properties of *Cordyceps*

The imbalanced composition of antioxidants and free radicals in the body, known as oxidative stress, is a major factor in age-related illnesses such arthritis, cancer, and dementia (31). Age-related illnesses including dementia, cancer, and arthritis are commonly associated with oxidative stress, an imbalance between free radicals and antioxidants in the body. Cordycepin and polysaccharides-chemicals with potent antioxidant qualities—are thought to

be present in cordyceps. These compounds work with free radicals to shield the organism from oxidative stress. (32,33)

Cordyceps Anti-Tumor Effects

Cordyceps mushroom helps in treating cancer, by improving the body's immune response against cancer or working to kill cancer cells directly, or prevent them from growing or spreading to other parts of the body (**34**). Test tube studies have demonstrated that *cordyceps* has an anti-tumor effect on cancer cells that affect the breast, bladder, liver, prostate, and leukemia. (**35**).

Cordyceps for enhance activity sexual and reproductive function

Human sexual function has been stimulated by traditional medicine using Cordyceps, and some data suggests that *C. militaris* and Sinensis They can strengthen poor reproductive functions and increase reproductive activity. One of *C. sinensis's* proteins was involved in the vasorelaxant and hypotensive effects that were noted (36). This protein may enhance sexual function by assisting the penis in capturing blood during an erection. (**37**).

Cordyceps Enhancing Liver and Kidney Functions

Some clinical investigation showed that administering *C. sinensis* might dramatically enhance kidney function and general immunity in individuals with chronic kidney failure. Furthermore, treating individuals with gentamicin-induced kidney injury resulted in a recovery of 89% of normal renal function in a reasonably short period. Cordyceps' kidney-enhancing effect is attributed to its capacity to increase The body's levels of 17-ketosteroid and 17-hydroxycorticosteroid shield tubular cells' sodium pump function , expedite tubular cell regeneration, and lower calcium concentration in particular tissues. *Cordyceps* is routinely used in the co-treatment of chronic hepatitis B and C.*Cordyceps* extract mixed with other medicinal mushrooms and lamivudine, an antiviral medication, was utilized to treat hepatitisB , on the other hand, *Cordyceps* supplementation enhanced liver function in individuals with post-hepatic cirrhosis (38).

Cordyceps Protect Organs and Glands

Cordyceps sinensis has different activities affecting different body systems, such as sedative and anticonvulsant activities, and has a clear effect on the central nervous system. It plays a major role in bronchial constriction caused by histamine, has a strong relaxing activity for the bronchial tubes, is an expectorant, antitussive and anti-asthma, and prevents emphysema regarding *C. sinensis* promotes the secretion of adrenaline and acts as a male hormone. Polysaccharides derived from Cordyceps raise plasma corticosterone levels. It has been used in traditional medicine for long periods to enhance male fertility. A study found

that use of *C. militaris* mycelium increases sperm formation, production, and activity, The substances deoxyadenosine, adenosine, nucleosides, and related adenosine type nucleotides,present in *Cordyceps* extract contribute to stabilizing the heart rhythm by correcting its arrhythmia. The same compounds have an importance and impact on the coronary and cerebral circulation. It has been known that *Cordyceps* is used in chronic hepatitis B and C. On the other hand, its intake enhancement of liver function in cirrhosis patients (**39**).

Cordyceps **decreases of fatigue**

For hundreds of years, people have used cordyceps to relieve fatigue and weakness and to give them vitality in the high highlands of Tibet. In other words, it raises the energy that ATP represents. Athletes are currently using it to boost energy, remove weakness, and extend endurance. C. sinensis has been used in several trials to treat chronic fatigue in older people, and the results have improved memory loss, tiredness, and dizziness. (41).

Cordyceps **Side Effects and Safe**

There have been no reported side effects for Cordyceps and it is safe at the recommended dose (**42**).

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