



Unlocking the Secrets of *Cordyceps Militaris*: A Medicinal Mushroom Marvel

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Medicinal mushrooms are fascinating because they combine biology, chemistry, and pharmacology to develop new drugs through biotechnology. One notable example is *Cordyceps militaris*, a type of fungus known for its wide range of health benefits. This mushroom, which grows on insects and belongs to the Ascomycetes class, has been used as a traditional remedy and tonic in East Asia for many years. *Cordyceps militaris* contains several active compounds like cordycepin, polysaccharides, ergosterol, and mannitol, which contribute to its various health-promoting properties. Found across North and South America, Europe, and Asia, it thrives in both subtropical and temperate regions. This mushroom's unique composition makes it valuable for multiple medicinal uses.

Biological Activities and Medicinal Values of *Cordyceps militaris*

Cordyceps militaris, a prominent medicinal mushroom, is renowned for its diverse biological activities and medicinal properties. The primary active compound in its fruiting bodies is cordycepin, also known as 3'-deoxyadenosine. Initially isolated from *C. militaris*, cordycepin has also been found in other *Cordyceps* species like *C. sinensis* and *C. kyushuensis*. This nucleoside analogue is a key component in the mushroom's therapeutic potential, acting as a nucleic acid antibiotic that might inhibit cancer cell formation and help in the normalization of cancer cells. Cordycepin is metabolized within cells into its phosphorylated forms—cordycepin 5'-monophosphate, 5'-diphosphate, and 5'-triphosphate. These forms inhibit several enzymes involved in the purine biosynthesis pathway, further highlighting the compound's role in influencing cellular processes.

Medicinal Values

Anticancer Agent: One of the most significant applications of cordycepin is in cancer treatment. As a bioactive compound, cordycepin has demonstrated various properties including antimicrobial, anticancer, antimetastatic, immunomodulatory, and insecticidal effects. Its anticancer properties are particularly notable. Due to the specific growth requirements and scarce natural availability of *C. militaris*, producing cordycepin on a large scale remains challenging. However, innovations like repeated batch surface liquid culture methods are being explored to address this issue and increase production.

Antioxidant Activity: *Cordyceps militaris* has shown substantial antioxidant activities, which are crucial for combating oxidative stress. Studies have demonstrated that CM-hs-CPS2, a preparation derived from *C. militaris*, exhibits high levels of antioxidant activity. Specifically, it has shown 89% scavenging activity against DPPH radicals, a notable reducing power of 1.188, and 85% ferrous ion chelating activity. These properties underline the mushroom's potential in protecting cells from oxidative damage and related diseases.

Improvement of Sperm Production: Research has indicated that supplements of *C. militaris* can enhance reproductive health in male animals. In sub fertile boars, *C. militaris* supplementation increased total sperm count, motility, and normal morphology. This effect persisted even after supplementation was discontinued for two weeks, suggesting that cordycepin may improve sperm production and quality. Elevated plasma levels of cordycepin following supplementation suggest its direct role in these improvements.

Anti-Influenza Virus Activity: An acidic polysaccharide (APS) derived from *C. militaris* grown on germinated soybeans has shown potential in treating influenza A virus infections. APS may exert its effects by modulating the immune response of macrophages, offering a promising avenue for antiviral therapies.

Antifungal and Anticancer Activities: A specific antifungal protease, identified as *C. militaris* protein (CMP), was purified from the mushroom. CMP has demonstrated potent antifungal activity against *Fusarium oxysporum* and cytotoxicity against human breast and bladder cancer cells. This enzyme, with a molecular mass of 12 kDa and a pI of 5.1, operates optimally at 37°C and pH 7.0-9.0. Its activity is inhibited by phenylmethylsulphonyl fluoride, a serine protease inhibitor. The protease's amino acid composition and sequences of major peptides provide insight into its antifungal and anticancer properties.

Antibacterial Activity Against *Clostridium* spp.: Cordycepin, a naturally occurring antibacterial agent, holds promise as a preventive measure against diseases caused by clostridia. It can influence intestinal flora and potentially mitigate the development of harmful agents, contributing to overall human health.

Suppression of Diabetes-Regulating Genes: Cordycepin has also been observed to suppress genes involved in Type 2 diabetes regulation. By inactivating NF-κB-dependent inflammatory responses, cordycepin presents potential as an immunomodulatory agent, offering therapeutic benefits for various inflammatory diseases.

Biological Activities and Clinical Applications of *Cordyceps militaris*

Cordyceps militaris, an edible and medicinal mushroom, exhibits a range of significant biological activities that contribute to its medicinal value. One notable activity is its fibrin binding capability, which involves the enzyme derived from *C. militaris* interacting with fibrin. This interaction facilitates the local activation of the fibrin degradation pathway, offering potential benefits for thrombolytic therapy. Similar to other fibrinolytic agents such as natto kinase and earthworm enzyme, this enzyme could serve as a cost-effective alternative to current thrombolytic treatments used for heart disease, especially considering its efficient production.

In addition to its fibrinolytic activity, *C. militaris* demonstrates potent anti-inflammatory effects. Research on hot water extracts from *C. militaris* fruiting bodies (CMWE) reveals that they significantly inhibit the production of inflammatory mediators like nitric oxide (NO), tumour necrosis factor-alpha (TNF-α), and interleukin-6 (IL-6) in lipopolysaccharide (LPS)-stimulated RAW 264.7 macrophage cells. This anti-inflammatory potential underscores the therapeutic value of CMWE in managing inflammation-related conditions.

Clinically, *Cordyceps militaris* shares similarities with *Cordyceps sinensis* in its applications. It is used to address a variety of health issues including respiratory problems, coughing, dizziness, memory impairments, and visual disturbances. Additionally, it may aid in conditions such as cold virus infections, poor appetite, night sweats, anaemia, and insomnia. Although *C. sinensis* has been more widely utilized, the medicinal applications of *C. militaris* are extensive and continue to be explored for additional benefits.

***C. militaris* cultures have versatile uses**

The fruiting bodies can be consumed directly in various culinary preparations such as stews, soups, and teas, particularly popular in Southeast Asia, including Guangdong, Hong Kong,

and Taiwan. Consumption is generally considered safe at levels below 2.5 g/kg of body weight. Additionally, *C. militaris* is incorporated into health products and pharmaceuticals, including oral liquids, capsules, wines, vinegars, teas, and soy sauce. These products are utilized for enhancing kidney and lung function, anti-aging, sleep regulation, and managing chronic bronchitis. Over 30 types of *C. militaris* based health products and drugs are available, reflecting its broad acceptance and application in traditional and modern medicine.

Conclusion

Cordyceps militaris stands out as a versatile and valuable medicinal mushroom with a wide array of biological activities and therapeutic potentials. Its active compounds, especially cordycepin, exhibit promising anticancer, antioxidant, and antifungal properties, alongside benefits for reproductive health and immune modulation. The mushroom's ability to improve sperm production, combat oxidative stress, and offer antiviral and antibacterial support highlights its significance in modern medicine. Additionally, *C. militaris* demonstrates potential in thrombolytic therapy and anti-inflammatory treatment, making it a valuable alternative or complement to existing therapies. Its applications extend to various health products and pharmaceuticals, underscoring its broad acceptance and utility in traditional and contemporary medicine. As research continues, the full spectrum of *Cordyceps militaris* medicinal benefits will likely expand, further solidifying its role as a cornerstone in health and wellness.