# CORDYCEPS SINENSIS SCIENTIFICALLY PROVED EFFECTIVE ADAPTOGEN

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**ABSTRACT**

Adaptogens are non-toxic plants that are marketed as helping the body resist stressors of all kinds, whether physical, chemical or biological. Their repeated administration (adaptation) gives rise to an adaptogenic or stress-protective, leading to a prolonged state of non-specifc resistance to stress and increased endurance and stamina under extreme conditions.

The genus Cordyceps has about 750 identified species which are distributed in many regions of the World, but mainly found in South Asia, Europe and North America. The species of the genus are highly priced and are widely used as food and medicine for the treatment of various ailments. Thirty five Cordyceps species have been reported in the literature to have medicinal properties or has a report on the isolation of bioactive compounds. Cordyceps sinensis was identified as the most frequently used and most explored member of the Cordyceps genus.

Many subsequent studies were conducted using cultured C. sinensis and have yielded positive results suggesting the cultivated fungi might possess the same health-promoting functions as the natural counterpart.

**Conclusion.** Having analysed scientific data, we concluded that *Cordyceps sinensis* Sacc has been extensively studied, mainly by Chinese scientists and the results showed that it represents an effective adaptogen that can successfully be used for treatment of various ailments. An ever growing list of symptoms remedied using C. sinensis include respiratory, renal, liver, nervous system, cardiovascular diseases, cancerous tumors, decreased libido and even stress, fatigue and aging. In fact, long before any of these studies had been published, C. sinensis has officially been classified as a drug in the Chinese Pharmacopoeia since 1964.

**Key words:** Cordyceps sinensis Sacc, adaptogen.

**რეზიუმე**

ადაპტოგენები წარმოადგენს არატოქსიურ მცენარეებს, რომლებიც ორგანიზმს ეხმარება ფიზიკურ, ქიმიურ თუ ბიოლოგიურ სტრესორებთან გამკლავებაში. მათი ხანგრძლივი გამოყენება ზრდის ექსტრემალურ პირობებში სტრესთან გამკლავების უნარს.

გვარი Cordyceps მოიცავს 750 სახეობას, რომლებიც გავრცელებულია მთელს მსოფლიოში, ძირითადად, სამხრეთ აზიაში, ევროპასა და ჩრდილოეთ ამერიკაში. ეს სახეობები ძალიან ძვირია და ფართოდ გამოიყენება როგორც საკვები და სხვადასხვა დაავადების საკურნალო საშუალება. სამეცნიერო ლიტერატურაში აღწერილია Cordyceps-ის 35 სახეობა, რომლებიც გამოიყენება, როგორც სამკურნალო საშუალება ან რომელთაგანაც მიღებულ იქნა ბიოლოგიურად აქტიური ნივთიერებები. Cordyceps გვარის ყველაზე ხშირად გამოიყენებული და ყველაზე მეტად შესწავლილი წარმომადგენელია Cordyceps sinensis.

ბევრი კვლევაა ჩატარებული და დადებითი შედეგები მიღებული კულტივირებულ Cordyceps sinensis-ზეც, რაც ადასტურებს, რომ კულტივირებულ სოკოსებრებს გააჩნიათ ბუნებრივის მსგავსი თვისებები.

**დასკვნა.** სამეცნიერო მონაცემების ანალიზის საფუძველზე მივედით დასკვნამდე, რომ *Cordyceps sinensis* Sacc აქტიურად არის შესწავლილი, ძირითადად ჩინელი მეცნიერების მიერ, და კვლევის შედეგები აჩვენებს, რომ ის წარმოადგენს ეფექტურ ადაპტოგენს, რომელიც წარმატებით გამოიყენება სხვადასხვა დაავადების სამკურნალოდ. *Cordyceps sinensis* Sacc გამოიყენება რესპირატორული, თირკმლის, ღვიძლის, ნერვული სისტემის, გულ-სისხლძარღვთა დაავადებების, სიმსივნეების, დაქვეითებული ლიბიდოს სამკურნალოდ, ასევე, სტრესთან, დაღლილობასთან და დაბერების პროცესთან საბრძოლველად. აღნიშნული კვლევების ჩატარებამდე, *Cordyceps sinensis* Sacc, როგორც სამკურნალო საშუალება, 1964 წლიდან ოფიციალურად კლასიფიცირებულია ჩინურ ფარმაკოპეაში.

**საკვანძო სიტყვები:** *Cordyceps sinensis* Sacc, ადაპტოგენი

**Adaptogens** are non-toxic plants that are marketed as **helping the body resist stressors of all kinds,** whether ***physical, chemical or biological***. Immune stimulants are agents that activate the body's nonspecific defence mechanisms against infectious organisms, particularly viral and bacterial pathogens (1). Adaptogens are herbs that help the body better adapt to stressors by fine-tuning the stress response. It has recently been shown that the stress-protective effect of adaptogens is not the result of inhibition of the stress response of an organism, but actually comes from the adaptation of the organism to the mild stressful effects of the adaptogen. The repeated administration (adaptation) of adaptogens gives rise to an adaptogenic or stress-protective effect in a manner analogous to repeated physical exercise, leading to a prolonged state of nonspecifc resistance to stress and increased endurance and stamina under extreme conditions. This is in fact hormesis (4), a phenomenon in which a harmful substance gives stimulating (beneficial) effects to living organisms when the quantity is small (3). Recurring physical and psychological stresses are not harmful and are even beneficial to health, provided they are within managable imits. But the degree of tolerance for these stresses varies greatly from one indiidual to another.The maximal stressl tolerance is from about 20 to 30 years of age. It is estimated that by age 70, stress tolerance is diminished by approximately one-half (2).

Adaptogens or adaptogenic substances are used in herbal medicine for the claimed stabilization of physiological processes and promotion of homeostasis. These herbs and roots have been used for centuries in **Chinese and Ayurvedic** healing traditions, but they're having a renaissance today (1).

**Cordiceps (*Cordiceps sinensis*) are the most effective representative of common adaptogens.**

The genus Cordyceps has about 750 identified species which are distributed in many regions of the World, but mainly found in South Asia, Europe and North America. The species of the genus are highly priced and are widely used as food and medicine for the treatment of various ailments. This present review compiles literature information on the ethno-medicinal, phytochemistry and pharmacological properties of species in the genus Cordyceps. In addition, the review also suggest recommendations for the future researches. Thirty five Cordyceps species have been reported in the literature to have medicinal properties or has a report on the isolation of bioactive compounds. In vitro and in vivo research studies reporting the validation of the medicinal properties of some species were also reviewed. The phytochemical diversity of this genus was demonstrated with over 200 metabolites including nucleosides, sterols, cyclic peptides, flavonoids, dihydrobenzofurans, bioxanthracenes, polyketide, terpenes, alkaloids and phenolics isolated from various Cordyceps species. Cordyceps sinensis was identified as the most frequently used and most explored member of the Cordyceps genus. Cyclodepsipeptides, nucleosides and polysaccharides were identified as the most studied class of compounds from the genus and they show immunomodulatory, antioxidant, antitumor, cytotoxic, anti-inflammatory, anti-allergic, antidiabetic, analgesic, anti-HIV, antibacterial, antimalarial and antifungal activities. Thus, species belonging to the genus Cordyceps showcases an important source of treating various disorders due to the presence of bioactive constituents that displays potent bioactivities and could serve as possible leads in drug discovery (5).

A great mystique and aura surrounds Cordyceps sinensis (syn.: Cephalosporium sinensis), an endoparasitic fungus which has claims of anti-cancer and anti-aging properties. Much research has been conducted over the years on crude extracts and its bioactivity. More research is now focused on culturing C. sinensis and on isolating and identifying pure compounds novel to C. sinensis in an attempt to alleviate strain on demand for the natural fungi (9).

The caterpillar fungus known as Cordyceps sinensis (Berk) Sacc. stands out as the most documented species of Cordyceps with reports from Tibetan doctors dating as far back as the late 1400 (10), (11).

Cordyceps in its wild form is the small blade-shaped fruiting body of a parasitic fungus, *Cordyceps sinensis* Sacc. (Figure 1), family Clavicipitaceae, that frows on the larvae of moths, particularly in the mountainous regions of China and Tibet. It has been extensively used in China as a cure-all and tonic for nearly 250 years.


**Figure 1.** ***Cordyceps sinensis***

The naturally occurringfruiting bodies are scarce, so a number of hyphal isolates capable of mycelial growth in saprophytic culture have been obtained from them. These have quite different morphological forms and have been given different scientific names by mycologists.The activity of the fungus apparently resides in the polysaccharide and nucleoside fractions, but definitive conclusions are not yet possible (6).

The natural production of Cordyceps undoubtedly summoned the interest of first discoverers. The fungal spores infect and take over the host organism causing its eventual demise. The fungus continues to grow and emerges from the corpse of the host organism (Figure 2,3).

Adding to the mystique is the location in which the relationship between the fungus and the larva of the ghost moth occurs. The caterpillar fungus lives on the Tibetan Plateau including parts of India and western China, otherwise known as the "Roof of the World". During the 1993 National Games in Beijing, China where three female runners set 5 world records for the 1500, 3000 and 10,000 meter races. After testing negative for anabolic steroids and other banned substances, it was later revealed by the coach that the runners had taken C. sinensis extracts. Anecdotal evidence of the potential performance enhancing properties of C. sinensis ignited consumer interest. In fact, the larva-fungi complex has long been used in Traditional Chinise Medicien to "invigorate the lung and nourish the kidney" in China for hundreds of years (12).

Demand for the fungi was further accentuated by the numerous scientific reports stating specific pro-health-related claims. C. sinensis tonic can be purchased over the counter and is believed to provide the immune system with a boost especially after serious illness (13),(14), (15). An ever growing list of symptoms remedied using C. sinensis include respiratory, renal, liver, nervous system, cardiovascular diseases, cancerous tumors, decreased libido and even stress, fatigue and aging (12),(16), (17), (18), (19),(20),(21), (22),

**Figure 2.**

**Figure 3**

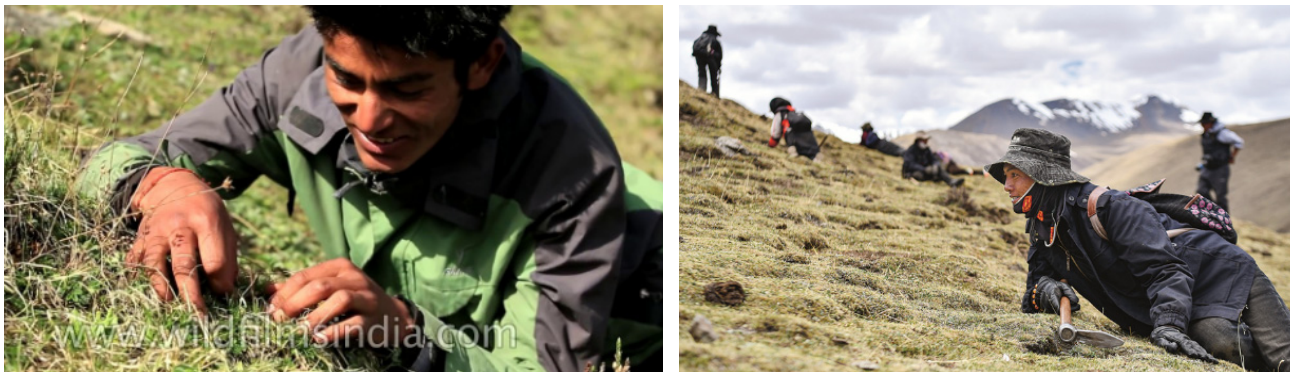


**Figure 4. Tibetans collecting Cordiceps sinensis**

(23). In fact, long before any of these studies had been published, C. sinensis has officially been classified as a drug in the Chinese Pharmacopoeia since 1964 (Committee of Pharmacopoeia, Chinese Ministry of Health, 1964, 2005).

The value of the fungi received a sharp increase following the severe acute respiratory syndrome (SARS) outbreak in China in 2003.

With the inflated value of the fungi comes increased demand leading to severe price hikes. According to 2008 prices, the price of natural C. sinensis ranged from 3000 to over 18,000 USD per kg depending on size of the larvae (11). In a decade (1998–2008), the price of C. sinensis has increased 900% (24). This creates a strong socioeconomic strain in the Tibetan Plateau where many villagers have fought over the desecration of grasslands containing the sought-after fungi (Figure 4).

The availability of the fungi is limited by its confined geographic location. With the added effects of large-scale harvests, the fungi has been classified as an endangered species by CITES (Convention on International Trade in Endangered Species) Management Authority of China and China Customers. The scarcity of natural C. sinensis sparked novel approaches such as artificial cultivation of the pure mycelium in liquid culture or on grains.

Many subsequent studies were conducted using cultured C. sinensis and have yielded positive results suggesting the cultivated fungi might possess the same health-promoting functions as the natural counterpart (12), (14), (15).

A number of clinical trials Cs-4 in various conditions have been conducted in China on a total of more than 2000 patients.The quality of these studies, some of which were blinded, is quite variable. A double-blind placebo controlled study of the effects of 3 g of Cs-4 daily on 358 elderly people with various symptoms of senescence have been carried out. Significant improvements in patients consuming Cs-4 were found in the alleviation of fatigue, cold intolerance, dizziness, frequent nocturia, tinnitus, hyposexuality, and amnesia (7).

A study lasting about 26 months, examined the effectiveness of Cs-4 as an adjuvant treatment in patients suffering from congestive heart failure (8). In 64 patients, the addition of 3-4 g daily of Cs-4 resulted in a significant improvement in the quality of life as measured by standard methods, in comparison to those taking only conventional treatment for the condition. The results of otherclinical trials measuring increasedefficacy of oxygen utilization and free radical scavenging activity, improved sexual function , and reduction of blood lipids have been summerized by researchers.

Cordiceps is employed as an adaptogen (tonic). The dosage range is 3-9 g daily of either the natural fruiting bodies or the saprophytically cultivated mycelium, or equivalent doses based on extracts.

Occasional side effects include dry mouth., skin rashes, diarrhea, and drowsiness. As is the case with various other herbs, it tends to inhibit blood platelet aggregation (1).

Cordyceps preparation, as an adjuvant therapy to conventional medicine, showed potential promise to decrease serum creatinine, increase creatine clearance, reduce proteinuria and alleviate chronic kidney disease (CKD)-associated complications, such as increased haemoglobin and serum albumin.

22 studies involving 1746 participants have been published. Among people with CKD who were not receiving dialysis, Cordyceps preparations were found to significantly decrease serum creatinine (14 studies, 987 participants): MD -60.76 µmol/L, 95% CI -85.82 to -35.71); increase creatinine clearance (6 studies, 362 participants): MD 9.22 mL/min, 95% CI 3.10 to 15.34) and reduce 24 hour proteinuria (4 studies, 211 participants: MD -0.15 g/24 h, 95% CI -0.24 to -0.05). However, suboptimal reporting and flawed methodological approaches meant that risk of bias was assessed as high in four studies and unclear in 18 studies, and hence, these results needed to be interpreted with caution (25).

Five studies (six reports; 447 participants) investigating Cordyceps compared with azathioprine (AZA)

(4 studies, 265 participants) and Cordyceps plus low dose CsA versus standard dose CsA (1 study, 182 participants) have been published. Compared with AZA, Cordyceps showed no significant difference in graft or patient survival, but improved graft function and may reduce acute rejection episodes. Anaemia, leucopenia, and liver function improved, and incidence of infection may also be reduced. However, Compared with low dose CsA versus standard dose CsA, Cordyceps did not demonstrate any statistically significant differences in patient survival, graft loss, acute rejection or allograft function (26).

Having analysed scientific data, we concluded that *Cordyceps sinensis* Sacc has been extensively studied, mainly by Chinese scientists and the results showed that it represents an effective adaptogen that can successfully be used for treatment of various ailments. An ever growing list of symptoms remedied using C. sinensis include respiratory, renal, liver, nervous system, cardiovascular diseases, cancerous tumors, decreased libido and even stress, fatigue and aging. In fact, long before any of these studies had been published, C. sinensis has officially been classified as a drug in the Chinese Pharmacopoeia since 1964.

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