



ISSN 2320-3862  
JMPS 2016; 4(1): 65-67  
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Received: 15-10-2015  
Accepted: 20-12-2015

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## Phytochemical and medicinal aspect of *Cordyceps sinensis* (Berk.): A review

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### Abstract

*Cordyceps sinensis* is age old herb in traditional Chinese herbology. *Cordyceps* species, including *C. sinensis*, *C. militaris*, *C. pruinosa* and *C. ophioglossoides*. It has been widely used as, antioxidant, anti-cancer, neuroprotective, nootropic, aphrodisiac and hepatoprotective. In Uttarakhand *Cordyceps sinensis* found in high altitudes of Western Himalaya. It is locally named as Keera Jari. In this review, chemical constituents and medicinal importance is presented from literature survey for future aspect.

**Keywords:** *Cordyceps sinensis*, medicinal plant, antioxidant.

### 1. Introduction

A medicinal fungus of a long and illustrious history, *Cordyceps sinensis* is an Ascomycetes fungus. Although it is not actually a mushroom in the taxonomic sense, it has been regarded as a medicinal mushroom throughout history. The name *Cordyceps* comes from the Latin words “cord” and “ceps,” meaning, “club” and “head,” respectively. The Latin word-conjunction accurately describes the appearance of this club fungus, whose stoma and fruit body extend from the mummified carcasses of insect larvae, usually that of the Himalayan Bat Moth, *Hepialus armoricanus*. *Cordyceps* (sometimes spelled “cordiceps”) is a rare and exotic medicinal fungus, and it has been a highly regarded cornerstone of Chinese medicine for centuries. The term “*Cordyceps*” usually refer to the specific species *Cordyceps sinensis*, but there are also many other species that come under the genus *Cordyceps* <sup>[1]</sup>. The medicinal value of this fungus has been recognized for more than 2000 years in China and the Orient. But knowledge of this reached Western scientific audiences only in 1726, when it was introduced at a scientific meeting in Paris. The first specimens were carried back to France by a Jesuit priest, who chronicled his experiences with the *Cordyceps* mushroom during his stay at the Chinese Emperor’s court <sup>[2]</sup>. The ascocarp or fruit body of the *C. sinensis* mushroom originates at its base, on an insect larval host (usually the larva of the Himalayan bat moth, *Thitarodes* (*Hepialis*) *armoricanus*, although occasionally other insect hosts are encountered) and ends at the club-like cap, including the stipe and stoma. The fruit body is dark brown to black; and the “root” of the organism, the larval body pervaded by mycelium, appears yellowish to brown. *Cordyceps* is a fungus with an annual appearance. The normal harvesting period is between the months of April and August. Fruiting off of moth larvae, *Cordyceps* thrives only at altitudes above 3800 m above sea level, in cold, grassy, alpine meadows on the mountainous Himalayan region. It is consumed traditionally as a medicine with a variety of meats in the form of a medicinal soup, with the type of meat used dependent upon the target medical condition <sup>[3]</sup>. *Cordyceps* is a member of the largest subdivision of true fungi, Ascomycotina. As finds itself well-known fungi such as *Penicillium* is from same from which the antibiotic penicillin is derived, the most potent hallucinogen, L.S.D., derived from the plant-parasitic ergot fungus (*Claviceps purpurea*), and the most highly prized and rare fungal delicacies (truffles and morels). The *Cordyceps* organism was discovered by yak herders in the Himalayas of ancient Tibet and Nepal who, recognizing the ardent behavior of their animals after grazing on *Cordyceps* at high altitudes in the spring, sought the causal agent. The cap-less mushroom they eventually found has been used in traditional Chinese medicine ever since to treat kidney, lung, and heart ailments, male and female sexual dysfunction, fatigue, cancer, hiccups, and serious injury, to relieve pain, and the symptoms of tuberculosis and hemorrhoids, to restore general health and appetite, and to promote longevity. Because of the rarity and high prices of the wild collected variety, attempts have long been made to cultivate

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*Cordyceps*. By the mid-1980s, the majority of *Cordyceps* available in the world's marketplace were artificially cultivated [4, 5].

## 2. Chemical compounds

Literature review showed that *Cordyceps* contains all of the essential amino acids, vitamins E and K, and the water-soluble vitamins B<sub>1</sub>, B<sub>2</sub>, and B<sub>12</sub>. In addition, it contains many sugars, including mono-, di-, and oligosaccharides, and many complex polysaccharides, proteins, sterols, nucleosides, and trace elements (K, Na, Ca, Mg, Fe, Cu, Mn, Zn, Pi, Se, Al, Si, Ni, Sr, Ti, Cr, Ga, V, and Zr) [2, 5]. From *C. militaris*, cordycepin (3'-deoxyadenosine) and cordycepic acid (D-mannitol) were isolated by Chen and Chu [6]. Characterization of cordycepin and 2'-deoxyadenosine was reported by nuclear magnetic resonance (NMR) and infrared spectroscopy (IR) in an extract of *C. sinensis*. Cyclosporin, a constituent of the species *C. subsessilis* was also reported [7]. Nucleosides have been found in *Cordyceps*, including uridine, several distinct cordycepin triphosphate, guanidine, deoxyguanidine, and altered and deoxygenated nucleosides polysaccharides were also reported. A number of polysaccharides and other sugar derivatives, such as cordycepic acid (D-mannitol), have been identified. Research has shown that these polysaccharides are effective in regulating blood sugar, and have antimetastatic and antitumor effects. *Cordyceps* contains proteins, peptides, polyamines, and all essential amino acids also. Sterol type compounds have also been found in *Cordyceps*: ergosterol, Delta-3 ergosterol, ergosterol peroxide, 3-sitosterol, daucosterol, and campesterol. Twenty-eight saturated and unsaturated fatty acids and their derivatives have been isolated from *C. sinensis*. Polar compounds of *Cordyceps* extracts include many compounds of alcohols and aldehydes, polycyclic aromatic hydrocarbons produced by *C. sinensis* as secondary metabolite were also reported [4].

## 3. Medicinal importance

*Cordyceps* species is used for many purposes. In traditional Chinese medicine it used to treat respiration and pulmonary diseases, renal, liver, and cardiovascular diseases, hypo sexuality, and hyperlipidemia. It is also used in the treatment of immune disorders and as an adjunct to modern cancer therapies. Presently it is highly advertised for treatment of impotence in both men and women. In TCM it was recommended for aches and pains, stemming from the kidneys and the lungs, it is also used to ease a range of respiratory ailments: cough and phlegm, shortness of breath, bronchial discomfort, chronic obstructive pulmonary disease (COPD), and asthma [4]. Literature review shows that in the high mountains inhabitants of Tibet and Nepal consume *Cordyceps*, for energy. The proposed reason for the alleged increase in energy is an increase in cellular ATP, as previously mentioned; likewise, increased oxygen availability has been posited as the primary agent in combating the effects of altitude sickness [8, 9]. *C. sinensis* reported a clinical improvement for fatigue, cold intolerance, dizziness, frequent nocturia, tinnitus, hypo sexuality, and amnesia [1, 2, 10-12]. Studies have shown that much of *Cordyceps*' kidney enhancing potential stems from its ability to increase 17-hydroxy-corticosteroid and 17-ketosteroid levels in the body [4]. In one clinical trial, 95% of patients show improvement in their blood sugar by 3 g/day of *C. sinensis*, while the other showed only 54% improving with treatment by other methods [13]. Polysaccharides isolated from *C. sinensis* show improvement in blood glucose metabolism and increase

insulin sensitivity in normal animals [14] to lower blood sugar levels in genetically diabetic animals [15] and to positively affect blood sugar metabolism in animals with chemically induced diabetes [16]. It is also used in stabilizing the heartbeat and correcting heart arrhythmias in China. It may be due to presence of nucleotides, and nucleosides. It has been shown that these compounds have an effect on coronary and cerebral circulation [17, 18]. *Cordyceps* has been used traditionally to treat patients with heart disease and those recovering from stroke [2]. Reports showed that it is used in the treatment of chronic hepatitis B and C [19, 20]. *Cordyceps* has been associated with cholesterol and triglyceride reduction and an increase in the ratio of HDL to LDL cholesterol [2, 4, 8].

## 4. Conclusion

The Himalayas have a great wealth of medicinal plants and traditional medicinal knowledge. The Central Himalayan Region covers the new state of India, provides excellent opportunities for studying the Traditional Knowledge Systems. Uttarakhand is a storehouse of a rich variety herbs and medicinal and aromatic plant species. The Government intends to exploit this advantage. Uttarakhand has observed an increase in the area under cultivation of aromatic and medicinal plants. The presence of *Cordyceps* in high altitude of Uttarakhand Himalaya will become a source of income and mode of employment for peoples belonging those areas. As I have seen some areas of district Pithoragarh like Dharchula and Munsiyari region, people sold it 5 to 8 lac /Kg presently. So it's necessary to make a scientific policy to state government to conserve and use it from Uttarakhand.

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