

Chemical Constituent, Inorganic Elements and Properties of *Cordyceps sinensis* - a Review

(*Cordyceps sinensis* - a Review)

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ABSTRACT: This review looks in depth at the history and medicinal value of the *Cordyceps* species, especially *C. sinensis*. In Uttarakhand Himalayan region *Cordyceps* genus of Ascomycete fungi is represented by *Cordyceps sinensis* (*Keera jari*). The Latin etymology describes cord as club, ceps as head, and sinensis as Chinese. *Cordyceps sinensis*, known as caterpillar fungus in English commonly and considered as medicinal mushroom in oriental medicines, such as Traditional Chinese Medicines and Traditional Tibetan medicine. When a *Cordyceps* fungus attacks a host, the mycelium invades and eventually replaces the host tissue, while the elongated fruiting body (stroma) may be cylindrical, branched, or of complex shape. The stroma bears many small, flask-shaped perithecia that contain the asci. These in turn contain the thread-like ascospores, which usually break into fragments and are presumably infective. The best known of the *cordyceps* family of fungi is *Cordyceps sinensis*, known in English commonly as caterpillar fungus as it is known to grow inside caterpillars and take them over. While *cordyceps sinensis* may be the species of *cordyceps* that is most well known throughout the world, there are many other species of *cordyceps* in which modern science has found valuable medicinal properties in as well. A few studies have shown *cordyceps* feeding to increase the ratio of adenosine triphosphate (ATP) to inorganic phosphate (Pi) in the liver. [Nature and Science 2010;8(9):253-256]. (ISSN: 1545-0740).

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INTRODUCTION

Cordyceps is a fungus of subphylum ascomycotina, class pyrenomycetes, order clavicipitales, and family claviupitaceae. *Cordyceps* is a rare and exotic medicinal mushroom known in china for centuries. People in the west have come to know this medicine in only last two decade or so. The name *Cordyceps* come from Latin words cord and ceps, meaning “club” and “head” respectively. The Latin word-conjunction accurately describes the appearance of these club fungi, whose stroma and fruit body extend from the mummified carcasses of insect larvae, usually that of the Himalayan ghost Moth, *Thitarodes armoricanus* (*Hepialis armoricanus*). The term “*Cordyceps*” usually refer to the specific species *Cordyceps sinensis*, but there are also many other species that come under the genus *Cordyceps* (Mizuno 1999). *Cordyceps sinensis* has been known and used for many centuries in Traditional Chinese Medicine (TCM). In nature it is found only at alpine pastures in north –west and

central Himalayan region. Because of the rarity and short duration of harvesting (45 days) this highly medicinal species of *Cordyceps* has always been one of the most valuable (Kobayasi, 1982). It has been a well regarded cornerstone of Chinese medicine for centuries; one that reportedly has a number of far reaching medicinal values (Mizuno 1999). *Cordyceps sinensis* found in the alpine region of the Himalaya at an altitude of more than 3500 meters. Most of people in the Indian Himalayan region have only come to know about *Cordyceps sinensis* within the last 20 years. In Indian Himalayan region *Cordyceps sinensis* is locally known as “keera jari” (Figure 1-2). Traditionally *Cordyceps sinensis* is well known as herbal Viagra.

HISTORY AND CONVENTIONAL USES

A member of the largest subdivision of true fungi, Ascomycotina, hundreds of species of *Cordyceps* were reported in all six continents and in many climatic zones with different habitats, feeding

off a range of hosts Kirk and Halpern (2007). The first written evidence of the *Cordyceps* species comes from China, in the year AD 620, at the time of the Tang Dynasty (AD 618–AD 907), bringing substance to the once intangible allegorical narrative, which spoke of a creature whose annual existence alluded to a transformation from animal to plant, in summer, and then again from plant to animal, in winter (Zhou et. al., 1998). Webster (1980) reported more than 310 species of *Cordyceps* while Sarbhoy (1983) had reported 150 species of *Cordyceps*. At present, there are more than 680 species are recognized world wide for *Cordyceps* (Holliday et al., 2005). Out of these, three species are well known for their medicinal value and among them, *Cordyceps sinensis* is highly valuable species (Kobayasi, 1982).

MARKET VALUE OF CORDYCEPS SPECIES

Although the spore is possibly an “infectious” agent that attacks the Himalayan ghost Moth, *Thitarodes armoricanus* (*Hepialis armoricanus*), still it is worth noting that the entomopathogenicity of the *Cordyceps* spp. is disputed (Zhou et. al.1998). This stands to logical reason, considering the remote and inhospitable environment in which the *Cordyceps*/moth pairing occurs. Nature tends to select against a parasite because a parasite usually results in the death of the host (Dai et.al. 2001). In nature, *Cordyceps* often exhibits a single-celled, yeast-like anamorphic growth stage (Suh et.al 2001). Globally many species of *Cordyceps* being harvested for medicinal purposes includes *C. sinensis*, *C. militaris*, *C. sobolifera*, *C. subssesilus*, *C. ophioglossoides*, and others (Hobbs 1995 and Mizuno 1999). In U.S market it was sold at \$75,000 per kilogram in 2008 while in India, Uttarakhand is the highest producer of *Cordyceps* which was traded to contractor at Rs 3 lakhs per kg (Singh et.al 2010).

PROPERTIES OF CORDYCEPS

A new issue has been raised about the consumption of *Cordyceps* in China and Taiwan is shown toxic property (Wu et.al 1996). A separate practice of adulteration, long practiced by the collectors of natural *Cordyceps*, introduces excessive lead into the organism. In its natural state, *Cordyceps* is attached to the mummified body of the caterpillar from which it arose. It is harvested from field and than dried whole, supplied into the bazaar and sold by weight (Holliday et. al.2004). Presence of lead and other active-ingredient in the growth medium certainly could be absorbed by any growing organism. *Cordyceps* cultivated by any of the usual modern practices is very safe from any heavy metal contamination. In addition, it contains many sugars, including mono-, di-, and oligosaccharides, and many

complex polysaccharides, proteins, sterols, nucleosides, and macro- and microelements such as K, Na, Ca, Mg, Fe, Cu, Mn, Zn, P, Se, Al, Si, Ni, Sr, Ti, Cr, Ga, V, and Zr (Hobbs 1995, Holliday et.al 2004 and Holliday et.al 2005). The presence of adenosine, cordycepin, cordycepic acid, polysaccharides, vitamins and trace elements in may be cause of well known effects of *Cordyceps sinensis*.

PROTEINS AND NITROGENOUS COMPOUNDS

Cordyceps spp. contains proteins, peptides, poly-amines, and all essential amino acids. In addition, *Cordyceps* spp. contains some uncommon cyclic dipeptides, including cyclo-[Gly-Pro], cyclo-[Leu-Pro], cyclo-[Val-Pro], cyclo-[Ala-Leu], cyclo-[Ala-Val], and cyclo-[Thr-Leu]. Small amounts of polyamines, such as 1,3-diamino propane, cadaverine, spermidine, spermine, and putrescine, have also been identified (Mizuno 1999).

STEROLS

A number of sterol-type compounds have been found in *Cordyceps* spp.: ergosterol, Delta-3 ergos-terol, ergosterol peroxide, 3-sitosterol, daucosterol, and campeasterol (Zhou et.al 1998).

COMERCIAL USES

Cordyceps have high efficiency and potency in therapeutic in various diseases, it is well known as a significant nourishing boost. However, as the resource and collection of the *Cordyceps* is rare and difficult, so its supply often falls short of demand. At least two chemical constituent cordycepin (deoxyadenosin) and cordycepic acid are found which results in an increase of cellular ATP (Dai et.al. 2001) and it is highly used by trained professional athletes for stamina (Parcell et.al 2004). This powerful, *Cordyceps*, effectively prevents and treats a wide variety of diseases, such as asthma, tuberculosis, chronic bronchitis, Kideny dilemma, Heart problems including cardiovascular disease and Hypertension, Leukopenia Insomnia, fatigue, stress, nervous system, Acute and chronic hepatitis, improving immunity, health problems and Strengthening body resistsnce to bacteria and virus. (Zhou et.al 1998). *Cordyceps* has proven to be a nontoxic fungal substance (Huang et.al.1987).

REGULATORY STATUS

New to the scrutiny of modern science, *Cordyceps* remains, in many nations through-out the world, an unrecognized substance. Other than import/export taxes and restrictions, which vary from country to country (many of which ban the import of

any such substance), most governments do not require a prescription to purchase or use *Cordyceps*. There are a few countries that do require a doctor's prescription: Portugal, Romania, and Austria, to name a few. Many governments require that vendors obtain a special license to distribute any product relating to human health. In the United States, *Cordyceps* is marketed privately and considered by the FDA as a dietary supplement. Generally recognized as safe applications referring to the status of *Cordyceps* as a food additive are unavailable; however, a premarket notification to the FDA regarding *Cordyceps*, containing in-depth information relating to preclinical trials and toxicology studies, has been available to the public via the FDA website since 1999 (<http://www.fda.gov/ohrms/dockets/dockets/95s0316/rpt0039.pdf>).

CONCLUSION

Natural product such as *Cordyceps* has such a long history of use, it seems logical that there is quite likely some truth behind the myths. Our dispute in the present era is to scientifically unravel the many claims and conflicts. Through *Cordyceps*, this challenge has been greater than with many other natural herbals due to the vast cost and scarcity of the substance. *Cordyceps* still has many secrets in store for us. More research is needed on these and other species of medicinal mushrooms. Awareness and scientific knowledge must be necessary for extensive scenario regarding to conserve *Cordyceps sinensis*.

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Figure 1. *Cordyceps sinensis* in its natural habitat (3550 meters) in Valley of flower biosphere reserve, Chamoli, India



Figure 2. Close up of wild *Cordyceps sinensis* showing spore bearing surface and slight insect-feeding damage at the tip.

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