

Ophiocordyceps sinensis and Pharmaceutical Industry

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Review Article

Received: 18/11/2016
Revised: 23/11/2016
Accepted: 30/11/2016

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Keywords: Bioactivity, Cordyceps,
Therapeutic, Antitumor,
Antifungal

ABSTRACT

Fungus has ever since been of great interest to science. Among the group of eukaryotic organisms, fungi are of great importance and use. The very amazing kingdom Fungi includes few important organisms. Out of those few important organisms, one such is the *cordyceps* species which is of great interest to the mycologists from the time of their discovery. The reason behind being popular among mycologists is because of its bioactivity. There are a lot of bioactive compounds that are found in *cordyceps* species that proves to be a boon for pharmaceutical industry. This review article includes short discussion on *Ophiocordyceps sinensis* and the bioactive compound that they possess.

INTRODUCTION

Fungi show an exceptional level of basic and utilitarian differing qualities with an expected 1 to 5 million surviving species, out of which around 100,000 fungal species have so far been depicted. The quantity of species distinguished keeps on rising prompting to expanding wellspring of biomolecules to be investigated for food, health, natural & environmental applications [1-10]. Current comprehension of contagious science has given a chance to recognize the extensive variety of exercises valuable for industrial, therapeutic, agricultural and environmental applications [8, 10].

Among these, the caterpillar fungus is of great importance. The caterpillar fungus popularly known as *Cordyceps sinensis* is an entomopathogenic fungus that parasitize insect larvae like arthropods and other related fungi [11-15]. In English it is known as 'Caterpillar Fungus' whereas in different geographic regions it is variously known as 'yarsa gumba' a Tibetan name [winter= (yarsa; summer=gumba), 'gunba' or 'gonba' or 'gumba'. In the Indian mountainous region it is popular as 'keera jhar' (insect herb), while in Chinese it is famous as 'Dong Chong Xia Cao' (meaning 'winter worm, summer plant') [16-20].

The regular natural fruiting body of *Cordyceps* has been known and utilized as a part of customary Chinese drug for a considerable length of time. Because of its little size and confined development, it is hard to acquire them in simple way. They are for the most part found at high elevation extending from 4,600–5,000 m asl and they show up every year in Himalayan locale of India, Nepal, and Tibet. In view of late developmental studies [21-27], the terminology has been changed to *Ophiocordyceps* Petch and the present name of this fungus is *Ophiocordyceps sinensis* (Berk.) Sung et al. Thus in the future *Cordyceps sinensis* will be referred to as *Ophiocordyceps sinensis* (*O. sinensis*) [28].

The *O. sinensis* fruiting body esteemed as an herbal medicine is found in mountainous locales of Nepal, Tibet and India. The fungus causes infection in the living larva, which eventually executes and embalms it, and afterward the stalk-like fruiting body rises up out of the carcass [28-37]. *Ophiocordyceps sinensis* is a very much depicted cure utilized as a part of conventional restorative framework in India, Nepal and china. The wild fungus, which has a plant-like fruiting body, grows from dead caterpillar loaded with mycelia [38-45]. *O. sinensis* is a slow developing fungus that grows at lower temperature, i.e., beneath 21 °C. Both, temperature and development rate are vital calculates recognizing *O. sinensis* from other comparable fungi Figure 1 [45-55].

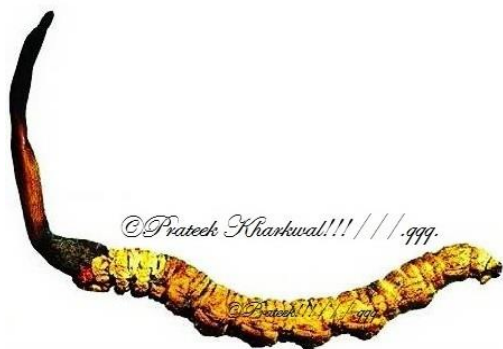


Figure 1: *Ophiocordyceps sinensis*.

Bioactive Compounds in *Ophiocordyceps sinensis*

In recent years, different medicines and other health-care products obtained from *O. sinensis* are extremely popular in diverse forms which include capsules, oral liquids, drinks etc. Due to immense medicinal properties that this fungus possesses, the wild fungus is highly priced. The cost of one kg of *O. sinensis* varies from about 3000 USD to 21000 USD in India, and approximately 1500 USD to 17000 USD in Nepal. Sources clarified that the price of the fungus depends upon the condition and colour of the collected wild samples [55-65]. As stated, the fungus can be used in the development of various medicines and other health-care products, **Table 1**. Includes the list of some bioactive compounds obtained from *O. sinensis*:

Table 1. List of Bioactive Compounds obtained from *Ophiocordyceps sinensis*.

| Cordyceps spp. | Compounds |
|--------------------------------|--|
| <i>Ophiocordyceps sinensis</i> | Cordycepic Acid ^[66] |
| <i>Ophiocordyceps sinensis</i> | Cyclofurans ^[67] |
| <i>Ophiocordyceps sinensis</i> | Beta-Glucans ^[68] |
| <i>Ophiocordyceps sinensis</i> | Beta-Mannans ^[69] |
| <i>Ophiocordyceps sinensis</i> | Ophiocordin ^[70] |
| <i>Ophiocordyceps sinensis</i> | L-Tryptophan ^[71] |
| <i>Ophiocordyceps sinensis</i> | Cordycepin ^[72] |
| <i>Ophiocordyceps sinensis</i> | Ergosterol and ergosteryl esters ^[73] |
| <i>Ophiocordyceps sinensis</i> | Hypoxanthine ^[74] |
| <i>Ophiocordyceps sinensis</i> | Acid deoxyribonuclease ^[75] |
| <i>Ophiocordyceps sinensis</i> | Polysaccharide and exopolysaccharide ^[76] |
| <i>Ophiocordyceps sinensis</i> | Cordyheptapeptide ^[77] |

Role in Pharmaceutical Industry

Cordyceps is considered for various positive viewpoints as far as pharmacological impacts and thought to be sheltered. Other than a little contrarily distributed information, it is generally thought to be a non-dangerous therapeutic mushroom. This medicinal fungus came in the spotlight amid Chinese National Games in 1993, when a gathering of women athletes won nine world records, had conferred that they had been taking *Cordyceps* routinely. It has been reported that *Cordyceps* likewise upgrades physical stamina making it extremely helpful for the elderly individuals and competitors. Latest writings further affirm that *Cordyceps* improves cell vitality as ATP (adenosine tri-phosphate) [78-85].

After the underlying revelation of some chemical constituents, center had been moved toward this ponder and wild growth, and plenty of substance mixes have been segregated and utilized for different purposes. *O. sinensis* is referred to in the west as a therapeutic mushroom. It is utilized for the treatment of diseases like cancer and fatigue [86-91]. Here is a list of bioactive compounds along with their bioactivity **Table 2**.

Table 2. Bioactivity of compounds isolated from *Ophiocordyceps sinensis*.

| Compounds | Bioactivity |
|--------------------------------------|---|
| Cordycepic Acid | Antitumor ^[66] |
| Cyclofurans | Antibacterial, Antitumor ^[67] |
| Beta-Glucans | Antibacterial, Antitumor ^[68] |
| Beta-Mannans | Antibacterial, Antitumor ^[68] |
| Ophiocordin | Antifungal ^[70] |
| L-Tryptophan | Antifungal ^[71] |
| Cordycepin | Antitumor ^[72] |
| Ergosterol and ergosteryl esters | Used in antifungal drugs ^[73] |
| Acid deoxyribonuclease | Used for DNA fragmentation and degradation |
| Polysaccharide and exopolysaccharide | Anti-diabetic, Antioxidant ^[74] |
| Cordyheptapeptide | Antioxidant, antibacterial, Antitumor ^[72] |

CONCLUSION

Entomopathogenic fungus has ever since been the center of research for mycologists. *Ophiocordyceps sinensis* is an interesting fungus which is yet to be explored in terms of science. There are several countries that use it as a traditional medicine ^[90-94]. There is a major need of planned study in reference to this fungus. Since, there are several compounds that can be isolated out of this fungus; attempts towards its molecular study must be made. As slowly this fungus is getting into picture and as the climate and environment is rapidly changing; steps must be taken in order to preserve the fungus. Different gene banks can be made, where the fungus can be preserved which can be used later for morphological and molecular studies. More focus on specific fungi will help in getting better results. Moreover, if an initiative can be taken keeping in mind only few fungi variety, it will be very much beneficial to science and to mankind as well. Advanced molecular studies of *Ophiocordyceps sinensis* is also very important. In various laboratories it has been found that samples collected from different regions had variations in their molecular structures. Best way to pursue the studies on *Ophiocordyceps sinensis* will be studying it morphologically first, identifying the associated fungi growth as the associated fungi are also very important and then at the same time going for the molecular studies. As it has been found that the fungus is a hub for pharmaceuticals. Studies on this regard can be very beneficial.

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