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Cordyceps Mushroom: Immuno-Modulator against COVID-19

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SUMMARY

The immune system, like other systems in our body, works best when it is regular exercised with taking something known an immune stimulant or immuno-modulator. Cordyceps mushrooms the best immuno-modulator boost immune system. These mushrooms are the kings of immunity regulation. Medicinal mushrooms differ greatly in their individual healing properties from one mushroom to the next, but despite their individuality, they nearly have a commonality of boosting our immune systems. Cordyceps has the unique ability to interrupt RNA/DNA synthesis, which has led to the inclusion of Cordyceps mushrooms in the treatment programs of viral based infections, such as HIV, hepatitis, as well as noval corona virus. In healthy cells, these RNA/DNA inhibitors are out-competed by endogenous, or native to the body, nucleotides – however, in cancer cells or virally infected cells which are rapidly dividing, Cordyceps is able to effectively inhibit the rate of replication.

INTRODUCTION

Mushrooms which are having medicinal properties have been known since thousands of years to produce bio metabolites which are used or studied as possible treatment for many diseases. Most of the cancer-related deaths can be prevented or reduced by modifying our diet with mushrooms, because they contain antioxidants. The name Cordyceps has been derived from two Latin words, i.e., cord and ceps meaning club and head, respectively. *Cordyceps militaris* belongs to the phylum Ascomycota classified in the order hypocreales, as spores are produced internally inside a sack, called ascus (Wang et al. 2011). It is an entomopathogenic fungus, which often grows parasitically on lepidopteron larvae and pupae of insects and spiders. It normally inhabits on the surface of insect's pupae in winters and leading to the formation of fruiting body in summers justifying its name as ''winter-worm summer-grass''. There have been a variety of pharmacologically active compounds reported from *Cordyceps* sp. Among them Cordycepin has received much attention due to its broad-spectrum biological activity and medicinal value.

Pharmaceutical and Therapeutic ability of *Cordyceps Sp.*

Cordyceps species is also known as traditional Chinese medicine (TCM) as it has wide applications in pharmaceutical and health sector (Russell and Paterson 2008). These Therapeutic development and Drug are also used for the treatment of COVID-19. This medicinal mushroom was in the limelight during the Chinese National Games in 1993, when a group of women athletes broke nine world records, committed that they had been taking *Cordyceps* regularly. It has been seen previously reported that Cordyceps also enhances physical stamina making it very useful for the elderly people and athletes.

How does it work

Cordyceps might improve immunity by stimulating cells and specific chemicals in the immune system. It may also have activity against cancer cells and may shrink tumor size, particularly with lung or skin cancers. The structure of Cordycepin is very much similar with cellular nucleoside, adenosine and acts like a nucleoside analogue. Once inside the cell, Cordycepin gets converted into mono-, di- and tri-phosphates that inhibit the activity of enzymes like ribose-phosphate pyrophosphokinase and 5-phosphoribosyl-1-pyrophosphate amido transferase which are used in de novo biosynthesis of purines.

Recent literature further confirms that *Cordyceps* enhances cellular energy in the form of ATP (adenosine tri-phosphate). Upon hydrolysis of phosphates from ATP, lots of energy is released which is further used by the cell. The studies by many researchers in the past on *Cordyceps* have demonstrated that it has anti-bacterial, anti-fungal, larvicidal, anti-inflammatory, anti-diabetic, antioxidant, anti-tumor, pro-sexual, apoptotic, immunomodulatory, anti-HIV and many more activities. *Cordyceps* has a long history of use as a lung and kidney tonic, and for the treatment of chronic bronchitis, asthma, tuberculosis and other diseases of the respiratory system. The cardiovascular effects of *Cordyceps* are being noticed more frequently by researchers as it works through variety of possible ways either by lowering high blood pressure via direct dilatory effects or mediated through M-cholinergic receptors resulting in improvement in the coronary and cerebral blood circulation. Thus, *Cordyceps* has implications at the therapeutic level as well by rectifying the abnormalities in rhythmic contractions (also known as cardiac arrhythmia). *Cordyceps* extract has also been found as a promising source to increase cardiac output up to 60 % in augmentation with conventional treatment of chronic heart failure. The product from wild type and cultured Cordyceps has also been shown to significantly decrease blood viscosity and fibrinogen levels preventing myocardial infarction. Another study showed that the fermentation products of Cs-4 reduce myocardial oxygen consumption in animals under experimental lab conditions revealing dramatic anti-anoxic effects. These studies provide strong evidence that Cs-4 and its fermentative solution prevent platelet aggregation stimulated by collagen or adenosine di-phosphate (ADP).

Also work as an Entomopathogenic fungus

It is known as an entomopathogenic fungus because *Cordyceps* usually infects insects at different stages of their development ranging from insect larvae to adult. Insect's epidermis is covered with a thick layer of cuticle (procuticle and epicuticle) which is also known as integument. Insect's integument comprises chitin, proteins and lipids. Beside this, it also contains variety of enzymes and phenolic compounds. Epidermis is formed by a single layer of epithelial cells followed by a thick layer of procuticle. Procuticle is differentiated into an inner soft part known as an endocuticle while the outer hard part is called exocuticle. Epicuticle and wax are known to constitute the outermost covering of the cuticle. This not only serves as a protective barrier against pathogenic organisms but also prevents water loss and acting as an interface between insect and its environment. Further a short germ tube protruding out of the conidia starts thickening at the distal end which is known as appressorium. This appressorium maintains a kind of mechanical pressure on the germinating germ tube further improving the penetration effect of germ tube so as to reach into the insect's haemolymph (Hardeep and Sharma 2014). As the germ tube penetrates the epicuticle layer of insect's integument, it starts forming a plate-like structure called penetration plate. The penetration plate further produces secondary hyphae, which cross the epidermal layer and reach into the haemocoel of insect's body. From these hyphae, protoplast bodies bud off and start circulating into the insect's haemocoel. Fungus now starts growing into a filamentous mode invading internal organs and tissues of the host. During growth inside the host, fungus produces various kinds of toxic secondary metabolites, which are insecticidal. These secondary metabolites take the insect to its final life stage and ultimately insect dies out. Fungal mycelium emerges out through the cuticle and lead to the formation of fruiting body under suitable environmental conditions (Webster 1980). Finally the insects become sluggish and then die, the mycelium modifies and develops into a sclerotium, which remain coverd by the integumwent of the dead insect.

Metabolites Isolated from *Cordyceps*

Cordyceps, especially its extract has been known to contain many biologically active compounds like Cordycepin, cordycepic acid, adenosine, exo-polysaccharides, vitamins, enzymes etc. Out of these, Cordycepin,

i.e., 3-0-deoxy adenosine isolated from ascomycetes fungus *C. militaris*, is the main active constituent which is most widely studied for its medicinal value having a broad-spectrum biological activity.

Medicinal Uses of Cordycepins:

- Immune system stimulator
- Respiratory diseases
- Antitumor properties
- Sexual potentiator
- Kidney, liver and heart problms
- Athletes/ sportsmen stamina
- Acute and chronic hepatitis cancer

CONCLUSION

Cordyceps being an ancient medicinal mushroom used as a crude drug for the welfare of mankind in old civilization is now a matter of great concern because of its unexplored potentials obtained by various culture techniques and being an excellent source of bioactive metabolites with more than 21 clinically approved benefits on human health including antidiabetic, anti-tumor, anti-oxidative, immunomodulatory, sexual potentiator and anti-ageing effects (Das et al. 2010). Cordycepin alone has been widely explored for its anti-cancer/anti-oxidant activities, thus, holding a strong pharmacological and therapeutic potential to cure many dreadful diseases in future. Further investigations need to be focused on to study the mechanistic insight into the mysterious potential of this medicinal mushroom on human health and promoting its cultivation strategies for commercialization and ethno pharmacological use of this wonderful herb against the COVID-19.

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