

AN OVERVIEW ON PROMISING PHARMACOLOGICAL AND BIOLOGICAL ASSETS OF NATURAL HIMALAYAN VIAGRA (CORDYCEPS SINENSIS)

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Article Received on 21/03/2021

Article Revised on 11/04/2021

Article Accepted on 31/05/2021

ABSTRACT

Cordyceps, a caterpillar fungus is found to be used as high medicinal value by the people around the world. It is a highly valued aphrodisiac commonly known as “Himalayan Viagra”. *Cordyceps* spp. genus comprises a plethora of compounds and some of them showed therapeutic and pharmacological activities. Yarsagumba is known to science as *Ophiocordyceps sinensis*. The taste is of mushroom, flavoursome, sweet and neutral in nature. It can be eaten plain or powdered, mixed with milk or water. It is considered to have high medicinal value and used to treat diseases like cancer, diabetes, pulmonary diseases cardiovascular disorder, sexual dysfunction, renal disease and many other diseases for centuries in Chinese Traditional Medicine and Bhutanese Indigenous Medicine. The present study reviews about its basic knowledge, about the properties of *Cordyceps* species along with ethnopharmacological properties, application in food, chemical compounds, and various pharmacological properties with a special focus on various medicinal uses, phytochemical and pharmacological studies conducted so far.

KEYWORDS: *Yarshagumba; Therapeutic; Cordycepin; Polysaccharide and exopolysaccharide; Myriocin; Immunity; Socio- Economic Status.*

INTRODUCTION

Himalayan Viagra has been used for about 1000 years as an aphrodisiac or as a treatment for hyposexuality. Yarsagumba the world's most expensive medicinal fungus, at least 700 species are known. The fungus is found in the Tibetan Plateau and in regions like Gansu, Qinghai, Sichuan, Yunnan, Bhutan, India, and Nepal, as well as across the southern flank of the Himalayas. The peculiar life cycle of the fungus has also earned it the names 'winter worm, summer grass' and 'caterpillar fungus'. *Cordyceps* is a type of medicinal mushroom said to offer antioxidant and anti-inflammatory benefits. The fungus *Cordyceps* spp. belongs to Tibetan medicine and consumers describe it as an important source of energy. The word *Cordyceps* originates from the Greek term "kordyle", which means “club”, and the Latin etymon “ceps”, which means “head” (Olatunji et al., 2018). The caterpillar fungus *Ophiocordyceps sinensis* is a medicinal mushroom increasingly used as a dietary supplement for various health conditions, including

fatigue, chronic inflammation, and male impotence. (Martel, J. et al 2017). In Chinese, it is called *Dong cong xia cao*. However, the origins are Tibetan: *Yart Swa Gun Bu*, which means 'herb in the summer and insect in the winter'. The fungus is also known as Keera jari in Uttarakhand because of its caterpillar-like appearance. Keerajari, the caterpillar fungus is an exotic species and known as Himalayan Viagra of Indian Viagra for its libido boosting power. The fungus *Cordyceps sinensis*, *Ophiocordycipitaceae* has been known as an effective tonic and aphrodisiac in Traditional Chinese Medicine (TCM) and is increasingly used in China as a popular dietary supplement and/or medicine.. Before the rainy season, the fungus infects caterpillar larvae living in the grassy soil. When it finally attacks the head, the larvae die. The stalks of the fungus then propagate in the head, growing 2-3 inches long and becoming brown in colour. A parasitic fungus that grows inside the ghost moth caterpillar and then kills its host by bursting through its head is itself threatened with extinction.

Ophiocordyceps sinensis, the world's most expensive fungus, only grows on the Tibetan Plateau where it has become the main source of income for some communities. To grow, it needs a specific climate with winter temperatures below freezing but where the soil is not permanently frozen. *Cordyceps sinensis* thrives from 3000 to 5000 meters above sea level, in cold, grassy, alpine meadows of Tibet Autonomous Region. The best times to pick it in Nepal are May and June, though it can also be found in Bhutan, India and Tibet. Yarsagumba also provides vitality and increases physical stamina of the body. Yarsagumba is a natural product, the chances of any side effects are minimal.



Himalayan Viagra

The "Himalayan Viagra"

Chinese name:
Dong chong xia cao

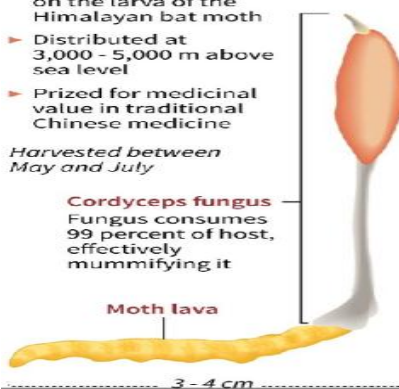
- ▶ Parasitic fungus grows on the larva of the Himalayan bat moth
- ▶ Distributed at 3,000 - 5,000 m above sea level
- ▶ Prized for medicinal value in traditional Chinese medicine

Harvested between May and July

Cordyceps fungus
Fungus consumes 99 percent of host, effectively mummifying it

Moth larva

3 - 4 cm



Major Chemical Constituents of *Ophiocordyceps Sinensis*

Yarsagumba contains a number of active ingredients, including cordycepin and cordycepic acid. This small herb is an exceptional combination of a yellow caterpillar and a mushroom (fungus). *Cordyceps Sinensis* is rich with a variety of beneficial nutrients and minerals including cordycepin acid, cordycepin, D-mannitol, polysaccharide, SOD, fatty acid, nucleocide protein, vitamin A, vitamin B1, B2, B6, B12, serien, zinc, copper, carbohydrates etc.

Bioactive Components in *Cordyceps Sinensis* with Their Biological Activities

The genus *Cordyceps sinensis* contains a large number of chemical compounds and their derivatives in the form of secondary metabolites. Major chemical compounds such as nucleosides, sterols, flavonoids, cyclic peptides, phenolic, bioanthracenes, polyketides, and alkaloids are found in *Cordyceps sinensis*. Zhu et al. (1998), reported that 28 saturated and unsaturated fatty acids and their derivatives were isolated from *C. sinensis* along with polar compounds include several alcohols and aldehydes.

Cordyceps is a fungus that lives on certain caterpillars in the high mountain regions of China. Natural cordyceps is hard to get and may be expensive. Most supplements are made with cordyceps grown in a laboratory. *Cordyceps* is most commonly used for kidney disorders and male sexual problems. Its collection and illegal trade have transformed remote villages of Uttarakhand, where it is found in the wild. The fungus cannot be cultured in the laboratory. Excessive harvesting and climate change are affecting its reproduction but there is no conservation policy in place.

1. Cordycepin

Cordycepin (0.97 and 0.36 %) is 30-deoxyadenosine, a purine alkaloid. Cordycepin is considered most vital, due to its utmost therapeutic as well as nutraceutical potential. (Ashraf, S.A et al 2020). Cordycepin is a potent anti-inflammatory and analgesic medicine. (Qi, W. et al 2013). Cordycepin has a neuroprotective effect in the ischemic brain. Cordycepin has been found effective against tuberculosis as well as in the treatment of leprosy.

2. Cordycepic Acid

Cordycepic acid (7-29%), an isomer of quinic acid, is one of the main active medicinal components. Cordycepic acid plays a great influence in treating liver fibrosis (Guo and Friedman, 2007), diuretic, plasma osmotic pressure, and anti-free radical properties (Nomani, et al. 2014). It is now believed that cordycepic acid is, in fact, D-mannitol.

3. N-Acetylgalactosamine

N-Acetylgalactosamine is necessary for intercellular communication, and is concentrated in sensory nerve structures of both humans and animals.

10. Adenosine

Nucleosides such as adenine (0.18 and 0.06 %), adenosine, inosine, cytidine, cytosine, guanine, uridine, thymidine, uracil, hypoxanthine, and guanosine have been isolated from *C. sinensis*. Among the nucleotide components, guanosine has the highest content ratio than other components (Shaoping et al., 2001). Mycelia and fruiting bodies of *Cordyceps sinensis* are rich in adenosine and therefore mild hypotensive effect and platelet aggregation inhibition are observed. It shows anti arrhythmic, vasodilating effect, negative inotropic effect and also inhibits thrombus formation. (Chakraborty, S. et al 2014).

5. Ergosterol

Ergosterol is present in two forms, as free ergosterol or esterified ergosterol, which have different physiological functions. Ergosterol is a characteristic of fungi sterol and an important source of vitamin D₂. It is an important raw material in the production of steroid hormone drugs. (Kitchawalit, S. et al 2014). A number of other sterol-type compounds have been found in *Cordyceps*: d-3-ergosterol, 3-sitosterol, daucosterol and campeasterol etc.

4. Hypoxanthine

Other Components include peptides, a glycoprotein (Kawaguchi et al. 1986), adenosine, adenine, hypoxanthine.

9. Polysaccharide and Exopolysaccharide

These polysaccharides (3–8%) can effectively control the blood sugar level in the body (Kiho et al., 1993), The important species of *Cordyceps* spp. From which polysaccharides have been isolated and developed, possess antitumor activities. The cordyceps

polysaccharides can improve the immunological functions of organic cells, removing harmful components and thus reducing the injury to liver cells. (Chakraborty, S. et al 2014). The ability of the polysaccharide-enriched fraction to reduce blood glucose level by 60–70% is noteworthy. Polysaccharides from *Cordyceps sinensis* possess a wide spectrum of biological activities like antitumor, antioxidant, immunomodulatory activity, kidney and lung protection, etc.

7. Myriocin

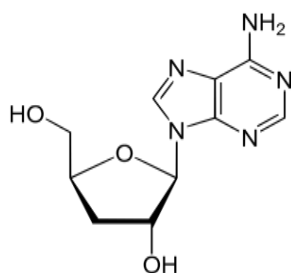
Myriocin is an amino acid-based antibiotic derived from *Cordyceps sinensis*, acts as a potent inhibitor of serine palmitoyltransferase, the first step in sphingosine sphingosine biosynthesis. Myriocin also possesses immunosuppressant activity.

Protease

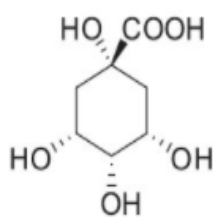
Most of the proteins in *C. sinensis* are enzymes, including the intracellular proteases and extracellular proteases.

Cordymin

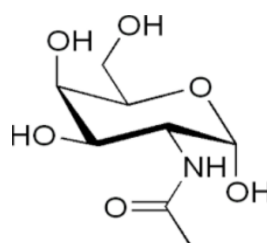
Cordymin, a peptide purified from the medicinal mushroom *Cordyceps sinensis*, showed potent antiinflammatory and analgesic properties. Cordymin significantly boosted the defense mechanism against cerebral ischemia by increasing antioxidants activity related to lesion pathogenesis. (Wang, J. et al 2012). It has a neuroprotective effect in the ischemic brain due to inhibited inflammation and increased antioxidant activity. Cordymin, a peptide purified from the medicinal mushroom *Cordyceps sinensis*, showed potent antiinflammatory and analgesic properties.



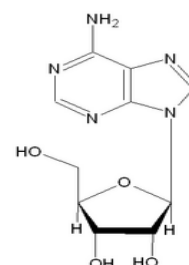
1. Cordycepin



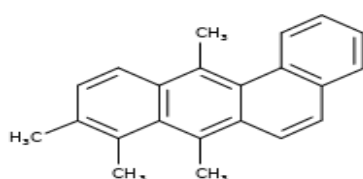
2. Cordycepic acid



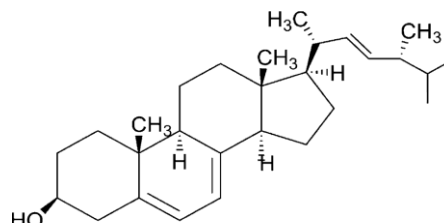
3. N-acetylgalactosamine



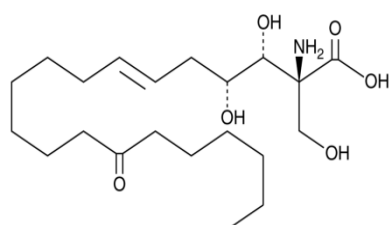
4. Hypoxanthine



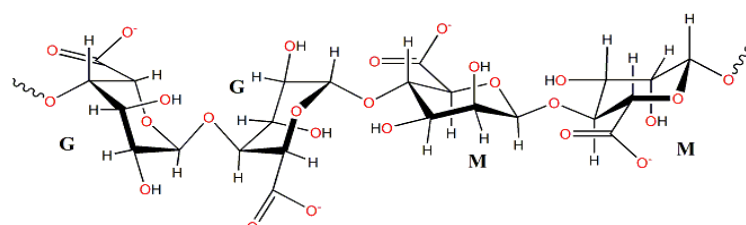
5. Ergosterol



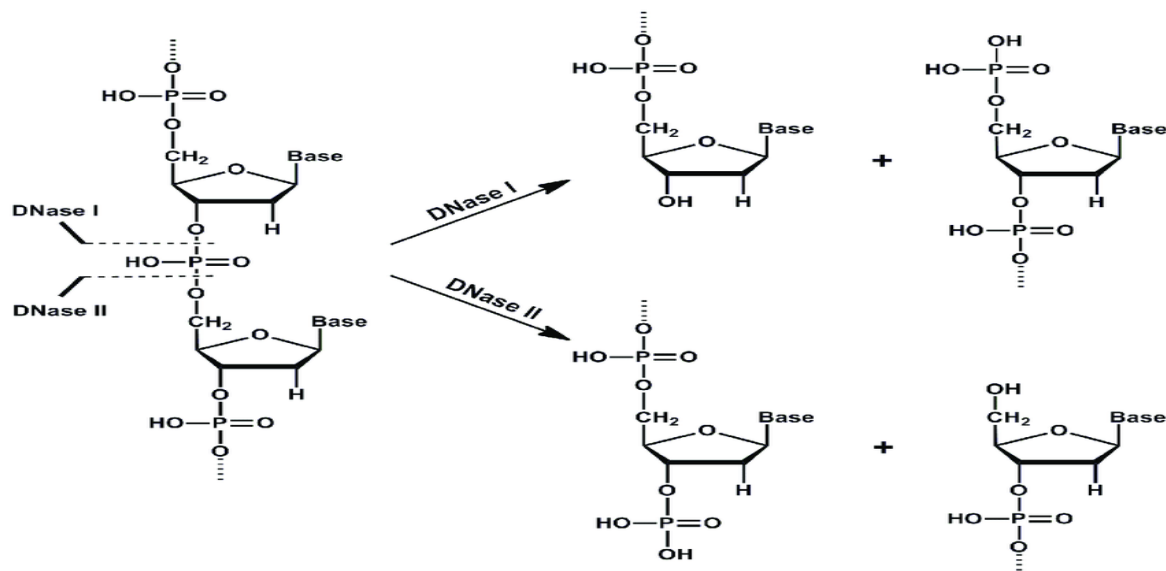
6. Bioxanthracenes



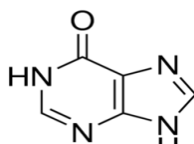
7. Myriocin



8. Acid deoxyribonuclease



9. Polysaccharide and exopolysaccharide.

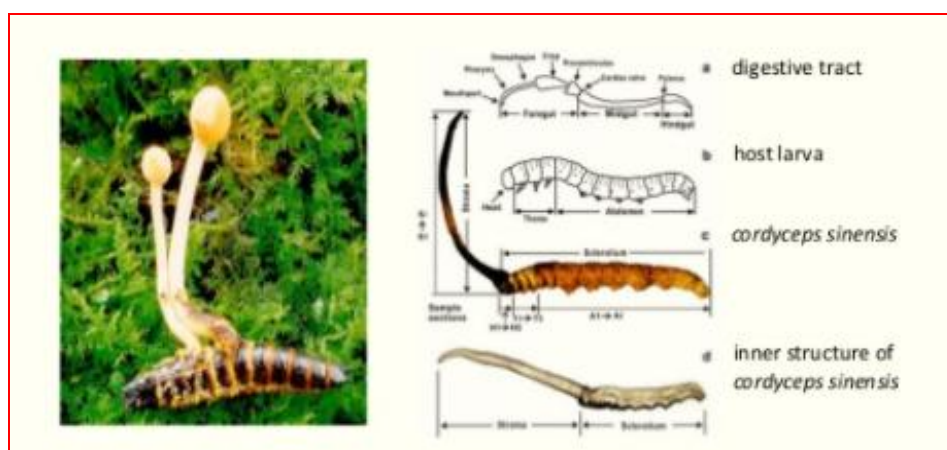


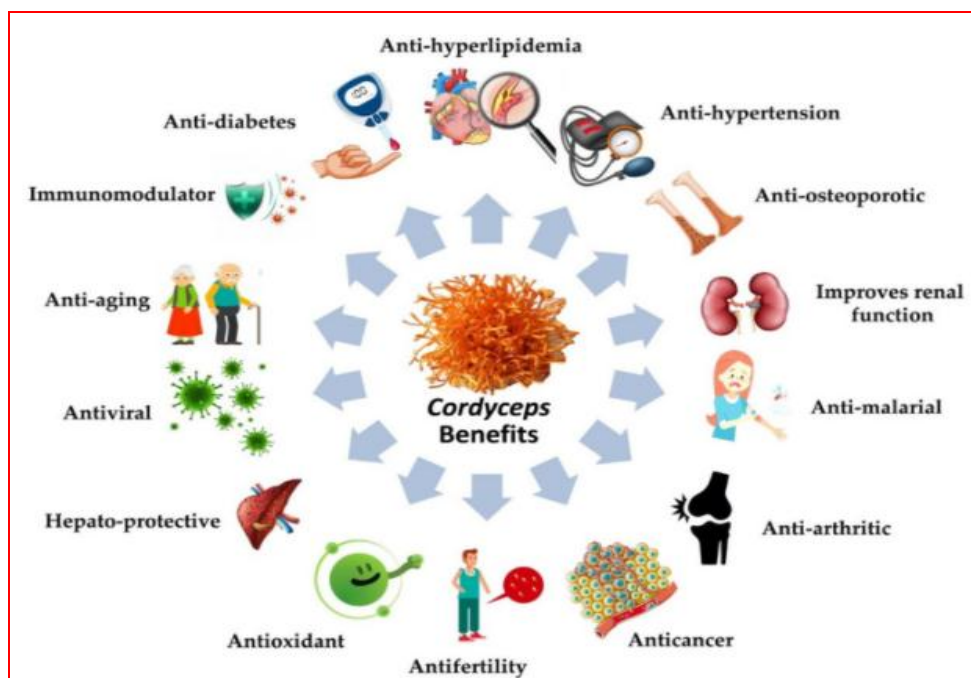
10. Adenosine

Some of the important chemical compounds present in *Cordyceps sinensis*

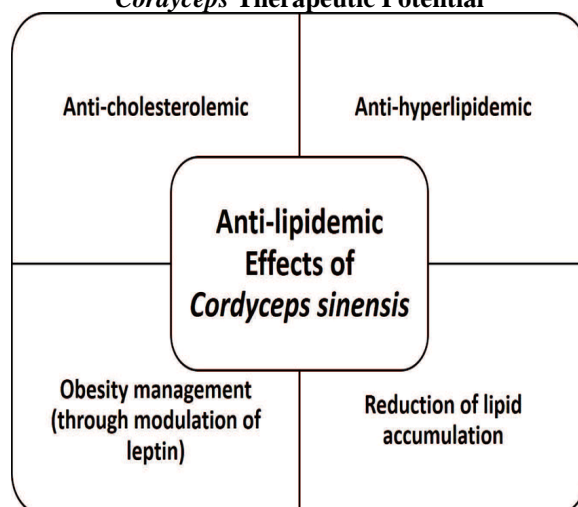
High medicinal and commercial value attributed to this plant has earned it the reputation as “Himalayan Gold” or “Himalayan Viagra”. The herb is used to treat many ailments affecting children, adults and the aged. It is

widely used as a tonic and medicinal food in traditional Chinese medicine (TCM), as it possess wonderful health benefits *Cordyceps* could be considered as one of the most significant mushrooms, enriched with various nutrients with possible nutraceutical value.

*Ophiocordyceps sinensis*



Cordyceps Therapeutic Potential



Cardiovascular System

It enhances the circulation of the blood, regulates blood pressure, and also strengthens the heart muscles, which in turn improves the cardiac function. It also aids in regulating the heart rhythm, ensuring regular blood flow by hindering the clotting of platelets. Jordan et al. (2008) reported use of *Ophiocordyceps sinensis* to reduce acute and chronic rejection associated with cardiac transplantation. The herb remarkably increases cardiac hypoxia tolerance. Previous research results have reported several pharmacological activities including improvement of physical performance, circulatory functions, atherosclerosis inhibition, respiratory system, kidney and renal system and anti-tumor, anti-metastatic (Holliday & Cleaver 2008)

Boosts Respiratory Function

Studies show that it can alleviate respiratory ailments such as asthma, tuberculosis and chronic bronchitis by protecting the lungs. It decreases the production of

phlegm as well. *Ophiocordyceps sinensis* is known for its beneficial effect on various lung ailments (Holliday and Cleaver 2008) as well as in severe acute respiratory syndrome (SARS) (Chen et al., 2012).

Boosts Immune System

The Cordyceps fungus increases the growth of immune cells and promotes antibody production in the body, enhancing its resistance to bacterial, virus, yeast and fungal infections. It helps with post-cancer recovery too. The important chemicals found in the herb are calcium and selenium, the latter being well known for its ability to enhance immunity against cancer. The caterpillar fungus has a hypoglycemic effect and may be beneficial for people with insulin resistance. Yarsagumba is believed to be an excellent tonic for nourishment of the body and for the brain and its long-term use is said to improve organic functioning as well as the immune system. (Gupta and Manvitha 2017).

Anti Aging

Cordycepin exhibits many health benefits, including anti-photoaging and anti-pigmentation. (Kunhorm, P. et al 2019). The herb has anti-aging, anti-inflammatory and antioxidant properties, which help reduce weakness stress and fatigue associated with aging, and boosts energy during over exertion. Cordycepin may be of great value owing to its medicinal potential as an external drug, such as in cosmeceutical, traumatic, antalgic and muscle strain applications.

Combats Sexual Dysfunction

Cordyceps helps in boosting testosterone levels in men. It has been claimed as a tonic supplement for sexual and reproductive dysfunctions for a long time in oriental society. It also increases the energy levels.

Cordyceps helps in boosting testosterone levels in men. It has been claimed as a tonic supplement for sexual and reproductive dysfunctions for a long time in oriental society. It also increases the energy levels and reproductive capabilities of both men and women. *Cordyceps sinensis* have been appreciated for many centuries in Traditional Chinese Medicine (TCM) for its use as sexual stimulant and health promotion.

Kidney Health

The renal failure is one of the major human health issues and improvement of renal function by use of *O. sinensis* is reported (Guan et al. 1992). The herb strengthens the kidneys and other renal functions. It also prevents excess toxins from accumulating in the body. It has a diuretic effect and thus, prevents kidney pain.

Enhances Energy Levels And Boosts Exercise Capacity

The benefits of *Cordyceps* spp. have also been observed in athletes due to energy improvement derived from the increment of the cellular ATP level, which releases energy in muscle cells. Awareness of this benefit was popularized by Chinese female athletes who obliterated three long-distance running world records during China's Seventh National Games in 1993. It takes care of oxygen utilization by the cells and tissues of the body.

Supports Liver Function

Studies show that it helps improve and restore liver function in cases of liver damage, such as from chronic hepatitis B and C infection. It is used by the Chinese to cure chronic Hepatitis-B and liver ailments. Bioactive components of cordyceps for liver protection are mostly cordyceps polysaccharides (CPs). (Chakraborty, S. et al 2014) It could improve the liver function, reduce liver inflammation, and fight against hepatic fibrosis.

Role of Cordyceps In Sexual Dysfunction

Cordyceps can effectively stimulate the secretion of DHEA from the adrenal cortex, which stimulates both men's and women's sexual function and energy. *Ophiocordyceps sinensis* a trusted aphrodisiac, which

enhances of libido and fertility in both sexes. (Huang et al. 2004). For men, *Cordyceps sinensis mycelium* can effectively delay muscle fatigue, and promote and extend erectile capacity and endurance. Generally, men feel a bigger impact than women in terms of sexual dysfunction when consuming Cordyceps. Cordyceps can be double-boiled to form a decoction, boiled into a tea, or consumed as a capsule. It is usually recommended to be consumed once daily, using between four to eight grams of Cordyceps each time. For a quicker option, there are also Cordyceps capsules and pre-packaged drinks with Cordyceps in them. Cordyceps sinensis have been appreciated for many centuries in Traditional Chinese Medicine (TCM) for its use as sexual stimulant and health promotion. (Chakraborty, S. et al 2014).

Nutritional Value of Cordyceps

This is used traditionally as a medicinal herb to strengthen lungs and kidneys, increase energy and vitality, stop haemorrhage, decrease phlegm and treat fatigue and more recently as aphrodisiac and tonic known as Himalayan Viagra. Caterpillar fungus has antibiotic properties. The herb is used to treat lung and respiratory infection. Cordyceps Sinensis also has analgesic and anti-inflammatory properties to alleviate common pains and aches such as sciatica and backache. Yarsagumba also provides vitality and increases physical stamina of the body. It is used by the Chinese to cure chronic Hepatitis-B and liver ailments. Cordycepsin has been found effective against tuberculosis as well as in the treatment of leprosy. Cordyceps sinensis has also been found to be useful to address certain symptoms and conditions associated with leukemia.

CONCLUSION

Cordyceps sinensis used as a crude drug for the welfare of mankind, and being an excellent source of bioactive metabolites benefits on human health including anti-diabetic, anti-tumor, anti-oxidative, immunomodulatory, sexual potentiator and anti-ageing effects. Cordyceps sinensis is one of the miracle traditional Chinese medicines, which can undoubtedly be supplemented in ordinary foods, health foods, functional foods or as nutraceuticals. It is gaining popularity because of its attributed extraordinary health benefits like enhanced physical stamina for superior performance, anti-cancer and protection for lungs and kidneys. As the cordyceps sinensis has been used as food for so long and the trend still continues, logic remains that the side effect is very minimal or it has no side effects at all. The chemical constituents and their pharmacological uses are reviewed here highlighting the potentiality of this highly esteemed traditional Himalayan medicine. There is an urgent need to devise methods of effective cultivation methods and to ensure effective process technologies for utmost recovery of bio-active principles. There is a strong urge to use interdisciplinary biotechnological and chemical tools to isolate and enhance the bioactivity of the metabolites from this entomopathogenic fungus.

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