



## ***CORDYCEPS SINENSIS* (YARSAGUMBA): A PROMISING CATERPILLER MUSHROOM**

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**Abstract:** *Cordyceps sinensis* has been described as a medicine in old Chinese medical books and Tibetan medicine. It is a rare combination of a caterpillar and a fungus and found at altitudes above 4500m in Sikkim. Traditional healers and local people of North Sikkim recommend the mushroom, i.e., *Yarsa gumba*, *Keera jhar* (*C. sinensis*) for all diseases either as a single drug or combined with other herbs. The present study was undertaken to collect information regarding the traditional uses of cordyceps in Sikkim. It was found that most local folk healers/traditional healers use cordyceps for the treatment of 21 ailments.

**Introduction:** Nature always stands as a golden mark to exemplify the outstanding phenomenon of symbiosis and beside the three important necessities of life – food, clothing and shelter; nature has provided a complete store house of remedies to cure all ailments of mankind.<sup>1</sup> Medicinal plants play a major role and constitute the backbone of Traditional System of medicine<sup>2</sup>. In the recent days, most of the prevailing diseases and some nutritional disorders are treated with natural medicines.<sup>3</sup> One such fungus is *Cordyceps sinensis*, a

therapeutic biofactory, is a combination of fungus and dead insect and has been used as a Traditional Chinese medicine (TCM) for centuries. “*Yarsagumba*”, as it is known in Tibetan and Nepalese language, with both the caterpillar and fungal part in an intact single piece is an item of commerce in many countries as well.<sup>4</sup>

### **Name and General Description:**

*Cordyceps sinensis* (Berk.)Sacc., commonly known as cordyceps mushroom and caterpillar fungus, is an ascomycetes fungus and belongs to the family *clavicipitaceae*. The name Cordyceps comes from the Latin words ‘cord’ and ‘ceps’ meaning, ‘club’ and ‘head’, respectively. These words describe only about the appearance of the fungus.<sup>5</sup>

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English name – Caterpillar fungus, *Cordyceps* mushroom

Latin name – *Cordyceps sinensis*

Phylum – Ascomycota

Class – Ascomycetes

Order – Hypocreales

Family – Clavicipitaceae

Related species – *Cordyceps milaris*, *Cordyceps barnesii*, *Cordyceps ophioglossoides*, *Cordyceps hyphae*, etc.

Vernacular names

Local Name – Yarsa gumba, Yarcha gumba

Nepali Name – Keera jhar, Jeevan buti, Keeda ghash, Chyou kira, Sanjeevani bhooti<sup>[8]</sup>

Chinise Name – Dong chong xi cao

Japanase – Tocheikasa

### Mycological features and vernacular names of *Cordyceps sinensis*<sup>6</sup>



Fig. 1: A mature *Cordyceps sinensis* in its natural habitat<sup>7</sup>



Fig. 2: Dried *Cordyceps sinensis* ready for market

### Lifecycle:

It is a mushroom which grows on a larva of ghost moth. During the summer and early autumn, mature fruiting bodies of *Yarsagumba* release millions of ascospores in the air which infect the larva and germinate inside its body. The fungal cells spread throughout the body through the circulatory system. As the larva is subterranean in habit, it continues digging the soil and enters inside from its rear part in a vertical position. During the winter season, the fungal cells rapidly proliferate inside the larva body and consume all the internal organs of the larva except its exoskeleton. Then the fungal cells convert into the compact white mass inside the body of larva, which is called endosclerotium. It is a dormant stage in the life cycle which can resist unfavorable environmental snow cold condition. When outer temperature slowly rises up at the beginning of the spring, the endosclerotium starts germinating and extrudes through the head part of the larva and ultimately protrudes through the soil. This part called stroma gets fully mature in the summer (fruiting bodies) and again produces ascospores, which infect the larvae in that region. At this season the collectors start collecting this fungus. The life cycle needs one year to complete. In spring and summer it grows out of the host larva and forms a mushroom fruiting body above the ground, but grows inside the host larva during autumn and winter.<sup>8-9</sup>

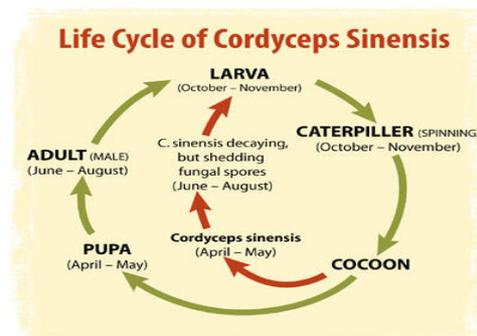


Fig. 3: Life cycle of *Cordyceps Sinensis*



Fig. 4: Life cycle of *Cordyceps Sinensis*

**Morphology:**

It is 5-15 cm long and 0.14 to 0.4 cm thick and resembles a caterpillar in shape and colour. It has a black or brown stem about 2-5cm long. Based on colour, it has 2 types. The whitish yellow is larger and good in quality. The other type is of copper colour and is smaller as well as qualitatively compromised.<sup>10</sup>

**Distribution:**

It grows in high mountains at an altitude of 3,600 – 4,200 meters above sea level. It is found in Nepal Himalaya, Tibet, Bhutan, Sichun, Qunghai, Xizang and Yunnan provinces of China. In India it is mainly found in higher altitudes of Kumaun Himalaya and Garhwal Himalaya and also in higher altitudes of Arunanchal Pradesh and Sikkim.<sup>11</sup>

**Chemical Constituents:**

Important components of *Cordyceps sinensis*:

Sn	Component	Unit	Value
1	D-mannitol	mg/g	76.81
2	Polysaccharide	%	11.2
3	Protein	%	25.44
4	Viatamin A	mg/g	0.315
5	Viatamin B12	mg/g	0.02
6	Zinc	Ppm/g	13.9
7	Copper	Ppm/g	2.8

Chemical composition of *Cordyceps sinensis*:<sup>12</sup>

S.N.	Component	Unit
1.	Water	10.84%
2.	Fat	8.4%
3.	Coarse protein	25.32%
4.	Coarse fiber	18.53%
5.	Carbohydrate	28.9%

**Nutritional Constituents:**

*Cordyceps* contains a broad range of compounds, which are considered nutritional.<sup>13-14</sup> It contains all of the essential amino acids, vitamins E and K, and the water-soluble vitamins B1, B2, and B12. 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).<sup>15</sup>

**Materials and Methods:**

The specimens were wrapped inside the moss plants and then packed in the ice cubes. The specimens were washed with tap water to remove the adhering dust particles on it. The stroma of the fresh specimen of *Cordyceps* were washed 2-3 times in double distilled water and dipped in 0.1% HgCl solution for one minute. Further the stroma was washed with sterile distilled water, surface dried by pressing between sterilized filter paper. In order to propagate the mycelium in vitro, tissues were taken from the different parts of the *Cordyceps* body like spores, stalk tissue and tissue from stroma region. These tissues were excised from the *Cordyceps* body with the help of a sterilized scalpel inside a laminar flow and cultured in to the various culture media. Eight different types of media were prepared to get the pure culture of the fungus. Culture media utilized for pure mycelium culture were Potato Dextrose Agar (PDA), Casein Hydrolysate Dextrose Agar (CHDA), Beef ssExtract Dextrose Agar (BEDA), Soya bean Seed Extract Dextrose Agar (SEDA), Rice Extract Dextrose Agar (REDA) and Black Soya Seed Extract Dextrose

Agar (BSEDA). The cultures were incubated at the various range of temperature (5 to 250C) inside the incubator.<sup>16-19</sup>

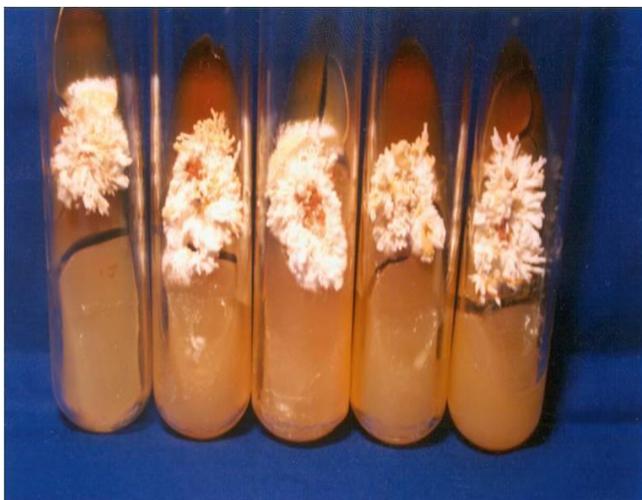


Fig. 5 In vitro culture of *Cordyceps sinensis* on artificial medium under laboratory conditions.

#### **Toxicology:**

*Cordyceps* is considered to be very safe and an oral LD50 (median lethal dose) could not be defined. Doses in mice of 80 g/kg body weight did not cause death. One study indicated that *Cordyceps* is not mutagenic or teratogenic. There are reports from clinical studies of mild GI discomfort (including nausea, upset stomach, and dry mouth). In another report, some patients taking Cs-4 developed a systemic allergic reaction.<sup>20</sup>

#### **Medical uses of Cordyceps – Yarsagumba:**

- 1) *Cordyceps* or *Yarsagumba* or *Yarchagumba* is also considered potent at strengthening lung and kidneys, increasing energy and vitality, stopping hemorrhage, decreasing phlegm.
- 2) *Cordyceps* or *Yarsagumba* or *Yarchagumba* has traditionally been used for impotency, backache, to increase sperm production and to increase blood production.
- 3) *Cordyceps* or *Yarsagumba* or *Yarchagumba* is used specifically for excess tiredness, chronic cough and asthma, impotency, debility, anemia, to build the bone marrow.
- 4) *Cordyceps* or *Yarsagumba* or *Yarchagumba* is taken for shortness of breath, asthma,

impotency, emission, soreness of loins and knees, dizziness and tinnitus.

5) *Cordyceps* or *Yarsagumba* or *Yarchagumba* is also use for strengthen the immune system of tumor patients who have received radiotherapy, Chemotherapy or operation *Cordyceps* or *Yarsagumba* or *Yarchagumba* can also used as Natural Viagra.

6) Restore health during convalescence and treat deficiency syndrome caused by overstrain.

7) Strengthen the immune system to help the body resist and withstand attacks from virus and bacteria.

8) Prevents tumor activity.

9) Regulates abnormal wakefulness and other sleep problems at night and thus improves sleep quality, also reduces severity of nocturia.

10) Improves blood circulation and regulates blood pressure.<sup>21</sup>

#### **Adverse effects:**

This medicine may cause the following reactions to the user allergic to it Breathing problems or tightness chest; chest pain, skin rashes, itchy or swollen skin. Two major side effects in some cases: Low blood sugar (hypoglycemia) and upset stomach and dry mouth.<sup>22</sup>

#### **Analytical Approaches and Standardization:**

High performance liquid chromatography (HPLC):

HPLC is a conventional method for analysis of nonvolatile compounds. For most cases, HPLC with UV-vis detection is the prevailing technique, which has been widely used for determination of components in Chinese medicine. Using HPLC coupled with UV detector, ergosterol, adenosine, cordycepin, and other nucleosides, Polysaccharides, Amino acids in *Cordyceps* were determined.

#### **Gas chromatography (GC):**

GC-MS have been employed for analysis of the essential oil of *C. sinensis* and many compounds are identified. Verticilol, a compound resembling with verticine, has been found in *C. sinensis* which indicates anti-tussive and expectorant effects of *C. sinensis*.

**Capillary electrophoresis (CE):**

High performance capillary electrophoresis (HPCE), a powerful tool in natural product analysis, has been applied for the analysis of compounds found in *Cordyceps*.<sup>23-24</sup>

**Economics and impact:**

In rural Tibet, yartsa gumba has become the most important source of cash income. The fungi contributed 40% of the annual cash income to local households and 8.5% to the GDP in 2004. Prices have increased continuously, especially since the late 1990s. In 2008, one kilogram traded for US\$3,000 (lowest quality) to over US\$18,000 (best quality, largest larvae). The annual production on the Tibetan Plateau was estimated in 2009 at 80–175 tons.<sup>25</sup>

In 2004 the value of a kilogram of caterpillars was estimated at about 30,000 to 60,000 Nepali rupees in Nepal, and about Rs 100,000 in India.<sup>26</sup> In 2011 the value of a kilogram of caterpillars was estimated at about 350,000 to 450,000 Nepali rupees in Nepal. A 2012 BBC article indicated that in north Indian villages a single fungus was worth Rs 150 (about £2 or \$3), which is more than the daily wage of a manual laborer.<sup>27</sup>

The price of *Ophiocordyceps sinensis* has risen dramatically on the Tibetan Plateau, basically 900% between 1998 and 2008, an annual average of over 20% (after inflation). However, the value of big sized caterpillar fungus has increased more dramatically than smaller size *Cordyceps*, regarded as lower quality.<sup>28</sup>

Year	% Price Increase	Price/kg (Yuan)
1980s		1,800
1997	467% (incl. inflation)	8,400
2004	429% (incl. inflation)	36,000
2005		10,000–60,000
2013		125,000–500,000

**Research:**

Clinical research has shown that *Cordyceps* increased cellular bio-energy—ATP (adenosine triphosphate) by as much as 55 per cent.

Increased synthesis of ATP and faster energy recovery has also been reported. It would seem that *Cordyceps* improves the internal balance mechanism, thus making the utilization of oxygen more efficient. These properties may account for the overall physical enhancement, the extra endurance and the anti-fatigue effects that are seen in humans using *Cordyceps*.<sup>29</sup>

**Marketed Formulation:**

**Royale V<sup>2</sup> Plus:**



V<sup>2</sup> Plus is a product formulation based on the extract of Damiana (*turnera diffusa*) & *Cordyceps Sinensis*. It is formulated to promote men & women health & vitality.

**Dosage:** 2 capsules once, 1-2 times daily. To be taken before meal.<sup>30</sup>

**Cordyceps Sinensis Oral Liquid:**



This product is extracted and refined from natural *cordyceps sinensis* by scientific methods. 100% all natural cordyceps sinensis.

**Ingredients:** *cordyceps sinensis*, pure water

**Specification:** 10ml x 10 bottles

**Direction:** one bottle a day

**Packing:** 10ml x 10 bottles/box, 40 boxes/ctn<sup>31</sup>

**Conclusion:**

Plant remedies, although based on natural products, are not found in 'nature', but are the products of human ethnobotanical knowledge. Indigenous technical knowledge in this respect has to be carefully abstracted and the design of effective conservation strategies must therefore include safeguarding the plant genetic resources as well as indigenous knowledge and techniques which can conserve the biodiversity and improve the well being of mankind. The importance of protecting the indigenous and local knowledge is being recognized in national and international fore. People in Dolpa normally consider *C. sinensis* as tonic and sexual stimulant. The overall knowledge on the natural distribution, abundance, population structure, dynamics of a species and ethnomycological knowledge are crucial.

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