

Cordyceps sinensis Medicinal Fungus: Traditional Use among Tibetan People, Harvesting Techniques, and Modern Uses

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Lithang Town with its Gelugpa monastery in the back. A few *Cordyceps sinensis* gathering areas are located beyond the ridge of Pomra (sPom ra), the mountain dominating Lithang. Photo ©2009 Alessandro Boesi

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The fungus cordyceps (*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. Owing to the upsurge in consumer demand for this ingredient in the past few decades, Tibetan peoples have been gathering increased amounts of cordyceps over the high-altitude expanses of Tibetan regions, and this activity has become one of their most important sources of income in certain parts of the country. Prices rose significantly from the early 1980s until 2008,^{1,2} at which point they dropped due to the global economic crisis.*

Cordyceps is also renowned within other international markets, and it is available in several countries around the world, where it is sold in different forms. Although not as highly prized in the Tibetan traditional system of medicine as in Chinese medicine, the fungal ingredient is included in the *materia medica* of Tibetan medicine. Its first citation in Tibetan medical treatises actually predates its reference in Chinese texts by a few centuries.

The present article analyzes the use of cordyceps among Tibetans with particular reference to its classification and therapeutic properties, gathering and processing, combination with other medicinal substances in Tibetan medicine, as well as its use on the popular level.



The weight of the dbyar rtswa dgun 'bu is taken using small scales. The measurement is quite accurate, yet between traders arguments often arise about the precision of the weight or the quality and the price of the produce. Those quarrels can often become real fights.

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Data in this article were obtained during several field-research trips conducted by the authors in different Tibetan cultural regions: Lithang and Dardo/Kangding Counties (Ganzi/Kandze Tibetan Autonomous Prefecture, Sichuan Province, China), where the authors spent 9 months during 2 consecutive vegetative seasons in 1999 and 2000; the region of Baragaon located in Mustang District, central Nepal (2001); and Repkong/Tongren County (Huangnan Tibetan Autonomous Prefecture) and Rushar, Huangzhong County (Xining Prefecture-level city) in Qinghai Province, China (2007).

The methods used during fieldwork included participant observation and open-ended and structured interviews conducted with cordyceps gatherers, traders, users, and in particular with Tibetan medical practitioners—both independent and belonging to recognized medical institutions. Excerpts from Tibetan medical treatises have been thoroughly examined, particularly the *Mennag chewa rinsel* (*Ten Millions of Instructions: a Relic*), written by the famous Tibetan doctor Zurkhar Namnyi Dorje in the 15th century,³ the Tibetan *materia medica* that the Mongol Jampal Dorje compiled in the 19th century,⁴ and a few modern treatises devoted to Tibetan pharmacopeias and medical preparations.^{5,6,7} The botanical identifications presented in this article are mainly those reported in modern Tibetan *materia medica*^{5,6} and those related to the specimens gathered on the field by the authors. We note that, because the botanical taxonomic identification of Tibetan *materia medica* may vary throughout Tibetan regions, the identification presented herein may represent only one of

the possible species to which a Tibetan designation corresponds.

The Fungus *Cordyceps sinensis*

Cordyceps is a genus of ascomycete fungi belonging to the family Ophiocordycipitaceae (formerly Clavicipitaceae), parasitic mainly on insects and other arthropods. These type of fungi are thus named entomophagous (feeding on insects) fungi. [Authors' taxonomic note: According to the recent DNA review of the genus *Cordyceps*, the new name for *Cordyceps sinensis* is *Ophiocordyceps sinensis* (Berk.)

G.H. Sung, J.M. Sung, Hywel-Jones & Spatafora.^{8]} *Cordyceps sinensis* s.l. (in the broad sense) is a parasitic fungus living on lepidopterous (butterflies and moth) larvae. It attacks and grows on caterpillars, specifically on larvae from the genus *Thitarodes* (Hepialidae, Lepidoptera). *Cordyceps sinensis* thrives from 3000 to 5000 meters above sea level, in cold, grassy, alpine meadows of Tibet Autonomous Region (TAR, Chinese: Xizang), Sichuan, Gansu, Qinghai, and Yunnan Chinese provinces, and in a few Nepalese, Bhutanese, and Indian Himalayan areas. The infected hosts, of which *T. armoricanus* (Oberthür) Ueda is the most commonly-mentioned species, live underground on the Tibetan plateau and Himalayan regions in the same areas where *C. sinensis* thrives, and they spend up to 5 years before pupating.



A monk from Lihang monastery scans the ground looking for cordyceps, Lihang County, 4200 meters.
Photo ©2009 Alessandro Boesi

The spores of *C. sinensis* are spread by the wind over the soil and onto plants, where they come into contact with *Thitarodes* larvae, particularly when the caterpillars emerge to feed on roots and herbaceous vegetation. Larvae were observed eating tender roots of alpine meadow species such as *Polygonum*, *Astragalus*, *Salix*, *Arenaria*, and *Rhododendron*.⁹ The caterpillars may eat the spores or the spores lying on their bodies may germinate and enter their bodies through the mouth or the respiratory pores (2 of them are present over each metamere). When *C. sinensis* attacks *T. armoricanus*, its mycelium invades the caterpillar's body, filling its cavity, killing the insect, and eventually completely replacing the host tissue. The dead caterpillar appears yellowish to brown in color. The cylindrical club-shaped fruiting body, 5-15 cm long and dark brown to black in color, grows up from spring to early summer, protruding and developing out of the caterpillar's forehead.

The stroma (mass of fungus tissue) bears many small, flask-shaped perithecia (fruiting bodies) that contain the asci (sacs in which the sexual spores are formed). According to Li et al., *C. sinensis* spores disperse and break up into 30-60 propagules, which attach themselves to the larval state of the insect; usually 15 days pass between spore dispersion and larval infection.¹⁰

In the Lithang area, where most of the fieldwork was conducted, the authors observed *C. sinensis* between 4000 and 4500 meters of altitude in the alpine grasslands on the northern slopes of the Shaluli Shan Range mountains. The length of the larvae varies roughly from 3 to 6 centimeters. The length of the dry mushroom spans from 3 to 10 centimeters.

Cordyceps Harvesting

During our fieldwork in east Tibet, we participated in the gathering of cordyceps, both with Tibetan medical practitioners and professional gatherers. The season starts at the beginning of April and lasts until the end of June, although normally the harvesting season spans from the beginning of May until the middle of June. After that period, according to a modern text of Tibetan *materia medica*, “the body of the ‘worm,’ which is within the ground, gets rotten... until its interior becomes hollow.”⁵

The gathering of cordyceps represents the principal source of income for many Tibetans from Lithang and neighboring areas.^{11,12,13} Many people from Lithang—young and old, laymen and monks, men and women—walk everyday along the steep path that leads to the collecting areas. A few Chinese citizens, some of them coming from lowland regions, also participate in the gathering. According to our informants, most of the picking areas are located on the north-facing slopes of the mountains.

Most of the gatherers lie on the ground over the high-altitude expanses, attentively scanning the terrain. The search for the tiny cordyceps in the high altitude grasslands, interspersed with small *Rhododendron* bushes and various vegetation, still dormant at the beginning of spring, is a difficult task, requiring concentration and patience. In fact, the height and thickness of the fungus are so small that it cannot be easily seen: in spring the ground is covered with short vegetation stumps as brownish as the tiny cordyceps. But Tibetan people generally seem happy to perform this work since it is not considered particularly strenuous, the enterprise is highly profitable, and because they like spending their time together in the mountains.



Cordyceps on sale at Chengdu medicinal ingredients market.

Photo ©2009 Alessandro Boesi

The gatherers proceed slowly on hands and knees, or bending the body and leaning on a small hoe. They usually carefully scan the area in front of them, keeping their faces close to the ground. If they do not recognize any cordyceps, they take a few steps forwards and proceed in the search to an adjacent area. Cordyceps is extracted from the soil with a hoe or a small knife. It is important not to damage the larva, because it would lose value. We have noticed many gatherers carrying thin sticks of wood (like toothpicks) that may be used to repair cut or broken larvae or to increase the weight of the product, once inserted in them.

Some gatherers claim that they may find 30 to 40 worms a day. Nawan Tashi, an independent doctor who often spends a few days of the gathering season collecting cordyceps, says that the average amount collected in that area does not usually exceed 20 specimens a day; the maximum specimen number that he has found in one day has been 27. On the day that we met with him, he arrived home late in the afternoon with only 14 specimens in his leather bag. After drying the amount collected, Nawan Tashi saved some of it in his store room with other herbal materials. He generally sells most of the product on the local market to make some money, with which he then buys other medicinal plants, usually manufactured Tibetan pills from the Derge Tibetan Medical Institute. At the time of our fieldwork, a few small bags full of cordyceps were hanging from the wooden ceiling of his home. He had decided to sell them the next winter when the price would be higher.

Cordyceps Use at the Popular Level

Traditionally, Tibetan people perceive cordyceps as a single substance that undergoes a

metamorphosis on passing from spring to summer. They refer to it as *yartsa gunbu*, meaning “summer-grass winter-worm,” although they frequently shorten the name to *bu* (“worm”) at the popular level. All the Tibetans with whom we spoke believe that, during winter, cordyceps lives as a worm and that, after a metamorphosis occurring at the beginning of spring, it changes into a kind of grass. In certain confined areas, such as a few sacred sites, cordyceps seems to have connections with the local popular religion. Its gathering was banned, for example, in the Dzachuka (*rDza chu kha*) and Sertha (*Se tha*) regions (located in Sêrxü County and Sêrtar County, respectively, Ganzi Tibetan Autonomous Prefecture, Sichuan Province).¹⁴ Animals that dwell underground in burrows, as Huber reports, “are negatively associated with the archaic cosmology. These species are considered to be too close to the realm of the local subterranean and sub-aquatic deities, who are believed to be easily offended and also quick to cause harm to humans and their livestock in retribution for human encroachment upon their realm.”¹⁵

The use of cordyceps is not particularly common at the popular level in Lithang County and in the other fieldwork areas. Several Tibetan medical practitioners agree on the fact that, in general, this substance is seldom used as a medicine or diet supplement among Tibetans, who essentially regard it as a trade item.

The few people who consume the product typically do so as a tonic in the form of a beverage that may be prepared in different ways. We have sometimes observed Tibetans sipping small amounts of these potions from tiny bottles while conducting activities such as carving religious prayers on stones and gambling. Nearly 80 informants (i.e., gatherers of and traders in cordyceps, plus Tibetan traditional doctors) maintain that these potions are helpful to the body’s general health and for increasing strength and vigor, and that they are also a good aphrodisiac. Our informants from Lithang explain that these potions are prepared by dipping a few cordyceps specimens into a container filled with *arak* (*a rag*), a local alcoholic spirit processed from barley or rice. The number of specimens may vary according to the quantity of *a rag* held in the container and the potion strength required. Usually 3 to 5 specimens of cordyceps are used for each half-liter of *a rag*. The potion is ready after having been kept in a cool place for 2-3 months. Some people wait a year or more before consuming it, claiming that the long period of the drug permanence in the alcohol increases the potion potency and effectiveness. When the *a rag* is exhausted, some more may be added by filling the container again. Most informants state that the refilling can be done several times and are aware that, in this case, the potion’s overall potency decreases. Some people may add other ingredients, as is often done by traditional doctors. Winkler reports that “in Lithang there is already a distillery that produces liquor (*qingke jiu*) from regionally grown barley with a few caterpillar fungi or fritillary bulbs floating in the bottle.”¹³

A few scholars provide evidence that cordyceps is employed at the popular level in other regions inhabited by populations of Tibetan language and culture. In the Dolakha District (Central-east Nepal), the Sherpa people use cordyceps as an aphrodisiac and tonic: “One to two fruiting body are orally administered with milk, once a day.”¹⁶ According to Sacherer, in the Rolwaling Valley of the same District, the product is popularly used as a tonic and aphrodisiac and “it is eaten in its entirety, caterpillar and fungus, mostly by middle aged men.”¹⁷ In Nar (Central Nepal, Manang District), it is said that “if a person mixes yertsagumbu with 13 other herbs and takes the mixture over a period of three years, he will become as thick as an elephant, quick as a horse and pretty as a peacock,”¹⁸ and it has been assessed that “the product is ground, boiled in milk and drunk with honey or rock candy.”¹⁸ According to a publication by the Ministry of Forests and Soil Conservation of Nepal, in the Thak areas (Central Nepal) cordyceps “is taken orally in combination with *Dactylorhiza hatagirea* (Orchidaceae), honey and cow’s milk,” and it is also administered as a tonic to yak and sheep.¹⁹ A similar use is attested also among the Tibetan practitioners of Dolpa District (West Nepal).²⁰ According to Phuntsho Namgyel, who has been conducting extensive survey in Bhutan on cordyceps as an economic resource for local people, in several areas of this country the fungus is

also known as a medicine at the popular level (e-mail to A. Boesi, March 10, 2004).



Distribution Map reprinted from of Daniel Winkler's article on Yartsa gunbu in *Economic Botany* 62.3 (2008).
www.danielwinkler.com

Cordyceps in Tibetan Medicine

Cordyceps in Tibetan Medical Texts. In Gawe Dorje's modern text about Tibetan *materia medica*, the term *tsa tachi* (*rtswa da byid*, "grass *da byid*") is given as the main name for *yartsa gunbu*.^{6†} We have never heard Tibetan doctors employing this designation, although a few of them claim to have known of the term from that same text. To our knowledge, apart from this occurrence, the expression has never been mentioned to indicate *yartsa gunbu* in classic or other modern Tibetan *materia medica*. A modern Tibetan medical dictionary presents the entry *tsatachi* as a synonym of *yartsa gunbu*.²¹ This designation has probably been devised recently in connection to the drug named *tachi*, which according to Gawe Dorje, corresponds to a salamander (*Batrachuperus pinchonii*).⁶ Zurkhar Namnyi Dorje, who devotes an entire chapter to describing the so-called *tachi* and its varieties, affirms that this term connotes several other substances from plants, minerals, and animals that share the same properties as *yartsa gunbu*, although *yartsa gunbu* itself is never mentioned.³ Attributing this new denomination to *yartsa gunbu* has possibly been done to include it in the same group as the most powerful aphrodisiacs and tonics, and it is probably due to Chinese influence: Aphrodisiacs, notably cordyceps, represent highly praised drugs in Chinese medicine. It seems that, only in the past few decades, the use of cordyceps has been spreading in modern Tibetan medical institutes located in Central Tibet.

The first Tibetan author who described *yartsa gunbu* seems to be the famous Tibetan doctor Zurkhar Nyamnyi Dorje (1439-1475) mentioned above, the practitioner who founded the so-called *Zur* medical tradition. In his treatise *Ten Millions of Instructions: a Relic* (commonly and incorrectly also referred to as "Oral Instructions on a Myriad of Medicines"), he mentions *yartsa gunbu* among the drugs that cure the *rotsa* (*ro tsa*) ailments—those concerning sexual virility.³

The fundamental treatise of Tibetan medicine, *The Four Tantras* (*rGyud bzhi*), of which the first edition dates between the 8th and the 12th century, does not mention this medicinal fungus.²² Also,

The Crystal Rosary (Shel phreng), a text devoted to Tibetan *materia medica*, composed by the Tibetan doctor Deumar Geshe Tenzin Phuntsok in east Tibet in the 18th century and still considered the fundamental reference for Tibetan practitioners owing to its completeness and details in medicinal substance description, surprisingly does not mention *yartsa gunbu*.²³ Cordyceps is a very common product in eastern Tibetan regions, and certainly at that time it already represented an important trade item as documented from several sources. For example, Rockhill reports that “this mountain [in the valley called Lit’ang Golo] is famous as producing that curious worm-plant known as the *Shar-tsa gong-bu (tung-chung hsia-ts’ao* in Chinese), called by botanist *Cordyceps sinensis*.”²⁴ *Yartsa gunbu* is also not included in a Tibetan *materia medica* describing the plants used at the Lhasa Medical and Astrological Institute in the first part of the 20th century.²⁵

The medicinal fungus is, however, described in the illustrated Tibetan *materia medica* written by Jampal Dorje in the 19th century, where it is mentioned among the “herbaceous medicines,” *nomen (sngo sman)*, the so-called category that includes medicinal plants growing mostly in the higher zones of the mountains, exhibiting an herbaceous aspect, slender stem, and tiny underground organs.⁴ The author provided an illustration of the fungus, in which he depicted some specimens already prepared in bundles kept together by small strings, ready to be sold, exactly as is customary today in some traditional Chinese pharmacies. This figure testifies to the importance of the product as a trade item at that time. It is also possible that among Tibetan peoples cordyceps was already more famous as an item of trade than as a medicine, exactly as it happens at the present time. Jampal Dorje describes *yartsa gunbu* as follows: “It grows on high mountains, during summer the root is similar to a worm, the leaves are similar to the ones of the ‘mountain garlic’ *rigok (ri sgog, Allium spp., Liliaceae)*, the flower is similar to that of the plant called *Awa*” (*A wa*, a plant belonging to the Gramineae).

Contrary to traditional treatises, in Chinese Tibetan cultural areas, all recently-published modern texts devoted to describing Tibetan *materia medica* give a large emphasis to cordyceps. The fungus is included in the first modern Tibetan *materia medica* published at Lhasa in 1973.²⁶ Certainly under Chinese influence, in the modern pharmacopeia of Gawe Dorje, cordyceps has been added to the so-called “essence medicines,” *tsimen (rtsi sman)* category, which includes peculiar medicinal substances coming from animals, minerals, and plants such as camphor (*ga bur, Cinnamomum camphora*, Lauraceae), cardamom (*sug smel, Elettaria cardamomum*, Zingiberaceae), saffron (*gur kum, Crocus sativus*, Iridaceae), musk, bear bile, and bitumen.⁶ Even a small amount of them is considered very powerful, and they share a particular fragrance. Differently, Karma includes the product in the category named *tangmen (thang sman*, “medicines of the plains”), which includes bulky herbaceous or sometimes tiny woody plants usually not growing at high altitude, and reports that throughout Tibetan regions there are 5 different varieties of it.⁵ We have never obtained this last piece of information during our fieldwork.

Tibetan doctors from Lithang state that they do not frequently employ and do not highly value cordyceps, claiming to know other herbs that, once mixed, have the same properties but give more effective results, particularly *wang lag* or *wangpo lagpa (dbang po lag pa, Gymnadenia orchidis, Orchidaceae)*;⁶ *G. crassinervis* and *G. conopsea*;⁵ and *Dactylorhiza hatagirea* (Orchidaceae).²⁰ The *Gymnadenia* species is also deemed a good tonic and aphrodisiac according to Tibetan medical treatises.

The utilization of cordyceps was not very common also at the Kumbum Medical Institute (Qinghai Province) and at the Lhasa Medical and Astrological Institute before the arrival of the Chinese. Today it seems that the product is utilized more frequently in central Tibet (particularly at Lhasa) according to information given by several doctors at the 2000 Lhasa International Tibetan Medicine Congress, who lamented that cordyceps had become rare in the last decades. As was noted earlier, it has been reported that local Tibetan practitioners frequently use this product in the region of Dolpo (Nepal),²⁷ and it is also employed in the Nepalese region of Manang.²⁸ According to Phuntsho

Namgyel, although knowledge of cordyceps as an important medicinal plant exists in the Himalayan kingdom of Bhutan, the Bhutanese traditional medicine system, which is similar to Tibetan medicine, started incorporating it in its formulations only a few years ago.

The Energetics of Cordyceps in Tibetan Medicine. According to the modern texts of Tibetan *materia medica*, the fungus must be gathered between spring and summer (May-June).^{5,6} Both the worm and the grass are used after removing the earth that encapsulates the larva. Also the worm's white-to-yellowish mycelium that encapsulates the larva must be peeled off. The fungus is then cleaned and dried in a cool place at a constant temperature. The therapeutic properties mentioned in the texts are described according to the pharmacological theory of Tibetan medicine. The taste of the *dbyar rtswa dgun 'bu* is sweet (*mngar mo*) and salty (*lan tshwa ba*), its post-digestive taste is sweet, its potency is unctuous (oily; *snum*) and hot (*drod*). The fungus has the properties of increasing the energy of the body, of restoring semen functionality, and of increasing its production. Furthermore, it increases kidney strength and heat, it cures all the disorders caused by unbalance of the humor wind (*rlung nad*) and the disorders caused by unbalance of the humor bile (*mkhris nad*). It also prevents increasing of the humor phlegm (*bad kan*). Gawe Dorje reports that, according to a treatise compiled in the 19th century, cordyceps is among the 4 best plants to treat the ailments concerning sexual virility.⁶

Tibetan doctors from Lithang prepare 2 slightly different potions that contain cordyceps. These 2 recipes seem to be devised by mixing together medicinal herbal preparations deemed to be good tonics and aphrodisiacs in order to get a strong and effective preparation. Practitioners prepare both recipes by adding cordyceps and other materials to a container filled with *a rag*, which is then kept in a cool place for 2-3 months, as described earlier. The first recipe includes the following ingredients: cordyceps, *dugme* (*dug med*, *Fritillaria cirrhosa*, Liliaceae) bulbs, the root of a herbaceous plant not yet identified, and a fragment of *shara* (*sha rwa*, deer's antler, probably *Cervus albirostris*, white-lipped deer, or *C. elaphus macneilli*, a red deer). The second recipe includes cordyceps, *dugme* bulbs, and *dretserma* (*'dre tsher ma*, *Lycium barbarum*, Solanaceae; aka goji or wolf berries). These 2 medicines do not represent typical Tibetan medical preparations. They are not reported on written sources and most likely originate from oral transmitted knowledge influenced by Chinese tradition.

A preparation aimed at improving physical strength and sexual virility,⁷ administered as a pill, includes as the main ingredient 50 grams of crushed cordyceps, to which the following powdered medicinal substances are added: *aruserdog* (*a ru gser mdog*, *Terminalia chebula*, Combretaceae); the so-called *sanpodrug* (*bzang po drug*), *dzati* (*dzwa ti*, *Myristica fragrans*, Myristicaceae; nutmeg), *lishi* (*li shi*, *Eugenia caryophyllata*, Myrtaceae; clove), *chugan* (*cu gang*, *Bambusa textilis*, Poaceae), *gurkum* (*gur kum*, *Crocus sativus*, Iridaceae; saffron), *sukmel* (*sug smel*, *Elettaria cardamomum*, *Amomum compactum*, Zingiberaceae; cardamom), and *kakola* (*ka ko la*, *Amomum subulatum*, *A. tsao-ko*, Zingiberaceae). The following substances are also added: *powari* (*pho ba ris*, *Piper nigrum*, Piperaceae; black pepper), *giwan* (*gi wang*, bezoar), *tomtri* (*dom mkhris*, bear bile), *tandromkarpo* (*thang phrom dkar po*, *Przewalskia tangutica*, Solanaceae), and *lantantse* (*lang thang rtse*, *Hyoscyamus niger*, Solanaceae; henbane).

Cordyceps is also employed in another preparation, named *tachi chusum* (*da byid bcu gsum*, “*tachi* 13”), similarly administered as a pill.⁷ This preparation's main constituent is *tachi*, and it includes the following 13 ingredients, most of them coming from animal substances: *tachi* (*da byid*), *wangpo lagpa*, *drekar* (*'bras dkar*, white rice), *ghiakil gomar* (*rgya mchil mgo dmar*, sparrow [meat]), *samsha* (*sram sha*, otter meat), *tsangnya* (*gtsang nya*, river fish), *tugdre* (*thug 'bras*, ram testicles), *ciwisha* (*'phyi ba'i sha*, marmot's meat), *pukronsha* (*phug rong sha*, pigeon's meat), *chilwisha* (*mchil ba'i sha*, sparrow [meat]),[‡] *kimchasha* (*khyim bya'i sha*, cock's meat), cordyceps, and *gonmosha* (*gong mo'i sha*, Tibetan partridge's meat). The medicine, administered early in the morning with honey, has the property of boosting the body's energy, supporting the 5 senses, and increasing life span.

Although the primary focus of this paper is not about reviewing the modern pharmacological and clinical data on cordyceps, it is constructive to mention a few recent clinical studies that have investigated the efficacy of cordyceps preparations. Human clinical trials have demonstrated the effectiveness of *C. sinensis* fermented mycelia in combating decreased libido and virility.^{29,30} In a clinical study of elderly patients with chronic fatigue, results indicated that most of the subjects treated with *C. sinensis* pure mycelium reported a significant clinical improvement in the areas of fatigue, cold intolerance, dizziness, frequent nocturia, tinnitus, hypo sexuality, and amnesia, while no improvement was reported in the placebo group.^{31,32,33} In recent years, *C. sinensis* has been investigated in animal and *in vitro* studies for anti-aging effects, activity on sexual function, and immune modulation, among other potential uses.^{34,35}

Sustainability Issues

The increased harvesting of cordyceps all over its distribution area certainly implies sustainability issues. Winkler reports that, “according to current official statistics, *yartsa gunbu* harvest was below 40,000 kg for Tibet [Tibet Autonomous Region] between 1999 and 2001, reached nearly 44,000 kg in 2002 and 2003, and then 50,544 kg in 2004.”¹ Unfortunately, at present no data regarding the long-term impact of this intensive collection are available. At the time of the fieldwork, Lithang gatherers and traders stated that they had not noticed a reduction in the abundance of cordyceps since they had come into the business, except for some seasonal decreases attributed to bad weather conditions in early spring. Collectors and dealers interviewed by

Winkler reported the same data but complained about reduced harvesting rates per individual due to steadily-increasing competition.¹ Winkler applied to this issue the “Rapid Vulnerability Assessment” (RVA) technique, as developed by ethnobotanist Tony Cunningham (after Wong 2000)³⁶ and formalized for analysis by Wild and Mutebi.³⁷ He obtained a score of 20, indicating a moderate degree of vulnerability. Namgyel, by applying the same technique, obtained a score of 26 for Bhutan’s cordyceps species, noting that the score would be slightly lower “if the traditional rights of the collectors are recognized and a community-based natural resources management system is put in place.”³⁸

Conclusion

Since *C. sinensis* grows over much of the area traditionally inhabited by populations of Tibetan language and culture, and since its citation in Tibetan medical treatises pre-dates by 2 centuries its mentioning in Chinese medical texts, it may be assumed that Tibetan people were probably the first to notice this fungus thriving on the high pasturelands, examine its morphological traits, understand its biological features, assess its qualities and therapeutic properties, and to attribute it a name. It is remarkable and difficult to explain that this medicinal fungus, so highly praised as a tonic and aphrodisiac by Zurkhar Namnyi Dorje in the 15th century,³ is not mentioned in many Tibetan *materia medica*. While this interesting fungus is used in some Tibetan medicinal formulations, it is certainly not employed as heavily as in Chinese culture. Its popularity within Chinese medicine, however, has certainly made the fungus an important economic resource for Tibetan people.

The recent drop in sales of cordyceps may therefore have serious economic consequences for some Tibetan communities, and it remains to be seen whether sales of cordyceps will rebound to or surpass previous levels as the global economy stabilizes. With further clinical investigation, it is possible that use of cordyceps may eventually spread to or increase within other cultures. As Tibetan people continue to gather cordyceps for medicinal use and/or international markets, it will be important to occasionally reassess sustainability and environmental impact.

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‡Sparrow meat is listed twice with different names. The 2 different Tibetan designations indicate 2 species belonging to the genus *Passer*. The latter is identified as *P. montanus*; the identification of the former is not confirmed in modern Tibetan *materia medica*.

*According to Daniel Winkler, MSc, following economic liberalization in the early 1980s, cordyceps prices increased dramatically from Chinese yuan (CNY) 1,800 (8 CNY = \$1 USD in 2005) per kg in the Tibetan capital Lhasa, to CNY 8,400 in 1997 (an increase of 366%), then to CNY 36,000 in 2004 (a further increase of 1,900%). In June 2005, prices in Tibet ranged from CNY 10,000–60,000 (USD 1,250–7,500) per kg. Yet in late 2008, due to the global crisis, prices went down significantly. [References: Winkler D. Yartsa gunbu (*Cordyceps sinensis*) and the fungal commodification of Tibet's rural economy. *Economic Botany*. 2008;62(3):291-305 and Winkler D. Present and historic relevance of Yartsa Gunbu (*Cordyceps sinensis*). An ancient myco-medicina in Tibet. *Fungi*. 2008;1(4):6-7.]

†Traditional treatises utilize the term "yartsa gunbu;" the notion of "cordyceps" is not known in such documents.

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