

## MEDICINAL PROPERTIES OF CERTAIN SPECIES OF CORDYCEPS

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For centuries, the Chinese have extolled the medicinal values of the 'Caterpillar Fungus' or *Cordyceps sinensis*. It is found naturally in the highlands of China, Tibet and Nepal.. The term 'Cordyceps' caught public attention in 1993 when at the national athletics championships (China Games) a group of mediocre Chinese female athletes repeatedly achieved several world records. Their coach attributed such outstanding performance to the use of a Cordyceps-based tonic known, among other properties, to enhance oxygen uptake by the brain and the heart.

The genus *Cordyceps* has many different species and belongs to the Pyrenomycetes, i.e., a group in the Class of Ascomycetes. Some species of *Cordyceps* have been reclassified into another genus *Paecilomyces*. Not all species of *Cordyceps* infect the caterpillar larvae of insects belonging to the order Lepidoptera. Australia has several species of *Cordyceps* of which *C. gunnii* is probably best known and commonly seen in certain rainforests where the large stroma grow from the underground caterpillar larva of a moth. Some species of *Cordyceps* e.g., *C. militaris* grow from the nymph stage of other kinds of insects, such as the cicada. The life cycles of the different species of *Cordyceps* are complex and highlight the extraordinary adaptation of these unique parasitic fungi to their particular host. *Cordyceps sinensis*, for example, releases thread-like ascospores from asci during the summer months. The ensuing part-spore, upon contacting a suitable host, produces a germ tube that penetrates the larvae and spreads systemically. Once the larvae burrow underground to await metamorphosis, the fungus proliferates by yeast-like budding until the larva (caterpillar) is killed. The mycelium entirely consumes the internal structures of the larvae to produce a sclerotium in which the 'mummified' larva retains its shape and exoskeleton throughout winter. In the ensuing spring the 'fruiting body' or stroma emerges from the larval body to appear above ground level. Whilst the natural *C. sinensis* harvested from the field is extremely valuable, today its growth on artificial media provides unlimited commercial supplies relatively cheaply. Strains are selected for maximum production of particular actives extracted from the mycelium. The biological activities include anti-tumour, anti-viral and many other properties.

Another species *C. militaris* produces 3'-deoxyadenosine (cordycepin) which inhibits transcription or RNA methylation and mRNA polyadenylation. This property is being exploited as an inhibitor of HIV-1 replication. Cordycepin can specifically kill human leukaemic cells that express the DNA synthetic enzyme, terminal deoxynucleotidyl transferase (TdT) when used in combination with an inhibitor (deoxycoformycin) of deamination to 3'-deoxyinosine by the enzyme adenosine deaminase. The mechanism of cell killing in TdT-positive cells is the activation of programmed cell suicide or apoptosis.

Such actives in the species of *Cordyceps* appear to have a role in thwarting the complex process of metamorphosis or tissue re-modelling of the larva or nymph at a precise stage in the lifecycle of the host. Timely killing ultimately allows the developing stroma to emerge from the ground for spore dispersal.

Reports have indicated that extracts of *C. sinensis* can cause regeneration of kidney tubules damaged by the antibiotic gentamicin and also inhibit nephrotoxicity caused by the immuno-suppressive fungal product, cyclosporin A. Indeed extracts of *C. sinensis* are able to prolong graft survival similar to that of cyclosporin A, without infection. Special interest is in the claim that extracts of *C. sinensis* can produce significant conversion from a carrier (infectious) state of Hepatitis B to a non-infectious condition.

In another study over 84% of patients with cardiac arrhythmias improved following treatment with Cordyceps where in Chinese medicine 'Cordyceps Fungus' refers to *C. sinensis* or *Dong Chong*.

While most cordyceps in herbal formulations, manufactured in USA, are derived from the cultured mycelium, some Chinese preparations are derived from wild cordyceps that can be bought from collectors for as much as \$1000 for 100grams. The extremely high lead content in some preparations of cordyceps was reported in *Lancet* recently to be due to fine slivers of lead inserted into the mummified larvae to fraudulently increase the weight.

Compounds found in Cordyceps include: hemicellulose, polysaccharides, polysaccharide-peptides, nucleosides, triterpenoides, complex starches among other metabolites. Either alone or in combination their diverse physiological and pharmacological effects will continue to engage the interest of practitioners in either conventional or complementary medicine, or both.