Chapter-5

Discussion
DISCUSSION

5.1 COLLECTION OF YARTSA GUMBA

Yartsa gumba is primarily collected from wild occurrence as the grown Cordyceps is of lower quality but the wild Cordyceps is usually very expensive and cost upto $1000 for 100 g. Wild Cordyceps from Tibet is supposed to be best in the world. So far there is neither the people are identified nor any standard protocol has been developed. Even local people are not trained to identify infected/uninfected caterpillars, stages of insects and other than host caterpillars. Alpine meadows above 9000 feet are entirely covered with snow from Oct-Nov to mid April every year. Entire flora and fauna remains under the snow and local people come down to their main home located at about 5000-6000 feet. As soon as snow starts melting local farmers with their entire family, pets and sheep's/goats start moving in the month of mid May to reach the target area. There are more than 3-5 stoppages in the form of boundarised area made by stones, wood in open and covered by polythene where they reside inside. Most of the stores are transported by sheep's and goats for their use to sustain for 2-3 months.

In India this fungus was popularized a decade back when it was collected by some local people called Khambas (a Tibetans race) in high altitude areas of Dharchula (Pithoragarh) of Kumaon hills in Central Himalaya. Keeping in view its medicinal value in mind, a large number of local people from nearby areas started visiting at such an inaccessible area for collection regularly. Since there is no demarcation for collection village wise, so to avoid dispute, areas are defined by their own village panchayat. In recent past eligible passes/permits have been issued to Schedule Tribes and Schedule Caste community by the forest authorities.
For collection stalk of Cordyceps requires very sharp eye to locate it among its host grasses. In summer the stalk gives it the appearance of grass (Fig. 15) and hence the name dbyar-rtswa-dgun-bu which literally means grass in summer and worm in winter. Yartsa gumba is extracted during May- June before the onset of monsoon. Because of antibiotic properties of cordycepin the larva does not decay and remain intact. Gatherers have kudal, steel wire and long screws devices to dig out the Yartsa gumba. They first sit down on the ground (Fig. 26 and 27) and some time lie down on the ground to locate the stalk and take out the Yartsa gumba and keep all collections in shallow aluminum plates so as to get the collection exposed and dried in nature (Fig. 29 and 30).

Fresh specimens are covered with soil and caterpillar is some what loose (Fig. 31) and swollen. After collection, specimens are kept in open and dried in nature. These specimens are directly sold to local mediator among them at the cost of Rs. 80000/ kg on the spot in alpine meadows and local mediator transports it to roadside where there collections are sold to Indian traders of Dharchula and Munsiyari @ Rs 100000/kg. Finally collections are sold to Tibetan traders of nearby market, Taklakot @ Rs, 1,20000-1,50000/kg depending on the production, collection and availability. Thus there are three stages of collection and disposal in India connected by 4th stages of foreign traders a given below:
Level-I
Local people

Level-II
Local Mediator

Level-III
Local traders

Level-IV
Foreign Traders

Local people are given authorized pass by District Forest officers with necessary instructions. Collection is done under the vigil and watch of forest guard and local patwari so as to have an estimate of collection and to follow the instruction and to avoid local disputes. Usually I-III level gatherers are open, however, IV level gatherer are secret so as to avoid taxes and international legal problems related to trader. Only a few traders are authorized by the Indian government but during the season there are a number of unauthorized traders, present in the area of collection and main market. Depending on the size of specimen there weight varies from 260 mg to 1160 mg and one kilogram contains 2000-5000 specimens since specimens are of mixed size and weight so there number varies. However, graded size of higher weight may contain 1000 specimens per kg.

According to Sharma, (2004) Primary gatherers (mostly villagers of the valley) stay in alpine regions for several days and collect the fungus. During the growing periods of the fungus the main brokers from the regional market send their employees to various localities for collection of material. Other than this channel, various mechanism have
been developed. Few more independent agents also work, but the final destination for most of the collected material in that area is usually a regional brokers. Gathering information about the collection, route and market is difficult because it is secret type of mission.

A new trend has been observed in the inner mountain ranges of the central Himalayas, where collection and selling ranges of the Cordyceps has emerged as a new source of income in the rural areas. In the river valleys of Gori Ganga alone, the number of fungus gatherers at alpine habitats has increased about four fold since the year 2000. Total 900 persons visited in seven different habitats in 2000, thus 128 person per habitat visited with total collection of 186 kg. This came to 200g/gatherer costing Rs.8600/gatherer. Price increases to Rs.7000 after carrying material few kilometers down to the local market. Purchase price has also increased at the field site and in the local market tremendously and so the income of gatherers of wild materials between 2000-2002 increased by 3.7 fold to 4.0 fold. Thus selling price was 68000-80000 in Tibet, Rs 80000-90000/kg in 2000 in Nepal and Rs 1.25-1.30 lakh/kg in India.

5.2. GENUS *HEPIALUS* (SWIFT OR GHOST MoTH)

*Hepialus* belongs to the family Hepialidae of Lepidoptera containing 500 species from the world. Adults are small to large in size, diurnal, crepuscular or nocturnal moths whose proboscis is short or absent. The family is cosmopolitan, though about one quarter of the species occurs only in Australia. Larvae are subterranean and live in vertical tunnels excavated either in wood, feeding on re-grown bark at the entrance, or in soil where they feed on roots of grasses or emerge to eat low growing foliage or leaf litter and some are important grassland pests (Ross, 1965; Grillot, 1980; Metcalfe & Flint, 1990 and Arif & Kumar,
The hepialid in New Zealand are well known by the common name Porina which strictly refers only to the pasture pest genus Weiseana. The economic damage to pasture grasses caused by the feeding activity of Porina caterpillar is second to that of grass grubs. There are few species of *Hepialus* viz., *Hepialus hectar* (L.) (Gold swift moth), *Hepialus humuli* (L.) (Ghost moth), *Hepialus sylvania* (L.) (Orange swift moth), *Hepialus lupulinus* (L.) (Common swift moth) and *Hepialus flusconebulosa* (Be Geer) (Jamieson et al., 1999). *H. lupulinus* completes its life cycle in 2 years.

The normal reproductive cycle for *Thitarodes* (=*Hepialus*) takes upto 5 years out of which most of the life cycle lived as caterpillar, the moth itself live for only a short time, 2-5 days in the case of *Hepialus biruensis*. (Chen et al., 2002). As many other ghost moths, the adult of Thitarodes moth is not able to eat. The host for *C. sinensis* most commonly reported is *Thitarodes armoricanus* (Oberthur) under family Hepialidae of Lepidoptera. Other host larvae have been identified such as *Hepialus oblifurcatus*, (Chu). *Hepialus baimaensis* (Liang) and *Hepialus biruensis* (Fu-Huang) (Chen et al., 2002). Nearly 40 species of *Thitarodes* (*Hepialus*) moths are recognized in the ‘Tibetan Plateau’ region. According to Chen et al. (2002) 30 species can be infected by *C. sinensis*. Chinese entomologists are still using the generic name *Hepialus*, although it has been restricted to a single European species *H. humuli* for some thirty years. The genus *Thitarodes* was erected in 1968 to accommodate *H. armoricanus* and other related species placed originally in *Hepialus* (Nielsen et al., 2000), many of them are the host for *C. sinensis*. 
5.3. CATERPILLAR (LARVAL STAGE)

Young larva hatches out from egg in the grass litter and starts their development on the host plants. Grehan and Rawlinsa (2002) reported that larva forms a typical '7' shaped tunnel and a silk covered external feeding scar over the entrance. The larva moult into three phases in which they complete their growth. The entire larval period may take as much as 4 years and mature larva may exceed 100 mm in length (Fig. 17)

Larva digs a burrow more or less vertically into the soil. The soft phase larva lines the burrow with silk and construct a silken runway from the entrance out to its feeding area. Larva emerges at night and cut grass shoot at the base or aerial parts of the plants and drags them back into the burrows so as to eat later. The life cycle is completed in one year. In Tibetan medical literature it is described as one with slender, short and bamboo shaped root which has smoke or ochre colour with light yellowish or skin colour exterior and white fleshy interior. The root has worm like head, body and legs with numerous thin and fine transverse wrinkles. There are about eight pairs of legs on the body of the root and out of them four middle pairs are more prominent (Fig. 18). Larval stages viz., 2\textsuperscript{nd}, 3\textsuperscript{rd}, 4\textsuperscript{th} and 5\textsuperscript{th} instars and eggs collected were studied (Fig. 33, 34, 35, 36, 37, 38, 39 and 40).

The host plants of caterpillar in alpine meadows are grasses and plants including, dock, nettle, dandelion and burdock (the local herbs of high altitude habitat) roots of several lower plants including Plantago, Urtica, Rumex, Solidago and Fragaria are also eaten by the caterpillar.

Their lower part is thin while upper part is slightly thicker. Caterpillars collected from different location were observed under Zoom Binocular Microscope where 3 pairs of thoracic legs, 4 pairs of
abdominal legs and caudal segment are modified into caudal legs (Fig. 17 and 18). Thus caterpillar of *H. armoricanus* posses 12 segments with thoracic and abdominal legs more prominent as compared to other lepidopteron caterpillars. Present observations support the findings of Arif & Kumar (2003).

Infected and uninfected caterpillars are often observed in soft soil under trees in mountains over 3500-5000 m altitude or in cold and well-drained grassy marshy land. The life cycle of uninfected caterpillars take one years to complete. In present investigation it was observed that freshly harvested caterpillars are encased in a black topsoil layer (Fig. 31 and 32). During collection, soil coating is first opened by hand or commonly with a toothbrush, which exposes the caterpillar’s body. Gatherers are very careful while digging out the specimen and their cleaning to avoid breaking of stroma, which reduces the cost of Yartsa gumba.

**5.4 PUPA**

Pupation takes place inside the soil when the temperature goes down and snow fall start. All larval stages further goes deeper under the soil for pupation. Final instar caterpillar makes burrow lined with silk and prepare an earthen cell where in caterpillar pupates (Fig. 41, 42, 43 and 44). Remaining stages remains inside the burrows lined with silk or remain hidden under tunnel or excavation of the roots to avoid climatic stress.

**5.5 MOTH (ADULT)**

Imms (1973) reported that moths of all hepialids are difficult to obtain in perfect condition. In adult, antennae are very short and mouthparts are vestigial. *H. armoricanus* are mostly moderate size with
average wing span of 45-70 mm. However the size may vary from 35 mm to 150 mm. Wings are usually large and strong and many species are known to be swift fliers. However, these do not tend to disperse far from their place of origin, life span of the adult is brief.

Most of the *Hepialus* adults emerge in spring or early summer. Adults may be on the wing between September and April, depending on species and altitudinal locations. Usually adults emerge and fly in the late afternoon or around dusk and may be on wing for only an hour or so, especially the males. Most species emerge in warm and misty weather. Male differs markedly from female in colour. In *H. humuli* the males being commonly white and is readily sought out by the females. (Ealand, 1984 and Imms, 1973).

### 5.6 GENUS-CORDYCEPS

The genus *Cordyceps* is classified as under:

- **Subphylum**: Ascomycotonia
- **Class**: Pyrenomycetes
- **Order**: Clavicipitales
- **Family**: Clavicipitaceae
- **Genus**: *Cordyceps*

New classification of *Cordyceps* spp. has been suggested on the basis of chemotaxonomy of partial nucleotide sequences of 18S rDNA obtained from four different species (Ito & Hirano, 1997). Among various species of genus, *C. sinensis* is highly valued in the traditional medicinal system of China.

Kobayashi (1941) listed 137 valid species under the genus *Cordyceps* and of these 125 were recorded as parasitic on insects order...
viz., Lepidoptera, Diptera, Hymenoptera, Coleoptera, Hemiptera, Isoptera, Orthoptera and Spiders. Dube (1983) has recorded 200 species of genus *Cordyceps* which are known to be parasite of insects. The genus *Cordyceps* is the oldest genus of the family Clavicipitaceae recorded in literature as plant worm, vegetative wasps, trees growing of insect. *Cordyceps militaris* (Linn) have been unsuccessfully used as insect biocontrol agents by Von Tubeuf (Mc Ewen, 1963). Further, dried fungus has been grown on the larvae of *H. armoricanus* (Oberthur) (Huang, 1999). Some of the well known species of *Cordyceps* are *C. multiaxialis* (Mu Zang), *C. nepalensis* (Mu Zang), *C. Canadensis* (Linn), *C. memorabilis* (Cesati), *C. sobolifera* (Berk), *C. cicadae* (Berk), *C. forquignon* (Quelet), *C. capitata* (Link), *C. militaris* (Linn), *C. ophioglossides* (Link), and *C. sinensis* (Berk) (Sarbboy, 1996; Jagadde & Patil, 1983 and Kinjo & Mu Zang, 2001).

Normal range of occurrence of this *C. sinensis* is at 2000 m. elevation, however, it has been observed as high as 6000 m altitude. It is found for a short time each summer, growing on its natural host.

Sung (2004) reported 300-400 species of *Cordyceps* of which 68 species have been recorded in China (Wang, 1999) and 33 species in Tibetan Plateau and Himalayan region (Zang & Kinjo, 1998). *Cordyceps* spp. parasitize larval, pupal and adult stages of insect of the order Lepidoptera, Hymenoptera, Diptera, Orthoptera, Coleoptera and Spiders and sometimes deers. However, only a few are collected for their medicinal properties and most commonly used among these is *C. sinensis*. 

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5.7 PARASITIZATION OF CATERPILLAR OF *HEPIALUS* BY FUNGUS *CORDYCEPS*

*C. sinensis* grows by infecting larvae or mature insects with spores that germinate often before the cocoon is formed and the fruiting bodies (stromata) germinates from the dead host (Fig. 16,17 and 18). The infection is estimated by the filiform ascospore or their fragment landing on the proper insect host. These spore occur in abundance in the nature and adhere to the integument of the caterpillar while escaping from the adverse climate and going inside the soil for pupation. The fragments become globular and put out a germ tube which penetrates the integument and gives rise to hyphae. The fungus produces chitinase enzyme in vitro (Hubner, 1958). The hyphae break up into fragments that get distributed in haemocoel and the fragments bud off more propagules which give rise to hyphae. Soon the insect gets stuffed with the mycelium and consequently the host become sluggish and die. The mycelium modifies and develops into a scleroteum which remain covered by the integument of the dead insect. The cadaver of the insect enlarges in size and becomes resistant to decay due to toxin-antibiotics (cordycepin) produced by the fungus (Dube, 1983; Nair and Balakrishana, 1995; Zhou *et al.*, 1998; Hobbs 1986 and Lie *et al.*, 1999). Life cycle of *H. armoricanus* is given in Fig. 45.

The antibiotic (cordycepin) released by parasitizing fungus keeps insect free from bacteria and thus infected caterpillar does not decay. This antibiotic is also used in molecular biology to block RNA synthesis. The cadaver with endo sclerotia lie buried underground until the favourable spring weather condition for sclerotial germination are available and thus the fungus survives the winter in this stage usually in or on the surface of the soil (Fig.45). In the spring club shaped orange coloured stroma with a
stalk and head arise above the ground and bear peritheca in the periphery of the head region. In section it was observed that the asci have a characteristic apical apparatus containing 8 filiform ascospore (Fig. 51 and 52), which are released violently in succession. The ascospore multiplies by division into small segments and get dispersed by wind.

*C. sinensis* infects to host through integument usually when the epicuticular wax is for one reason or another removed or abraded. Symptoms of a fungal disease infection include behavioural symptoms such as ascending plants stems and foliage which seem well suited to efficient dispersal of the fungal spores. Restlessness is a common symptom for parasitized larvae and thus causes them to wonder away before climbing and dying. Paralysis is also a very common symptom, along with colour changes to creamy black or brown in the infected larvae. When the dying larvae climbs up a grass stem it dies attached to its support by its paralyzed legs or tied by the fungus hyphae growing from its body. (Jolivet, 1998). Continued hyphal growth within the body produces a kind of *pseudosclerotium* and bears peritheca and conidia (Carlile *et al*., 2001).

In the present study it was observed that the larva gets infected by the fungus at the end of autumn and therefore in winter it is still alive and gradually infects the entire body and covers the whole larvae and subsequently kills it. It remains buried under the soil up to 14-20 cm deep. As soon as the snow begins to melt in May, the soil softens and stalk appears above the ground (Fig. 45). Stalk interestingly emerges from the dorsal side of the head of the larva (fig. 17 and 18) which resembles grass sprouting or grass blade like structure, however, it differs in colour which is dark blue or black. Usually a stalk is single and from the same region has been recorded. In the present study two stalks from
the same region have been recorded and unusually four stalks 2 stalk each form head and caudal region have also been observed (Fig. 46, 47 and 48) which seems that some caterpillars after infection could not go inside the soil. Stromata are usually reported to be 5 cm, however, in the present study the size varied from 2.5 to 6.4 cm. Dark brown grassy stalk (Stromata) is thickened at the middle with slightly pointed tip and slender base (Fig. 50).

In formerly old days, Chinese people thought that the caterpillar fungus (Dong Chong Xig cao) was worms, however, after years of study it was found that it is really a fruiting body produced by the fungus C. sinensis on dead caterpillar, from where the spores are spread in the wind to the next generation of caterpillar. The spores are colourless and grows on caterpillars and pupae burried in the soil in meadows. C. sinensis (Berk) parasitize a range of grass root-boring caterpillar which would hatch as whitish ghost moths, when not attacked by C. sinensis.

Kendrick (1992) reported that C. sinensis have developed a special adaptation to improve their chances of reproductive success. Since reproduction is dependent on a very specific host and each spore fragments into 100 or more part of spores so that each fungal fructification produces 32 million propagules, thus increasing the odds of landing on a larva. Lie et al., (1998) reported that C. sinensis produces 30-60 propagules and that usually attach themselves to the larval stage of the insect but also can attach to mature moths. Apparently the larvae are forced by the fungus to move into its final position before being immobilized since the fungus needs proximity to the surface to grow its fruiting body (Stroma) above ground.

The mycelium develops inside the body of insect, first feed on less vital parts, until it has taken over the complete organism filling the
caterpillar with its hyphae. After the insect is completely mummified and emptied of nutrients leaving behind the larval exoskeleton filled with the *C. sinensis* mycelium, the fungus will develop a fruiting body out of the head above the eyes, where the larva has a horn like protuberance in early spring. The 5-10 cm long brown club shaped fruiting body grows above ground to have its propagules dispersed by the wind in order to find a new host insect. The stroma is nearly twice as long as the caterpillar (Fig. 17) when it is fresh and it takes several weeks for the spores to mature. It is reported that fungi usually weigh 75-85% of their weight when dried. In present observation drying percentage is 68 - 93.20% (Table 8).

Since *C. sinensis* grows at the expense of insect internal organs so the size of stroma depends on the size and stage (instars) of the host caterpillar. In the present study the size of host caterpillars varied 2.9 - 4.4 cm in specimens of Laspa area, 3.2 - 4.2 cm in Ralam Dhara glaciers (Fig. 46,47,48, 49 and 50) and size of stromata 3.8- 6.4 cm in the specimens of Laspa area (Fig. 47,49 and 50) and 2.5-5.0 cm in Ralam Dhara glaciers area. Boesi (2003) reported that too much snow during harvest season cause the rotting of stromata and accordingly harvest is lost. In present observation during third collection in the month of June-July because of heavy snow during harvest season delayed the expedition of local collection and even they were forced to remove snow with the help of Belcha to provide suitable climate to grow the stroma. Gatherers started digging to root out infected caterpillars and killing uninfected host caterpillar with low production . The killing of uninfected caterpillar are may have catastrophic in population of the host. There may be the reason of varying size of stromata that due to unfavorable climatic condition, it could not grow properly in higher elevations.
5.8 CHEMICAL PROPERTIES OF YARTSA GUMBA

Yartsa gumba in real is an entomo-fungal combination in which fungus viz., *C. sinensis* parasitize lepidopteran insect viz., *H. armoricanus* both occurring in the same location of high altitude alpine meadows ranging from 3500-5000 m altitude. *C. sinensis* after parasitizing its host caterpillar grow at the expense of entire internal organs of the insect thus we can say it that fungus inside the capsule of insect integument. In this combination both are integral in nature and *C. sinensis* possess medicinal properties.

Cordycepic acid has been isolated from Cordyceps which is an isomer of quimic acid (Chatterjee *et al.*, 1957 and Canningham, 1951) found in cincona bark from which quinine is obtained. Chaterjee (1957) studied the chemical constituents of Cordyceps and crystalline substance cordycepic acid was isolated (Sprecher, 1963). Chinese studies appeared predominantly on constituents of Cordyceps but mostly the presence of known substances i.e. amino acids, adenosine and palmitic acid (Xu, 1988). Chemically 25-30% of the herb consists of Crude protein, Cordycepin-3'-deoxyadenosine (\(C_{10}H_{13}O_{3}N_{6}\)) and de-mannitol. Cordyceps naturally contains many ingredients such as Adenosine, Uracil, Uridine Guanine, Guanosine, Cordycepic acid, 2' and 3'-deoxyadenosine, Crude protein, Peptide, Vitamin, B1, B2, B 12, E and K, Polysaccharides, Cyclic peptides, Inorganic elements (P, Mg, Fe, and Ca), Peptide, nonhormonal sterols, trace elements, Flavones, 2'-deoxyadenosine, Galactomannas, Polyamines (Spermine, Spermidine, Homospermidine, Putrescine, 1,3-diaminopropane), Glutamic acid, L-tryptophan, L-arginine, Lysine, D-mannitol, Ergosterol, Alkaloids, Fatty acids (Oleic acid, Linoleic, Palmitic and Stearic acids),and Sterols.
There was a greater bio-diversity noted in compounds of different strains of single species of Cordyceps than in almost any other organism analyzed. King Wah et al., (2004) reported nucleoside as the main class of active compounds in Cordyceps and active principles of Cordyceps are believed to come from nucleosides including uracil, hypoxanthine, uridine, inosine, guanosine, adenine, adenosine, cordycepin.

There are a number of other deoxynucleosides produced by Cordyceps, such as compound 2 and 3- deoxyadenosine which is marketed in the United States as a drug for the treatment of AIDS under the trade name of ‘Didanosine.’ As for as quality of Cordyceps is concerned so for there have been no universally recognized test methods for analyzing this particular supplement. Moreover each company producing / supplying Cordyceps has used different tests, or tested for different substances in order to show their product standing out above all the rest. Analysis is focussed for adenosine, cordycepin, cordycepic acid and for particular sugars or polysaccharides by different workers. Nearly all of the samples of wild Cordyceps analyzed are very similar in chemical composition, but there was a tremendous variation in the secondary metabolite compounds present in cultivated Cordyceps and other species of C. sinensis.

Literature reveals the determination of nucleoside, and specifically the deoxy-nucleosides which is most reliable indicators of potency. This class of compounds showed more variation in different samples of cultivated Cordyceps. Many of the deoxy-nucleosides are not found in other organism or at best a very limited number. This compound N6 - (2 hydroxyethyl ) – Adenosine is chosen as indicator compounds because it was found in all specimens of Cordyceps and have not found in any other organism. This compound along with Adenosine and 3- deoxyadenosine
(cordycepin) were used in summation as the quality indicator to compare different strains and production methods of Cordyceps. The quantities of the three compounds were added to gather to came up with a numerical quality index for Cordyceps.

5.9 PRODUCTS OF YARTSA GUMBA

Due to its high medicinal properties, products are available in the market of the Western countries as over the counter medicine, tonic, however, the primary source is Tibet. Its products are formulated in the form of tablets, capsules, teas in the name of Cordymax (S-4), CSF-30, CS-81002, CSB-414, Trimyco Gen (TRI), Trimyco Gen Powder (TRP), Trimyco Gen TM, a daily herbal nutritional supplement, MP-7 and Mycoplex-77M. Its uses are suggested as 2-4 capsules of 600 mg/day and thirty drops liquid 2-3 times/day between meals. Cost of the products in European market is $ 7.99 for 75 g, Cordyceps powder, Optygen 90 capsules ($49.95) and Steel Erex 60 capsules ($22.99). However, in India final products of Cordyceps have so far not been developed and usually it is cooked with the vegetables/meat or immersed in the breavage/alcohol. Villagers of Munsiyari and Dharchula are seen to eat one or two yartsa gumba in wild dried form while going for expedition and patients suffering from weakness, cold and cough are given raw yartsa gumba.

There is large number of market worldwide for Cordyceps as a medicine and as a health supplement at high price. Nevertheless there is no standard of quality and well standard cultivation protocols which can be used to produce high quality Cordyceps (Zhu et al., 1998). Marketed products in China is Cordyceps pill (Guangzhou), superior quality Dong Chong Xia Cao (Sichuan), China Cordyceps King, in Korea Dong Chunghacho Green Tea, Dongchunghacho Tea, Powdered Dongchunghacho and Dongchunghacho (cold and dry) and in Japan C.
The strain viz., CS-4 was one of the first commercial strains of Cordyceps isolated in 1982 at the Institute of Materia Medica, Chinese Academy of Medical Sciences known by the Latin name of Paecilomyces hepiali Chen, the aseptically fermented mycelium of their strain under vast extensive human testing and clinical trials during the 1980's and resulted in a commercial product with wide usage in China, known as Jin Shui Bao capsules. More than 200 patients were involved in the clinical trials with CS-4 and the chemical composition, therapeutic activity and toxicity are very well known for this strain (Bao et al., 1998 and Li et al., 2001). A number of other strains have been isolated from wild Cordyceps since then. In traditional medicinal practices, wild harvested plants are considered to have higher, therapeutic benefits thus they have higher prices. Cordyceps has been highly prized for its medicinal properties for centuries and the same tradition still continues. Traditionally, the fungus is traded in China for its weight in silver or gold.

Coales. (1919) described about the trade of the fungus in China for example in 1994 one kg. of fungus was sold at U.S. $ 700 (Steinkraus\ and Whitefield, 1994). So far market price, trade and channels of Cordyceps collection are not transparent in the Indian sub continent, however, commercial trading does exist. In local areas of fungus availability, the price may vary between NR (Nepali Rupees) 30,000 and 60,000 for a Kg. in Nepal. In the market of Tibet and India the cost per Kg. varies and is above Rupees one Lakh /Kg. It is believed that in the international market the fungus may fetch a price between one and two million rupees per Kg. The cost also varies among the trade channels which start from wild material gatherers in the field, brokers and
traders. In Bhutan each Stroma (one plant) weighs about 0.3 to 0.5 g. One kilogram of Yartsa Goenbub is believed to fetch more than Nu 30,000 when sold across the border. Prices varied from $1,000 to $10,000 per Kg. During surveys in the present study it has been recorded that Cordyceps has been traded very extensively in Dharchula and Munsiyari area since 1996, however, it became more commonly known during 1999-2000. The great demand worldwide for Cordyceps and the enormous cost of the wild collected variety has led to many unscrupulous manufacturers and distributors providing adulterated and counterfeit Cordyceps in the world market (Hsu, et al., 2002).

In present studies it was observed that most of the consumers of wild Cordyceps already know that it is normal practice for collectors to insert small segments of twigs or even pieces of wire into the body of the caterpillars to increase the weight. Many consumers of capsulated, Cordyceps do not know what is real Cordyceps even tastes or smells. After testing of some specimens of ‘Cordyceps capsules’ which contained nothing but rice flour and other samples which contained nothing but flour and nutmeg. Deceptive production practice will be stopped only after standard quality analytical procedures, which is still required as per present observation.

Most of the western world prefers their medicine to come in clean white bottles and need little capsules, rather than in the whole caterpillar form. This makes it even easier and more tempting for some suppliers to sell just about anything under the label of Cordyceps. To identify real Cordyceps, analysis of available Cordyceps both as commercial products and bulk raw material products, grown by nearly all of the cultivators and suppliers worldwide was done and the results were shocking. Almost all of the commercially available Cordyceps product available in the United
States that were imported from China, contained no detectable amounts of Cordyceps and the results of American Cordyceps products were little better. The American grown Cordyceps products consisted almost entirely of unconverted grain substrate upon which the Cordyceps is grown (Wu et al., 1996).