

## SEARCH FOR INSECT FUNGI LEADS TO THE DISCOVERY OF NEW SPECIES OF CORDYCEPS FROM GEDU FOREST

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### Introduction

On October the 30<sup>th</sup> a team led by a prominent scientist of Insect fungi Dr. Nigel Hywel-Jones visited the forest around Gedu. Some passer-by who saw the team, studiously turning over the leaves and decayed forest materials and fully absorbed in observation, might have felt it strange to come across us. Mr. Kuenzang Dhendup, Ranger of RNR-RC Yusipang, who has been working with Dr. Nigel for almost three years with *Cordyceps sinensis*, located the first insect fungus. Dr. Nigel identified this as *Isaria tenuipes*. He told us that the Koreans claim that it has same (aphrodisiac) properties as *Cordyceps sinensis* and is mass produced. The Koreans have developed herbal tea based on this insect fungus and he suggested the Institute of Traditional Medicine Services could do the same in the future.



Fig.1 *Isaria tenuipes* that has same aphrodisiac properties as *Cordyceps sinensis*

Our search continued in the thick forest where it was almost dark although it was only three in the afternoon. “Here is another fungus”, shouted Mr. Dawa Tshering, who is also a Ranger of RNR-RC Yusipang and has been working in the same field with Dr Nigel for the last few years. “Oh! That is *Beauveria*”, said Dr. Nigel. “*Beauveria* is found all around the World and has been examined as a good biological control”, he explained.

“I am not sure if this is the plant pathogen or *Isaria*”, said Mr. Sonam Tashi, Officer In-charge of the RNR-RC Gedu showing it to Dr. Nigel. “Hey! That’s good. It is *Isaria* species”, Dr. Nigel assured him. “What are these white offshoots?”, asked Mr. Chencho Tshering, also from RNR-RC Gedu. “Oh! That looks like a *Xylaria* and it is a plant-related fungus which we are not so interested in”, replied Dr. Nigel.

### New *Cordyceps* (Yartsa Gunbub) found growing in a thick forest

“Wow! There are many of your *Xylaria* here”, murmured Mr. Phurpa Wangchuk, a Biochemist working in the Pharmaceutical and Research Unit, ITMS. However as he uprooted one of the so-said *Xylaria*, he found a worm attached. “You should see this and take a photograph”, he called to Dr. Nigel. “Umm! That is really surprising. I saw this before but never thought that it would be a *Cordyceps*”, he exclaimed. “Sometimes this happens because firstly, the insect fungi are not easily identifiable with the naked eye in this now dark forest and secondly there are many fungi that mimic insect fungi and can easily fool even a so-called expert like me”, he explained further. Dr Nigel then explained that the white fungus was a hyperparasite growing on an insect fungus. So, one fungus has killed the insect and now another fungus has killed the insect fungus.

The search continued and Dr. Nigel spotted *Torrubiella luteorostrata* and explained that the genus was named after a Cuban Christian Jesuit priest – Father Torrubia who was possibly the first Westerner to appreciate what insect fungi were in the seventeenth century even though they had been known to eastern science for almost two thousand years! When it reached four in the afternoon Dr. Nigel called the search off for the day.



• Fig.2 New *Cordyceps bhutanensis*

“Wait, I found a *Cordyceps*”, Mr. Phurpa Wangchuk reported. “That is a really unusual *Cordyceps* and you will get a treat from me tonight”, Dr. Nigel promised. “This species could be another gold mine for the Bhutanese farmers”, Mr. Phurpa Wangchuk remarked. “It is almost certainly a new species – not just for Bhutan but for the World - I am 99% sure and we could name it as *Cordyceps ‘bhutanensis’* or we could name it after you, if you are interested”, Dr. Nigel remarked. There is no hard and fast rule in the taxonomy of fungi and any new species could be named after a host country or after the person who first located and collected it or after a person who has dedicated so much of their life to the insect fungi or after a famous man/women of the country, he further explained.



Fig.3 New *Cordyceps bhutanensis* (?) uprooted

“Since it is the first and only kind of *Cordyceps* found in Bhutan, let us name it as *Cordyceps bhutanensis* or name it after our beloved fifth King”, replied Mr. Phurpa Wangchuk. The team agreed and thus this likely new species found in the Gedu forest growing at an altitude ranging from 1,900 to 2,100 meters above sea level has been tentatively named *Cordyceps ‘bhutanensis’*.

Dr. Nigel pointed out that he would have to confirm this finding with a further literature search when he went back to Thailand. At least, for now what he could say is that this fungus infesting *hepialids*, which is a night flying moth, is a close relative of *Cordyceps nutans* specific to the stink bug *Hemiptera*, an adult insect.



Fig 5: *Cordyceps nutans* on stink bug *Hemiptera*.

Dr. Nigel said that the hyperparasite found infesting *Cordyceps bhutanensis*(?) is also probably a new species, might be even a new genus. He noted this would require further traditional microscope work as well as more modern molecular work not available in Bhutan.

The challenge is how to send the specimens abroad given the strict local regulations on transferring biological specimens, even for such tasks. Dr. Nigel told us that he had problems ten years ago in Thailand when Thai fungi were illegally exported and sold to industry. He told us that he did not want this problem to happen for Bhutan and was therefore happy to follow all of the rules and regulations.

### Biological Significance of Insect Fungi

Our search continued for 12 days and about 50 species of insect fungi were found inhabiting the forests near Gedu. Some of the common insect fungi found included *Gibellula* on spiders, *Ophiocordyceps myrmecophila* on ants and *Metarhizium* and *Aschersonia* on scale insects. *Isaria* species was the most common insect fungus found there. Dr. Nigel expected possibly 4 other species to be new, but again it could be only confirmed by molecular and careful microscopical work.

Dr. Nigel has been working with insect fungi since 1981. Although born in Britain he is now based in Thailand at a Thai government research institute called the National Center for Genetic Engineering and Biotechnology, often referred to as BIOTEC. He said that there are about 120 species of *Cordyceps* alone in Thailand and about 800 species of *Cordyceps* and its relatives

Fig. 4 Perithecium of the new *Cordyceps bhutanensis* (?) infested by the white



reported worldwide. He agrees that Bhutan is also rich in insect fungus diversity. When asked if Bhutan could do bio-prospecting of insect fungi, he agrees easily. The Thai National Center for Genetic Engineering and Biotechnology has even patented one Anti-Tuberculosis Drug based on one of the insect fungi found by his wife (who works with him and is an expert at finding rare insect fungi).

He explained that insect fungi are like HIV-AIDS in the insect world. The spores invade the insect, fight with the insect's immune system and then kill the insect slowly – just like HIV does in humans. Interestingly, some *Isaria* species have been isolated from HIV-AIDS patients. However, the relationship between the insect fungus *Isaria* and the human *Isaria* species are unknown. Biochemists at Dr. Nigel's Institute believe that secondary metabolites could be used for developing antibiotics or new drugs based on many insect fungi. Thus, Bhutan also has a good potential for bio-prospecting on these materials. However, international cooperation may be desirable in this area.

What has been neglected or has been overlooked so far, is that our forests seem to have lots to offer in terms of species for biological control and for bio-prospecting. *Cordyceps bhutanensis* (?), although its medical utility and potential demand are as yet unknown, looks much more promising at least for now. Further studies on its Edibility and Medicinal Rating to rule out its toxicity, is highly desirable. If its' Edibility and Medicinal Rating turns out high without any toxicity, then this species could be another gold mine, but this time for the "Cattle Herders" and the "Farmers" of the sub-tropical forest belt of Bhutan and not the Yak Herders. However, from our field experience it seems rare and work on its relative abundance is required.

## Conclusion

"There is much more to gain by preserving and researching the natural forest than by logging it", Dr. Nigel says. Sadly, Gedu forests have been degraded by industrialization over the past years and there are only a handful of areas which have not been disturbed by human activities. However, the climatic conditions around Gedu which remains blanketed by fog almost year-round, have created a conducive environment for the growth of Insect fungi. Dr. Nigel has future plans to visit other sub-tropical belts with us in Bhutan to find and document more insect fungi. And may be even more new species can be found.