Part II Mushroom for Better Life

Chapter 10

Regional Studies

MUSHROOMS AND CULTIVATION OF MUSHROOMS IN VIETNAM

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Natural Environment

Vietnam lies in the center of the south east Asia, and experiences an annual rainfall of 1,200-2,000mm, a relative humidity of 80-100%, and an average temperature of 22-27℃. Due to these favorable conditions, plants are green year round, there are always fresh flowers, ripe fruits available, and the rice fields produce two or three crops of rice every year.

Within the relative uniformity of the weather and climate, each locality in the country has its own characteristics. In the South, the dry season and the rainy season are prolonged. The northern areas experience a warm and a cold season. During the cold winter, sometimes it snows in some mountainous regions. In summer the temperatures sometimes rise to 39-40℃. This climatic diversity is why farmers in Vietnam can cultivate many different species of mushrooms, ranging from the species of tropical regions like straw mushroom[1] to the mushrooms of the temperate zone such as button mushroom[2] and shiitake[3]. This mushroom abundance is one reason why Vietnam is recognized around the world as one of the nations with highest biodiversity. Indeed, flora and fauna are abundant in Vietnam, including a rich mycoflore containing many species of edible mushrooms, toxic mushrooms, and medicinal mushrooms, and other mushrooms as yet not recognized.

Figure 1. Map of Vietnam

Mushroom Production

Outline

The ethnic minorities of Vietnam have known for more than a thousand years how to cultivate some species of mushrooms such as shiitake, even if the culture was only occasional and mostly by chance. To start the process these people would crush shiitake and mix into a dilute rice soup, and then use a feather to brush this solution on the bark of felled tree species such as *Elaeocarpus* sp.[4], *Quercus* sp.[5], and pasania[6]. After a period of time the mushrooms would appear and the people gather them. This method is wasteful because for even a large tree, the amount of mushrooms collected would not be large.

In the 1960's the cultivation of mushrooms according to standard farm methods began in Vietnam, and straw mushrooms

[1] *Volvariella volvacea*, Vietnam name (Vnn): Nam rom, nam ra
[2] *Agaricus bisporus*, Vnn: Nam mo
[3] *Lentinula edodes*, Vnn: Nam huong, Nam dong co
[4] Vnn: Cay com
[5] Vnn: De do
[6] Vnn: De soi

were cultivated in beds and in the field, and shiitake was grown using the hole method. Due to many causes, the industry experienced many ups and downs, and in general the movement was still essentially undeveloped. In the 1990's the culture of mushrooms gradually become stabilized and the industry was created, along with standards of production.

If it was necessary to cultivate mushrooms with machines and modern equipment, Vietnam could not develop a mushroom cultivation industry. A considerable financial investment and large scale operation are not appropriate for the small family farms in Vietnam, so mushroom cultivation advocates have developed a "small tent" production model, based upon hand-crafted construction, and this model is a good fit with the realities of the Vietnamese farmers.

The combined annual crop of all cultivated mushrooms in Vietnam is valued at USD40 million. The production capacity of Vietnam is rising, mainly as the scale of the many home farm operations enlarges. Now average family farms have a capacity to handle 1-6 tons of raw substrate material per crop. Most farms use handcrafted equipment that often lowers the productivity levels. Those operations that have the capacity to process 10-15 tons of raw substrate per crop are in the minority, and make up only 3.5% of the growers.

Cooperatives operate in some villages, and tend to produce good crops, and the "farm mushroom" and "village mushroom" models are being promoted.

The benefits

The principle financial advantage of mushroom growing is that the turnaround time is short, and the recovery of invested capital is rapid. Mushroom cultivation is not difficult, and is possible in every part of the country. The cultivation of mushrooms has brought benefits to many rice farmers, as a result of which these farmers have enjoyed years of sufficient farm production. There is a general feeling in Vietnam that mushroom cultivation has made peoples' lives better. Mushroom cultivation is thought to be 3 or 4 times more efficient as a farm activity than raising pigs or chickens, 2 or 3 times more efficient than planting mulberry and cultivating silkworms, and 4-5 times more efficient than working in a rice field.

The cost for one ton of straw and supplements for the cultivation of oyster mushroom are about USD55. This can produce 600kg of mushrooms, and the price per kg of oyster mushrooms is USD0.28.

Balance: USD0.28 $\times$ 600kg = USD171, USD171-USD55=USD116

Thus 1 ton of straw in 30m^2 can produce USD116 in three months. A farmer would need to cultivate 3,500m^2 of rice for six months to earn a similar amount.

It can be calculated that for a day's labor, a farmer can realize USD1 for growing rice, USD1.5 for cultivating straw mushrooms, USD1.9 for cultivating button mushrooms, and USD2.2 for cultivating oyster mushrooms. Mushroom cultivation can also be done in a farmer's spare time, and family members and especially children can easily assist. Also, there is a lower initial investment than growing rice.

In the Mekong Delta some rice farmers have increased their income through selling the rice straw to mushroom growers. Other farmers are using the straw themselves to grow mushrooms, and these farmers can now produce rice and mushrooms, with the rice generating 70% of the income, and mushrooms producing the other 30% of the total farm revenue.

In the province of Vinh Phuc in northern Vietnam an average rice farmer will generate USD1,400-1,500 in income every year and have 4-5 months of unoccupied leisure time. Many farmers have learned recently that they can also cultivate mushrooms, and thereby generate incomes USD2,300-2,400 per year. This increase in income has allowed many farmers to improve their living conditions, repair their houses, and buy televisions and motorcycles.

In the district Long My province of Can Tho in the Delta of the Mekong in the past year, the cultivation of straw mushroom contributed to reduce the house of hunger and poverty from 22% to 13%. The houses surmounting the poverty reach to 40%. About the scale of cultivating mushroom, in Vietnam according to each area there are the models convenient to the cultivation of different mushrooms.

In the north of the country, most mushroom farming is done on small family farms. In the south, in addition to the small family farms, there are some much larger mushroom growing operations, ranging in size from those that generate USD1,000 per month to those that have an income of over USD10,000 per month.

In some places these larger operations take the form of a village cooperative having between ten and one hundred houses producing together. There are a very few well financed commercial mushroom businesses with capital ranging up to USD320,000. Success and failure of both the small and the larger mushroom business depend on technical expertise, management efficiency, and fluctuations of the mushroom buying markets.

One unique aspect of the mushroom cultivation systems in Vietnam is the common cyclical use of the substrates. In this system straw mushrooms are cultivated on fresh straw substrate, oyster mushrooms are next grown on the residual substrate, then worms (for poultry feed) are raised on the remaining organic material, and finally the last stage materials are

used as fertilizer for garden plants cultivation.

Cultivated mushroom species in Vietnam

Today Vietnamese farmers are producing six kinds of mushrooms: straw mushroom, button mushroom, oyster mushroom, wood ear mushroom, *Ganoderma* mushroom, and monkey head mushroom. With variations according to regional climate, farmers can cultivate these kinds of mushrooms year round in many regions. In the southern provinces, farmers cultivate mainly straw mushroom, wood ear mushroom, and *Ganoderma* mushroom, whereas in the provinces of the north farmers cultivate button mushroom, oyster mushroom, shiitake, straw mushroom, wood ear mushroom and *Ganoderma* mushroom. There are many different strains, some better than others, because there are no dominant outstanding strains.

Following are descriptions of some the various mushrooms that are currently cultivated in Vietnam, both for use in the country and for exportation abroad.

Straw mushroom

Figure 2. Straw mushroom beds

This is the mushroom with the highest cultivation productivity in both North and South Vietnam, despite the fact that the seasons vary widely between the two regions. In the north mushroom production is possible only in summer, but in the south, such as the region around the Mekong delta, the weather is hot all year around. This climate also produces abundant straw, the raw material for growing this mushroom. This southern area produces most of the national crop of straw mushrooms.

In past years, the total annual crop was 50,000-60,000 tons but recently the production has diminished because of less exportation. This mushroom has probably the shortest cycle of all plant crops, as the whole period from sowing to harvest is very short. In optimal conditions the first harvest can begin within 11 days after inoculation.

The raw material for the culture of the straw mushroom is chiefly straw and stubble. Some growers use other materials such as discarded cotton, and sugarcane dregs, from which a farmer can produce 25kg of mushroom from 100kg of raw material: The provinces of the south produce 90% of the national crop of straw mushroom. Farmers take full advantage of any sawdust produced, and with this they cultivate mostly wood ear mushroom, but also some straw mushroom.

Button mushroom

Figure 3. Washing button mushrooms harvested in the cave

In the south there is only one location, the holiday city of Da Lat, located at 1,500m altitude in the province of Lam Dong, where the average annual temperature 21℃ is favorable for the culture of button mushrooms. Because the raw substrate materials must be transported from the plains up into the mountain, the culture of the button mushroom here has not developed. In the north the cold winter and plentiful availability of raw straw and stubble material make the area a very favorable location for the culture of button mushrooms. The national button mushroom crop is about 1,000 tons per year, all from this region. Local residents consume about 20% of the crop, and the rest is exported to France, Italy, and Taiwan, often as salted button mushrooms packed in plastic 20 liter jars.

On the average, from one ton of raw dry straw and stubble, with a cultivation period from October 15 to April 15, a farmer can harvest 200-300kg of fresh mushrooms. In addition, the spent compost is abundant and a good garden fertilizer.

Oyster mushroom[7]

Oyster mushrooms are cultivated both in the north and the south of the country. In the 1990's the mushroom was cultivated in the region surrounding Ha Noi and in most of the provinces of the Red River Delta.

The annual crop weighs 7,000-8,000 tons and is increasing every year. In addition to the species *Pleurotus ostreatus*, some others are also cultivated such as *Pleurotus sajor-caju*, *P. florida*, *P. pulmonarius*, and *P. eryngii*. The possible substrates on which to cultivate oyster mushrooms in Vietnam are widely varied, including straw and stubble, cast-off cotton, sugarcane

[7] *Pleurotus ostreatus*, Vnn: Nam so, Nam bao ngu

dregs (*Saccharum officinarum*), *Cana edulis*[8] dregs , and coffee seed husks. Oyster mushrooms are often produced average 70kg of mushrooms per 100kg of raw material. In some provinces of the South, such as Ben Tre, coconut husk fiber from the plantations has been used to cultivate both straw mushrooms and oyster mushrooms.

Figure 4. Oyster mushroom drying

Wood ear mushroom[9]

In Vietnam, wood ear mushrooms are sometimes cultivated by boring a hole into substrate trees such as *Artocarpus heterophyllus*[10], *Ficus racemosa*[11], or *Sesbania grandifolia*[12]. This method will not work with tree species that have notable essential oils. The old method of boring holes is little utilized today because of the large area required, the high probability of infection by other fungi, and the long time period required.

Today the majority of farmers cultivate wood ear mushrooms in sawdust contained in nylon bags. Farmers can cultivate on miscellaneous sawdust or on sawdust of a specific tree like *Ficus religiosa*[13]. The sawdust of the tree *Hevea brasiliensis*[14] gives the highest productivity. While the average productivity of the culture on miscellaneous sawdust reaches 60-70g/block, the sawdust of the rubber tree yields 100g/block, with each block containing 1.2-1.4kg of substrate.

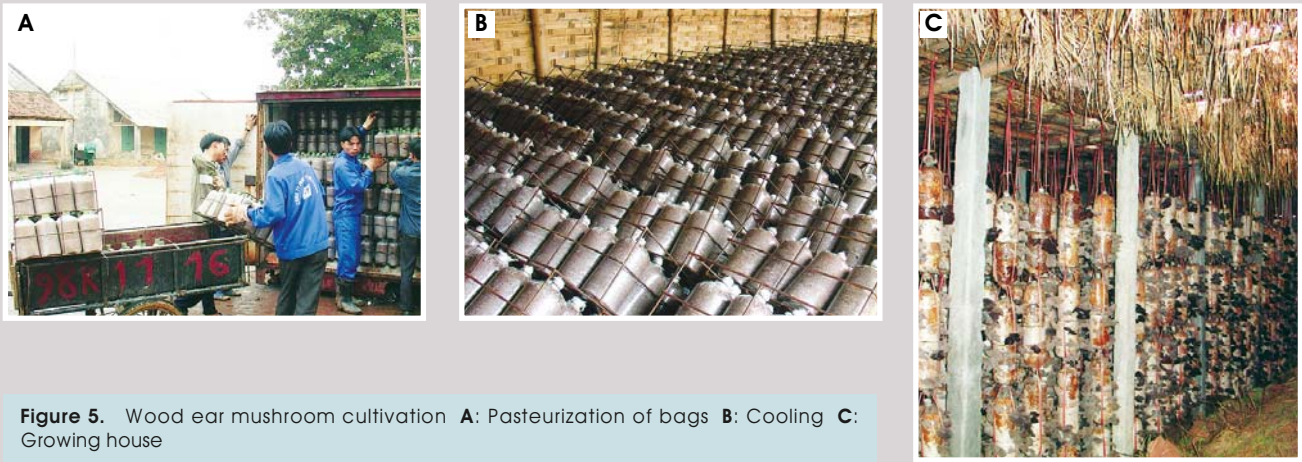

Figure 5. Wood ear mushroom cultivation **A**: Pasteurization of bags **B**: Cooling **C**: Growing house

Wood ear mushrooms develop all around the year but do best in the summer season in the North and in the rainy season in the South. The annual national wood ear mushroom crop weighs 1,500-2,000 dry tons/year, and represents about 10% of the world totals. Formerly exported only to some countries in Asia, this mushroom is now exported to both in Europe and America. Besides the sawdust substrate in Vietnam wood ear mushroom is also cultivated on sugarcane dregs, cast off cotton, and manihot[15] stems .

Ganoderma mushroom[16]

This mushroom is cultivated both in the north and in the south of Vietnam, most often on a substrate of sawdust. Sawdust from rubber tree gives the highest productivity.

Other substrates such as cast off cotton and sugarcane dregs are also used, but the sugarcane dregs must be treated to avoid infection from other fungi. Vietnam produces enough sugar to create 3 million tons of sugarcane dregs every year. This waste leads to the pollution of the environment around the sugar factories and cane fields. The sugarcane dregs are used for mushroom culture by adding some nutritive substance like rice bran, maize flour, urea nitrogen, super phosphate, or lime powder ($CaCO_3$). From one ton of sugarcane dregs, a farmer can produce 35-40kg of dry *Ganoderma* mushrooms. The results of biochemical analysis of the mushrooms cultivated on the sawdust and the mushrooms cultivated on sugarcane dregs are similar, especially the amino-acid contents. The production of *Ganoderma* mushroom in the year 2003 was about 100 tons.

Ganoderma mushrooms are converted into teas, capsules, refreshment beverages, and tonic wines that are consumed

[8] Vnn: Dong rieng
[9] *Auricularia polytricha*, Vnn: Nam tai meo, Moc nhi
[10] Vnn: Cay mit
[11] Vnn: Cay sung
[12] Vnn: Cay so dua
[13] Vnn: Cay bo de
[14] Vnn: Cay cao su
[15] *Manihot esculenta* (Vnn: Cay san)
[16] *Ganoderma lucidum*, Vnn: Nam linh chi

locally and exported to various other countries in Asia, Europe, and North America. Many *Ganoderma* mushrooms are sold in Korea and China, where the consumers prefer the Korean *Ganoderma* mushrooms even though their price is higher.

Figure 6. Ganoderma mushroom cultivation **A**: Mixing sawdust **B**: Spawn run **C**: Fruiting

Monkey head mushroom[17]

This species of mushroom grows normally at temperatures of 16-20℃. In Vietnam there was much research done in an effort to cultivate this mushroom in the tropical conditions of 25-33℃. This research resulted in the large scale cultivation of this mushroom in Vietnam. Monkey head mushroom is both eaten and used as a medicine to treat illnesses. One particular fortifying tea manufactured from monkey head mushrooms by a private company has been awarded a gold medal at the national fair. One kg of monkey head mushroom in Ho Chi Minh City is priced at VND[18]300,000 (USD19). The price of a similar kg in Japan and Hong Kong is USD100.

Others

In addition to the species of cultivated mushrooms mentioned above, some private and governmental agencies have cultivated several other species of mushrooms, but these mushrooms are not productive in Vietnam: *Trametes versicolor*[19], winter mushroom[20], shiitake, *Pholiota nameko*[21], and *Tremella fuciformis*[22].

Many production firms from America, Japan, Italia, Germany, and Taiwan make visits to Vietnam to investigate the possibility of producing mushrooms there. In the future there may be the required cooperation and investment to initiate this activity. Today, Vietnam still imports some edible and medicinal mushrooms from China, such as the Tuckahoe mushroom[23] 100 tons, silver ear fungus 200 tons, and shiitake 500 tons.

Mushroom Consumption

Mushrooms have been eaten by Vietnamese peoples for many centuries. The most commonly eaten mushroom has been the wood ear mushroom, and all regions of Vietnam are familiar with this type. However, wood ear mushrooms are not used in great quantity because they are mainly used in meat pies and other dishes as a flavoring agent. The stuffing for ethnic dishes such as steamed rolls, meat pies, and fried meat rolls all contain wood ear mushroom as a flavoring. Foreign visitors are also fond of the flavor of wood ear mushrooms.

Shiitake was traditionally considered a luxury food, appropriate for consumption on the national Tet holiday or during wedding ceremonies, but today shiitake are much more widely consumed, and are commonly imported from China. Straw mushrooms are more commonly consumed in the south, and prices fluctuate, rising on the first and fifteenth of each month, as well as on holidays.

In the past eating mushrooms has been more common among the more sophisticated citizens, and it is for this reason that most mushrooms were traditionally consumed in the towns. The consumption of mushrooms among the rural citizens is rising rapidly. Although canned mushrooms from China are common in both rural and city areas, the market for wood ear mushroom and shiitake seems to be ready for expansion. The consumption of fresh mushrooms is increasing everywhere, aided by a general awareness that mushrooms are a clean vegetable with high nutritional value.

[17] *Hericium erinaceus*, Vnn: Nam hau thu
[18] VND (Vietnam Dong, USD1 ˙, VND15.789 in March, 2005)
[19] *Coriolus versicolor*, Vnn: Nam van chi
[20] *Flammulina velutipes*, Vnn: Nam kim cham
[21] Vnn: Nam chan chau
[22] Silver ear mushroom, Vnn: Ngan nhi
[23] *Poria cocos*, Vnn: Nam phuc linh

In addition to fresh mushrooms, many mushrooms are consumed dried, salted or canned. About 20% of the annual consumption is dried mushrooms, mainly shiitake and wood ear mushrooms. Salted mushrooms are prepared by first boiling and rinsing, then packing in a 20 liter plastic jar, adding fresh layers of salt over every layer of mushrooms. Salted mushrooms are aged for 12 months before using. Salted mushrooms, mostly straw mushrooms and button mushrooms make up another 20% of the annual crop. Canned mushrooms make up about 10% of the crop. Salted and dried mushrooms are usually done by family farms, while the canning is done in factories in the south. Other mushroom containing products include deep fried mushrooms, noodles with mushrooms, mushroom powder (flour) and mushroom salads. In 2003, an initiative to register a processing system approved by the American FDA (Food and Drug Administration) started with the intention to assist Vietnamese mushrooms growers in preparing products for export to the USA.

The export markets for straw mushrooms include Italy, Germany, France, Japan, Australia, but 70% of the salted canning mushrooms exported from Vietnam go to Malaysia, Taiwan, and Thailand. Since 2002, Vietnamese canning factories have been exporting canned mushrooms to America. This new business increased the trade profits of the canning factories in the South by 50%. The southern provinces export salted straw mushrooms and canned mushrooms by the thousands of tons per year to markets in Taiwan, Hong Kong, and Thailand. The northern provinces export salted button mushrooms and canned button mushrooms to Japan, Taiwan, Germany, and Russia. The production cost of salted mushrooms is USD800 per ton, and the selling price is USD1,200 per ton.

Mushroom Development Projects

Mushroom cultivation projects in Vietnam have been carried on by both government agencies and international organizations. In 1985 the FAO assisted the Hanoi mushroom research into productive local strain development, and in 1986 the FAO assisted similar work in Ho Chi Minh City. In 2000, the FAO assisted the province of Thai Binh in managing a program to teach farmers about producing edible mushrooms.

In 1991 through 1993 the Vietnamese Ministry of Science - Industry and Environment managed a project to teach local farmers the mushroom growing systems used in Taiwan. In 1992 and 1993, a mushroom company imported the canning factory equipment needed to process mushrooms according to the Italian industrial system. The provinces and cites such as Hanoi, Quang Ninh, Ha Nam, Ninh Binh, Nam Dinh, Thai Binh, and Ha Tay have all invested significant amounts in research and farmer education concerning edible mushroom production. Although the future capacity for this industry is great, current activity is still low.

In recent years, the state has launched a variety of projects such as "Research on the industry of culture of some edible and medicinal mushrooms and the means of prevention illness with cultivated mushrooms," "Project to select and produce the strains required for the culture of edible and medicinal mushrooms, for both local consumption and export abroad," and "Research to select the kinds of edible mushrooms and precious medicinal mushrooms in Vietnam." These projects have contributed well to the general knowledge about the Vietnamese mushroom cultivation industry, but the industry growth has not been as robust as it might have been, due to the lack of any widely available quality mushrooms strains. Most strains used are still imported from other countries, as there is not a local factory capable of producing the required spawn on a large scale. General confidence in the export market is also low, and in general, Vietnamese mushroom farmers are not as aggressive and productive as mushroom farmers in other countries around the world.

Mushroom Cultivator Requirements

The cultivation of mushrooms has recently become a viable profession that is capable of generating significant income. In order to succeed in this endeavor, beginning mushroom cultivators need to follow these guidelines:

1) Growers must cultivate the correct types of mushrooms according to their situation. For example, *Ganoderma* and wood ear mushrooms should be cultivated in areas where there is sawdust available. Oyster mushrooms and button mushrooms should be cultivated where there is plenty of rice straw.
2) Potential pest problems must be avoided in order to produce high volumes of mushrooms. Cultivation areas must be kept clean and full of fresh air. The mold and insects that occur in areas of poor hygiene will harm productivity. After every final harvest, the mushroom cultivation area should be cleaned thoroughly and disinfected with powdered lime or formalin.
3) Only one kind of mushroom should be cultivated in one room. The cultivation rooms should not be crowded and grow-

ers should not cultivate combinations such as straw mushrooms on the floor and blocks of wood ear mushroom hanging above.

4) Market conditions should be noted before cultivation begins to avoid over production.

These ideas are the important points which the new cultivator must consider, and much research should be done before any cultivation begins.

Conclusion

Vietnam has a great potential for the development of the mushroom cultivation industry. The raw materials are plentiful, and the climate is favorable, including temperature ranges that allow the cultivation of a wide variety of species. The required labor is readily available in Vietnam, and the world market for mushrooms is expanding every year. Certainly in the future, the mushroom cultivation industry of Vietnam will develop in an impressive fashion.

To take advantage of the potential of this crop, farmers and assisting agencies should press forward and encourage a further development of this industry. Vietnam is blessed with abundant raw substrate materials and labor, and should increase the cultivation of mushrooms for consumption locally and export abroad.

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Appendix 1. Edible Wild Mushrooms of Vietnam

Figure 1. Wild wood ear mushrooms in Vietnam

For hundreds of generations the Vietnamese people, especially those in the country and mountainous regions, have collected the many wild species of mushrooms growing around the houses, in the fields and in the forests, both as food and as medicine. First on the list is the wood ear mushroom (Fig. 1).

This is the most common wild species, and many people know how to gather it. Wood ear mushroom is found everywhere, from the plains to the mountain region, from the North to the South and from the countryside to the cities. Wood ear mushroom grows abundantly on many different substrates, even on the trunk of toxic plants belonging to the family of Apocynaceae such as *Nerium oleander* L.[1], *Thevetia neriifolia* Juss.[2]. In addition to their value as foodstuffs, the Vietnamese people use wood ear mushroom to treat illness by employing traditional popular remedies.

The next mushroom on the list is the shiitake. The minority peoples in the province of the North, such as the Tay, Nung, Muong go into the forest to gather wild mushrooms that grow spontaneously during the cold winter days from November to April. The shiitake usually grows in the trunks of trees such as *Elaeocarpus* sp., *Quercus* sp., *Pasania* sp., and *Pithecolobium* sp.[3]. Every year during springtime in SA Pa, a tourism point in north Vietnam, many people go in the forest to gather the edible shiitake. Wild shiitake are smaller in size than the cultivated ones, but they have a stronger aroma. The mushroom *Lentinus tigrinus*[4], usually grows on the trunks of different trees. In the rainy season, the people of the mountain region gather young edible *Lentinus* mushrooms. When these mushroom age, they become leathery, and this has given these mushrooms their popular name. The small termitomyces mushroom[5] is named Tua rua, signifying the pleiad of seven stars, because the mushroom appears at the end of the spring and the beginning of the summer, at the same time as the pleiad of 7 stars appears in the sky. The mushrooms are small, but usually grow densely on lawns, and on termite nests, where people gather it to eat.

The mushroom *Termitomyces eurrhizus*[6], is so named because the mushroom grows usually on termite nests. The mushrooms appear in summer and sometimes continue until till November. The mushroom has a large fruitbody, and the diameter of the fruitbody sometimes reaches more than 20cm. This species of mushroom has been mentioned in poetry, such as the poem March in Tay Nguyen. It was also mentioned in the war again the aggressor in south Vietnam recently. One unit of the Army in the mountain region of Tay Nguyen lacked food and was hungry, but survived by finding and eating mushrooms. Some farmers have special tortoises that can assist in searching for this mushroom because this tortoise also usually looks for and consumes the Termitomyces. This mushroom grows in most provinces of Vietnam, on lawns, at the edge of the forests, on hills, in fields and particularly on termite nests in summer.

The straw mushroom grows in the country on heaps of straw or other stubble in a state of putrefaction. The mushrooms appear after summer rainfall and people gather the straw mushrooms to make soup. In the Red River Delta, they still plant the *Zizania latifolia*[7] as a food crop. In the stems of the plant there is a kind of parasite mushroom named *Yenia esculenta*. This species was formerly named *Ustilago esculenta*. When the plant is parasitized by the mushroom, the stems of the plant swell out, giving the phenomenon the name "the tuber of nieng." The tuber of nieng can be cut in small pieces to eat raw or stir-fry with egg or *Tylorynchus heterochaetus*[8]. The French in Vietnam years ago were very fond of eating the tuber of nieng boiled and dipped in butter.

Besides the mushroom mentioned above, in the Red River Delta the countryfolk still gather some species of wild mushrooms on the lawns, such as *Calvatia lilacina*[9], *Agaricus campestris*[10], and *Entoloma clypeatum*[11]. From the ancient capital Hue to the provinces in the South there exists the mushroom *Boletus cf. felleus*[12]. These mushrooms usually grow under the shade of the *Melaleuca leucadendron*[13] tree. From April to July, people gather many *Boletus*, and often carry them on their shoulders to the Dong Ba or An Cuu markets in Hue City for sale. When it is the season for mushrooms, most of the restaurants in Dong Ba market sell dishes with these Nam tram mushrooms. The Nam tram has a bitter taste like the fruit of *Momordica charantia*[14]. According to local tradition, the Nam tram mushroom has a fresh taste, is easy to digest, serves as a cleanser for the

[1] Vnn: Truc dao
[2] Vnn: Thong thien
[3] Vnn: Do ngon
[4] Vnn: Nam dai
[5] *Pordabrella* microcarpa, Vnn: Nam moi mu nho, Nam vuot
[6] Vnn: Nam moi
[7] Vnn: Cay nieng
[8] Vnn: con ruoi
[9] Vnn: Nam trung
[10] Vnn: Nam co day
[11] Vnn: Nam co tranh
[12] Vnn: Nam tram
[13] Vnn: Cay tramn
[14] Vnn: Muop dang, Kho qua

liver, acts as a sleep aid and has the ability to expel worms. The Nam tram mushroom is boiled in soup with the leaves of the sweet potato *Ipomoea batatas*[15] or the leaves of the *Piper lalot*[16]. When making soup one can add shrimp[17], and the flavor of the soup will be better and sweeter.

As the region of Hue, in the provinces in southeast Vietnam mushrooms appear after rainfall at the beginning of the season, and here many people rush to the forests to gather the mushrooms. Many poor children go to the forest to gather the tram mushrooms in order to sell them. Because they can thereby get money, the children call the mushroom "The present from the Gods." The season of tram mushroom always provides hope for poor people, because they can eat the mushrooms fresh, or they can dry them, or they can sell them to the traders of Ho Chi Minh City who travel around buying mushrooms.

In the province of Lang Son one of the species *Russula* sp.[18] grows under the leaf canopy of the tree *Engelhardtia chrysolepis*[19]. Due to the fruitbody of the mushroom having a red color like fire, the common name used by the local ethnic minority in the area is fire mushroom, Biooc pheo. In July, during the rainy season, the local people go into the forest and hunt Cheo trees in order to gather the mushroom. Many of these mushrooms are sold in the markets of Lang Son. In the vacation town Da Lat, at an altitude above 1,500m, the climate is fresh all year long. In the pine forest, *Boletus edulis*[20] mushroom grow. This species is gathered by the people and eaten fresh or cut in small pieces and then dried and sold to the popular restaurants in Ho Chi Minh City. During summer some of the minority people in the province of Lao Cai gather the mushrooms known as the split-gill or bird's foot mushroom[21]. The collectors will cut down trees and leave the bark on, laying the logs near their homes or at the edge of the forest. When the mushrooms on the logs develop in thick clusters they gather them in their clothes-baskets and bring them to sell at the market (Figs. 2 and 3). Among vegetables in the market, the split-gill mushroom always is the product most quickly sold. According to Professor S. T. Chang, in 1993 the combined production of the mushrooms *Coriolus versicolor*, *Lentinula edodes*, and *Schizophyllum commune* produced sales of USD1.2 billion. Even in 1987, these 3 kinds of mushrooms brought to the branch of pharmaceutical produce of Japan USD769 million.

Figure 2. Wild Schizophyllum commune

Figure 3. Northern Vietnam ethnic people selling and buying Schizophyllum commune in market in Lao Cai Province

Figure 4. Wild edible Cantharellus luteoromus, sold in market in Quang Ninh Province

In the provinces of Quang Ninh and Hai Duong during the months of July and August, the people go into the pine forests to gather the *Cantharellus luteocomus* for both eating and selling at the market. The mushrooms usually grow in large groups on the carpets of rotten pine leaves (Fig. 4).

In the 1990's people began exploring the forests looking for *Ganoderma lucidum*. These mushrooms were then sold in China. In Vietnam today, many newspapers speak of the current fever for collecting the ancient lingzhi[22]. Many people go in the deepest forests, and even into the forests of neighboring countries like Laos and Cambodia to look for this mushroom. In the province of Lam Dong it was reported that a thousand people were going into the forest everyday to look for the mushrooms.

It is claimed that the largest *Ganoderma* mushroom found in the world was harvested in Vietnam, and had a diameter of 110cm, a thickness of 33cm, and weighed 42kg. All ancient lingzhi mushroom collectors in the

[15] Vnn: Khoai lang
[16] Vnn: La lot
[17] *Macrobrachium nipponense*, Vnn: Con tom
[18] Vnn: Nam cheo
[19] Vnn: Cay cheo
[20] Vnn: Nam thong grows
[21] *Schizophyllum commune* Vnn: Nam chan chim
[22] *Ganoderma applantum*, Vnn: Nam co linh chi

mountain forests of Vietnam should be careful not to destroy the source of the precious medical materials of Vietnam, many of which are still unknown.

Due to the active business of treating incurable illnesses with the ancient lingzhi mushroom, In July of 2003 the Vietnam government created within the Ministry of Health a special research facility devoted to the ancient lingzhi mushroom. Special attention is being paid to research on the treatment of illness and to the methods that can be employed to maintain the genetic security of this mushroom. Among the wild mushroom species of Vietnam mentioned above, several species have been cultured, such as the straw mushroom, wood ear mushroom, shiitake, and *Ganoderma* mushroom. But the majority of the cultivated species in Vietnam are actually introduced varieties that were not isolated from a source in Vietnam. There is hope that in the future biologists of Vietnam will be able to isolate and cultivate wild mushrooms from Vietnam in order that these species might provide appropriate cultivation species.