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Case Report

Utilization of Pine Caterpillars (*Dendrolimus spp.*) in Yunnan, China

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Abstract: The history and current utilization of pine caterpillar by those ethnic groups living in the Yunnan province was introduced in the paper, and its potential evaluation as a cheap notorious food source was analyzed. The pine caterpillars can provide high quality proteins and high fat as well as caloric values, it means that these insects can be used as resource insects instead of pest insects. Mass harvesting the pine caterpillars by local people may reduce the use of pesticides considerably in one hand, and in the other hand, it may provide the indigenous people with high quality protein food.

Keywords: Pine Caterpillars, Utilization, Resource Insects, Pest Insects

1. Introduction

Insects offer many benefits, including their use in human and animal nutrition, in medicine, religion, art and handicrafts [15]. They have been consumed as food in many parts of the world and played an important part in the history of human nutrition in Africa, Asia, and Latin America [4, 6, 8]. Considerable quantities of insects are regularly eaten by human beings in many parts of the world. These are generally looked upon as delicacies by tribals living in forest [10]. Edible insects constitute a very important food source in many developing countries [1].

There is a very long history of Chinese people using insects as foods. As early as three thousand years ago, people collected and processed ants and their eggs as food especially for the emperors at that time [19]. Today, it is not uncommon for people to eat insects such as locusts, termites, ants, honey bees, water bugs and so on in China. Yunnan province especially has a lot of different ethnic groups and also the richest insect resources both in species and in quantities [21]. Half of edible insect species are found in this province [22]. What to deal with in this paper are some very special insects, which are popularly consumed among ethnic groups in Yunnan, but, strangely, a fact almost unknown to outsiders.

It is well known in China that pine caterpillars (*Dendrolimus spp.*) are the most destructive forest pests. On the scale of forest fire, the destruction has been described as 'non-smoking fire disaster'. These pests chew vast areas forest each year, causing a loss of billions of dollars annually and many environmental problems [3, 9, 13, 20, 23]. The toxic hairs of the caterpillars may cause many troubles to people and domestic animals if they are in or nearby the pine forests. In China attention has long been paid to how to control and prevent its occurrence. Regrettably few researchers, including those who have long been working in the forest areas, know the tradition of eating pine caterpillar in Yunnan.

Beginning in 1995, an intensive investigation of this tradition was made in over 30 counties in Yunnan and found that indigenous communities favor using the pupae of the insects as food and for other purposes in at least 14 of them. In some counties such as in Majoring and Lincang, the pupae can be found on market. The paper reports the investigation results on the history and current situation of the practice of using pine caterpillars among different ethnic groups in Yunnan, and discusses the relationship between insect utilization and integrated pest management.

2. History

Since there is not any record about the traditional practice of using pine caterpillars, it is difficult to make positive conclusions on many issues, however, some inference conclusions can be made in accordance with our investigation.

When and where did the practice of using caterpillars begin? Which ethnic group first ate the pupae and why? According to Mr. Zhang Dechai (Kaduo Hani, 55 years old) from Jepai Village, his father Zhang Yanzhou (87 years old) and grandfather began eating the pupae since their childhood. Many people in this community believed that this tradition began at least three or four generations earlier, dating from the Qing Dynasty. The Hani group, especially Kaduo (a branch of Hani) in Mojang country particularly favor eating the pupae. At the mention of it, everyone has something to say, admitting their fondness of the pupae without any hesitation. Many people said that the pupae is too delicious to be bored with. "I prefer the pupae so much that I even do not want to barter one kilogram of the pupae for three kilograms of bacons", the words by the head of Jepai village, Mr. Li Zhixiang, was very famous in Mojang and was cited by most people during our investigation. Some people we visited believed that the current practice of eating the pupae had nothing to do with famine. Although most households have sufficient provisions and it is not unusual to have pork, beef, chicken and so on, they still like the pupae. The situation is different in other counties. For example, though there are many more pupae eaters in Jinggu county than in any other counties, relatively few are particularly fond of the pupae, most of people considered the practice closely associated with famine in history. For example during the famine period of the Great Leap Forward, the pupae eaters were much more popular. In other counties, the similar opinions were expressed.

3. Current Status

The ethnic communities with the tradition mostly live in the forests frequently infested by these pests, that is because, easy collection of the insect is one condition that gives rise to this practice. The Jepai village mentioned above is the pine caterpillar center in Mojang. Although there are many pupae eaters in Yunnan, a majority of them said that with living standards have been improved day by day, the number of eating pupae decreased year by year, and some people who had the habit do not encourage or may even forbid their descendants to eat the pupae. There are many reasons for this trend. Some people stop eating the pupae because of the use of chemical pesticides. They think the chemicals may accumulate in the caterpillar's body after the caterpillar eats the polluted needles, so it is not safe to eat the pupae. Some are afraid of being despised by outsiders if they are known to eat the pupae. During our interview, some villagers said they used to eat the pupa and stopped eating now. However, their neighbors told us that they still eat the pupae. Despite this, in recent years, more and more people accept the use of the pupae and moths for other purposes such as fodder for pigs and chickens or feeding fish. With the development of science, people in remote mountain areas become aware of the importance of insect protein and the use of pine caterpillars increases substantially. It is predicted that the concept of controlling the pine caterpillars population by utilizing and exploiting the pupae will be accepted in the near future. In fact, the program of developing and exploiting pine caterpillars as a way of managing the pests had been underway in Yunnan province since 1997.

3.1. Pine Caterpillar Species and Their Hosts in Yunnan

There are 27 species of pine caterpillars with an infested forest area of 2.7~3.3 million ha in China annually [3], 7 species are found in *Yunnan: Dendrolimus houi Lajonquiere, D. kikuchii Mats, D. punctatus wenshanensis Tsai et Liu, D. punctatus techangensis Tsai et Liu, D. angulata Gaede, D. rex Lajonquiere*, and *D. monticola Lajonqiere* [9]. Among them, *D. houi* and *D. kikuchii* are the dominant species in Yunnan, hosting on *P.* yunnanensis Franchet and *P. kesiya* var. *langbianensis*, which are parallelly distributed from South to North and are perpendicularly distributed from different altitude in Yunnan.

3.2. Ethnic Groups Using Pine Caterpillars

Investigation has revealed that indigenous groups who favor using the pupa of the pine caterpillar as food and for other uses are mainly distributed in 14 counties of four prefectures. These groups are Hani, Yi, Dai, Lafu, Wa and Bulang. The habit of eating the pupa of the pests is very popular in Shimao Prefecture.

The following two counties in Simao prefecture are worth mentioning particularly.

Mojang Autonomous County of Hani, situated in the southern tropical zone, is one of major forest areas in Yunnan. Besides Hani tribe, there are other ethnic groups such as Yi, Dai and Lafu and so on. There are two pine caterpillar species, *Dendrolimus houi Lajonquiere* and *D. kikuchii Mats* in this county. The forest areas infected by these two species reached 2000 ha annually on the average, the maximum was up to 38000 ha in history. They can be found in 11 out 18 townships. The pupae are widely accepted as food in six townships, among which Xingfu township is typical. There are 30000 people and 10 villages in this township. Hani amount to 79% of the population. In some villages almost everyone likes eating the pupae of these insects. For example, all the people in both Chesha village (about 900 people) and Naxian village (more than 2000 people) like consuming the pupae, on the average, each villager eating about 1.5kg pupae annually. Occasionally the pupae can be found in the market to sell. It is estimated that 50,000 people regularly eat the pupa consuming a total of 10,000 kg each year in Mojiang country.

Jinggu Autonomous County of Dai and Yi, located in the east of Langcang River with 132 villages, 12 townships, was also seriously infested by pine caterpillars. In 1970s, the pest infested forest areas amounted to 67,000 ha annually in four years uninterruptedly. In this county the ethnic groups eating the pupae of pine caterpillars were not as much as those in Mojian country, but there were still more pupae eaters. In the townships, Mingle and Yongping, the tradition of eating pupae

was most typical. The population in Mingle was about 22,400 people, with Dai and Yi amounting to 47% respectively, other ethnic groups being Lafu, Hani and Wa et al. 80% of the people in this township used the pupae as food or as feed. As early as twenty years ago, some indigenous people bartered the pupa for other commodities. The pupae eaters might come to as many as 80,000 and the consumed pupae might be approximately 12,000 kg in Ginggu country annually.

3.3. Ways for Cooking the Pupae

Different ethnic groups in different regions have different ways in cooking the pupae. The first step is to remove the cocoon from the pupae. It must be done so carefully, because there are a lot of toxic hairs on the cocoons. One way is by roasting them on stove or in the live coat ash until the cocoons are reduced to ash and the pupae inside turn golden; another way is to cut open the cocoons on the tree with scissors and pick out the living pupa inside. Next step is to wash the pupae in salt water for a few times. After washing clean, the pupae are ready for cooking. There are following ways to cook: 1) Deep frying method. Fry the pupae in hot oil until they turn golden, then adding different spices; 2) Roasting method. Roast the pupae on oven or in the burning coat ash for a few minutes, eating with sauce; 3) Braising method. After the pupae are fried in oil or roasted for a moment, pulverize the pupae and braise them with some spices such as garlic, pepper and ginger; 4) Pickling method. Mix the pupae with salt, hot pepper and liquor, then put the treated pupae in a sealed container for about a month. It is said that the pickled pupae taste a bit sour, but many natives like this dish; 5) Boiling method. Cook the pupae in boiling water for a few minutes, then pick them out and add some hot sauces.

In addition to consuming the pupae as food, local people use both the pupae and moths of the pine caterpillars as other purposes. 1) As feed for animals. Both the pupae and moths are used as fodder for chickens, pigs and fish; 2) As rat's bait. *Hani* group uses the pupae as rat's baits to catch rats; 3) For medicinal purpose. Some people soak the pupae in the alcohol for a period of time and use the mixed product to treat arthritis and to stop the itch or to allay inflammation bit by insect.

It should be made clear that the larvae of the pine caterpillars cannot be eaten because of toxic hairs on the larvae, though occasionally some people eat so called elder larvae, which means the larvae are in their late development at stage and will soon become pupae. It proves to be very dangerous to eat such elder larvae.

3.4. Nutritional Value of Pine Caterpillars

The insects are highly nutritious and they can provide large quantities of proteins, carbohydrates, fats, vitamins, salts and minerals [2, 10]. In the book subtitled *Insects in Human Nutrition*, data are collated on food values for a range of insects, comparing their protein, fat, carbohydrate, mineral, vitamin and calorific values with those for beef, lamb, pork, chicken, fish, milk and eggs [16, 18]. The quantity and quality of proteins, lipids, vitamins, minerals and calories present in edible caterpillars are comparable to those of beef, fish, lamb, pork, chicken, milk and eggs [7, 14, 17].

How about pine caterpillars if they are going to be exploited? Many people cannot help raising this question. Much work has been done to determine proximate compositions, amino acids and fatty acids of body material of pupae and adults of four species of pine caterpillars. The results of our analysis on protein, fat, ashes and chitin was provided (Table 1.), it can be seen that the protein content of both pupae and adults of caterpillars are very high, ranging from 58.15% to 68.30%. The analysis results are very close to Landry's analysis on the six species of Lepidoptera [12].

Amino acid analysis demonstrated that the essential amino acid compositions of caterpillars compared with proposed standards by WHO/FAO/UNU [11]. (Table 2)

Table 1. *Proximate composition of pupae and adults of four caterpillars.*

Composition%	*D. Houi*		*D. punctatus techangensis*		*D. punctatus wenshanensis*	*D. kikuchii*
	Pupae	Adults	Pupae	Adults	Pupae	Pupae
Protein	58.15	68.30	61.11	58.04	61.26	53.55
fat	22.42	6.56	21.82	24.63	19.75	26.46
Glycogen	6.82	1.51	0.65	0.43	9.70	0.61
Chitin	7.47	17.83	9.99	9.85	6.49	11.79
Ash	4.98	2.95	3.47	3.21	2.75	2.99
Calorfic value（kcal/100g）	406	327	442	454	473	452

Table 2. *Essential amino acids (mg/100g protein) of pine caterpillars against the WHO/FAO/UNU pattern.*

Amino acids	WHO/FAO/UNU 1985	*D. houi*		*D. punctatus Tehchangensis*		*D. punctatus winshanensis*	*D. kikuchii*
		Pupae	Adults	Pupae	Adults	Pupae	Pupae
Lysine	58	36.29	43.85	44.17	48.91	44.15	19.16
Leucine	66	38.34	59.14	52.41	55.22	42.02	58.30
Isoleucine	28	32.01	43.34	39.53	35.55	30.85	43.00
Methionine	25	26.43	13.12	39.87	24.91	33.33	18.34
Valine	35	35.73	55.48	40.38	41.15	32.30	66.65
Phenylalanine + Tyrosine	66	65.33	59.63	77.85	77.61	66.84	85.6
Threonin	34	30.34	31.56	34.71	35.73	31.74	41.17
Histidine	19	19.73	29.57	22.51	21.66	20.21	46.47
Tryptophan	11	NA	NA	NA	NA	NA	NA

NA: Not attempted.

4. Discussion

Many researchers agree that harvesting of pest insects as food can be incorporated into IPM (integrated pest management). Insect protein literally abounds all around us, but exploratory research is needed to determine the true economic feasibility of harvesting this protein and of utilizing insects in recycling wastes for the production of protein [5]. The pine caterpillars might be looked upon as special insect resources. They are still pests according to current human standard, but, the traditional utilization of these insects among indigenous people makes us reconsider what we have done with the pests in the past. Maybe they are potential insect resources worth further and intensive exploitation, and their population as well as damage to forests could be controlled through utilization and exploitation. Mass harvesting methods for turning insects that threaten crops into available protein might do much to reduce pesticide pollution[18], and perhaps as Defoliart (1989) has emphasized, if we can push prejudice and ignorance aside, the beneficial effects of utilizing insects for human food on a large scale could be immense. So it is of great significance to study the pine caterpillars from the viewpoint of ethnoentomology and insect resources.

Traditional knowledge of ethnic people can be of impact on modern scientific research and social development. The discovery of the traditional knowledge about pine caterpillars in Yunnan helped us to think in a new way as how to deal with these pests. That is, the pest insects may be brought under control by both encouraging local people to eat the insects and use them for other purposes, and by developing and processing different insect products after proper scientific exploration. In fact, on the basis of the traditional knowledge and through our effort, some scientific programs on the utilization of pine caterpillars supported by the Forestry Ministry of China and by Yunnan Scientific and Technology Fund Commission have been undertaken. It goes without saying that there is great need to do more studies on how to develop and exploit the pine caterpillar resources. They could provide much food and create more opportunities for employment and cash income in the poor rural and mountainous areas, thus being of great help in the Chinese poverty eliminating program.

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References

[1] Akinnawo, O. O, Abatan, M. O and Ketiku, A. O. (2002) Toxicological study on the larva of Cirina forda (Westwood). African Journal of Biomedical Research (5):43-46.

[2] Bodenheimer. F. S. [1951]: Insects as Human Food. Springer Netherlands, 1951, 11(5):395-399.

[3] Chen Canje (chief editor) [1990]: Integrated Management of Pine Caterpillars in China. Forestry Press of China, Beijing.

[4] Cherry. R. H. [1991]: Use of Insects by Australian Aborigines. American Entomology 37(1):9-13.

[5] Defoliart G. R [1975]: Insects as a source of protein. Bull. Ent. Soc. Amer. 21(3):161-163.

[6] Defoliart. G. R. [1989]: The human use of insects as food and as animal feed. Bull. Entomol. Soc. Am. (35):27-35.

[7] Defoliart. G. R. [1991]: Insect fatty acids: similar to those of poultry and fish in their degree of unsaturation, but higher in the polyunsaturates. Food Insects News Letter, (8): 6.

[8] Defoliart. G. R. [1992]: Insects as human food, Crop Protection, (11): 395~399.

[9] Hou Taoqian. [1987]: Pine caterpillars in China. Science Press, Beijing.

[10] Joshi, K. C., Roychoudhury N., Kulkarni N and et al. [1993]: Insects as tribal food, Journal of Tropical Forestry 9(III):264~269.

[11] Ladron de Guevara O., Padilla P and Garcia et al. [1995]: Amino acid determination in some edible Mexican insects. Amino Acid. (9):161-173.

[12] Landry S. V., Defoliart G. R. and Sunde M. L. [1986]: Larval protein quality of six species of Lepidoptera (Saturniidae, sphingidae, Noctuidae). J. Econ. Entomol. (79):600-604.

[13] LI Shuo [2016]: A Review on Several Control Approaches for Dendrolimi in China. The Journal of Hebei Forestry Science and Technology, (3):76~79.

[14] Mbata K. J. and Chidumayo E. N. [2003]: Traditional values of caterpillars (Insecta: Lepidoptera) among the Bisa people of Zambia. Insect Sci. Applic. 23(4):341-354.

[15] Ramos-Elorduy, J. [1997]: Insects: a sustainable source of food? Ecology of Food and Nutrition. (36):247-276.

[16] Taylor, R. L. [1975]: Butterflies in my stomach or insects in human nutrition. 224 pp. Santa Barbara, Woodbridge Press.

[17] Van Huis A. [1996]: The traditional use of arthropods in sub-saharan African. Proceedings of the Section Experimental and applied Entomology of the Netherlands Entomological Society 7, 3-20.

[18] Vane wright. R. I. [1991]: Why not eat insects? Bulletin of Entomological research (81):1-4.

[19] Wen Li Zhang. [1997]: Edible entomology principle and application. Hunan Science and Technology press. Hunan.

[20] YANG Chen [2015]: Occurrence Rule of Yunnan Pine Moth in Changning Xigui Forest Region and Its Control Methods. Forest Inventory and Planning. 40(3):48~50.

[21] Yang Darong. [1999]: Edible insect resources insect-eating culture in Yunnan province, Entomological Knowledge. 36 (2):122-125.

[22] Ying Jianzhong, Xong Xianglin, Zhou Linxian et. al. [2000]: Study on the Vitamins B1, B2 and C in five edible insects. Yunnan Veterinarian, (3): 2.

[23] Zhang Sufang [2015]: Volatile Characters of Masson Pine Needles from Dendrolimus punctatus Frequent Outbreak Area, Occasional Outbreak Area, and Non-Outbreak Area. Scientia Silvae Sinicae, 51(3):170~174.