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# Scientific Explorations of the Snow Fungus (*Tremella fuciformis* Berk.) in Republican China: A Brief Review

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**Abstract**

This review describes the research status of *Tremella fuciformis* Berk. during the Republican period (1912-1949) on the basis of precious data from National library of China, Shanghai library, Nanjing agriculture university library, Shanghai academy of agricultural sciences library. This paper aims to lay the foundation for further studies with emphasis on other periods in Chinese history.

**Key words:** Cultivation, Inoculation, Republican period, *Tremella fuciformis* Berk.

## 1. Introduction

The snow fungus (*Tremella fuciformis* Berk.), typically called 'yin er' 銀耳 (the silver ear fungus), is a highly valued commercial tonic in Southeast Asia, especially China (Chen & Huang 2002; Chang & Miles 2004: 327).

*Tremella* polysaccharides (TP) are the major component and activity unit of *Tremella*. TP have anti-aging effects by regulating transcription and expression of cell cycle negative regulator P21, anti-oxidation and strengthen immunity (Li 2004). *Tremella fuciformis* polysaccharide (TFP), has good stability as well as excellent moisturizing effect and antiwrinkle effect. It can improve the skin texture, lower the skin harshness and increase the skin flexibility (Lai *et al.* 2010)

According to contemporary biological classification of fungi, it belongs to the *Tremella* genus, Tremwllaceae family, Tremellales order, Basidiomycetes class, Eumycota phylum (Peng *et al*. 2005). It belongs to *Tremella* genus, Tremwllaceae family, Tremellales order, Tremellomycetes class, Basidiomycota phylum (Kirk *et al.* 2008).

The pre-Republican history of the cultivation of this fungus, which has been reviewed by Chen (1983), is roughly clear, but still remains inconsistencies in historical records. Generally speaking, it was first discovered in Tongjiang county, Sichuan province in 1832, while the log cultivation of this fungus began no later than 1894 (Yang 1988; Chen & Huang 2001). In addition to Chen, Luo Xinchang (2013) also briefly summarizes the history of *T. fuciformis* during the period from 1940s to 2000s. Both authors neglect to pay attention to the social context within which new knowledge of *T. fuciformis* was generated and disseminated, and wielded profound influence on the material and spiritual life of human beings. Nevertheless, this article still places emphasis on the scientific studies of *T. fuciformis*, part of the result of localizing western scientific knowledge, in Republican China regarding the gap in extant historical narratives of these studies. The sources for this brief review were gathered from the

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National Library of China, Shanghai Library, Nanjing Agriculture University Library, and Shanghai Academy of Agricultural Sciences Library.

## 2. Morphology and Taxonomy

Wu Bingxin published her article titled 'Research on the tonic *Tremella fuciformis*' in *Journal of Natural History*, 1914. It is the first scientific study of *T. fuciformis* on the basis of modern biology, involving morphological characteristics, scientific names, taxonomy, and properties of spores and hyphae. Morphological features (characteristics) of *T. fuciformis* fruiting bodies: white or ivory, pliable, translucent, gelatinous, cluster or single, normally 3-15 cm in diameter. Basidia division forming four cell, every cell has a stipe, basidiospore forming at the end of stipe, the hyphae are clamped, The basidiospores is ellipsoid, smooth. The spore is oval, normally 3-5 μm in diameter (Wu, 1914).

## 3. Nutrition

Hu (1932) investigated the place of origin and chemical components in *Tremella fuciformis*. He found that it contained 15.2% water, 4.5% inorganic salt, 2.4% crude fiber, 71.2% carbohydrate, 6.7% protein and 0.6% fat.

One year later, Tang (1933) identified the nutritional components in *T. fuciformis* and compared them with those in *Auricularia auricular-judae* and *T. aurantia*. He found that it contained 18.76% water, 5.44% ash, 2.75% crude fiber, 64.92% carbohydrate, 7.02% protein and 1.28% fat respectively. From then on, similar comparisons began to receive more and more attention from biologists.

For example, Zhou *et al*. (1937) also intended to characterize the nutritive value of *T. fuciformis* by comparing its nutritional components with those in *Dictyophora phallodes* and *Tricholoma gambosum*. The data showed: 12.55% water, 5.39% ash, 2.58% crude fiber, 69.14% carbohydrate, 8.96% crude protein and 1.38% crude fats.

## 4. Cultivation Technologies

There were two kinds of inoculation methods, spore inoculation and artificial inoculation.

### 4.1 Spore inoculation

Spore inoculation, the spore releasing in the air was the major means of inoculation, but the yield was very poor. According to Xiong (1941), only 31% of wood could be used for mushroom cultivation, while the other wood (69%), contaminated by microorganisms, could substantially reduce the yield on *T. fuciformis*.

### 4.2 Artificial inoculation

There were four artificial inoculation methods.

**Spore suspension**, Fresh fruiting body(the weight on own experience) was put into cool boiled water,

**Fig. 1** *T. fuciformis*

stirred, poured into watering can, sprayed on the wood, mycelium would grow up in a few days (Xiong, 1941). Wei Xinnong reported that fresh fruiting body (medium size, open, 1 liang =50 g ) was washed with clean water(2 he = 0.2 L), spore suspension could be syringed or grinding into bark (Wei, 1934).

**Powder spawn** was developed in1923-1928, but Wang Qingshui's handout on the artificial cultivation of *Tremella fuciformis*, published in 1929, doesn't mention it. So it remains unknown whether it was fruiting body or mycelium or mixture (Wang, 1929). In 1932, Pan Zhinong, a native of Minhou county, Fujian province, introduced filamentous strains to artificial inoculation (Pan, 1947). Meanwhile, Chen Bingkun of Quanzhou city, Li Min and Zheng Jianguang of Jinjiang city performed the same experiment (Huang, 1993). Furthermore, Shi Gongshan reported that the wood containing precious mycelium could be cut down, ground into powder, sieved, and then used in inoculation (Shi, 1935).

**Spore, mycelium and sawdust mixture**. The wood which had produced a lot of *T. fuciformis* were selected. Then, its bark and xylem were scraped (approx. 2.6 inches in diameter), mashed and mixed with suspended spores, pressed into block. This was a mixture of spore, mycelium and sawdust (Li, 1940). Although these results (the first three) had some practical application value and were significant to theoretical research, they formed one of the first steps to explore the cultivation of *T. fuciformis* in order to lay the foundation for obtaining pure spawn.

**Yeast-like conidia of *T. fuciformis*.** In 1941, Yang Xinmei obtained yeast-like conidia using ejection separation method for the first time in Meitan county Guizhou province. Then he first used spore suspension to inoculate in the field for the first time in 1942-1944 (Chen & Yang, 1945). A higher yield (58%) was obtained in comparison with that inoculated through the spread of spore in the air (31%) (Yang, 1954). Moreover, he also provided a new method for studying *T. fuciformis* cultivation.

## 5. Cultivation Methods

There were three cultivation methods.

### 5.1 Cultivation through spore release in the air.

Decades of trees were cut every February or March, and low yield was obtained through natural-log cultivation, which relied on spore release in the air. The way of cutting trees was based on ancestral experience passed from generation to generation and kept a secret. Many researchers had been engaged in investigating and summarizing it to unmask this technique (Tauler, 1940).

### 5.2 Log cultivation.

Tree species, Zheng Jixi (1934) reported that there were three tree species suitable for cultivating *T. fuciformis* in Wanyuan county, Sichuan province, namely *Quercus glanaulizeera*, *Q. sarrata* BI. and *Q. dentata* Thunb. The first two were particularly suitable. Zheng's report was the first time describing the tree species used to cultivate *T. fuciformis*. Optimum condition, Natural-log was cut and packed in the form of tic-tac-toe. When its dryness was appropriate, carving it. The packed period of wood was a complex physiological process. Data revealed that the optimum condition was: when wood was cut in spring rather than winter, substrate was mixed with the rotted leaves of *Cyclobalanopsis glauca*, sand, gravel and yellow soil; wood was 60 cm in length, and the inoculation time was mid-June. Yield was higher in September and October (autumn), and April (spring) (Chen & Yang 1945).

### 5.3 Cohabitant fungus of *T. fuciformis*

Many reports described that yellow germ existed before the emergence of *T. fuciformis*,

cohabitant fungus of *T. fuciformis* was observed and studied by Yang Xinmei in the Republican period. He published the paper '*Tremell fuciformis* of China' in 1954, which described the phenomenon and relationship, Xiang-hui-jun (Cohabitant fungus of *T. fuciformis*) was not the generation of *T. fuciformis*. This laid the groundwork and provided the theoretic foundation for further study of spawn of *T. fuciformis* (Yang, 1954). Shi Gongshan summarized three methods of cultivation techniques: wooden cultures, culture with horse manure, and bottle culture with sawdust (Shi 1935). Although the former was lagging behind the latter two, it was still a necessary stage in the history of wood-rotting fungi cultivation. Wooden cultivation technology was developed from the cultivation of *Lentinula edodes*, but the study of *T. fuciformis* was highly regarded in the Republican period. All aspects of the wooden cultivation technology have been previously explicated, but had not been widely adopted in the Republican period. This technology was widely used through to the 1950s in China.

**5.4 Cultivation of *T. fuciformis* using sawdust.**

The yield of wood-cultured was higher than that of bottle culture involving the use of sawdust (sawdust bottle-cultured). It suggested new ways to use agricultural waste to cultivate *T. fuciformis* (Pan, 1948).

## 6. Production and Marketing

Commercial production was investigated in Tongjiang County, instructed by Sichuan Provincial Government in June 1932 (Huang, 1993). Next year, the medicine merchants in Longxi country, Longhai County, Zhangzhou city, Fujian province had succeeded in cultivating *T. fuciformis* following example in Tongjiang. In the meantime, *T. fuciformis* had also been widely cultivated in many places, including Nanjing, Zhao'an, Yunxiao, Pinghe, Zhangpu, Changtai and Hua'an. It is commonly known as '*yin er* of Zhangzhou' (Huang, 1993). Besides, Zheng Jixi had dedicated himself to the study of *T. fuciformis*, and published the article '*Introduction to Tremell fuciformis* and *Tremell fuciformis* of Sichuan' (Zheng, 1934 & 1935). Liu Shulin inspected the status of *T. fuciformis* production in Zunyi city Guizhou province, and introduced its history, method, market and tax situation in 1937 (Liu, 1937).

There were some investigation reports about Tongjiang and Wanyuan counties of Sichuan province, Zunyi county of Guizhou province, indicating that they were the places of origin, or important production bases of *T. fuciformis* (Hu, 1932; Xiong, 1941; Zheng, 1934; Liu, 1937). Tongjiang county was the foremost production area (Chu, 1937). Wang Yanmou and Hu Ze reported that Shanghai was a center for the trade in *T. fuciformis* (Hu, 1932; Wang, 1936).

Moreover, some Republican literature records the distribution, cultivation technology, yields and economic efficiency in great detail (Yu, 1933; Chu, 1937; Zhou, 1948). They provide crucial data for the study of the history of *T. fuciformis* cultivation.

## 7. Conclusion

The Republican period was a blank but crucial time in the scientific history of *T. fuciformis*. Many researchers of that time made new observations and studied it from different perspectives. Creative scientific theories and practical cultivation techniques surrounding this highly esteemed tonic fungus had also been developed. These explorations and discoveries witnessed the significant efforts made by native biologists in China. They also contributed to the transformation of the science of edible fungi in the Republican period, adding a powerful voice of native creation into the acquisition of scientific knowledge in Republican China.

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