



木薯茎秆资源化利用技术及其应用

Technology for resource utilization of cassava stalks and its application

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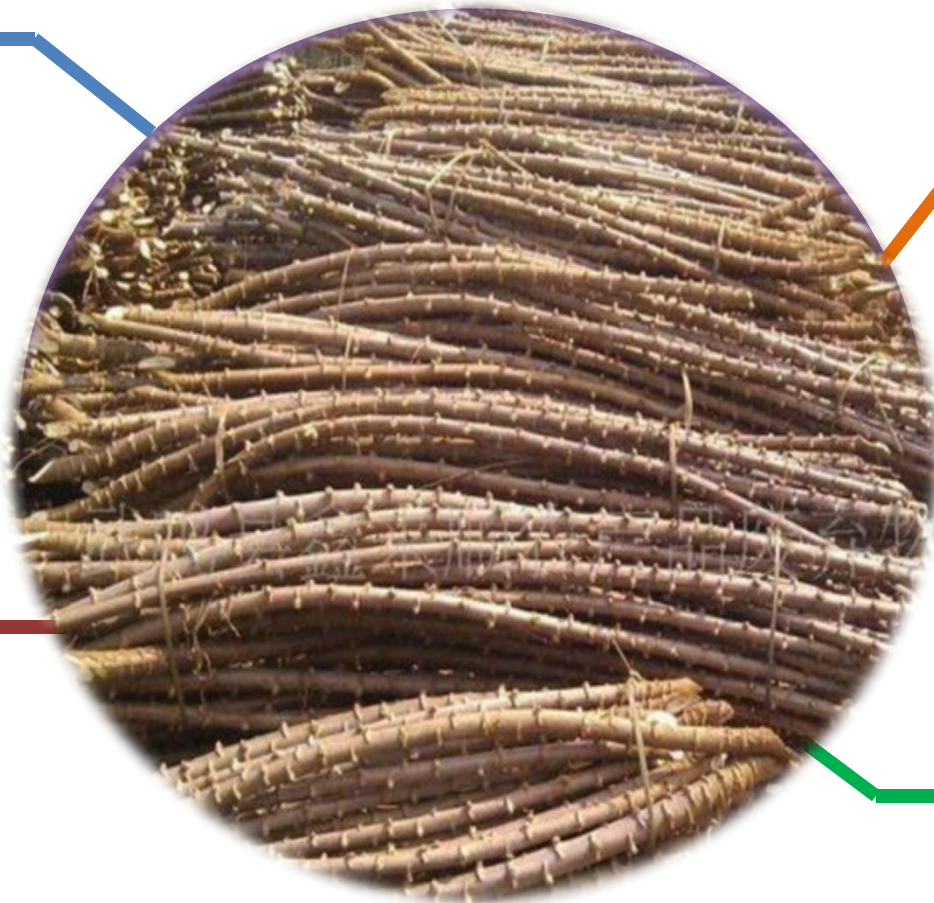
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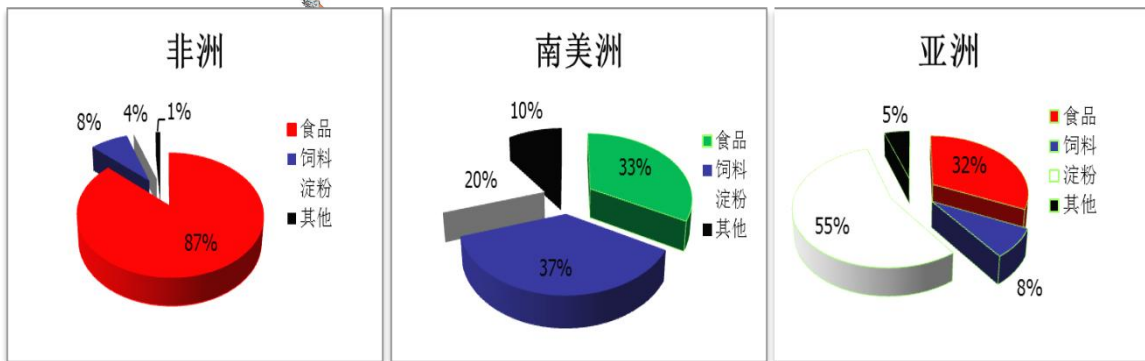
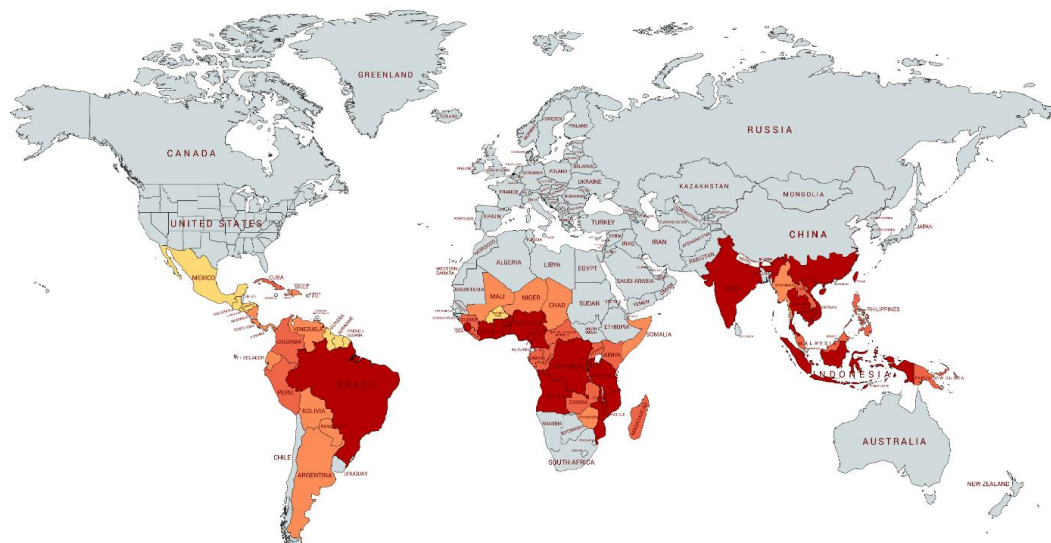
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一、基本情况 Basic Information

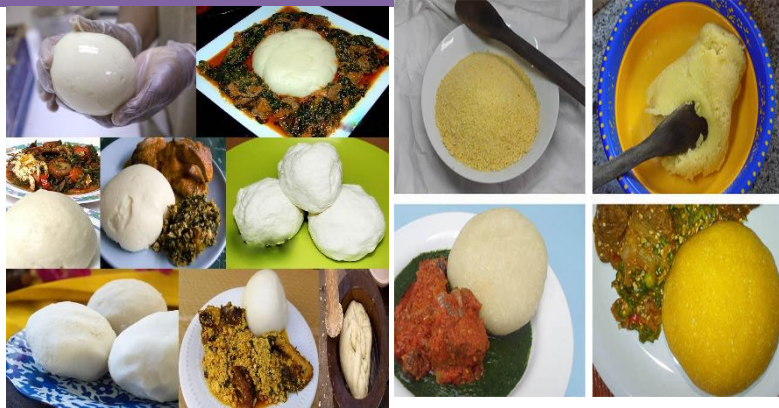


- ◆ 木薯主要种植于中国的南方9省区，是南方一种重要经济、饲料和粮食兼用作物，全国木薯种植面积最大的地区在广西。
- ◆ Cassava is mainly grown in the nine southern provinces of China and is an important economic, fodder and food crop in the south, with the largest area of cassava planted in Guangxi.

一、基本情况 Basic Information

□ 国外块根利用方式 Foreign ways of utilization of cassava tubers

非洲木薯主要利用方式 (In Africa)



FuFu和Gari是每天饮食里的主食部分，会配着各种汤汁和肉一起食用。
FuFu and Gari are a staple part of the daily diet and are served with a variety of soups and meats.

南美洲木薯主要利用方式 (In South America)



Sancocho,也叫木薯肉汤，是哥伦比亚、巴拿马等拉美国家较为传统的一道菜。Sancocho, also known as cassava broth, is a traditional dish in Colombia, Panama and other Latin American countries.

Sagu, 巴西南部有名的一道甜品小吃，将木薯珍珠与肉桂和丁香一起在红酒中煮熟，放冷食用。
Sagu is a famous dessert snack from southern Brazil. Cassava pearls are cooked in red wine with cinnamon and cloves and then cooled it down for consumption.

亚洲木薯利用方式 (In Asia)



印度尼西亚Sawut singkong, 鲜木薯切丝蒸熟、油炸，通常配上椰肉丝。
Sawut singkong, from Indonesia, is made from freshly shredded cassava which is steamed and then fried, usually served with shredded coconut meat.

菲律宾大小节日的必备小吃，木薯蛋糕。
Cassava cake, a must-have snack for Philippine festivals, both big and small.

一、基本情况 Basic Information

□ 国外叶片利用方式 Foreign ways of utilization of cassava leaves

据报道，马达加斯加科研人员发现，将木薯叶捣碎后放入盐水中煮，然后与大米饭一同服用，每周连续3d，服用3个月，可治疗各阶段的膀胱炎。

It has been reported that Malagasy researchers have found that crushing cassava leaves and boiling them in salted water, then taking them with rice for 3 days per week for 3 months, can treat all stages of cystitis. 秘鲁与巴西一带的土著印第安人均有食用木薯叶的传统，他们将木薯叶晒干磨成粉，然后随意地加入任何菜肴中，喝水时也会放一些木薯叶干粉，这一带居民的抗病能力明显高于其他地区。

The indigenous Indians of both Peru and Brazil have a tradition of eating cassava leaves. They dry and grind the cassava leaves into powder and freely add it to any dish, as well as drinking water with it. They are significantly more resistant to disease than inhabitants of other regions.



印度尼西亚，北苏门答腊美食，木薯叶菜 Gulai ubi tumbuk
Gulai ubi tumbuk, a cassava leaf delicacy from North Sumatra, Indonesia.



Sakasaka。在刚果民主共和国，嫩木薯叶洗净，捣碎，然后煮沸。烹煮过程中不要盖锅盖，这有利于毒素氰化氢的逸出。通常会加入油，洋葱，鱼等配料。

Sakasaka, from the Democratic Republic of Congo. It is made from young cassava leaves which are washed, pounded and then boiled. (Leave the pan uncovered during cooking as this facilitates the discharge of the toxin hydrogen cyanide.) usually topped with oil, onions, fish etc.

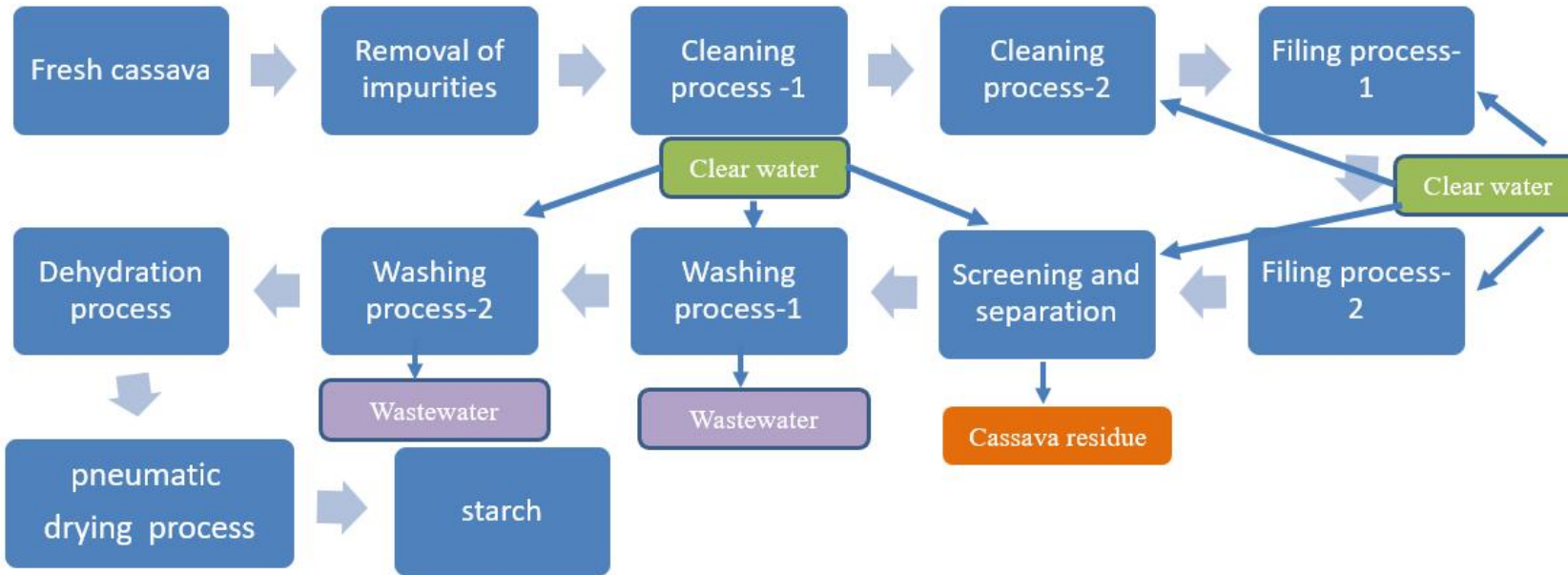
一、基本情况 Basic Information

- 国内块根利用方式
- Domestic ways of utilization of cassava

■中国每年木薯淀粉产量约45万吨，主要分布在广西，淀粉加工技术已经具备较强的工艺和设备自主研发、设计能力

■China's annual cassava starch production is about 450,000 tons, mainly in Guangxi, and the starch processing technology already has strong independent research and development as well as design capabilities for processes and equipment

◆ 淀粉加工



点击鼠标即可弹出英文流程图

木薯淀粉加工工艺及产业化进程
Cassava starch processing and industrialization process

一、基本情况 Basic Information

- ◆ 木薯淀粉由于无异味、透明度高、峰值粘度高、冻融稳定性好等优点，广泛应用于食品、化工等行业。也可根据特殊需求，进行改性。
- ◆ Cassava starch is widely used in food and chemical and other industries due to its odourlessness, high transparency, high peak viscosity and good freeze-thaw stability. It can also be modified according to special requirements.

- ✓ 变性淀粉
- ✓ Modified starch



- ✓ 造纸
- ✓ Papermaking

- ✓ 添加剂
- ✓ Additive



- ✓ 药品用
- ✓ Medicinal use

- ✓ 粘合剂
- ✓ binding agent



一、基本情况 Basic Information

◆ 酒精加工 ethanol processing

地区 area	%	燃料乙醇推广 promotion of fuel ethanol
巴西Brazil	20	25%
泰国Thailand	10	曼谷 Bangkok
印度India	5	南部地区 southern region
瑞典Sweden	5	全国 all over the country
哥伦比亚Colombia	10	3个主要城市 3 major cities
中国China	10	5个城市 5 major cities



年产20万吨食用酒糖、10万吨醋酸乙酯、10万吨甲醛等二十多条生产线，年产各类化工产品近70万吨，产品主要销往华东、华南地区，出口往欧美和日韩等地。 With 200,000 tons of edible liqueur sugar, 100,000 tons of ethyl acetate and 100,000 tons of formaldehyde produced annually by over 20 production lines , the company has an annual production capacity of nearly 700,000 tons of various chemical products, which are mainly sold in Eastern and Southern China and exported to Europe, America, Japan and Korea.

一、基本情况 Basic Information

国内叶片利用方式 Domestic ways of utilization of cassava leaves

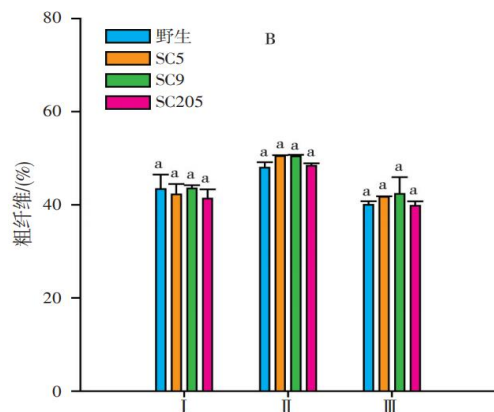
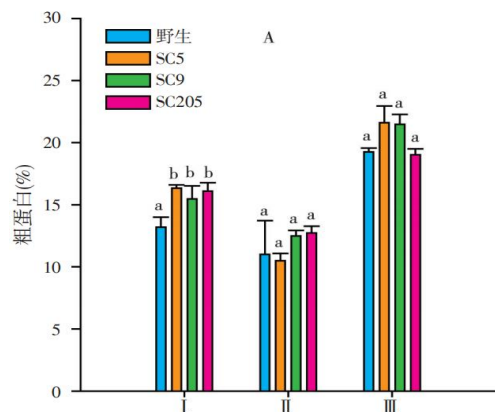
从木薯嫩茎叶主要成分看，原料中粗蛋白含量20.6-36.4%，且必需氨基酸约占全部氨基酸的50%，是一种十分理想的粗蛋白饲料来源。

According to the main components of young cassava stems and leaves, the crude protein content of the raw material is 20.6-36.4% and the total essential amino acids account for about 50% of all amino acids, making it a very ideal source of crude protein feed.



木薯叶养蚕。新鲜木薯叶采摘后直接饲养蓖麻蚕。每亩可采摘250-300公斤，能养10000只蚕。

Using cassava leaves for silkworm rearing. Fresh cassava leaves are harvested and then directly used for raising castor silkworms. Each mu of cassava land can harvest 250-300 kg of cassava leaves that can raise 10,000 silkworms.



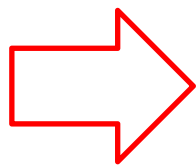
木薯叶发酵用作饲料，在饲养黑猪与黄牛上，日增重取得良好效果。

Fermented cassava leaves have been used as feed for black pigs and cattle, with good results in daily weight gain.



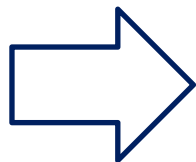
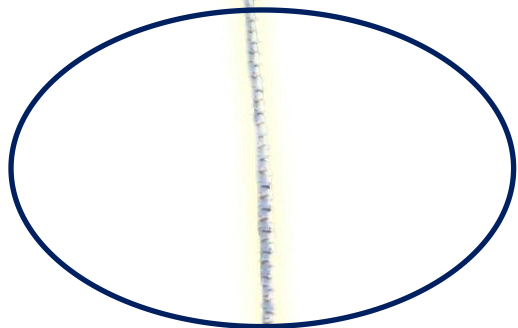


一、基本情况 Basic Information

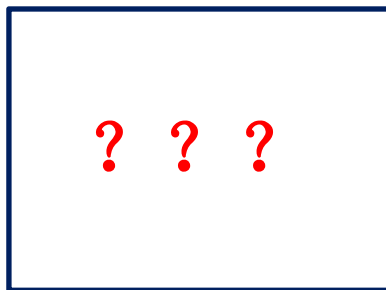


叶片可用于牛、猪、鱼的饲料等

The blades can be used as feed for cattle, pigs, fish, etc.

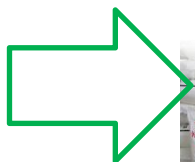


种植材料 Planting material



茎秆用于种植，资源化利用有待开发

Stems are used for planting, and resource utilization remains to be developed



淀粉 starch



酒精 ethanol



食品 food



块根可用作加工淀粉、酒精、食品等

The root tubers are used for processing starch, alcohol, food, etc.



一、基本情况 Basic Information



图 木薯茎秆用作柴火

Cassava stalks are used for firewood

茎秆除了10%用作种植材料，90%未得到充分利用，大多用作柴火或丢弃在农田，对环境造成较大负担。

Apart from 10% of the stalks being used as planting material, 90% are under-utilized and mostly used as firewood or discarded on farmland, creating a large burden on the environment.



图 木薯茎秆堆放

Cassava stalks stack together

二、利用方式 Ways of utilization

茎秆利用方式：粉碎还田、用作饲料或日粮配制、生物质燃料等

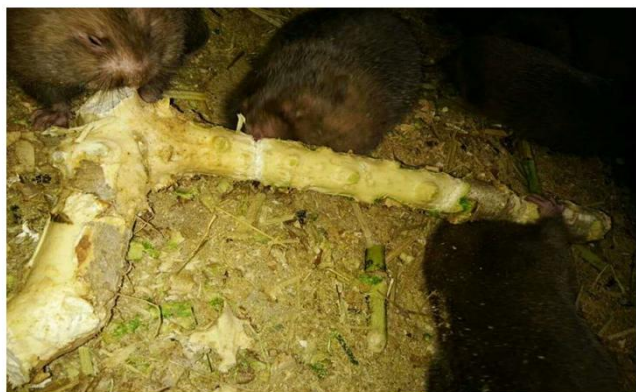
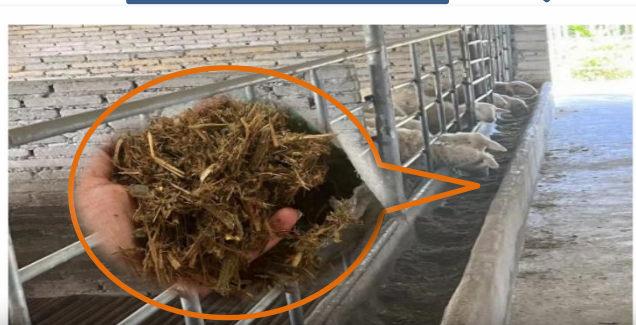
Stalk utilization: **crushed and returned to the field**, used as feed or daily ration preparation, **biomass fuel**, etc.

粉碎还田



施用600kg/ha粉碎茎秆可起增产作用
Application of 600kg/ha of crushed cassava stems can increase yield

饲料日粮



生物质燃料





二、利用方式 Ways of utilization

研究表明，木薯茎秆中粗纤维含量为5.1%、粗蛋白为含量23.3%（干基），是一种理想的食用菌栽培基料。

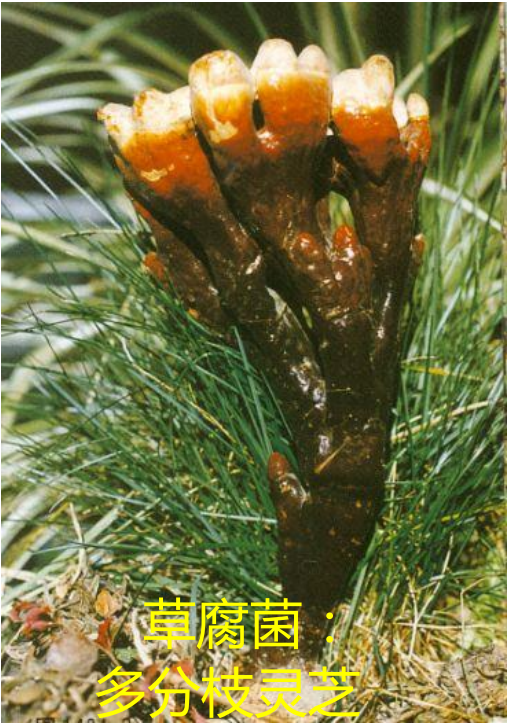
Research shows that cassava stems contain 5.1% crude fiber and 23.3% crude protein (dry basis), which is a kind of ideal culture substrate for edible mushroom cultivation.

nitrogen-free-extract

基料 substrate	粗蛋白 crude protein%	粗脂肪 crude fat%	纤维素 cellulose%	半纤维素 hemicellulose%	木质素 lignin%	无氮浸出物 NFE%	灰分 ash content%
杂木屑Mixed wood shavings	1.57	3.12	36.12	12.58	19.17	24.52	2.92
棉籽壳cottonseed hull	5.07	1.57	32.73	21.42	15.18	18.19	5.84
玉米芯Corn cob	2.05	0.78	30.26	34.13	17.19	13.46	2.13
玉米秸秆maize straw	3.51	0.82	32.91	31.89	14.65	11.36	4.86
小麦秸秆wheat straw	2.63	1.16	43.6	22.21	9.32	14.81	6.27
高粱秸秆Sorghum straw	3.42	1.73	40.11	30.15	7.68	10.79	6.12
木薯秆cassava stems	4.47	0.38	39.32	11.88	19.84	21.32	2.79



二、利用方式 Ways of utilization



草腐菌：
多分枝灵芝

Grass-rotting fungus:
Multi-branched
Ganoderma lucidum

◆ 什么是食用菌

是一种可供人类食用的**大型真菌**。世界上已被描述的真菌达12万余种，能形成大型子实体或菌核组织的达6000余种，可供食用的有2000余种。

◆ What is an edible fungus

It refers to a **large fungus** that can be used for human consumption. More than 120,000 species of fungi have been described in the world, and more than 6,000 species can form large fruiting bodies or mycorrhizal tissues, and more than 2,000 species are edible.



木腐菌：金耳

Wood-rotting fungus: *tremella aurantialba*

◆ 根据其栽培所需的原材料，食用菌可分为何种类别？

- 1、木腐菌（主要指禾木科秸秆原料）
- 2、草腐菌（主要有阔叶树的木屑和棉籽壳）

◆ According to the raw materials required for the cultivation, what kinds of edible mushrooms can be classified?

1. wood-rotting fungi (mainly refers to the raw material of graminaceous straw)
2. Grass-rotting fungi (mainly include wood chips of broad-leaved trees and cotton seed hulls)

二、利用方式 Ways of utilization

食用菌的生长繁殖都在一定的温度下进行。根据生长发育所需的最适温度分成：

- 1、低温型。最适温度：24°C-28°C，如滑菇、松菇等；
- 2、中温型。最适温度：24°C-30°C，如香菇、蘑菇、黑木耳等；
- 3、高温型。最适温度：28°C-34°C，如草菇、茯苓等。

The growth and reproduction of edible fungi all take place at a certain temperature. According to the optimum temperature required for their growth and development, the fungi can be divided into:

- 1、 Low temperature type. Optimum temperature: 24°C-28°C, such as pholiota nameko, pine mushroom, etc.
- 2、 Medium temperature type. Optimum temperature: 24°C-30°C, such as shiitake, agaric, black fungus, etc.
- 3、 High temperature type. Optimum temperature: 28°C-34°C, such as straw mushroom, poria, etc.



滑菇 *pholiota nameko*



香菇 *shiitake*



草菇 *straw mushroom*

二、利用方式 Ways of utilization

利用木薯茎秆屑已成功栽培出的食用菌，产量及品质表现良好

Edible fungi have been successfully cultivated using cassava stalk chips with good yield and quality performance

pleurotus
citrinopileatus



榆黄蘑

oyster
mushroom



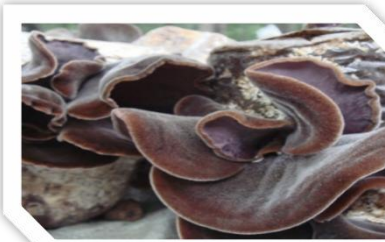
平菇

black
fungus



黑木耳

auricularia
polytricha



毛木耳



姬松茸

agaricus
blazei murill



金针菇

needle
mushroom



杏鲍菇

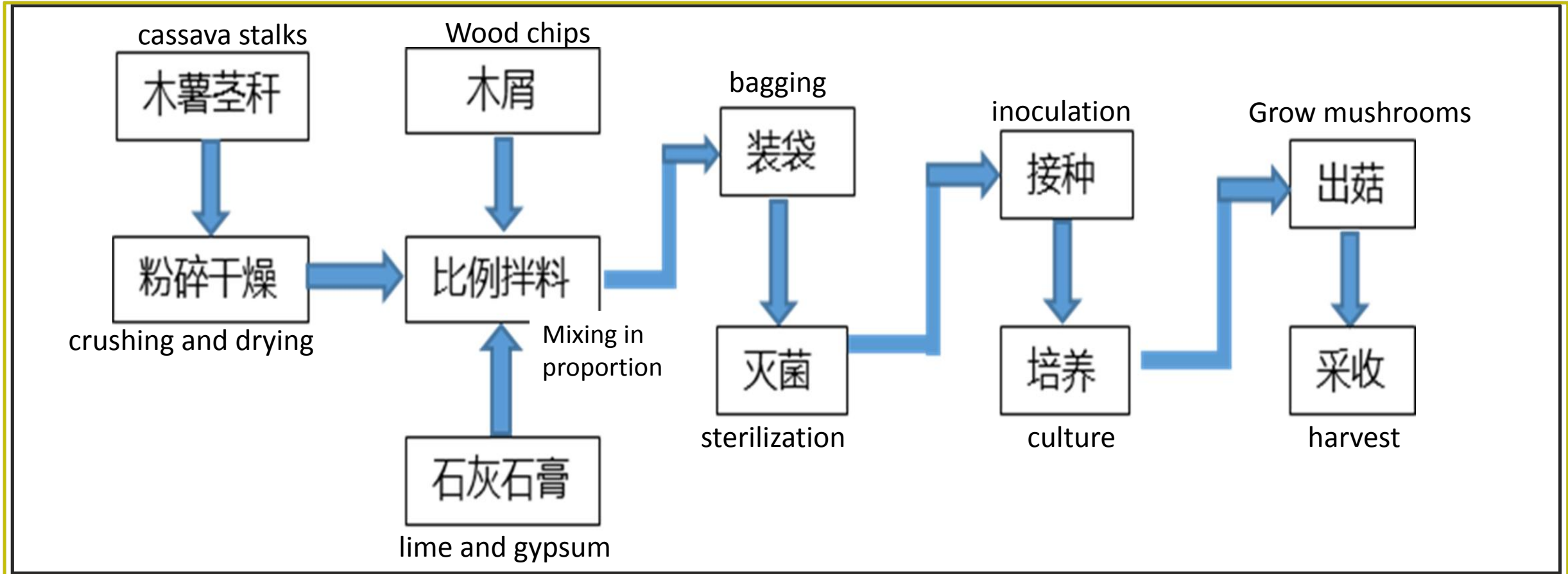
pleurotus
eryngii



滑菇

pholiota
nameko

三、栽培步骤 Cultivation steps



操作流程图 operation flow chart

三、栽培步骤 Cultivation steps

1、茎秆粉碎干燥 Stalk crushing and drying

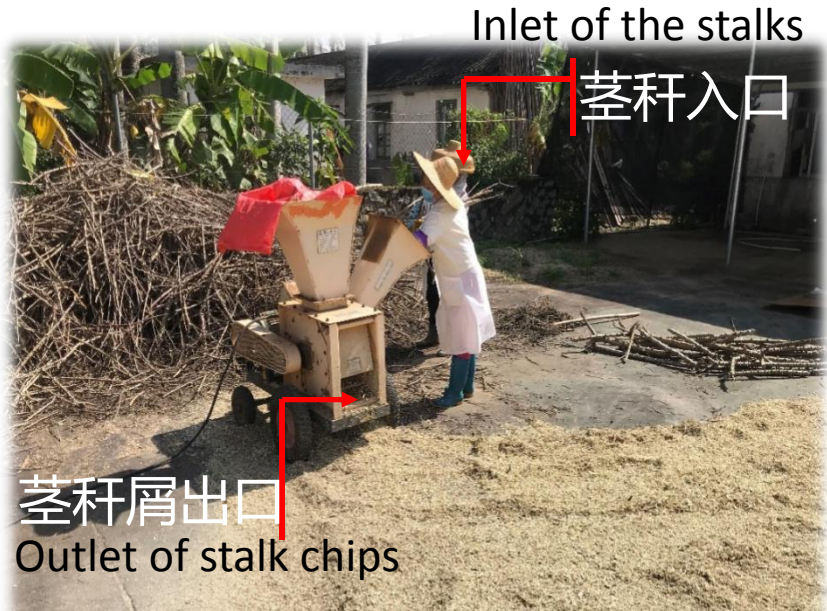


技术要点：采收后的新鲜、无病虫害、无霉变的木薯秆、枝晒干，粉碎成5~12mm×5~12mm颗粒

Technical points: harvest the fresh, pest-free, mold-free cassava stalks and branches and sun-dry them, then crush them into 5 -12 mm × 5 - 12 mm particles

三、栽培步骤 Cultivation steps

1、茎秆粉碎干燥 Stalk crushing and drying



Inlet of the stalks

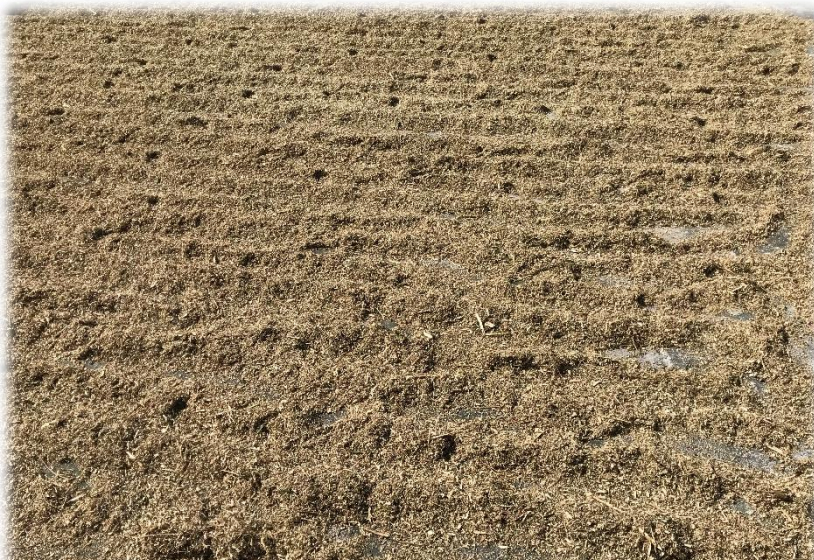
茎秆入口

茎秆屑出口

Outlet of stalk chips

➢ 木薯茎秆放入粉碎机

➢ Cassava stalks are put into the crusher



➢ 晴朗天气晾晒茎秆屑，遇雨天及时收集，避免淋雨

➢ Dry the stalk chips in sunny weather and collect them in time when it rains to avoid getting wet



➢ 晾晒完成后收集装袋，保持干燥备用

➢ After drying, collect the stalk chips for bagging, keep it dry and reserve it for future use



三、栽培步骤 Cultivation steps

2、基质配比 Substrate proportioning

配方 ratio	木薯杆 Cassava stalks (%)	木屑 Wood chips (%)	麸皮 bran (%)	石灰 lime (%)	石膏粉 gypsum powder (%)
1	20	70	8	1	1
2	30	60	8	1	1
3	40	50	8	1	1
4	50	40	8	1	1

经过0%-100%木薯杆添加量的试验作为基质栽培食用菌，最终筛选出对食用菌种植产量与品质影响不大的木薯杆添加量为20%、30%、40%、50%4种基质配比，如表所示。添加量木薯杆20%以下、50%以上添加量产量有所降低。

After the experiment of 0%-100% cassava stalks additions as substrate for the cultivation of edible fungi, researchers finally screened out four substrate ratios which have little influence on edible fungi cultivation yield and quality, and the cassava stalk additive amounts of the four ratios are 20%, 30%, 40%, 50%, as shown in the table. The yield has been reduced when the added amount of cassava stalks below 20% or above 50%.

技术要点：基质需提前12~24小时预湿。水可分次加入，以手捏住料不松散、不滴水为宜。料水总比为1:1.3~1.7，pH 7~8。拌好的培养料用网筛筛除杂质，培养料搅拌后堆闷1~2小时后装袋。

Technical points: the substrate needs to be pre-wetted 12 to 24 hours in advance. Water can be added in stages till the material is not loose and does not drip water when squeezed by hand. The total ratio of material to water is 1:1.3~1.7, pH 7~8. The mixed material is sieved with a net to remove impurities, and the material is piled and smothered for 1-2 hours and then bag it.

三、栽培步骤 Cultivation steps

2、基质配比 Substrate proportioning



食用菌原来是这样栽培的



三、栽培步骤 Cultivation steps

3、装袋 Bagging

食用菌栽培方式
Cultivation patterns of edible fungi

1

段木栽培法。就是将天然木料砍伐下来，经过简单处理后直接接种，培养管理。

Segmental wood cultivation method. It is to cut down the natural wood, inoculate it directly after simple treatment, and cultivate it for management.



2

粪草栽培法。它是利用禽畜粪便及各种秸秆进行堆制发酵，作为培养料，进行接种栽培

Manure and grass cultivation method. It is to use livestock manure and various straws as culture material for pile fermentation to conduct inoculation cultivation



3

代料栽培法。它是利用工农副产品下脚料栽培食用菌的方法。

Substitute cultivation method. It is the method of cultivating edible fungi by using the scrap of industrial and agricultural by-products.



小结：三种栽培方式各有优势，综合评价来看，代料栽培仍是主流方式

Summary: Each of the three cultivation methods has its own advantages, and from the perspective of comprehensive evaluation, substitute cultivation is still the mainstream method

三、栽培步骤 Cultivation steps

3、装袋 Bagging

图 人工装袋 manual bagging



图 机器装袋 machine bagging



技术要点：料装进袋后将原料适当压紧、装均。培养料紧密接触,以利定植和生长,并用无菌棉塞封闭袋口

Technical points: the material are put into bags and then properly compacted and packed evenly. Culture material is close contacted, in order to facilitate the planting and growth, and use sterile cotton plug to seal the bag mouth

三、栽培步骤 Cultivation steps

4、灭菌 Sterilization

常压
灭菌

Atmospheric pressure
sterilization

灭菌条件：采用不透气、耐高温的篷布覆盖住菌袋，四周扎紧，确保篷布内温度能维持在 100℃左右,常压下8~10小时即可。

Sterilization conditions: Use impermeable, high temperature resistant tarp to cover the fungi bag for 8-10 hours under normal pressure., tie it tightly around to ensure that the temperature inside the tarp can be maintained at about 100°C.



高压
灭菌

Autoclaving

高压灭菌条件：将装满菌袋的菌架推入灭菌锅中，关闭灭菌锅门。设置灭菌参数，压力为 1.50×10^5 Pa。温度为121℃。时间为2~4小时。

Autoclaving conditions: Push the rack filled with fungi bags into the autoclave and close the autoclave door. Set sterilization parameters: pressure is 1.50×10^5 Pa. temperature is 121°C. Time is 2 to 4 hours



三、栽培步骤 Cultivation steps

4、灭菌 Sterilization



食用菌为何要灭菌
Why should edible fungi be sterilized

无论是在栽培原料中还是在空间环境中，都存在着大量危害食用菌生产的微生物，在食用菌栽培中统称为杂菌。杂菌能通过多种渠道污染培养基质，使菌种制作和栽培失败。进行环境消毒，是保证菌种制作和栽培成功的关键环节。

Both in the cultivated raw materials and in the cultivation environment, there are a large number of microorganisms that are harmful to the production of edible fungi, which are collectively called infectious microbe in terms of the cultivation of edible fungi. The microbe can contaminate the culture substrate through various channels and make the strain production and cultivation fail. Environmental disinfection is a key part of ensuring the success of strain production and cultivation.

常见杂菌种类
Common species of infectious microbe



2、毛霉和根霉 Mucor and Rhizopus

这两种菌的形状相似，毛较长，毛霉的菌丝白色，根霉的菌丝灰白如针状，都长有黑色颗粒状的孢子囊。这两种菌都是在潮湿和空气不良的环境中生长蔓延较快。

These two bacteria are similar in shape, with longer hairs, the mycelium of mucor is white, and the mycelium of rhizopus is grayish white like needles, both have long black granular sporangia. These two seedlings grow and spread faster in the humid environment with poor air.

1、青霉菌 Penicillium

为青绿色菌落。多在25°C左右和潮湿、空气不良的地方发生。
It is greenish colony. More prone to occur in the environment of around 25 °C with humid, poor air.



3、曲霉 Aspergillus

黄曲霉色黑黄，黑曲霉色黄黑灰，在培养基中温度低时蔓延快。
Aspergillus flavus's color is black yellow, Aspergillus niger's color is yellow black gray, they spread fast in the culture medium when the temperature is low .



4、木霉菌 Trichoderma harzianum

初生为白色；成熟后变成铜绿色。
Initially white; becomes copper green after maturity.



杂菌与食用菌栽培种属于竞争关系
infectious microbes and edible fungi cultivation are in competition



国家木薯产业技术体系

Chinese Cassava Agro-technology Research System



国家薯类加工技术研发分中心

National R&D Center for Potato Processing



中国热带农业科学院热带作物品种资源研究所

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三、栽培步骤 Cultivation steps

5、接种 inoculation

接种示意 inoculation demonstration

接种前准备 preparations before inoculation



clean benches



超净工作台



已灭菌菌袋

Sterilized fungi bags

Inoculation tools



接种工具



酒精灯

Alcohol lamps

Clean lab-gowns



洁净实验服



待接菌种

Strains awaiting inoculation

技术要点：栽培料灭菌后料温降至30°C以下，在无菌条件下打开培养袋塞子，迅速接种后封口。操作人接种前需全身进行消毒，避免污染菌包。
Technical points: After sterilization of cultivated material, the material temperature should be lowered to below 30°C, and the culture bag should be unplugged under aseptic conditions and sealed after rapid inoculation. The operator needs to disinfect his or her whole body before inoculation to avoid contaminating the bag.



二、栽培步骤 Cultivation steps

6、培养 cultivation



技术要点：暗光培养，控制空气相对湿度60-70%左右，定期通风换气，菌袋温度始终控制在22-25°C

Technical points: culturing in dark light, control relative air humidity at about 60-70%, regular ventilation, always control the bag temperature at 22-25°C

三、栽培步骤 Cultivation steps

6、培养 cultivation

菌丝开始生长，从接种处由上至下生长，菌丝的生长速度因品种而异。出现菌丝的时间大约为接种后2-5天。
Mycelium starts to grow from where inoculated from top to bottom, and the growth rate of mycelium varies from species to species. The time of mycelium appearance is about 2-5 days after inoculation.

发菌20天后，菌丝生长已过菌袋大半，此时进入发菌后期，同样需控制好发菌的温湿度，避免出现菌丝未长满菌袋而出菇，影响后期产量
After 20 days of fungal growth, the mycelium growth has been over half of the bag, entering the period of late fungal growth. Similarly, we need to control the temperature and humidity of the environment of fungal growth to avoid the mushroom emergence before the mycelium grows to the full bag, affecting the yield in the later period.

First stage



菌种接种培养后，菌袋颜色主要呈深褐色，菌丝处于萌发阶段
After inoculation and culture, the color of the bag is mainly dark brown and the mycelium is in the germination stage.

Second stage



Third stage



接种后14天左右，正常情况下菌丝生长至菌袋一半高度左右，期间注意观察发菌房的环境条件是否合适
About 14 days after inoculation, under normal circumstances mycelium grows to about half the height of the bag. During the period, observe whether the environmental conditions of the germination room is suitable

Fourth stage



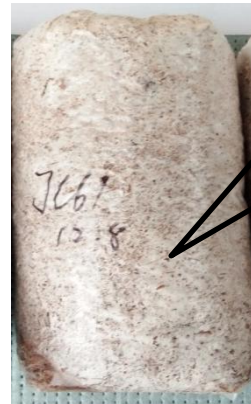
Fifth stage



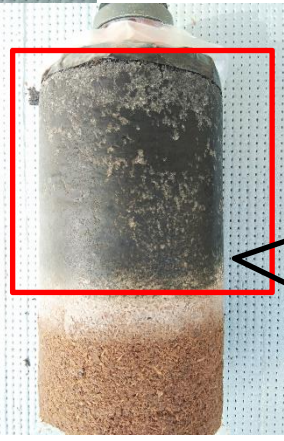
接种培养后1个月左右，菌丝均匀布满整个菌袋，菌袋呈纯白色，无其他杂色。
About 1 month after inoculation culture, mycelium evenly covers the entire bag, the bag is pure white, no other miscellaneous colors.

三、栽培步骤 Cultivation steps

6、培养cultivation



正常生长菌袋，菌丝分布均匀，长满整个菌包，颜色洁白
Fungi bag growing normally. Mycelium is evenly distributed throughout the bag, with white color



已污染菌袋，表现为出现黑色或绿色等菌丝，需及时清理，避免污染正常菌袋
Contaminated fungi bags. Mycelium is manifested as black or green etc. which need to be cleaned up in time to avoid contamination of normal bags

技术要点：接种3-4天后开始检查有无杂菌污染情况，7-8天进行第1次翻堆，以后每隔7天翻堆1次，每次检查、剔除污染菌袋，并及时处理。早晚各通风换气一次，保持空气湿度60-70%，培养25-30天，直至菌丝发满菌袋，再后熟培养 3-5 天可进行出菇管理。
Technical points: After 3-4 days of inoculation, we should start to check if there is any contamination by infectious microbe, turn the material for the first time in the 7th to 8th days, then turn the material every 7 days, check and reject the contaminated bags every time, and deal with them in time. Ventilate once in the morning and once in the evening, keep the air humidity at 60-70%, cultivate for 25-30 days until the mycelium is full of bags, and then cultivate for 3-5 days for fruiting management.



- 1、选择优质菌种；
 - 2、合理配置培养料；
 - 3、控制好合理温湿度；
 - 4、保持洁净
- 1、Select high-quality strains.
 - 2、Rational configuration of culture material.
 - 3、Control the temperature and humidity at a reasonable level.
 - 4、Keep clean

解决方案
Solution

三、栽培步骤 Cultivation steps

污染原因 Causes of contamination

1、菌种。老化退化，质量欠佳的菌种非常容易引起播种后菌丝不萌发、不吃料；

1、 Strain. Aging degradation, poor quality strains are very easy to cause the mycelium not to sprout, not to absorb material

2、培养料。碳氮比失调，导致食用菌菌丝不发菌。培养料中水分过多，导致料面发黑；

2、 Culture material. Carbon to nitrogen ratio is out of balance, resulting in edible fungi mycelium not germinating. Excessive moisture in the culture material, resulting in blackening of the material surface.

3、温度。菌袋料温、堆温、发菌室温过高，都会造成高温烧菌的现象，导致菌丝生长困难，最终污染。温度低于15度，不利于菌丝的生长和发育。而温度高于25度，但通风时间不够，在高温高湿缺氧状态，也会导致菌丝退化，甚至死亡。

3、 Temperature. Bag material temperature, pile temperature and spawn running room temperature are too high, which will cause the phenomenon of high temperature burning fungi, resulting in mycelium growth difficulties, and eventually contamination. Temperature below 15 degrees, is not conducive to the growth and development of mycelium. While in the environment where the temperature is higher than 25 degrees without enough ventilation time, it will also lead to mycelium degradation and even death in the state of high temperature and high humidity and lack of oxygen.

4、湿度。食用菌培养料的含水量应该保持在63%~65%之间，播种前培养基过湿或者过干，会造成供氧不足，活力下降或者失水萎缩；

4、 Humidity. The moisture content of edible fungi culture material should be maintained between 63% and 65%. That the medium is too wet or too dry before sowing will cause insufficient oxygen supply, decreased vitality or water loss and shrinkage.

5、病虫害。螨虫和线虫等害虫会导致菌丝断裂，萎缩死亡；

5、 Pests and diseases. Pests such as mites and nematodes can cause mycelium to break, shrivel and die.

6、操作。接种期间操作不当或是培养间不洁净，也会造成污染率上升

6、 Operation. Improper operation or unclean culture room during inoculation will also cause the contamination rate to rise

三、栽培步骤 Cultivation steps

6、培养 cultivation



技术要点：菌丝生长至开袋时，需及时出菇，以免出现“应出不出”情况，影响后续食用菌产量

Technical point: When the mycelium grows until the bag is opened, the fruiting process should be conducted in time to avoid the situation of "mushrooms not coming out when they should", which will affect the yield of subsequent edible fungi.

图 菌丝后熟过度 Excessive after-ripening of mycelium

三、栽培步骤 Cultivation steps

7、出菇 fruiting



打开袋口，保持出菇房温湿度

Open the bags , maintain the temperature and humidity of the fruiting room



技术要点：打开袋口，采取层架式排放出菇。出菇棚的环境温度保持在18-28℃，温差以6-10℃为宜，空气相对湿度保持80-90%左右；采取空中喷雾的方式保持空气湿度，避免向袋口喷水，防止菇体积水，增加通风，保持室内空气新鲜，并保证一定的散射光，利于原基形成。

Technical points: open the bag and place the fungi bags on the multi-layer shelf for fruiting. The ambient temperature of the mushroom-budding shed is kept at 18-28℃, and the temperature difference of 6-10℃ is suitable, and the relative humidity of air is kept at about 80-90%; adopt aerial spraying to keep the air humidity yet avoid spraying water to the bag mouths to prevent the water accumulation of mushrooms , increase ventilation to keep the indoor air fresh and ensure a certain amount of scattered light to facilitate the primordium(an organ or part in the earliest stage of development) formation.

三、栽培步骤 Cultivation steps

7、出菇 fruiting

黑木耳出耳管理技术要点：利用 2%~5% 的高锰酸钾溶液对菌棒表面、穿孔工具消毒。一般开 "1"、"Y" 或 "O" 形小口，散光照射且每日通风，持续 5~7天，使菌袋菌丝封住出耳口。

Key points of black fungus fruiting management technology: Use 2%~5% potassium permanganate solution to disinfect the surface of the culture sticks and perforation tools. Generally open "1", "Y" or "O" shaped small openings; diffuse light and daily ventilation for 5 to 7 days, so that the mycelium of the fungi bags seals the bag openings.



待出菇菌袋
A fungi bag awaiting fruiting



木耳打孔机
Black fungus perforating machine



菌袋入口 inlet of fungi bags

打孔
perforate



后熟
After-ripening



淋水出耳
Spray water for black fungus budding





三、栽培步骤 Cultivation steps

7、出菇 fruiting

雾化喷淋

1、出菇环境湿度均匀，菌袋淋水充分；
2、食用菌子实体含水量不会过高，易于保存。

水管喷淋

淋水不均匀，易造成菌袋积水，影响后期菌体二次生长



工厂化雾化喷淋

Industrial atomized spraying



水管喷淋

Hose spraying

Moisture management methods	features	Recommendation
Atomized spraying	1、 The fruiting environment has uniform humidity, and the mushroom bags are fully watered; 2、 The water content of edible mushrooms will not be too high, which is easy to be preserved.	
Hose spraying	Uneven watering, easy to cause water accumulation in the bag, affecting the secondary growth of the fungus later	





三、栽培步骤 Cultivation steps

8、采收 harvest



木耳采收
The harvest
of
fungus (*Auricularia auricula*)



料面清除
Material surface
cleaning

技术要点：采收前1天停止喷水。采收后，及时清除料面菇根和病菇、死菇，防止腐烂感染杂菌，同时停止喷水2-3天，让菌丝体恢复生长。压住根部，用手轻轻将子实体拧下，少留耳基，避免残根腐烂引起杂菌感染和害虫为害

Technical points: stop spraying water 1 day before harvesting. After harvesting, remove mushroom roots and diseased and dead mushrooms on the material surface in time to prevent rot and being affected by infectious microbes, meanwhile stop spraying water for 2-3 days to let the mycelium restore its growth. Press the roots and gently wring down the substrate by hand, leaving less fungus in the air to avoid the rotting of residual roots causing infection of infectious microbes and pest infestation

三、栽培步骤 Cultivation steps

9、采后处理 post-harvest treatment



图 自然晾晒 Natural drying



图 设备干燥 Drying machinery

自然晾晒：晒制时，将木耳均匀地平铺在晒帘或苇席、尼龙纱上。晴朗天气晾晒1~2天即可干燥。在木耳未干之前，不宜多次翻动，以增加阳光照射面。

设备干燥：50℃，8小时。烘干即可，期间翻动一次。

Natural drying: When drying, lay the fungus evenly and flatly on the drying curtain or reed mat or nylon yarn. It can be dried in 1 to 2 days in sunny weather. Before the fungus is dried, it should not be turned many times in order to increase the sunlight exposure surface.

Equipment drying: 50℃, 8 hours. Drying is sufficient, turning once during the period.

四、栽培方式 Cultivation pattern



室内栽培平菇
Indoor cultivation of
oyster mushrooms



传统大棚栽培
Traditional greenhouse
cultivation

室内栽培榆黄蘑
Indoor cultivation of
pleurotus citrinopileatus



四、栽培方式 Cultivation pattern

林下吊袋栽培

Under-tree hanging bag cultivation

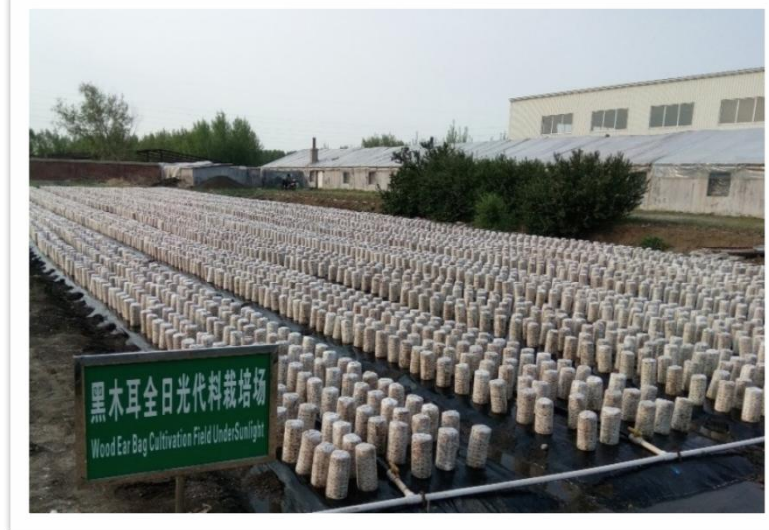


林下栽培

Under-tree cultivation

露天栽培

Open-air cultivation



四、栽培方式 Cultivation pattern



覆土栽培鸡腿菇

Soil-mulching cultivation
of *Coprinus comatus*



覆土栽培杏鲍菇

Soil-mulching cultivation of
pleurotus eryngii



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谢谢!
Thank you!



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