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Wood Ear (Pepeiao) Production in Forest Understory

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Summary

Production of high value timber products does not generate revenue until the first harvest, often requiring 20 or more years. The development of non-timber forest products has the potential to offset negative cash flow, lower risk, and result in greater economic and biological diversity than production of a single timber product. This report describes work on one of several potential secondary forest products. Wood ears (*Auricularia polytricha*), also known in Hawaii as pepeiao, are the fruiting bodies of saprophytic mushrooms that grow on a number of different hardwood species in Hawaii. Pepeiao are used in soups and stir-fry dishes and are popular in oriental cuisine in the USA and Asia. We have described a production system that may have potential for forest understory as a secondary crop. High value timber understory can provide shady, humid environments that are favorable for forest mushrooms like pepeiao. In addition, forest residuals from thinning or harvesting tree stands can provide woody substrate for pepeiao production. Additional work will be needed to develop a commercial production system.

Pure cultures of the fungus were obtained from spores produced by wood ears collected in the wild in Hawaii. The fungal mycelium was grown on agar and stored at 18°C. For inoculation of koa and other logs, a method of spawn production was developed. The best material for spawn was sterile sugarcane bagasse with 2% wheat bran added. Sterile spawn medium in clear polycarbonate plastic boxes was inoculated with agar plugs from the mycelium culture and grown for one to two weeks at room temperature until the mycelium had grown throughout the bagasse. The small boxes of spawn were used to inoculate large (1 gal) autoclavable plastic bags of sterile bagasse. Freshly cut *Acacia koa* (koa), *Aleurites moluccana* (kukui), and *Hibiscus tiliaceus* (hau) logs were used for production. Spawn culture was packed into holes drilled in the logs and sealed over with paraffin. The logs were placed in the forest understory in a shady, humid environment. After three months, pepeiao fruiting bodies began to appear on the logs and harvesting continued every one to two weeks for the next three months. All three log types produced pepeiao, but kukui logs were the most productive.

Introduction

Wood ears or pepeiao (*Auricularia polytricha*) are the fruiting bodies of a fungus, native to Hawaii, that invades and lives in the wood of cut or fallen logs of several tree types. They resemble ears in shape and are gelatinous to leathery in texture and brownish-purplish in color. The mushroom is prized in Chinese cuisine and is commonly used to give texture to soups. They were known to the early Hawaiians and became an export product to the Chinese in China and San Francisco during the late 1800s (Anon. 1914). They were also exported from New Zealand during the same period (Stamets 1993). When dried, they shrivel to a much smaller size and may be shipped in that state and rehydrated for later use.

The genus *Auricularia* contains a number of species and is classified in the order *Auriculariales* in the basidiomycete group of fungi (Alexopoulos *et al*. 1996). *Auriculariales* is the largest order of jelly fungi and the fruiting bodies or basidiocarps of many of the species are produced on wood. The brown, rubbery, earlike structures may reach 4 to 6 inches in diameter and are produced on dead stumps, logs, and branches of hardwood trees. Species of *Auricularia* are found worldwide and *A.*

polytricha occurs in both tropical and subtropical regions (Cheng and Tu 1978). The fungi are spread by airborne spores produced on the basidiocarps. Spores that land on a suitable substrate germinate, penetrate the wood and produce microscopic hairlike mycelium that grows throughout the wood. It is only when the fungus sporulates that the basidiocarps or wood ears are produced on the log surface.

Wood ears have been collected in the wild for many centuries in China and it was the Chinese that first learned to cultivate them, at least as early as 300 BC (Cheng and Tu 1978). The protein, vitamin, and carbohydrate content of wood ears are reported to be higher than that of many vegetables and fruits and the caloric content is relatively low (Cheng and Tu 1978), so they make a nutritious ingredient of soups or other dishes. For some reason, *A. polytricha* and other related edible species have never been a popular food in Europe. However, in Hawaii a ready market exists that could be supplied by commercial production in forest understory or by small farmers or backyard gardeners. The dried mushrooms need no further processing or refrigeration and could be sold to local markets, hotels, or restaurants.

Materials and Methods

Culture isolates. Pure cultures of *Auricularia polytricha* were isolated from mushrooms found growing naturally on wood. Isolates came from koa logs on Oahu and Hawaii islands and from an unidentified log at Kaalaea, Oahu. Other cultures were made from reisolates from logs inoculated from the original cultures. Pure cultures were obtained *in vitro* by cutting a small piece of pepeiao fruiting body and taping it, sporulating side down, to a petri plate lid. The lid was placed on an agar plate such that the fungal spores fell onto the agar. The agar used for isolation, growth of cultures and storage was 1% malt agar (malt extract 1%, Difco agar 2%, water 1000 ml) (G. Wong, personal communication). The isolation plate was left overnight and the following morning white spores could be seen on the agar surface. Under a dissecting microscope, individual spores were removed from the agar surface and placed on another malt agar plate where they germinated and grew. These plate cultures became the original cultures for further spawn inoculations. Storage of the isolates was in 1% agar slants at 19°C (G. Wong, personal communication).

Inoculation medium production. Sawdust or sawdust mixed with rice bran have been recommended as spawn culture medium (P. Stamets 1993, Cheng and Tu 1978). We tried koa sawdust, koa shavings or bagasse mixed with 2% malt, 20% malt, 2% wheat bran, 20% wheat bran or 2% malt and 2% wheat bran together. Bagasse containing 2% wheat bran proved to be the most suitable for our purposes. The spawn medium was moistened and squeezed in the hand to remove excess water and placed in a one inch deep layer in a polycarbonate Magenta box. Covered boxes were sterilized by autoclaving. After cooling to room temperature, the boxes of bagasse were inoculated with four to six agar plugs of fungal mycelium. Within one week at 24°C, extensive mycelium had colonized the bagasse.

TABLE 1. *Pepeiao production on koa, kukui, and hau logs measured as total fresh weight (grams) produced per harvest date.*

Date	Hau Total (range for 5 logs)	Kukui Total (range for 5 logs)	Koa Total (range for 5 logs)
April 14	0	0	30.2 (0-18.5)
April 27	0	0	1.6 (0-0.8)
May 19	0	121.4 (0-110.0)	1.9 (0-1.2)
June 16	0	290.4 (0-223.0)	24.7 (0-24.7)
July 2	9.2 (0-7.1)	130.5 (0-83.7)	12.8 (0-8.3)
July 14	5.7 (0-5.7)	81.8 (0-41.0)	2.5 (0-2.5)
Cumulative Yield	14.9	624.1	73.7

Spawn production. Production of larger amounts of spawn for log inoculation was made in sterilized bagasse 2% wheat bran. About one gallon volume of moistened bagasse mixture was sterilized in a special autoclavable polypropylene bag with a filtered opening on the side to allow pressure to escape during autoclaving and oxygen to diffuse in during mycelial growth (Field & Forest Products, Inc., Peshtigo, WI). Bags were filled about one-third full with bagasse and autoclaved for one hour. Inoculation of a bag with one or two Magenta boxes of mature spawn culture resulted in complete colonization of the media in the bag in one month.

Log inoculation. Methods for log production of mushrooms are described in Cheng and Tu (1978). Mushrooms can also be produced in cylindrical plastic bags of sterilized sawdust (Stamets 1993). A number of wood species have been reported as suitable for pepeiao production including: Taiwan acacia *(Acacia confusa)*, paper mulberry *(Macaranga tenarius)*, and small-leaf banyan *(Aleurites fordii)* (Cheng and Tu 1978), as well as a number of North American hardwood trees. The logs must be inoculated within seven days of cutting (Cheng and Tu 1978).

Koa *(Acacia koa)*, kukui *(Aleurites moluccana)* and hau *(Hibiscus tiliaceus)* logs about 3-ft long and 4-6 inch diameter were cut at Maunawili, Oahu and transported to the greenhouse. Within two days of cutting, holes 1 cm diam. x 2 cm deep were drilled in the logs in an alternating pattern. Each hole was filled by hand with spawn bagasse and sealed over with paraffin to prevent drying. The logs were placed on the ground in the shady understory of two-year-old koa stands at Maunawili, Oahu on January 7, 1998. One end of each log was laid on another supporting log to allow air circulation underneath. Logs were kept out of direct sunlight to prevent them from getting too hot or drying out. For pepeiao production, logs must be kept at 24-30°C with 90-100% RH and adequate air circulation (Stamets 1993). Once the wood has been colonized, a slightly lower temperature (12-20°C) is needed to initiate fruiting. During the winter months at Maunawili the temperature and humidity were within these ranges.

Wood ears or pepeiao (Auricularia polytricha) on Acacia koa four months after innoculation.

Results

On April 14, 1998, three months after inoculation, pepeiao fruiting bodies began to appear on the koa logs. By May 18, the kukui logs also had pepeiao, but hau logs still had not yet produced fruiting bodies. Eventually, on July 2, a couple of the hau logs did produce a few fruiting bodies, but production was very low. Fruiting seemed to correlate with rainfall, although no measurements were taken. Harvesting of pepeiao mushrooms took place every one to two weeks and continued from April 14 through July 14, 1998. Production figures are shown in Table 1. The most prolific production was from kukui which had yields almost eight times greater than koa.

Conclusions

Wood ear or pepeiao production is easily accomplished and could be carried out on a small or large scale. Isolation of pure cultures of the fungi and sterilization of bagasse spawn require laboratory equipment, so small growers may need to obtain spawn cultures from a producer. Supplies for cultivating mushrooms and cultures of some edible species other than pepeiao can be obtained from Field & Forest Products, Inc., N3296 Kozuzek Road, Peshtigo, WI 54157. Although we did not attempt it, it should be possible to inoculate logs by plugging the drilled holes with pieces of wood from another log already colonized by the fungus. The harvested pepeiao can be dried and stored for several weeks. When rehydrated, they retain their

former size and texture in a few hours and can then be cooked and consumed.

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References

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