

The Australian Wild Fungi Research Group — Creating a Better Future for Australian Horticulture

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ABSTRACT: Within Australia there is a rapidly-growing national and international demand for both cultivated and exotic mushrooms, in particular those gathered from the wild. The multicultural populations of the larger metropolitan areas have instigated significant harvesting of wild, edible fungi. The product is finding its way to market but is of variable quality, irregular supply and uncertain origin. With this in mind, a collection of wild fungi has been under development for the past two years at the School of Horticulture. The collection consists of living vegetative cultures and freeze-dried fruit bodies of over 400 wild mushrooms, which form the basis for a research and teaching program within the School. The collection provides the resources for pre-commercial cultivation trials of a wide variety of species, currently including *Lepista*, *Morchella*, *Flammulina*, *Volvariella* and *Lycoperdon*. It also provides a valuable teaching resource and an ecological reference resource.

1 INTRODUCTION

'A large number of wild mushrooms growing in nature are still locally picked for human consumption and have not adequately been investigated for the possibility of artificial cultivation. At present, there is a substantial trade in the marketing of the so-called exotic mushrooms which are gathered from the wild and because of their seasonal occurrence and rarity, command exceptionally high prices' (Jong 1989).

This statement in many ways reflects the Australian situation. It is conservatively estimated that there are 3000 to 5000 species of Australian fungi (Wood 1992), only 20% of which have been taxonomically identified. Of these, several are known to be edible, although only an extremely

small proportion have been scientifically assessed for edibility. Chang (1981) states that of the more than 200 edible fungi known, only 25 species are widely accepted as human food and of these only a few are commercially cultivated. In recent years the rate of consumption and production of fungi has increased around the world, which indicates that it is imperative to explore sources of new edible fungi (Purkayastha and Chandra 1985).

Australia has an untapped resource of edible fungi with the potential to meet increasing domestic and international demand for cultivated specialty mushrooms. Throughout the world there is a substantial trade in marketing of specialty mushrooms that have been gathered from the wild. Research into the catering industry in Sydney, Australia has indicated that there is an increasing demand among consumers and from chefs and restaurateurs for different varieties of mushrooms. Some confirmation of this can be seen by the increasing availability of exotic (commercially grown) and wild-harvested mushrooms in retail outlets and the increasing numbers of the population gathering fungi from the wild.

However, there is no cultural heritage of eating wild fungi in Australia and until recently the knowledge of and familiarity with edible and poisonous mushrooms has been lacking. The English in particular developed what at best might be called a 'wariness' about mushrooms, and in Australia today this attitude to fungi seems to have been inherited via the early British heritage. The majority of Australians are reluctant to try wild fungi even when assured of their safety. By contrast, the more recent European migrants now hunt for wild mushrooms and Asian migrants import and cultivate fungi from their nations.

This has until recently been compounded by the lack of documented information on Australian macrofungi. Gradually, the influence of the increasing European and Asian migrant population has had an effect. Their knowledge and traditions of collecting mushrooms from the wild has led to increased collecting from the wild, a higher profile for wild mushrooms among exotic foods and consequently increased demand for variety in mushrooms available to the consumer.

Australians are good consumers of mushrooms — *Agaricus* production has increased at an average annual rate of 10% per annum since 1989/90 with a resultant increased domestic market share and reduction in market imports. Market growth has been encouraged by a number of factors including: increased 'eating out' and exposure to a wider product range; improved economic climate and the tendency to try foods beyond basic necessities; and the trend towards healthier, 'natural' foods. However, the *Agaricus* market is now regarded as being in the mature stage of development, and specialty mushrooms may provide one option

for continued growth. In 1994, the domestic market was estimated at 36000 tonnes valued at approximately 135 million dollars. Exotic mushrooms made up just 1% of this market by volume and earned just over 2% of the market value. Of this exotic fraction, most was made up of Shiitake, Oyster, Enoki and Swiss browns, while wild collected mushrooms that passed through the markets amounted to less than 2 tonnes. However, much of the wild trade is direct from collector to retailer/restaurant and does not feature in the statistics.

This illustrates the vast potential that cultivated wild mushrooms offer to the future of the mushroom industry in Australia as both a domestic and export product. The Australian Wild Fungi Research Group was established with the following overall aims:

- 1) to collect fungi from the wild and to establish a living culture collection of Australian macrofungi
- 2) to create voucher documentation of the collection that provides new fundamental information on the biology of these wild fungi and creates an environmental record of the occurrence of fungi in their natural habitat
- 3) to determine the edibility of species of fungi that grow in Australia and identify which of the edible species have special appeal and are therefore most desired by the marketplace
- 4) to study the requirements of selected fungi for fruit-body production, and to develop feasible pre-commercial growing methods
- 5) to provide a teaching resource for training university students and industry personnel
- 6) to maintain a high research profile within national and local communities to satisfy both people's general fascination with mushrooms and their desire to obtain and eat a much greater variety than is currently available.

2 THE CULTURE COLLECTION

Since the majority of fungi fruit after rain, this means collecting mainly in autumn and spring in mainland Australia. The very hot conditions in summer and the dry conditions in winter mean that few fungi are found at these times, other than in specialized habitats (Wood 1980, Wood 1992). Collection is conducted on special trips made by students within the School of Horticulture, on fungal forays with interest groups such as the 'Sydney Fungal Studies Group' in which our research personnel play leading roles, or by collectors sending specimens into the university from their local areas. To cope with this variety of input into the collection, informa-

tion sheets have been written on how to collect (i.e. selection of specimen, harvesting, wrapping, transport, maintenance of viability of tissue) and to record field characteristics (photo, description of environment, weather, map location, growth habit, form, substrate, preliminary identification).

The collected material is then brought to our laboratories where tissue cultures, spore cultures and spore prints are taken. Microscopic identification techniques include: size, shape and ornamentation of spores; amyloid/dextroid reaction of spore walls (Zoberi 1972, Watling 1986); hyphal morphology and arrangement in flesh and gills; presence or absence of clamp connections etc. Entire fruit bodies are then stored in a domestic freezer at -15°C .

The vegetative cultures of the collected fungi are first grown on suitable agar media in incubators. They are then transferred to storage on agar slopes at 5°C in a refrigerator. Most specimens in the collection have then been committed to long-term storage at -80°C . These are available to interested researchers, subject to the research priorities of the Australian Wild Fungi Research Group.

3 VOUCHER DOCUMENTATION

All macro- and microscopic information is lodged in a database alongside the identified fungus. This type of voucher documentation is essential if the culture collection is to be of use for future reference (Moodie 1977, Wood 1980). Damage to the environment by extensive harvesting of mushrooms from the wild is currently unquantified in Australia. However, the demands from the multicultural population of Australia and from wholesale markets has resulted in significant wild harvesting of edible fungi. Unmonitored and unregulated, this harvesting can (and has in other parts of the world) lead to serious loss of fungi from their natural habitat. Voucher documentation of the kind developed for this collection provides a detailed ecological record of the site of origin which includes the time of observation, place (map reference if possible), location characteristics, accompanying vegetation, weather, growth form, abundance, etc. This information is the first of its kind in Australia and will provide us with the ability to accurately document the fungal ecology of the region and to observe change with the passing of time.

4 DETERMINING EDIBILITY

How do you know if the fungus you are about to eat is going to have no adverse effects, make you ill or perhaps even kill you? Fungi are much more

difficult to identify in the field than most edible life forms and their specific characteristics are only noticeable after much practice. As mentioned earlier, attitudes to wild fungi are rapidly changing, but confirmation of edibility remains a problem. There are numerous remedies and methods in mushroom folklore to determine edibility, and these are best categorized, with respect, as 'old wives tales'. All have exceptions and none can be used reliably (Christensen 1970). Human response to mushrooms can also compound the problem — what makes one person ill may have no effect on another. What you have eaten or drunk along with the mushroom can also alter the medical effects. With the lack of definitive chemical testing, careful identification remains the only answer — and then only for those fungi with an established edibility status. Access to the information, testing and microscopy needed for identification is also out of reach of most individuals.

Groves (1962) stated that there was only one way to find out whether a mushroom is poisonous and that is to eat it. If it makes you sick or kills you, it is poisonous, and it is mainly through such human experience that we have built up our existing knowledge. We would of course advocate a more cautious approach to testing mushrooms for edibility. There are now many 'mycophagists' associated with our program who are experienced at trying mushrooms that have importantly first been identified as most likely to be of edible (or at least not deadly) varieties. Their steps involve trying a small piece for bitterness -spitting it out if unpleasant and retaining samples in case of needed medical attention. If there are no adverse reactions after a couple of days, larger quantities of the mushroom are tried, and so on. This is not done indiscriminately and is never recommended to the general public.

A great deal of knowledge about Australian species of mushrooms is lacking and we cannot yet confirm edibility of many of our collection. When expanding the frontiers of knowledge on Australian fungi we stress the importance of the phrase: 'there are plenty of old mushroom hunters and plenty of bold mushroom hunters, but there are no old, bold mushroom hunters' (Fox 1992).

5 USE AS A COMMERCIAL RESOURCE

Wild-gathered mushrooms are of variable quality, unreliable supply and uncertain origin yet are fetching premium wholesale and retail prices. Market research conducted by ourselves and independent market research by supermarket retailers shows great opportunity for specialty mushrooms. With the domestic *Agaricus* market on a 'plateau', diversification is seen as the way forward.

Commercial mushroom growers support the projects of the Australian Wild Fungi Research Group and the Rural Industries R&D Corporation and Australian Research Council have also recognized, via their long-term support, the importance of the research for future domestic and export mushroom industries in Australia. Several types of wild fungi in the collection have great commercial potential and work is being conducted on their cultivation requirements. Edible fungi selected from the collection for their commercial potential are being studied by students and visiting scientists. Two Ph.D. projects are currently underway on the biology and cultivation of *Lepista* and *Morchella*, while visiting scientists from China and India have contributed work on the culture of *Lycoperdon* species (puff-balls) and a new, robust giant Australian strain of *Volvariella*. Members of the team have also published work on the culture of an Australian *Coprinus* species (Stott and Broderick 1995) and have developed an Australian substrate and cultivation method for an Australian *Flammulina velutipes* strain - now in use commercially. The cultivation process is conducted in laboratories and a pilot-scale growing room at the university. The involvement of a commercial enterprise in the research, provides the opportunity to use facilities for scale-up when required.

At present, research has concentrated on spawn production methods and the substrate and environmental conditions required for spawn run and fruiting of the mushrooms. These experiments and results are the subject of technical papers at this conference. Studies are not only aimed at production methods. We all need to know a lot more about the biology and taxonomy of these fungi and studies of lipid metabolism and mitochondrial genome analysis is currently underway to meet these needs.

6 TEACHING RESOURCE

Once frozen, the fruit bodies of the mushrooms are preserved, but must never be allowed to thaw as deterioration is rapid and irreversible. This makes the frozen specimens of little use and we now use modified freeze-drying techniques developed in our laboratories to further process the fruit bodies. The mushrooms are transferred direct from freezer to freeze drier where they are dried to constant weight — which can take from 1-10 days depending upon size and weight. The dried mushrooms maintain good shape, size, texture and coloration — a great improvement over air drying techniques. These entire specimens are far more effective visual aids to teaching than conventionally dried fruit bodies.

The fruit bodies are extremely delicate, but once mounted in sealed glass jars containing silica crystals, they are able to be stored on

shelves with no special requirements. At present, the freeze-dried fruit bodies of the collected mushrooms are well-preserved and have lasted for years. There are some exceptions that do not emerge from the process as well as others — most notably the extremely small, fragile mushrooms. However, with care and practice these are also able to be presented in a much-improved way to previous methods. The fruit bodies make excellent teaching aids, since these glass containers can be passed around a group of students or trainees to help illustrate a discussion. The vegetative cultures are also used for practical teaching with undergraduate and post-graduate students, assisting development of skills and knowledge in the biology of higher fungi and mushroom cultivation methodology.

7 COMMUNITY INTERACTION

The activities of the research group have attracted wide national and local interest with national television stations filming programs on the project and researchers have given dozens of radio interviews across Australia. The project has also featured prominently in national newspaper and magazine articles. This reflects the generally high level of interest — indeed it is a fascination — of the general public for mushrooms. Karen Stott is currently the coordinator of the 'Sydney Fungal Studies Group' — a group of individuals whose hobby is to expand knowledge of Australian fungi by collecting, photographing, identifying or simply eating mushrooms. The research team have produced a display entitled 'Fungi in your Garden' for the Australian Museum and provide an ongoing identification service to collectors of wild mushrooms.

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