

## Book Review by Solomon P. Wasser

*Growing Gourmet and Medicinal Mushrooms*,  
Third edition (2000)

by Paul Stamets

(574 pp., 510 figs., ISBN 1-58008-175-4, Ten  
Speed Press, Box 7123, Berkeley, California  
94707, USA, \$45.00)

Mushrooms are not a taxonomic group. They include approximately 12,000 species from different fungal classes having macroscopic fruiting bodies that are large enough to be seen with the naked eye and are usually picked by hand. Mushrooms are being evaluated for their nutritional value and acceptability as well as their pharmacological properties. They are a nutritionally functional food and a source of physiologically beneficial and noninvasive medicine. Some of the most recently isolated and identified substances originating in mushrooms have been shown to be promising immunomodulators and have demonstrated significant antitumor, cardiovascular, antiviral, antibacterial, antiparasitic, hepatoprotective, and antidiabetic activities (Mizuno, 1999). As S. T. Chang (1999) suggests, "mushrooms have many beneficial effects to human welfare, e.g., as food, health tonic, and medicine, as feed, as fertilizers, and for protecting and regenerating the environment. In addition, cultivation and development of edible and medicinal mushrooms can positively generate equitable economic growth and, have already had an impact at national and regional levels. The predictions are that this impact will continue to increase and expand in the 21st century, because over 70% of agriculture and forest has become non-productive materials and has been wasted in processing. Therefore, sustainable research and development of mushroom cultivation and mushroom products has been named the nongreen revolution."

It is my pleasure to review the third edition of Paul Stamets' renowned book, *Growing Gourmet and Medicinal Mushrooms*. It surely has no rivals so far in many respects of its subject. Also, the

book has more than one dimension; there are many facets that I want to point to, consider, and summarize in this review.

### SUMMARY OF THE BOOK

The book contains 24 short chapters and one long one in its 574 pages. Its first chapter, "Mushrooms, civilization and history," sets the stage of the long and rich history of human and fungal coexistence and interconnections. P. Stamets covers mostly discoveries of ethnomycology, concentrating on use of mushrooms for spiritual and religious purposes. The second chapter, "The role of mushrooms in nature," moves on to ecology and biology, describing basic ways mushrooms relate to their environment and obtain food: mycorrhizal, parasitic, and saprophytic. He gives very bright examples of each group, and illuminates the ways the mushrooms affect their environment in special situations, such as catastrophic events and accumulation of toxic wastes.

Then, the third chapter "Selecting a candidate for cultivation," simply lists the mushrooms of choice, those that can be cultivated today. P. Stamets gives 46 species names, dividing them by their habitat (woodland, grassland, dung and compost/disturbed habitat). The fourth chapter, "Natural culture: Creating mycological landscapes," is very assertive, and I would say, seductive in its description about growing desirable mushrooms outdoors using all possible facilities. The author outlines ways of inoculation (spore mass, transplantation with mycelium from wild patches, pure cultured spawn), site location, and many tricks suitable for any gardener.

Now, as we move into the fifth chapter, "Permaculture with a mycological twist," we go into the real passion of the author. When he gives his name to the model of sustaining environment ("Stametsian model for a synergistic mycosphere"), we must admit he has a full right to it. There he shares his vision of intelligent approach to agriculture, where the system is balanced and therefore stable for a long time. He advocates the use of mushrooms in such a system, and gives descriptions of eight different ways mushrooms can participate in permaculture.

Chapter 6, "Materials for formulating a fruiting substrate," speaks for itself. P. Stamets is very sensitive about recycling, and there he describes various ways of using byproducts of human industries for mushroom cultivation, along with more traditional wood and straws. There is a separate chapter dedicated to it, 18, "Cultivating gourmet mushrooms on agricultural waste products."

Chapter 7, "Biological efficiency: An expression of yield," shortly introduces the idea of how much fungal biomass could be produced through cultivation. Chapter 8, "Homemade versus commercial spawn," is also short. P. Stamets gives various proofs that commercial growers can generate their own spawn and lists the possible advantages of it. The next few chapters provide the background and discuss the techniques for doing just that. Chapter 9, "The mushroom life cycle," is pure biology with excellent photographs. Chapter 10, "The six vectors of contamination," is a very detailed description of major ways the mycelium can become contaminated. It is very practical indeed. The next two chapters, "Mind and methods for mushroom culture" and "Culturing mushroom mycelium on agar media" follow this trend of how to generate your own spawn of valuable mushrooms.

There is a very interesting chapter, "The stock culture library: A genetic bank of mushroom strains" (13). It reflects the talent of P. Stamets to introduce serious scientific matters into general practice. Ways of preserving culture slants are described there; also, different types of mycelium are characterized, such as linear, rhizomorphic, zonate mycelia, and so on. Chapter 14, "Evaluating a mushroom strain," follows the description of practical work with mycelium.

P. Stamets outlines there 28 features for evaluating and selecting a mushroom strain! As in other chapters of the book, he embroiders all of them with examples from cultivating particular medicinal and gourmet mushrooms.

Chapter 15, "Generating grain spawn," is larger than any of the previous ones. It reflects the importance of the process in a real work of a cultivator. P. Stamets does not leave any major factor of it unconsidered. He described different sorts of grains, suitable containers, supplements (such as gypsum), and then carefully described the necessary steps for generating first- and then second- and third-generation grain spawn. Liquid inoculation and spore mass inoculation are also included.

Sawdust stays in the center of attention for the next two chapters, "Creating sawdust spawn" (16) and "Growing gourmet mushrooms on enriched sawdust" (17). P. Stamets gives his own supplemented sawdust "fruiting formula." He then carefully covers the structure and operation of autoclave, indeed one of major components in modern cultivator equipment. P. Stamets carefully describes the steps of inoculating sawdust, even giving duties for the personnel (lab manager and two assistants).

Chapter 19 has abundant information about "Cropping containers." It includes tray culture, a traditional method of cultivation *Agaricus*; vertical wall culture (used mostly for *Pleurotus*); slanted wall or A-frame culture (when bags of inoculated substrate are stacked to build sloped faces); and bag, column, and bottle cultures. P. Stamets weighs various pros and cons of different containers, and supplements the materials richly with photographs.

Chapter 20, "Casing: A topsoil promoting mushroom formation," is short, as P. Stamets feels that "the possible benefits of casing are often outweighed by the risks they pose." He provides readers with two casing formulas, one traditional (with peat moss and gypsum), and one recent alternative, with vermiculite and "water crystals."

Chapter 21, "Growth parameters for gourmet and medicinal mushroom species," is the core and heart of the book. It runs 230 pages. Thirty-two species of valuable mushrooms are described in a painstakingly detailed manner. Several pages of

discussion are devoted to each species, with subsections titled as follows:

- Introduction
- Common names
- Taxonomic synonyms and considerations
- Description
- Distribution
- Natural habitat
- Microscopic features
- Available strains
- Mycelial characteristics
- Fragrance signature
- Natural method of cultivation
- Recommended courses for expansion of mycelial mass to achieve fruiting
- Suggested agar culture media
- First-, second-, and third-generation spawn media
- Substrates for fruiting
- Recommended containers for fruiting
- Yield potentials
- Growth parameters
- Harvest hints
- Form of product sold to market
- Nutritional content
- Medicinal properties
- Flavor, preparation, and cooking
- Comments

I will say more about this most important chapter further on.

The book concludes with four more chapters that discuss harvesting, storing, and packaging; mushroom recipes; and troubleshooting. Chapter 22, “Maximizing the substrate’s potential through species sequencing,” echoes and promotes the holistic concern of P. Stamets. The logic of sequencing and underlying scientific data [such as those of Chang and Miles (1989) who found that the net available nitrogen in the waste substrate after cultivating paddy straw mushrooms actually increases] are well outlined. Chapter 23 is called “Harvesting, storing, and packaging the crop for market.” P. Stamets lists advantages of the young mushrooms over the aged ones, clusters over individuals, simple dryer over sophisticated ones, and good planning schedule over the lack of it.

Chapter 24, “Mushroom recipes: Enjoying the fruit of your labors,” provides a rest for the

readers of this extensive volume. It is simple and straightforward: two dozen recipes. It concludes with a list of “Recommended mushroom cookbooks.”

The final chapter, 25, is “Cultivation problems and their solutions: A troubleshooting guide.” Dozens of problems are accompanied by probably a hundred of their possible causes and even greater number of solutions.

Six appendices provide details on farm layout, laboratory design, and growing room design. In addition P. Stamets has included a resource directory, data on hundreds of substrate materials, a glossary, and a bibliography.

The book is richly illustrated with more than 500 original photographs.

## WHAT’S NEW IN THE NEW EDITION

The key difference between the new and the old editions is that this latest edition is expanded by more than 30%. It adds cultivation information for six more species, bringing the total to 31. The latest additions are:

- *Agaricus blazei* (Hime-matsutake)
- *Agaricus brunnescens* (Portobello)
- *Pleurotus tuberregium*
- *Trametes versicolor* (turkey tail)
- *Tremella fuciformis* (white jelly)
- *Sparassis crispa* (cauliflower)

Each of these mushrooms has some special flavor. Let me briefly introduce couple of the chapters dedicated to them.

### ***Agaricus blazei* Muzz**

P. Stamets calls it “a rising star” in medicinal mushrooms, and there is no doubt about it. A body of scientific studies of this mushroom is already quite big and continues to expand. It is primarily noted for immunopotentiating  $\beta$ -glucans.

For some time, its cultivation was a difficult task, but the breakthrough was finally made by Japanese researchers, mostly by the group lead by

Professor T. Mizuno (1999). Japan is still the main producer and primary market for “himematsutake,” as they call it.

P. Stamets describes methods of *A. blazei* cultivation on sterilized sawdust and manure-based composts. He gives an interesting technique of preparing a casing layer with alternating mounds of casing soil—a ridge bed—and inoculating plugs of grain spawn in it as separate “islands.” This method was for some time popular by button mushroom growers, but then abandoned in favor of through-spawning (Atkins, 1966).

P. Stamets, as usual, is very conscious about recycling, and in the *A. blazei* chapter he outlines its growing on the recycled sawdust blocks from the end of the cultivation cycles of shiitake, maitake, reishi, and other primary saprophytes. He also considers the advantages of *A. blazei* cultivation over other common mushrooms. For instance, it predominates many molds, and is not easy to contaminate; it also repels many insects (when grown outdoors) that plague oyster mushroom cultivation.

### ***Agaricus brunnescens* Peck**

The brown button mushroom was re-introduced into the world market in the 1980s with an Italian-sounding name, “portobello.” Previously these mushrooms were viewed as unsalable because of their unusual size, but now they have become the center of a multibillion-dollar industry, being a very popular gourmet mushroom. P. Stamets provides a figure of 861 million pounds sold in 1998 in the United States. In addition to carefully described ways of cultivation, he brings up two major problems connected with portobello. One of them is its heavy use of pesticides in the *A. brunnescens* industry, because of the attractiveness of the compost and the mushrooms to insect parasites. Many of those pesticides have become banned in the United States and Europe owing to their carcinogenic and groundwater damaging properties. An obvious solution to it is organic cultivation. But the other problem does not have such an easy solution.

*A. brunnescens* contains hydrazines, and more than 80% of hydrazines are carcinogenic. The most notable carcinogenic hydrazine from this mushroom is agaritine, a powerful mutagen. This is not a very new information, but P. Stamets draws attention to the facts of recent studies of hydrazines activities after cooking or heating. For years, the conventional wisdom was that hydrazines are destroyed by cooking. However, P. Stamets draws together the results of studies (such as those of Walton et al., 1998) that show that quick cooking does not affect their activity. He adds that at any rate up to 80% of all button mushrooms are eaten uncooked. And free radicals from other foods can help to activate hydrazines into highly carcinogenic constituents (Price et al., 1996). This poses clear economic and ethical problems for the button mushroom industry, and P. Stamets speaks of them clearly and honestly. He also describes a way of resolving this problem, namely, quick development of agaritine-free strains of portobello, or at least strains with low content of agaritine.

Most of the other changes involve the addition of details and updates on techniques and procedures that should make things work more smoothly and successfully. The resources in the appendices were, of course, updated too.

### **WHAT GROWS IN “GROWTH PARAMETERS . . .”**

As I already mentioned, the core of the book is its 21st chapter, “Growth parameters for gourmet and medicinal mushroom species.” Besides the new seven species, it describes the cultivation of:

- Black poplar—*Agrocybe aegerita*
- Shaggy mane—*Coprinus comatus*
- Enokitake—*Flammulina velutipes*
- Brown gilled wood lover—*Hypholoma capnoides*
- Chestnut or kuritake—*Hypholoma sublateritium*
- Shimeji—*Hypsizygus tessulatus*
- Shirotamogitake—*Hypsizygus ulmarius*
- Shiitake—*Lentinus edodes*
- Nameko—*Pholiota nameko*

- Golden oyster—*Pleurotus citrinopileatus*
- Abalone—*Pleurotus cystidiosus*
- Pink oyster—*Pleurotus djamor*
- King oyster—*Pleurotus eryngii*
- Tarragon oyster—*Pleurotus euosmus*
- Tree oyster—*Pleurotus ostreatus*
- Phoenix oyster—*Pleurotus pulmonarius* (= *P. sajor-caju*)
- Caramel capped *P. psilocybe*—*Psilocybe cyanescens*
- King Stropharia—*Stropharia rugosoannulata*
- Paddy straw—*Volvariella volvacea*
- Reishi—*Ganoderma lucidum*
- Hen-of-the-woods—*Grifola frondosa*
- Zhu ling—*Polyporus umbellatus*
- Lion's mane—*Hericium erinaceus*
- Wood ear—*Auricularia polytricha*
- Morel—*Morchella angusticeps*

P. Stamets gives separate parameters for spawn run, then for primordia formation, and then for fruiting body development, each in terms of moisture, lighting, air exchange, and temperature. The discussion on each species includes several illustrative black and white photographs, at least one for each stage of development, and sometimes diagrams and charts. There is also a center special section of the book with 76 stunning, full-color photos of a variety of species, growth stages, habitats, and cultural practices. The color plates are truly stunning. Beautiful specimens of many of the species discussed in the book are shown under various forms of cultivation.

Let me review some of the chapters dedicated to particular mushrooms.

### **Enoki Mushroom (*Flammulina velutipes*)**

This medicinal mushroom has promising anticancer properties [in fact, it was one of the very first mushrooms with shown anticancer activity back in 1968 (Ikekawa et al., 1969)]. Its cultivation takes a critical use of the influences light and carbon dioxide have on fruiting body formation. The mushrooms grown in nature and cultivated are markedly different in appearance, because the cultivators use elevated carbon dioxide levels and limited light exposure. This helps them to obtain mushrooms with very small caps

and long stems, making the harvesting of enoki easy, and yielding final products that are highly uniform. Here we might deal with an example of what is rare now, but might become very typical in the near future with quick development of cultivation technologies of gourmet and medicinal mushrooms.

Showing how enoki mushrooms could fruit on paper substrates, P. Stamets with his excellent sense of humor gives a picture of enoki fruiting bodies from his book *The Mushroom Cultivator*.

### **The Caramel Capped *Psilocybes* (*Psilocybe cyanescens*)**

P. Stamets is a well-known authority on the identification, cultivation, and use of psychoactive mushrooms. For years, he has promoted scientific knowledge about them and their cautious and wise use for spiritual and medicinal purposes [see his books *Psilocybe Mushrooms and Their Allies* (1978) and *Psilocybin Mushrooms of the World* (1999)]. He dealt extensively with their systematics and himself has described several new species (for instance, Stamets, Beug, and Guzman, 1980). As he describes it, the cultivation of *Psilocybe* species pioneered in North America many techniques later applied to many other gourmet and medicinal mushrooms. As P. Stamets notes himself, cultivation of *P. cyanescens* has no commercial appeal, these mushrooms do enjoy a popular reputation, and are sought and cultivated by many.

The primary method P. Stamets is describing is outdoor cultivation in wood chip beds. *P. cyanescens* is unusual among cultivated mushrooms in that it can fruit not only on hardwood, but on softwood as well, particularly on conifer (Douglas fir).

### **The King Stropharia (*Stropharia rugosoannulata*)**

If we would count how many times P. Stamets uses King Stropharia in examples throughout this volume, it surely turns out to be a

large number. It is obvious he is fond of this mushroom. *S. rugosoannulata* is not popular for cultivation in growing rooms, because the yields are lower when compared to other mushrooms. However, it is very adaptive for outdoor cultivation in temperate climates. It is rapidly gaining popularity among mycologically astute recycling proponents. P. Stamets describes it as “majestic and massive.” They are large indeed: one mushroom can weigh up to 2.5 kg a piece. Woodchip beds work well for them, although this mushroom does have complex biological requirements. P. Stamets describes many ways of potentiating yields, such as mycelium disturbance, casing with microbially rich soil, harvesting young fruiting bodies, and so forth.

### The Lion’s Mane Mushroom (*Hericum erinaceus*)

*Hericum erinaceus* is an excellent gourmet mushroom, and it has medicinal properties as well, such as anticancer effects and stimulation of nerve growth factor synthesis (Kawagishi et al., 1994), and is thus potentially significant for the treatment of senility, Alzheimer’s disease, and others. Its cultivation has many peculiarities, such as that of mycelium growth. P. Stamets notes that “this mushroom requires greater attention to the details of mycelial development for the creation of spawn than most other species.” One technique P. Stamets suggests is agitation of mycelial colonies, when they already start forming primordia, into liquid culture, and then transferring to the grains. It should work much better than the traditional scalpel and wedge technique, which results in comparatively slow growth.

### CONCLUSIONS

When P. Stamets states that “mushrooms are the body intellect, the neural network of this book,” I wonder how far this metaphor goes. The lines of the text often remind me a mycelium of, say, oyster mushroom, in its aggressive, steady, and all-pervading movements. It lightens the fantasies and awakens all latent instincts to grow, to try, to experiment! I heard several times people

call it “a bible;” it might be a good comparison not only because of its comprehensiveness, but also because it probably brought many people to the camp of mycophils, and maybe further to amateur and professional mushroom growers and mycologists. It has the right spirit, besides being information-rich material.

Growing mushrooms is an area that has developed so quickly in the past few decades, that a constant updating of such information is absolutely necessary. Everything grows fast in it: technical facilities and methods, knowledge about beneficial properties of mushrooms, and people’s appreciation of their fine qualities. P. Stamets works inside a culture that historically is not favorable to the mushroom world (English and Irish mycophobic cultures, as R. Gordon Wasson called them). The greater is his challenge and achievements!

I would recommend this new edition of *Growing Gourmet and Medicinal Mushrooms* without hesitation to all individuals who deal with mushroom cultivation, be it scientific pursuits, commercial enterprise, or amateur interest. I use this volume extensively, both in teaching mycology to university students and doing experimental work in my laboratory. The data P. Stamets gives are very accurate, as to my experience, and his own thoughts are bright and intelligent.

This body of his work is really a fruiting body!

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