

# Oyster Mushroom Cultivation

## Part III. Mushrooms Worldwide

### Chapter 10

#### Regional Research

## MUSHROOM INDUSTRY IN ZIMBABWE

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### The Climate of Zimbabwe



Figure 1. Map of Zimbabwe

Zimbabwe is a beautiful country that lies on the great southern African plateau. Being in the subtropical region, the vegetation is predominantly savanna with short scattered bushes and lush grass to feed the livestock and, of course, provides ample substrate for mushroom cultivation. The year is divided into two main seasons the hot and wet summer stretching from October to March and the long dry winter covering the remaining months of the year. Although summer temperatures are often oppressive, in excess of 35°C in the southeast Lowveld, the northern Highveld region is often cooler with a summer average of 26°C and receiving more rainfall (about 1,500mm per annum versus 500mm in the Lowveld). The eastern highlands receive the highest annual rainfall amounts (2,500mm+) distributed more or less evenly throughout the year and enjoy temperatures averaging 18°C. The region, naturally, is home to most of the wild

mushrooms found in Zimbabwe. As rainfall amounts (and thus relative humidity) and temperatures increase and decrease respectively from south to north and from the west to the east of the country, so does the concentration and importance of mushroom farming. The variability in soils and climate within Zimbabwe allows for the production of various crops that produce a wide range of residues suitable for use as substrates in mushroom cultivation.

### Mushroom Industry

The mushroom industry in Zimbabwe is dominated by many small-scale producers and a few well-established companies. The larger companies, accounting for approximately 75% of the white button mushrooms marketed, are mostly family-owned businesses concentrated around the country's major cities of Harare, Bulawayo and Mutare in the eastern highlands. There are approximately ten large-scale producers, of which two are located around Bulawayo, the country's second largest city. Although no statistics are available, this group of producers accounts for about three hundred tons of button mushrooms and an estimated 50 tons of oyster mushrooms produced per year.

The small-scale producers, concentrating on the most important specialty mushroom, the oyster mushroom, account for about 60% of the total annual production of that species.

Although per capita demand in Zimbabwe for both the button and oyster mushroom has increased dramatically in the last five years, mushrooms still remain a preserve for the high-income class comprised of mostly the white population and an emerging group of rich and trendy indigenous black people. The rapid growth of this industry in recent years, most importantly the oyster mushroom cultivation, could be attributed to the need for alternative sources of protein to complement the traditional sources. This has become necessary because of the falling yields in legumes and pulses due to frequent droughts, and diseases like Anthrax and foot-and-mouth disease, which have detrimentally affected the livestock industry in recent years. In a country with beef priced at ZWD\*18,000/kg (USD22.50/kg) and an unemployment rate of well over 75%, mushrooms not only reduce protein malnutrition, but also provide an important avenue for income generation especially among women and orphaned youths. In fact, most mushroom growers are women's co-operative groups, and they are located in both urban and rural areas. Mushroom cultivation has, therefore, to a large extent, been adopted as a tool for poverty alleviation most importantly for families affected by HIV-AIDS. Zimbabwe has about 1.4 million people (35% of the population) living with HIV-AIDS.

## Important Mushrooms in Zimbabwe

### The wild mushrooms

The diversity in vegetation and climate in this country allows for a wide range of wild mushrooms to flourish. There are over 60 wild edible species in Zimbabwe and these are most commonly found in Miombo woodlands, composed mostly of *Brachystegia*, *Uupaca* and *Julbernadia* species. The Mackintoshia truffle (*Mackitonshia persica*), although little known and very rare, has recently been added to the list of edible fungi of Zimbabwe. The most important wild mushrooms are listed in the table 1.

**Table 1. Wild mushrooms of Zimbabwe**

<b>Mushroom group</b>	<b>Popular varieties (English)</b>	<b>Popular varieties (Vernacular)</b>
Termite fungi ( <i>Termitomyces</i> )	Beefsteak / Taproot mushroom	Huvhe/Nhedzi (Shona) Amakhowa (Ndebele)
Chantarelles ( <i>Cantharellus</i> )	Apricot fungus	Tsuketsuke (Shona) Ubushabishabi (Ndebele)
Button mushrooms ( <i>Agaricus</i> )	Field mushroom	Chikunguwo (Shona) Ubudzugwe (Ndebele)
Boletes ( <i>Boletus</i> )	Penny Bun / Cep / Sponge fungus / King Bole	Dindinde (shona) Kapewpew (Tonga)
Parasols		Nzeveyambuya (Shona) Indlebekagogo (Ndebele)

(Source: AREX and Partners Integrated Community Support Programme)

The boletes and the chanterelles are by far the most important mushrooms and they have a ready market for export. A number of South African and Italian companies visit the Eastern Highlands and areas around Domboshawa and Gweru during the rainy season to buy these fresh mushrooms that are picked by the locals from the forests and anthills. Unfortunately the pickers, who are often rural communities with no knowledge of the market potential or value of the mushrooms, do not earn much income from this business. For example, a picker can only get USD1 for a bucketful of fresh mushrooms!

Although locals enjoy eating these mushrooms, there is still a widespread fear of mushroom poisoning especially in urban areas. Although poisoning is not very common, there is a need to train mushroom lovers on identification of edible mushrooms and to break the misconceptions concerning mushroom poisoning.

### The button mushroom

Button mushroom (*A. bisporus*), originally cultivated as a hobby, is Zimbabwe's most important export mushroom. It is mainly produced by the more serious growers with a large capital base and sizable investment in training concerning cultivation and management of the enterprise. Although the wholesale and supermarket prices are higher than in the oyster mushroom, many newcomers are often worried about the higher prevalence of diseases with button mushroom. This mushroom, being of temperate origin, requires a more strict management of temperature while oyster mushroom can tolerate temperatures of up to 27°C as it is of subtropical origin. Electricity is expensive and few low capital investors tend to grow the button, as heaters or air conditioners are required. The button mushroom is mainly grown in trays. Wheat straw and horse or chicken manure are mixed and used as substrate.

### The oyster mushroom

The oyster mushroom bears close resemblance to some wild mushrooms found in Zimbabwe. This, and the fact that it is easier to cultivate using low cost inputs makes oyster mushroom the favorite for smallholder farmers especially those in rural Zimbabwe. Oyster mushroom has been popularized by organizations seeking to alleviate poverty through employment creation. Other objectives include reduction in protein malnutrition and promotion of environmental awareness. The Biotechnology Trust of Zimbabwe (BTZ) has trained some rural farmers in Hwedza and Venice Mine among other sites while the Intermediate Technology Development Group (ITDG) has initiated training of orphans and other members of the community in Chakowa, located in Zimbabwe's Lowveld region. Two varieties of the oyster mushroom are grown: *Pleurotus ostreatus* in winter and *P. sajor-caju* in summer.

## Oyster Mushroom Cultivation and R&D

### Spawn



Figure 2. Oyster mushroom spawn marketed in bottles (Photo courtesy of Mswaka)

Spawn production is perhaps the most important factor limiting mushroom industry, not only in Zimbabwe, but in other countries in the region as well. Although there are a good number of people trained in microbiology, molecular physiology or basic spawn production techniques, it is unfortunate that setting up these laboratories and purchasing such expensive equipment as autoclaves has been hindered either by lack of capital or interest in this business. Spawn production has, therefore, been historically performed by mushroom enthusiasts as a hobby and only quite recently as a money producing enterprise. Local spawn is widely viewed by investors as inferior in quality. They prefer to import spawn from South African companies. Although the Biotechnology Trust of Zimbabwe (BTZ) has cultured some high quality spawn at the Biological Science Department, University of Zimbabwe, the spawn has been targeted mainly for the farmers who are involved in their programs. Local spawn usually degenerates quickly and contamination levels are also high. Rural farmers usually do not have the facilities to store spawn for a later spawning date. There is a poor network of spawn supply, and customers need to respond to advertisements listed in newspapers.

Spawn is commonly sold in plastic packets, each weighing about 500g. Bottles are not very common nowadays because of the higher cost attached.

**Table 2. Prices of spawn in Zimbabwe**

Variety	Price per kg in USD
Oyster mushroom	10-15
Button mushroom (Local)	12-20
Button mushroom (imported)	40-50

There is a growing need to train farmers, especially those in rural areas on low cost spawn production in order to improve the profitability and viability of their enterprises.

### Substrate

The most common substrate is wheat straw and grass. Banana leaves, although higher yielding and producing higher quality mushrooms, are not usually favored because they give a delayed break and this substrate is not as abundant as the other two. Water hyacinth, a problem weed on some of Zimbabwe's most important lakes, e.g., Lake Chivero that makes the function as an important domestic and industrial water source for the capital city, Harare, has been used in a project run by Margaret Tagwira in Mutare.

### Growing rooms

There is a wide variability in terms of growing room construction. They range from mud and pole thatched huts in the rural areas to modern state-of-the-art growing rooms in peripheral urban areas. One common growing room in both urban and rural areas is the thatched wooden house. Thatch is important because it allows indoor temperatures to remain cooler under hot weather. The emphasis has been on encouraging growers to use any locally available materials to construct their growing rooms while at the same time ensuring that these rooms provide the right environment required for the production of mushrooms.

### Processing

75% of the mushrooms marketed in Zimbabwe are fresh. About 40% of the oyster mushroom is sold dried while virtually all the white button mushroom is sold fresh. With the recent trend towards partially processed foods, some suppliers are now slicing these mushrooms and mixing them with such vegetables like broccoli, carrots and peas. Packaging is often done in plastic packets with a net mass of 200 gram. Mushrooms are also sold from baskets in both rural and urban markets.

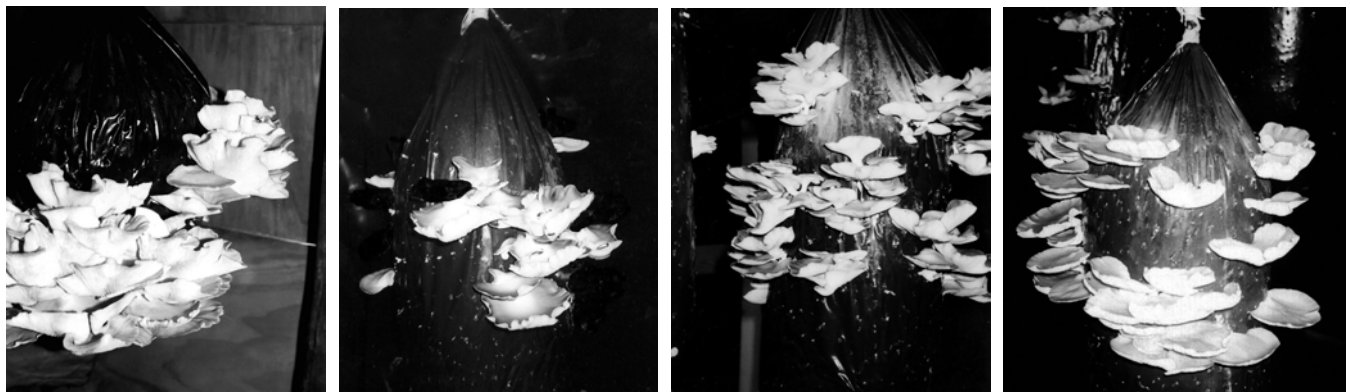
### Marketing

The phrase "whoever has the market is a king" is very relevant in the mushroom business in Zimbabwe. Market information especially on mushroom trade is kept in secret. The most common buyers are fast food chains (for pizza and burgers mainly), hotels (usually served as a soup), restaurants, supermarkets especially in the leafy suburbs and exporting companies. Although prices vary greatly, these are the general price guides:



A. Banana leaves      B. Groundnut shells  
 Figure 3. Oyster mushrooms cultivated with substrates

C. Grass      D. Wheat straw



A. Banana leaves      B. Groundnut shells  
 Figure 4. Oyster mushroom yields from different substrates

C. Grass      D. Wheat straw

**Table 3. The prices of mushroom at market**

	Price per kg in USD	
	Wholesale	Retail
Oyster mushroom	5-7.50	10-15.00
Button mushroom	7.50-10.00	12.50-17.50

**Training**

Although many people in both urban and rural Zimbabwe could benefit immensely from mushroom production, there are very few trainers available. Assistance in terms of funding to make this training feasible and affordable to the general populace has been very limited. The Biotechnology Trust of Zimbabwe (BTZ) and the Intermediate Technology Development Group (ITDG) have been very instrumental in facilitating training and promotion of the adoption of mushrooms for poverty alleviation in a number of communities in Zimbabwe.

Consultants often charge high fees, about ZWD160,000 (USD200) per grower

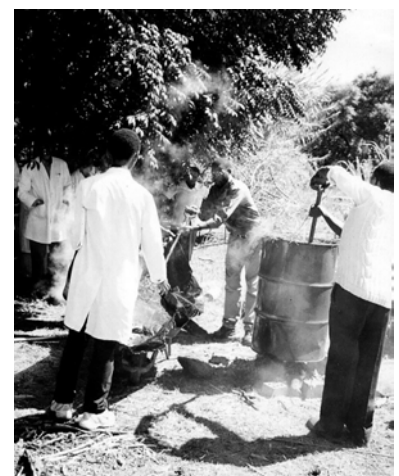


Figure 5. Trainees pasterurizing substrate(Photo courtesy of Mswaka)

per day. Very few would-be growers can afford these fees, and those who can afford are usually not willing to pass on this knowledge for free to other people interested in going into mushroom projects. Short courses, although sketchy and done over six to eight hours spread over two days, are available in most urban centers. This training costs about USD40-60. Unfortunately, trainees still need a follow-up consultancy to complement this training. In rural areas especially, courses should be run over a number of weeks as this would allow the trainees to master the art of mushroom growing and have enough knowledge to produce mushrooms in an environmentally sustainable and financially profitable manner.

### Research and development

Most research done on mushrooms in Zimbabwe has been centered on improving the capacity of farmers with low resource bases to adopt this vegetable as both an income-generating and diet-supplementing crop. Examples of projects undertaken by some undergraduate students at the University of Zimbabwe are:

- Evaluation of mushroom yields under different crop residues.
- Determination of suitable spawn carriers to achieve spawn run. Wheat, millet, crushed maize and sorghum were tested and wheat was determined to be a more suitable spawn carrier.
- Comparison of biological efficiencies of different strains of the oyster mushroom on various substrates.
- Post-harvest storage and handling of mushrooms

Breeding trials are currently underway and local scientists are trying to select suitable strains for low rainfall and high temperature regions, where poverty is more common due to higher risk of crop failure. Trials have also been done with culture spores from wild mushrooms, the *Termitomyces* in particular.



Figure 6. A researcher culturing *Termitomyces* spores (Photo courtesy of Mswaka)

### Future studies

Mites, flies, pathogenic fungi and bacteria are all common problems that reduce yields and quality of mushrooms produced in this country. There is a need to develop an integrated pest management programme to enable the small-holder producers of mushrooms in Zimbabwe and neighboring countries to produce with minimum reliance on chemicals. They have detrimental environmental effects and also increase the cost of production. This author seeks funding to carry out this research project at the Masters of Philosophy level.

### Constraints

- There are still widespread misconceptions about mushrooms. Many people fear mushroom poisoning even in cultivated mushrooms like the button and oyster.
- Lack of capacity for research due to limited funding from both the corporate and donor sector.
- The Mushroom Growers Association is little known and has not been helping growers to secure fair prices for their produce. The buyers, not the growers, often decide prices.
- Growers lack knowledge of business management.
- Poor spawn quality and limited availability of both spawn and substrate in some areas.

### Advice for Prospective Growers in Zimbabwe

Mushroom production may appear to be a lucrative business, but before one ventures into this business there are a number of factors that should be considered to avoid disappointment at mushroom growing business.

**- Is mushroom production a viable business?**

Mushroom growing is one of the most viable enterprises when one uses low cost inputs to produce the crops. Harvesting may be done a few weeks after spawning (planting) and it thus offers an earlier income. However, unless one is able to secure a good market he is likely to earn low incomes. Mushrooms are highly perishable and unless they are processed, they should be sold as soon after harvesting as possible. It is advisable that growers are able to locate a suitable market prior to harvest.

**- Which mushrooms should I grow?**

You may grow any mushroom of your choice, as long as you can access the spawn and the market for that type of mushroom. However, for a new grower it is advisable to start with oyster mushrooms which require low capital investment and low level of management skill. This will afford the grower a chance to learn more about the practices in mushroom production and prepare them for higher capital investments in such mushrooms as the buttons, creminis and portabellas. Although many mushrooms can be cultivated, the market for specialty mushrooms is still limited. The potential mushroom producer would be wise to thoroughly investigate the demand for each species before committing large amounts of time and capital to the production stage of the enterprise development.

**- What does it take to grow mushrooms?**

Perhaps the most critical input in any enterprise is skill. Prospective growers need to undergo training. This training may be done over a short period of less than a week in some cases.

Another important element is time. Mushrooms are like children in that growing them involves dedication of time, love and discipline. Management of the internal environment may be time consuming, especially where investment in machinery like air conditioners and humidifiers is low or absent. Critical stages like substrate pasteurization, bagging and harvesting may require one to hire extra labor.

**- What is the risk of producing poisonous mushrooms?**

The risk of mushroom poisoning is lower in cultivated mushrooms than in wild mushroom collecting where similar looking mushrooms can, in fact, be toxic relatives of the edible mushroom. However, if one uses substrates previously treated with chemicals, e.g. sawdust, the residual chemicals may find their way into the mushroom body, accumulate and render the mushroom toxic. Accumulation of gases like ammonia in the growing room as well as spoilage of the mushrooms may lead to stomach upsets when consumed.

**- Which is the best substrate to use?**

Mushrooms can be grown on a wide range of crop residues. In Zimbabwe, wheat straw, horse manure, and grass are the most commonly used substrates although banana leaves, sawdust, water hyacinth, maize stover, and groundnut shells have also been tried. It should be noted that the profitability of a mushroom enterprise will not only be determined by the final yield attained at the end of the cropping season, but, as well, the cost of the substrates used to produce that yield. Current training emphasis is on using what are readily available within one's locality. When harvesting the substrate, growers need to make sure that this action is in harmony with the environment. In urban areas, women's groups involved in mushroom production may benefit from the roadside grass mowed by the city or town council to improve visibility for motorists, or they could sickle the grass themselves and save their communities' financial resources. Growers may also have to enter into contracts with wheat farmers so that when the wheat crop has been harvested, they may come in and collect the straw.

**- Is growing room environment manageable?**

Efficiently managing of the growing room is perhaps the most critical stage in ensuring good yields. Growers should be concerned with temperature, humidity, pests and diseases.

Most of the mushrooms cultivated are not adapted to local climates. Button mushroom originated from temperate regions and thus growers need to ensure that temperatures remain below 18°C to allow for optimum

productivity. Always keep a thermometer in your growing room and check the temperature up to three or so times a day. Enquire with your trainer or spawn supplier the temperature requirements for the mushroom you intend to cultivate. The oyster mushroom does relatively better in the Zimbabwean climate and the challenge of growing room management is lower. Use *P. ostreatus* in winter and *P. sajor-caju* in summer, as the latter is more adapted to warmer temperatures.

Where mist blowers or humidifiers are not available, keep the floor continuously wet by pouring water on it. Placing a plastic sheet below the sand floor will prevent water loss by infiltration. Keep a hygrometer and use the readings to determine when to raise the humidity. A small difference between the two thermometers means that humidity is very high!

#### **- How do I manage diseases and pests?**

Most trainers will emphasize the need to minimise use of chemicals to control pests of mushrooms. Organically produced foods (without chemical application) are healthier to eat and will fetch a higher price. Management of diseases and pests in mushrooms is possible without reliance on chemicals. Ensure thorough pasteurisation of your substrate and practice extreme hygiene at every step of your production line. Too many people entering a growing room should be avoided as they may introduce various insects and pathogens. Prevent entry of insects which may transmit diseases by blocking any possible entry points. A grower friend of mine bought mosquito nets to cover behind the doors and the windows! Mosquito net is a good way to keep out insects.

#### **- How do I get an ‘Organic Certificate’?**

The demand for organically produced foods is still low in developing countries like Zimbabwe, but a wider market exists in Europe and USA. And early birds are already producing organic foods in Zimbabwe! ‘Organic Certificate’ may be obtained from your local agriculture department after an inspector has verified a number of factors. Neighbouring farms’ use of chemicals might affect one’s produce. If so, close attention should be made to preclude this inadvertent chemical exposure.

#### **- How can one best market mushrooms?**

Produce high quality mushrooms. This is one of the best and self-evident ways to best market one’s products. In Zimbabwe the major buyers of mushrooms are the high-income group who tend to be choosy and trendy. They will not settle for poorly packaged and stale mushrooms. Sell your mushrooms while they are at their freshest and invest enough money in packaging. Always secure a ready market prior to each harvest otherwise you risk running around with your mushrooms trying to find a customer while your mushrooms become stale. Ensure that you honour contracts by delivering the agreed quality and quantity on time. That will give you a good name and more customers to go with it.

#### **- How can I improve my market base?**

A successful grower keeps old customers satisfied and goes on to get new customers. Some people only want the slight mushroom flavour- not the whole gourmet. You may pack sliced mushrooms together with minimally processed vegetables like carrots, broccoli and peas and recommend these for soups for mushroom beginners. Try introducing mushrooms to vegetarian clubs or certain religious groups that do not eat flesh. The major challenge facing mushroom industries in developing countries is low demands. Encourage consumption by giving out spoonful of mushroom soups in large supermarkets where you intend to sell your crop. Beware; some people may react to mushrooms! Local growers may also export regionally or to the international market. Visit embassies of countries to which you wish to export get to know the buying companies and contact them. If you have access to the Internet, you may also get your customers there, BUT, beware of con men!!

So, I wish you good luck in your chosen enterprise. You have chosen well. Now you need to work extra hard to reap the mushrooms of your labour. And always ask when you are not sure.