Émile Glück-Thaler

Dr. Caroline Begg

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# Oyster Mushroom Cultivation on Coffee: A Unique Opportunity for Urban Agriculture

# Introduction

 Mushrooms are incredibly well suited for indoor urban agriculture. Unlike some other urban food crops, mushrooms do not require gardens or greenhouses and can grow inside in repurposed rooms all year round. Most impressive of all is the unique opportunity they provide to reuse urban generated wastes, such as used coffee grounds. Every major city in North America has hundreds of dedicated coffee shops, not to mention restaurants that serve coffee. A single highly trafficked café can end the day with over 20kg of coffee grounds, most of which is currently thrown out. Mushrooms, specifically the pearl oyster *Pleurotus ostreatus*, can use these grounds as a nutritional substrate to grow and fruit on. This project will explore the technical feasibility of growing gourmet pearl oyster spawn for the purpose of inoculating used coffee grounds in an urban environment.

# Literature Review

 Urban agriculture is best defined as the “growing, processing, and distribution of food and other products through intensive plant cultivation and animal husbandry in and around cities**”** (Smit et al. 1996). Indeed, an increasing amount of the food grown globally is produced in urban agricultural farms (Brown and Bailkey 2002). This surge in production, particularly in North America, is being fueled by a number of factors including food security and conscious decision-making by consumers (Brown and Bailkey 2002). Yet a quick survey of North American urban farms reveals that mushrooms are not usually grown presumably because their growth and management require a completely different skillset from that of vegetables. As well, valued gourmet species like oyster mushrooms have traditionally required growth substrate difficult to obtain within a city, such as straw. But as new information and opportunities present themselves, these two barriers to urban mushroom cultivation are fast breaking down.

 The gap between plant and mushroom cultivation knowledge has long been present. While the cultivation of plants stretches back thousands of years, the earliest recording of a large scale macrofungi farm was in 18th century Paris (Stamets 2000). There, white button mushrooms (*Agaricus bisporus)* were grown in abandoned plaster mines beneath the city until the early 20th century. Much of the commercial mushroom production since then has been limited to large-scale operations growing only white buttons outside of urban areas. This status quo is changing as demand for gourmet mushroom species, like pearl oysters, increases (United States International… 2010). As well, more information about how to grow these gourmet species is becoming available. In particular, two landmark publications *The Mushroom Cultivator* by Chilton and Stamets (1983) and *Growing Gourmet and Medicinal Mushrooms* by Stamets (1993, 2000) provide detailed information about how to grow valued gourmet species. While neither book is an explicit outline for urban mushroom farming and describe cultivation methods more suitable for spacious rural settings, they provide much needed basic information. With some exceptions, there are not very many other books that provide new information that cannot be found in the two previous titles. There is, however, a large online open-source do-it-yourself community that has recently formed. Many of the members grow only on a small scale but still provide interesting information, experimental techniques and useful advice (The Shroomery 2012, Mycotopia 2012). For example, using water-soaked perlite to increase humidity within a fruiting chamber. One drawback is that much of the information presented on these sites cannot be verified. Still, for some techniques, there is a consensus within the community as to what works and if anything, the information can inspire individuals to conduct their own experiments. Although it can sometimes be fuzzy around the edges, the core knowledge provided by both books and online resources ensure that the information necessary to start an urban mushroom farm is readily available. The gap between plant and mushroom cultivation know-how is sure to close even further with continued experimentation.

 Oyster mushrooms are especially good candidates for indoor urban cultivation, particularly because they are the easiest and least expensive to grow (Stamets 2000). They grow aggressively on a range of substrates, each with its own advantages and disadvantages. The traditional growth mediums of oyster mushrooms are woodchips and straw (Stamets 2000). Availability is a disadvantage for straw within cities because it is difficult to find and must be imported from rural areas. It must also be purchased. Availability is not usually an issue for woodchips as they can be obtained for little to no charge from landscapers or carpenters. However, a common disadvantage of using straw and woodchips is that they must be pasteurized before they are inoculated with mushroom spawn (Stamets 2000). Pasteurization of large amounts of substrate requires significant amounts of water, effort and large containers that can be heated up for several hours. This can be especially problematic for a small-scale urban operation. One advantage to using traditional substrates is that there is a lot of information available about how to use them, like what to mix in with the substrate and how to prepare the substrate for mushroom growth. Some examples of North American urban producers who use these traditional substrates are “Mushroom Maestros” (2011) located in Oakland, California and “Cottonmill Mushroom Farms” (2011) in Landis, North Carolina.

 Used coffee grounds are an unconventional and relatively untried growth substrate for oyster mushrooms. Only recently have attempts been made to grow oyster mushrooms on spent coffee, although some authors have tried growing other species on them as early as 1989 (Fan et al. 2000, Thielke 1989). As it is a relatively new concept, there is not a lot of documented literature on it. While coffee grounds are similar enough to other lingo-cellulosic substrates such that the lack of information does not affect most of the production stages (ex, growth conditions), it means that there is not yet a clear winning formula for substrate composition. One distinct advantage of using coffee grounds is that theoretically, they need not be pasteurized because the hot water of the coffee machine has already produced a similar effect (Stamets 2000, Arora et al. 2012). Limiting contamination after the grounds have been espressed is of utmost importance. It involves storing the used grounds in a clean container on site, collecting them as soon as possible and then storing them in a freezer until use. Daily collection routes would be necessary, as well as relationships with coffee shops to ensure that the used grounds are properly treated. However, when compared to pasteurization, no water is used and less space is required. Using coffee grounds also provides a unique opportunity to reuse urban generated waste. Additionally, they do not require extra steps to be brought into the city and can always be obtained for free. Although there are no known urban mushroom farmers who use coffee grounds, there are companies who use them as substrate in growing kits. These kits are colonized with mycelium at the producer’s location and are then sold to individuals so that they can grow the mushrooms at their home. The most successful company who does this is “Back to the Roots”, based in California. In 2011 alone, they collected over one million pounds of coffee and used it as a substrate for oyster mushrooms growing kits (Back to the Roots 2012). Another company that prepares growing kits from coffee is Fungi Futures (2010) located in Devon, UK, although it does not appear to be located within a city or town.

 Fan et al. (2000) report a 90% biological efficiency, or BE (see Evaluation Criteria) for used coffee grounds. Back to the Roots report up to 200% BE for used coffee grounds, but do not give any guarantee. Meanwhile, a leading oyster mushroom kit made of woodchips guarantees a 160% BE. The above values were obtained through private communications, which are available upon request.

# Research Objectives

1. To grow as many edible oyster mushrooms in the shortest amount of time possible using spent coffee grounds.

* 1. To determine the benefits, if any, of using hydrogen peroxide (H2O2)
		1. Using H2O2 as a means to reduce contamination (ie, increasing the amount of spawn generated) is a recent procedure developed by Wayne (1999). It has been well received by the online community, as well as various authors (Nicholas and Ogamé 2006).
	2. To determine the benefits, if any, of introducing mushrooms to coffee at the petri dish stage
		1. Some authors have suggested that mushroom strains grow faster on their fruiting substrate after they have already been introduced to its main constituents in previous expansion stages (Stamets 2000).

2. To keep operating costs at a minimum by:

* 1. Producing the spawn that will be used
	2. Using substrate that need not be pasteurized (used coffee grounds)

3. To minimize the environmental impact of urban mushroom farming by using waste products when possible

1. To determine if reused plastic bottles are a viable alternative to conventional plastic bags as growing containers.

4. To compare the biological efficiencies of various coffee-based substrates (see Table 4)

# Materials and Methods

## Spawn

“Espresso Oyster” sawdust spawn was purchased from the American company “Fungi Perfecti”. It arrived on site 7 days prior to use and was stored in a refrigerator until use.

## Materials of Note

### 3% Hydrogen peroxide

### Plastic bottles

Standard 2L plastic bottles were obtained and were modified into sealed containers made of 2 bottles stacked on top of each other. They were then washed with soap, sprayed with 70% alcohol and left to dry before use.

## Substrates

### Coffee

The ground coffee was obtained from a local Second Cup© Coffee Shop. It was collected every 1-3 days over a period of 3 months. On site, it was stored in a plastic Tupperware with a sealed top. Once collected, it was placed in plastic bags and frozen at -21°C until 2 days before inoculation.

### Cardboard

The cardboard was collected from recycling bins around Macdonald Campus 5 days prior to inoculation. Samples did not contain any visible glue or ink residue. Cardboard is a good addition to the substrate because it provides cellulose and improves the structure of the substrate.

### Filter paper

The recycled unbleached filter papers were purchased new. Packages were opened the day of inoculation. Filter papers are a good addition to the substrate because they provide cellulose and improve the structure of the substrate.

## Substrate Formulas

Table 1: Comparison of Substrate Materials

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristic | Coffee Grounds | Cardboard | Filter Paper |
| Size | 1mm across | 2cm x 5cm | 2cm x 5cm |
| Water content(% of weight) | 75% | 2% | 2% |
| C:N Ratio by weight (approx.)\* | 30:1 | 560:1 | 200:1 |
| PH 5.4 N/A N/A |

\* Source: Cornell Composting (1996)

Table 2: Malt Yeast Agar (MYA) Substrate Formulas (per 10 petri dishes)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Substrate | Agar (g) | Malt extract (g) | Nutritional yeast (g) | Water (ml) | Coffee | H2O2 (ml) |
| Agar | 6 | 6 | 0.6 | 300 | - | - |
| Agar, H2O2 | 6 | 6 | 0.6 | 300 | - | 2.4 |
| Coffee, agar | 6 | 6 | 0.6 | 300 | 0.45 | - |
| Coffee, agar, H2O2 | 6 | 6 | 0.6 | 300 | 0.45 | 2.4 |

Adapted from Stamets (2000) and Wayne (1999)

Table 3: Grain Substrate Formulas (per 500ml jar)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Substrate | Rye grain, dry (g) | Boiling Water (ml) | Gypsum (g) | H2O2 (ml) |
| Grain | 100 | 150 | 0.5 | - |
| Grain H2O2 | 100 | 145 | 0.5 | 5 |

Adapted from Stamets (2000) and Wayne (1999)

Table 4: Ground Coffee Substrate Formulas (per fruiting container)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Substrate Type | Coffee (ml) | Gypsum (g) | Spawn (g) | Paper filter (ml) | Cardboard (ml) | H2O2 (ml) |
| Coffee and filter paper\* | 1900 | 16.4 | 82 | 100 | - | - |
| Coffee and filter paper and H2O2\*\* | 1900 | 16.4 | 82 | 100 | - | 24 |
| Coffee and cardboard\*\*\* | 1500 | 15.4 | 77 | - | 500 | - |
| Coffee and cardboard and H2O2\*\*\*\* | 1500 | 15.4 | 77 | - | 500 | 24 |

\*Adapted from Arora et al. (2012)

\*\*Adapted from Arora et al. (2012) and Wayne (1999)

\*\*\*Adapted from Fungi Futures (2010)

\*\*\*\*Adapted from Fungi Futures (2010) and Wayne (1999)

## Inoculation procedures

All inoculations, excluding that of the coffee substrate, were performed in sterile conditions in front of a laminar flow hood. The following procedures were adapted from Stamets (2000), Nicholas and Ogamé (2006) and online recommendations.

### Preparation of petri dishes

 Mycelium samples approximately 3 cm2 were removed from the “Espresso Oyster” kit and placed onto MYA petri dishes that had been autoclaved 6 hours before (see Table 2). The dishes were then incubated at 20°C for two weeks. 10 petri dishes/substrate type were prepared, totaling 40. Strains grown in an agar medium containing H2O2 would hereon be grown in H2O2 containing mediums, and ditto for the strains grown in a non- H2O2 medium.

### Preparation of grain spawn

 Grain substrate was prepared (no H2O2) and placed in 500ml mason jars capped with an autoclavable plastic lid with a 3/8” hole fitted with a microporous filter disc (see Table 3). All jars were left to soak overnight and autoclaved the next day. H2O2  was then added. Two replicates of each petri dish strain were then selected based on their appearance and growth rate. Each dish was cut up into 10 triangular wedges. Wedges were placed in jars at a rate of 2 wedges per jar. The grain jars were shaken, then incubated on a slant at 20°C for 2 weeks. The grain jars were shaken and rotated 4 and 10 days after the inoculation. 10 grain jars/strain type were prepared, totaling 40.

### Preparation of coffee substrates

 Various coffee substrates were prepared in four 58L Rubbermaid containers (see Table 4). Grain spawn from the non-peroxide treatment and the peroxide treatment was added to the appropriate substrate at a rate of 20% by weight. The inoculated substrate was then placed in either autoclavable spawn bags or plastic bottles at an approximate rate of 2.0-2.5L per bag. The bags were then sealed with Duct tape and the bottles were sealed with felt fabric and Duct tape. 4 replicates per treatment/container type were prepared, totaling 64.

## Fruiting Procedure

### Colonization

**Specifics**: All of the bags and bottles were randomly placed in 4 incubators. In order to increase humidity within the incubators, trays of perlite were soaked with water and left inside.

**Incubation duration:** 21 days

**Temperature:** 24**°**C

**Light:** none

### Primordia formation

**Specifics:** Six to eight 1-inch long incisions in the shape of an “X” were cut into each fruiting container.

**Incubation duration:** 11 days

**Temperature:** 12**°**C for first 6 days, 16**°**C for final 5

**Light:** 1200-1500 lux

### Fruitbody development

**Specifics:** All bags and bottles were misted with water every two days. Mushrooms were harvested once the edge of their caps began to curl up.

**Incubation duration:** 16 days

**Temperature:** 20**°**C

**Light:** 1200-1500 lux

## Evaluation Criteria

### Biological Efficiency

Mushroom yields are generally expressed as a measure of biological efficiency (BE). This is the conversion rate of dry substrate into fresh mushrooms. The moisture content of the coffee substrate was 73.5%.

 BE = Mass of fresh mushroom x 100%

 Mass of dry substrate

# Results

In total, there were 8 different treatments. Their abbreviations are as follows:

**A-F**: a strain grown first on MYA and later in a coffee and filter medium

**A-C:** a strain grown first on MYA and later in a coffee and cardboard medium

**AP-F**: a strain grown first on MYA with H2O2 and later in a coffee, H2O2 and filter medium

**AP-C**: a strain grown first on MYA with H2O2 and later in a coffee, H2O2 and cardboard medium

**C-F**: a strain grown first on MYA with coffee and later in a coffee and filter medium

**C-C**: a strain grown first on MYA with coffee and later in a coffee and cardboard medium

**CP-F:** a strain grown first on MYA with coffee and H2O2 and later in a coffee, H2O2 and filter medium

**CP-C**: a strain grown first on MYA with coffee and H2O2 and later in a coffee, H2O2 and cardboard medium

**Table 5**: Final Amount of **Contaminated** Petri Dishes

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Treatment: | Agar | Agar and Coffee | Agar and H2O2 | Agar and Coffee and H2O2 |
| Total | 1/10 | 1/10 | 0/10 | 0/10 |

\*There was no contamination in any of the grain spawn replicates.

**Table 6**: Final Amount of **Contaminated** Coffee Substrates

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | A-F | A-C | AP-F | AP-C | C-F | C-C | CP-F | CP-C | Total |
| Bottle | 0/4 | 1/4 | 1/4 | 4/4 | 0/4 | 3/4 | 0/4 | 4/4 | 13/32 |
| Bag | 0/4 | 1/4 | 0/4 | 4/4 | 0/4 | 0/4 | 0/4 | 4/4 | 9/32 |
| Total | 0/4 | 2/8 | 1/8 | 8/8 | 0/8 | 3/8 | 0/8 | 8/8 | **22/64** |

**Table 7**: Final Amount of **Non-Producing** Coffee Substrates\*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|   | A-F | A-C | AP-F | AP-C | C-F | C-C | CP-F | CP-C | Total |
| Bottle | 1/4 | 3/4 | 2/4 | 4/4 | 0/4 | 3/4 | 2/4 | 4/4 | 19/32 |
| Bag | 2/4 | 1/4 | 0/4 | 4/4 | 1/4 | 0/4 | 0/4 | 4/4 | 12/32 |
| Total | 3/8 | 4/8 | 2/8 | 8/8 | 1/8 | 3/8 | 2/8 | 8/8 | **31/64** |

\* Figures include contaminated replicates

**Figure 1:**

**Table 8**: Average Biological Efficiency of All Treatments

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | A-F | A-C | AP-F | AP-C | C-F | C-C | CP-F | CP-C | Average |
| Bottle | 4.22 | 1.02 | 3.39 | 0.0 | 5.48 | 1.37 | 6.08 | 0.0 | 2.70 |
| Bag | 6.71 | 5.76 | 16.42 | 0.0 | 7.77 | 7.46 | 9.20 | 0.0 | 6.67 |
| Average | 5.47 | 3.39 | 9.91 | 0.0 | 6.63 | 4.42 | 7.64 | 0.0 |  |

Replicates that were contaminated or did not produce were included in the calculation of the average biological efficiency of a particular treatment.

A statistical analysis was performed using Duncan’s New Multiple Range Test.

| **Table 9:** Tests of Between-Subjects Effects |
| --- |
| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
| Corrected Model | BE | 1224.120a | 15 | 81.608 | 4.139 | .000 |
| Intercept | BE | 1424.895 | 1 | 1424.895 | 72.268 | .000 |
| Container | BE | 297.147 | 1 | 297.147 | 15.071 | .000 |
| Treatment | BE | 698.201 | 7 | 99.743 | 5.059 | .000 |
| Container \* Treatment | BE | 236.432 | 7 | 33.776 | 1.713 | .129 |
| Error | BE | 926.690 | 47 | 19.717 |  |  |
| Total | BE | 3543.112 | 63 |  |  |  |
| Corrected Total | BE | 2150.810 | 62 |  |  |  |
| a. R Squared = .569 (Adjusted R Squared = .432) |
| b. R Squared = .562 (Adjusted R Squared = .423) |
| **Table 10**: Treatment Affect on Biological Efficiency |
| Duncana,,b,,c |
| Treatment | N | Subset\* |
| A | B | C |
| AP-C | 8 | .000000 A |  |  |
| CP-C | 8 | .000000 A |  |  |
| A-C | 8 | 3.389561 A | 3.389561 AB |  |
| C-C | 8 | 4.412812 A | 4.412812 AB |  |
| C-F | 8 |  | 6.175774 B | 6.175774 BC |
| A-F | 7 |  | 6.245440 B | 6.245440 BC |
| CP-F | 8 |  | 7.638246 B | 7.638246 BC |
| AP-F | 8 |  |  | 9.939744 C |
| Sig. |  | .077 | .096 | .132 |
| The error term is Mean Square(Error) = 19.717. |
| a. Uses Harmonic Mean Sample Size = 7.860. |
| b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed. |
| c. Alpha = .05. |

\*Values present within the same subset do not differ significantly.

**Table 11**: The Overall Effect of Container on Biological Efficiency

| Dependent Variable | Container | Mean | Std. Error | 95% Confidence Interval |
| --- | --- | --- | --- | --- |
| Lower Bound | Upper Bound |
| BE | Bag | 6.944 | .801 | 5.333 | 8.556 |
| Bot | 2.590 | .785 | 1.011 | 4.169 |

# Discussion and Recommendations

Overall, there was a high degree of variability in the data because of the high number of 0 values due to contaminated replicates or replicates that did not produce (see Table 7). This can account for the lack of differences among certain treatments, for example, between A-C, C-C and AP-C, CP-C (see Table 10). Still, we can conclude that the effect of the treatment did not vary significantly according to the container. Furthermore, while none of the treatments involving filter paper differed significantly among themselves, only the AP-F treatment differed from all of the treatments involving cardboard. This leads to the tentative conclusion that the AP-F treatment was overall the most effective.

 Given this finding, it is interesting that the other H2O2 strains grown on the coffee and cardboard mediums (AP-C and CP-C) had a contamination rate of 100% (see Table 6). One reason for this could be that the cardboard harbored more contaminants than the filter paper. However in spite of this, the majority of non-H2O2 strains’ replicates grown on the coffee and cardboard medium were able to produce mushrooms, so the cardboard cannot be the only source of difference. This leads to a second possibility for the discrepancy between the productivity of the H2O2 strains on the filter and cardboard mediums: perhaps the H2O2 strains were more susceptible to contamination because they had previously been grown under more sterile conditions. Growth on a more sterile medium could have the effect of conditioning the strains to not produce defensive compounds that inhibit competitors. If a mushroom strain is grown with H2O2 in the future, it is recommended that the substrates it grows on be as sterile as possible.

 The biological efficiency (BE) values of the coffee were lower than what could be expected from a traditional substrate. This is fine because reaching a traditional BE is not that critical, as the coffee is being thrown out anyways and can be obtained at no cost. The same could not be said for straw or woodchips since these substrates would have to have a high BE to justify their purchase for use as a mushroom substrate rather than for something else. This being said, it would still be beneficial to find ways of increasing the BE of coffee. A simple way to do this would be to initiate fruiting on the containers a second time. Other ways of doing this include increasing the cellulose content of the substrate by adding more filter paper, increasing the fruiting surface area and increasing the humidity of the growth chamber.

 Treatments in bags performed better than in bottles. The bags had a 95% confidence interval of [5.33, 8.56] and the bottles had [1.01, 4.17]. In addition, the bags were much easier to make incisions in. This makes them the ideal growing container as of now. In future experiments, it could be interesting to find ways of maximizing the fruiting surface area of the bags by perhaps entirely removing the bag from the colonized substrate block and replacing it with a larger bag. It could also be useful to search for containers that are more efficient at growing mushrooms en masse, like vertical trays.

 Maintaining humidity in the incubators was an issue during the fruiting stages. Some fruiting bodies dried up even though the containers were misted with water every two days and there were trays of water and perlite. This may be that while the above treatment is suitable for cultivation of a few containers, having so many of them in one space requires an unprecedented amount of moisture. Additional methods for increasing humidity should be used in future experiments. For example, an automatic humidifier or nylon stockings filled with perlite and soaked with water that can be hung around the growing room.

 Introducing coffee to the mushroom mycelia at the petri dish stage had no significant effect. If we look at Table 10, no significant difference is found between counterparts: C-F was not significantly different from A-F; CP-F was not significantly different from AP-F, etc. It is therefore not recommended that this method be used. However, if one wanted to experiment further with this, it would be recommended to autoclave the coffee separately and then sprinkle them on top of the agar after pouring instead of initially mixing the coffee with the agar. This way, the mycelium would have more access to the coffee. Using H2O2 at the petri dish stage did have some success at reducing contamination (see Table 5).

 The coffee and cardboard mediums had higher rates of contamination than the coffee and filter mediums (see Table 6). This makes sense, as the filter papers came from an unopened package. The filter papers had to be purchased new because the coffee obtained from the Second Cup© did not include any. However, it is reasonable to assume that any filters obtained with collected coffee would be as sterile as the coffee and would therefore be appropriate for use. As of now, it would be recommended to use unbleached filters. If future researchers wanted to experiment further with using cardboard or other waste paper, it would be recommended that they find ways to pasteurize it. These may include boiling or steaming. This could be very useful, as there is a lot of cardboard and paper that is currently thrown out or recycled. This could lead to the cultivation of other gourmet mushrooms that require cellulose rich substrates, like shiitake.

 Most of the contamination of the coffee substrate occurred on the top surface layer. Contaminants such as green mold were able to colonize this area faster than mycelium in most cases, for whatever reason. Given this, it would be advisable to sprinkle additional mushroom grain spawn on the top surface layer for future inoculations. Doing so would hopefully give the mycelium an advantage. It is also interesting to note that the oyster mushroom mycelium was able to overcome contamination in the coffee substrate over time in some cases (see Figure 1). This demonstrates the aggressiveness of the pearl oyster and strengthens its choice as a candidate for cultivation on coffee.

# Conclusion

Spent coffee grounds are cheaper and require less space than conventional mushroom substrates. Using them to grow mushrooms in a city will reduce energy costs and will reduce urban generated waste. As more people become aware that the cultivation of oyster mushrooms on spent coffee grounds is possible, more effective growing techniques will become publicly available. It is sure to become one of the more popular methods of growing mushrooms in urban settings.

This project will further be developed in the upcoming year by establishing a permanent growing facility on McGill campus and by developing formal relationships with McGill Food and Dining Services and local coffee shops.

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