



## Optimal Conditioning of Growth Media White Oyster Mushroom (*Pleurotus ostreatus*) to Increase Productivity

Asep Hodijat<sup>1</sup>, Elin Nurlina<sup>2</sup>

<sup>1</sup>Departement of Food Technology, Faculty of Agriculture, Ma'soem University. Jln. Raya Cipacing No. 22 Jatinangor Sumedang 45363, Sumedang Regency, West Java, Indonesia

<sup>2</sup>Faculty of Engineering, Jenderal Achmad Yani University, Jl. Terusan Jend. Sudirman, Cibeber, Kec. Cimahi Sel., Cimahi City, West Java 40531

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Corresponding Author:  
Asep Hodijat

### ABSTRACT

The cultivation of white oyster mushrooms is the difficulty of making mushroom seedlings, especially the technology is quite expensive and the nature of mushroom growth which has two different temperatures, namely low temperature when making seedlings and medium temperature when forming mushroom fruit bodies. Therefore optimal conditioning of the growth medium of white oyster mushroom (*pleurotus ostreatus*) to increase production yield. Judging from the business opportunity, oyster mushrooms are among the most popular compared to other types of mushrooms. In general, white oyster mushroom cultivation is considered easy to do, as long as the living environment is well considered. Although mushrooms are more optimal to grow in the highlands (cool areas), cultivation in the lowlands can also be done, as long as the place of maintenance is conditioned the same as its natural habitat.

### I. INTRODUCTION

White oyster mushrooms are known as an alternative source of protein because they contain 9 essential amino acids, supplements for dieters, alternative foods for vegetarians and people with high cholesterol and are believed to act as antioxidants and antitumors because they contain pluran compounds. This mushroom also contains unsaturated fatty acids and crude fiber so it is safe for consumption. Yield productivity Cultivation of white oyster mushrooms (*Pleurotus ostreatus*) needs optimal growth media, from the preparation of mushroom seeds, transfer of seedlings in baglogs and formation of fruit bodies of mushrooms. Because the problem that is often faced in the cultivation of white oyster mushrooms is the difficulty of making mushroom seeds, especially the technology is quite expensive and the nature of mushroom growth which has two different temperatures, namely low temperatures when making seedlings and intermediate temperatures when forming mushroom fruit bodies. Therefore optimal conditioning of the growth medium of white oyster mushroom (*pleurotus ostreatus*) to increase production yield.

Judging from the business opportunity, oyster mushrooms are among the most popular compared to other types of mushrooms. In general, white oyster mushroom cultivation is considered easy to do, as long as the living environment is

well considered. Although mushrooms are more optimal to grow in the highlands (cool areas), cultivation in the lowlands can also be done, as long as the place of maintenance is conditioned the same as its natural habitat

The problem that is often faced in the cultivation of white oyster mushrooms is the difficulty of making mushroom seeds, especially the technology is quite expensive and the nature of mushroom growth which has two different temperatures, namely low temperatures when making seedlings and medium temperatures when forming mushroom fruit bodies. These two types of problems are behind the research. Complaints that often occur are usually when the rainy season arrives. Cold weather conditions and simple beetle houses make the growth of mushroom fruit bodies less optimal. As a result, production decreased by 70%. Efforts to solve these problems are actually always carried out by mushroom farmers, but the results have not been too optimal. To assist mushroom growers in overcoming the problem, Problems that occur in oyster mushroom cultivation are due to:

- Less sterile working environment,
- Poor slum environmental conditions
- Poor growth of seedlings
- From media contamination problems

## II. METHOD

### A. White Oyster Mushroom Seeds

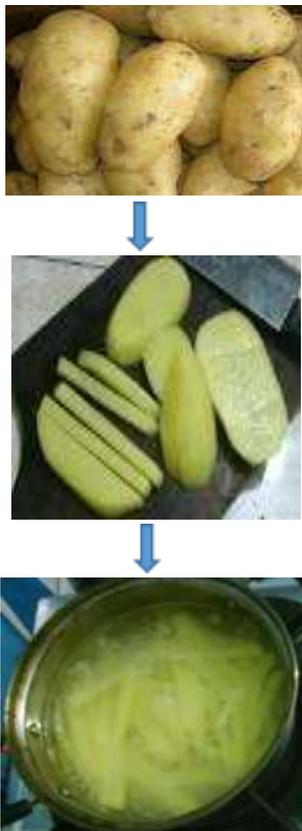
To carry out the cultivation of white oyster mushrooms, the process begins with the preparation of mushroom seedlings, the removal of seedlings in baglogs and the formation of mushroom fruit bodies. For novice farmers, it is usually not willing to take risks at the time of breeding. So seedlings are obtained from groups of farmers who are already more experienced.

Tips for getting good mushroom seeds are: (a) White mycelium grows evenly, not too dense / sparse (b) The age of seedlings is not more than 4 weeks after the time of inoculation / Nursery. So it is necessary to know the date of seeding; (c) Seedlings should be kept in a cool room and protected from light when not in use. When it will be used, the seedlings should not be cold; (d) Seeds taken from bottles should be all planted, no one left.

The process of preparing seedlings is actually not too difficult. However, because prospective seeds are very vulnerable to microorganism contamination, not all farmer groups want to do it. The preparation of seedlings and the process of transferring seedlings into fungal growth media can be done as follows.

#### Preparation of white oyster mushroom growing media

(a) A total of 200 grams of potatoes are washed, thinly sliced (5 mm), plus 1000 mL of water, boiled until soft and the water is half



**Figure 1:** Preparation of white oyster mushroom growing media

- (a) Potatoes are removed and drained
- (b) The cooking water is filtered, heated with 20 grams of stem gelatin, then added 20 grams of glucose, stirred 15 minutes and becomes liquid.
- (c) A warm solution is inserted in a tube containing a quarter of the volume of the tube, covered with cotton wool lined with aluminum foil, then tied with rope. This process produces 150-200 tubes.
- (d) Sterilization of all tubes at 120oC for 40 minutes. After cooling, all tubes are stored in the refrigerator

#### Preparation of F1 mushroom seedlings

- (a) Good mushrooms washed with 70% alcohol
- (b) The crown of the mushroom is cut with a sterile knife, that is, a knife that has been washed with alcohol and heated on a flame
- (c) Made thin slices with a sterile knife, called an explant
- (d) The explant is grown on potato media that has been made obliquely in a sterile test tube (a tube that has been sterilized two days before use).
- (e) Explants in tubes are stored at a temperature of 24-29oC for 15-30 days.

#### F2 mushroom media preparation

- (a) F2 media is prepared by mixing the following ingredients evenly : sifted sawdust (75-85%) ; bran (10-15%) ; chalk (1-3%) ; Gypsum; TSP fertilizer ; water moderately. The mixture is stirred evenly so that the water content in the mixture is around 45-60%, indicated by the condition that if the mixture is grasped, it does not drip water and does not break if removed.
- (b) The mixture is put in bottles, then sterilized at 120oC for 3.5 hours
- (c) The mixture is stored in an incubator with a temperature of 24-29oC for 2 days

#### Manufacture of F2 mushroom seedlings

- (a) Seeds that have grown in F1 media in 1 bottle are taken aseptically (free of contaminants)
- (b) The seedling is put in a bottle already containing F2 media
- (c) The F2 bottle is then incubated at a temperature of 24-29oC for 2 days
- (d) The results obtained are 8-10 F2 breakdowns

#### F3 mushroom media preparation

- (a) F3 media is made by mixing evenly the following materials: sawdust that has been sieved (75-85%) ; bran (10-15%) ; chalk (1-3%) ; Gypsum; TSP fertilizer ; Water moderately until the mixed water content is around 45-60%, which is shown by not dripping water when held and not breaking when released.
- (b) The mixture of ingredients is put in bottles, then sterilized at 120oC for 3.5 hours
- (c) The mixture in the bottle is then incubated at a temperature of 24-29oC for 2 days.

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(b) The mixture of ingredients is put in bottles, then sterilized at 120oC for 3.5 hours

(c) The mixture in the bottle is then incubated at a temperature of 24-29oC for 2 days.

### Preparation of F4 mushroom seedlings

(a) F4 media is made by mixing evenly the following ingredients: sifted sawdust (75-85%); bran (10-15%) ; chalk (1-3%) ; Gypsum; TSP fertilizer and sufficient water so that the water content becomes around 45-60%, indicated by the state of the powder mixture does not drip water when grasped and does not break when released.

(b) The mixture is put in a plastic bag (polyethylene material) evenly and densely, then put in a steamer bath with a temperature of 105-110oC for 8-10 hours, then allowed to cool. Steaming for 12 hours is recommended to produce a more contamination-resistant mold growth medium. This mushroom media material is referred to as baglog.

(c) The baglog is closed by making a ring on the top

(d) The result is 33-35 pieces of baglog

For work efficiency, it is necessary to make efforts to maintain the quality of seedlings can be done by: by using sterile tools; (3) Seeds that have been opened from their containers must be removed, because they can be overgrown with other fungi; (4) If the seedlings are to be transported to a distant place, the appropriate temperature and humidity must be maintained.

### B. Efforts to Maintain and Anticipate Disease Pests

The maintenance of white oyster mushrooms can be done in the following ways: (a) Observe every day the temperature and humidity of the beetle house. The regulation of this condition can be helped by ventilation. The temperature difference of 10o C during production is considered normal. (2) Watering is carried out morning, afternoon and evening to regulate the temperature and humidity of the room in the beetle house. Watering is carried out on the inner and outer walls of the beetle, floor, as well as baglogs. (3) Avoid pests such as: flies, rats, worms, insects, ants and termites.

### C. Harvesting and Post-Harvest

Oyster mushrooms that are worth harvesting are those whose fruit body growth has been optimal. During 1 planting period, it can be harvested 4-8 times, depending on the supporting conditions. Weight about 750 grams/baglog. Harvest time is usually done in the morning, afternoon or evening. The fungus must be treated immediately, as it is easily damaged. When harvesting, mushrooms are selected

according to their size, color and shape. If there is dirt, it is cleaned with a sterile tool. Mushrooms are stored at low temperatures (1-5oC) so that they can last 2-3 days, then can be processed according to taste.

### III. DATA AND ANALYTICS

White oyster mushroom (*Pleurotus ostreatus*) is one type of mushroom that can be consumed. Her easy cultivation, beautiful appearance



Figure 2. White Oyster Mushroom (*Pleurotus ostreatus*)

### A. Nutritional Value Data. White Oyster Mushroom (*Pleurotus Ostreatus*)

White oyster mushrooms contain many nutrients that are good for health, namely.

Table 1. Nutritional Content of Oyster Mushrooms Per 100 grams

Component	Content
Calorie	45,65 kj
Ca	8.9 mg
Fe	1.9 mg
P	17 mg
Vit B1	0.15 mg
Vit B2	0.75 mg
Vit C	12.4 mg
Protein	5,94 %
Carbohydrates	50,59 %
Fiber	1.56 %
Fat	0.17 %

One alternative that can be used as a planting medium for white oyster mushrooms is coconut husk. Coconut coir is lignocellulose waste that has such great potential but has not been fully utilized for productive activities that can increase its added value. Coconut coir has lignin (35%-45%) and cellulose (23%-43%) content, while sengon wood has a high cellulose content (Holo-cellulose 74.9% and alpha-cellulose 46.0%) and lignin content of 25.7%. The amount of nutrients in coconut fibers includes elements N 0.975%, P 0.095%, K 0.29% and C 54.89% (Purnamasari, 2013, in FITRA, 2018.).

The increase in NPK fertilizers (nitrogen, potassium phosphate) can affect the productivity of oyster mushrooms compared to those without NPK. Data taken from his research From the fingerprint analysis, it is known that the treatment of various sawdust and NPK fertilizer treatment has a real effect and the interaction of the two also has a real effect on the number of mushroom hoods/clumps. The M1

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(rubber) treatment showed the highest average number of mushroom hoods/clumps of 5.39 hoods while the M3 (coconut) treatment showed the lowest number of mushroom hoods/clumps of 3.77 hoods. The treatment of M1 (rubber) is significantly different from M2 (pecan) and M3 (coconut). Table 2. Average number of mushroom hoods/clumps on various sawdust media and NPK fertilizer application. Sawdust NPK Fertilizer (g/baglog) P Average 0 (Without Fertilizer)

**Table 2.** Age of mushroom harvest on various sawdust media and NPK fertilizer application

Sawdust	NPK (gr/baglog)			Average	
	P0(0)	P1 (5.6)	P2 (11.2)		P3 (16.8)
M1 (rubber)	65.50	60.67	64.33	60.33	62.71a
M2 (pecan)	62.42	63.08	61.42	63.08	62.50a
M3 (coconut)	60.92	53.75	52.00	54.00	55.17b
Average	62.94	59.17	59.25	59.14	

Description: Numbers followed by different notations in rows and columns show markedly different according to Duncan's Multiple Spacing Test at 5%

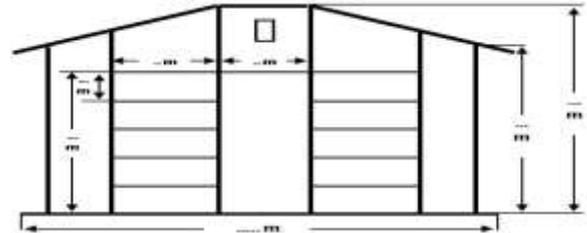
Based on this data, white oyster mushrooms are recommended as an alternative source of protein because they contain 9 essential amino acids, supplements for dieters, alternative foods for vegetarians and people with high cholesterol and are believed to act as antioxidants and antitumors because they contain pluran compounds. This mushroom also contains unsaturated fatty acids and crude fiber so it is safe for consumption. White oyster mushrooms have a beautiful physical shape with a hood like oysters. It is generally pure white.

### B. Conditions of the place of growth

The plant is easy to grow in areas of 550-800 meters above sea level (cool areas), although now many have also been planted in the lowlands. The growth temperature ranges from 20-30°C with a humidity of 80-85%. The required moisture content is about 60% and the pH is between 6-7. The growth of fungi is highly dependent on the amount of oxygen, although not excessive. And (1) Mushroom seeds should be stored at an appropriate temperature (24-29°C), humidity 90-100%, sufficient light and not exposed to direct sunlight; (2) Mushroom seeds should be kept away from other fungal disorders, therefore the conditions of the mushroom house should be made in such a way that oxygen is available in sufficient quantities. Common thermophilic mushrooms grow in the temperature range of 40°-75°C, with an optimum temperature of 55°C.

White oyster mushrooms are mesophilic. Basically mushrooms love damp places, even the required level of humidity can reach 80-90%.

Generally, kumbung houses are made with sizes: length = 4 m, width 6 m, height 3-6 m which can contain 1000 baglogs of production. The sketch drawing of the beetle is as follows:



**Figure 3.** Sketch of the beetle

The house is equipped with stacking shelves, the distance between rows is 80-90 cm. Each rack contains 15 baglogs (upright position) and 20-30 baglogs (lying down). Each rack can contain 15 x 20 = 300 baglogs. As an illustration, mushroom business actors who cultivate 1000 baglogs will need a gathering room with a length of 4 meters, a width of 6 meters and a height of about 3-6 meters. The size of the beetle is very important to note, so that the air circulation is smooth and the humidity in the beetle can be stable.



**Figure 4.** Home mushroom beetle

Mushroom beetle houses, can be made using bamboo, wood, gedeg (woven bamboo), tiles, plastic, and nails. First of all, a frame of bamboo is made, then the wall can be covered with a large which is then coated with plastic. When the mushroom beetle has been established, the roof tile is installed and doors and windows are made to regulate air circulation.

### C. Sales Calculation Data Per One Period Oyster mushroom productivity

1. Production per each one period is 2500 Baglogs x 90% x 0.75kg = 1.687.5 kg
2. The current selling price of oyster mushrooms to middlemen is IDR 10,000 / kg so that per each period farmers receive income of IDR 16,875,000
3. Especially if sold to retailers or consumers at a price of IDR 12,000 - IDR 15,000 / kg

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- then the income of mushroom farmers ranges from IDR 20,250,000 - IDR 25,312,500,-

### Profit Per One Period of Productivity of Oyster Mushrooms (Sold to middlemen)

$$\begin{aligned}\text{Profit} &= \text{Sales result} - \text{Total cost} \\ &= \text{IDR } 16,875,000 - \text{IDR } 8,738,815 \\ &= \text{IDR } 8.136.185,-\end{aligned}$$

### Break Event Point (BEP)

$$\begin{aligned}\text{BEP production volume} &= \frac{\text{Total cost}}{\text{Selling Price}} \\ &= \frac{\text{IDR } 8,738,815}{\text{IDR } 10,000/\text{kg}} \\ &= 873.88 \text{ kg}\end{aligned}$$

The breakdown point for oyster mushroom cultivation using a 6m x 6m beetle during one planting period will be reached if production reaches 873.88kg

### Return Of Investment (ROI)

$$\begin{aligned}\text{ROI} &= \frac{\text{Profit}}{\text{Total cost}} \times 100\% \\ &= \frac{\text{IDR } 8.136.185,-}{\text{IDR } 8.738.815} \times 100\% \\ &= 93.10\%\end{aligned}$$

ROI of 93.10% means that every Rp 1 spent will generate profits IDR 0.93

In utilizing the benefits of mushroom cultivation, it can be developed again for the mushroom processing business in the campus central canteen, so it is hoped that the profits obtained can be even greater. So that through the application of the results of this research is expected to motivate efforts, creativity. develop knowledge, business expertise, and form business units of research results in science and technology development applications.

### D. Oyster Mushroom Productivity Inhibition Data

Microbial contaminants that interfere with the productivity of oyster mushroom production



Figure 5. Contaminated Baglogs

Microbial contaminants not only grow in seedling media, but often grow also on baglogs for the growth of oyster mushroom fruit bodies, as shown in Figure 2. Baglogs that have been contaminated are usually immediately separated or disposed of, for fear of contaminating other baglogs. Poor growth of seedlings can occur due to contamination of the media.



Figure 6. Black mold and green fungus that often interfere

### E. CONCLUSION

Yield productivity Cultivation of white oyster mushrooms (*Pleurotus ostreatus*) needs optimal growth media, from the preparation of mushroom seedlings, the transfer of seedlings in baglogs and the formation of mushroom fruit bodies. For the success of the white oyster mushroom (*pleurotus ostreatus*) business, it is necessary to master the mushroom cultivation technique, starting from the seeding stage, sterilization of planting media, mushroom maintenance, to product marketing. Many problems that can arise in business, mushroom cultivation include media contamination problems and a mushroom growth environment that is less steri, unfavorable beetle climate conditions and poor seeds. Maintaining and providing good growth media can increase the productivity of oyster mushrooms (*Pleurotus Sp*), among others with the addition of NPK fertilizer.

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