

## Vegetable Waste-A Potent Substrate for Cultivation of *P. Ostreatus*

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**Abstract:** *P. ostreatus* is commonly called as oyster mushroom. It is one of the most commonly cultivated and second largest to be cultivated. They are known for their nutritive values and medicinal properties. It belongs to the Class Basidiomycetes and Family Agaricaceae. It is one of the most suitable fungal organism for producing protein rich food from various agro waste without composting. The present study describes the cultivation of oyster mushroom with the utilization of vegetable waste (peels of carrot, radish, potato, cucumber and onion) in combination with agro waste (paddy straw, rice husk, wood shaving and sugarcane bagasse) as substrate. Different ratios of both the substrates were used for the cultivation. When cultivation was carried out on vegetable waste alone, there was absence of mycelium spread and fructification. However, the combination of 50% vegetable waste and 50% paddy straw supported significant growth. Thus the study implies that vegetable waste can prove to be a potent substrate for cultivation of oyster mushroom.

**Keywords:** oyster mushroom, vegetable waste, agro waste, cultivation

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### 1. INTRODUCTION

India is the second major producer of vegetables in the world and contributes 14% of total world vegetable production. Taking estimated production of fruits and vegetables in India at 150 million tons, the total waste generation comes to about 50 million tons per annum [1]. Fruits and vegetables wastes are more prone to spoilage than cereals due to their chemical composition. This creates unhygienic condition leading to spread of diseases and loss of resources. The wastes produced from these vegetables are a rich source for nitrogen and carbohydrate but are not fit for consumption. This resource can be utilized for the production of not so fastidious mushroom such as the oyster variety.

In the recent times the management of waste disposal has created a hot of topic for debate. Proper management and execution of waste disposal practices have become the need for the hour. The inappropriate management of waste has led to many problems such as rapid spread of infectious diseases, development of new varieties of diseases and inability of the common man to cope with them.

The exponential increase in the present amount of waste produced brings to notice an immediate requirement of an answer to the threat. Managing the day to day wet waste produced at a home seems to be the only probable solution.

Lignocellulosic materials are generally low in protein content, insufficient for the cultivation of mushrooms, which requires nitrogen, phosphate and potassium. Since the C:N ratio plays an important role in spawn running and the growth of fruiting body, nitrogen supplementation is an important factor for the growth and yield of mushrooms. Cultivation of mushroom on these residual wastes is one of the most eco-friendly practices to fight the malnutrition and environmental pollution caused by these wastes.

The present study focuses on the advantage of utilization of vegetable waste as a source of substrate for cultivation of oyster mushroom. These mushrooms are known for their nutraceutical and medicinal properties and according to the study these properties are enhanced with the utilization of these substrates providing a possible solution to the problem at hand.

## 2. MATERIALS AND METHODS

### 2.1. Collection of Spawn and Substrate

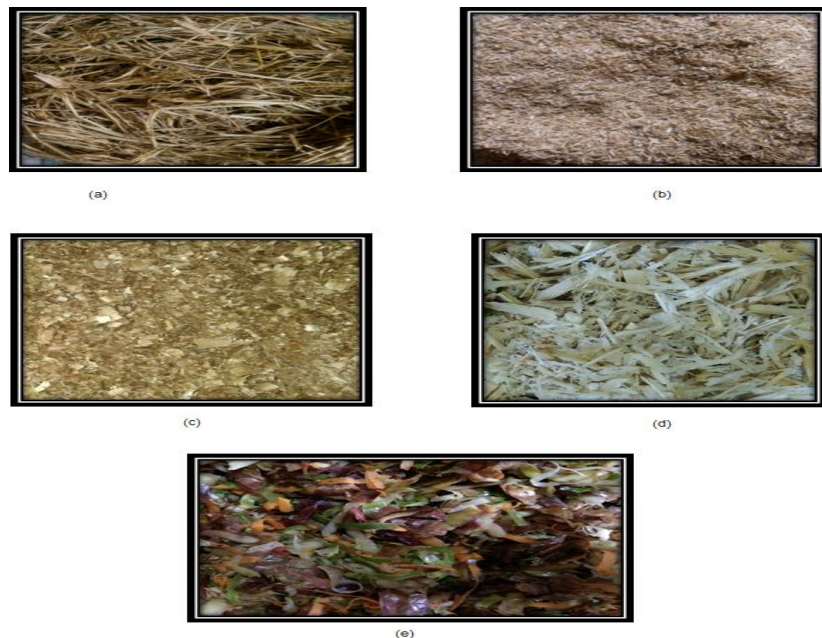
The spawn seeds of *P. ostreatus* were collected from Biocentre, Department of Horticulture, Bannerghatta Road, Bengaluru. It was stored at cold temperature until it was used. For cultivation both agricultural waste and vegetable waste was collected. Four different agro wastes as substrates were used. Paddy straw (PS) was collected from agricultural field, rice husk (HK) from rice mill, wood shavings (WS) collected from saw mill and sugarcane bagasse (SB) from sugarcane juice centre. Vegetable waste (VW) such as carrot, radish, potato, cucumber and onion were collected from the nearby household.

### 2.2. Sterilization of Substrates

The collected agro waste (AW) and VW was subjected to heat treatment before its use to minimize contamination. PS (chopped into 2-4cm), HK and WS were soaked in water over night and then excess water was drained out [2]. All the three substrates were dried on newspaper and each substrate was filled into separate bags and then autoclaved for a certain period of time at 15 psi that is 121°C [3].

SB was treated to remove any residual sugar. The cane was cut into small pieces (4-6cm) and then soaked in water for 30 minutes and water was drained. This step was repeated for next 30 minutes by changing water. Next it was soaked in boiling water for 30 minutes and then dried on newspaper. Once it was dried the bag was packed and autoclaved at 121°C for certain time [4].

Equal proportions of VW (peels of carrot, radish, potato, cucumber and onion) were sterilized by soaking them in boiled water for 30 to 45 minutes. After that the content was strained and it was dried on newspaper. This dried substrate was used for packing. Fig 1 depicts the substrates utilized for cultivation.



**Fig1.** substrates utilized for cultivation (a)paddy straw,(b)rice husk (c)wood shavings (d)sugarcane bagasse and (e)vegetable waste

### 2.3. Packing and Spawning

After the sterilized substrates had reached room temperature, it was ready for packing and spawning. Substrate moisture content was maintained at 70% before filling the bags. Polythene bags (48cm x 20cm) were used for packing. Spawning was done by layer spawning, where the substrate was filled in the bag and pressed at the bottom to the depth of 6-9cm and handful of spawn was spread outwards. Same way 3 to 4 layers of substrate was spread with simultaneous spawning [3]. Fig 2 indicates the packing of agro waste as substrate.

Another set of packing and spawning was carried out by using the combination of agro waste and vegetable waste as substrate (as depicted in Fig 3). Two different types of packing were carried out:

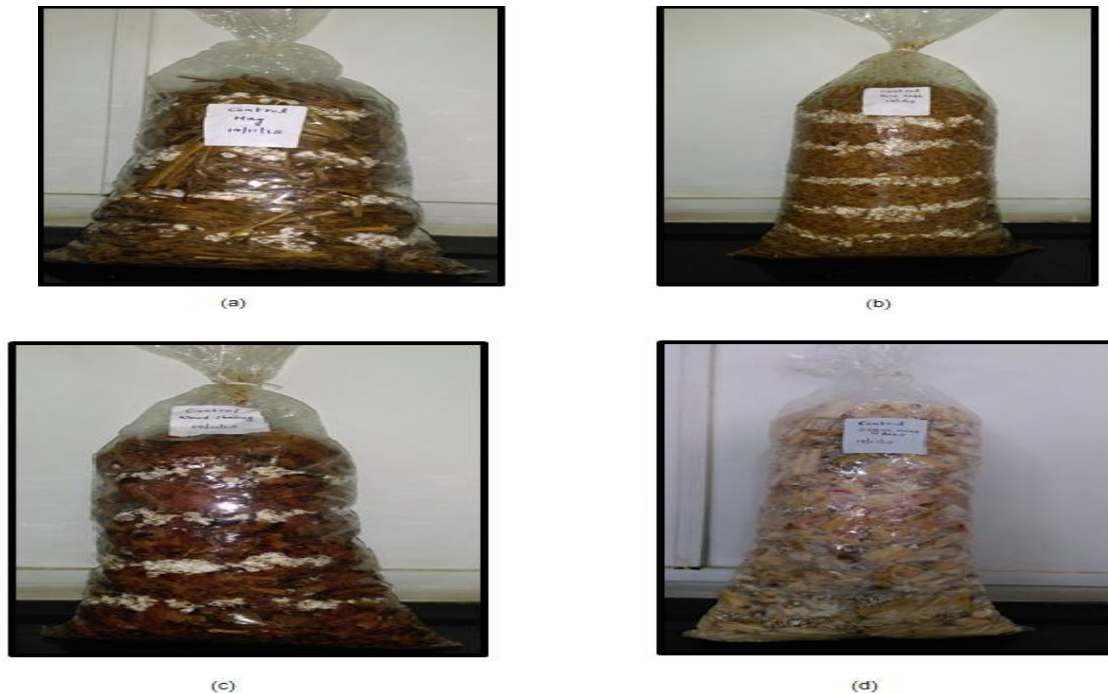
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In the first type, each of the agro (PS, HK, WS and SB) waste was mixed with VW in two combinations (50% + 50% and 75% + 25% respectively) before packing. After mixing the contents, the bags were packed and spawning was done by layer spawning.

In the second type, the bag was first filled with agro waste and then a layer of vegetable waste (2 cm) was spread, followed by layer of spawn.

A single bag comprising only vegetable waste as substrate was also inoculated i.e. 100% VW.

All the bags were closed tightly by using a thread without leaving much of head space. The bags were kept in a clean and well ventilated place providing 25-32°C temperature. Also the place was sprayed with water to maintain the moisture conditions. The bags were observed for mycelium growth and pin head formation [1].



**Fig2.** Packing of agro waste substrates (a)paddy straw (b)rice husk (c) wood shavings and (d)sugarcane bagasse



**Fig3.** Packing of 50% vegetable waste+ 50% agro waste (a)paddy straw (b)rice husk (c)wood shavings and (d)sugarcane bagasse

### 2.4. Harvest

When the whole bag was covered with white mycelium, small cuts were made on the bag randomly using a sterile blade. The bags were placed in such a way that there was enough space between each of them. The relative humidity was maintained by spraying water on the floor two to three times a day during cropping. Once the pin head started appearing, light water was sprayed. The number of days required for the completion of spawn running in the substrate bag was recorded. Days for pinhead formation, fruit body (flush) formation and harvest was recorded. The mushrooms were harvested once maximum size had reached and also before spore formation. The mushrooms were packed in perforated polythene bags and stored in refrigerator to keep them fresh.

### 3. RESULTS AND DISCUSSION

#### 3.1. Spawn Running and Pinhead Formation

Cultivation of the mushroom on VW alone showed a total absence of mycelium spread. The mushrooms cultivated on 50% PS + 50% VW showed pinhead formation by 20th day of inoculation which was three days earlier in comparison to the mushrooms grown on PS alone (depicted in fig 4). In 50% WS + 50% VW and 50% HK + 50% VW, mushrooms failed to grow due to degradation of VW. For WS and HK alone as substrates the pinhead formation was observed on 16th and 23rd day respectively. The results obtained for HK were deviated from those reported by Obodai M [5]. According to their results mycelial spread required 15 days which is much less compared to the present study.

The findings of the spawn run did not agree with those of Ahmed I [6] who stated that *P. ostreatus* completed the spawn run in 17-20 days and pinheads formation in 23-27days when WS was utilized. Shah Z A *et al.* [2] reported 24 days for pinheads formation in sawdust medium. The days for pinhead formation recorded in this study were sooner than the previous findings.

In the case of 50% SB + 50% VW, there was fungal contamination due to the presence of residual sugar content. This was confirmed as similar fungal growth observed in SB alone as a substrate. Thus the highest rate of contamination was observed in these substrates with green and black fungi infecting the bags during the stage of spawn running. Similar results were observed by Sopit Vetayasuporn [7].

Since degradation was observed when 50% of VW was utilized, the combination of 25% VW+75% AW was taken into consideration. It was observed that mycelium colonization and pinhead formation was delayed in all the substrate combinations and required greater than 60 days for primordium formation.

This confirms that the amount of time required for spawn running and pinhead formation was faster in the combination of 50% VW and AW when compared to that of 25% VW + 75% AW.



**Fig4.** Harvest obtained from (a)PS alone and (b) 50% PS and 50% VW

#### 3.2. Harvesting stage

The minimum number of days observed for the fruiting body to develop was observed in the combination of 50% PS and 50% VW which was 20 days. 100% PS took 28 days for primordial development..This was found to be slightly delayed to that of the results observed by Jawad Ashraf *et al* [8]. It is thus proved that VW enhances the rate of fruiting body formation when combined with AW

For 100% WS, optimum primordial maturation was observed at 23 days similar to that reported by Quimo [9],[10] stating that fruiting bodies appear 3-4 weeks after inoculation of spawn. 38 days were required for harvesting fruiting body from 100% HK. WS substrate is better when compared to PS and HK for commercial cultivation. VW enhances the growth of fruiting bodies when combined with PS.

#### **4. CONCLUSION**

Mushroom provide ample amounts of proteins, carbohydrates, vitamins and fibre and hence are usually referred to as boneless vegetarian meat. Their culinary importance lies in their nutritive quality and flavor. Commercial cultivation processes utilize the agriculture waste commonly available. The present study focuses on utilizing vegetable waste with the combination of these commercially utilized substrates for the cultivation of oyster variety. The results indicate that equal ratios of both the AW and VW are better when compared to other combinations. It can be concluded that VW can be a potential substrate for cultivation of oyster mushroom. In the recent years disposal of waste has become a threat to the society. Improper management of the same leads to health hazards and disease outbreaks. Utilization of the vegetable waste at small scale cultivation can be an immediate answer for partially addressing the issue. Also vegetable waste is rich in nutritional composition but belongs to the non edible component and hence utilization of these can help in conversion of these non edible components into nutritively rich edible mushrooms.

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