Research Paper

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Cultivation and Study of Growth of Oyster Mushroom on Different Agricultural Waste

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Abstract

The study was conducted to compare the effects of different agro-wastes on the growth and yield of oyster mushroom *Pleurotusostreotus*. Cultivation of *Pleurotusostreotus* on different substrate such as sugarcane, paddy straw and sorghum. Sugarcane produced highest yield, biological efficiency and number of fruiting bodies, recommended as a best substrate for oyster mushroom cultivation. The highest number of primodia and fruiting bodies and the amount of fresh weight was obtained with sugarcane bagasse in all flushes whereas, the lowest with paddy straw and sorghum.

Keywords: cultivation, Oyster mushroom, Substrates, Sugarcane baggase, Yield

Introduction

Mushrooms are one kind fungus which may be edible or inedible. Edible fungi belong to the genus *Pleurotus* under the class of*Basidiomycetes*. Oyster mushroom (*Pleurotusostreatus*) is one of the edible mushrooms having excellent flavour and fine taste. *Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia and Europe because of their simple and low

cost production technology and higher biological efficiency [1]. Cultivation of oyster mushroom have increased tremendously throughout the world now-a-days because of their abilities to grow at a wide range of temperature and they can be harvested all over the year [2]. *Pleurotus* have the ability to excrete hydrolyzing and oxidizing enzymes [3]. *Pleurotusostreatus* demands few environmental controls and their fruiting bodies are not often attacked by diseases and pests and they can be cultivated in a simple and economic way [4]. It requires a shorter growth time in comparison to other edible mushrooms [5]. Mushrooms require carbon, nitrogen and many different inorganic compounds as their nutritional sources. The main nutrients are less nitrogen and more carbon congaing substrate such as most organic matters containing cellulose, hemicelluloses and lignin can be used (i. e. rice and wheat straw, cottonseed hulls, corncob, sugarcane baggase, sawdust, waste paper, leaves and so on) which supports the growth, development and fruiting of mushroom [6]. The growth of diverse type of mushrooms require different type of substrates (organic or inorganic) and availability of varied type of materials that may dictate which type is used [7]. In general edible mushrooms are low in fat and calories but rich in vitamins B, D, K, A and C [8]. They contain more protein than any other food of plant origin and are also a good source of mineral nutrients [9]. Malnutrition is a major problem in developing third world countries. Mushrooms with their flavour, texture, taste, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries [10]. Oyster mushroom cultivation can play an important role in managing organic wastes whose disposal has become a major problem worldwide [11]. These wastes can be recycled into an environment and may be less endangered by pollution [12]. Strengthening mushroom production sector could be essential in order to enable the rural economy to keep its vibrancy and development, increasing and diversifying business which beings employment opportunities in the rural areas as well as providing income opportunities to small family farms. Furthermore, the use of these residues in bioprocesses technology also may be one of the solutions to bioconversion of inedible biomass residues into nutritious protein rich food in the form of edible mushrooms [13]. Apart from food value, its medicinal value for diabetics and cancer therapy has been emphasized [14]. Many of mushrooms pose a range of metabolites of intense interest to pharmaceutical sector e.g. antitumour metabolites, antigenotoxic metabolites, antioxidant metabolites, anti-inflammatory metabolites, anti-

hypertensive metabolites, antipalletel aggregating metabolites, anti-hyperglycaemic metabolites, antimicrobial metabolites, antiviral activities and food industries [15].

Classification of Oyster Mushroom:

Scientific classification:

Kingdom – Fungi

Phylum – Basidiomycota

Class - Agaricomycetes

Order - Agaricales

Family - Pleurotaceae

Genus – *Pleurotus*

Species – *ostreatus*

Materials and Method

Materials

1. Spawn (Source:- M. G. Science Institute, Ahmedabad, Gujarat)
2. Sugarcane baggase, Paddy straw as raw materials.
3. Water bath
4. Hot Air Oven
5. Plastic Bags
6. Poly propylene bottles
7.

Chemicals

1. 1N NaOH
2. Chloroform : Methanol (2:1)

3. 1% Gypsum
4. Potato Dextrose Agar
5. 1% Calcium super phosphate

Methods

Microorganism and spawn preparation:

The methodology that was used in these experiments was standardized following the methods of Siddiqui [16].*Pleurotusostreatus*, obtained from the Mushroom Spawn was grown on the potato dextrose agar (PDA 200 g/l diced potatoes; 20 g/l glucose; 15 g/l agar) medium at 25^{0}C for regular subculture. Oyster mushroom spawn was prepared in 850-ml polypropylene plastic bottles filled with cotton seed hull 87%, wheat bran 10%, sucrose 1%, plaster stone 1% and calcium superphosphate 1% (w/w, in terms of dry weight), then sterilized in autoclave at 121^{0}C for 80 min. After cooling down to room temperature, 1% gypsum was added. Then sterilized cotton seed hulls of every bottle were inoculated with 5 cm^2 mycelial agar discs. The spawn was incubated in the laboratory at 26 ± 2^{0}C and 70% relative humidity for two weeks.

Image: Spawn Preparation

Substrate preparation:

Oyster mushroom was grown on various substrates *viz.* Paddy straw, sugarcane baggase and sorghum. All the substrates were chopped into 3-4 cm lengths with cutter and then completely sun dried.

Soaking:

All three substrates were then soaked in water with 1-5 ppm formaldehyde overnight before the final step performed for substrate preparation. Physico-chemical methods were used for the sterilization purpose. Heat treatment was given to each and every substrate for avoiding contamination problems. Such treatment also helps in giving higher and almost constant yields from particular substrate used. Widely used method is pasteurization.

Pasteurization:

Water was boiled in a wide mouth container (steel/aluminium). The wet substrates were filled in gunny bags before they get dry. The filled bags were dipped in hot water (approximately 70^0 C) for about 10-15 min. After pasteurization, excess hot water was drained off from container so that it can be reused for other sets and thus temperature was also maintained.

Spawning:

Pasteurized substrates were cooled down to room temperature. At this stage, moisture content maintained at constant degree in all substrates at about 70%. Polythene bags were used for cultivation. Bags of 25cm×15cm in size were used. About 2.5 % grain spawn were inoculated on the surface of substrate and incubated in a controlled dark ttemperature around 25-35^0 C. The bags were closed after spawning. Humidity maintained at 70-85% by spraying water twice a day on walls and floor.

Cropping and harvesting:

After 10-15 days of incubation, bags were fully impregnated with white mycelium. Polythene covers were removed for further analysis. Mushroom was kept in a temperature range of 20-33^0 C (Mesophillic range). Relative humidity was maintained by spraying water twice a day on the wall and floor. A light spray of water was given on blocks as soon as small premordia appeared. Once

premordia appeared, watering to blocks was stopped to allow them to grow. After harvesting, the mushroom weight was recorded to calculate the biological efficiency.

$$\text{Biological efficiency} = \frac{\text{Weight of fresh mushroom}}{\text{Dry weight of substrate}} \times 100\%$$

$$\text{Mushroom weight} = \frac{\text{Total weight of harvested fresh mushroom per bag}}{\text{Total number of mushrooms harvested per bag}}$$

After harvesting, the mushrooms were packed in perforated polythene bags to keep them fresh till evaluation. It loses freshness after about 6 hours, which can be enhanced by keeping them in refrigerator. Oyster mushroom can be shed dried for 2/3 days and dried product are marketed in labelled polythene bags.

Results

Number of primordial:

The highest numbers of primordia (20 primordia) were found in sugarcane baggase and the lowest found in sorghum waste. The similar trends were observed in the second and third flush.

Figure 1. Primordial in sugarcane waste

Figure 2. Primordial in Paddy straw

Number of fruiting bodies:

The highest number of fruiting bodies of oyster mushroom was found in sugarcane baggase (20) and lowest numbers found in sorghum waste in 1st flush. Numbers decreased at second and third flush.

Figure 3. Fruiting bodies

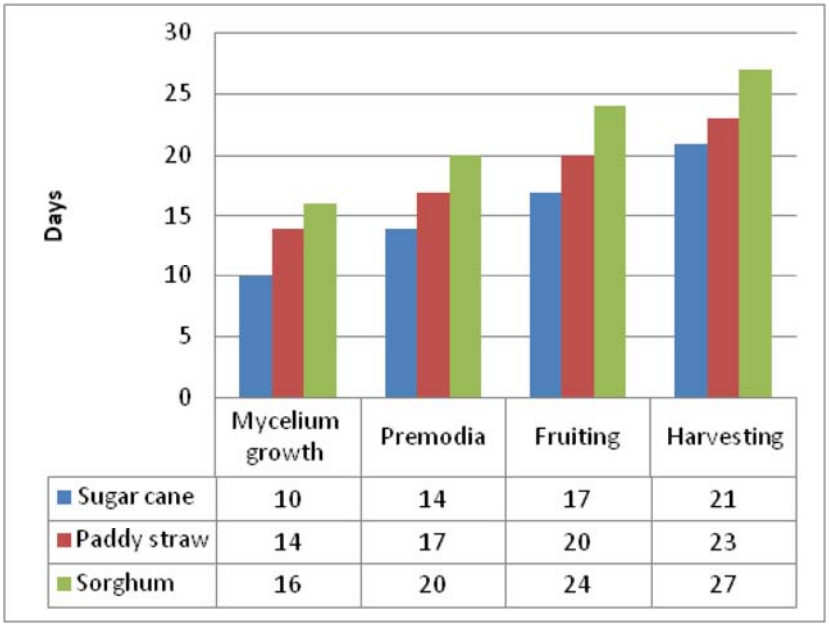
Fresh weight of fruiting bodies:

The highest fresh weight of fruiting bodies was obtained in sugarcane baggase, whereas the lowest found in sorghum. These results were found statistically different in different substrates.

Figure 4. Sorghum Fruiting

Figure 5. Harvested oyster mushroom

Table 1. Comparison between three different substrates



	Mycelium growth	Premodia	Fruiting	Harvesting
Sugar cane	10	14	17	21
Paddy straw	14	17	20	23
Sorghum	16	20	24	27

Discussion

In the first flush, the number of primordia was found with significant variation in all substrates. The number of fruiting bodies was found to vary significantly among all substrates. The similar kind of results was observed in the 2nd and 3rd flush.

For each of the treatments, two flushes of mushroom were harvested. The yield was significantly highest obtained in the first flush of all treatments used. The study revealed that the yield for sugarcane baggase was highest yield among all treatments, but it was not significantly highest. Paddy straw was also almost at par. Growth on sorghum waste was also at par with sugarcane baggase.

Sugarcane baggase gave maximum number of primordia and fruiting bodies and fresh weight followed sorghum. The variations were probably occurred due to the difference of bulk density and constituents of the substrates used in study [17]. found that the yield of mushroom was correlated positively with cellulose content and cellulose**:** lignin ratio, but negatively with lignin and ortho-dihydroxyphenolics content remarkably [18].Stated that cellulose rich organic substances have been reported to be of good substrates for the cultivation of this kind of edible mushrooms.

Substrates with high lignin and phenolic content decreased the activity of cellulose enzyme, but less lignin would enhance enzyme activity and thus ensure higher yield of mushrooms grown by such method [19]. Mshandete*et.al*. (2008) reported that sugarcane baggase contains both cellulose and sucrose content which is easily degraded by *oyster* mushrooms. It is also rich in nitrogen content, which is favorable for mushrooms [13].

Conclusion

Mushroom cultivation is one of the efficient ways by which residues can be recycled. *P. ostreatus*grown on different substrates are nutritious with high protein content, fiber content and low fat content. It may also offer economic incentives for agribusiness to examine these residues as valuable resources and develop new enterprises to use them to produce nutritious mushroom products. Therefore, the mushroom cultivation may become one of the most profitable agribusiness which could produce food products from different agricultural wastes or other substrates and help to dispose them in an environment friendly manner.One can conclude from the results of above experiments that sugarcane baggase have higher nutritional value in comparison of other substrates used. It is one of the cheapest sources of nutrition for mushroom cultivation.

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