Effects of Different Substrates on Total Yield of Oyster Mushrooms (Pleurotus spp.)

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***Abstract*: The study was conducted to evaluate the total yield of oyster Mushroom Pleurotus ostreatus spp. Seven substrates Formulas including Maize, Wheat straw (WS), Paddy straw (PS), Soyabean, Black gram (SB), Mixed (M), Sugarcane Bagasse (SB) and Jowar (J) were investigated. The results indicated that different substrate formulas gave a significant difference in total colonization period, characteristics of fruiting bodies, yield, and biological efficiency (BE). Substrates with 100% M and 100% WS were the most suitable substrate formulas for cultivation of oyster mushrooms PO in which they gave the highest values of cap diameter, stripe thickness, mushroom weight, yield, However, substrate formula 100% Jowar gave the slowest time for the first harvest of mushroom PO.**

***Keywords*: Oyster mushroom, Substrates, Yield.**

INTRODUCTION

Mushrooms are saprophytic macro fungi which belong to class Basidiomycetes. Edible Mushrooms have been used and consumed by ancient people. Traditional knowledge about mushroom benefits have been transmitted from one generation to another one orally. It has been mentioned in ancient texts like Vedas. Roman and Chinese, think that mushrooms have a power for life and strength and it is the God Osiris gift for them. In ancient days in India, China and Iran, people used mushrooms in their religious activities. Ethno mycology of edible medicinal mushrooms has been reported in many countries like India and China. Mushrooms are described as highly tasty and nutritional foods by many populations around and the world. In comparison to other edible mushrooms, *Pleurotus* species need a short growth time and their fruiting bodies are not often attacked by diseases and pests. Number of mushrooms is approximately 14.000 species and only 14.000 species are described. They are also identified as a source of food and medical treatment purposes. It is used in traditional treatments in many countries such as Mexico, Japan, China, Africa, and Korea and in Central and North American countries.

For large scale production, large steamers, sometimes one-room steamers are used. For the home or cottage industry, an autoclave or pressure cooker or a drum can be used for sterilization of mushroom bags or containers. Mushrooms have been used traditionally by ancient people as a source of food and in their religious activities. Ethno mycology of mushrooms has been reported in many countries including India. Many species of mushrooms provide an excellent source of natural compounds that are useful for the treatment of many diseases.

Pleurotus Ostreatus, the **Pearl Oyster Mushroom** or **Tree Oyster Mushroom**, is a common edible mushroom. It was first cultivated in Germany as a subsistence measure during World War I and is now grown commercially around the world for food. It is related to the similarly cultivated king oyster mushroom. The oyster mushroom is one of the most commonly sought mushrooms, though it can also be cultivated on straw.

Substrates:

Agricultural wastes are rich in various types of nutrients and their disposal is difficult to manage as excess of nutrients in them can cause leaching left in the field, as a compost. Mostly they are disposed of by means of incineration which causes pollution. Hence, there is always a high demand for discovering an agricultural waste management method which is cost effective and contributes less to environmental pollution. Mushroom cultivation on agricultural wastes fulfils these requirements. Agricultural wastes are rich in lignin cellulosic components which are difficult to break down, but can effectively be done mushroom cultivation. Mushrooms are fleshy fungi, spore bearing fruiting bodies which are produced above ground on soil. They often refer to the fruiting body of the gill fungi, which do not contain chlorophyll like green plants and as a result cannot manufacture food by their own. They are very nutritious products that can be generated from lignocellulose waste materials. The bioconversion of agricultural wastes into a value added product is a good means of their use. The property of edible mushroom fungi to convert complex organic compounds into simpler ones is used to transform the useless agricultural waste into valuable products.

MATERIALS AND METHODS

Oyster Mushroom Cultivation Process:

The process for the cultivation of oyster mushrooms is simple because its cultivation does not lend itself to complex scientific procedures. Farmers can cultivate the fungi with less supervision. The cultivation of the fungi relies on the interaction of a particular set of physical, chemical and biological factors (Rangel et al., 2006). The important areas to note in the cultivation of oyster mushrooms in order to balance the three factors include substrate selection, composting, sterilization of substrates, bagging of substrate, spawning / inoculation, incubation, fruiting.

The agro-climatic conditions in our country especially in the North Indian States are conducive for mushroom cultivation when the temperature is 15-30° and relative humidity is 70-8-%. The production decreases during peak periods of winter. Cultivation of Oyster Mushroom requires:

- Wooden racks
- Polythene bags (polypropylene bags)
- Plastic bags
- Pleurotus spawn (Hypsizygus ulmarius)
- Formaldehyde (25ml/15l water)• Bavistin (8gm/15lwater)

Preparation of mushroom beds

1. Climate and other conditions

Pleurotus spp. Is one of the choice edible mushrooms which can be cultivated in the tropics. It is cultivated in many countries and has gained importance in the last decade. Different species of *Pleurotus* are suited for growing within temperatures up to 28-30°C, although it produces faster and produces larger mushrooms at 25°C during the cooler season of the year.(i.e. winter season).

2. Substrates

Like other mushrooms, pleurotus species can be grown on various agricultural waste materials using different technologies. They grow well on lignocellulosic materials, converting them into digestible and protein rich. substances for animal feeds. The *pleurotus spp.* can be grown on various agricultural wastes. I.e. Maize, wheat straw, paddy straw, soybean and blackgram, mixed substrate, sugarcane bagasse, and Jowar. The substrates used in every region may depend on availability of agricultural wastes (substrates).

3. Preparation of substrate – Sterilization/ Pasteurization

Sterilization at 100° C (pasteurization) is more acceptable because the cost is lower (the steamer may only be an ordinary large capacity casserole or a drum and substrates thus steamed are less susceptible to contamination. The substrate is steamed for 2-3 hours, depending on the volume and size of the bags. When using a lower temperature (60-70°C) as in room or bulk pasteurization, the substrates whether in bulk or already packed in bags are steamed for at least 6-8 hours.

Chemical sterilization technique (DMR, Solan 1987).

Ninety litres of water are taken in a rust proof drum (preferably of galvanized sheet) of 200 liters of capacity. Ten kg of wheat straw is slowly steeped in water. in another plastic bucket carbendazim 50% WP (75.ppm) . Bavistin 7.5gm and 125 ml formaldehyde (37-40%) is dissolved slowly poured on already soaked wheat straw. Straw is pressed and covered with a polythene sheet after 15-18hours straw is taken out and excess water drained.

4. Inoculation / spawning

Spawning is carried out aseptically, preferably using the same transfer chamber or the same inoculation room as is used in spawns preparation. Grain or sawdust spawn is commonly used to inoculate the substrate in bags. With grain spawn, the bottle is shaken to separate the seeds colonized with the white mycelium. After lifting the plug and flaming the mouth of the bottle, a few spawn grains (about 1to 2 tsp.) are poured into the substrate bag. Both the plug of the spawn and the plug of the compost bag are replaced and the next bags are then inoculated. The newly inoculated bags are slightly tilted to distribute the grains evenly in the shoulder area of the bag around the neck.

The Mushroom Spawns were obtained from "Nutrimost Mushroom Farm and Training Centre Shendra Shewar Aurangabad", Maharashtra, India 431007.

5. Incubation:

The spawned compost bags are kept in a dark room until the mycelium has fully penetrated to the bottom of the substrate. In 20 to 30 days, depending upon the substrate/substrate combination, the substrate appears white, due to the growth of the mycelium. The bags were kept for an additional week before they are opened to check that the mycelium is mature enough to fruit. Most strains of the mushroom form primordial after 3 to 4 weeks of mycelia growth. The bags are opened to initiate fruiting, inside a mushroom house.

❖ The agro wastes were collected from local farms/places and were used for filling the bags.

❖ The substrates were chopped in pieces and soaked in water overnight to moisten it and excess water was drained off.

❖ After soaking the substrates were chemically sterilized. The polythene bags of the size 35 x 45 cm were filled with 2kg dried substrates and added at the rate of 2% of the wet weight wet basis of substrates. Pinning of bags was done for proper aeration.

After inoculation the bags were kept in a room where the temperature and humidity were maintained around 25°C and 80 to 90% humidity respectively with sufficient light and ventilation for 20 days. The spawn run was completed within 16 days. The polythene bags were tear-off following the spawn run. Formation of fruit bodies was evident within 3-4 days after removal of poly bags. The beds were maintained up to the harvest of the third flush, which was completed in 35 days after spawning.

6. Fruiting

Fruiting requires an appropriate temperature range (20-28°C), ventilation, light, moisture and humidity (80-95%). To provide moisture, daily watering of the substrate is required but excessive watering should be avoided. If the temperature inside the room rises to more than 30°C, a light water mist should be used to lower the temperature.

Approximately 3-4 days after opening the bags, Mushroom primordial will begin to form. If the substrate is not fully colonized, the onset of fruiting is likely to be delayed. The harvesting of mushrooms takes place within 20-24 days from the time for bed preparation.

While harvesting the Mushroom, they are to be grasped by the stalk and gently twisted and pulled. A knife should not be used. If kept in a refrigerator or in a cool place the Mushrooms can remain fresh for upto 3-6 days.

Harvesting

7. Drying

The drying of mushrooms was done using shade dry. It is the best method for preserving flavour and potency. It's important to have the right environment to do this drying procedure.

A good spot has been selected for drying mushrooms to make sure it's protected from moisture, insects, and animals. Some airflow was allowed to pass. The Mushrooms were sliced into 1/2-inch pieces or, depending on the shape, and size of the Mushrooms. The Mushrooms were placed in a big tray, and covered with a white cotton cloth taking care not to stack them on top of each other. The Mushrooms were checked a few times throughout the day. For complete drying of Mushrooms it takes 2-3 days. Depending on the environment, there's a good chance for mushrooms to get fully dry.

RESULTS & DISCUSSION:

1. Harvesting

2. Substrates

3. Sterilization substrates

4. Inoculation

5. Incubation

6. Fruiting

7. Drying

8. Dried mushroom

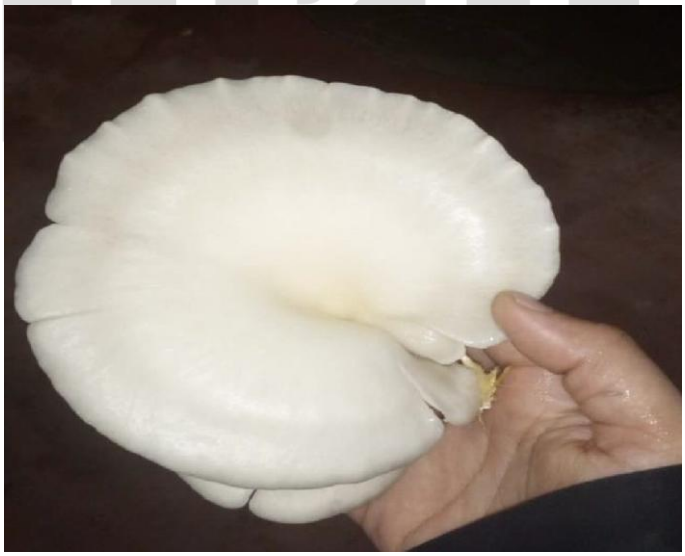

Table 1.: Effect of various substrates on total yield of mushroom

Sr. no.	Substrates	Harvesting (gms)		Total production(g ms)
		Ist	IInd	
1.	Maize Straw	120.56	122.36	245
2.	Wheat Straw	163	75	238
3.	Paddy Straw	150	35	185
4.	Soyabean, Blackgram	152	175	327
5.	Mixed	176	135	311
6.	Sugarcane Bagasse	122	115	237
7.	Jowar	105	45	150

Mushrooms are protein rich eco friendly food and it is cultivable initially as an empirical process. But the scientific understanding of mushroom cultivation will help in improving the cultivation technology. Rajini Bisaria *et al.,* (1987) cultivated oyster mushrooms on different agro wastes like paddy straw, wheat straw etc and they have reported maximum yield with wheat straw. Singh *et al.* (1995) suggested the use of sugarcane trash for the production of oyster mushrooms.

The wide range of plant waste that have been reported include, paddy straw, sugarcane bagasse, wheat, maize, rice straw etc. and does not require costly processing method and enrichment material (Mondal, 2010; Stanley, 2011).

Mushrooms with their pleasant flavour, texture and high productivity per unit area have been recognized as an exceptional food source to alleviate malnutrition in developing countries.

Karuppuraj *et al.,* (2014) reported that the yield improvement of *P. florida* on unexplored locally available lignocellulosic materials such as paddy straw, wheat straw was used.

The growth of mushrooms on wheat straw and other substrates, the paddy straw was considered as the best substrate in terms of relative digestibility and nutrient status (Calzada, *et al.,* 1987).

In the present study, pinhead formation first formed on mixed substrate on day 6, followed by maize and wheat straw, which formed on day 7. The pinhead formation of sugarcane bagasse and jowar appeared on the 8th day, while the pinheads formation on substrates paddy straw and soyabean-blackgram formed on the 9th day. (Table 1). In the present study, *H.Ulmarius* gave the highest yield in soybean-blackgram used as a substrate (327g), followed by mixed substrate (311). The moderate yield was observed in maize (245g), wheat (238g), sugarcane bagasse (237g), used as a substrate. The lowest yield was recorded in paddy straw (185g), and jowar (150g) used as a substrate.

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