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Optimizing the growth conditions and adopting new methods growing oyster and milky mushrooms in same conditions

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Abstract

The growing conditions of oyster and milky mushrooms were optimized by repeated trails test, for this experiment different oyster mushroom varieties-*Pleurotus florida*, *P. oysteratus*, *P. Sajurkaju* and different milky mushroom varieties *Calocybe sps* were used. The temperature requirements needed for oyster mushroom varieties were optimized 28°C-30°C in this same conditions milky mushrooms were also grown on the same room with 70% humidity, 2 times water spray daily, with two open ventilators. This method yielded 4 kg of oyster and 4 kg of milky mushrooms in three different periodical harvest. This method of growing is an improved conventional method of mushroom cultivation in a closed concrete room.

Keywords: *Pleurotus florida*, *P. Sajurkaju*, *Calocybe sps*,

Introduction

Edible mushrooms are with great source quality protein, minerals and various vitamins. From the age old period of time mushroom were used as a food materials without knowing its medicinal values starting from 60s. It is an important food item concerning human health, nutrition and disease prevention^[1]. Their nutritive and medicinal values were known as early as 1500 BC based upon many ancient literatures^[2, 3].

Though the production of mushrooms were presently 1,4 lakh tonnes of mushroom were produced but it still under demand of production all over the world. Our present approaches are to optimize the growing conditions of oyster mushrooms in different room conditions. Although the optimal growing conditions for different mushroom strains vary, mushroom growth is generally favored by warm and humid conditions. Where environmental conditions are unfavorable for mushroom growth, one could insulate or equip the structure or house with appropriate structures in order to minimize the influences of outside conditions on the microclimate inside the growing room. Normally the oyster mushrooms of varieties like *Pleurotus florida*, *P. oysteratus*, *P. Sajurkaju* will grow in 20-30 °C and milky mushrooms will grow only when the temperature is at 25- 35 °C to opt this both conditions in warm places were highly a tricky obstacle for mushroom growers.

Mushroom is an exotic and nutritious source of vegetarian food. It has many varieties. Most of them are edible. Mushrooms have a high nutritional value and are high in protein. They are also a good source of vitamins (B1, B2, B12 and C), essential amino acids and carbohydrates but are low in fat and fiber and contain no starch. When fresh they have a very high water content of around 90%. Oyster mushrooms (*Pleurotus spp.*, viz., *P. ostreatus*, *P. flabellatus*, *P. sajor-caju*, *P. florida* etc.) are a good choice for beginning mushroom cultivators because they are easier to grow than many of the other species and they can be grown on a small scale with a moderate initial investment. There species grow wild in the forests which can be cultivated in thatched, polythene, brick or stone houses.

In order to overcome this problem the following objectives were formulated to grow oyster and milky mushrooms in all conditions.

1. Growing of oyster and milky mushrooms together in a same temperature conditions
2. Growing of oyster and milky mushrooms in a concrete room
3. Increasing the yield of oyster and milky mushrooms compared to regular methods of growing

Materials and Methods

Collection of different varieties of mushroom

Varieties of *Pleurotus*, *P. florida*, *P. ostreatus*, *P. djamor*, *P. sajorcajuand* *Calocybe indica* (APK 2) were collected from Tamil Nadu Agriculture University. One mother culture plus two working cultures were maintained in PDA medium under 4 °C.

Preparation of media

Potato dextrose Agar Medium (PDA)

Peeled sliced potato pieces: 250g, Dextrose : 20g, Agar Agar: 20g, pH: 7, Dis. Water: 1L. Peeled potato were sliced and boiled. Dextrose and Agar Agar were mixed with filtered juice of potato extract. Dispensed in a sterile flask made up to 1 L with dis. water and sterilized in a autoclave for 20lbs/15min.

Isolation of mushroom

Fresh mushrooms were collected swabbed with 80% ethyl alcohol, with sterile blade the pileus of mushroom were cut and surface sterilized with 2% sodium hypo chloride. After repeated distilled water wash kept in PDA plates incubated at room temperature for 7 days. After incubation pure mycelium cultures were sub cultured in fresh PDA plates.

Chemical sterilization technique

Take 90 litres of water in a drum of 200 litre capacity. Slowly steep 10 kg of chopped paddy straw in the water. Mix 125ml of formaldehyde (37-40 percent) and 7 g of Bavastin dissolved in 10 litres of water in another container and pour the solution slowly into the drum. Straw should be pressed and drum should be covered with a polythene sheet. Take out the straw after 12 hrs. Spread the pasteurized or chemically sterilized straw on neat and clean cement flooring or on raised wire mesh frame, inside the chamber where bag filling and spawning are to be done.

Mother spawn preparation

Sorghum or wheat grains are used for spawn preparation. Half cooked grains, are mixed with calcium carbonate @ 20g per kg of grains (dry weight), thoroughly mixed and filled in polypropylene bags (15x30 cm size) provided with PVC rings as neck. The bags are tightly plugged with non-absorbent cotton and sterilized at 1.42-kg/cm² pressure and 126 °C temperature for 1.5-2.0 hours in an autoclave. When the bags are cool, they are aseptically inoculated with fresh cultures of oyster mushroom fungus. The work should be done in a culture room or in a laminar flow chamber. After inoculation the spawn bags are stored in a clean room for 15-20 days before use. These bags with white mycelial growth serve as mother culture. Each mother spawn bag can be used for inoculating 30 bed spawn bags that can be prepared following the above procedure.

Mushroom bed preparation

Polythene bags of 60x30 cm or 75x45 cm size are used for bed preparation. Chaffed paddy straw bits of 3-5 cm length are soaked in cold water for 4-5 hours. After draining the excess water, the straw bits are boiled for 45-60 minutes in a separate drum. Though hot water treatment is the safe and best method of sterilization, steam treatment or chemical treatment with a solution containing carbendazim and formalin can also be followed. After treatment, the substrate is shade dried to remove excess moisture before bed preparation. At the time of bed preparation the substrate should contain around 60%

moisture (can be tested by squeeze method). Cylindrical beds are prepared following layer method of spawning. A layer of straw is laid and sprinkle one tablespoon full of spawn over the filled straw around the peripheral region. A second layer of processed straw is filled and spawned as above. Repeat the process until the soaked straw is finished. Every time before spawning, press the straw with hand for making it compact. Finally the bag is close tightly with twine and the beds are incubated for spawn running under semi-dark condition in a clean room. Spawn run will be completed in 12-15 days at 30-35 °C.

Casting

Unlike oyster mushroom cultivation, milky mushroom production involves an additional process called casing. After the completion of spawn run, the cylindrical beds are cut horizontally into two equal halves. Apply casing soil on to both halves to a height of 1-2 cm. The casing soil is prepared by steaming garden soil (clay loam, pH around 8.0) for one hour.

Cropping

After casing, the beds are to be incubated over racks in a partially sunken chamber lined with blue coloured high-density polythene sheet as roofing material. Optimum relative humidity of 80-95%, room temperature of 24-28 °C and light intensity of about 1600-3200 lux should be maintained in the cropping room. Proper ventilation for gaseous exchange is also essential in this chamber. The beds are regularly sprayed with water to maintain 50-60% moisture level on the casing surface. Pinheads appear in 8-10 days after casing and the first harvest can be made in 6-8 days after pinhead formation. After obtaining the first harvest the casing medium is gently ruffled, slightly compacted back and sprayed regularly with water. Second and third harvest may be obtained within 45-50 days of bed preparation. Then the beds are removed and fresh beds may be kept for cropping.

Mushroom harvesting and weighing

The milky mushroom (*Calocybe indica*) is a potentially new species to the world mushroom growers. It is a robust, fleshy, milky white, umbrella like mushroom, which resembles button mushroom. The species is suitable for hot humid climate and can be cultivated indoor in high temperature and high humidity areas. It grows well at a temperature range of 25-35 °C and relative humidity more than 80%. Milky mushrooms can be cultivated throughout the year in the entire plains of India.

The cultivation technology is very simple, involves less cost and no special compost is needed for the cultivation. The cultivation process resembles that of oyster mushroom but for the additional process of casing. The mushroom can be harvested from 24-28 days after spawning and the total crop cycle is only 45-50 days. Most importantly, the milky mushroom has an extended shelf life of 3-5 days compared to other cultivated species, making it more amenable to handling, transportation and storage. So, there is a growing interest among the farmers towards milky mushroom. The production technology of milky mushroom is outlined here: Substrates Milky mushroom can be cultivated on a wide range of substrates like, paddy straw, maize stalks, sorghum stalks, pearl millet stalks, palmarosa grass, vetiver grass, sugarcane baggase, soyabean hay, groundnut haulms etc. However, for commercial production paddy straw is the best substrate.

Cropping and harvest

After 20-22 days, when bags are fully impregnated with white mycelium, transfer the bags into cropping room and remove polythene/ polypropylene covers. The open blocks should be kept in racks about 20cm apart. Rack should be 60 cm wide with gap of 50-60 cm between two shelves. Mushrooms grow in a temperature range of 20-33 C. Relative humidity is maintained by spraying water twice a day on the walls and floor of the room. Spraying of blocks should be avoided for the first 2-3 days. A light mist spray of water is given on blocks as soon as the small pin heads appear. Once pinheads are 2-3 cm big a little heavier watering is to be done on blocks and father watering of blocks is to be stopped to allow them to grow. Mushrooms should be plucked before they shed spores to maintain quality. After 1st flush of harvest, 0.5 to 1 cm outer layer of the block should be scrapped. This helps to initiate 2nd flush which appears after about 10 days. After harvest, the lower portion of the stalk must be cleaned with dry cloth. They should be packed in perforated (5-6 small holes) polythene bags to keep them fresh. It loses freshness after about 6

hours, which can be enhanced by keeping them in refrigerator. Oyster mushroom can be sun dried for 2 days and dried product marketed in polythene bags. Dried mushrooms should be soaked in water for 10 minutes before use.

Results

On an average single mushroom weighs 55-60 g and mean yield is 356 g/bed (contains 250g of paddy straw on dry weight basis), which accounts to 143% bio-efficiency. Milky mushroom is a rich source of protein with protein content of 32.3% and fetches high market price compared to oyster mushrooms. It is highly suitable for drying, canning, soup powder preparation and pickle making.

Growing of oyster and milky mushrooms together in a same temperature conditions

This result implies that both mushrooms (Oyster and Milky) were grown in a same room temperature i.e 24 °C. The humidity and water spraying were same to both the species of mushrooms. Ventilations and air circulations were un-altered.



Fig 1: Milky mushroom growing Concrete room under temperature 28C

Growing of oyster and milky mushrooms in a concrete room

Apart from maintaining the same conditions both the species were grown in a closed concrete room with size of 25X14' size. The complete growth of mushrooms with long stipe and fruiting body were observed. This artificial condition favored with air conditioner.

Increasing the yield of oyster and milky mushrooms compared to regular methods of growing

Compared to regular growing condition the increasement of yield were observed in all the species of mushroom (Oyster, Milky). Especially in *P. Sajurkaju* showed highest weight increase of about 50g compared to regular method of cultivation. Similarly *calocybe* showed 100g of weight increase over the regular ones (Table 1).

Table I: Measurement of mushroom weight

S.No	Variety	Species	Weight (gms) Harvested after 22days	
			Concrete room	Regular teacher room
1	Oyster	<i>Pleurotus florida</i>	325g	250g
		<i>P.oystratus</i>	300g	250g
		<i>P. Sajurkaju</i>	350g	300g
2	Milky	<i>Calocybe</i>	400g	300g

Table 2: Measurement of mushroom weight

S. No	Variety	Species	Morphology (cm) Measured after 22days	
			Concrete room	Regular teacher room
1	Oyster		Length of Stipe/ Dia. Of fruit body	Length of Stipe/ Dia. Of fruit body
		<i>Pleurotus florida</i>	4cm/8cm	3cm/6cm
		<i>P.oysteratus</i>	3.8/7.5cm	2.7/6.5cm
		<i>P. Sajurkaju</i>	4.3cm/8.5cm	4cm/8cm
2	Milky	<i>Calocybe</i>	15cm/5cm	10cm/2.5cm

As observed in the weight the increasement of morphology structure were observed in *P. Sajurkaju* i.e *P. Sajurkaju* showed 4.3cm length of stipe and 8.5cm diameter of fruit body. It shows 0.5cm increasement over the regular cultivation method (Table 2).

Table 3: Comparison of mushroom growth between regular condition and with new optimized condition

S. No	Character	Oyster mushroom						Milky mushroom	
		<i>P. florida</i>		<i>P.oysteratus</i>		<i>P. sajurkaju</i>		<i>Calocybe (APK 2)</i>	
		New optimized method	Regular Thatched method	New optimized method	Regular Thatched method	New optimized method	Regular Thatched method	New optimized method	Regular Thatched method
1	Substrate	Paddy straw	Paddy straw	Paddy straw	Paddy straw	Paddy straw	Paddy straw	Paddy straw+compost	Paddy straw+compost
2	Germinating temperature	20-30 °C	25-30 °C	20-30 °C	25-30 °C	20-30 °C	25-30 °C	20-30 °C	25-30 °C
3	Crop cycle	35-50d	30-45d	35-50d	30-45d	35-50d	30-45d	35-50d	45-50d
4	First harvest	18 th d	26 th d	18 th d	26 th d	18 th d	26 th d	18 th d	26 th d
5	Yield/bed	1kg	500g	1kg	500g	1kg	500g	900g	350g
6	Shelf life	1-3d	1-3d	1-3d	1-3d	1-3d	1-3d	3-5d	3-5d

In this comparison chart shows that the substrate were same to both species. The germination temp is lesser in oyster and milky mushroom. The differentiation of growing temperature is 5°C. The crop cycle is increased up to 5 days in both species. First harvest can be made on 18th day itself it implies that the growth of the mushroom is faster in controlled optimized condition. Besides the yield and shelf life is also increased compared to regular thatched method.

Discussion

Growing oyster and milky mushrooms in a same conditions is a difficult practice. Because each one of them differ in their growing conditions and in morphology. Our present attempt aims in growing of oyster and milky mushrooms in same condition resulted positively. This research result paved a new methodology of mushroom growth development previous works and mushroom growth reported about the growth of oyster and milky in a separated environment. Though the previous reports are satisfactory there are no reports about the optimizing the growth conditions of oyster and milky. This report resulted the effective way of mushroom cultivation. Generally oyster and milky mushroom were grown in coconut thatched roof shed with ventilations and partially in open atmosphere. In the early works following reports were made like paddy straw is reported as the most suitable substrate for cultivation of white summer mushroom, *Calocybe indica* [4, 5, 6]. But there were very few reports were available on optimization work so optimization of casing process for enhanced bio efficiency of *calocybe indica*, an indigenous tropical edible mushroom was reported by kathiravan *et al.*, in 2015 [7]. But the present report about growing of oyster and milky mushroom in a closed concrete room is a new approach. Few attempts were made by previous workers were failed in optimizing the above growth conditions. But our present report on growing oyster and milky mushrooms in a closed concrete room resulted in better way of mushroom growth.

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