Low Cost Cultivation of Oyster Mushrooms (*Pleurotus ostreatus*) on Agricultural Wastes

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ABSTRACT

Present study deals with production of Pleurotus ostreatus (Oyster mushroom) using agricultural waste products and with minimal lab requirements which reflects that mushroom cultivation can be a promising low cost enterprise.

INTRODUCTION

Mushrooms have been known for ages in respect to their nutritional and culinary values as well as for their use as tonics and medicines. Mushrooms have been featured in traditional Chinese medicine for more than 3,000 years of use for the prevention and treatment of diseases and dried extracts from fruit bodies occupy a lucrative segment of the market for herbal medicines in western countries (Bhatt et al. 2018). In modern terms, they can be considered as functional foods that can provide health benefits beyond the traditional nutrients they contain. Moreover, there has been a recent upsurge of interest in mushrooms not only as a health food but also as a source of biologically active compounds of medicinal value, which were termed "mushroom nutraceuticals". They are low in calorific value but rank very high for their vitamin, mineral and protein content. Their protein content is of good quality and characterized by high digestibility (Singh et al. 2017, Donnini et al. 2013).

Mushrooms have been collected and consumed by people around the world for thousands of years. The archaeological record reveals edible species associated with people living 13000 years ago in Chile. Mycophagy has also been a part of ancient Chinese, Greek and Roman cultures (Rojas and Mansur 1995, Boa 2004). Mushroom culture in artificial conditions could be started in 17th century in France. Scientific cultivation, however, started only at the beginning of the 20th century when pure cultures of mushroom were prepared from spore and tissue (Sharma et al. 2017). Though mushroom production in Asian countries started 1000 years ago, cultivation of mushrooms is relatively new phenomenon in India (Sharma et al. 2017).

Mushroom cultivation can be a big source of income through rural development program for farmers if they are made aware its cultivation process and its importance. By taking into consideration of drought and food and nutrition security problems in some countries, mushroom production could be an alternative source to overcome these problems. In addition, livelihood can be improved because the demand of mushroom has been increasing due to increasing population, market expansions and changing of consumer behaviour (Celik & Peker 2009). Even as the mushroom production and consumption are on the rise in rest of the world, India witnesses a lukewarm response in its growth. Mushroom industry in India is overwhelmingly focused on white button mushroom which is a highly sophisticated and capital-intensive activity. The recent production data (official data of ICAR-DMR, Solan) showing that, the share of button mushroom in India is maximum amounting to 73% followed by oyster mushroom which contributes about 16% (Sharma et al. 2017). The raw materials which can be applied for Oyster mushroom cultivation are cheaply available in farmer's yards and easily cultivated in various climatic conditions as a fast maturing crops. Cultivation of mushrooms is simple, labor intensive and suitable for rural areas improving the socio-economic condition of farmers, families by solving the employment problems of both literate and illiterate, especially women (Pokhrel 2016, Biswas 2014).

Uttarakhand is primarily a mountainous state with only about ten percent of its total geographical area in the plains. Of the thirteen districts, Haridwar, Udham Singh Nagar and some parts of Dehradun and Nainital districts are in the plains, while the remaining areas of the state are hilly. More than three forth of state's population depends on agriculture and the economy is predominantly dependent on mountain agriculture with small and fragmented land holdings and limited irrigation facilities. There is critical geographical inequality between hilly and plain areas which affects the development and living standards of populations in these areas. The inter-district inequality leads to increasing disparity in terms of income and livelihood. As a result, the majority of the rural population in the hills either survives on subsistence agriculture or migrates to other parts of the country for employment. The state faces the challenge of promoting livelihoods to retain people through local employment and income generation and to enhance their quality of life. Development of industrial infrastructure is problematic in hill areas of Uttarakhand due to its peculiar geography. So, the sectors like horticulture (fruit and vegetable cultivation), tourism and micro and small enterprises like mushroom cultivation, bee keeping etc can participate effectively in growth of income generation and employment in these areas (Sawan et al. 2015, Kar 2007).

An attempt have been made in present study to show the cost effective cultivation of *Pleurotus ostreatus* (oyster mushroom) using common agricultural waste substances in a remote region of Uttarakhand.

MATERIALS & METHODS

Only one species of *Pleurotus* was attempted to cultivate on three substrates. Cultivation rooms were established in Negwad locality of Gopeshwar. Agricultural wastes for

preparation of substrates were collected from the farmers of Matai, Ghat. Spawn was purchased from PURP Kalimath, Rudraprayag.

Substrate preparation

Three different substrates were prepared for inoculation. Type A, Type B and Type C were prepared with rice straw, saw dust and mixture of (1:1) rice straw and saw dust respectively.

Substrates were chemically sterilized with solution of Bavistin and formalin. Substrates were soaked in the solution overnight and then dried until the moisture content was 40-60%. Composting was done in a room measuring 5×1 m. Before the use, room was sterilized with formalin and 2% formaldehyde. Walls were also disinfected with 2% $KMNO_4$. In addition, windows and door was kept covered with a black polythene sheet.

Substrate inoculation

Polybags measuring 40×30 cm were used as fermentors. Each bag contained 1000 g substrate on dry weight basis. Substrates were inoculated with the spawn by hand and mixed thoroughly to facilitate rapid and uniform mycelia growth. Openings of the bags were tied and holes were made over the polythene bags for aeration. Then, they were incubated in the dark at 20^0C and 70-85% humidity. Diffused light and fresh air was provided by opening the door and exhaustion by fan for 1-2 hours every day. Mycelia development in the bag was observed and noted within a week.

Harvesting

The mature fruiting bodies were harvested when the pilei were fully opened. Fresh weight of the mushrooms collected from each substrate was taken after the harvest. Three flushes were taken from each substrate during the cultivation period of 60 days.

RESULTS & DISCUSSION

Growth of mycelia and sporocarps was observed on different substrates and it was found that spawn run started on 42nd day on Type A substrate, 47th day on Type B and 43rd day on Type C. Formation of dense mycelium was observed on 49th day on Type A, 51st day on Type B and 50th day on Type C. First pinhead formation occurred on the successive day of full mycelia invasion on each substrate.

It took 3-4 days from pinhead formation to maturation of sporocarps. After 5-7 days, fruiting bodies were ready for harvesting. Duration of fruiting body maturation varied among different substrates and the number of fruit bodies recorded from different substrates is related to the mycelia development. Figure 2 shows progressive development of fruiting bodies. Pinhead formation was followed by formation of sporocarps (fruiting bodies) and mature sporocarps were obtained on 52nd day on Type A and 55th day on Type B and Type C substrate. In addition, it was interesting to note that the size of sporocarps was larger on Type A substrate followed by Type C and Type B.

Among three substrates used during the present study, Type A (Rice straw) was found to be the most suitable substrate to start with the cultivation of *Pleurotus ostreatus* on small scale as the time taken by the spawn to form the mycelia and formation of fully mature sporocarps was less than the other substrates. Present finding was found in support of Zhang et al (2002) and Gurung et. al. (2017) who explored that rice straw might be the favorable substrate for the cultivation of *Pleurotus ostreatus*.

It is evident from this attempt of cultivation that mushroom cultivation can be a promising enterprise for local people who rely upon agriculture for the livelihood. It is a low cost venture which can be performed with the easily available agricultural wastes and on optimum temperature and humidity.

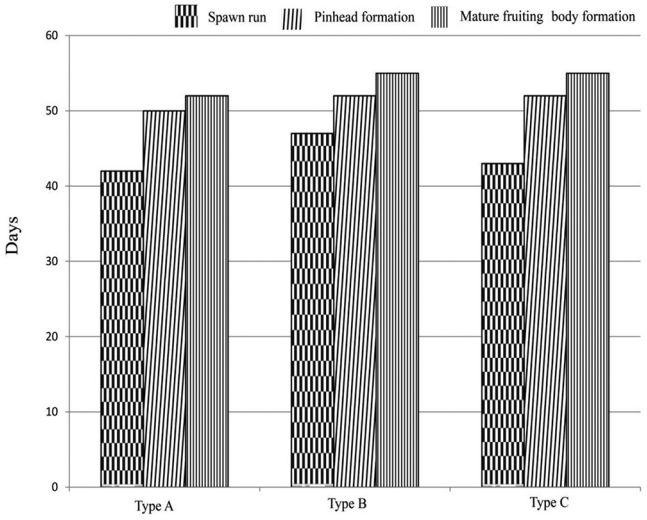

Figure-1: Days for spawn run, pinhead formation and maturation on different substrates.

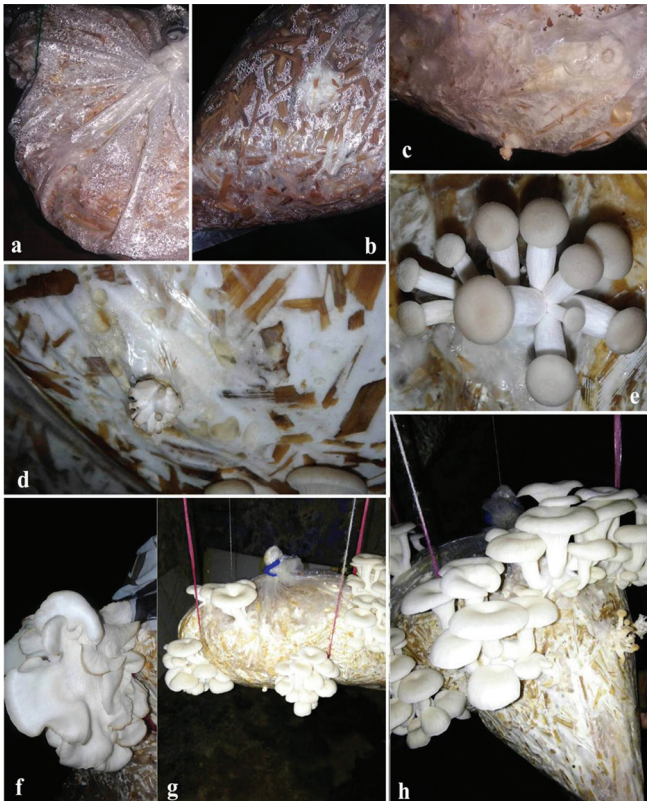

Figure-2: a. Formation of moisture in bag. b. Starting of spawn run. c. Pinhead formation. d. Cultivation bag showing a pinhead cluster and dense mycelia, e-f . Developing sporocarps. g-h. Mature sporocarps of Pleurotus ostreatus.

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