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Comparative effect of cultivation system (Plastic pot vs polythene bag) on yield and biological efficiency of *Pleurotus ostreatus* in different agricultural residue

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Abstract

The present study evaluated the comparative effect of two cultivation systems: plastic pot and polythene bag on the growth performance, yield, and biological efficiency of *Pleurotus ostreatus* cultivated on chickpea straw, moong straw and wheat straw under controlled conditions. Among the two systems, polythene bag cultivation showed the excellent performance over plastic pots in all substrates taken in the study. Maximum yield (93.37 g) and biological efficiency (101.48%) were recorded in *P. ostreatus* grown on moong straw using polythene bags, followed by chickpea straw (79.74 g; 106.32% BE). In contrast, plastic pot cultivation resulted in comparatively lower yield and efficiency, with moong straw yielding 58.33 g (83.32% BE) and chickpea straw 53.56 g (71.42% BE). Wheat straw exhibited the lowest productivity in both systems, particularly in plastic pots. The enhanced performance in polythene bags may be due to the improved moisture retention, aeration, and uniform mycelial colonization, which leads to efficient substrate utilization. Overall, the findings indicate that polythene bag cultivation, is a more effective and economically viable method for maximizing yield and biological efficiency in *Pleurotus ostreatus* cultivation.

Keywords: Biological efficiency, Nutrition, Cultivation system, Agric residue, Productivity

Introduction

Edible mushrooms, particularly *Pleurotus* species, are well known for their high nutritional value, rapid growth, and ability to utilize diverse lignocellulosic residues (Bijla & Sharma, 2023; Singh *et al.*, 2022) [1, 13]. Oyster mushrooms play a substantial role in sustainable agriculture by converting low-value agro-wastes such as wheat straw, chickpea straw, and moong straw largely produce in Bundelkhand region of the Central India into high quality protein rich food and hence play role in circular (Dehariya & Vyas, 2020; Singh *et al.*, 2020) [5, 15]. Their cultivation is seen to be both economically and environmentally feasible, particularly in underdeveloped nations with an abundance of agricultural leftovers (Boadu *et al.*, 2023; Singh & Vyas, 2021) [2, 16].

The cultivation system is a crucial factor that affects mycelial development, substrate colonization, yield, and biological efficiency, among other aspects of mushroom productivity (Shin *et al.*, 2025; Singh *et al.*, 2025) [12, 14]. Oyster mushrooms have historically been produced using a variety of culture techniques, including bed systems, tray systems, pots, and polythene bags.

Several studies have demonstrated that polythene bag cultivation provides a controlled microenvironment with better moisture retention, aeration, and contamination management, leading to enhanced yield performance (Chang, 1999; Sánchez, 2010; Vaidya, 2001) [3, 11, 17]. In contrast, rigid containers like plastic pots may restrict aeration and uniform mycelial spread, thereby reducing substrate utilization efficiency.

Several researchers have reported the influence of substrate type on mushroom yield, emphasizing that substrates with optimal carbon-to-nitrogen (C:N) ratio and favourable physicochemical properties significantly improve biological efficiency (Dehariya & Vyas, 2015; Hoa *et al.*, 2015; Khatana *et al.*, 2024; Shin *et al.*, 2025) [4, 7, 8, 12]. However, comparative studies integrating both substrate type and cultivation system remain limited, particularly under regional agro-climatic conditions.

Therefore, the present study was undertaken to evaluate the comparative effectiveness

of plastic pot and polythene bag cultivation systems on the growth, yield, and biological efficiency of *Pleurotus ostreatus* grown on different lignocellulosic substrates. This work aims to identify an efficient, cost-effective cultivation strategy that maximizes productivity while promoting sustainable utilization of agricultural residues in regional area of Central India.

Materials and Methods

Procurement of the mushroom strain and Subculturing

The mushroom strain of *Pleurotus ostreatus* (DMRP-115) was obtained from the DMR Solan, Himachal Pradesh. The obtained culture was maintained in culture plate and slant tube using PDA medium.

Spawn preparation

Spawn was prepared on wheat grain using the method described by Dehariya & Vyas, (2015) [4]. Briefly, the grains were soak in water for over night and then boiled for 15 min, the excess water was drained off and cooled to room temperature. Then after 1.2% gypsum and 0.3% Calcium carbonate was mixed thoroughly, filled in wide mouth bottle and autoclaved for 2hrs at 121 °C under 15lbs. After autoclaving the bottles were inoculated with mycelium of the sub-cultured strain of the mushroom and kept for incubation after complete run of mycelium used as spawn.

Collection and Preparation of the substrate

Agricultural residues Chickpea, Moong Straw and Wheat straw were collected from the nearby village of the University. The straws were chemically sterilized using Carbendazim and Formalin. The pots used in the study were of 9 x 6 cm and poly bags were size 16x18 cm. Spawning was done at the rate of 4% in pot as well polybag. For each treatment three replicates were used. Substrate were used on dry basis, the dry weight varies with the type substrates: Chickpea (CP)-75g, Wheat straw (WS)- 70g and Moong Straw (92g) in pot and polythene bags.

Yield and biological efficiency (BE)

The fresh harvested mushroom fruiting bodies of each flush were recorded and total sum of the harvest was calculated using electronic weighing balance.

The biological efficiency was calculated using given method:

Biological Efficiency (BE)=Dry weight of substrate (g)/Fresh weight of mushrooms harvested (g)×100.

Result and Discussion

The comparative influence of cultivation systems, namely plastic pot and polythene bag, on the growth and yield performance of *Pleurotus ostreatus* cultivated on different lignocellulosic substrates is presented in Tables-1 while the corresponding trends in total yield and biological efficiency are illustrated in Figures 1. In *Pleurotus ostreatus*, cultivation in polythene bags consistently resulted in higher total yield and biological efficiency compared to plastic pots across all substrates (Table-1; Figure-1). Among the substrates, moong straw cultivated in polythene bags recorded the maximum total yield (93.37 g) and biological efficiency (101.48%), followed by chickpea straw in polythene bags (79.74 g; 106.32% BE).

In contrast, the corresponding pot-grown treatments showed comparatively lower yields, with moong straw (58.33 g; 83.32% BE) and chickpea straw (53.56 g; 71.42% BE). Wheat straw showed the lowest productivity in both systems, particularly under pot cultivation (50.48 g yield and 54.86% BE), indicating inferior bioconversion efficiency relative to moong and chickpea straw. The superior performance of polythene bags may be attributed to improved moisture retention, better aeration, and more uniform mycelial colonization, which collectively enhanced substrate utilization efficiency.

Overall, the combined interpretation of Tables 1 along with Figures 1 clearly establishes that the polythene bag system is superior to plastic pot cultivation for *Pleurotus ostreatus* in terms of yield maximization and biological efficiency. Furthermore, moong straw emerged as the most efficient substrate under polythene bag cultivation, indicating its favourable physicochemical properties, optimal C:N ratio, and higher microbial accessibility. *Pleurotus ostreatus* shows higher yields in Moongs then Chickpea though both are leguminous plant that contain more nitrogen source then wheat straw, this is primarily due to the more favourable lignocellulose composition and balanced C:N ratio, which enhances the mycelium growth and enzyme activity. Balanced C:N ratio plays crucial role in basidiocarp development and increases the pinhead appearance rates and the numbers in the bags of spawned substrates (Osunde *et al.*, 2019) [9]. One of the major reason of Chickpea straw showed less efficiency then the Moong straw is due to the higher content of polyphenolic compound and the antinutritional compound in the straw (Gebbru *et al.*, 2024; Pascariu *et al.*, 2025) [6, 10].

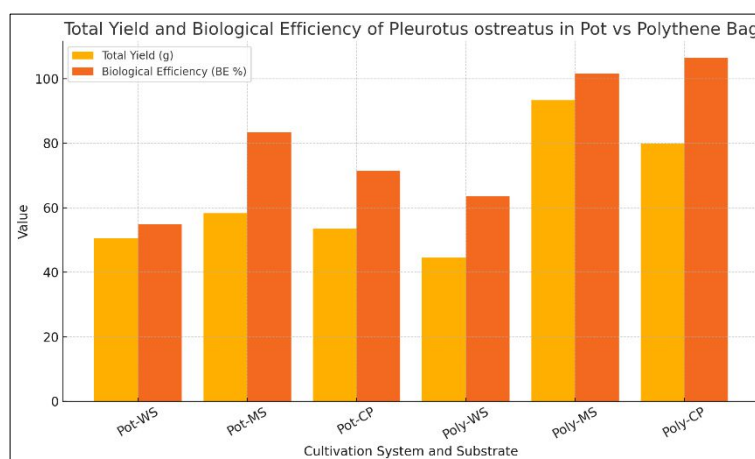


Fig 1: Comparative analysis of total yield and biological efficiency of *Pleurotus ostreatus* cultivated in plastic pot and polythene bag systems on different lignocellulosic substrates.

Table 1: Comparative study on growth and yield parameters of *Pleurotus ostreatus* in plastic pot Versus polythene bag on different cellulosic substrates

Mushroom	Substrates	Spawn run (days)	Pin head appearance (Days)	Harvest (g)			Cap diameter (cm)	Stipe length (cm)	Total yield (g)	Biological efficiency (BE)%
				1 st	2 nd	3 rd				
<i>Pleurotus ostreatus</i> (in Pot)	Wheat straw (WS)	18.7 ±0.6	20.00 ±1.73	31.82 ±0.6	12.23 ±0.6	6.43 ±0.2	7.6±2.3	2.00±1.0	50.48	54.86
	Moong straw (MS)	17.3 ±0.6	21.00 ±1.7	22.1 ±1.1	20.73 ±2.6	15.5 ±0.7	5.6 ±0.4	4.03±0.1	58.33	83.32
	Chickpea (CP)	18.7 ±2.1	24.00 ±1.00	21.3 ±1.1	18.56 ±1.2	13.7 ±1.0	6.7 ± 1.0	4.87±0.3	53.56	71.42
<i>Pleurotus ostreatus</i> (in Poly bag)	Wheat straw (WS)	19.0 ±1.0	20.33 ±1.5	24.41 ±1.0	13.23 ±2.1	6.89 ±0.6	8.5±1.5	2.03±0.1	44.53	63.61
	Moong straw (MS)	18.7 ±0.6	23.33 ±1.53	56.8 ±1.3	20.47 ±3.7	16.1 ±1.2	7.4 ±0.8	5.00±1.0	93.37	101.48
	Chickpea (CP)	17.3 ±0.6	21.33 ±2.1	49.25 ±4.7	21.66 ±1.2	8.83 ±0.9	8.6±1.2	3.87±0.3	79.74	106.32

Conclusion

The present study deals with the cultivation system in two conditions where polythene bag cultivation is significantly more efficient than plastic pot systems for the production of *Pleurotus ostreatus*. Polythene bag yield higher productivity and biological efficiency across all the substrates. Moong straw proved to be the most suitable across all the substrate due to its favourable physicochemical properties and balanced C:N ratio, enhancing mycelial growth and substrate utilization efficiently. The findings highlight an effective, low-cost cultivation strategy for sustainable mushroom production using locally available agricultural residues.

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