Biological efficiency and Yield of *Pleurotus sajar-caju* on Different Agricultural Wastes

AbhishekRaut
Department of Botany,
Dr. BabasahebAmbedkarMarathwada University Aurangabad – 431004 (MS) India

Kharade Rahul
Department of Botany,
Dr. BabasahebAmbedkarMarathwada University Aurangabad – 431004 (MS) India

Vishal Hiwale
Department of Botany,
Dr. BabasahebAmbedkarMarathwada University Aurangabad – 431004 (MS) India

Shrikant B. Mane*
Microbial Culture and Collection Lab., Department of Botany,
Dr. Babasaheb Ambedkar Marathwada University Aurangabad – 431004 (MS) India.

Abstract : Present investigation is made on biological efficiency and yield of *Pleurotus sajar-caju*on different agricultural wastes like Wheat Straw, Maize straw, Moong pod husk, Chick pea pod husk, Bajara husk, Pigeon pea husk, Baobab fruit rind, Sugarcane bagasse and Soybean pod husk were evaluated for the yield and biological efficacy Chick pea pod husk substrate showing highest yield 690 gm/ kg and 69 % biological efficiency in *Pleurotus sajor-caju*species were recorded during the investigation. Next to the Chick pea pod husk substrate, Pigeon pea husk high yield were recorded during the study i.e yield 460 gm/kg with 46% Biological efficacy, followed by Bajra husk substrate showing 45.5% biological efficiency with 455 gm/kg total yield. Wheat straw substrate showing 37% Biological efficiency with 370 gm/kg yield. The Moong pod husk shows 305 gm/kg yield with 30.5% biological efficacy. Soybean pod husk substrate showing 297gm/kg with 29.7% Biological efficiency.
KEYWARDS: Biological efficiency, *Pleurotus sajor-caju,* agricultural wastes

I.INTRODUCTION

Mushroom is a fleshy fruiting body of some fungi arising from a group of mycelium buried in substratum. Most of the mushrooms belong to the Sub-Division: Basidiomycotina and few belong to Ascomycota. In general, the fungi are put under a separate kingdom. In Basidiomycota, three types of mycelia viz., primary, secondary and tertiary are noticed. The primary mycelium is monokaryotic and is formed by germination of Basidispores. These are the different mating types and give rise to secondary mycelium by somatogamy or fusion of two basidispores or spermatization of two female sex organs. The secondary mycelium firm's major portion of the somatic phase and later produces tertiary mycelia, which gives rise to fruiting body-basidiocarp (Mushroom). Oyster mushroom is scientifically known as pleurotus spp. Pleurotus is Basidiomycetes fungus belonging to order Agaricales and family Trichomataceae /Polyporaceae. There are about 38 species described under genus Pleurotus from different part of the world, out of which 25 species are under cultivation. They mainly include *Pleurotusostreatus*, *Pleurotusflabellatus*, *Pleurotussajorcaju*, *Pleurotussapidus*, *Pleurotuseous*, *Pleurotusflorida*, etc.

World production of cultivated, edible mushrooms has increased more than 30-fold since 1978.china is the main producer of cultivated, edible mushrooms…. Lentinula and four other genera (*Pleurotus, Auricularia, Agaricus,* and*Flammulina*) account for 80-85%of the world's total supply of cultivated edible mushrooms. Italy is on second number for worldwide production and up to that USA. India ranked on 18th number in the production of edible mushrooms).Annual mushroom production has increased to 80,000 ton in 2006 from a mere 1,000 ton in 1981. Fifty percent of this is produced by marginal and small production units and the rest by industrial establishments. Mushroom husbandary is now one of the major sources of income for farmers of many states like Haryana, Uttar Pradesh, Punjab, Uttarakhand and Himanchal Pradesh. The major producers of mushrooms are Punjab (35,000 MT) Tamilnadu (15,000MT), and Andhra Pradesh (5000MT). Mushroom production of Uttarakhand alone increased from 2,640MT in 2000 to 5340MT in 2006, with Dehradun, Nainital, Haridwar and Udham Singh Nagar the major production centres. Button mushroom (Agaricusbisporus) constitutes about 90% of total production

in India where that of other cultivated mushrooms viz. Pleurotus, Lentinula, Auricularia and Calocybe are very marginal. [1].

Mushroom was first cultivated in India in 1940; however, its systematic cultivation was first attempted in 1943. Department of Agriculture, Solan, Himachal Pradesh, started the work on a small scale to grow mushrooms. In India, commercial cultivation of mushrooms had been with the joint effort of scientists and farmers [2]. The cultivation of *Pleurotus* mushrooms through solid-state fermentation help in the recycling of agro wastes. Various agricultural by-products are used as substrates to cultivate oyster mushroom, for instance, banana leaves, peanut hull, and corn leaves, wheat and rice straw, mango fruits and seeds, sugarcane leaves. The widely used substrate for cultivation in Asia is rice straw and cotton wastes. Oyster mushroom is having capacity to grow in tropical and subtropical region. It is being cultivated in Himachal Pradesh, Uttar Pradesh, Andhra Pradesh, Jammu and Kashmir, Karnataka, Goa, Tamil Nadu, and Punjab [3].

Pleurotussajor-caju is a typical edible fleshy species of Oyster mushroom. It belongs to the class Basidiomycetes, Order Polyporales, family Polyporaceae and genus *Pleurotus*. The fruiting bodies of *Pleurotussajor-caju* are solitary or in clusters, grown on logs or growing medium (substrates). The pileus ranges from 10-50 (70) mm in diameter, broadly, convex, shallow land narrowly depressed when young, becoming infundibuliform in old specimens; surface white initially, turning brownish grey on maturity, brownish squamules at the centre, margin initially incurved, becoming decurved, entire becoming crisped to eroded. Lamellae de current, crowded, white to yellowish white, margin entire not forked, not anastomosed at the base. Stipe 5-20×3-9 mm, central to eccentric, solid, white, smooth, equal, somewhat flattened. Annulus present, thick, center (bell shaped), volva absent. These are rich in protein, carbohydrate and vitamins. Mushrooms are low in caloric value and hence are recommended for heart and diabetic patients. *Pleurotussajor-caju* is proteins as compared to cereals, fruits and vegetables. In addition to proteins (3.7 %), they also contain carbohydrate (2.4 %), fat (0.4%), minerals (0.6 %) and water (91%) on fresh weight basis. Mushrooms contain all the essential nine amino acids required for human growth. Mushrooms are excellent source of thiamine (vitamin-B1), riboflavin (B2), niacin, pantothenic acid, biotin, folic acid, vitamin C, D, A and K which are retained even after cooking. Since mushrooms possess low caloric value, high protein, high fibre content and high K: Na ratio, they are ideally suited for diabetic and hypertension patients. They are also reported to possess anticancer activities. [4].

The mushrooms have long ago drawn attention of human beings as a food, nutritionally and medicinally and now-a-days is a leading food component. *P.sajor-caju*; a species of oyster mushroom growing easily in warmer condition may be the best alternative for the year round supply of Oyster mushroom supporting summer season. *Pleurotus sajor-caju*gives the highest yield at 30 o C and is preferred for summer season [16]. The growth of *Pleurotus sajor-caju*in Cotton waste mixed with wheat bran produced higher yield (74.35g) than Paddy straw (51.38g). The incubation period to the emergence ofsporophores was longer for cotton waste mixed with wheat bran (seven weeks) compared to that for the Paddy straw (Four weeks). The main substrate material alone sometimes cannot provide enough nitrogen required for optimal growth of mushrooms. Additives such as rice or wheat bran provide a nitrogen source [5].Considering the fact that mushroom have high Nutritional Values, Medicinal Values, Economical Values, Environmental Values, and Ecological Values mushroom cultivation is beneficial. Mushrooms are good alternative source of food as well as farmer side business it will empowering the employment therefore the topic is taken “Impact Of Different Substrates On Mushroom Cultivation” to check impact of different substrates on mushroom cultivation different agricultural waste were taken as study. The different agro-wastes are Wheat Straw, Maize straw, Moong pod husk, Chick pea pod husk, Bajara husk, Pigeon pea husk, Baobab fruit rind, Sugarcane bagasse and Soybean pod husk etc.

II. MATERIAL AND METHODS

The cultivation of Oyster mushroom or Pleurotus spp is relatively simple. The agro-climatic conditions in our country especially in the Indian States are conducive for mushroom cultivation when the temperature is 15-30^{0}C and relative humidity is 70-80%. *Pleurotus*Spawn*(P.* sajor-caju*)*culture and prepared spawn were obtained from Nutrimist Mushroom Farm, Taklivaidya, Aurangabad. Ta.Dist. Aurangabad(M.S.) India.

1 Material requirement:

1.1 Substrate:

The mushroom laboratory at Department of Botany, Dr. Babasaheb Ambedkar Marathwada University Aurangabad – 431004 (MS) India. Mushroom (*Pleurotussajor-caju*) culture and prepared spawn were the selection of mushroom, production of the subculture, production of mother spawn, and production of grain spawn as outlined in the method presented by [6]. Nine different organic wastes used as substrates *Pleurotus sajor-caju*bed preparation viz. Wheat Straw, Maize straw, Soyabean pod husk, Bajra husk, Chick pea pod husk, Sugarcane bagasse, Moong pod husk, Baobab fruit rindand Pigeon pea huskwere sterilized with Bavistin (Carbendazim 50% WP (75.ppm),

Formaldehyde (37-40%) the substrates were then drained to remove excess water and packed into transparent plastic standard with 14 x 22 cm size for mushroom cultivation[4].

1.2 Bag filling Method:

The bag filling method was used throughout the studies. The polythene bags of 14 x 22 cm and the bottom of the bags were tied with rubber to provide a flat circular bottom to the mushroom beds. The dry weight of the substrates was recorded and the bags full of different substrates were weighed and were maintained at 1 kg in a bag for each substrate. The first layer was filled with the substratum up to 5 cm in height. The spawn was sprinkled over the entire surface of the substratum. Similarly, four such layers were filled with the substratum. Inoculation was made with pure grain spawn at 10 grams per kg of the substrate on a dry weight basis under aseptic conditions. The bags were tied and two vents of one cm diameter were provided.

1.3 Climate & other conditions

In the fruiting house, the bags were put on the wooden racks, water was sprayed onto the bags to keep them moist, the floors were also wetted to help increase the humidity to not less than 85.0%, were mentioned at culture room. 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.

1.4 Harvesting

As soon as the fruiting bodies developed and attained their full size, they were cut just above the surface of the substrate with a sharp knife or blade. Scrape out 1 cm outer layer of the bed after the first harvest and do not sprinkle water for 12 hours. From the second day onwards sprinkle water. Within 3 to 4 days basidiocarps develop.

1.5 Yield and Biological efficiency (B.E.)

The total weight of all the fruiting bodies harvested from all three pickings was measured as the total yield of mushrooms. The biological efficiency (yield of mushroom per kg substrate on dry wt. basis) was calculated by the following formula [7].

$$\text{B. E (\%)} = \frac{\text{Fresh weight of Mushroom}}{\text{The dry weight of the substrate}} \times 100$$

IV. Result and Discussion:

Present work was undertaken to find suitable substrates from the numerous agriculture waste for Oyster mushroom Growth and Yield. Different five types of substrates were investigated to determine Yield/ Growth and development of *Pluerorus spp*. to find out the best substrates for getting more economic benefit. Effect of different substrates viz. Wheat Straw, Maize straw, Soybean pod husk, Bajra husk, Chick pea pod husk, Sugarcane bagasse, Moong pod husk, Baobab fruit rindand Pigeon pea huskwere studied for mycelial growth of *Pleurotus sajor-caju*and results were seen from Table No 1 and photo plate no. 1. It was clearly found from the table no 1 that substrates also showing effect on growth and development of oyster mushroom. To see the mycelial growth of *Pleurotus sajor-caju*observation were taken of 3 days, 6 days, 9 days & of time interval.

During the mycelial growth of *Pleurotus sajor-caju* on different 9 substrates showed the variation in growth as well as the first pinhead appearance the different substrates influence on mycelial growth that is 3 days, 6 days, 9 days of time interval. The highest mycelial growth was seen at in Bajra husk, Moong pod husk, Wheat Straw and Baobab fruit rindafter that Pigeon pea husk and Chick pea pod husk shows the growth at 6 days of time interval and the lowest growth was seen in Sugarcane bagasse and soybean pod husk.

During the observation earliest first pinhead seen at 14 days on Moong pod husk substrate, on Chick pea pod husk substrate pinhead seen at 15 days. In Bajra husk and Baobab fruit rindsubstrate pinhead were seen at 16 days of time interval. In Wheat Straw, Maize straw, Pigeon pea husk substrate pinhead were seen at 18 days of time interval. Impact of substrate also seen on days of first pin head on, moong substrate at 14 days and Pigeon pea husk influence on pin head it was shown at 17 days. As compares these substrate wheat straw and maize substrate bed first pin head was seen after 17 days.

Table No. 1. Effect of Substrates on Mycelium growth of *Pleurotus sajor-caju*

Sr. No	Substrates	Mycelial Growth (Days)			Days of First Pin Head
		3	6	9	
1	Wheat straw	+	+ + +	+ + +	17 Days
2	Maize straw	-	+	+ +	17 Days
3	Moong pod husk	+	+ + +	+ + +	14 Days
4	Chick pea pod husk	+	+ +	+ + +	15 Days
5	Bajra husk	+	+ + +	+ + +	16 Days
6	Pigeon pea husk	+	+ +	+ + +	17 Days

7	Baobab fruit rind	+	+ + +	+	16 Days
8	Sugarcane bagasse	-	-	+	25 Days
9	Soybean pod husk	-	-	+	22 Days

Photo plate no. 1. Impact of Different Substrates (Agro-Waste) on Mycelium Growth of *Pleurotus sajor–caju*

Photo plate no. 2. Impact of Different Substrates (Agro-Waste) on Growth of *Pleurotus sajor–caju*

Chick pea pod husk

Moong pod husk

Wheat Straw

Pigeon pea husk

Bajara husk

Baobab fruit rind

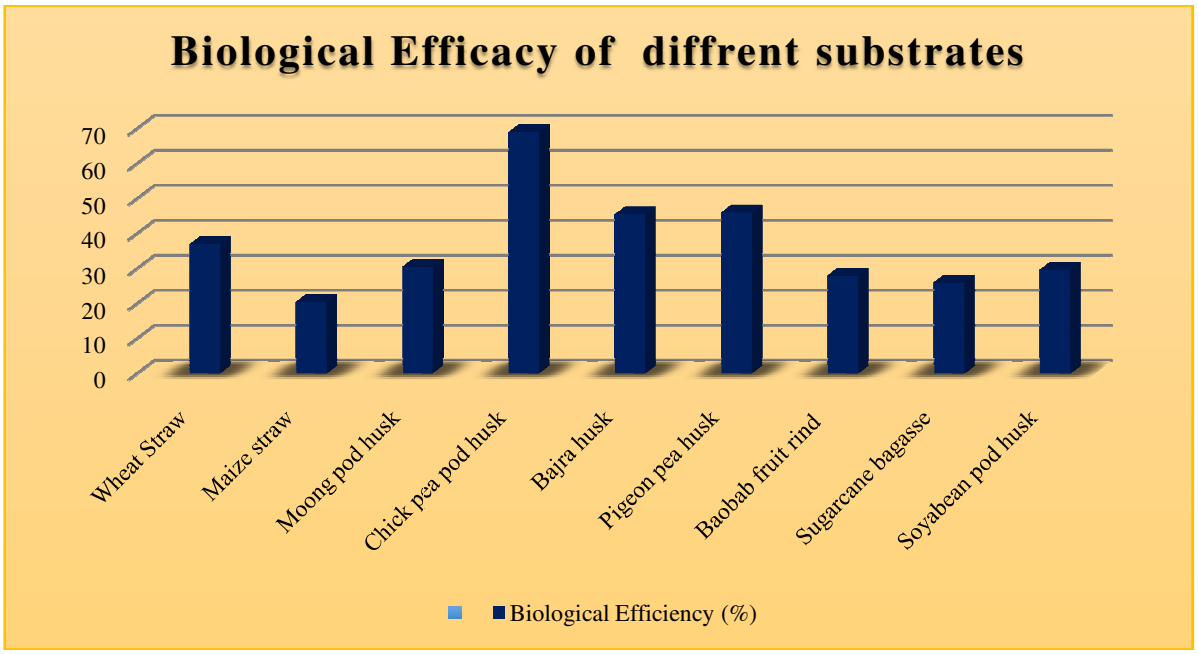
Effect of substrates on yield and Biological Efficiency of *Pleurotus sajor-caju*

It is cleared that impact of different lignocellulosic substrates also play an important role in Yield and biological efficiency of oyster mushroom *Pleurotus sajor-caju*from Table no.2. and Photo plate number 2 of impact of substrate on yield and Biological efficiency of different lignocellulosic agricultural wastes viz. Wheat Straw, Maize straw, Moong pod husk, Chick pea pod husk, Bajara husk, Pigeon pea husk, Baobab fruit rind, Sugarcane bagasse and Soybean pod husk. The Chick pea pod husk substrate showing highest yield 690 gm/ kg and 69 % biological efficiency in *Pleurotus sajor-caju*species were recorded during the investigation. Next to the Chick pea pod husk substrate, Pigeon pea husk high yield were recorded during the study i.e yield 460 gm/kg with 46% Biological efficacy, followed by Bajra husk substrate showing 45.5% biological efficiency with 455 gm/kg total yield. Wheat straw substrate showing 37% Biological efficiency with 370 gm/kg yield. The Moong pod husk showing 305 gm/kg yield with 30.5% biological efficacy. Soybean pod husk substrate showing 297gm/kg with 29.7% Biological efficiency. Baobab fruit rind substrate showing 280 gm/kg with 28 % Biological efficiency. Sugarcane bagasse substrate showing 260 gm/kg with 26 % Biological efficiency. The lowest biological efficacy and yield were seen in Maize straw/ cob leaves i.e.205 gm/kg yield with 20.5% biological efficacy. . The result was in agreement with [8] had done experiment with maize stalk, pea residue and banana leaves. Each substrate was separately supplemented with 10 % chicken manure or rice bran and mixed thoroughly; substrate without supplement was considered as a control. The total yield in maize stalk with rice bran was highest followed by control and chicken manure respectively. The total yield in pea residue with rice bran was highest followed by chicken manure and control, respectively. The total yield in banana leaves with rice bran was highest followed by

chicken manure and control. The substrate materials viz. Paddy straw, Wheat straw, Apple leaves and Chinar leaves was used by [9] highest yield was found on Paddy straw substrate followed by Wheat straw, Apple leaf and Chinar leaf substrate. A variety of agricultural wastes used by [10] namely wheat straw, paddy straw, sugarcane baggases, sugarcane leaves, black gram straw, sorghum leaves, maize heart, ashoka leaves, banana leaves, barley straw, sorghum stalks and mustard straw. Among the all substrate paddy straw resulted the highest yield followed by wheat straw, black gram straw. The agro waste had been experiment by [11], soybean straw, paddy straw, wheat straw, groundnut straw, Pigeon pea stalk and sunflower stalk [12]done cultivation with cotton waste, paddy straw and wheat straw [13]. The substrate used for this experiment was wheat straw and [14] used soybean get best result. Substrates preparation and Cultivation with, the highest yield was found in corn-cob followed by sawdust and coconut husk respectively [15].

Table No.2. Effect of substrates on yield and Biological Efficiency of *Pleurotussajor-caju*

Sr. No	Substrates	Yield (gm)			Total Yield (gm)	Biological Efficiency (%)
		I	II	III		
1	Wheat Straw	170	120	80	370	37
2	Maize straw	120	65	20	205	20.5
3	Moong pod husk	120	110	75	305	30.5
4	Chick pea pod husk	300	210	180	690	69
5	Bajra husk	240	125	90	455	45.5
6	Pigeon pea husk	200	160	100	460	46
7	Baobab fruit rind	160	80	40	280	28
8	Sugarcane bagasse	60	120	80	260	26
9	Soyabean pod husk	125	96	76	297	29.7



V. CONCLUSION

Mycelial growth and pinhead were shows the different growth in different substrates i.e. Wheat Straw, Maize straw, Moong pod husk, Chick pea pod husk, Bajara husk, Pigeon pea husk, Baobab fruit rind, Sugarcane bagasse and Soybean pod huskit shows the substrates influence on the growth of mushroom.

Chick pea pod husk substrate have the highest yield i.e. 690 gm per kg and the highest biological efficiency i.e. 69% and as compared to that Maize straw/ cob leaves i.e.205 gm/kg yield with 20.5% biological efficacy. Hence we conclude that different substrates influence also on the yield and biological efficiency.

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