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Anita Kumari
SMS, Home Science, KVK, Khagaria Bihar Agricultural University, Sabour, Bihar, India

Maya Kumari
Scientist (H.Sc.), KVK, Sahibganj,(Birsa Agricultural University), Ranchi, Jharkhand, India

Brajendu Kumar
Senior Scientist and Head, KVK, Khagaria, Bihar Agricultural University, Sabour, Bihar, India

Archana Kumari
Krishi Vigyan Kendra, Saran, Bihar, India

Correspondence
Anita Kumari
SMS, Home Science, KVK, Khagaria Bihar Agricultural University, Sabour, Bihar, India

Efficacy of different substrates on the production of oyster mushroom (*Pleurotus sajor-caju)*

Anita Kumari, Maya Kumari, Brajendu Kumar and Archana Kumari

Abstract
The study was conducted to examine the efficacy of different type of agro-waste viz. Wheat straw (*Triticum aestivum*), Paddy straw (*Oryza sativa*) and Maize stalks (*Zea mays*) on Oyster Mushroom (Pleurotus sajor caju) production. The results indicated that different substrate formulas gave a significant difference on spawn running, fruiting bodies formation and pin head formation, yield and biological efficiency. Wheat straw showed significantly highest yield (747.1±3.2) with biological efficiency (149.4) per cent and lesser time for spawn run (17-19 days) and mushroom pin head appearance (21-23 days). Maize stalks required more time for spawn run (25-28 days) and pin head appearance (31-36 days) and resulted less yield (478.1±2.1) with (95.62) per cent biological efficiency. The study revealed that lesser time taken to colonize the substrates is consistent with better yield and highest biological efficiency.

Keywords: Pleurotus sajor-caju, Agro-wastes, Biological efficiency, and Yield

Introduction
Oyster mushroom (*pleurotus spp*) belonging to class Basidiomycetes and Family Agaricaceae is properly known as Dhingri in India. Dhingri is an important edible mushrooms gaining popularity in recent years because of its high nutritional value and ability to grow on diverse agricultural wastes.

Food production in large quantity is a challenge but safe disposal of crop residues is a great problem. Edible fungi are natural recycler which converts lignocelluloses wastes into protein rich health food. Malnutrition is a problem in developing third world countries. The Food and Agriculture Organization have recognized mushrooms as food contributing protein nutrition to the countries depending largely on cereals. Mushrooms with their flavour, texture, nutritional value and high productivity per unit area have been identified as an excellent food source [1]. A high nutritional values of Oyster mushrooms has been reported with protein (25-50%), fat (2-5%), sugars (17-47%), mycocellulose (7-38%) and minerals (potassium, phosphorus, calcium, sodium) of about 8-12%. Edible mushrooms are also rich in vitamins such as niacin, riboflavin, vitamin D, C, B1, B5 and B6. The genus is characterized by its high protein content 30- 40% on dry weight basis [2] which is twice that of vegetable. Dhingri mushroom can help in solving the problems of malnutrition and disease. Poppe [3] reported that there are about 200 kinds of waste in which edible mushrooms can be produced. Various agricultural wastes rich in cellulose are being used as substrates for cultivation of Dhingri mushrooms [4]. Most of all, *Pleurotus* spp. can utilize various kinds of substrate materials than any other mushrooms. *Pleurotus* species require a temperature of 20-30°C both for its vegetative growth and reproductive phase in natural habitat [5]. The present study aimed to examine the biological efficiency or yield of *P. sajor-caju* on different agro-based wastes used for its cultivation Mushroom production gives additional or alternative income to farmers looking for a value added product and a way to supplement farm income while making use of byproducts or co-products from other crops. However, development of cost-efficient and alternate substrate to cultivate Oyster mushroom without sacrificing mushroom quality is a major focus of many researchers and growers. Therefore, cultivation of *P. sajor-caju* on various agricultural substrates offers high value products with nutritional and medicinal properties. Hence, the study was undertaken sduring October 2015 to February 2018 at Krishi Vigyan Kendra, Khagaria under On Farm Trials, Front Line Demonstrations and various Vocational training programme for Self-employment of rural youth, farmers and farm women.

Materials and Methods
Substrate preparation
A medium was prepared using conventional *viz*. Wheat straw (*Triticum aestivum*), Paddy

straw (*Oryza sativa*) and Maize stalks (*Zea mays*) All the substrates were dried and cut into 3-4cm long pieces. The substrates were soaked in water for 8-10 hours in cemented pond to obtained 70-75 per cent moisture level. All the substrates were sterilized by boiling method where the substrates were boiled for one hour at 70-75 °C. Then they were spread on the steep cemented floor so as to remove the excessive moisture from the substrates to get 65-75 per cent moisture level. The substrates were cooled up to room temperature (25 °C). A local method was developed for determination of moisture. In this method moisture was determined by pressing a handful mixture. If there was no water runoff and the material stayed in form indicates that the moisture content was around 65 per cent. Five kilogram of each substrate was filled in transparent polythene bag (30x45cm) and seeded with 150g of *P. sajor-caju*. The pinholes at 10- 12cm distance were also done in the bags with help of led pencil after sterilization in 2 per cent formaldehyde solution. The bags were incubated in dark cropping room where ambient temperature ranged between 22-28+10C. The humidity 80 – 90 per cent of the room was maintained by spraying of water twice a day on the floor covered with jute bags. After complete colonization of substrate polythene was removed and bags were put on the bamboo made structure for fruiting. The humidity of the bags was accomplished by spraying of water on them twice a day. The experiment was laid out in complete randomized design (CRD) with three replications and three treatments. Time was recorded in days for the completion of growth of mycelium on substrates, appearance of pinheads and maturity of fruit bodies in different treatments. The data on average values of observations were also recorded for the yield, number of fruit bodies. Biological efficiency of mushroom on fresh weight basis was calculated by using formula given by Chang and Miles (1989) [6].

$$\text{Biological efficiency (\%)} = \frac{\text{Yield of fruiting body (g)}}{\text{Total weight of substrate used (g)}} \times 100$$

Result and Discussion

Spawn running

All the substrates were spawned at the same day. It was evident from the Table 1. That spawn running took 2-3 week after spawning.

Pin head formation

The pin head formation is the second stage of mycelia during cultivation of mushroom. Small Pin head like structures were observed, these pin head were formed 4-5 days after spawn running (Table1). Our results were corroborated with Ahmed (1986) [7] who stated that *P. sajor-caju* completed spawn running in 17-28 days on different substrates and the time for pin head formation was noted as 21-36 days.

Fruit bodies formation

This is the third and final stage during the cultivation of mushroom. The fruit bodies appeared 4-5 week after pin head formation and took 21-28 days later after inoculation of spawn (Table1). Sharma and Jandaik (1981) [8] reported that *P. sajor-caju* cultivation on wheat straw took 32 days for the first harvest.

Table 1: Days for completion of spawn running, pinhead formation and fruiting body formation of different phases of *P. sajor-caju* production on different substrates.

Substrates	Spawn running (Days)	Pinhead formation (Days)	Cap diameter (cm)	Fruiting body formation (Days)
Wheat straw	17-19	21-23	8.6	42-44
Paddy straw	22-24	28-30	8.1	32-34
Maize stalk	25-28	31-36	7.8	25-27

Table 2: Yield performance of *P. sajor-caju* on wheat straw, paddy straw and Maize stalk.

Substrates	Yield (g)/500 g dry substrate					Biological Efficiency (%)
	first flush	second flush	third flush	fourt flush	Total	
Wheat straw	280.4±4.3	265.7±3.9	120.6±2.7	80.4±2.1	747.1±3.2	149.4
Paddy straw	225.1±2.6	220.4±2.9	113.5±3.1	64.7±2.8	623.7±2.8	124.7
Maize stalk	169.3±3.1	146.5±2.4	101.2±2.7	61.1±2.3	478.1±2.1	95.62

Number of fruit bodies

The caps of mushroom was also counted in three flushes, average 7.8-8.6 were formed in three flushes (Table1). Highest number of fruiting body (42-44) were produced by wheat straw followed by paddy straw (32-34), whereas least number of fruit bodies (25-27) were harvested from maize straw.

Yield of Oyster mushroom

The crop was harvested in three flushes where maximum yield was obtained in first flush than the second and third flush. The results (Table 2) showed that out of three substrates evaluated for their potential to produce sporophores of P. sajor-caju, wheat straw supported (747.1±3.2) gram mushroom per kg straw gave higher yield followed by paddy straw (623.7±2.8) and maize straw 478.1±2.1. Other substrates have also proved to be the promising substrates for the cultivation of oyster. The lower performance and yield of different agricultural wastes might be due to low lignolytic and cellulytic activity. However, high and significant performance of other substrates ensures the possibilities of utilizing the locally available substrates for Pleurotus sajor-caju cultivation.

Biological Eficiency

Considerable variation was found in yield of Oyster Mushroom using different substrates.

The biological efficiency was calculated on the dry weight basis of the substrate. It was evident (Table 2) that as a substrate wheat straw showed best biological efficiency 149.4 per cent followed by paddy straw 124.7 per cent and maize straw 95.62 per cent. Pleurotus sajor- caju was found to utilize all the agricultural wastes and were observed suitable for spawn run, yield and biological efficiency (Das *et al*., 2000) [9]

Conclusion

The study revealed that wheat straw showed significantly

highest yield 747.1±3.2 and lesser time for spawn run (17-19 days) and pin head appearance (21-23 days). maize straw required more time for spawn run (25-28 days) and pin head appearance (31-36 days) and resulted less yield (478.1±2.1kg/5.0 kg substrate) with 95.62 per cent biological efficiency. The study revealed that lesser time taken to colonize the substrates is consistent with better yield and highest biological efficiency.

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