Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(4): 3407-3409
Received: 15-05-2018
Accepted: 20-06-2018

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Efficacy of different agricultural by product substrates and moisture content on mycelial growth of *Pleurotus cornucopiae*

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Abstract
Increasing demand for edible mushroom has led to investigation into the suitability of agricultural waste as substrates for commercial production. The objective of this research experiment was carried out to evaluate the effect of four different substrates (Banana leaf, Sugarcane bagasse, Saw dust and Paddy straw) and combination of six different substrates (Banana leaf + Saw dust, Banana leaf + Sugarcane bagasse, Banana leaf + Paddy straw, Sugarcane bagasse + Saw dust, Saw dust + Paddy straw and Sugarcane bagasse + Paddy straw) on the growth and yield of *Pleurotus Cornucopiae* with five moisture levels (50±2% to 90±2%) and radial growth. Highest mycelial growth rate was recorded in substrate sugarcane bagasse and combination of banana leaf + sugarcane bagasse (1:1) at 70±2%. Therefore the use of those agricultural by products showed itself viable for *Pleurotus cornucopiae* mushroom mycelium growth due to its availability and low cost, besides decreasing discards to environment.

Keywords: *Pleurotus cornucopiae*, oyster mushroom, sugarcane bagasse, banana leaf, moisture content, mycelial growth and substrates

Introduction

Pleurotus cornucopiae is a fungi of basidiomycetes commonly known as Branched Oyster mushroom. Pleurotus species are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency [1]. Cultivation of oyster mushroom has increased tremendously throughout the world because of their abilities to grow at a wide range of temperature and harvested all over the year [2]. Pleurotus have the ability to excrete hydrolyzing and oxidizing enzymes [3]. Which have capable of utilizing complex organic compounds that occurred agricultural wastes and industrial by-products with broad adaptability varied agro- climatic conditions [4].

Oyster mushroom cultivation can play an important role in managing organic wastes whose disposal has become a problem [5]. These wastes can be recycled into food and environment may be less endangered by pollution [6]. Strengthening mushroom production sector could be essential in- order-to enable the rural economy to keep its vibrancy and development, increasing and diversifying business and employment opportunities in the rural areas, and providing income opportunities of small family farms. Furthermore, the use of these residues in bioprocesses maybe one of the solutions to bioconversion of inedible biomass residues into nutritious protein rich food in the form of edible mushrooms [7]. Many of mushrooms pose a range of metabolites of intense interest to pharmaceutical e.g. anti-tumour, antigenotoxic, antioxidant, anti-inflammatory, anti-hypertensive, antiplatelet - aggregating, antihy perglycemic, antimicrobial, antiviral activities and food industries [8].

Mushrooms are considered as a functional food, which can provide health benefits beyond the traditional nutrients the contain. Agricultural wastes are rich in various types of nutrients and their disposal is difficult to manage as excess of nutrients in them can cause leaching is left in field, as a compost. Mostly they are disposed by means of incineration which causes pollution [9]. Hence, there is always a high demand of discovering an agricultural waste management method which is cost effective and contribute less in environment pollution. Mushroom cultivation on agricultural wastes full fills these requirements [10].

Agricultural wastes are rich in lignin cellulosic components which are difficult to breakdown, but can effectively be done mushroom cultivation. They are very nutritious products that can be generated from lingo cellulosic waste materials. The bioconversion of agricultural wastes into a value-added product is a good mean of their use.

The property of edible mushroom fungi to convert complex organic compounds into simpler one's is used to transform the useless agricultural wastes into valuable products.

During cultivation when the parameters, such as light, temperature and humidity, are controlled yields are much higher. Production of oyster mushroom the substrate is prepared from herbal residues like: wheat, soya, rice, straw, bean, pea, cotton stems and other waste parts of the industry such as: sugarcane, sunflower husks and stems, etc [11].

Utilizing these by-products for mushroom cultivation using locally available technologies may be one of the solutions to transforming these inedible wastes into accepted edible biomass of high market value. The aim of present experiment was undertaken to find the best substrates and suitable moisture content among the others substrates for mycelium growth of *Pleurotus cornucopia*.

Materials and Methods

The studies on different physiological parameters (substrate and moisture content) of the fungus *Pleurotus cornucopiae* were conducted under *in vitro* conditions. *Pleurotus cornucopiae* was cultured on different substrate namely paddy straw, sawdust, banana, Sugarcane bagasse as a medium, to find out the best substrate for maximum mycelium growth.

The experiment of five different moisture regimes (50±2%, 60±2%, 70±2%, 80±2% and 90±2%) was carried out on the different substrate viz., Paddy straw, Sugarcane, Saw dust, and Banana leaf to evaluate the suitable moisture level for higher mycelium growth of *Pleurotus cornucopiae*. The different moisture level and their combination of different substrate viz., (Banana leaf + Saw dust (1:1), Banana leaf + Sugarcane bagasse (1:1), Banana leaf + Paddy straw (1:1), Saw dust + Sugarcane bagasse (1:1), Saw dust + Paddy straw (1:1) and Paddy straw + Sugarcane bagasse (1:1)). The different moisture level of desired moisture content substrates was sterilized in an autoclave at 15psi pressure (121.6 °C) for two hours. After cooling, five grams of sterilized substrate was kept in 9cm diameter sterilized Petri plates with different treatments. The five mm mycelium bits of *Pleurotus cornucopiae* was placed at the center of Petri plates containing different substrate having different moisture content under aseptic conditions and were incubated at 28±2°C. The observations on radial mycelia growth were recorded at an interval of 72 hours, after incubation up to 12 days. All the analyses were carriedout in five replicates.

Result and Discussion

The type of employed substrates was found to impact the mycelium growth of *Pleurotus cornucopiae*. The perusal of data (Table 1) revealed that the significant variations in radial mycelium growth of *Pleurotus cornucopiae* were observed in substrates, viz., sugarcane bagasse, paddy straw, banana leaf and saw dust; by various moisture levels and at different days. From figure 1 revealed that, maximum mycelium growth of *Pleurotus cornucopiae* was observed in sugarcane bagasse (40.50 mm) at 70±2%. In comparison with this substrate, significantly slower mycelium growth was recorded in the banana leaf (38.12 mm) at 70±2% followed by paddy straw (38.75 mm). The minimum mycelium was observed in the saw dust (31.56mm) at 60±2%.

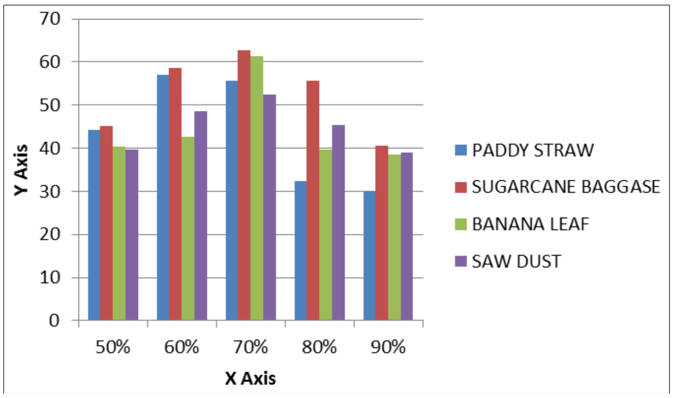

Fig 1: Effect of different substrates and moisture content on radial growth of *Pleurotus cornucopiae* X = Radial Growth, Y = Moisture content

Table 1: Effect of combination of six different substrates and its moisture content on radial growth of *Pleurotus cornucopiae*

S. No	Moisture Content (%)	Banana Leaf + Saw Dust (1:1)					Banana Leaf + Sugarcane Bagasse (1:1)					Banana Leaf + Paddy Straw (1:1)					Saw Dust + Sugarcane Bagasse (1:1)					Saw Dust + Paddy Straw (1:1)					Paddy Straw + Sugarcane Bagasse (1:1)				
		3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean	3	6	9	12	Mean
1	50%	9.76	18.52	29.73	46.47	26.12	10.76	23.65	35.12	43.89	28.36	11.63	28.76	36.24	52.43	32.27	10.86	27.53	34.48	55.06	31.98	12.58	20.93	35.49	42.18	27.79	12.56	26.48	33.23	42.98	28.81
2	60%	12.65	23.71	31.89	51.06	29.83	15.70	32.82	46.74	60.54	38.95	15.52	33.64	41.23	61.56	37.99	16.94	31.85	46.86	60.52	39.04	14.58	22.50	37.87	46.67	30.41	14.28	35.79	49.65	62.03	40.44
3	70%	14.60	27.86	39.98	52.70	33.78	18.97	35.74	55.98	72.18	45.72	17.81	38.16	50.68	67.72	43.59	18.68	36.92	48.52	63.97	42.02	17.89	32.58	41.02	56.73	37.06	17.49	33.87	54.49	71.52	44.34
4	80%	11.25	20.35	36.12	49.07	29.19	13.43	29.76	40.16	58.26	35.40	12.27	32.84	45.92	51.89	35.73	16.74	25.66	33.68	51.25	31.83	9.52	16.26	24.77	40.58	22.78	11.62	22.84	36.19	54.85	31.38
5	90%	10.29	18.54	30.19	45.78	26.20	11.63	18.48	22.14	41.43	23.42	9.72	16.84	25.93	50.93	25.86	12.65	23.88	31.17	49.82	29.38	9.62	14.95	21.73	39.67	21.49	8.58	17.93	28.53	51.05	26.52
	MEAN	11.71	27.79	33.58	49.02	-	14.09	28.09	40.03	55.26	-	13.39	30.05	40.0	56.91	-	15.17	29.16	38.94	56.12	-	12.83	21.44	32.18	45.17	-	12.91	27.38	40.42	56.49	-

The perusal of data (Table 1) revealed that the significant variations in radial mycelium growth of *Pleurotus cornucopiae* were observed in combination of substrates, viz., Banana leaf + saw dust (1:1), Banana leaf + Sugarcane bagasse, Banana leaf + Paddy straw, Saw dust + Sugarcane bagasse, Saw dust + Paddy straw and Paddy straw + Sugarcane bagasse; by various moisture levels and at different days. Table 1 revealed that, Among the six-different combination of substrates, maximum growth was observed in case of Banana leaf + sugarcane bagasse (45.72 mm) followed Paddy Straw + Sugarcane bagasse(44.34 mm), Banana leaf + Paddy straw (43.59 mm), Saw dust + Sugarcane bagasse(42.02 mm), Saw dust + Paddy straw (37.06 mm) and Banana leaf + Saw dust (33.78mm) at 70±2%moisturelevel.Thus, best mycelium growth of *Pleurotus cornucopiea* was obtained when Banana leaf + Sugarcane bagasse was used as substrate having 70±2% moisture content as compared to the other treatments.

This agrees with the reports of Jagdeep Singh *et al*., (2017) [12] 70±2% substrate moisture content optimum for G. *lucidium* growth. Belewu *et al.* 2005 [13] banana leaves as a good substrate for cultivation of *Volvariella volvacea*. Rajapakse *et al.* 2007 [14] highest mycelia growth rate was recorded in banana leaf as a substrate. Poonam *et al.* 2013 [15] found that there is positive correlation of cellulose: lignin with mycelia growth and high yield in *Pleurotus ostreatus*. Similar results were obtained by obodai *et al.* (2003) [16] who used banana leaves supplemented with rice bran as substrate for oyster mushroom cultivation. Cellulose rich organic substance has been reported to be good substrate for cultivation of mushrooms substrate with high lignin and phenolic content decreased the activity of cellulose, but less lignin would enhance enzyme activity and thus ensure higher yield of mushroom.

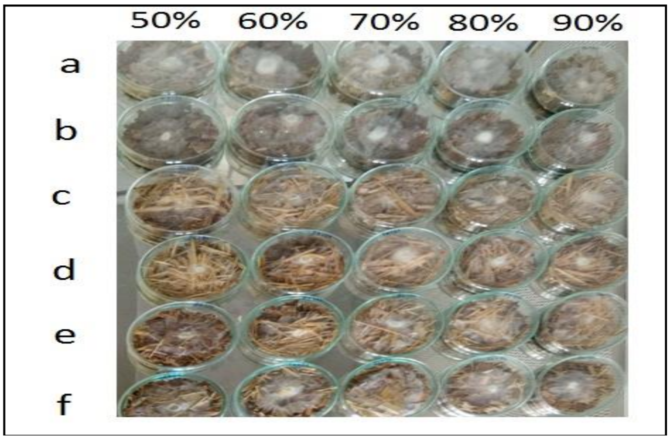

Plate 1: Effect of different substrates after 12 days of inoculation in *Pleurotus Cornucopiae*

(a) Sugar cane bagasse + saw dust (b) Banana leaf + saw dust
(c) Sugar cane bagasse + paddy straw (d) paddy straw + saw dust
(e) Banana leaf + paddy straw (f) Sugarcane + Banana leaf

Conclusion

Pleurotus cornucopiea showed higher mycelium growth in the substrate sugarcane bagasse was obtained at a moisture level 70±2% in substrate sugarcane, followed by 60±2% in substrate Paddy straw followed by Banana leaf and Saw dust at 70±2%moisture all the substrates. The combination of substrates having different moisture contents maximum mycelium growth was obtained at a moisture level 70±2% in Banana leaf + Sugarcane bagasse (1:1), followed by Paddy straw + Sugarcane bagasse, Banana leaf + Paddy straw Saw dust + Sugarcane bagasse, Saw dust + Paddy straw and Banana leaf + Saw dust. India is agricultural country and rich in agricultural waste. The cultivation of *Pleurotus cornucopiea* on these agro wastes decrease the environmental problem and provide a suitable means of adding value to the farmers. Thus the banana leaves and sugarcane bagasse can be a best alternative and replacement of traditional substrates.

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