Agricultural Sciences Journal
Available online at http://asj.mnsuam.edu.pk/index.php
ISSN 2707-9716 Print
ISSN 2707-9724 Online

Research Article

USE OF PEANUT (ARACHIS HYPOGAEA) SHELLS WASTE ALONG WITH DIFFERENT AGRICULTURAL WASTES FOR THE CULTIVATION OF PLEUROTUS PULMONARIUS

Nasir Ahmad Khan[1], Muhammad Hammad Hassan[1], Saba Aslam[1], Luqman Amrao[1]
[1]*Department of Plant Pathology, University of Agriculture, Faisalabad.*

Abstract

The renovation of agro-industrial waste to valuable form such as protein containing food is dire need of world to decrease the agricultural and industrial waste material. Pleurotus pulmonariusis a type of oyster mushroom used generally as protein rich food. Oyster mushroom is commonly used as commercial level for the protein consumption. Peanut (Arachis hypogaea) shells are not easily degradable in the natural environment so mushroom cultivation can easily convert the cellulosic material into protein with less effort and time. Research was conducted on the Pleurotus pulmonaris cultivation by utilizing chiefly peanut shell along with other agricultural wastes such as wheat straw, cotton straw and Paper waste. Cultivation of oyster mushroom was observed on peanut shell substrate by mixing it with cotton waste, wheat straw and paper waste. It was found that the best yield 337.68 g of mushroom was observed when peanut shell was mixed with cotton waste with maximum biological efficiency 33.38%. While the minimum yield 156.58 g was observed when peanut shell alone was used as substrate with minimum biological efficiency 18.21%.

Keywords: Peanut, *P. pulmonaris*, cotton waste, biological efficiency.

1. INTRODUCTION

About 70 percent of agricultural product is eliminated as waste residue (Pala et al., 2014). Peanut shells waste of peanuts are massive agricultural and industrial wastes material that are not simply degradable in normal environment or atmosphere (Zheng et al., 2013) due to the high value of amount of lignin in it (Barton et al., 1974). Rising production of peanut is causing increase in the gathering and expanding of peanut shells globally (AgMRC 2015). In Pakistan production of peanut is 67.8 thousand tonnes and its yield is 609 kg per hectare (Qasim et al., 2016). One pound of peanuts is supposed to yield about 250 grams of peanut shells (Zhao et al., 2012). Burning or otherwise degrading the earth's natural resources results in the burial or destruction of around 14 million metric tons per year (Philippoussis et al., 2001; Kerr et al., 1986). These millions of metric tonnes waste can be made useable and one of its best uses is in eatables (Wilson et al., 2006) like in the preparation of edible mushrooms rich in proteins. Peanut shells can be very effective with the combination of one or more other substrate (Salami et al., 2018). Mostly the peanut shells hold lignin which is the hardest constituent of plant which cannot be decomposed easily (Cesarino et al., 2012). And lignin surrounds the other cellulosic components very hardly and keeping their structure (Pérez et al., 2002). Oyster mushroom is white rot fungi have very good helpful enzymes which can easily break lignin (Waldner et al., 1988) they like lignin as target (Thakur et al., 2013). White rot fungi are natural resource of cheap, friendly to environment multifaceted enzymes that can targetly decompose lignin (Waldner, 1988). Pleurotus ostreatus white rot fungus, is chiefly a lignocellulosic biomass having biodegradation

(Received: 13 March 2022, Accepted: 21 June 2022) Cite as: Khan. N. A., Hassan. M. H., Aslam. S. A. Amrao. L., 2022 Use of peanut (arachis hypogaea) shells waste along with different agricultural wastes for the cultivation of pleurotus pulmonarius. Agric. Sci. J. 4(1): 63-70.

characteristics. Numerous tests describe that P. ostreatus can efficiently take over various lignocellulosic components (Philippoussis et al., 2001; Darwish et al., 2012), it decomposes lignin and leave behind mass of cellulose and/or hemicellulose behind (Thakur et al., 2013). Experiments on the probable utilization of three agricultural substates for producing Pleurotus species (Philippoussis et al., 2001) resulted that the degradable rate of peanut shell waste was considerably less than cotton waste and wheat straw. Experiments have concluded that P. ostreatus could efficiently decompose single or mixed lignocellulosic substrates (Yang et al., 2013; Survase, 2012). Although biodegradation was enhanced in mixed substrates (Isikhuemhen and Mikiashvili, 2009). The current research was designed to evaluate the use of peanut (Arachis hypogaea) shells waste along with different agricultural wastes for the cultivation of Pleurotus pulmonariu.

2. MATERIALS AND METHODS

The experimental trial was conducted in the Mushroom lab, Plant Pathology Department, University of Agriculture, Faisalabad (UAF). For the evaluation Completely Randomized Design CRD was applied. The mushroom growth lab consists of 2 sections, one section for the running of spawn and the second section for cropping. Both sections consist of three lines of racks with five steps in each of them. It was designed in a way that maximizes the amount of space available for mushroom cultivation. For the running of the pawn, the room temperature was controlled at 25 degrees Celsius, and for fruiting bodies, it was kept lower than 25 degrees Celsius by sprinkling water on the lab floor and bed.This study evaluates the effect of different substates on growth of oyster mushroom Pleurotus pulmonarius. The polythene bags with 12*8-inch size was taken from the local markets of Faisalabad city. The spawn called the seed was Pleurotus pulmonarius collected from the mushroom growing lab. The substrates were collected from different localities of the University of Agriculture Faisalabad and from local markets of Faisalabad. Agricultural wastes such as wheat straw (WS) and cotton waste (CW) were taken from the Agronomy farm of university, Paper waste (PW) was collected from the market of the university market and waste of peanut (Peanut shells) was taken from dry fruit markets of Faisalabad.

Substrates were prepared individually and in grouping with wheat straw and cotton waste with proportion 1:1. These substrates were chopped into (2-4 cm), wheat straw (WS), Cotton waste and Peanut Shell were soaked in water for the night and then surplus water was removed after then gypsum was spread on it in purpose to keep away from insects. After that, they were enclosed in polythene sheet for (1 day). They were packed in such a manner the part of a bag filled in two-third portion. Nitrogen supplies for example urea, (NH4NO3) were saturated in water at 10g/L to soak down in substrate. After this procedure substrates were rapped with polythene bags for the purpose of fermentation for about (1 week). After only four hours of soaking, the wheat straw and paper trash were ready to be used. Polythene bags containing (0.5 kg) of substrate were sealed with elastic bands after the preparation of the substrates. For each treatment, three replications were performed.The treatments were taken as follows:

T1 = 100% Peanut Shell

T2 = 50% Wheat straw + 50% Peanut Shell

T3 = 50% Peanut Shell + 50% Paper waste

T4 = 50% Peanut Shell + 50% Cotton waste

T5 = 25% Wheat Straw + 25% Cotton waste + 25% Peanut Shell + 25% Paper waste

The autoclaving of the bags filled with the substrate was done. For this sterilization was done with the help of a drum. The drum was selected and top of the stand was remain above the water. Then drum was heated for 120 minutes. when sterilization was completed, bags were open for cooling and then later the inoculation with prepared spawn was done at the rate of 5 percent spawn in each bag.

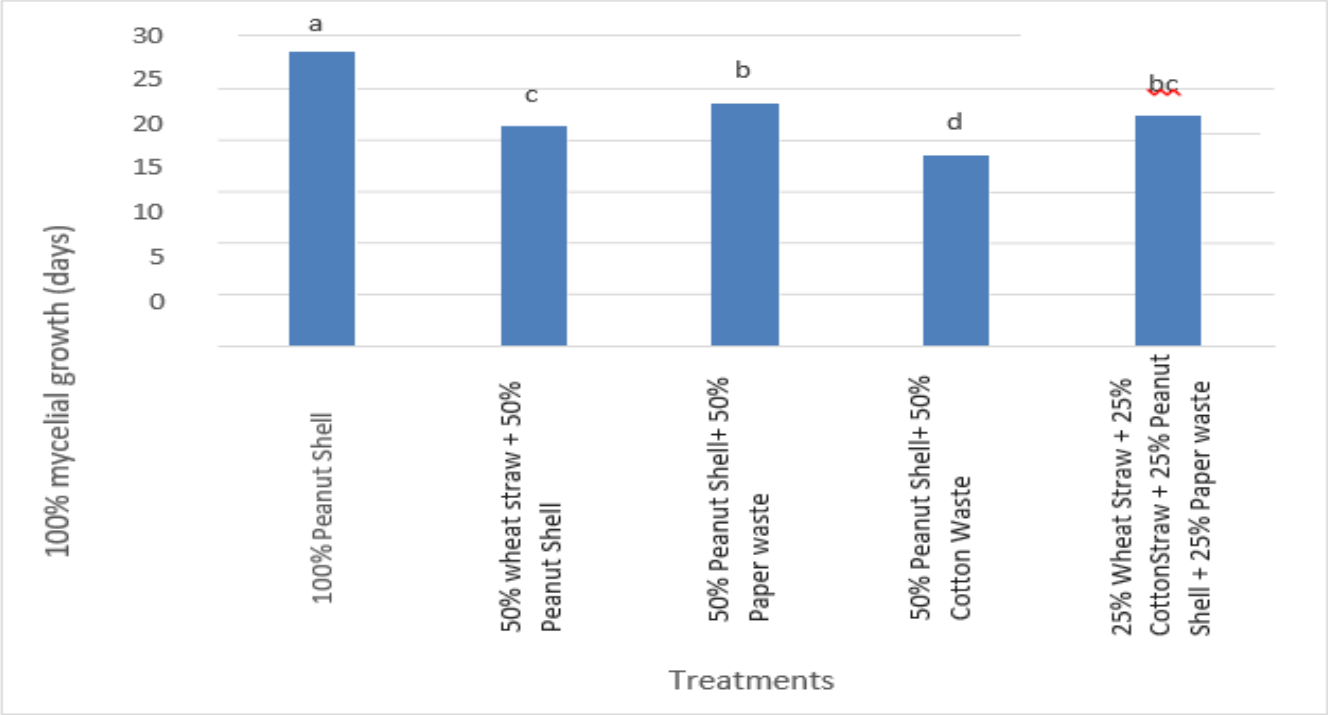

Figure 01:Comparative effect of different treatments (T1, T2, T3, T4, T5) on mycelial growth (days)

Spawning is the procedure of mixing of spawn in the well-prepared substrate/compost. Freshly prepared (20-30 days old) grain spawn was utilized for spawning process. About 5 percent% spawn grains were inoculated by opening each bag and then the mouth of each bag was sealed with a rubber band. After doing spawning process bags were placed for mushroom growth with neat and clean room furnished with iron racks, desert cooler, exhaust fan and lights, where normal temperature is maintained between 15-30°C and humidity is maintained between 80-90%. A sterile blade was used to make small cuts on the bag when the white mycelium had completely coated it. In order to leave adequate space between each bag, the containers were arranged in a grid pattern. The bags were sprayed three times a day with water to maintain a high level of humidity, which is essential for the development and appearance of fruiting bodies. Once the pin head started appearing, light water was sprayed.

Spawn running pattern was evaluated by days as mycelium growth covered 25, 50, 75 and 100% on substrate in bags. Primordial formation data in substrates were evaluated by days. Data was taken with day wise from pinhead initiation to the maturation of fruiting bodies. Mushroom was harvested at maturation. Fruiting body weight was taken according to yield data and

Table 1:COMPLETELY RANDOMIZED AOV FOR 100% MYCELIAL YIELD

Source	DF	SS	MS	F	P
Trt	4	216.700	54.1750	39.6	0.0000
Error	15	20.500	1.3667		
Total	19	237.200			

Grand Mean 22.800 CV 5.13
Significant
data

the formula was used to calculate the biological efficiency.

$$\text{Bio. E (\%)} = \frac{\text{Fresh weight of mushroom harvested}}{\text{Substrate dry matter}} * 100$$

The data that consist of five treatments with four replications each was analyzed statistically by using CRD (Steel et al., 1997). ANOVA was applied on the data.

3. RESULTS

The results showed that 100 % P. Pulmonarius mycelia growth was achieved by treatment 4 (50% Peanut shell + 50 % Cotton waste) in 19.00 days while slowest growth by treatment 1 (100% peanut shell) completed 100% mycelia growth in 29.00 days. Other treatments T2 (50% Peanut shell + 50% wheat straw) achieved 100% mycelia growth in 21.00 days, treatment T3 achieved 100% mycelia growth in 24.00 days and treatment T5 (25% peanut shell + 25%

wheat straw + 25 % cotton waste + 25% paper waste) achieved 100% mycelia growth in 22.00 days. All the results of treatments were significantly different from each other. 100 % mycelial growth was achieved in 19 days when peanut shell was used with combination of cotton waste in treatment T4 (50 % Peanut shell + 50% cotton waste) (Fig:1). These results were same as Tan (1981), did experiments and his results showed that cotton takes about three weeks for 100% mycelial growth.

3.1 Total Yield

Total yield that treatment T4 (50% Peanut shell + 50% cotton waste) showed the maximum yield 337.68 g, while the treatment T1(100% peanut shell) showed the minimum yield which was 186.58 g. Other treatments T2(50% Peanut shell + 50% wheat straw) yield recorded was 243.35 g. For T3 (50% peanut shell = 50% paper waste) yield recorded was 220.19 g while for While T5 (25% peanut shell + 25% wheat straw + 25 % cotton waste + 25% paper waste) yield recorded was 279.13 which was second to the maximum yield by T4. All the results were significantly different from each other (Figure 02).

It was also concluded (Table 2) that peanut shell alone cannot produce sufficient results. It must be mixed with any other substrate to gain maximum results to produce oyster mushrooms. As in this experiment The Treatment T1 (100% Peanut shell) showed the least results in yield and biological efficiency. These results were same as N. Salmalian et al. (2016) studied experiment by cultivating oyster mushrooms with the help of rice straw and peanut shells. The results concluded that substrate cotton waste combination with peanut shell showed the highest efficiency in terms of production which was almost 337.68 g and these results were same as Manan (2000) reported the production of Pleurotus ostreatuson substrates of wastepaper, cotton waste and wheat straw and concluded that substrate cotton waste was highest in efficiency and production.

Table 2: MYCELIAL GROWTH 100% (NO. OF DAYS)

TREATMENTS		No. of days (Means)
T1	100% Peanut Shell	29.00 A
T2	50% Peanut Shell + 50% Wheat Straw	21.00 C
T3	50% Peanut Shell +50% Paper Waste	24.00 B
T4	0% Peanut Shell + 50% Cotton Waste	19.00 D
T5	25% Peanut Shell + 25% Wheat Straw + 25% Paper Waste + 25% CottonWaste	22.00 BC

3.2 Total yield in (g)

Biological efficiency was calculated with the help of following formulae:

$$\text{Bio. E (\%)} = \frac{\text{Fresh weight of mushroom harvested}}{\text{Substrate dry matter}} * 100$$

And it was concluded that 25% date palm with the other agricultural products waste mixed with 75% other agricultural wastes resulted in best results.

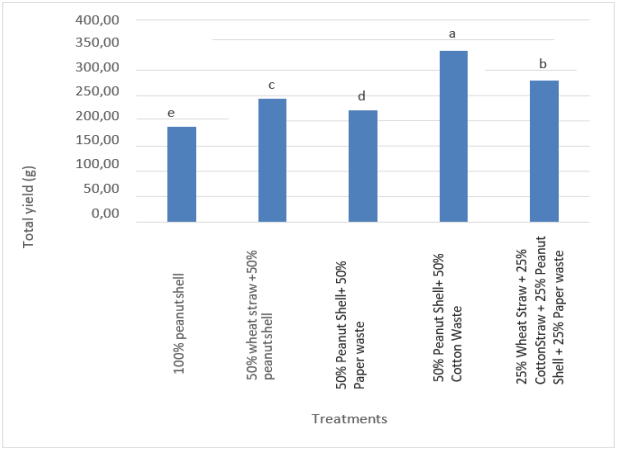

Figure 02: Comparative effect of different treatments (T1, T2, T3, T4, T5) on Total yield (g)

3.3 Biological efficiency

Biological efficiency for *P. pulmonarius* cultivation on peanut shell substrate along with combination of other substrates it was recorded that maximum biological efficiency was showed by treatment T4 (50% Peanut shell + 50% cotton waste) whose biological efficiency was 33.38% while treatment T1(100% peanut shell) showed minimum biological efficiency which was 18.21%. While the other treatments T2 (50% Peanut shell + 50% wheat straw) biological efficiency was 23.71% for T3 (50% peanut shell = 50% paper waste) biological efficiency was 22.59% it took 18 days while for While T5(25% peanut shell + 25% wheat straw + 25% cotton waste + 25% paper waste) biological efficiency was 27.22% which was second most efficient result. All results were significantly different from the other (Figure 03).

It was concluded that if 25% peanut shell is used along with other agricultural waste like in

Table 3: COMPLETELY RANDOMIZED ANOVA FOR TOTAL FLUSH

Source	DF	SS	MS	F	P
Trt	4	53733.4	13433.3	3872	0.0000
Error	15	52.0	3.5		
Total	19	53785.4			

Grand Mean 253.39; CV 0.74

Table 4: TOTAL YIELD IN GRAMS (G)

Treatments	Flush (g)	
T1 = 100% Peanut Shell	186.58	E
T2 = 50% Peanut Shell + 50 % Wheat Straw	243.35	C
T3 = 50% Peanut Shell + 50%Paper Waste	220.19	D
T4 = 50% Peanut Shell + 50 % Cotton Waste	337.68	A
T5 = 25% Peanut Shell + 25%Wheat Straw + 25% Paper Waste + 25% Cotton Waste	279.13	B

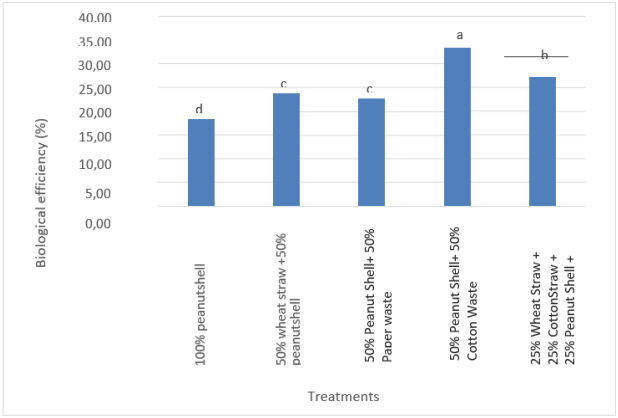

Figure 03: Comparative effect of different treatments (T1, T2, T3, T4, T5) on biological efficiency (%)

treatment T5 (25% peanut shell + 25% wheat straw + 25% paper waste + 25% cotton waste) and it gave second most efficient results and these results were same as Kholoud *et al.*, (2014) tested the oyster mushroom cultivation on the residues of date palm by combining it experiment by cultivating oyster mushrooms with the help of rice straw and peanut shells.

The results (Table 6) showed that compared the production of oyster mushrooms with the help of mixed substrate with the production from pure substrate and found that mixed substrates were more efficient in the yield and production

of oyster mushrooms. As the pure 100% peanut shell showed the least results while when peanut shell was mixed with the other substrate then the results were better. And this result was same as Ogundele *et al*. (2014) did experiments and concluded the same results.

waste was the most efficient substrate for producing *Pleurotus ostreatus.* The results concluded that substrate cotton waste combination with peanut shell showed the highest efficiency in terms of production which was almost 337.68 g and these results were

Table 5: COMPLETELY RANDOMIZED ANOVA FOR BIOLOGICAL EFFICIENCY (%)

Source	DF	SS	MS	F	P
Trt	4	53733.4	13433.3	3872	0.0000
Error	15	52.0	3.5		
Total	19	53785.4			

Grand Mean 253.39; CV 0.74

Table 6: Biological efficiency (%)

Treatments	Percentage %
100% Peanut Shell	18.21D
50% Peanut Shell + 50 % Wheat Straw	23.71C
50% Peanut Shell + 50% Paper Waste	22.59C
50% Peanut Shell + 50 % Cotton Waste	33.38A
25% Peanut Shell + 25% Wheat Straw + 25% Paper Waste + 25% Cotton Waste	27.22B

4. Discussion

It was also concluded that peanut shell alone cannot produce sufficient results. It must be mixed with any other substrate to gain maximum results to produce oyster mushrooms. Treatment T1 (100 percent Peanut shell) had the worst yield and biological efficiency outcomes in this experiment. These findings matched those of a previous study conducted by Salmalian *et al.* (2016).The experiments showed that peanut shells degradation can be improved along with adding other substrates with it as the experiments concluded that peanut shell gave better results in cultivation of oyster mushroom when other substrates were added in it. These results were same as Anike *et al*., (2016) performed a research on peanut shells degradation by *P. ostreatus* and concluded that by *P.ostreatus* peanut shells degradation can be improved along with corns talk as additive substrate.

Cotton waste combined with peanut shell was found to be the most efficient substrate for producing Pleurotus ostreatus, with a yield of 337.68 g. These results are consistent with those of Manan (2000), who reported that cotton

same as Manan (2000) reported the production of *Pleurotus ostreatus* on substrates of wastepaper, cotton waste and wheat straw and concluded that substrate cotton waste was highest in efficiency and production. 100% mycelial growth was achieved in 19 days when peanut shell was used with combination of cotton waste in treatment T4 (50 % Peanut shell + 50% cotton waste). These results were same as Tan (1981), did experiments and his results showed that cotton takes about three weeks for 100% mycelial growth. Cotton waste produced the best results when paired with peanut shell, as in treatment T4, and the results were similar to those of (Tsegaye and Zerihun, 2015), who grew oyster mushrooms on a variety of substrates, including cotton, coffee, and woodchip wastes (as in treatment T4).Combining cotton waste and coffee pulp yielded a 79% increase in growth and production, the best combination.

Oyster mushroom cultivation on the residues of date palm by combining it with the other agricultural waste products yielded the second most efficient results, according to the findings of this study (Kholoud et al., 2014 tested the oyster mushroom cultivation on the residues of date palm by combining it with the other agricultural waste products). And he concluded that the best results were achieved by mixing 25 percent date palm waste with 75 percent other agricultural wastes.

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