



EFFICIENCY OF HARDWOOD TREES (SHEESHAM, SIRIS) SAWDUST FOR YIELD PRODUCTION OF (*PLEUROTUS DJAMOR*) WITH CORN FLOUR AS A SUPPLEMENTARY MATERIAL

HASSAN B¹, KHAN NA¹, HADI M¹, ABBAS A^{2*}

¹Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan

²Department of Plant Breeding and Genetics, Faculty of Agricultural Sciences, University of the Punjab
P.O.Box.54590, Lahore, Pakistan

*Correspondence author email address: ali.bukhari.91112@gmail.com

(Received, 10th January 2023, Revised 24th March 2024, Published 26th March 2024)

Abstract Mushroom cultivation is a very useful business to produce protein-enriched food by decomposing lignin-containing substances. To investigate the effectiveness of saw dusts of hardwood trees (Sheesham and Siris) along with supplement (corn flour) research was carried out in the mushroom house, Department of Plant Pathology, UAF. The local strain of *O. mushroom* (*Pleurotus djamor*) was studied for evaluation of mycelia growth, formation of pinhead, formation of fruiting bodies, quantity of fruiting bodies, yield production from 1st, 2nd and 3rd flushes, total yield and biological efficiency. RCB design was used in this experiment. The results show that treatment four has the fastest mycelium growth, the first pinhead formation, the fastest pinhead formation, and the highest yield (yield per unit area). But, as was already said, putting too much of the supplement on the substrate can make it dirty and lower the yield. It is very important to be very careful to get the best crop yield. In the end, the study gives us a way to start growing *P. djamor* on sawdust-based substrates. This could be used to raise the market value of this healing and highly nutritious mushroom.

[Citation: Hassan, B., Khan, N.A., Hadi, M., Abbas, A. (2024). Efficiency of hardwood trees (Sheesham, Siris) sawdust for yield production of (*Pleurotus djamor*) with corn flour as a supplementary material. J. Life Soc. Sci, 2024: 23]

Keywords: mushroom cultivation; protein-enriched food; hardwood trees; mycelia growth; biological efficiency

Introduction

Mushrooms have been characterized as large-scale organisms with particular organic product bodies, which are noticeable to the unaided eye. Mushrooms have a place in the class Basidiomycetes (Gressler et al., 2021). Mushrooms are set in mycology, derived from the old Greek word "mykes". Pakistan being a farming nation has 65% of its complete populace being pursued in agriculture part straight forwardly or in a roundabout way. Farming is the biggest segment of the nation which is responsible for giving work to about 70% of the provincial workforce (Raza et al., 2023). Mushrooms are a piece of the organism's kingdom that can change over hardwood plant materials into a profoundly healthful natural product body that is well-thought-out for enhanced qualities of surface and taste. Generally, the most obvious piece of a mushroom is its organic product body which is the regenerative composition furthermore produces spores. The protein content in mushrooms is someplace in the middle of milk and meat (Arzon, 2021). In any case, mushroom development has a few points of interest yet this business has not pulled out up the ideal force because of different factors simply as unseemly learning about mushrooms, mushroom

developing strategies and poor inspiration are the fundamental requirements that keep the development of mushroom on moderate track (Li et al., 2022). In 600 A.D first mushroom which was grown artificially was *auricularia* (Chang, 2018). Afterward, in 800-900 A.D *Flam Mulina velutipes* were grown in some places of China (Chang, 2018). Primarily *Lentinus edodes* growing period was 1000-1100 A.D. Farming of extensively cultured *Agaricus bisporus* mushrooms was started after 1600 A.D (El Sebaaly et al., 2021). Mushroom have moved toward becoming a need of the time and has significance as an imperative nourishment component since old-fashioned times, its utilization is additionally expanded with the progression of time because of its considerable part in human well-being, sustenance and ailments (Karri et al., 2021). The world is in a tough situation because of nourishment meekness which demonstrates to progress of sustenance in nonindustrial countries because the humans are increasing in numbers day by day, to satisfy the hunger of the congregate population, there's got to give food for an outsized integer of primates. *O. mushroom* (*P. pulmonarius*) is an eatable mushroom

having a top-notch aroma and has fun with and its improvement on harvest deposits is appraised as a possible wellspring of pay, an elective nourishment creation, association of work, and for reusing of rural squanders ([Díaz-Godínez and Téllez-Téllez, 2021](#); [Tagkouli et al., 2021](#)). The market for mushrooms has been accounted for to be on a nonstop development because of the enthusiasm for their culinary, dietary, and medical advantages and their potential for use in waste administration. Oyster mushrooms are one of the most heavenly nourishments because of their high dietary benefit, very great taste, and therapeutic worth. *Pleurotus ostreatus* (white-decay organisms), moreover known as oyster mushroom, is industrially significant on the planet mushroom showcase ([Maurya et al., 2020](#)). Mushrooms are one sort of consumable fungus having a place with the sort *Pleurotus* under the class Basidiomycetes ([Gupta, 2022](#)).

Materials and Methods

This research was conducted at Mushroom House, Plant Pathology Department UAF, Faisalabad. A complete randomized design along with six treatments with three replications was established. The mushroom cultivation room consists of iron racks having four stages in every row. With this design maximum space was utilized for the growth of mushrooms.

Preparation of substrate

The substrate that includes sawdust of Sheesham and siris was soaked in water along with the addition of supplement corn flour and spread on the floor. pH was checked before and after soaking of substrate to maintain the pH of the substrate lime was added to it.

Data analysis in Mushroom House

5 % lime was added to the substrate. Complete soaking and fermentation was done in 8 days. By using the layman method find out the moisture of substrate. In this method, moisture was determined by taking a handful of substrate and pressing it. If there was no runoff of water occurs it means there is almost 65% moisture content is present. Bags for the filling of substrate were 6 X 12" in size and each bag was filled @ 1000g along with 3 replications. Bags were then closed with rubber bands properly. Following were the treatments:

T1 =Sawdust 100%

T2=98% Sawdust (Sheesham + Siris) + 02% Corn flour

T3=96% Sawdust (Sheesham + Siris) + 04% Corn flour

T4=92% Sawdust (Sheesham + Siris) + 08% Corn flour

T5=88% Sawdust (Sheesham + Siris) + 12% Corn flour

T6=86% Sawdust (Sheesham + Siris) + 16% Corn flour

Spawning of bags

For the effective production of oyster mushroom local strain *pleurotus djamor* was used. For all treatments

and replications 10g spawn was applied it was prepared on maize seeds. After spawning polythene bags which contain substrates were again sealed with rubber bands properly so that no contamination could occur. Mushroom house in which temperature and humidity were maintained at 24-28 °C and 75- 80% respectively, in this room bags were placed on iron-made racks for incubation. Bags were transferred to the cultivation room after complete mycelium growth.

Wetness supplies

85-90 % humidity was maintained in the mushroom house for good production of mushrooms for maintaining wetness in the room shower was applied daily so that growth was not disturbed.

Cause of freshening

Small electric fans were used in the room to maintain air passage. These fans were switched on whenever fresh air was needed.

Outline

The design which was applied for this experiment was completely randomized and all data was statistically analyzed.

Production and biological efficiency

All fruiting bodies which were picked were measured as the whole production of mushrooms. The biological effectiveness was measured by adopting the following formula ([Win and Ohga, 2018](#)).

B. E= $\frac{\text{Fresh weight of mushroom}}{\text{Dry matter weight}} \times 100$

Dry matter weight

Results and Discussion

Pleurotus djamor a local strain of Oyster mushroom was examined by using basal material which contained saw dusts of hardwood trees Sheesham and Siris. Corn flour was also added along with the substrate to increase its efficiency. This research was observed at the University of Agriculture Faisalabad. Various parameters were examined throughout the experiment. Parameters which were studied were as follows time duration for mycelia growth, time duration for complete pinhead formation, time duration for fruiting bodied formation, biological efficiency and total yield production obtained from three flushes. The main basal material on which mushrooms were grown was saw dusts (Sheesham and Siris). For the evaluation of substrate efficiency, six treatments were made with different combinations.

Spawn Running pattern

Treatment 4 includes in its substrate 8 % supplement (corn flour) and 92 % saw dusts of hardwood trees (Sheesham and Siris) in this substrate 25 % mycelia growth was completed in 6 days, 50 % in 12 days, 75 % in 16 days and 100% in 20 days. It was taken 32 days for the completion of mycelia by *Pleurotus djamor* as described by ([Illuri et al., 2022](#)). examined that *Pleurotus* species complete mycelia growth in 2 – 3 weeks on different saw dusts ([Otinla et al., 2018](#)). For completion of 100 % mycelia growth 26 – 28 days are required ([Chan et al., 2021](#)). Spawn running was

assessed over several days. Table. 1 Showed completion of spawn running on different days.

Table 1. Different phases of completion of mycelia growth (days) grown on saw dusts of hardwood trees (Sheesham and Siris) along with supplement (corn flour).

Treatments	Phases of mycelia growth (in days)			
	25 %	50 %	75 %	100 %
T1 (100% saw dusts)	3.5 b	9 b	15.5 b	25.3 b
T2 (2% corn flour & 98% saws dusts)	4 c	10 c	16 c	22 c
T3 (4% corn flour & 96% saws dusts)	4.5 a	11 a	17 a	22 a
T4 (8% corn flour & 92% saws dusts)	6 e	12 e	16 e	20 f
T5 (12% corn flour & 88% saws dusts)	6.5 d	13 d	19 d	24 e
T6 (16% corn flour & 84% saws dusts)	7.5 e	15 e	21f	28.6 f

Pinhead formation

Results showed that treatment four (8% corn flour & 92% sawdust) takes a minimum number of days to complete pinhead formation. (Win and Ohga, 2018) examined the duration of time for the formation of fruiting bodies of mushrooms grown on wood chips and oat husk substrate and he explained that it takes 26 and 32 days for formation correspondingly. (ASHA, 2020) studied the cultivation of mushrooms on sawdust and he found that within 34 – 36 days pinhead formation completes. (HAQUE, 2021)

examined the cultivation of mushrooms on sawdust and reported that it takes 22.7 days for primordial formation, 29.43 days for fruiting bodies formation and produced 20.3 numbers of fruiting bodies in 1000g of substrate's bag. Table. 2 Shows different phases of completion of mycelia growth (days) grown on saw dusts of hardwood trees (Sheesham and Siris) along with supplement (corn flour). According (Zakil et al., 2022) in sawdust containing basal material primordial formation completes in 26 days.

Table 2. Different phases of completion of mycelia growth (days) grown on saw dusts of hardwood trees (Sheesham and Siris) along with supplement (corn flour)

Treatments	Phases of mycelia growth (in days)			
	25 %	50 %	75 %	100 %
T1 (100% saw dusts)	3.5 b	9 b	15.5 b	25.3 b
T2 (2% corn flour & 98% saws dusts)	4 c	10 c	16 c	22 c
T3 (4% corn flour & 96% saws dusts)	4.5 a	11 a	17 a	22 a
T4 (8% corn flour & 92% saws dusts)	6 e	12 e	16 e	20 f
T5 (12% corn flour & 88% saws dusts)	6.5 d	13 d	19 d	24 e
T6 (16% corn flour & 84% saws dusts)	7.5 e	15 e	21f	28.6 f

Yield production

Treatment 4 produced yields in 1st flush 176.1 grams, in 2nd flush 148.9 grams and 3rd flush was 120.1 grams basal material of this treatment contained 8% corn flour as a supplement and 92% saw dusts of hardwood trees (Sheesham and Siris). The mushroom's yield production 179.2, 148.5, 106.9, 93.4, 56.3, 27.6, 14.2, 19.43 and 5.3 grams cultivated on various saw dusts and agricultural waste. (Illuri et al., 2021), found from a study to grow *Pulmonarius* on various lignin-containing basal materials i.e., wood chips, oat husk, bark of trees and wood logs. Two to three flushes were obtained from these basal materials. Maximum yield

was obtained from sawdust-containing substrate (531.37 g/1kg bag) other substrates produced as oat husk (268.3 g/1kg bag), tree bark produced (367.8 g/1kg bag) and wood logs produced (125.6 g/1kg bag). (Agba et al., 2021) evaluated that the yield of *O. mushroom* was harvested in 2 – 3 flushes and 1st flush gave maximum yield and then it reduced in 2nd and 3rd flush in table 3. (Balan et al., 2022) examined that supplements can enhance the growth of mushrooms but they have also limitations the heavy amount of supplements leads to lower yield due to contamination.

Table 3. Total production of yield (grams) from *P. djamor* in three flushes

Treatments	Yield in all flushes			Total yield (grams)
	1 st flush	2 nd flush	3 rd flush	
T1 (100% saw dusts)	120.97e	87.78b	61.75e	270.5e
T2 (2% corn flour & 98% saws dusts)	113.84a	92.2d	74.66c	280.7c
T3 (4% corn flour & 96% saws dusts)	152.3b	121.8b	107.2e	381.2a
T4 (8% corn flour & 92% saws dusts)	176.1d	148.9d	120.1a	445.1d
T5 (12% corn flour & 88% saws dusts)	106.2d	75.12a	66.08e	247.4e
T6 (16% corn flour & 84% saws dusts)	102.3a	65.7b	56.2e	224.2d

Biological Efficiency

110.2 % was the maximum biological efficiency which was achieved by treatment 4 whose basal material combination was 8% corn flour (supplement) and 92 % saw dusts of hardwood trees (Sheesham and Siris) (Tembe, 2018), evaluated the biological efficiency of mushrooms which ranges from 47% – 92 %, which was cultivated on sawdust of pine extended with 14 % maize husk as a supplement. The biological

Table 4. Biological efficiencies of *P.djamor* cultivated on saw dusts of hardwood trees (Sheesham and Siris) along with supplement (corn flour)

Treatments	Over all yield (g)	Biological efficiency (%)
T1 (100% saw dusts)	270.5	68.1e
T2 (2% corn flour & 98% saws dusts)	280.7	69.9c
T3 (4% corn flour & 96% saws dusts)	381.2	97.3a
T4 (8% corn flour & 92% saws dusts)	445.1	110.2c
T5 (12% corn flour & 88% saws dusts)	247.4	59.3d
T6 (16% corn flour & 84% saws dusts)	224.2	56.7b

Conclusion

Overall, the *Pleurotus djamor* strain of oyster mushrooms we studied at the University of Agriculture Faisalabad grew and produced a lot of mushrooms. Additional sawdust and corn flour did a great job of providing a base for this mushroom to grow on. There weren't many days when mycelia grew, pinheads formed, and fruiting bodies formed either. Also, in all three flushes, the biological efficiency and total yield production were fantastic. A fascinating finding revealed that when the supplements were present in large amounts, they ruined the crop and stopped it from growing. According to other research, this part of the urease was probably found in my research, even though it was ours.

References

- Agba, M., Markson, A., Oni, J. O., and Bassey, G. A. (2021). Growth and yield impact of Oyster mushroom *Pleurotus ostreatus* (Jacq P. Kumm) cultivated on different agricultural wastes. *Journal of Bioscience and Agriculture Research* 27, 2225-2233.
- Arzon, M. R. (2021). Pharmacological and nutritional importance of mushrooms, Brac University.
- Asha, I. (2020). Effect of substrates on oyster mushroom production. *Department of horticulture sher-e-bangla agricultural university dhaka -1207*.
- Balan, V., Zhu, W., Krishnamoorthy, H., Benhaddou, D., Mowrer, J., Husain, H., and Eskandari, A. (2022). Challenges and opportunities in producing high-quality edible mushrooms from lignocellulosic biomass in a small scale. *Applied Microbiology and Biotechnology* 106, 1355-1374.
- Chan, X. Y., Saeidi, N., Javadian, A., Hebel, D. E., and Gupta, M. (2021). Mechanical properties of dense mycelium-bound composites under

efficiency of *P.djamor* grown on saw dusts of more than three trees ranges from 95.3 – 107.2 %. (Guo et al., 2021) observed that the highest biological efficiency was obtained from sawdust which was 83.4% in table 4. (Haukongo, 2023) studied the consequences of supplements in his experiment oat husk increased biological effectiveness to 83.5% but an excessive amount of additive decreased biological efficiency to level of 34.5 %.

- accelerated tropical weathering conditions. *Scientific Reports* 11, 22112.
- Chang, S.-T. (2018). Mushroom and mushroom biology. In "Genetics and breeding of edible mushrooms", pp. 1-13. Routledge.
- Díaz-Godínez, G., and Téllez-Téllez, M. (2021). Mushrooms as edible foods. *Fungi in sustainable food production*, 143-164.
- El Sebaaly, Z., Hammoud, M., and Sassine, Y. N. (2021). History, Health Benefits, Market, and Production Status of Button Mushroom. *Mushrooms: Agaricus bisporus; Sassine, YN, Ed.; CABI: Boston, MA, USA*, 1-65.
- Gressler, M., Löhr, N. A., Schäfer, T., Lawrinowitz, S., Seibold, P. S., and Hoffmeister, D. (2021). Mind the mushroom: natural product biosynthetic genes and enzymes of Basidiomycota. *Natural product reports* 38, 702-722.
- Guo, Y.-X., Chen, Q.-J., Qin, Y., Yang, Y.-R., Yang, Q.-Z., Wang, Y.-X., Cheng, Z.-a., Cao, N., and Zhang, G.-Q. (2021). Succession of the microbial communities and function prediction during short-term peach sawdust-based composting. *Bioresource Technology* 332, 125079.
- Gupta, K. (2022). Screening of agricultural waste for mass production of edible oyster mushroom (*Pleurotus*).
- Haque, T. (2021). Performance of different media for mother culture production of different mushroom spp. *Department of horticulture sher-e-bangla agricultural university dhaka -1207*.
- Haukongo, K. (2023). Comparative study on the quality of Namibian commercial oyster mushrooms cultivated on encroacher bushes as substrates, University of Namibia.
- Illuri, R., Eyini, M., Kumar, M., Prema, P., Nguyen, V.-H., Bukhari, N. A., Hatamleh, A. A., and

- Balaji, P. (2022). Bio-prospective potential of *Pleurotus djamor* and *Pleurotus florida* mycelial extracts towards Gram positive and Gram negative microbial pathogens causing infectious disease. *Journal of Infection and Public Health* **15**, 297-306.
- Illuri, R., Kumar, M., Eyini, M., Veeramanikandan, V., Almaary, K. S., Elbadawi, Y. B., Biraqdar, M., and Balaji, P. (2021). Production, partial purification and characterization of ligninolytic enzymes from selected basidiomycetes mushroom fungi. *Saudi Journal of Biological Sciences* **28**, 7207-7218.
- Karri, R. R., Ravindran, G., and Dehghani, M. H. (2021). Wastewater—sources, toxicity, and their consequences to human health. In "Soft computing techniques in solid waste and wastewater management", pp. 3-33. Elsevier.
- Li, Q., Xu, R., Fan, H., Xu, J., Xu, Y., Cao, P., Zhang, Y., Liang, T., Zhang, Y., and Chen, W. (2022). Smart mushroom-inspired imprintable and lightly detachable (MILD) microneedle patterns for effective COVID-19 vaccination and decentralized information storage. *ACS nano* **16**, 7512-7524.
- Maurya, A. K., John, V., and Rathore, U. S. (2020). Cultivation Techniques of Oyster Mushroom (*Pleurotus* sp.). in *Food Technology and Nutrition*, 93.
- Otunla, C., Jonathan, S., Idowu, O., and Olawuyi, O. (2018). Mycelial growth and sclerotia production of *Pleurotus tuber-regium* (Fries) Singer on four sawdust types at three composting intervals. *Agronomski glasnik/Agronomy Journal (0002-1954)* **80**.
- Raza, M. Y., Wu, R., and Lin, B. (2023). A decoupling process of Pakistan's agriculture sector: Insights from energy and economic perspectives. *Energy* **263**, 125658.
- Tagkouli, D., Bekiaris, G., Pantazi, S., Anastasopoulou, M. E., Koutrotsios, G., Mallouchos, A., Zervakis, G. I., and Kalogeropoulos, N. (2021). Volatile profiling of *Pleurotus eryngii* and *Pleurotus ostreatus* mushrooms cultivated on agricultural and agro-industrial by-products. *Foods* **10**, 1287.
- Tembe, N. J. (2018). Effects of Carbon, Nitrogen, Particle Size and Moisture on Oyster Mushroom Production in KwaZulu Natal-Cedara, University of Zululand.
- Win, T. T., and Ohga, S. (2018). Study on the cultivation of *Agaricus blazei* (Almond mushroom) grown on compost mixed with selected agro-residues. *Advances in Microbiology* **8**, 778-789.
- Zakil, F. A., Xuan, L. H., Zaman, N., Alan, N. I., Salahutheen, N. A. A., Sueb, M. S. M., and Isha, R. (2022). Growth performance and mineral analysis of *Pleurotus ostreatus* from various agricultural wastes mixed with rubber tree sawdust in Malaysia. *Bioresource Technology Reports* **17**, 100873.

Declarations

Author Contribution statement

BH conducted research and wrote initial draft of manuscript. NAK, MH and AA helped in data analysis, interpretation and final editing of manuscript. All authors approved final version of manuscript.

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Funding

Not applicable

Conflict of Interest

Regarding conflicts of interest, the authors state that their research was carried out independently without any affiliations or financial ties that could raise concerns about biases.



Open Access This article is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/). © The Author(s) 2024