IJBPAS, July, 2023, 12(7): 2993-3003

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

NUTRITIONAL PARAMETERS AND BIOACTIVE COMPOUNDS OF *Pleurotus* sp CULTIVATED ON PADDY STRAW SUBSTRATES

ANUSUYA A[1*], MOHANDOSS R[1], AMBIKAPATHY V[2], PANNEERSELVAM A[2], PRAKASH P[3], KANMANI A[3] AND RATHNA D[3]

1: Department of Biotechnology, Marudupandiyar college, Thanjavur – 613 403, (Affiliated to Bharathidasan University, Trichy-24)

2: P.G. & Department of Botany, A.V.V.M. Sri Pushpam College (Autonomous), Poondi, Thanjavur – 613 503, (Affiliated to Bharathidasan University, Trichy-24)

3: Indian Biotrack Research Institute, Thanjavur – 613 005

[*]**Corresponding Author: Dr. Anusuya Arockiasamy: E Mail: aroanus@gmail.com**

Received 11th July 2022; Revised 16th Sept 2022; Accepted 14th Oct. 2022; Available online 1st July 2023

https://doi.org/10.31032/IJBPAS/2023/12.7.7227

ABSTRACT

Pleurotus mushrooms are rich in proximate content, water-soluble vitamins, and minerals. *Pleurotus* sp. were subjected to bioactive compounds using aqueous, methanol, ethanol and di-ethyl ether solvents. *Pleurotus* species are commercially important mushrooms that are widely grown around the world. *Pleurotus* species grow on fallen branches, dead and decaying tree stumps, moist logs, and are mostly found in tropical forests. *Pleurotus* mushroom extracts verify were subjected for biological analysis and neutraceutical parameters. The existence of important bioactive substances such as alkaloids, flavonoids, phenols, and steroids revealed maximum in diethyl ether solvent when compared with other solvents. *Pleurotus* mushrooms grown on paddy straw have superior growth and nutritional qualities. So, the present study focused on cultivation of *Pleurotus* sp using paddy straw substrate and estimated the nutritional parameters and biological analysis.

Keywords: *Pleurotus* sp, cultivation, proximate, vitamins, minerals and bioactive compounds

INTRODUCTION

In tropical and subtropical rain forests, *Pleurotus* sp are naturally found in good conditions which support their development. Cultivation of this mushroom is very simple and low cost production technology which gives consistent growth of high biological efficiency. Different species of *Pleurotus* can grow well in variable temperature conditions. Since they are perfectly suited for year-round production in many tropical countries like India **[1]**. *Pleurotus* mushrooms are thought to be healthful due to their high protein, fibre, vitamin, and mineral content **[2]**. *Pleurotus* mushrooms are used in a variety of dishes a functional food with a pleasing flavour and scent nutritive and therapeutic properties Species of *Pleurotus* (Oyster mushrooms) have a significant commercial value. Edible mushrooms that are grown all over the world **[3]**. The Basidiocarps of oyster mushrooms are fashioned in a variety of hues such as white, cream, and grey **[4]**, which can be yellow, pink, or light brown. Oyster mushrooms, according to many researchers, could be regarded as a healthy food because of their beneficial effects on human health **[5]**. The extractable bioactive compounds from medicinal mushroom would enhance human's immune systems and improve quality of life. The fruiting bodies that have been harvested either can be exported as a major source of foreign exchange or sold in local markets for more family income, which will both definitely raise the economic standards of those living in and around the research region **[6]**. The aim of this research was to investigate the effect of paddy straw substrate on the growth, nutritional and bioactive components of three oyster mushroom species.

Research site: *Pleurotus florida, P ostreatus* and *P sajor gaju* were among the oyster mushroom species cultivated in the culture house at Madhakottai, Thanjavur, Tamil Nadu, India.

METHODS

A. Mushroom cultivation

Paddy straw waste material was used as substrate for growth of mushroom. The substrate was prepared by soaking in H_2O for 72 hrs and then, it was allowed to

MATERIALS AND METHODS

MATERIALS

extrude extra moisture by spreading on the inclined plane. This substrate was filled in polyethene bags at 1 kg/bag and dry sterilized **[7]**.

B. Spawn production

Grain spawn of three species was prepared using the standard methodology suggested by **[8]**. Healthy, uncrumpled sorghum grains were washed and boiled (grain: water 1:25w/v to tender without rupturing of the seed coat. Extra water was

drained of and the grains were allowed to dry on sieve. Commercial grade gypsum and calcium carbonate were mixed at 3% of grain to maintain pH level. The grains were filled in clean polythene bags and the bags were plugged with non-absorbent cotton.

C. Spawning and spawn run

Spawning was done under aseptic conditions, the grain spawn of different species of *Pleurotus* were mixed thoroughly at 2% in the substrate contain 65-70% moisture filled up in polythene bags at 4kg each. After spawning bags were kept in the room temperature (24-28˚C) and relative humidity (80-85%) was maintained for spawn run. Humidity was maintained by spraying water twice a day.

After the completion of spawn run in the straw, it became a compact mass which is also sticking to the polythene bags. The polythene bags were cut by sharp sterilized blade and opened for sporophores formation .At the time for sporophores formation, the windows were kept open for 1-2 hrs to provide fresh air inside the crop room and release of CO_2 and maintaining the relative humidity at 80-90%.Total harvesting period is 40 days. Fruit body (mushroom) harvest was done twice a day, when the fruiting bodies presented the pileus with an almost flat format, which is considered the harvest point for *Pleurotus* sp. The fruit bodies were weighed and measurements such as the number of bunches, basidiomes, average size of the stipe, and average diameter of the pileus were taken. The fruit bodies were dried in an oven with ventilation at 45 °C to obtain the dry weight and for further usage.

$$\text{Biological efficiency (\%)} = \frac{\text{Weight of fresh mushroom fruiting bodies}}{\text{Weight of dry substratum}} \times 100$$

D) Nutritional Parameters

1) Proximate analysis

Proximate composition analysis was carried out to estimate the percentages of moisture, ash, crude protein, crude fats, and fibre as described by Association of Official Analytical Chemists **[9]**.

2) Vitamin analysis

Vitamins A, B1, B2, B3, C and E present in *Pleurotus* species were analysed as described by Association of Official Analytical Chemists **[9]**.

3) Mineral analysis

Preparation of the sample for mineral analysis was completed as described by **[10]** Calcium (Ca^{2+}) and magnesium (Mg^{2+}) contents were determined by EDTA versanate complexometric titration method as described by **[11]**. Potassium (K^{2+}) and sodium (Na^{+}) ion contents were determined by flame photometry as described by **[12]** Zinc, manganese, copper, iron, and phosphorus were determined using atomic absorption spectrophotometer. Values of the individual metals were read from

spectrophotometer after standardizing with respective elements.

E) Bioactive compounds

After collection, the mushrooms samples were wrapped in newspaper and stored in moisture free open places. The removal of all foreign matters was done. Thereafter they were cut in to small pieces of around 2 to 3 cm across using a knife. They were incubated for 2 days at a temperature of 50°C. Then, they were ground using metal mortar and pestle. The powder was collected and ground again at the end. The bioactive components of oyster mushroom were determined using standard procedures **[13, 14, 15]**.

2) Qualitative bioactive analysis

The bioactive compounds such as alkaloids, amino acids, coumarins, flavonoids, phenols, saponins, steroids, tannins, terpenoids and quinones were analysed with the solvents of aqueous,

1) Preparation of extracts

ethanol, methanol and diethyl ether extracts using standard method [11] were followed. General reactions in these analysis revealed the presence or absence of these compounds in the mushroom extracts.

3) Quantitative bioactive analysis

The bioactive compounds such as alkaloids, amino acids, coumarins, phenols, steroids, terpenoids and quinones were analysed using standard method **[11]**, flavonoids **[16]**, saponins **[17]** and tannins **[18]** were followed. These analysis revealed the amount of these compounds in the mushroom extracts.

Statistical Analysis

Experiments were carried out in triplicate and the results are expressed as mean values with standard deviation.

RESULT AND DISCUSSION

Pleurotus sp were cultivated on the paddy straw substrate have sufficient amount of growth yielding property. Three species of *Pleurotus* has fleshy fruit bodies, showed in the **(Figure 1)**. Among the three species *Pleurotus sajor caju* has low quantity of yield compared with *P. ostreatus* and *P. florida*. In recent years, several studies described most aspects associated with oyster mushroom cultivation. *Pleurotus sajor caju* increase mycelial growth upto 100% regardless of the substrate composition compared with *P. ostreatus* and *P. florida* **[19]**.

Many factors influence the nutritional makeup of edible mushrooms including the substrate composition, which is also highlighted by **[20]**. Nutritional qualities vary with species, but this variation is also dependent on the substrates **(Table 2 & 3)**. These findings also showed that the oyster mushroom species tested have a high nutritional value for humans **(Table 1)**. Protein is an essential nutrient, and protein shortage is the world's leading

cause of death. Human nutrition is a concern, particularly in developing countries such as Cameroon **(Table 3)**. As a result, oyster mushroom is a viable diet that could help third-world countries overcome protein energy malnutrition and mineral shortage. Although the protein level is smaller than that of eggs, meat, or fish, it is sufficient to be used as a substitute in the general public's diet. These oyster mushroom species contain low fat content and high in unsaturated fatty acids, making it a nutritious food for all types of people **(Table 2 & 3)**.

The presence of important bioactive components such as flavonoids, phenols, saponins, terpenoids, and steroids **(Table 4)** was discovered in the bioactive component analysis of edible mushrooms *P. ostreatus, P. florida*, and *P.sajor caju* [21]. Compounds with bioactivity discovered in edible mushrooms are well-known for their health-promoting properties. Saponins, for example, are a vast family of structurally similar substances steroid or terpenoid containing substances. They're said to contain a variety of medicinal benefits, including anti-inflammatory and anti-diabetic capabilities **[22]**. As a result, these mushrooms can be utilised to treat diabetes and inflammatory illnesses **(Table 5)**. Terpenoids have been shown to provide a wide range of pharmacological advantages, including anti-inflammatory properties.

Phenolic substance are antioxidants with a wide range of therapeutic benefits, including anti-cancer and anti-inflammatory capabilities. As a result, these mushrooms can be used to treat oxidative stress. Since phenol and flavonoids have been demonstrated to have a variety of antioxidant properties, they have been used to treat stress-related diseases **(Table 4)**. Flavonoids have been identified from hundreds of mushroom species and have been shown to be useful against a variety of chronic diseases, with the bioactive contents of *P. florida* confirming that it is one of them. The presence of secondary metabolites **[23]** may explain the mushroom's therapeutic efficacy. These metabolites, which are found in the human diet, provide a variety of health benefits **(Table 5)**.

Table 1: Proximate content of *Pleurotus* species

Proximate content (%)	Quantity (mg/g)		
	Pleurotus ostreatus	*Pleurotus florida*	*Pleurotus sajor caju*
Ash	**8.61**	**8.33**	**7.23**
Moisture	**89.42**	**89.54**	**88.04**
Carbohydrate	**35.04**	**39.70**	**38.02**
Protein	**28.11**	**22.71**	**25.56**
Crude fat	**4.86**	**4.10**	**4.08**
Crude fibre	**21.16**	**25.41**	**25.12**

Table 2: Vitamins content analysis of *Pleurotus* species

Vitamins	Quantity (mg/g)		
	Pleurotus ostreatus	*Pleurotus florida*	*Pleurotus sajor caju*
Vitamin A	**2.52**	**2.13**	**2.47**
Vitamin B_1	**1.16**	**1.41**	**1.74**
Vitamin B_2	**2.11**	**2.03**	**2.16**
Vitamin B_3	**0.46**	**0.51**	**0.87**
Vitamin C	**1.58**	**1.74**	**1.19**
Vitamin E	**2.33**	**2.18**	**2.15**

Table 3: Minerals content analysis of *Pleurotus* species

Minerals	Quantity (mg/g)		
	Pleurotus ostreatus	*Pleurotus florida*	*Pleurotus sajor caju*
Calcium (Ca)	**32.66**	**33.40**	**32.50**
Copper (Cu)	**3.16**	**3.44**	**3.27**
Iron (Fe)	**42.05**	**45.00**	**40.42**
Magnesium (Mg)	**11.89**	**11.0**	**11.80**
Manganese (Mn)	**2.52**	**2.30**	**2.20**
Nitrogen (N)	**4.50**	**3.63**	**4.08**
Phosphorus (P)	**0.91**	**0.81**	**0.82**
Potassium (K)	**1.32**	**1.14**	**1.23**
Zinc (Zn)	**13.27**	**11.20**	**11.50**

Table 4: Qualitative bioactive components of *Pleurotus* species

	Pleurotus ostreatus				*Pleurotus florida*				*Pleurotus sajor caju*			
	Aqueous	Ethanol	Methanol	Diethyl ether	Aqueous	Ethanol	Methanol	Diethyl ether	Aqueous	Ethanol	Methanol	Diethyl ether
Alkaloids	+	+	+	+	+	+	+	+	+	+	+	+
Amino acids	-	+	+	-	-	-	+	-	-	+	-	+
Coumarins	+	-	-	+	+	-	-	+	-	-	-	+
Flavonoids	+	+	+	+	+	+	+	+	+	+	+	+
Phenol	+	+	+	+	+	+	+	+	+	+	+	+
Saponins	-	-	-	+	-	-	-	+	-	-	-	+
Steroids	+	+	+	+	-	+	+	+	+	+	+	+
Tannins	+	-	-	+	-	-	-	-	+	-	-	+
Terpenoids	-	-	+	+	-	-	+	+	-	-	+	+
Quinones	-	-	-	+	+	-	+	+	+	-	-	+

(+) Present, (-) Absent

Table 5: Quantitative bioactive components of *Pleurotus* species

Bioactive compounds	Quantity (mg/g)											
	Pleurotus ostreatus				*Pleurotus florida*				*Pleurotus sajor caju*			
	Aqueous	Ethanol	Methanol	Diethyl ether	Aqueous	Ethanol	Methanol	Diethyl ether	Aqueous	Ethanol	Methanol	Diethyl ether
Alkaloids	12.54±0.02	14.19±0.23	07.25±0.09	15.04±0.11	14.05±0.03	13.10±0.03	15.09±0.06	12.02±0.06	12.51±0.21	11.04±0.01	13.27±0.31	14.10±0.41
Aminoacids	-	12.11±0.62	13.12±0.47	-	-	-	12.14±0.17	-	-	12.53±0.09	-	13.41±0.13
Coumarins	09.15±0.21	-	-	12.06±0.45	12.03±0.00	-	-	11.03±0.23	10.09±0.05	-	-	-
Flavonoids	11.02±0.09	06.45±0.80	05.48±0.21	09.35±0.12	14.10±0.07	13.69±0.00	15.49±0.09	12.07±0.08	11.17±0.13	13.18±0.17	12.56±0.08	15.41±0.66
Phenol	10.56±0.25	05.35±0.12	06.16±0.10	08.26±0.14	15.51±0.01	14.38±0.03	14.44±0.43	12.26±0.08	12.35±0.06	13.07±0.23	12.09±0.16	12.75±0.04
Saponins	-	-	-	09.08±0.16	-	-	-	11.36±0.03	-	-	-	13.02±0.22
Steroids	09.61±0.54	08.46±0.13	06.23±0.26	08.08±0.38	13.45±0.00	11.74±0.03	11.17±0.09	11.75±0.05	09.05±0.15	07.15±0.18	08.21±0.07	08.11±0.31
Tannins	07.06±0.67	-	-	09.42±0.06	-	-	12.05±0.18	-	10.23±0.47	-	09.70±0.16	10.03±0.11
Terpenoids	-	-	07.12±0.44	10.06±0.61	-	-	11.36±0.36	11.63±0.02	09.14±0.23	-	10.45±0.71	10.12±0.41
Quinones	-	-	-	09.11±0.34	09.47±0.54	-	10.26±0.15	10.12±0.17	09.41±0.15	-	-	10.16±0.10

The values are expressed in terms of (Mean ± Standard deviation)

Figure a: ***Pleurotus ostreatus***

Figure b: ***Pleurotus florida***

Figure c: ***Pleurotus sajor caju***

Figure 1: Cultivation of *Pleurotus* sp on paddy straw substrates

CONCLUSION

As per the finding of the study the growth of *Pleurotus* sp relatively faster on paddy straw it took about 11 days of their level up at pre winter season. Mushrooms are regarded a super food because of their high nutritious content, particularly in terms of protein, dietary fibre, vitamins, and minerals. The potential of mushrooms in food applications has been investigated in studies. The results of these investigations demonstrated that mushrooms into food products improves their nutritional value as well as its physical qualities. As a result, it should come as no surprise that the food and pharmaceutical sectors use mushrooms or mushroom bioactive substances to make functional mushrooms food of neutraceutical applications. Through the creation of a quick-yielding, nutrient-rich food supply and a steady source of income, mushroom cultivation can help people become less vulnerable to poverty and increase their quality of life.

ACKNOWLEDGEMENT

We are thankful to the principal, Marudhupandiyar college, Thanjavur-613 403 for providing facility in my Research work.

REFERENCE

[1] Ahmad S. A., Kadam, J.A., Mane, V.P., Patil, S.S. and Baig M.M.V. Biological efficiency and nutritional contents of *Pleurotus florida* cultivated on different agrowastes. *Nature and Science.* (2009). **7**: 44-48.

[2] Feeney, M.J., Dwyer, J. and Hasler-Lewis, C.M. Mushrooms and health summit proceedings. *J Nutr*. (2014).**144**(7):1128S–1136S.

[3] Knop, D., Yarden, O. and Hadar, Y. The ligninolytic peroxidases in the genus *Pleurotus*: divergence in activities, expression and potential applications. *Appl Microbiol Biotechnol*; (2015).**99**(3): 1025–1038.

[4] Singh, M.P. and Singh, V.K. Yield performance and nutritional analysis of *Pleurotus* citrinopileatus on different agro wastes and vegetable wastes. *The 7th International Conference on Mushroom Biology and Mushroom Products*. (2011). Oct 4–7.

[5] Golak-Siwulska. I., Kaluzewicz, A. and Spizewski, T. Bioactive compounds and medicinal properties of Oyster mushrooms (*Pleurotus* sp). *Folia Hortic*. (2018). **30**(2):191–201.

[6] Kinge, T.R., Adi, E.M., Mih, A.M., Ache, N.A. and Nji, T.M. Effect of substrate on the growth nutritional and bioactive components of

Pleurotus ostreatus and *Pleurotus florida*. *African Journal of Biotechnology*. (2016).**15**(27): 1476-1486.

[7] Khan, S.M., Nazir, J., Zahoor, H.K. and Sultan, M.K. Yield performance of oyster mushroom. *Pak. J. Phytopathology.* (2006).**18**: 89-93.

[8] Garcha, H.S. A manual of mushroom growing. PAU, Ludhiana. (1994).

[9] AOAC "Official Methods of Analysis of Association of Official Analytical Chemists, 18th edition". AOAC, Arlington, Virgina, USA. (2006).

[10] Amadi, B.A. "Toxicological studies of *Asmina triloba* leaves on haematology, liver, kidney using rats model". *International Science Research Journal 4*. (2013). **2**: 11-17.

[11] Harbone, J.B. "Phytochemical methods a guide to modern technique of plant analysis. 2nd edition. Chapman and Hall. New York, NY. (1973).

[12] Onwuka, G.I. "Food analysis and instrumentation (Theory and Practical)".1st edition. Surulere, Lagos: Naphtali Prints (2005): 50-58.

[13] Sofowora, E.A. Medicinal Plants and Traditional Medicine in Africa. John Wiley and Sons Ltd., Hoboken, (1982). 64-79.

[14] Trease, G.E. and Evans, W.C. Textbook of pharmacognosy. 12th Edition, Tindall and Co., London, (1983). 343-383.

[15] Sofowora. A Phytochemical Screening of Medicinal Plants and Traditional Medicine in Africa Edition. Spectrum Books Ltd., Nigeria, (1993).150-156.

[16] Bohm Bruce, A. and Mohammed, R. Koupai-Abyazani. Flavonoids and Condensed Tannins from Leaves of Hawaiian *Vaccinium reticulatum* and *V. calycinum* (Ericaceae). *Pacific Science*. (1994). **48**:(4). 458-463.

[17] Obadoni, B.O. and Ochuko, P.O. Phytochemical Studies and Comparative Efficacy of the Crude Extracts of Some Homeostatic Plants in Edo and Delta States of Nigeria. *Global Journal of Pure and Applied Science*, (2001). **8**:203-208.

[18] Van Buren, J. P. and Robinson, W. B. Formation of Complexes between Protein and Tannic Acid, *Journal of Agric Food Chemistry*, (1981).**17**:772 – 777.

[19] Olasupo, O.O., Asonibare, A.O. and Nurudeen, T.A. Relative performance of oyster mushroom (*Pleurotus florida*) cultivated on different indigenous wood wastes. *Journal of Agricultural Research and Natural Resources*. (2019). **3**(2): 1-11.

[20] Belewu, M.A. Nutritional qualities of corn cobs and waste paper incubated with edible mushroom (*Pleurotus sajor caju*). *Niger. J. Anim.Prod*. (2003). **30**:20-25.

[21] Iwalokun, B.A., Usen, U.A., Otunba, A.A. and Olukoya, D.K. Comparative phytochemical evaluation, antimicrobial and antioxidant properties of *Pleurotus ostreatus*. *Afr. J. Biotechnol*. (2007). **6**:1732-1739.

[22] Hamzah, R.U., Jigam,A.A., Makun, H.M. and Egwin, E.C. Phytochemical screening and antioxidant activity of methanolic extract of selected wild edible Nigerian mushrooms. *Asian Pac. J. Trop. Dis*. (2014). **4**:153-157.

[23] Pandimeena, M., Prabu, M., Sumathy, R. and Kumuthakalavalli, R. Evaluation of Phytochemicals and in vitro Anti-Inflammatory, Anti Diabetic Activity of the White Oyster Mushroom,*Pleurotus florida*. *Int. Res. J. Pharm. Appl. Sci.* (2015).**5**:16-21.

[24] Price, K.R., Johnson, I.T. and Fenwick, G.R. Chemical and Biological significance of saponins in foods and feeding stuffs. *Crit. Rev. Food Sci. Nutr*. (1987).**26**:130-135.