IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 10 Issue 01, January 2023
ISSN (Online) 2348 – 7968 | Impact Factor – 6.72
www.ijiset.com

Comparative Study of Nutritional Composition of Oyster Mushroom *Pleurotus florida* Cultivated on Different Consortiums of Substrates

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Abstract

Nowadays, people enjoy eating mushrooms more and more because of their many health benefits and ability to treat a wide range of disorders. It has incredible nutritional qualities. Numerous research articles describe its applications. Oyster mushrooms may be grown in both temperate and tropical areas because of the temperature range in which they thrive. Oyster mushrooms come in a variety of kinds that are very therapeutic. Animals can benefit from the antioxidant and anticancer effects of *Pleurotus florida*. Today's most affordable biotechnology for recycling lignocellulose organic waste may be mushrooms, which combines the production of protein-rich food with pollution avoidance. Due to its dietary or chemical makeup, *Pleurotus* species of mushrooms offer therapeutic potential. However, a variety of elements, including the nature of the growth substrate, affect nutritional composition. This study compared the nutritional makeup of *Pleurotus florida* mushrooms grown on various combinations of substrates. The highest protein content was found in the mushroom grown on consortia number 9, while the highest carbohydrate content was found in the mushroom grown on consortium number 7. But it was discovered that consortium number 9 was the best combination for achieving the highest protein content in *Pleurotus florida*. As a result, this mushroom may be the best option for vegetarians to satisfy their daily protein and other nutritional requirements. These consortiums can be used by the entrepreneurs for both small- and large-scale businesses.

Keywords: *Nutritional Analysis, Pleurotus florida, Oyster Mushroom, Protein Content, Agricultural Residues.*

1. Introduction

Mushrooms have been recognised as an important food source since ancient times. Their importance in human health, nutrition, and disease is increasing their use every day. *Pleurotus* sp. mushrooms are also known as oyster mushrooms [1,2]. They are the world's second most popular mushrooms, after button mushrooms, and the most popular in many countries. Oyster mushrooms grow at temperatures ranging from 15 to 30 ^{o}C, making them ideal for cultivation in both temperate and tropical climates [3,4]. Several species of oyster mushrooms are extremely medicinal. *Pleurotus florida* has antioxidant and antitumor properties in animals. *Pleurotus florida* methanol extracts inhibit inflammation and platelet aggregation [1,5,6]. Mushrooms may be the one nowadays cost effective biotechnology for lignocellulose organic waste recycling which thus combines the production of protein rich food with pollution prevention.

Pleurotus sp. mushrooms have medicinal properties due to their nutritional or chemical composition. However, nutritional composition is influenced by a variety of factors, such as strain variations, growth substrate composition, cultivation method, harvesting phase, specific portion of the fruiting bodies used for analysis, harvest interval, and evaluation techniques. There are very few scientific studies to evaluate the nutritional compositions of various mushrooms in different growth substrate compositions [1,7,8,9,10,11,12].

With this aim, this study was carried out to compare the nutritional composition of the *Pleurotus florida* mushroom grown on different consortiums of substrates.

2. Materials and Methods

2.1 Procurement of spawn sample and Purchasing and processing of the selected agro-industrial residues

For the first time, *Pleurotus florida* spawns were procured from Peeper Agro Industry in Vimanapura, Bengaluru, India, and it's pure culture was obtained on potato dextrose agar plates (pH 7.2). A local farmer and market provided dried bread grass (*Brachiaria brizantha*) (X_1), soybean straw (X_2), saw dust (X_3), rice straw (X_4), wheat straw (X_5), cotton straw (X_6) and sugarcane bagasse (X_7). With the exception of sawdust, all substrates were dried, cut into fine pieces, and pulverised with a grinder [2,13,14,15,16,17,18].

2.2 Cultivation of *Pleurotus florida* on different substrates

The chosen substrates were mixed to form a specific consortium design, as shown in Table 1, yielding a total of 15 formulations. Our previous paper [2] discussed in detail the cultivation methodology of *Pleurotus florida* on the aforementioned substrates as well as harvesting techniques.

2.3 Determination of Moisture

First of all, moisture content of fresh mushrooms harvested from each consortium was determined by using following formula [19].
Moisture content of mushroom (%) = [(Fresh weight of mushroom - Dry weight of mushroom)/Fresh weight of mushroom] × 100

2.4 Determination of total protein content

For 30 minutes, 5 g of ground mushroom were boiled in 50 mL of 1N NaOH. After allowing the solution to reach room temperature, it was subjected to centrifugation at 1000 g using centrifuge equipment (Remi make, Mumbai) [1]. The supernatant was separated, and the total protein content was estimated using the Biuret method [20].

2.5 Determination of total lipid

5 g of powdered mushroom were suspended in 50 ml of chloroform:methanol (2:1 v/v) mixture, thoroughly mixed, and allowed to stand for three days. A table centrifuge machine was used to centrifuge the solution at 1000 g. Using a Pasteur pipette, the upper layer of methanol was removed, and chloroform was evaporated by heating. The crude lipid was all that remained [1,20].

2.6 Determination of total carbohydrate

The following formula was used to determine the obtainable carbohydrate content of dried mushroom sample [1,20].
Carbohydrate (g/100g sample) = 100 – (Moisture + Fat + Protein + Ash + Crude Fiber)

2.7 Determination of crude fiber

After washing with ethanol and ether, the moisture and fat-free mushroom sample was treated with 0.255 N H_2SO_4 and 0.313 N NaOH. It was then transferred to a crucible, dried overnight at 80-100 ^oC, and weighed (W1) in an electronic weighing balance. The crucible was heated in an electric furnace for 6 hours at 600 ^oC, cooled, and weighed again (W2). The following formula was used to calculate the crude fibre content [1,20].
Crude fiber (g/100g) = {[100 - (moisture + fat)] × (W1-W2)}/ Weight of sample

2.8 Determination of total ash

1 g of the sample was precisely weighed into a crucible. The crucible was placed on a clay pipe triangle and heated first over a low flame until all of the material was completely burnt, then for about 6 hours at 600 ^{o}C in an electric furnace. It was then weighed after cooling in a desiccator. The total ash was then calculated using the equation below [1,20].
Ash content (g/100g) = (Weight of ash × 100) / Weight of sample taken

3. Results and Discussion

3.1 Moisture determination

Maximum moisture content of mushrooms grown on consortium no. 6 was recorded followed by consortium numbers 13, 7, 5,14,8,4, 15,2,1,11,10,12,3 and 9. Figure 1 shows moisture content of mushrooms (*Pleurotus florida*) harvested from each consortium.

3.2 Determination of nutritional parameters

Maximum total protein of mushrooms grown on consortium no. 9 was recorded 29.36% among all consortiums of substrates. Figure 2 shows total protein content of mushrooms (*Pleurotus florida*) harvested from each consortium. Carbohydrate, fat, ash and crude fibre content of *Pleurotus florida* has given in Table 2.

Agriculture waste could be turned into healthy items rich in protein by growing oyster mushrooms. These mushrooms can be created using agricultural waste products that are readily available locally, such as wood chips, sawdust, straws, seed hulls, and grass. These resources can be used to continue mushroom production all year round [16,17,18]. Finding a strategy to handle agricultural waste that is both economical and environmentally friendly is constantly in high demand. These prerequisites are met by mushroom growing on agricultural wastes [19]. Agricultural wastes contain a lot of lignin-cellulosic materials that are hard to break down but are useful for mushroom development. Mushrooms are products that can be made from lignocellulosic waste that are incredibly nutrient-dense. A good way to utilise agricultural wastes is through bioconversion into products with value added [20,21,22,23,24].

Numerous agricultural residues' compositions have been described in literature. Here, we're reporting on a few of them. Wheat straw contains 1% protein, 13% lignin, 39% hemicellulose, and 40% cellulose. Whereas, in essence, rice straw contains numerous components, including 41% cellulose, 14% lignin, and 0.8% total nitrogen. Sugarcane bagasse contains 35–40% cellulose, 20–25% hemicellulose, 18–24% lignin, 1%–4% ash, and 0.7% nitrogen [22].

The *Pleurotus florida* mushroom has not been linked to any hazardous effects on humans in the literature, despite being grown on the substrate utilised in the current experiment and any of the aforementioned agricultural residues. Actually, numerous research [19,20,21] have supported the fact that this cultivar is edible. *Pleurotus florida* is included in the safe list of mushroom species. This is generally regarded as safe (GRAS) [1, 25].

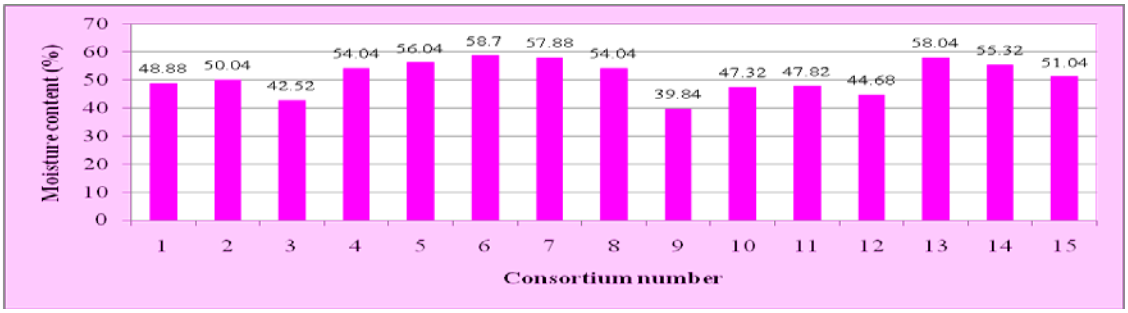

Figure 1: Moisture content of mushrooms (*Pleurotus florida*) harvested from designed consortium numbers

Table 1: Formulation of different consortiums of selected substrates for the cultivation of *Pleurotus florida*

Consortium number	Substrate mixture ratio						
	X1 (%)	X2 (%)	X3 (%)	X4 (%)	X5 (%)	X6 (%)	X7 (%)
1	100	0	0	0	0	0	0
2	0	100	0	0	0	0	0
3	0	0	100	0	0	0	0
4	0	0	0	100	0	0	0
5	0	0	0	0	100	0	0
6	0	0	0	0	0	100	0
7	0	0	0	0	0	0	100
8	14.29	14.29	14.29	14.29	14.29	14.29	14.29
9	8	15	25	20	15	10	7
10	20	25	15	8	7	10	15
11	25	15	8	20	15	7	10
12	3	12	17	32	16	9	11
13	13	11	15	12	7	3	39
14	10	10	10	10	10	40	10
15	7	10	15	20	25	15	8

Table 2: Carbohydrate, fat, ash and crude fibre content of *Pleurotus florida* (g/100g of dried sample)

Consortium no.	Carbohydrate	Moisture	Fat	Protein	Ash	Crude fibre
1	67.32	1.65	0.5	12.49	9.68	8.36
2	65.75	1.36	0.9	15.66	10.35	5.98
3	63.43	1.69	0.6	11.37	10.56	12.35
4	72.98	2.36	0.3	9.22	6.45	8.69
5	76.33	1.36	0.55	10.46	7.65	3.65
6	77.14	1.69	0.34	8.69	5.66	6.48
7	78.15	1.36	0.12	7.57	4.15	8.65
8	64.22	2.45	1.65	21.42	3.48	6.78
9	54.35	0.69	1.12	29.36	2.78	11.7
10	67.36	1.45	1.2	25.18	2.36	2.45
11	64.50	1.65	1.11	26.55	4.83	1.36
12	59.72	2.98	1.33	27.22	2.36	6.39
13	72.16	1.36	1.44	18.71	3.68	2.65
14	69.32	1.48	1.01	20.62	2.68	4.89
15	66.46	1.48	0.98	24.65	2.78	3.65

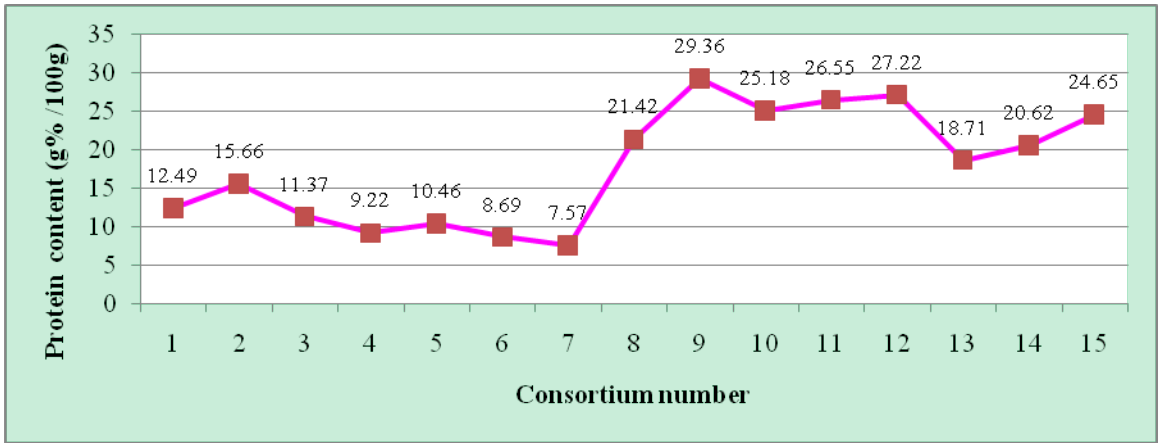

Figure 2: Total protein content of mushrooms (*Pleurotus florida*) harvested from designed consortium numbers

4. Conclusions

Pleurotus florida mushroom growing on various agricultural leftovers with each unique consortia produced remarkable nutritional value. The mushroom produced on consortium number 7 had the highest carbohydrate content (78.15%), while the mushroom cultivated on consortium number 9 had the highest protein content (29.36%). However, consortium number 9 was shown to be the optimum combination that helped to reach maximal protein content in *Pleurotus florida*. The different compositions of chosen agricultural residues could effect on nutritional component variation of *Pleurotus florida*. Therefore, this mushroom may be the ideal choice for vegetarians to meet their daily dietary protein needs.

Acknowledgments

Dr. Mukundraj Govindrao Rathod would like to thank Hon. Dr. Udhav V. Bhosle (Vice-Chancellor), Dr. Sarita Yennawar (Asst. Registrar, Academic Planning and Development Section) and all concerned authorities of Swami Ramanand Teerth Marathwada University, Nanded, Maharashtra, India, for sanctioning a research project (APDS/RGSTC/Proposal-ASTA/2020-2021/1944) under the scheme 'Assistance for Science and Technology Application through University System' of Rajiv Gandhi Science and Technology Commission (R.G.S.T.C.), Government of Maharashtra, Mumbai, India. Hon. Dr. Shaikh Rafiyoddin Shaikh Sirajoddin, President of the M.E.C.H. and W. Society, Parbhani, is gratefully acknowledged by Dr. Mukundraj Govindrao Rathod for providing the facilities and infrastructure needed for conducting research.

Conflict of interest

The authors declare that there is no conflict of interest.

References

[1] Khan, M. A., Amin, S. R., Uddin, M. N., Tania, M., & Alam, N. (2008). Comparative study of the nutritional composition of oyster mushrooms cultivated in Bangladesh. *Bangladesh J. Mushroom*, *2*(1), 9-14.
[2] Rathod, M.G., (2023) Substrate dependent growth optimization of Pleurotus florida mushroom on inexpensive substrates. World Journal of Biology Pharmacy and Health Sciences, 13(1), 322-330.
[3] Pathak AP, Rathod MG. (Eds) (2022) Biotechnology of Mushroom. 1-69. Bhumi publishing, India ISBN: 978-93-91768-86-7
[4] Rathod MG., Gadade RB, Thakur GM, and Pathak AP. (2021) Oyster mushroom: cultivation, bioactive significance and commercial status. In: Frontiers in Life Science (Volume II): 21. Bhumi publishing, Kolhapur, India.
[5] Rathod M.G., (2019) Bhosale A.D., Kamble A.D., Shinde, P.D., Masure N.V., Katkuyare D.,Pankhade V., Ghatul S.K., Sonawane S.S., Pathak A.P. Cultivation of commercially important oyster mushroom on inexpensive substrates, 8(1) 124-129. Ajanta Prakashan, Aurangabad (M.S.)

[6] Ujagar A.B. & Rathod M.G. (2021) Use of different agroindustrial residues for mushroom cultivation. In: Research insights of life science students (Volume - 3) Chapter no. 256, p. 708-709 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[7] Rahatkar T.A. & Rathod M.G. (2021) Arrangement and necessary infrastructure for oyster mushroom cultivation. In: Research insights of life science students. (Volume - 3) Chapter no. 260, p. 717-719 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[8] Shaikh B.S. & Rathod M.G. (2021) Cultivation of oyster mushroom on mixed substrate. In: Research insights of life science students.(Volume - 3) Chapter no. 263, p. 727-728 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[9] Gadade R.B. & Rathod M.G. (2021) Sterilization and disinfection of agro-waste for mushroom cultivation. In: Research insights of life science students (Volume - 3) Chapter no. 257, p.710-711 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[10] Thakur G.M. & Rathod M.G. (2021) Spawn preparation techniques in mushroom cultivation. In: Research insights of life science students (Volume - 3) Chapter no. 258, p.712-714 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[11] Dhole A.B. & Rathod M.G. (2021) Diversity of cultivable edible species of mushrooms. In: Research insights of life science students. (Volume - 3) Chapter no. 259, p. 715-716 (ISBN: 978-93-91342-27-2) JPS Scientific Publications, India.
[12] Tolera, K. D., & Abera, S. (2017). Nutritional quality of Oyster Mushroom (Pleurotus Ostreatus) as affected by osmotic pretreatments and drying methods. *Food science & nutrition*, *5*(5), 989-996.
[13] Pathak A.P., Devkatte, S.B., & Rathod, M.G. (2016). Production of amylase by Penicillium sp. using solid state fermentation method and inexpensive agricultural residues. International Journal For Research In Biology & Pharmacy, 2(4), 32-42.
[14] Pathak A.P., Sarsar, M.S., Gavali, J.T., & Shendage, M.H. (2016). Food and Agricultural residues: Potential substrates for amylase production. International Journal For Research In Agricultural And Food Science, 2(4), 01-06.
[15] Pathak A.P., Sarsar, M.S., Gavali, J.T., & Sonwane, R.G. (2016). Amylolytic enzyme production using agricultural residue. International Journal For Research In Agricultural And Food Science, 2(4), 30-36.
[16] Pathak AP, Rathod MG (2013) Utilization of agricultural residues for production of alkaline protease by alkaliphilic Bacillus firmus LAP52 : A Lonar soda lake isolate. National conference on Emerging trends in plant sciences (ETPS-2013), 14-19
[17] Rathod M.G., & Pathak A.P. (2014). Wealth from waste: Optimized alkaline protease production from agro-industrial residues by Bacillus alcalophilus LW8 and its biotechnological applications. Journal of Taibah University for Science, 8(4), 307-314.
[18] Rathod M.G., & Pathak, A.P. (2016). Optimized production, characterization and application of alkaline proteases from taxonomically assessed microbial isolates from Lonar soda lake, India. Biocatalysis and agricultural biotechnology, 7, 164-173.
[19] Ahmed, S. A., Kadam, J. A., Mane, V. P., Patil, S. S., & Baig, M. M. V. (2009). Biological efficiency and nutritional contents of Pleurotus florida (Mont.) Singer cultivated on different agro-wastes. *Nature and science*, *7*(1), 44-48.
[20] Khan, M. A., Khan, L. A., Hossain, M. S., Tania, M., & Uddin, M. N. (2009). Investigation on the nutritional composition of the common edible and medicinal mushrooms cultivated in Bangladesh. *Bangladesh Journal of Mushroom*, *3*(1), 21-28.
[21] Pathak AP, Rathod MG, Rakhe SA, Bhure NU, Borade RS,. Kamalapure PS (2021) A step to attain sustainable development in crop production and soil health. In: Ecology Research 2, 1-16, Bhumi Publication, India.
[22] Kamthan, R., & Tiwari, I. (2017). Agricultural wastes-potential substrates for mushroom cultivation. European Journal of Experimental Biology, 7(5), 31.
[23] Pathak A. P., Rathod, M. G., Mahabole, M. P., & Khairnar, R. S. (2020). Enhanced catalytic activity of Bacillus aryabhattai P1 protease by modulation with nanoactivator. Heliyon, 6(6), e04053.
[24] Rathod, M.G., & Pathak, A.P. (2016). Data on optimized production and characterization of alkaline proteases from newly isolated alkaliphiles from Lonar soda lake, India. Data in brief, 8, 863-866.
[25] Gebrelibanos, M., Megersa, N., & Taddesse, A. M. (2016). Levels of essential and non-essential metals in edible mushrooms cultivated in Haramaya, Ethiopia. International Journal of Food Contamination, 3(1), 1-12.

Biography of authors

Dr. Mukundraj Govindrao Rathod (Ph.D. & MH-SET)

At Yeshwant College of Information Technology in Parbhani, Maharashtra, India, Dr. Mukundraj G. Rathod (Ph.D. in Biotechnology & MH-SET) is the in-charge Principal. In addition, he heads this college's Biotechnology and Bioinformatics department. More than 77 research papers, including review articles in various peer-reviewed international and national journals and proceedings of conferences in various research fields, have indeed been published by the author. He has 300 citations in Google Scholar, an i10 index of 10, and a H index of 10, which is impressive. He has an amazing H index of 4, with 31 Scopus citations. He had given oral talks and posters at numerous conferences and seminars. He has also reviewed publications for a number of reputable scientific publishers. He had donated seven crucial industrial cultures to the National Center for Cell Science's Microbial Culture Collection in Pune, Maharashtra, India, for use by the general public. He is currently the lead researcher on a study supported by Swami Ramanand Teerth Marathwada University in Nanded through the Rajiv Gandhi Science and Technology Commission's application scheme for science and technology (Government of Maharashtra). According to the AD Scientific Index 2023, he recently held the 17th rank among the top 20 scientists at Swami Ramanand Teerth Marathwada University, Nanded, and its jurisdiction.

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Mr. Jivan M. Dhotare serves as an assistant professor at the College of Agricultural Biotechnology, Hatta. He has mastered the art of instructing students in microbial genetics, r-DNA technology, and related topics. He has taken part in numerous extracurricular and co-curricular activities and published three full-length research papers. He works as a programme officer for the National Service Scheme (NSS) in his college. Additionally, he attended the NSS State Adventure Camp in Chikhaldara, Amravati. He coordinates community service projects through NSS, such as blood donation, tree plantings, AIDS awareness campaigns, and awareness campaigns for intoxicants.

Dr. Anupama P. Pathak
(Ph.D. & MH-SET)

Prof. Dr. (Mrs.) Anupama P. Pathak was previously serving as the School of Life Sciences' director and currently serving as the microbiology department's head at Swami Ramanand Teerth Marathwada University, Nanded. More than 200 research papers, including review articles, in various peer-reviewed international, national journals and conference proceedings were published by her. She has 774 citations in Google Scholar, an i10 index of 28, and a H index of 15, which is impressive. She has an amazing H index of 8, with 239 Scopus citations. More than 110 16S rRNA gene sequences and numerous industrially significant bacterial cultures are among her contributions. She had finished two research projects in microbiology on extremophiles that were funded by the University Grants Commission of New Delhi. She is a member of the university's Microbiology Board of Studies. She is a renowned scientist who, according to the AD Scientific Index 2023, is ranking currently in ninth place of the top 20 scientists at Swami Ramanand Teerth Marathwada University, Nanded, and its jurisdiction.