Forage Res., **50**(1) : pp. 66-69 (2024) **http://forageresearch.in**

IMPACT OF CROP STRAW ON THE NUTRITIONAL QUALITY OF OYSTER MUSHROOM (*PLEUROTUS MEMBRANACEUS)*

ARCHANA KUMAWAT[1]*, ALOK RAJ WASNIKAR AND GAYATRI KUMAWAT[1]

Department of Plant Pathology, Jawaharlal Nehru krishi vishwa vidhalya, College of Agriculture
Jabalpur-482 004 (Madhya Pradesh), India
[1]Livestock Feed Resource Management and Technology Centre,
Rajasthan University of Veterinary and Animal Sciences, Bikaner-334 001 (Rajasthan), India
**(e-mail: archukumawat8@gmail.com)*

(Received : 5 June 2024; Accepted : 24 June 2024)

SUMMARY

This study explores the efficacy of various crop straw substrates for the cultivation of oyster mushrooms (*Pleurotus membranaceus*). Substrates tested includes *i.e.* wheat straw, rice straw, soybean straw, chickpea straw, maize straw, wood chips, sawdust and a combination with wheat straw. The first flush of mushrooms from each substrate was collected and air-dried until a constant weight was reached. Standard methods were employed to analyse key nutritional parameters such as moisture content, ash content and protein. Among the substrates examined, wheat straw 100% exhibited the highest moisture content (91.70%) surpassing all other substrates. Oyster mushroom cultivated on Rice straw 75% + 25% Wheat straw exhibited the highest protein content (22.45%). Notably, the combination substrate of Maize straw 25% + 75% Wheat straw displayed the highest ash content (9.18%). Remarkably, the combination substrate yielded the lowest overall nutritional content compared to the other substrates. The aim is to determine how these substrates influence mushroom quality. As per our knowledge this is the first and novel research to emphasise the importance of crop straw substrate selection in optimizing mushroom cultivation. Wheat and rice straws were found to be particularly effective, suggesting that the choice of substrate is crucial for optimizing mushroom cultivation. The study underscores the potential for utilizing different crop straws and wood-based materials in sustainable mushroom production.

Key words: Oyster mushroom, *P. membranaceus*, wheat straw, rice straw, soybean straw, chickpea straw, maize straw, wood chips, sawdust

Oyster mushrooms (*P. membranaceus*) are highly valued for their nutritional benefits, culinary versatility and medicinal properties. They are a rich source of proteins, vitamins, minerals and bioactive compounds, making them a popular choice among consumers and a profitable crop for growers (Atila & Okan, 2017). The cultivation of oyster mushrooms has gained significant attention as an environmentally sustainable practice, utilizing crop straw and by-products to produce high-quality food (Hoa *et al.,* 2015).

The substrate used in mushroom cultivation plays a critical role in determining the nutritional quality of the mushrooms, including their moisture content, protein levels and ash content. Crop straw substrates such as wheat straw and rice straw are widely used due to their high cellulose content and availability (Hoa *et al.,* 2015). However, exploring alternative substrates can provide insights into optimizing the nutritional value of the mushrooms. Various crop straws including, soybean straw, chickpea straw and maize straw, along with wood-based materials like wood chips and sawdust, offer potential as substrates for mushroom cultivation (Fan *et al.,* 2000; Atila & Okan, 2017).

This study aims to evaluate the suitability of crop straws for oyster mushroom cultivation by comparing the nutritional quality of mushrooms grown on wheat straw, rice straw, soybean straw, chickpea straw, maize straw, wood chips and sawdust. Specifically, the research focuses on analyzing the moisture content, protein levels and ash content of the mushrooms. The findings of this study could contribute to more sustainable and efficient mushroom cultivation practices, benefiting both growers and consumers by providing mushrooms with enhanced nutritional profiles (Biswas *et al.,* 2013; Pathmashini *et al.,* 2008).

Understanding the impact of substrate choice on the nutritional quality of oyster mushrooms is essential for optimizing production and sustainability.

This research addresses the need for comprehensive studies on alternative substrates, providing valuable data for growers and researchers in the field of mycology and sustainable agriculture. The outcomes of this study could facilitate the adoption of diverse crop straws substrates, reducing reliance on traditional materials and promoting the utilization of agricultural and wood-based residues in oyster mushroom cultivation (Royse, 2013; Pathmashini *et al.,* 2008).

MATERIALS AND METHODS

The experiment comprised 25 different treatments, each with four replicates. Seven different substrates were selected for this study *i.e.*, wheat straw, rice straw, soybean straw, chickpea straw, maize straw, wood chips and sawdust. Each substrate was sourced from JNKVV farm and processed as cut into pieces approximately 5 cm in length. Each substrate was soaked in water for 16 hours to increase moisture content and then drained to remove excess water. Subsequently, the substrates were sterilized by autoclaving at 121°C for 30 minutes to eliminate contaminants.

Inoculation and Cultivation

Sterilized substrates were inoculated with oyster mushroom (*P. membranaceus*) spawn at a rate of 30 grams of spawn per 1-kilogram bag of substrate. The inoculated substrates were filled into polyethylene bags, which were sealed and incubated in a controlled environment with the temperature: 25°C ± 2°C, relative humidity: 85% ± 5% and light: 12-hour light/dark cycle. The bags were monitored daily for mycelial colonization. Once the mycelium had fully colonized the substrate (approximately 2-3 weeks), the bags were opened to initiate fruiting.

Fruiting Conditions

The opened bags were transferred to a fruiting chamber with the temperature (20°C ± 2°C), 90% ± 5% relative humidity and 12-hour light/dark light cycle. Misting was performed twice daily to maintain humidity. Fruiting bodies were harvested once they reached maturity, typically 7-10 days after initiation of fruiting.

Nutritional Analysis

After harvest, the mushrooms were analyzed for moisture content, protein levels and ash content using standard methods.

Moisture Content: Determined by drying fresh mushroom samples at 105°C until a constant weight was achieved (AOAC, 2016).

Protein Content: Measured using the Kjeldahl method, with nitrogen conversion factor of 6.25 (AOAC, 2016).

Ash Content: Determined by incinerating dried mushroom samples at 550°C in a muffle furnace until a constant weight was achieved (AOAC, 2016).

Statistical Analysis

Data were collected through each substrate and analysed using ANOVA to determine significant differences in nutritional content across different substrates. Post-hoc comparisons were performed using Tukey's HSD test. Statistical significance was set at $p<0.05$.

RESULTS AND DISCUSSION

The results of the study on the nutritional content of *Pleurotus membranaceus* cultivated on different substrates are summarized in Table 1. The table presents data on moisture content, ash content and protein content for each treatment, including combinations of rice straw, soybean straw, chickpea straw, sawdust, wood chips, maize straw and wheat straw.

Moisture Content

The moisture content of the mushrooms varied significantly across the different substrates and their combinations. The highest moisture content was observed in the control treatment with 100% wheat straw (91.70%), while the lowest moisture content was found in mushrooms grown on 100% wood chips (87.35%). Treatments with high proportions of wheat straw generally exhibited higher moisture content, as seen in rice straw 25% + 75% wheat straw (91.33%) and rice straw 50% + 50% wheat straw (91.28%).

Ash Content

Ash content also showed significant variation among the treatments. The highest ash content was observed in mushrooms grown on a combination of 25% maize straw + 75% wheat straw (9.18%), followed closely by mushrooms grown on 50% maize straw + 50% wheat straw (8.55%). The lowest ash content was found in mushrooms cultivated on 100% wood chips (1.84%) and its combinations with wheat straw.

Protein Content

Protein content ranged from 17.43% to 22.45% among the different treatments. The highest protein content was observed in mushrooms grown on a combination of 75% rice straw + 25% wheat straw (22.45%), while the lowest protein content was recorded in mushrooms grown on 100% wood chips (17.43%). Generally, substrates with higher proportions of rice straw or soybean straw tended to produce mushrooms with higher protein content.

The proximate composition of *P. membranaceus* samples cultivated on various substrates revealed distinct nutrient compositions. Moisture content in *P. membranaceus* samples grown on wheat straw 100%, rice straw 25% + 75% wheat straw and rice straw 50% + 50% wheat straw combinations were determined as 91.70%, 91.33% and 91.28%, respectively. Notably, the wheat straw treatment yielded mushrooms with the highest moisture content at 91.70%. This observation is consistent with earlier research indicating that mushroom moisture content is influenced by factors such as harvest timing, maturation period and environmental conditions during growth (Onyeka *et al.,* 2018; Elattar *et al.,* 2019; Akter *et al.,* 2022). These variables likely account for the variations in moisture content among *P. membranaceus* samples from different substrate treatments.

Protein is a fundamental source of amino acids and a crucial dietary component (Hassan *et al.,* 2019). The crude protein content in samples from treatments involving rice straw 75% + 25% wheat straw, rice straw100% and rice straw 50% + 50% wheat straw substrates was determined to be 22.45%, 22.25% and 21.95% per gram of mushroom, respectively. Research suggests that mushroom protein content varies due to genetic factors of the species and the physical and chemical properties of the growth

TABLE 1
Effect of different substrates on moisture and nutrition aspects of P. membranaceus.

S. No	Treatments	Moisture (%)	Ash (%)	Protein (%)
T_1	Rice straw 100%	90.58	6.80	22.25
T_2	Rice straw 75% + 25% Wheat straw	90.80	5.85	22.45
T_3	Rice straw 50% + 50% Wheat straw	91.28	4.73	21.95
T_4	Rice straw 25% + 75% Wheat straw	91.33	3.70	20.40
T_5	Soybean straw 100%	87.55	7.70	20.83
T_6	Soybean straw 75% + 25% Wheat straw	87.60	6.85	20.68
T_7	Soybean straw 50% + 50% Wheat straw	88.83	6.00	19.78
T_8	Soybean straw 25% + 75% Wheat straw	89.15	4.73	19.63
T_9	Chickpea straw 100%	87.60	4.73	20.28
T_{10}	Chickpea straw 75% + 25% Wheat straw	90.18	4.63	20.03
T_{11}	Chickpea straw 50% + 50% Wheat straw	90.28	4.08	19.83
T_{12}	Chickpea straw 25% + 75% Wheat straw	91.20	3.70	19.63
T_{13}	Saw dust 100%	87.53	4.73	18.43
T_{14}	Saw dust 75% + 25% Wheat straw	88.83	4.33	18.63
T_{15}	Saw dust 50% + 50% Wheat straw	90.33	4.08	18.73
T_{16}	Saw dust 25% + 75% Wheat straw	90.25	3.33	19.15
T_{17}	Wood chips 100%	87.35	1.84	17.43
T_{18}	Wood chips 75% + 25% Wheat straw	88.88	1.61	17.83
T_{19}	Wood chips 50% + 50% Wheat straw	91.18	1.28	18.63
T_{20}	Wood chips 25% + 75% Wheat straw	91.20	1.02	19.15
T_{21}	Maize straw 100%	88.30	7.70	20.95
T_{22}	Maize straw 75% + 25% Wheat straw	88.88	8.38	20.83
T_{23}	Maize straw 50% + 50% Wheat straw	90.98	8.55	20.13
T_{24}	Maize straw 25% + 75% Wheat straw	91.18	9.18	19.78
T_{25}	Control (Wheat straw)	91.70	7.28	19.40
	S. Em±	0.18	0.14	0.14
	C. D. $p \geq 0.05$	0.50	0.39	0.40

medium (Sanmee *et al.,* 2003). Prior studies have indicated that any plant-based food contributing approximately 12% of its caloric value is considered a good source of protein. The present findings align closely with results from previous research, such as that conducted by Akter *et al.* (2022), which concluded that rice straw is a superior substrate in terms of protein content.

The quality of ash is associated with the presence of nutritionally significant mineral components in food materials (Olusanya, 2008). Regarding ash content, measurements were recorded as 9.18%, 8.55% and 8.38% per gram of mushroom for maize straw 25% + 75% wheat straw, maize straw 50% + 50% wheat straw and maize straw 75% + 25% wheat straw substrate combinations, respectively. These findings are consistent with previous studies by Ahmed *et al.* (2009) and Akter *et al.* (2022), both of which suggested that maize straw out performs other types of crop straw substrates in terms of ash content.

CONCLUSION

This study reveals that crop straw substrates choice significantly impacts the nutritional quality of *Pleurotus membranaceus* mushrooms. Higher moisture content was associated with substrates rich in wheat straw, while maize straw led to higher ash content, reflecting greater mineral accumulation. Rice straw provided the highest protein levels due to its high nitrogen content. These findings highlight the importance of selecting crop straw substrates based on desired nutritional outcomes, with rice straw and maize straw being particularly beneficial for enhancing protein and mineral content, respectively. For optimal mushroom quality, tailored substrate selection is crucial. Future research should further explore substrate interactions to refine cultivation practices and improve nutritional profiles.

REFERENCES

Ahmed S.A., J.A. Kadam, V.P. Mane, S.S. Patil and M.M.V. Baig, 2009 : Biological efficiency and nutritional contents of *Pleurotus florida* (Mont.) Singer cultivated on different agro-wastes. *Nature and science*, **7**(1): 44-48.

Akter, M., R. F. Halawani, F. A. Aloufi, M. A. Taleb, S., Akter and S. Mahmood, 2022 : Utilization of agro-industrial wastes for the production of quality oyster mushrooms. *Sustainability*, **14**(2): 994.

AOAC, 2016 : Official Methods of Analysis of AOAC International. 20th Edition. AOAC International, Gaithersburg, MD, USA.

Atila, F. and E. Okan, 2017 : The cultivation of Pleurotus ostreatus on different agricultural wastes. *Iranian Journal of Science and Technology, Transactions A: Science*, **41**(1): 1-7.

Biswas, M. K., R. Chandra and R. Bisaria, 2013 : Biodiversity and biotechnological potential of mushrooms. *Journal of Scientific and Industrial Research*, **72**: 171-178.

Elattar A.M., S. Hassan and S.F. Awd-Allah, 2019 : Evaluation of oyster mushroom (*Pleurotus ostreatus*) cultivation using different organic substrates. *Alexandria Science Exchange Journal*, 427-440.

Fan, L., A. Pandey and C. R. Soccol, 2000: Cultivation of Pleurotus mushrooms on different agro-industrial residues. *Food Technol. Biotechnol*, **38**(3): 211-215.

Hassan S., M. Alyemeni and K. Khan, 2011 : Cultivation of the oyster mushroom (*Pleurotus ostreatus* (Jacq.) P. Kumm). In two different agro ecological zones of Pakistan. *Afr. J Biotechnol*., **10**(2): 183-188.

Hoa, H. T., C. L. Wang and C. H. Wang, 2015: The effects of different substrates on the yield, quality and antioxidant activity of *Pleurotus ostreatus*. *Mycobiology*, **43**(4): 423-429.

Olusanya J.O., 2008 : Protein in: Essentials of food and nutrition. *Apex Book Limited, Lagos, Nigeria,* 13-21.

Onyeka E.U., E. Udeogu, C. Umelo and M.A. Okehie, 2018 : Effect of substrate media on growth, yield and nutritional composition of domestically grown oyster mushroom (*Pleurotus ostreatus*). *African Journal of Plant Science,* **12**(7): 141-147.

Pathmashini, L., V. Arulnandhy and R. S. W. Wijeratnam, 2008 : Efficacy of different spawn types on sawdust media on the growth and yield of oyster mushroom (*Pleurotus ostreatus*). *Tropical Agricultural Research and Extension*, **11**: 19-23.

Royse, D. J., 2013 : A global perspective on the high five: Agaricus, Pleurotus, Lentinula, Auricularia and Flammulina. In Edible and medicinal mushrooms: Technology and applications. *John Wiley and Sons* : 27-41.

Sanmee R., B. Dell, P. Lumyong, K. Izumori and S. Lumyong, 2003 : Nutritive value of popular wild edible mushrooms from Northern Thailand. *Food Chem*., **82**(4): 527-532.