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# DETERMINATION OF NUTRITIONAL VALUE OF *PLEUROTUS OSTREATUS* JACQ. EXFR. P.KUMN (OYSTER MUSHROOM) CULTIVATED ON SOME PLANT SUBSTRATES

***[1]Muhammed, H. M.,[1]Hafizat, K., [2]Rabe, A. M., [3]Danladi, G. H., [1]Stephen, D. Y., [4]Isah, A. O.**

[1]Departmental of Biological Sciences, Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria
[2]Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Sokoto State, Nigeria
[3] Department of Plant science and Biotechnology, Kebbi State University of Science and Technology, Aliero, Kebbi State, Nigeria
[4]Department of Botany, Federal University Lokoja, Kogi State, Nigeria

*Corresponding authors' email: habibamaliyu@gmail.com

## ABSTRACT

Oyster mushroom plays a vital role in human nutrition as it supplies the necessary growth factors such as protein, minerals, vitamins in the body. Fresh samples of Oyster mushroom (*Pleurotus ostreatus)* were collected from the agricultural research farm of Ibrahim Badamasi Babagida. University Lapai, Niger State, Nigeria located at latitude 9.0674ºN, longitude 6.5698º E. The aim of this study is to determine the nutritional value of Oyster Mushroom cultivated on some plant substrates. Sawdust, Maize (*Zea mays*) husk Rice (*Oryza sativa*) straw and Banana (*Musa acuminata*) leaves were collected from the Botanical garden of the Department of Biological Sciences, Ibrahim Badamasi Babagida. University Lapai, Niger State. Tissue culture techniques, spawn production, preparation and pasteurization of the plant substrates, inoculation of the mushroom spawn were conducted on the mushroom, nutritional analysis of the cultivated mushroom were determined and conducted using standard methods. The results indicated that among the selected substrates used, mushroom cultivated on banana leaves was found to be high in ash and moisture contents with 7.00% and 16.00 % respectively, rice straw was found the to be high in carbohydrate content with 51.70%. Maize husk was found to be high in crude fat and protein contents with 28.60% and 7.31% respectively, crude fibre content of 7.69% was found to be high in sawdust when compared with the other selected substrates .The present work demonstrated almost all the substrates used have certain levels of nutritive values. Mushroom cultivation under different plant substrates which serve as a bio-remedy of plant waste management.

**Keywords**: Oyster mushroom, nutritional analysis, plant substrates, *Pleurotus ostreatus*

## INTRODUCTION

*Pleurotus ostreatus* commonly known as Oyster mushroom are saprophyte fungi cultivated worldwide especially in South East Asia, India, Europe and Africa (Almi *et al*., 2017). Oyster mushrooms that belong to the genus *Pleurotus* are classed in the Phylum Basidiomycota, Subphylum Agaricomycotina, Class Agaricomycetes, Order Agaricales, Family *Pleurotaceae*. The third largest commercially produced mushroom in the world is oyster mushrooms (Josiane *et al*., 2018).

Oysters mushroom naturally occur on rotten wood materials. The cultivation and consumption enthusiasm of oyster mushroom is expanding to a great extent because of its taste, therapeutic (antitumor, cancer prevention agent and hypolipidemic activities) and healthful properties. *Pleurotus ostreatus* has a particular flavor, aromatic properties and it is considered to be rich in protein, fiber, carbohydrates, minerals and vitamins as well as low fat (Kalmis *et al*., 2008). An abundance of essential amino acids, minerals (Potassium, phosphorus, Calcium, sodium, iron), protein are found in *Pleurotus* species and furthermore contain folic acid, riboflavin, vitamins C, thiamine, niacin and B-complex (Krishnamorthy and Sankaran, 2014). In many countries the oyster mushroom *Pleurotus ostreatus* are encourage as an inclusion to the daily diet because its documented relatively high nutritive value and probiotic properties (Krishnamorthy and Sankaran, 2014).

Solving the problem of lignocellulosic agricultural wastes can be realized by promoting a biotechnological process that involves the use of the Basidiomycetes. In Nigeria, amongst the most achievable and financial strategy for the bioconversion of agro-lignocellulosic wastes is through the cultivation of edible mushrooms, these edible mushrooms are high in nutritional value, as sustenance as well as in customary drug. (Rani *et al*., 2008). With high increased demand in edible mushrooms such as *Pleurotus ostreatus*, these has led to research in what concerns the importance of agricultural wastes as substrates for commercial cultivation of these mushroom. Studies revealed that *Pleurotus* species fruiting bodies and that of other mushrooms produced on solid cultures in a traditional way by utilizing the substrates. For example in sawdust, wood or grain husks (Peksen and Yakupoglu, 2008). *Pleurotus* species are cultivated commercially (Krishnamoorthy and Sankaran 2014), the substrates used for the cultivation and harvesting of the *Pleurotus* mushroom are important as a compost and a soil conditioner for the growth and development of plants ( Krishnamoorthy and Sankaran, 2014).

The use of agro wastes substrates to cultivate mushroom will be of great importance to mushroom growers and the entire Nigerian population (Chukwurah *et al*., 2012). These agro wastes substrates can easily be collected traditionally. They can serve as environmental friendly and excellent choice to cultivate mushrooms. However, there are need to look for the appropriate combination of the agro wastes substrates to be used for oyster mushroom cultivation. The menace of agro wastes disposal and the protection of the environment, can be solved through the cultivation process of *Pleurotus ostreatus.* The successful outcome of oyster mushroom cultivation methods has a great importance of involving thousands of growers in mushroom cultivation, thereby producing sufficient oyster mushrooms to feed millions of people in Nigeria. Currently, Cotton wastes and Sawdust are the only agro wastes substrates currently in use for cultivation of

substrates required for mushroom growth (Chukwurah *et al*., 2012). There is need to focus on other agro wastes materials to promote other substrates that can be used adequately than the already known materials.

Mushroom cultivation can be used as an alternative for the management of these plant wastes. This study aims to determine the nutritional value of Oyster mushroom (*Pleurotus ostreatus*) cultivated under different plant substrates.

## MATERIALS AND METHODS

### Collection of Samples

The plant waste materials used for the study include sawdust, rice straw, maize husk and banana leaves. The materials were collected in dried form from the Agricultural Research Farm of Faculty of Agriculture , Ibrahim Badamasi Babangida. University of Lapai, Niger State, Nigeria. The dried Sawdust, Rice husk, Maize husk and Banana leaves were grounded using mortar and pestle. They were then mixed thoroughly with distilled water and labeled accordingly.

### Tissue Culture Technique of the Oyster Mushroom (*Pleurotus ostreatus*)

Pure Mushroom cultures was grown on Malt extract agar medium for the period of seven days. A fleshy tissue of oyster mushroom was sterilized with 75% alcohol base solution and transferred into the medium in a laminar airflow chamber. After inoculation, the cultures were then incubated at $25^0$ C to obtained maximum growth. The cultures were then transferred into petri dishes containing the malt extract agar medium and incubated at $25^0$C for the period of seven days. After seven days of incubation period the cultures was used for spawn preparation in accordance to Nithyatharani and Kavitha, (2018).

### Spawn Production of the Oyster Mushroom

Spawn is the vigorous mycelia growth of a single fungus on a chosen substrate material (liquid media, grains, saw dust substrate, wooden sticks). Sorghum was used as a mother spawn (Adedokun and George-David, 2016). About 20 kg of sorghum was washed and then soaked overnight in 15 litres distilled water. The excess water was drained off 20% wheat bran, 12% gypsum ($CaSO_4$. $2H_2O$), and 3% lime ($CaCO_3$) were added . The ingredients were thoroughly mixed, the moisture content was maintained at the level of 55 %, it was distributed equally into 500 ml glass bottle at the rate 370.66 gram per bottle and then autoclaved for $121^0$ C for 1 hour. After cooling, each bottle was inoculated with 7 day old culture mushroom which was grown on Malt extract agar. The substrate was allowed to be fully colonized (Nithyatharani and Kavitha, 2018).

### Preparation of the Plant Substrates

The mixtures were compressed by pressing down the bottles in transparent labelled poly bags with length of 50 cm and width of 27 cm (Chukwurah *et al*., 2012). They were kept for one day in a drum for fermentation to take place before steaming. The bags were then placed on wooden stands of 60 cm length inside four metal drums filled up to (1/5) its volume filled with distilled water such that the bags on the stands were 25 cm above the level of the water for steaming to occur. The bags were sterilized at 100°C for 7 hour and then allowed to cool down for another 48 hour before inoculation in a sterilized environment through a laminar flow chamber at the Microbiology Laboratory Department of Ibrahim Badamasi Babangida. University Lapai according to (Chukwurah *et al*., 2012).

### Inoculation of the Oyster Mushroom Spawn

The labeled polythene bags were then transferred to an incubation chamber immediately after inoculation for the mycelia growth. The bags were left opened after two weeks for mushroom growth (Chukwurah *et al*., 2012). A mist sprayer was used to moisten the polythene bags when necessary, spawn colonization and mycelia growth were observed. After the colonization, the upper parts of the bags were opened for fructification. The matured fruiting bodies of *Pleurotus ostreatus* were assimilated by the arrangement of twist edge of the cap. A sharp sterilized knife was then used to harvest the mushroom from the root of the base. The presence of primordia after 48 hours was observed for a matured mushroom (Subbu *et al.,* 2014).

### Nutritional Analysis of the Cultivated Oyster Mushroom

Chemical composition of the mushroom samples were analyzed for moisture, proteins, fat, carbohydrates and ash content using the AOAC procedures (Aida *et al*.,2009). Oyster mushroom collected were oven dried for one hour and allowed to cool. Ash, Proteins, moisture content, fibre, fat and total carbohydrates were estimated (Aida *et al*.,2009).

### Statistical analysis

The data were statistically analyzed using the statistical analysis system package (SAS). Means were separated by the least significant difference (LSD) at 5% significance level.

## RESULTS AND DISCUSSION

### Nutritional Analysis of the Oyster Mushroom

Oyster mushrooms cultivated on Saw dust, Rice straw, Maize husk and Banana leaves varied in their nutritional values. Mushroom cultivated on Saw dust and Rice husks was highly significant in carbohydrate content with 48.33% and 51.70% while Banana leaves was the least with 38.20%. Maize husks and Banana leaves were highly significant in crude fat with 28.60% and 27.90%. The moisture content was 16.00% for Banana leaves, Sawdust was 9.46% and least was recorded in Rice straw and Maize husk with 8.50% and 8.96% respectively. The protein content for Maize husk was highly significant with 7.31% while the least significant was recorded for Sawdust, Rice straw and Banana leaves with 6.99%. The ash content from the four plant substrates varied with 7.00% for Banana leaves while the remaining three wastes recorded 5.91%. Sawdust recorded 7.69% for crude fibre content while the least value was recorded in Maize husk with 3.54%.

**Table 1: Nutritional analysis of oyster mushroom (*Pleuratus ostreatus* ) cultivated on different plant wastes**

| Plant wastes | %Crude fat | %Protein | %Ash content | %Moisture content | %Crude fibre | %Carbohydrate |
|---|---|---|---|---|---|---|
| Sawdust | 22.51±0.001 | 6.10±0.001 | 5.91±0.001 | 9.46±0.001 | 7.69± 0.001 | 48.33±0.002 |
| Rice straw | 22.60±0.001 | 6.73±0.001 | 5.47±0.002 | 8.50±0.001 | 5.00±0.001 | 51.70±0.001 |
| Maize husk | 28.60±0.001 | 7.31±0.001 | 5.44±0.001 | 8.96±0.001 | 3.54±0.002 | 46.15±0.002 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Banana leaves | 27.90±0.001 | 6.99±0.001 | 7.00±0.001 | 16.00±0.002 | 4.11±0.002 | 38.20±0.001 |

Results are mean of triplicate value. ±SD of triplicate value

**Discussion**

The nutritional values of the *Plearotus ostreatus* cultivated on different plant substrates varied significantly, this may be due the nature of the different substrates affecting the nutritional composition of the mushroom. The results on nutritional composition of the mushroom was similar with the reports of Silva *et al*., (2002) who reported that although, there may be correlation in the chemical composition of mushroom and substrates used for the cultivation. The chemical composition of the mushroom does not correspond to the chemical composition of substrates. The reports of Khan *et al*. (2008) reported that the nutritional composition of *Plearotus ostreatus* differs significantly when grown under different plant substrates.

In this study the nature of protein in the substrates influenced the protein content of the fruiting bodies in Oyster mushroom. This agrees with the reports of Wang *et al*. (2001) who reported that plant substrates influences the protein content of the fruiting bodies in mushrooms. *Pleurotus ostreatus* cultivated on Saw dust, Rice straw and Banana leaves recorded low protein content, this may be as a result of the dried nature of the plant substrates used. This results is not in accordance with the reports of Kuforji *et al*. (2010) who reported high protein content on mushroom cultivated on Saw dust. Sopanrao *et al*. (2010) and Asneti, (2013) also reported that mushroom cultivated on Soybean straw, Wheat straw and Paddy straw recorded high values of protein content of 24.66% on *Pleurotus ostreatus*. Similar results were reported for *Pleurotus sajorcaju* (Mane *et al*., 2007).

Ash content of *P. ostreatus* on the plant substrates revealed significant difference this may be attributed to the nature of the substrates and in association with the grown mushroom. Similar results were reported by Shyam *et al*. (2010) and Mostak *et al*. (2016) when *Pleurotus* species were cultivated on paddy straw and soybean straw.

Maximum moisture content of *P. ostreatus* ranged between 8.50% to 16.00% between the plant substrates. This may be as a result of low moisture content on the fruiting bodies of the mushroom. This result was similar to the report of Bhattacharjya *et al*. (2015) when *P. ostreatus* was cultivated on Saw dust. The report of Manzi *et al*. (2001) confirmed high moisture content *P. ostreatus* cultivated on paddy straw. The crude fibre content recorded low percentage values, this may as a result of the correlation in chemical composition of mushroom and substrate used for cultivation. Patil *et al*. (2010) reported similar results on *P. ostreatus* cultivated on soybean straw with 7.15% and 7.68% for paddy straw. This results is not in accordance with Dundar *et al*. (2009) reported high amount of crude fibre contents in Millet stalk (31.32%), Cotton stalk (29.80%) and Soybean stalk (27.00%) in oyster mushrooms. The relatively low content of *P. ostreatus* was similar to the reports of (Chang and Mshigeni, 2001); (Wang *et al*., 2001) as much depends on the nature of substrates.

High significant values of carbohydrate content was recorded on all the plant substrates. This may likely be as result of the size and weight of the fruiting bodies of the mushroom. Similar results were reported by Patil *et al*. (2010) with 55.33% in mushroom cultivated on Paddy straw. Thongklang and Luangharn, (2016) with 50.00% on Rice straw. Das *et al*., (2016) on Maize husk, Shehzad, and Rafiq, (2011) on Banana leaves respectively.

**CONCLUSION**

The present study revealed that almost all the plant substrates used in the study have significant nutritional values and can be cultivated on agricultural wastes for free to conserve our environment by recycling the plant substrata and can be used as manure. However, *Pleurotus ostreatus* cultivated on maize husk recorded high values in crude fat, crude protein and low value in ash and crude fibre contents.

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