Original Research

Volume 5, Issue 2, pp 52-58, September, 2023

ACHIEVERS JOURNAL OF SCIENTIFIC RESEARCH

Opecn Access Publications of Achievers University, Owo

Available Online at www.achieversjournalofscience.org

Comparative Study of Nutritional Profile of Wild and Domesticated Oyster Mushroom (*Pleurotus ostreatus*)

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Submitted: July 12, 2023, Revised: August 25, 2023, Accepted: September 02, 2023, Published: September 28, 2023

Abstract

This study was carried out to determine the nutritional profile of wild and domesticated oyster mushroom. The wild mushroom was collected from forests around Owo and identified while the domesticated sample was grown on wood substrate prepared in the laboratory. Thereafter, the proximate composition and the mineral content were determined using standard techniques. The result of the proximate composition of the wild and domesticated *P. ostreatus* mushroom revealed that the moisture content and the Nitrogen free extract of the wild (8.96 % and 52.50 %) and the domesticated (8.59 % and 52.16%) mushrooms were comparable whereas, crude protein (32.11 %) and crude fibre (13.51 %) were significantly higher in the wild type than the domesticated samples. Also, lipids (0.42 %) and ash content (4.17 %) were significantly higher in the domesticated sample compared with the wild type. In the mineral content assay, nitrogen was found higher in the wild mushroom than the domesticated sample while potassium, calcium and magnesium were found to be higher in the domesticated samples than the wild types. Only phosphorus was found in comparable amount in both the wild and domesticated type of the mushrooms. Overall, there appears to be no significant ($p<0.05$) differences in the nutritional content of both the domesticated and wild-collected test mushroom.

Keywords: Oyster mushroom, Proximate, Mineral, Nutrition, Domestication, Substrate

1.0 Introduction

Since time immemorial, mushrooms have been utilized as a good source of health promoting food by man (FAO, 2004). Moreover, they have also been employed in the management of many ailments in folklore medical practices. Man has obtained naturally occurring antimicrobial agents from mushrooms which are particularly effective against pathogenic bacteria. They are also reported to contain high level of carbohydrate and protein and those proteins inherent in the fungi have been reported to possess various bioactivities such as antiproliferative, immunodulatory, antiviral, antifungi, and antibacterial effects (Jonathan and Fasidi, 2003; Ngai and Ng, 2004).

Organically produced mushrooms are now popular among different sets of people ll over the world. More than two hundred (200) different genus of mushrooms contain useful species to man. About ten of the numerous species of useful mushrooms are grown for culinary and pharmaceutical purposes. Those commonly cultivated include species like *Agaricus* spp, *Lentinus* spp, *Pleurotus* spp, *Volvariella* spp, *Hericium* spp, *Auricularis* spp, *Reishi* spp, *Grifola frondosa*, *Flammulina* spp, *Tremella* spp, *Pholiota* spp and *Coprinus* spp. Out of these, only three species are produced in commercial quantity all over the world, they are *Pleurotus* spp, *Agaricus bisporus*, and *Lentinula edodes*; and they represent about 70% of global production of mushrooms (Kayode, 2010).

According to the FAO (2004), production of mushroom may help to alleviate poverty among rural farmers by generating a fast and continuous source of income. It can also aid food security and sustainability by making highly nutritious food available to people in a very short time. The advantage of mushroom farming is that it does not require soil or large spaces. Moreover, the cultivation of mushroom is not a capital intensive venture since the growing substrate can be formulated from any conceivable wastes particularly from agricultural processes. The income generated from cultivation of mushrooms as well as improved nutrition may go a long way in ensuring the wellbeing of the local population. When mushroom farming is successful, the capacity of individuals engaged along the market chain is enhanced in such a way that other economic opportunities can be accessed.

Pleurotus spp. (Oyster mushroom) grows well on woods and woody materials, it is a good degrader of lignin and it can grow very well on various cellulosic materials such as wstes generated from crop production and agroforestry enterprises (Murthy and Manonmani, 2008). Mushroom is the choicest food of nutritionists because of its hypolipidemic, hypocholesterolemic, hypoglycaemic and antitumor properties. Mushroom contains 20-30% protein which is higher than vegetables and fruits and is of high quality (Jose and Kayode, 2009).

Pleurotus spp has been gaining popularity of recent since it has a very high nutritional value, the yield potential is great and it is easy to cultivate (Gregori *et al.*, 2007). It also assists in environmental protection by attenuating toxic substances in agricultural wastes (Fan *et al.*, 2000; Banik and Nandi, 2004). Oyster mushroom has the ability to breakdown directly the cellulose and lignin bearing materials without chemical or biological preparation (Chang and Miles, 1989). Thus, numerous agricultural wastes can be incorporated into the substrate for the production of mushrooms without adversely affecting its yield.

These wastes can be used by simple moistening or untreated, pasteurized, fermented or sterilized for cultivation oyster mushroom (Sharma *et al.*, 2013). Supplements or additives are normally used in the substrate of oyster and other mushrooms to enhance the yield of the mushroom or increase the bio-efficiency (Neelam *et al.*, 2014). It has been reported that increase in the nitrogen content of substrates leads to larger mycelial growth and reduces fruiting bodies formation in Basidiomycetes (Chang and Miles, 1989). Considering the tremendous nutritive values of edible mushrooms and their bioconversion ability we are attempting the production of these nutritionally versatile food sources particularly oyster mushroom from locally available agro-waste materials and also to make it available throughout the year across different seasons.

2.0 Materials and methods

2.1 Wild mushroom sample

Freshly harvested mature samples of the wild oyster mushroom were obtained from mushroom collectors at Oja Koko in Owo, Ondo state, Nigeria and were identified at the Mycology Section of the Environmenta Biology Unit, Science Laboratory Technology Department, Rufus Giwa Polytechnic, Owo.

2.2 Source of mushroom spawn and preparation

The spawn of the oyster mushroom used for this study was obtained from the stock of the Cocoa Research Institute, Ibadan, Oyo state, Nigeria.

2.3 Preparation and Inoculation of substrate

Substrate used for the domestication experiment was formulated from the wood dust of *Gmelina arborea* a lignocellulosic waste of wood processing centre in Owo. The following materials were added to the dust; 9.0 % wheat bran, 1.0 % $CaCO_3$, 0.05 % NH_4Cl, 0.03 % each of Potassium phosphate and Magnesium sulphate. These were thoroughly mixed and water was added until it was approximately 67 %. This preparation was filled inside transparent polythene bags and sterilized by autoclaving for 5 hours as described by Hoa et al. (2015). The prepared substrate was allowed to cool to room temperature. Thereafter, each bag containing sterilized substrates was inoculated with two spoonful of the spawns.

2.4 Incubation and harvest

The inoculated substrate bags were placed in a dark mycological room where the temperature and relative humidity were maintained at 28±2 °C and approximately 70 % respectively. The mycelial ramification was monitored on weekly basis until the entire substrate was covered with the mushroom mycelia. After complete ramification, the substrates were moved to fruiting room where room temperature was maintained and the relative humidity increased to about 90 % by generating water vapour in the room.

2.5 Samples Preparation

Freshly harvested mushroom samples were gently cleaned and then dried in the hot air oven at 65 °C until constant weight was achieved.

2.6 Proximate and Mineral analysis

Proximate composition including moisture content; crude protein, lipid content, crude fibre, ash content and nitrogen free extract was determined according to the method of AOAC (2005). The mineral content including N, P, K, Ca and Mg were assessed by atomic absorption.

2.7 Statistical analysis

The growth experiment was done in five replicates and data obtained subjected to a one way analysis of variance (ANOVA) and Duncan's multiple range test was used to compare the mean at $p < 0.05$ using the SPSS software (version 25).

3.0 Results and Discussion

The result of the proximate composition of the wild and domesticated P. ostreatus mushroom is presented in Table 1. The table revealed that the moisture content and the Nitrogen free extract of the wild (8.96 % and 52.50) and the domesticated (8.59 % and 52.16%) mushrooms were comparable whereas, crude protein (32.11 %) and crude fibre (13.51 %) were significantly higher in the wild type than the domesticated samples. Also, lipids (0.42 %) and ash content (4.17 %) were significantly higher in the domesticated sample compared with the wild type.

Table 1: Proximate Composition of wild and domesticated *P. ostreatus* Mushrooms (%)

Parameters	Wild	Domesticated
Moisture content	8.96±0.03	8.59±0.01
Crude protein	32.11±0.04*	30.09±0.02
Lipids	0.29±0.02	0.42±0.03*
Crude fibre	13.51±0.04*	11.17±0.03
Ash content	3.59±0.02	4.17±0.02*
Nitrogen free extract	52.50±0.03	52.16±0.01

Values are Mean±SD, values followed by * across rows are significantly different at $P < 0.05$

The values obtained in this study agrees with those reported by Jonathan *et al.* (2006) who reported slightly lower values with *P. ostreatus* grown on different substrates for protein, fiber and carbohydrate. In their study, they found fat with values ranging from 3.93 to 8.72%. This result is also agreeable to that obtained by Ahmed *et al.* (2009). The major compounds in mushrooms are proteins and carbohydrates. The protein proportion between 20 - 32 %, may be taken as significantly high in comparison with animal sources such as milk, meat as well as fish products as reported by Güner *et al*. (1998). Earlier, Breene (1990) and Agahar-Murugkar and Subbulakshmi (2005) opined that the lipid content of mushrooms used for culinary purposes are made up of healthy unsaturated fatty acids which are less harmful to the body than fats from animals which usually consists of saturated fatty acids.

These differences in the proximate content of the wild and domesticated samples may be attributed to the differences inherent in the substrates on which each is grown. The higher ash and lipid content of the domesticated mushroom suggests that the substrate contain more sources of minerals and fats. Earlier, Ahmed *et al.* (2009) submitted that the mineral content of the mushrooms cultivated in the laboratories generally have higher ash content which may be linked to the addition of certain salts in the substrate preparation.

It is also a general knowledge that the woods on which the wild mushrooms grow contain certain chemicals such as phytoconstituents and other bioactive substances as well as the nutrient density inherent in the wood resources. Oyster mushroom can easily be grown on agricultural waste and does not require compositing as a step in its cultivation. Oyster mushrooms have been shown to be a rich source of food in terms of nutrients and are also known to possess a number of interesting properties such as antimicrobial, antiviral (including human immunodeficiency virus), antitumor, antineoplastic, hepatoprotective and immunomodulatory (Deeppalaksshmi and Sankaran, 2014). This may explain the higher protein content of the wild mushrooms.

Studies have shown that different species of wild edible mushrooms and commercially cultivated mushrooms differ significantly from one another in a number of ways, most especially by way of nutrient composition especially when grown on different substrates. A number of studies have shown that nutrient composition is dependent on the type of substrate utilized and the growing conditions. Furthermore, many researches on the nutritional profile, growth performances, efficiency of biological activities, mycelial growth, amount and quality of fruit bodies of Pleurotus species shows that the type of substrate usually affect these parameters as pointed out by Mendeel *et al.* (2005).

The results obtained in this study were more agreeable to that obtained by Ahmed et al. (2009). In addition to the basic classes of food, mushrooms have been found to contain about eighteen different amino acids. Furthermore, the studied mushrooms have been reported to contain abundant level of various minerals. These suggests that the mushrooms could be exploited as a veritable source of functional food with diverse advantages ranging from intestinal flora balance to vitamin and mineral supply as well as managing oxidative stress. The increasing number of the medicinal substances extracted from mushrooms throughout the world is a confirmation of their worth as healthy foods. Also, there are many reports in Nigeria on the use of mushrooms in the management of malnutrition among children, treatment of obesity, diabetes, fever, as well as kwashiorkor (Akpaja *et al*., 2005; Idu *et al.*, 2007).

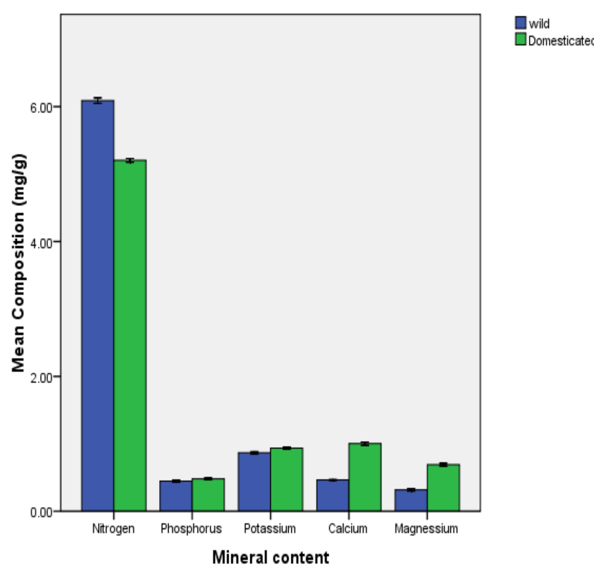

Figure 1: Comparative mineral content of wild and domesticated *P. ostreatus*

In the mineral content assay (Figure 1), nitrogen was found higher in the wild mushroom than the domesticated sample while potassium, calcium and magnesium were found to be higher in the domesticated samples than the wild types. Only phosphorus was found in comparable amount in both the wild and domesticated type of the mushrooms.

Mushrooms absorb mineral ions in different ways to plants. Therefore, the level of differences in the mineral content of the screened mushrooms is dependent on the species of mushroom as well as their specific habitat of cultivation. The trace metal contents in the mushrooms are mainly affected by acidic and organic matter content of their ecosystem and soil (Agahar-Murugkar and Subbulakshmi, 2005).

It has been reported that mushrooms are a very good source of essential elements such as Fe, Cu, Mn, and Zn; all of which play significant roles in the proper functioning of different metabolic processes in the body. Indeed, the levels of some important trace elements (such as potassium and phosphorus) are typically considerably higher in mushrooms than in most vegetables as confirmed in this study. The importance of minerals in human diet cannot be overemphasized. Potassium has been reported to be a major is an important electrolyte in the body and is known to perform major ion exchange processes in the cells where it counteract the effects of salts on the blood pressure. The mushrooms cultivated on the two saw dusts revealed a high density of mineral contents. This aligns with the observation of Calak *et al*. (2009) that Pleurotus species were largely high in minerals like K, Ca, Mg and Fe. Manzi *et al*. (1999) observed a rather low level of calcium in different mushrooms they studied which agree with the results obtained in this study. Moreover, reported literature range for calcium in mushrooms varies from 1.8mg/100g to 59.0mg/100g.

The assessment of both the wild and domesticated mushrooms for their proximate composition show that both types of mushroom contain comparable amount of nutrients. This corroborates the work of several workers (Okhuoya *et al*., 2010; Hoa *et al*., 2015); all of whom have described the richness of nutrients in mushrooms. It is fascinating that the wild-collected mushroom sample did not show any significant differences in these parameters from the cultivated ones. This should dispel any suspicions by people including consumers that cultivated mushrooms may contain lesser nutritional value compared with the wild-collected mushrooms. The results also aligns with the report of Okhuoya *et al.* (2010) that both the domesticated and wild-collected mushrooms retain important nutrients needed for the normal functioning of the human system. Overall, there appears to be no substantial variance in the nutritional content of both the wild-collected and domesticated Pleurotus mushrooms in this study.

4.0 Conclusion

From the outcome of this study, we may safely conclude that there is no significant ($p<0.05$) differences in the nutritional composition of the wild type and domesticated sample of *Pleurotus ostreatus*. However, the wild type had higher protein content while domesticated sample had higher mineral content. Further studies are needed to assess the effect of substrate fortification on the growth and performance of oyster mushrooms.

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