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**COMPARATIVE ANALYSIS OF USING YAM PEELS, LOAMY SOIL AND ITS COMBINATION AS SUBSTRATE FOR THE CULTIVATION OF *Pleurotus tuberregium* FR (SING) SCLEROTIA**  
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**ABSTRACT**

*Pleurotus tuberregium* FR (Sing) is an edible mushroom commonly known as king tuber mushrooms. Yam (*Dioscorea rotundata*) peels, loamy soil and a combination of 70% yam peels and 30% loamy soils were used as substrates in the cultivation of king tuber mushroom. This study investigated the best substrate for greater yield of *P. tuberregium*. The methods used were site preparation, substrate preparation, sclerotia preparation, bagging of substrates, cultivation of sclerotia, irrigation and harvesting of mushrooms. All treatments for the experiment were laid out using a Completely Randomized Design (CRD) with three treatments replicated ten times. Means were analyzed statistically using (ANOVA) to test for significance. Means were separated using Duncan's New Multiple Range Tests (DNMRT) using Statistical Analysis System (SAS) software. Loamy soil gave a total of 46 mushrooms after the six harvests while yam peel substrate and the mixture of yam peels with loamy soil substrate never gave any mushroom in all the harvest times. Only Loamy soil produced and recorded the highest sporophore height of  $9.67\pm 0.04$ cm, pileus diameter of  $8.55\pm 0.03$ cm, stipe height of  $5.27\pm 0.02$ cm and stipe girth of  $1.20\pm 0.14$ cm. Only Loamy soil recorded fresh weight of  $8.19\pm 0.02$ g and higher dry weight of  $3.28\pm 0.035$ g while yam peels and a mixture of yam peels with loamy soil did not record any of these. The growth of *P. tuberregium* was not supported by yam peels and a mixture of yam peels with loamy soil, and so cannot be used as substrate for its cultivation. Loamy soil is advised to be used as substrate for the cultivation of *P. tuberregium*.

**Keywords:** Mushroom, Cultivation, Loamy soil, Yam peels, Substrate, Yield, Sclerotia

## INTRODUCTION

Mushroom is achlorophyllous; macroscopic basidiomycetous species of certain fungi that bear spores embedded into fleshy fruiting bodies and are desirable as food in market places (Tripathi, 2017). According to Agina and Joshua (2004), mushrooms are fleshy saprophytic fungi with noticeable fruiting body which may be either epigeous or hypogeous and are large enough to be picked or harvested by hand. Mushrooms exhibit various shapes and sizes ranging from sessile form with typical cap (pileus), stalk (stipe), and root-like structure (Myler *et al.*, 2000; Okigbo and Nwatu, 2015). Most mushroom producing fungi are members of the phylum Basidiomycota or Ascomycota. The two phyla are under kingdom fungi (Cho, 2014). The vegetative portion of the fungus that gives rise to mushroom is a tangle of long cellular threads called mycelia. The substrates on which a mushroom grows may be bare soil, humus, dung, decayed wood, living trees or other organic materials (Cho, 2014).

Thousands of years ago, fructification of higher fungi have been used as a source of food (Mattila *et al.*, 2001) due to their chemical composition which is attractive from their nutritional point of view. The king tuber mushroom, *P. tuberregium* is edible gilled fungus native to the tropics, including Africa,

Asia, and Australia. Edible mushroom is a mushroom that can potentially be safely eaten including thousands of types of mushrooms that are regularly harvested (Okigbo *et al.*, 2017). It has a history of economic importance in Africa as food and as a medicinal mushroom (Isikhuemhen *et al.*, 2003). Mushroom is a source of some minerals including iron, selenium, potassium and phosphorus (Kalac, 2009). Mushroom offers tremendous applications as they can be used as food and medicine besides their key ecological roles. Mushrooms have been found effective against cancer, cholesterol reduction, stress, insomnia, asthma, allergies and diabetics. Mushroom as a functional food are used as nutrient supplements to enhance immunity in the form of tablets. Biologically, active compounds from the mushrooms possess antifungal, antibacterial, antioxidant and antiviral properties, and have been used as insecticide and nematicides as well. Wild mushroom serves as a source of food for many wild lives, which includes squirrels, deer and many insects. Mushrooms are one of the best sources of vitamins especially vitamins B (Mattila *et al.*, 2001). Mushrooms have been used in health care for treating simple and age long common diseases like skin disease. Mau *et al.* (2001), found antioxidant properties of several ear mushrooms.

Many studies have reported the use of *Pleurotus species* in bioremediation exercises (Isikhuemhen *et al.*, 2003; Adenipekun, 2008). Atlas and Bartha (1992) defined bioremediation as the enhancement of live soil organisms such as fungi, bacteria and plant to break down hydrocarbons and organic contaminants. White-rot fungi such as *P. Tuberregium* have been known for their ability to degrade lignin, a non-repeating structural polymer found in woody plants and this ability enables them to degrade xenobiotic pollutants (Adenipekun, 2008).

Many agricultural and industrial wastes can be utilized for the production of *Pleurotus spp* as a substrate. Studies have shown that *P. tuberregium* can be grown on organic wastes such as corn, sawdust, cardboard (Isikhuemhen and LeBauer, 2004). Mycelial growth occurs between 15 °C and 40 °C, with an optimum growth rate at 35 °C. Research examining this fungus has been done predominantly in Nigeria where it is utilized in many tribes as a significant food source as well as a remedy for various ailments (Tripathi, 2017).

This research work converts valueless and daily domestic wastes of different sources to useful products by using them in cultivation. Various wastes which are degradable by mushrooms can be made useful again. This study therefore investigates the effect of different

substrates especially wastes from products of fermented yam peels, loamy soil and mixture of fermented yam peels and loamy soil in the cultivation and yield of *P. Tuberregium* (king tuber mushroom) sclerotia and sporophores and thus, recommend the most appropriate and best substrate to farmers in developing countries.

The main objective of this research work is to examine the cultivation of *P. tuberregium* FR (Sing) using sclerotia also known as “Osu” by South easterners in Nigeria using column bags in a tropical environment. The aims of this study include; Comparative analyses of different substrates (fermented yam peels, loamy soil and 70% fermented yam peels mixed with 30% loamy soil peels) used in the cultivation of *P. tuberregium* and determine the best substrate for the cultivation of *P.tuberregium*.

## **MATERIALS AND METHODS**

### **Description of Study Location**

This study was conducted at the Botany Department laboratory premises, Nnamdi Azikiwe University Awka, Anambra State, which lies approximately between latitude 6°09’ and 6°14’ North and longitude 7°09’ and 7°13’ East with a total land area of 8183 hectares (Okigbo *et al.*, 2017).

### **Source of Materials**

Fresh yam peels were collected using a sack bag from Federal Government College Nise, and the sclerotia of *P. tuberregium* used in this study was obtained in lump from Eke-Awka market, both in Awka south local Government Area of Anambra State, Nigeria.

### **Preparation of Substrates**

Substrates used were fermented yam peels(Y), loamy soil(S) and mixture of yam peels with loamy soil (YS) in the ratio of 70%:30% prepared according to Okigbo and Nwatu (2015) method.

### **Sclerotia Preparation**

The sclerotia “Osu” was also soaked in different clean plastic buckets for ten days to make it softer in readiness for fruitification according to Oghenekaro *et al.*, (2008) method.

### **Bagging of Substrates**

Three hundred and fifty (350) grams of each substrate was placed in the polythene bags perforated under and by the side. This is to ensure adequate aeration, water drainage and mushroom emergence(Okigbo and Nwatu, 2015). Each substrate was replicated ten times.

### **Planting of Sclerotia**

This was done according to the method of Oghenekaro *et al.* (2008). The sliced

sclerotia were seeded into the bags containing the substrates by creating a hole of 3cm in the substrate surface and watered enough to create humid environment required for fruitification.

### **Irrigation**

The experiment was watered twice daily with clean tap water to ensure that the environment was kept humid until it has taken enough water to induce fruitification.

### **Harvesting of Mushroom**

The sporophores were harvested using Oghenekaro *et al.* (2008) method when they were six days old by picking in the morning hours. This was done manually by holding them between index finger and thumb on the surface of the substrate and with the other hand holding the base of the stipe. The sporophore is twisted in anticlockwise direction and pulled out of the substrate leaving the sclerotium.

### **Data Collection**

The growth of mushroom was recorded on weekly basis. Data were collected from different replicates and the mean of each set of data calculated. The yield of fruit bodies were harvested from the different substrates at the end of the experiment and the following parameters were measured: Height (cm), Stipe girth (cm), Number of the fruit bodies for each treatment after

sprouting, Diameter of the pileus (cm), Fresh weight (g) and Dry weight (g).

### Statistical Analysis

All treatments for the experiment were laid out using a Completely Randomized Design (CRD) and each treatment was replicated ten times. The results obtained were analyzed using Analysis of Variance( ANOVA) to test for significance. Means were separated using Duncan's New Multiple Range Tests(DNMRT) and analysis was carried out using Statistical Analysis System (SAS) software.

### RESULTS

Table 1 revealed that the number of harvested *P. tuberregium* cultivated in the loamy soil, fermented yam peel and loamy soil (30%) plus fermented yam peel (70%) substrates. The table revealed the growth of a total of 46 harvest of *P.tuberregium* in the loamy soil after six harvest times. Growth was not recorded in the yam peel treatment and the combination of yam peel and loamy soil treatments. The table also revealed higher number of 13 of *P. Tuberregium* in the 24th day of harvest time. Table 2 reveals the mean height (cm) and pileus diameter per harvest of *P. tuberregium* in yam peel, loamy soil and yam peel plus loamy soil as substrates. It was observed that the

Loamy soil substrate gave the highest height and pileus diameter of *P. tuberregium* in the fifth harvest. The mean height of sporophore recorded was  $9.67\pm 0.04$ cm and higher pileus diameter of  $8.55\pm 0.03$ cm. The yam substrate and the soil plus yam substrate did not give any growth. Table 3 reveals the stipe height (cm) and stipe girth per harvest of *P. tuberregium* cultivated in loamy soil, yam peel and soil plus yam peel as substrates. The table shows that loamy soil gave the highest stipe height of  $5.27\pm 0.02$ cm and higher stipe girth of  $1.20\pm 0.14$ cm. The yam peel substrate and soil plus yam peel substrate did not give any growth. Table 4 reveals the fresh and dry weight per harvest of *P. tuberregium* cultivated in loamy soil, yam peel and loamy soil plus yam peel as substrates. The table shows that loamy soil gave the highest fresh weight of  $8.19\pm 0.02$  g and highest dry weight of  $3.28\pm 0.03$  g.

### DISCUSSIONS

*P. tuberregium* also known as king oyster mushroom was successfully grown in this experiment using three different substrates(fermented yam peels, loamy soil and a combination of fermented yam peels and loamy soil).The results obtained in the experiment revealed that the loamy soil produced *P. tuberrigum* with highest height, pileus diameter, stipe

height, stipe girth, fresh and dry weights. Thus, proofing its preference for soil substrate over yam peel and loamy soil plus yam peels. This observation is in tandem with Okigbo *et al.* (2017) who reported that the loamy soil provided high nutrient and humus content, high water holding capacity, even water distribution and good aeration for the germination and fruitification of the mushrooms. Yam peel and combination of yam peel and loamy soil showed no growth at all. The observation could probably be due to the inhibitory effects of pathogens present in the yam peel which might have had antagonistic effects on the growth of *P. tuberregium* in that substrate. However, the ability of loamy soil to produce good stipe and pileus diameter and dry weight yield of the mushrooms agrees with the findings of Okhuoya and Etugo (1993); Okigbo *et al.* (2017) who reported that loam soil was the best for planting *P. tuberrigum*.

Also, it was observed in this study that there was significant difference between harvest times in the yield and growth of *P. tuberregium*. The result from this study shows that there was a progressive increase in the yield and growth of *P. tuberregium* with harvest time until the fifth harvest after which it started to decrease until there was no more growth observed. This is in tandem with

observations by Oghenekaro *et al.*, (2008) which reported that mushroom gradually adapts to substrates and then increase in growth with harvest time until the basic nutrients needed for their growth are used up.

### Conclusion and Recommendation

In conclusion, *P. tuberregium* can be grown in loamy soils. Yam peel and the mixture of yam peel with loamy soil as substrate is not recommended as it showed no growth of *P. tuberregium* if supplements are not added. Loamy soil is recommended as the best substrate for the production of *P. tuberregium* mushrooms. However, more research should be made in order to determine if there are feasible means of growing *P. tuberregium* with yam peel and other types of substrates by adding supplements.



**Plate 1:** Harvested Oyster Mushrooms (*Plerotus tuberregium*)

**Table 1:** Number of harvested *Pleurotus tuberregium* cultivated in the loamy soil, yam peels and loamy soil (30%) + yam peels (70%) substrates

Harvest time interval (days)	Number harvested		
	Loamy Soil	Yam peels	Soil + Yam peel
6	3	-	-
12	7	-	-
18	9	-	-
24	13	-	-
30	8	-	-
36	6	-	-
42	-	-	-
<b>Total</b>	46	-	-

**Table 2:** Height and pileus diameter of *Pleurotus tuberregium* cultivated in the loamy soil, yam peels and loamy soil (30%) (30%) + yam peels (70%) substrates

Harvest Times	Soil		Yam peels		Soil + Yam peels	
	Height (cm)	Pileus Diameter (mm)	Height (cm)	Pileus Diameter (mm)	Height (cm)	Pileus Diameter (mm)
1 <sup>st</sup>	9.11±0.01	9.28±0.03	-	-	-	-
2 <sup>nd</sup>	8.77±0.03	6.69±0.04	-	-	-	-
3 <sup>rd</sup>	6.88±0.05	6.72±0.02	-	-	-	-
4 <sup>th</sup>	7.57±0.03	7.33±0.02	-	-	-	-
5 <sup>th</sup>	9.67±0.04	8.55±0.03	-	-	-	-
6 <sup>th</sup>	8.21±0.02	5.49±0.02	-	-	-	-
7 <sup>th</sup>	-	-	-	-	-	-

Results are in Means ±Standard deviation

**Table 3:** Stipe height and stipe girth of *Pleurotustuberregium* cultivated in the loamy soil, yam peels and loamy soil (30%) + yam peels (70%) substrates

Harvest Times	Soil		Yam peels		Soil + Yam peels	
	Stipe Height (cm)	Stipe Girth (cm)	Stipe Height (cm)	Stipe Girth (cm)	Stipe Height (cm)	Stipe Girth (cm)
1 <sup>st</sup>	4.53±0.09	0.83±0.03	-	-	-	-
2 <sup>nd</sup>	3.48±0.01	1.20±0.14	-	-	-	-
3 <sup>rd</sup>	3.67±0.01	0.78±0.10	-	-	-	-
4 <sup>th</sup>	5.27±0.02	1.02±0.01	-	-	-	-
5 <sup>th</sup>	5.15±0.91	0.88±0.03	-	-	-	-
6 <sup>th</sup>	4.63±0.17	0.63±0.03	-	-	-	-
7 <sup>th</sup>	-	-	-	-	-	-

Results are in Means ±Standard deviation

**Table 4:** Fresh and dry weight of *Pleurotustuberregium* cultivated in the loamy soil, yam peels and loamy soil (30%) + yam peels (70%) substrates

Harvest Times	Soil		Yam peels		Soil + yam peel	
	Fresh Weight (g)	Dry Weight (g)	Fresh weight (g)	Dry weight (g)	Fresh Weig ht (g)	Dry Weight (g)
1 <sup>st</sup>	5.18±0.028	3.28±0.035	-	-	-	-
2 <sup>nd</sup>	5.53±0.014	1.58±0.014	-	-	-	-
3 <sup>rd</sup>	6.42±0.028	2.21±0.014	-	-	-	-
4 <sup>th</sup>	7.6±0.014	2.17±0.028	-	-	-	-
5 <sup>th</sup>	8.19±0.028	1.02±0.021	-	-	-	-
6 <sup>th</sup>	4.48±0.021	2.04±0.021	-	-	-	-
7 <sup>th</sup>	-	-	-	-	-	-

Results are in Means ±Standard deviation

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