
USAGE OF PURE AND MIXED SUBSTRATES ON THE GROWTH AND YIELD OF OYSTER MUSHROOMS IN ESIA MIXED FARM

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ABSTRACT

*The effect of pure and mixed substrates (medium) on growth and yield of oyster mushroom (*Pleurotus ostreatus*) was investigated. Seven different substrates namely cotton waste only (CWO), Sawdust only (SDO), Banana leaves only (BLO), Cotton waste + sawdust (CWSD), Cotton waste + Banana leaves (CWBL), Sawdust + Banana leaves (SDBL), and Cotton waste + Sawdust + Banana leaves (CWSDBL) were used. The substrates were pasteurized with hot water (90°C for 4 h) before spawns of oyster mushroom were inoculated to them. After inoculation, the substrates were kept in a controlled environment until fruiting took place. The CWO substrate gave the highest number (35) of fruiting body and highest yield (928.0 g). This was followed closely by the harvest from CWSDBL substrate. There was no fruiting recorded (0.0 g) in BLO substrate for oyster mushroom (*Pleurotus ostreatus*). The major conclusion from the research was that cotton waste, sawdust, are better substrates for mushroom cultivation whether in mixed or pure forms, meanwhile banana leaves are therefore not suitable for oyster mushroom (*Pleurotus ostreatus*) cultivation unless used in combination with either of the other two substrates.*

Key words: *usage of pure, mixed substrates, growth, yield of oyster and mushrooms*

Background of the Study

Fungi are a large group of fungi whose production differs from plants. They are saprophytes because their tissues lack chlorophyll for carbohydrate synthesis. However, humans have collected them from the wild and bred them for valuable food for many years. Article

Pleurotus can consume many crop residues as it has the ability to grow on residues (Mamiro et al., 2017)., 2011) and because they are saprophytes, they can decompose organic materials such as wood, straw, leaves and plant stems in nature. The raw material used by Pleurotus ostreatus should contain carbon such as cellulose, hemicellulose and lignin. Rice straw, barley straw, wheat straw, coconut straw etc. Most of the organic materials with the above elements can be used as fungi substrate. These fungal substrates should be adjusted to pH 6 to 8 by adding gypsum (Kong, 2004).

The morphology of the oyster mushroom is white, cream, yellow, red or brown, with a thick fleshy cap with eccentric or lateral stripes. They grow on logs or lignocellulosic agricultural residues and forest waste (Martínez-Carrera, 1998). Some fungal species commonly associated with oyster mushrooms, such as oyster mushrooms, psilocybin mushrooms, and poplar mushrooms, are similar in many ways, but have little morphological and ecological differences that can usually be explained by DNA analysis. Observations in this area are not clear (OECD, 2005).

Pleurotus ostreatus has different ecological requirements at different developmental stages. The best temperature for mycelial growth and needle formation is 20 to 30°C and 10 to 20 75%, but during fruiting it should be 80 to 95% because 80% or more of the fruiting body is water.

Pleurotus ostreatus prefers low light when growing. Because the forest light is blue, oyster mushrooms grow in the forest (Kong, 2004).

*There are many techniques used to prepare compost substrates, but some fungi (such as oyster mushrooms) grow directly on the substrate and therefore may not need composting (Atkins, 1972). Yet some people on mushroom farms, for example *Agricus ssp. Oyster Mushroom**

Problem Statement

Mushroom farming is an agricultural practice used by farmers as a source of food and livelihood, thereby ensuring food security in many communities.

However, their numbers are not enough to satisfy the audience. This can be attributed to their dependence on a (pure) substrate for growth. An attempt to realize various combinations to maximize the benefits of mushroom production using local waste. Item

*is the effect of Ndejje University substrate (cotton waste + sawdust + dry banana leaves) on the growth and yield of *Pleurotus ostreatus*.*

Specific Objectives

- 1. To examine the effectiveness of using pure substrates (100% cotton waste, 100% sawdust and 100% dry banana leaves) on the growth and yield of mushrooms.*
- 2. To examine the effectiveness of using mixed substrates (50% cotton waste + 50% sawdust, 50% cotton waste + 50% dry banana leaves, and 50% sawdust + 50% dry banana leaves) on the growth and yield of oyster mushrooms.*
- 3. To examine the effectiveness of using a combination of the three substrates (33.3% cotton waste + 33.3% sawdust + 33.3% dry banana leaves) on the growth and yield of oyster mushrooms.*

Research Questions

- 1. What is the effect of using pure substrates (100% cotton waste, 100% sawdust, and 100% dry banana leaves) on the growth and yield of oyster mushrooms?*

2. What is the effect of using mixed substrates (50% cotton waste + 50% sawdust, 50% cotton waste + 50% dry banana leaves and 50% sawdust + 50% dry banana leaves) on the growth and yield of oyster mushrooms?

3. What is the effect of using combination of all the three mixtures of substrates (33.3% cotton waste + 33.3% sawdust + 33.3% dry banana leaves) on the growth and yield of oyster mushrooms?

Methodology

Research design

The experiment contained seven (7) treatments of substrates each having 3 replicates in terms of gardens. They were hanged, 3 in series (figure 1) on the strings tied up across roofing bars

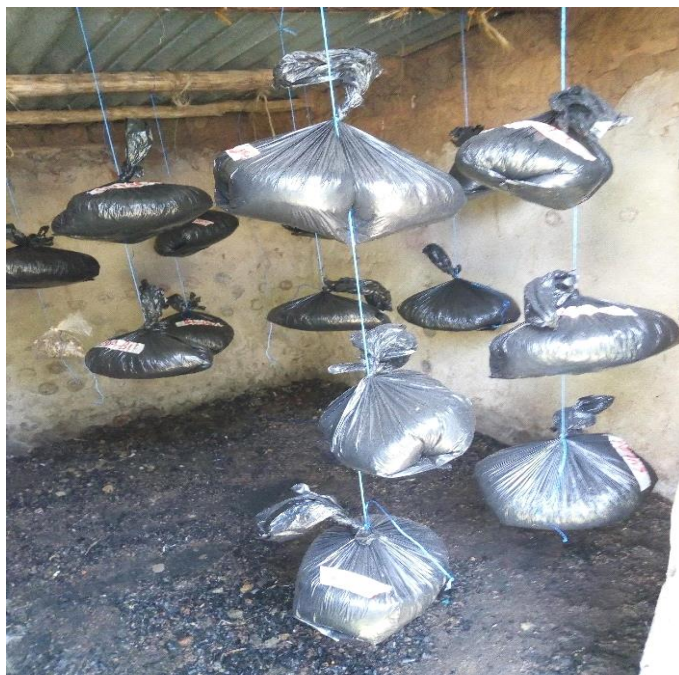


Figure. 1 shows arrangement of the gardens in series

Materials and Methods

The substrates namely: Cotton waste, sawdust, and banana leaves, ash, maize bran was sourced locally from Esia mixed farm while cotton waste and spawns were procured from National Agricultural Research Laboratories (NARL)

Preparation and formulation of substrates

The individual substrate combinations were well mixed (the formulation of the substrates is shown in Table 1) and soaked in water for 24 hours to moisten them.

Table 1: Substrate formulation for cultivation of oyster mushroom

Substrate Code	Compositions
CWO	Cotton waste only (100%)
SDO	Sawdust only (100%)
BLO	Banana leaves only (100%)
CWSD	Cotton waste (50%) + Sawdust (50%)
CWBL	Cotton waste (50%) + Banana leaves (50%)
SDBL	Sawdust (50%) + Banana leaves (50%)
CWSDBL	Cotton waste (33.3%) + Sawdust (33.3%) + Banana leaves (33.3%)

Explanation of the abbreviations used in the substrates is as follows: CWO = Cotton waste (100%) only, SDO = Sawdust (100%) Only, BL = Banana leaves (100%) only, CWSD = Cotton waste (50%) + Sawdust (50%), CWBL = Cotton waste (50%) + Banana leaves (50%), SDBL = Sawdust (50%) + Banana leaves (50%), CWSDBL = Cotton waste (33.3%) + Sawdust (33.3%) + Banana leaves (33.3%).

The banana leaves were dried and chopped into smaller particles using a local panga. Subsequently, they were stalked on polyethene bag surface so as to remove excess moisture from the substrates to get 65% moisture level.

*They were then subjected to sterilization through steaming to kill bacteria and other harmful organisms using a drum with a platform at the bottom which separates boiling water from the substrates. After heat treatment, the bags were cooled to 30°C before inoculating with the spawn of oyster mushroom (*Pleurotus ostreatus*) at the rate of 1 packet per 1.0 kg bag of substrate. Ash 5 g, maize bran of 70 g, and sugar of 30 g was added to regulate pH, supply carbohydrates and energy supply during mycelia run respectively.*

The substrates (now bagged and inoculated) were incubated in a darkroom for 2 to 3 weeks hanged on strings. The openings of the bags were closed with a plastic ring. During this period, daily temperature and humidity of the incubation room were monitored and controlled.

The bags were fully colonized by the mushroom mycelia within 16 to 20 days. Next, the bags were subjected for fructification. The bags were cut open with a blade to allow watering and initiate fruiting with some minimal amount of light allowed. The humidity of the bags during the cropping (fructification) stage was accomplished by spraying of water in the form of fine mist from a nozzle three times a day. Temperature and humidity of the cropping room were also monitored two times a day. The first primordial (pinheads) appeared 6 to 12 days after opening the bags depending upon the substrate. Matured mushroom were harvested by cutting gently to uproot from the base using a knife. The mushrooms generally mature in three to four days after the appearance of the pinheads.

STUDY SAMPLE

Sampling design

3 gardens from each of the 7 were picked randomly and measurements taken on their weight, height, leaf breadth, and number of fruit bodies using a ruler, weighing scale, a pen and a paper.

Sampling procedure

Sampling was done randomly during experiment to obtain raw data, where data on weight, height, leaf breadth and number of mushrooms harvested.

Sample size

A total of 21 garden samples were used for data collection from all the treatments, taking 3 samples from single substrates, 3 from the three substrate combinations and 3 from composite of all the three substrates.

Data Collection

Data collection sources

Primary data was collected right from the experimental field setup Esia mixed farm.

Instruments used in data collection

The instruments used in data collection included a ruler for measurement of the width and length of the mushrooms, a weighing scale for measuring the weight and a pen for recording data in the data record book.

Methods used in data collection

Pens, pencils and a record book were used in recording data and a string and ruler used to measure the width and length of mushrooms. The researcher used the observation method to note the changes in growth of the oyster mushrooms on the pure and mixed substrates.

DATA PROCESSING AND ANALYSIS

Statistical data analysis and presentation

Data obtained were subjected to manual data analysis and presented in table format.

Analysis of growth rate of oyster mushroom

The yield of oyster mushroom was determined by recording the number and size of cap of the fruit bodies after sprouting. The following parameters of growth and yield were measured.

Number of fruit bodies

This was done by directly counting the number of fruit bodies on each garden (bag).

Cap size/breadth (Pileus diameter)

This was achieved by measuring the broadness of the cap after harvesting. This was carried out in the morning hours using a measuring ruler.

Cropping time

This is the time from the completion of mycelium running to the time when the pinheads have fully blossomed and ready for harvesting. It was measured in days.

Yield of mushroom

This is the quantity (weight) of mushroom produced per bag of substrate per harvest time. It was weighed using a laboratory weighing scale. The crop of oyster mushroom was harvested in three flushes.

After all the three flushes, Cotton waste only (CWO) gave total weight of 928g, Sawdust only (SDO) 132g, Cotton waste + Sawdust (CWSD) 330g, Cotton waste + Banana leaves (CWBL) 245g, Sawdust + Banana leaves (SDBL) 213g, Cotton waste + Sawdust + Banana leaves (CWSDBL) 860g and Banana leaves only (BLO) 0g respectively.

RESULTS

Growth of the mushrooms in different substrates

In reference to table 3, SDO fruited first in 21 days, CWSD, SDBL and CWSDBL in 25 days, CWBL in 26 days, and CWO fruited late after 32 days, while BLO did not fruit.



Figure 2. Shows how oyster mushrooms appear after fruiting and ready for harvesting



Figure 3. Shows no fruiting in the substrate of banana leaves only (BLO)

Effect of using a pure substrate mixed substrates and a combination of three substrates on growth and yield of oyster mushrooms

The research looked at the effectiveness of using pure substrates (100% cotton waste, 100% sawdust and 100% dry banana leaves); the effectiveness of using mixed substrates (50% cotton waste + 50% sawdust, 50% cotton waste + 50% dry banana leaves, and 50% sawdust + 50% dry banana leaves) and the effectiveness of using a combination of the three substrates (33.3% cotton waste + 33.3% sawdust + 33.3% dry banana leaves) on the growth and yield of oyster mushrooms. Table 2 shows the results obtained.

Table 2: Effect of type of substrate on, number of fruit bodies, height and cap size (breadth) of oyster mushroom

	Weight of fruit bodies per flush in		Average	
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Substrate	(g)				Total fruit bodies	height(cm)	Average Breadth (cm)
	1st flush	2nd flush	3rd flush	Total flush weight			
<i>CWO</i>	403	345	180	928	35	17	10
<i>SDO</i>	95	21	16	132	12	6	3.5
<i>BLO</i>	0	0	0	0	0	0	0
<i>CW+SD</i>	200	90	40	330	17	5.5	3.4
<i>CW+BL</i>	130	70	45	245	14	7.5	4
<i>SD+BL</i>	120	75	18	213	15	6.5	3.8
<i>CW+SD+BL</i>	360	290	210	860	34	13	8.4
<i>Mean</i>	186.9	127.3	72.7	1970.9	18.1	7.9	4.7

CWO = Cotton waste (100%) only, *SDO* = Sawdust (100%) Only, *BL* = Banana leaves (100%) only, *CWSD* = Cotton waste (50%) + Sawdust (50%), *CWBL* = Cotton waste (50%) + Banana leaves (50%), *SDBL* = Sawdust (50%) + Banana leaves (50%), *CWSDBL* = Cotton waste (33.3%) + Sawdust (33.3%) + Banana leaves (33.3%).

The effect of substrate type on yield of oyster mushroom is shown in figure 5. Generally, the substrates had varying effects on the yield of oyster mushroom. The maximum yield (928.0 g) was obtained from *CWO* substrate followed closely by *CWSDBL* substrate (860.0 g), *CWSD* substrate (330.0 g), *CWBL* substrate (245.0 g), *SDBL* substrate (213.0 g), then *SDO* substrate (132.0 g), no yield (0.0 g) was obtained from *BLO* substrate.

Figure 4: Effect of substrate type on yield of oyster mushroom

CWO = Cotton waste (100%) only, *SDO* = Sawdust (100%) Only, *BL* = Banana leaves (100%) only, *CWSD* = Cotton waste (50%) + Sawdust (50%), *CWBL* = Cotton waste (50%) + Banana leaves (50%), *SDBL* = Sawdust (50%) + Banana leaves (50%), *CWSDBL* = Cotton

waste (33.3%) + Sawdust (33.3%) + Banana leaves (33.3%). Data are average of three readings.

Therefore, yields obtained from pure with (single) substrate have shown superior yields, followed by composite of (three) substrates followed in second position and lastly from mixed with (two) substrates

Effect of substrate media on mycelium running, pinhead formation and cropping period of oyster mushroom

Table 3: Usage of substrate media on mycelium running, pinhead formation and cropping period of oyster mushroom

Substrate	Parameters in Days			
	Mycelium running	Pinhead formation	Pinhead to harvest	Cropping duration
CWO	20	12	4	36
SDO	15	6	3	24
BLO	0	-	-	-
CWSD	17	8	4	29
CWBL	18	8	4	30
SDBL	17	8	3	28
CWSDBL	16	9	4	29
Mean	15.1	7.3	3.1	25.1

CWO = Cotton waste (100%) only, SDO = Sawdust (100%) Only, BL = Banana leaves (100%) only, CWSD = Cotton waste (50%) + Sawdust (50%), CWBL = Cotton waste (50%) + Banana leaves (50%), SDBL = Sawdust (50%) + Banana leaves (50%), CWSDBL = Cotton waste (33.3%) + Sawdust (33.3%) + Banana leaves (33.3%).

The broadest size of cap/breadth (10 cm) was obtained on CWO substrates, followed by (8.4cm) from CWSDBL substrate while the lowest cap size/breadth of (0.0 cm) was obtained from BLO substrate.

The tallest height (17 cm) was obtained from same CWO substrate, followed by (13 cm) from CWSDBL substrate, while the lowest height (0.0 cm) was obtained from BLO substrate followed by (5.5 cm) from CWSD substrate.

The most fruited body was found in pure single substrate body of CWO with (35.0), followed closely by a composite substrate of CWSDBL with (34), third was from mixed substrate of CWSD with (17), forth from mixed SDBL with (15), fifth from mixed substrate of CWBL with (14), sixth from pure single substrate of SDO with (12) fruited bodies while nothing was registered from substrate of BLO with (0.0) fruited body.

Conclusions

Pure Cotton waste is the best substrate for growing oyster mushrooms, followed composite substrates of cotton waste mixed with sawdust and banana leaves. Other mixtures of cotton waste + sawdust, cotton waste + banana leaves, sawdust + banana leaves can be used as well as alternative incase the above are unreliable. Using sawdust alone is not convenient for oyster mushroom production since they take long to release nutrients for the growth of the mushrooms unless they are partially decomposed. Finally, (BLO) banana leaves (pure) substrates are not recommendable for oyster mushroom production, because they over have larger particles, so in case one is choosing that, then he/she is advised to mill them into powder for better result expectation. Therefore, according to these findings the mixed substrates have shown better growth response in average compared to pure substrates.

Recommendations

Farmers are recommended to use cotton waste as the suitable substrate to grow the oyster mushrooms as it showed the maximum growth and yield responses.

I still recommend farmers to use the three combinations of cotton waste + sawdust + banana leaves for oyster mushroom production since it as well gave a great growth and yield responses

Farmers are therefore, encouraged to maintain good hygiene in the mushroom growing house since mushrooms are more sensitive to contamination by germs.

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