NISEB Journal Vol. 14, No. 2, June, 2014
Printed in Nigeria

1595-6938/2014
(2014) Nigerian Society for Experimental Biology
http://www.nisebjournal.org

Effect of Sawdust Extracts on the Vegetative Growth of *Pleurotus tuberregium* Singer

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Abstract
The study was carried out to determine the effect of some selected sawdust extracts on the mycelia growth of the edible and medicinal mushrooms, Pleurotus tuberregium. Sawdust extracts obtained from ten economic trees were used to prepare potato dextrose agar. The highest level of mycelial growth was exhibited by the extract from 'Cameleon' with mean mycelia diameter of 5.51 ±0.65 cm. This was followed by Triplochiton scleroxylon (4.95 ±0.15 cm) and 'Ukom' (4.14 ±0.24 cm). Compared to the control, the mycelia growth of the aforementioned extracts were significantly higher or lower (p=0.05). Sawdust extracts from Baphia nitida, Lophira alata and Ormocarpum spp gave the lowest mean mycelia diameter (0.50 ±0.00 cm) ten days after inoculation. The results obtained from this study suggest that 'Cameleon' favoured to a large extent the mycelia growth of P. tuberregium.

Key words: mycelia growth, *P. tuberregium*, sawdust extract.

Introduction

Mushrooms grow naturally in Nigeria during the early and late rainy seasons [1]. They are usually found in forests, grasslands, damp rotten logs etc. Species of *Pleurotus* are well known as edible mushrooms in different parts of the world. Indigenous people of Nigeria consume edible mushrooms including *Pleurotus tuberregium* as food or as medicine [2]. This is also practiced by people in West African countries such as Ghana and [3, 4].

P. tuberregium is a basidiomycete. It is a sclerotial mushroom which produces sclerotium as well as fruiting body. Both the sclerotium and the fruiting body are edible. The cap of the mushroom curves upwards to form a cup-like shape, the sclerotium is spherical to ovoid and can be quite large up to 30 cm (11.8 inches) or larger in diameter [2]

P. tuberregium is highly nutritious and medicinal. It is rich in essential amino acids such as lysine, leucine, histidine, arginine, methionine, cysteine and valine, hence it is a rich addition to human diets [5]. It contains minerals such as calcium, magnesium, potassium, sodium, copper, zinc, iron and manganese. It also contains an appreciable quantity of saponins, alkaloids, flavonoids and oligosaccharides [6]. Oyster mushrooms have been found to be medicinal as extracts and compounds obtained from them have been reported to have medicinal properties such as antitumour, immunomodulatory, antigenotoxic, antioxidant, anti-inflammatory, antiallergic, hypocholesterolaemic, antihypertensive, antihyperglycaemic, antimicrobial and antiviral activities [7].

Despite its nutritional and medicinal values, the cultivation of the mushroom is not widespread. The local people who use this mushroom for food and medicine usually collect the sclerotia from the wild, but it is getting difficult to find the sclerotia because of the depletion of its forest habitat. However, its cultivation on agricultural wastes such as corn cobs, cassava wastes, sawdust, plantain leaves, millet stalk etc have been reported [8, 9].

Sawdust is a type of waste produced in sawmills. Sawmilling is the process of converting logs of round wood to lumber or sawn timber by using a variety of machines. The amount of sawdust produced depends on the sharpness of the saw, the experience of saw operators, chemical, physical and anatomical properties of the logs.

The utilization of lumber waste material being produced everyday would alleviate the rising problem of environmental pollution. Unless processed into particle board, burned in a sawdust burner or used to make heat for other milling operations, sawdust may collect in piles and add harmful leachates into local water systems, creating an environmental hazard. Also, in rainy season, the saw mill environment is unhygienic because when sawdust mixes with water, bio-deterioration occurs, producing offensive odour. This constitutes a serious health hazard to the workers at the saw mill and others in the vicinity.

Sawdust is used for the cultivation of some edible mushrooms and can be used as a substrate for growing *Pleurotus* species by composting method where organic and inorganic substances such as rice bran, wheat bran, urea, sugar, calcium carbonate and calcium sulphate etc are used as supplements. These supplements increase yield through

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bioconversion of complex compounds into simple nutritive substances vital to mushroom growth [10]. In countries such as Japan, China and Korea, mushrooms such as *Lentinus edodes*, *Auricularia* spp., and *Pleurotus* spp. are grown using sawdust from soft wood and hard wood. Some other mushrooms are grown on partially decomposed wood and wood products [11].

Wood wastes provide nourishment for the fungus and are more readily available than other agricultural waste. *Pleurotus tuberregium* are able to degrade lignocellulosic material found in sawdust. These lignocellulosic materials include cellulose, amorphous hemicelluloses and complex lignin. *P. tuberregium* can degrade lignocellulosic wastes because they gain nourishment from cell wall structural polymers of these wastes.

The objective of this study was to determine the effect of different sawdust types on the vegetative growth of *Pleurotus tuberregium*.

Materials and Methods

Collection of materials and handling

Sawdust of ten economically important trees was collected from a saw mill in Benin City and was dried to constant weight. Sclerotia of *Pleurotus tuberregium* were obtained from a market in Benin City. They were rinsed with sterile distilled water and were induced to produce fruiting bodies as described by Okhuoya and Etugo [12]. The fruiting bodies were then used to generate pure cultures as described by Stamets and Chilton [13].

Sawdust extract and culture media preparation

Sawdust extracts for each tree species were prepared according to the method described by Dede *et al*. [14]. Sawdust extracts were used in place of distilled water to prepare potato dextrose agar (PDA) at various concentrations ranging from 100, 80, 40 and 20 % of sawdust extract (SDE). Potato dextrose agar prepared with distilled water served as control. Culture media prepared were sterilized at 121^0C and 15psi for 20 minutes after which they were allowed to cool and poured into sterile Petri dishes. Plates were inoculated with 5 mm mycelium plug of *P. tuberregium* taken from the growing edge of a 3 day old culture. Five replicates were made for each culture media.

Statistical analysis

The experiment was done using five replicates for each treatment and conformed to a complete randomized design. Data collected were analyzed using descriptive statistics such as means, percentages and standard errors. Where there were significant differences, means were separated using Duncan Multiple Range F-Test, with SPSS 16.0 package.

Results and Discussion

The eventual fruiting body production of a mushroom on any substrate depends on the mycelia growth (vegetative phase) of the mushroom on that substrate.

Extracts from 'Cameleon', *Sterculia oblonga* and *Ormocarpum* spp solidified like PDA while *Baphia nitida*, *Triplochiton scleroxylon* and 'Ukom' were semi-solid. *Alstonia* spp, *Bombax buonopozense* and *Brachystegia nigerica* did not gel at all (Table 1). This could be due to the variation in the chemical constituents of the sawdust extracts.

Table 1: Comparison of the gelling ability of culture media prepared with sawdust extract to PDA.

Source of extract	Gelling ability
PDA	+++
Alstonia spp	-
Baphia nitida	++
*'Cameleon'	+++
Sterculia oblonga	+++
Bombax buonopozense	-
Brachystegia nigerica	-
Triplochiton scleroxylon	++
Lophira alata	++
Ormocarpum spp	+++
*'Ukom'	++

* Trade names of the species

+++ = gelled like PDA ++ = gelled slightly like PDA - = did not gel at all.

In this study, the mycelia growth of *Pleurotus tuberregium* was supported by all the sawdust extracts used except *Baphia nitida*, *Lophira alata* and *Ormocarpum* spp which had the lowest mean mycelial diameter of 0.50±0.00 cm (Table 2). However, the sawdust extract of 'Cameleon' and *Triplochyton scleroxylon* had a mean mycelial diameter of 5.51 ±0.65 cm at 40 % concentration of sawdust extract and 4.95 ±0.15 at 20 % sawdust extract concentration respectively. 'Ukom' and *Alstonia* spp. also gave a high mean mycelia diameter of 4.39 ±0.19 cm at 80 % sawdust extract concentration and 4.39 ±0.25 cm at 100 % sawdust extract concentration respectively. This infers a high level of productivity when they are used in the cultivation of this mushroom. *Baphia nitida*, *Lophira alata* and *Ormocarpum* spp should not be recommended for the cultivation of this mushroom as they did not indicate any significant growth in the mycelial stage of development.

Table 2: Mean mycelial diameter, ten days after inoculation

	Concentration of extract (%)			
Source of extract	100	80	40	20
Alstonia spp	**4.39 ±0.25	4.25 ±0.70	3.54 ±0.02	2.31 ±0.56
Baphia nitida	0.86 ±0.36	0.50 ±0.00	0.50 ±0.00	0.50 ±0.00
*'Cameleon'	5.32 ±0.13	5.15 ±0.32	5.51 ±0.65	4.55 ±0.12
Sterculia oblonga	2.54 ±0.03	2.09 ±0.12	3.44 ±0.08	4.45 ±0.13
Bombax buonopozense	4.56 ±0.31	3.25 ±0.20	2.64 ±0.06	3.06 ±0.48
Brachystegia nigerica	3.94 ±0.45	3.56 ±0.18	2.99 ±0.22	3.28 ±0.19
Triplochiton scleroxylon	3.43 ±0.17	4.70 ±0.14	4.64 ±0.28	4.95 ±0.15
Lophira alata	0.50 ±0.00	0.50 ±0.00	0.89 ±0.12	0.99 ±0.11
Ormocarpum spp	0.50 ±0.00	0.50 ±0.00	0.50 ±0.00	0.85 ±0.16
*'Ukom'	4.14 ±0.24	4.39 ±0.19	4.14 ±0.16	3.59 ±0.04
PDA	3.01 ±0.15			

* Trade names of the species
** Mean of five replicates ± standard error. Values represents mycelial diameter ten days after inoculation (cm).

The growth rate of the mycelia of *P. tuberregium* 10 days after inoculation varied across the selected sawdust extracts at different concentrations of 20, 40, 80 and 100 % sawdust extract concentration respectively (Table 3). 'Cameleon' had the highest mycelial growth rate (0.58 cm/day at 40% concentration) while *Baphia nitida*, *Lophira alata* and *Ormocarpum* spp had the lowest (0.05cm/day). The variation could be as a result of the various treatments and the nutrient status of the respective extracts including the chemical constituents of the sawdust materials.

Table 3: Mycelia growth rate (cm/ day) of *P. tuberregium* on the various sawdust extract concentrations ten days after inoculation

	Concentration of extract (%)			
Source of extract	100	80	40	20
Alstonia spp	**0.44	0.43	0.27	0.23
Baphia nitida	0.09	0.05	0.05	0.07
*'Cameleon'	0.53	0.52	0.58	0.46
Sterculia oblonga	0.24	0.20	0.23	0.45
Bombax buonopozense	0.45	0.33	0.24	0.25
Brachystegia nigerica	0.37	0.36	0.31	0.34
Triplochiton scleroxylon	0.34	0.47	0.47	0.49
Lophira alata	0.05	0.05	0.08	0.11
Ormocarpum spp	0.05	0.05	0.05	0.08
*'Ukom'	0.42	0.45	0.41	0.34
PDA	0.31			

* Trade names of the species
** Mean of five replicates ± standard error. Values represents mycelial diameter ten days after inoculation (cm).

Edible mushroom fungi with appropriate enzymatic mechanism have potential of bioconversion of lignocellulosic waste into value added products [15]. The poor growth of the mycelia in *Baphia nitida*, *Lophira alata* and *Ormocarpum* spp sawdust extracts may be due to the fact that the mushroom could not produce enzymes that could hydrolyze and convert the substrate for its vegetative growth. This observation is supported by Okhuoya *et al*. [16] who reported that the mushroom could not grow well on sawdust of some tree species.

The ability of waste materials to support growth is dependent o the Carbon: Nitrogen ratio of the waste material. Some require additives such as rice and wheat bran to provide additional energy [17]. There is potential for further improvement in mushroom yields as well as cultivation technique through the utilization of some of these supplements.

Sawdust which is a source of environmental problem needs to be further studied for cultivation. Edible mushroom fungi which possess appropriate enzymatic mechanisms for the transformation of complex organic materials into simple compounds have been exploited as a means of biodegradation of a wide range of litters due to their particular ability for selective delignification [1, 19]. This biotechnological method leads to the conversion of agricultural wastes that have potential environmental hazards into food for high organoleptic properties and nutritive value [20].

The mycelia of *Pleurotus tuberregium* grew best on the sawdust extract of 'Cameleon' when compared to the other substrates. More research should be done on the cultivation of the mushroom using this substrate as this would favourably increase the yield of the mushroom and also improve the environment as this agricultural waste will be minimized by its use in the cultivation of this mushroom.

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