E-ISSN: 2346-7290

Performance of some agro-wastes on growth and yield of *Hypsizygus ulmarius* (Bull.:Fr.) redhead fruit bodies

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ABSTRACT

Mushroom science has gained importance mainly because of the nutritional and medicinal values of mushrooms. The cultivation of mushroom is seen as a profitable agricultural business. This study investigated the cultivation of *Hypsizygus ulmarius* using local substrates to evaluate their effect on pinhead formation, growth and yield of the fruit bodies. The substrates used were coconut fibre (CF), maize straw (MS), sugarcane bagasse (SB), coconut fibre + maize straw (CF+MS), coconut fibre + sugarcane bagasse (CF+SB), maize straw and sugarcane bagasse (MS+SB) and coconut fibre + maize straw + sugarcane bagasse (CF+MS+SB). Completely randomized design with seven treatments and four replicates was used. The result showed that pinhead formation varied from 15 (SB, CF+MS and CF+SB) – 19(CF) days, the mean stipe length ranged from 1.87 (SB) - 2.43 (CF+MS) cm; mean cap size varied from 4.43 (CF+MS)- 5.77 (MS+SB) cm, the fresh weight ranged from 2.44 (CF) - 5.10 (MS+SB) g, biological yield ranged from 41.32 (CF) - 141.72 (MS+SB) g while biological efficiency varied from 11.81 (CF) - 94.48 (MS+SB) %. The use of coconut fibre to cultivate *Hypsizygus ulmarius* should be discouraged because of its inability to produce reasonable yield of fruit-bodies. Maize straw is recommended for the cultivation of this mushroom species in other to achieve better growth and yield.

Keywords: mushroom, *Hypsizygus ulmarius*, fruit bodies, cultivation, pinhead formation

INTRODUCTION

Mushrooms are macro-fungi with distinctive structure, which can be hypogenous or epigenous, and large enough to be seen with the unaided eye and to be picked by hand (Okwulehie and Odunze, 2004b). Most mushrooms have a well-developed and observable spore-bearing structure called pileus (cap) and stipe (stalk). The cultivation of mushroom has gained importance and it is seen as the most versatile and profitable agricultural business all over the world (Ikeji, 2010). The cultivation of mushroom is an important tool that can be used for poverty alleviation and tackling lack of adequate nourishment (Imtiaj and Rahman, 2008).

Hypsizygus ulmarius is an edible saprophytic mushroom. In nature, they are found growing on hardwood, particularly on elm plant and they are also called elm oyster or blue oyster (Usha and Suguna, 2016). *H. ulmarius* is a small genus of fungi that are widely distributed in North Temperate Regions and

belongs to the family Tricholomataceae (Kirk *et al.*, 2008). Volk (2003) reported that *H. Hypsizygus* as *Pleurotus* species causes white rot while *Hypsizygus* causes brown rot. *Hypsizygus* was also cultivated both for food and medicinal purposes. This mushroom is a fast growing species and it is cultivated mostly in Asia and Europe due to their simple and low cost production technology and higher biological efficiency (Mane *et al.*, 2007).

In Nigeria, fungal fruit-bodies naturally appear in forests and farm lands during the early and late raining season (April – June and September – November) in great diversity and quantities (Okwulehie and Ogoke, 2013; Mmaduabuchukwu and Mbadiwe, 2013). In nature, mushrooms grow on different substances such as logs of wood; decomposing agro-wastes, decomposing animal wastes, and soil where they obtain their nutrients through external digestion and absorption by the mycelium (Okwulehie and Ogoke, 2013). This research aimed at determining the effect of some agro-wastes on the formation of pinhead, growth and yield of *Hypsizygus ulmarius* fruit bodies.

MATERIALS AND METHODS

Description of Study Area

The study was carried out in the mushroom house and laboratory of the Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture, Umudike, Abia State

Source of Materials

The spawn of the mushroom species *Hypsizygus ulmarius* used for this study was obtained from Dr. Magnus Nwoko of the Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture Umudike. The coconut fibre and sugarcane bagasse were collected from Ikot Mbang market, Ibiono and Nassarawa *ulmarius* was first named *Pleurotus ulmarius* and later placed under the genus
road, Itam in Akwa Ibom State and while the maize straw was collected from a farmland at Amaoba village in Abia State.

Preparation of the Substrates for Cultivation

The substrates were prepared to ascertain the one that will be preferred for use in the production of *Hypsizygus ulmarius* in terms of the quantity of fruiting bodies. Cultivation of *Hypsizygus ulmarius* was carried out by the method of Karthika and Murugesan (2015) but with little modification. Coconut fibre, maize straw and sugarcane bagasse were chopped to convenient sizes. The substrates were then moistened in fresh water overnight in a container. The moistened substrates which were kept overnight were then pasteurized using steam for 2 h in a closed chamber (metallic drum while cooking gas was the source of heat). The pasteurized substrates were removed from the closed chamber and placed in a clean container inside the room and allowed to cool at room temperature. The substrates used were: Coconut fibre (CF), Maize straw (MS), Sugarcane bagasse (SB), Coconut fibre and maize straw (CF + MS), Coconut fibre and sugarcane bagasse (CF + SB), Maize straw and sugarcane bagasse (MS + SB), Coconut fibre and maize straw and Sugarcane bagasse (CF + MS + SB). These mixtures were made in the ratio of 50:50 and 50:50:50 respectively.

Inoculation and Incubation

During inoculation, all the instruments used were first sterilized with alcohol while the perforated buckets were rinsed with dilute solution of hypo-chloric acid (5%). Thirty (30) grammes of grain based spawn of *Hypsizygus ulmarius* was poured at the bottom of the sterilized perforated bucket followed by filling the same bucket with 50 g

of pasteurized substrate. Thirty (30) grammes of grain based spawn was spread again on the surface of the substrate. The substrate was then filled to cover the spawn and pressed lightly. This method was repeated four times until the perforated bucket was filled and four replicates were made for each substrate. The perforated buckets were covered with lid. Perforation of bucket was for aeration of inoculated substrate. After inoculation, the buckets were kept in the ventilated room and covered with black polyethylene bag.

Measurement of Parameters

The following parameters of growth/yield were recorded.

Pinhead formation; the time from inoculation to initiation of pinhead was taken (days).

The stipe length (height) of *Hypsizygus ulmarius* was measured in centimetres using transparent rule from the stipe base to the level of pileus.

The cap (pileus) diameter was measured in centimetre with a transparent plastic ruler from one edge of the pileus across the stipe to the other edge.

Fresh weights of the fruit-bodies were determined immediately after harvest using electronic balance and their mean weights were recorded.

Biological yield was determined by counting the number of fruit-bodies for each treatment and the mean calculated.

Biological efficiency was determined using the following formula (Okwulehie *et al.*, 2017):

$$\text{B.E (\%)} = \frac{\text{Fresh Weight of Mushroom}}{\text{Dry Weight of Substrate}} \times \frac{100}{1}$$

Experimental Design

Completely randomized design with seven treatments and four replicates was used.

RESULTS

The result of the cultivation of *Hypsizygus ulmarius* showed that the mushroom produced a blue pinhead (Plate 1) followed by the development into a full grown mushroom (Plate 2). The formation of pinhead took 15 days in the substrate SB, CF+MS and CF+SB; 16 days in the substrate combination MS+SB and CF+MS+SB; 17 days in the substrate MS and 19 days for the substrate CF as shown in Figure 1. Also, it was observed that the substrate combination CF+MS had the highest mean stipe length (2.43 cm) while the least mean stipe length (1.87 cm) was observed from the substrate SB as shown in Figure 2. There was no significant difference ($p<0.05$) in the stipe length across the different substrates. The effect of substrates on the cap size as shown in Figure 3; showed that the substrate combination MS+SB produced fruit bodies with the widest mean cap size (5.77 cm) and the least mean cap size (4.43 cm) was from the substrate combination CF+MS. The substrate MS+SB produced the highest mean fresh weight of 5.10 g while the least mean fresh weight (2.44 g) was obtained from the substrate CF as shown in Figure 4. Also, the effect of substrates on biological yield (Figure 5) showed that the highest biological yield was obtained from the substrate combination MS+SB (141.72 g) and the least was obtained from the substrate CF (41.32 g). The highest biological efficiency was obtained from the substrate combination MS+SB (94.48%) and the least biological efficiency was obtained from the substrate CF (11.81%) as shown in Figure 6.

Biological efficiency further revealed that there was significant difference ($p<0.05$) in MS+SB when compared to other substrates.

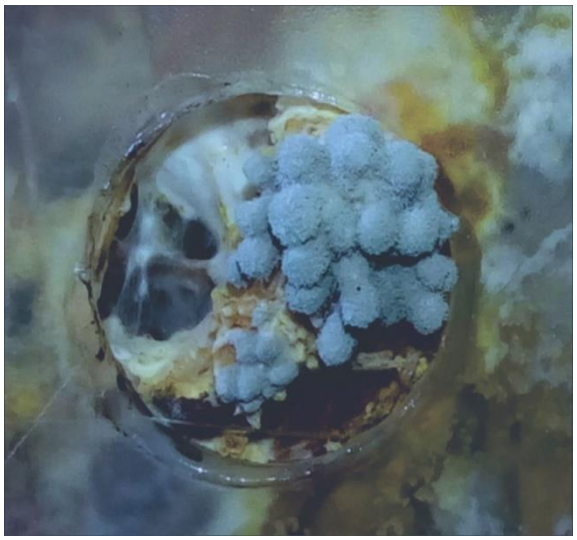

Plate 1: *Hypsizygus ulmarius* blue pinhead

Plate 2: *Hypsizygus ulmarius* growing on different substrates

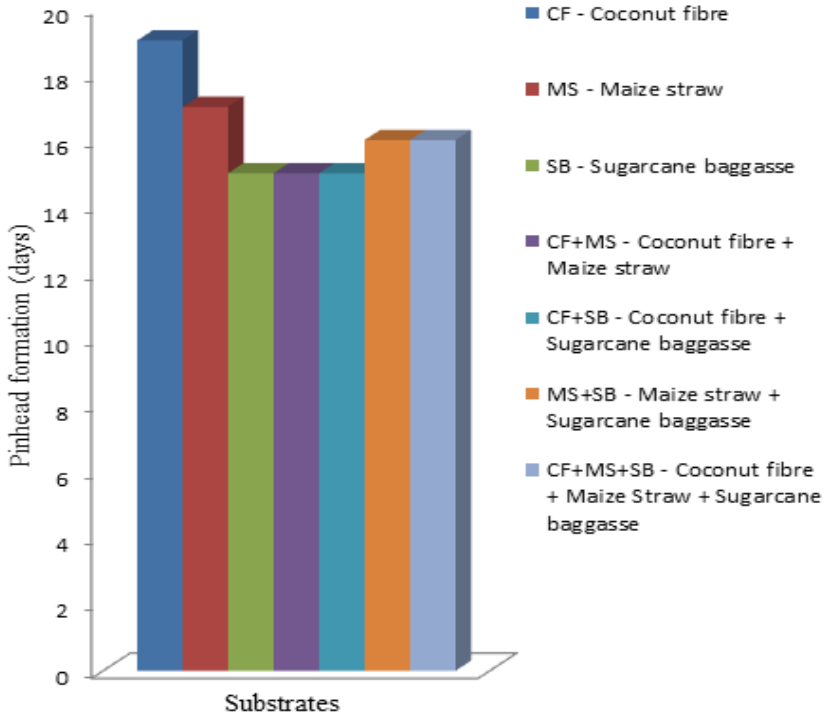

Fig. 1. Effect of Substrates on pinhead formation of *Hypsizygus ulmarius*

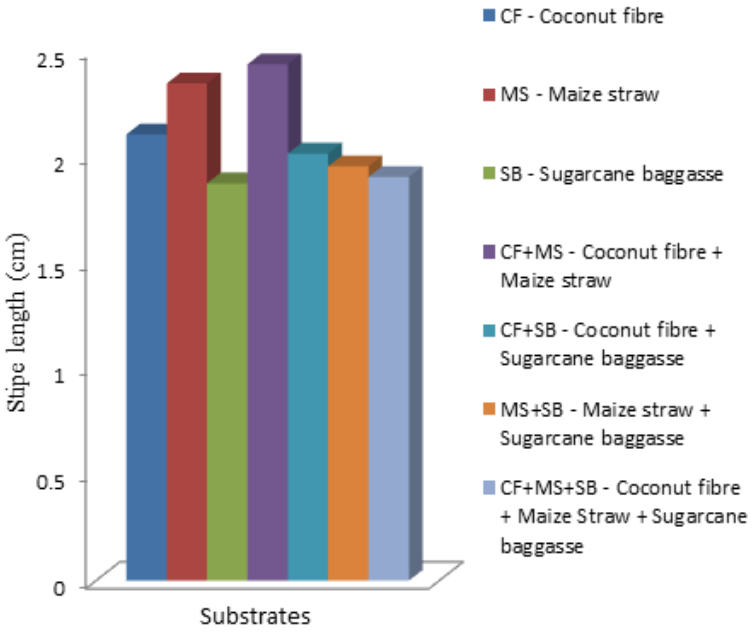

Fig. 2. Effect of substrates on the stipe length of *Hypsizygus ulmarius*

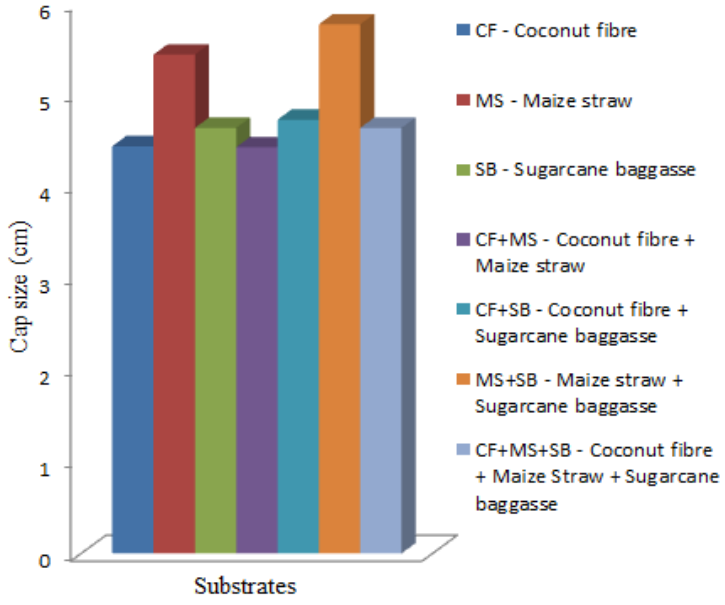

Fig. 3. Effect of substrates on the cap size of *Hypsizygus ulmarius*

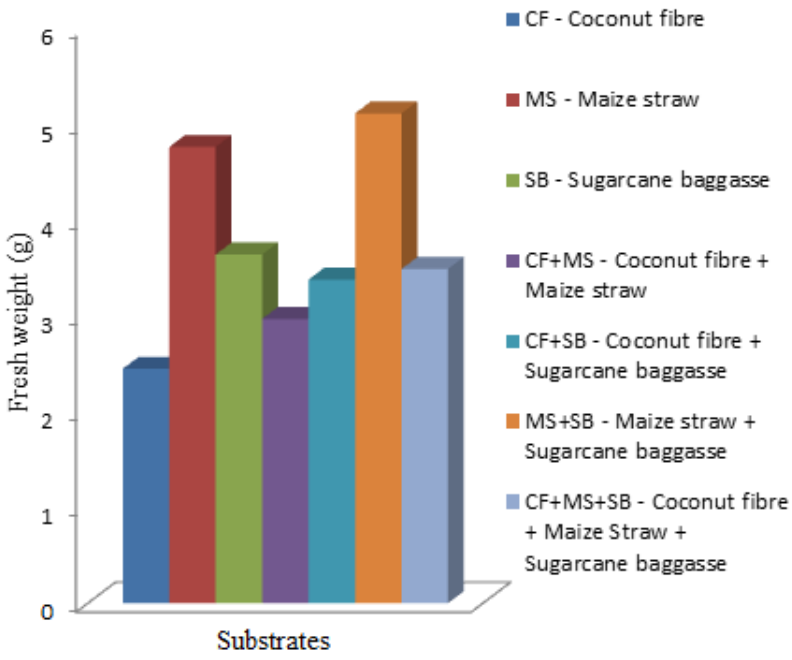

Fig. 4. Effect of substrates on the fresh weight of *Hypsizygus ulmarius*

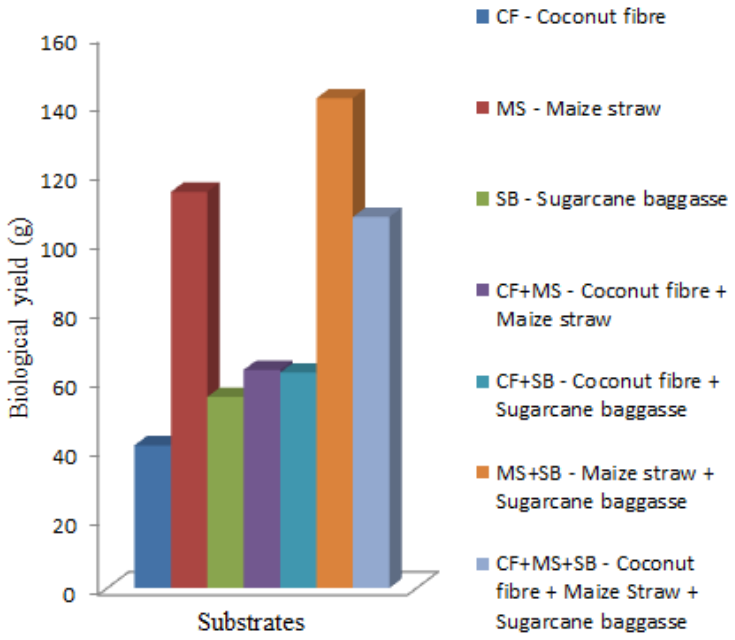

Fig. 5. Effect of substrates on the biological yield of *Hypsizygus ulmarius*

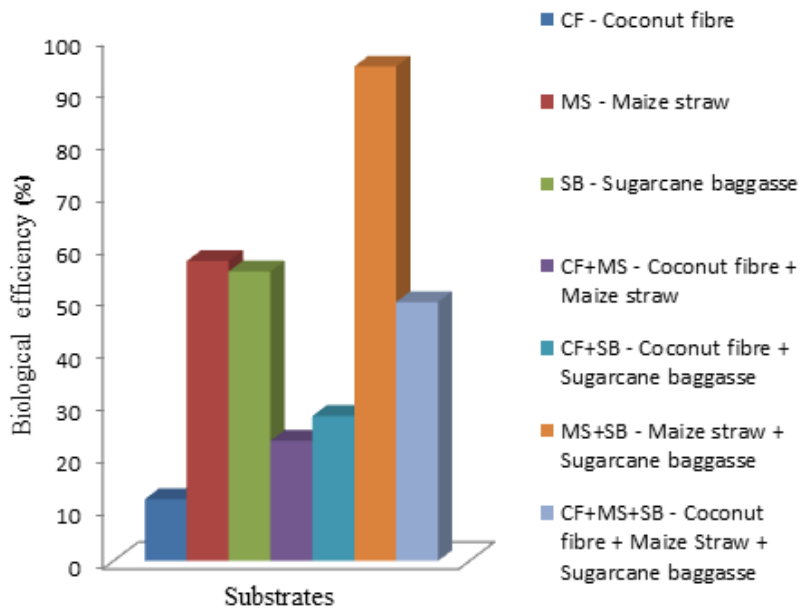

Fig. 6. Effect of substrates on the biological efficiency of *Hypsizygus ulmarius*

DISCUSSION

The growth of *Hypsizygus ulmarius* began with the colonization of the substrate by the mycelia after inoculation. This was followed by the production of a blue pinhead; a feature that brought about the common name blue oyster. The pinhead later grew into fully expanded flats (mushrooms). It was observed that the formation of blue pinhead from the day of inoculation differed across the substrates. The difference in days may be as a result of the quantity of spawn used per replicate during inoculation and the nature of the substrate. This result is in line with Usha and Suguna (2016) who reported that pinhead formation of both strains of *Hypsizygus ulmarius* CO2 and IIHR Hu1 takes 16 to 19days. The result of this study revealed that there was fructification of *Hypsizygus ulmarius* in all the substrates, indicating that the substrate contained nutrients that supported the growth of the mushroom. This result is in line with Okwulehie *et al*. (2017), Wabali and Wocha, (2013) and Badu *et al*. (2011) who reported that the growth of *Pleurotus ostreatus* is associated with the nutrients contained in the substrate

Stipe length obtained for *Hypsizygus ulmarius* was in line with the study of Habib (2005) and Sarker *et al.* (2007) which reported stipe length for *Pleurotus* spp on different substrate ranging from 1.93 - 2.97 cm. The mean cap size obtained was in agreement with the report of Habib (2005) that a cap size range of 4.85 - 8.95 cm. The fresh weight of the fruit- bodies ranged from 2.44 - 5.10 g. The result of the fresh weight obtained agrees with Bhattacharjya *et al.* (2014) who reported the fresh weight of the fruiting body of *Pleurotus Ostreatus* between the ranges of 2.95 – 4.45 g and attributed it to the environmental condition or the growing season. The higher biological yield and biological efficiency recorded in the substrate MS+SB and MS may be due to the quantity of spawn, amount and nature of substrate used and the level of nutrients in the

substrates. The result of the present study is in agreement with Siddhant *et al*. (2013) who attributed the high yield and biological efficiency to cultural condition such as the quality and quantity of spawn, amount and nature of substrate used and cultivation method. It also agrees with Okwulehie *et al.* (2017) who reported that the increase in biological yield is as a result of the nutrients status of the substrates, environmental conditions and nature of mushroom.

CONCLUSION

From the study, it was observed that the substrate combination MS+SB recorded the highest yield, followed by the substrate MS and CF+MS+SB (coconut fibre + maize straw + sugarcane bagasse) while the substrate CF (coconut fibre) had the lowest yield.

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