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Cultivation of *Pleurotus ostreatus* mushrooms on *Coffea arabica* and *Ficus sycomorus* leaves in Dilla University, Ethiopia

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***Coffea arabica* and *Ficus sycomorus* leaves were assessed for supporting growth of *Pleurotus ostreatus.* Comparatively, sholla leaves were highly supportive and their fruiting bodies appeared late, while coffee leaves were also supportive and their fruiting bodies appeared early. Results of the cultivation of *Pleurotus* on coffee and sholla leaves showed that they have promising effect for sustainable development, food security and supply. This study therefore revealed that both coffee and sholla leaves can serve as good substrates for mushroom cultivation.**

Key words: *Coffea arabica, Ficus sycomorus,* fruiting body, mushroom, *Pleurotus ostreatus,* Sholla, coffee.

INTRODUCTION

Mushroom cultivation is a potential biotechnological process where waste plant materials or negative value crop residues can be converted into valuable food. Mushroom has been studied for nutritional and medical purposes, and various potential antitumor and immune modulator substances, mainly polysaccharides have been identified (Zhang et al., 2007) for medical purposes. Mushrooms are consumed to prevent cancer and cardiac diseases, to improve blood circulation and to reduce cholesterol (Wasser and Weis, 1991). They are used for physical and emotional stress, asteoporosis, gastric ulcers and chronic hepatitis; for the improvement of the quality of life of patients with diabetes and especially for the stimulation of immunity (Menoli et al., 2004, Guterrez et al., 2004; Angeli et al., 2006; Choi et al., 2006; Grind et al., 2006).

Unlike in developed countries where mushroom food consumption is increasing (Kurtzman, 2005; Gregori et al., 2007; Neyrinck et al., 2009) especially in Ethiopia, eating of mushroom is very poor (Dawit, 1998). Information on nutritive value and sensory properties of edible oysters mushroom foods cultivated on agricultural residues in Ethiopia is limited. Such information is important to facilitate the population of mushroom cultivation, processing, marketing and consumptions.

Ficus sycomorus is commonly known as Sholla or Bamba in Amharic in Ethiopia. It is a large, semi-deciduous spreading savannah tree, up to 21 (max. 46) m; it is occasionally buttressed. Its leaves are broadly (ob) ovate or elliptic, the sub base is cordate, apex is rounded or obtuse, margin is entirely or slightly repand-dentate (2.5-13 (max. 21) x 2-10 (max. 16 cm) and is scabrous above; petiole is 1-5 cm long, with five to seven pairs of yellow lateral veins; lowest pair originates at the leaf base. It can be monocious or diecious (Berg and Corner, 2005).

Ficus is the Latin form of fig, derived from the Persian 'fica'. In Greek 'syka' means fig. The name of the species comes from the Greek 'sykamorea' (sycamore), used in the Gospel according to St. Luke; it was the tree that Jesus cursed because it was barren. Its leaves are said to be effective against jaundice, are antidote for snake

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Figure 1. This shows during (sample) Coffee and Sholla leaves collection.

bite and also are a much-sought fodder with fairly high nutritive value (9% crude protein and 7 mJ/kg net energy dry matters); .they are valuable fodder in overstocked semi-arid areas where the trees occur naturally. Its fruits are eaten by livestock, wild animals and birds (Orwa et al., 2009).

Coffee has other several components including cellulose, mineral, sugars, lipids, tannin, and several poly phenols amino acids such as alanine, arginine, asparagines and cytosine found in coffee bean (Belitz et al., 2009; Grembecka et al., 2007; Santos and Oliveira, 2001). Additionally, coffee bean contains vitamin complex B, niacin and chologenic acid proportion that may vary from 7 to 12%, three to five times higher than caffein (Beliz et al., 2009; Lima, 2003; Trugo and Macrae, 1984).

The present study deals with the cultivation of *Pleurotus ostreatus* on some common and abundantly available wastes of coffee and sholla leaves; they are used for conversions in foods, which otherwise are left for natural degradation and also provide necessary information for their further utilization. Most of these studies focus on the higher yield and quality of fruiting bodies of *Pleurotus ostreatus* with respect to higher yield substrate.

MATERIALS AND METHODS

Origins of selected mushroom species

The selected mushroom species used in this study were pleurotus species (*Pleurotus ostreatus*). They were initially imported from where they were available and obtained from Addis Ababa University, Mycology laboratory. They were finally brought to Microbiology Laboratory, Dilla University.

Preparations of culture media

Culturing of Pleurotus ostreatus on malt extract agar

The mushroom species, pure culture of pleurotus species was maintained on potato dextrose Agar (oxoid) at 4°C. After few days the culture was again recultured on Malt Extract Agar at 28°C.

Spawn production

Spawn was prepared in spawn bottles; 4 kg of whole grain of sorghum was soaked in water over night to moisten it. The ratio of sorghum and water was 1:1. It was mixed with 160 g of calcium carbonate; 360 g of wheat bran sorghum grain was packed in 10 spawn bottles and sterilized in autoclave at 121°C for 30 min. After the sterilization, the spawn bottles were inoculated with actively growing mycelium of pleurotas from media growth and incubated at 28°C for mycelium growth without any light for 15-20 days until the mycelium full covered the sorghum grains.

Substrate collection

The basic organic raw materials used for cultivation were *Coffea arabica* (coffee leaf) and *Ficus sycomorus* (Sholla) leaf and other additive like cow dung. Coffee and sholla leaves were collected from Dilla University main campus area. Cow dung was collected from Dilla University main campus (Figure 1).

Preparation of substrate

Based on the treatment, about 4 kg of fresh coffee and sholla leaves were mixed thoroughly with 80 g cow dung of calcium

Figure 2. Substrate prepared after sterilization for cultivating of mushrooms.

carbon. Ash was also added. Water was added to moisten it based on the rule of thumb method given by Buswell (1984) (Figure 2).

Cultivation of *Pleurotus ostreatus*

After preparation of substrate, each substrate was steam sterilized at 121°C for 15 min in autoclave. Balloon bags were filled with sterilized substrate; multilayered technique was adapted for spawning 4 kg of sholla leaves plus cow dung filled in bags and 4 kg of coffee leaves plus cow dung filled in plastic bags. Then spawn was added to each substrate after inoculation was maintained at room temperature. With sufficient light, the balloon tubes were torn off following the running of the spawn. The materials of the fruiting bodies were evident within some days, after removal of balloon tube bags.

Data analysis

The data of actively mycelium growth during spawn making and formation of full morphology of pleurotus mushroom species and fruiting body were observed during cultivation on substrate.

RESULTS AND DISCUSSION

Pleurotus ostreatus was cultured on malt extract agar for seven days at 28°C and mycelium covered the medium as indicated in Figure 3.

Preparation of spawn

Full white mycelia invasion of *pleurotus ostreatus* was observed in sorghum after 20 days of incubation (Figure 4). It was ready to for inoculation on solid substrate.

In spawn preparation, the *pleurotus ostreatus* mycelium gradual invaded the sorghum grains. Finally, the sorghum grain in the spawn bottles became completely covered by mycelium invasion; the growth of the mycelium is faster if it is kept in incubator under optimal temperature (Figure 4) within 15-20 days.

Cultivation of *Pleurotus ostreatus*

The formation of full morphology of fruiting bodies of *pleurotus ostreatus* was observed within 20 days.

Comparing the two lignocellulosic residues as substrates for the cultivation of *P. ostreatus* shows that sholla leaves led to the best growth of *P. ostreatus* as evidenced by the complete and heavy colonization of substrates forming a compact white mass of mycelium within 25 days of inoculation (Figure 6). Cultivation of the oyster mushroom on similar by-products has manifested variable levels of biological efficiency. These variations are mainly related to spawn rate, fungal species used and supplement added to the substrate (Mane et al., 2007).

The performances of the two substrates were also evident by their elevated fruiting body values on sholla leaves followed by coffee leaves (Figure 5). This might be due to the leaf content that contains some acids and phenols. Coffee waste is rich in anti-nutritional factors such as tannins. These substances have high capacity to bind proteins, making them unavailable to the organism and also act as enzyme inhibitors (Bressani, 1979; Mazzafera, 2002). Due to the presence of these anti-physiological/anti-nutritional factors, coffee waste is not considered as an adequate feed supplement for cattle and other livestock (Pandey et al., 2000).

In conclusion, mushroom cultivation involves having the wisdom and knowledge of growing fungi on waste plant materials that are not necessary consumed by humans. They may be converted to available foods. Commercial production of *P. ostreatus* mushrooms is largely determined by the availability and utilization of cheap by-products waste materials, which are agricultural wastes that are ideal and most promising substrates for cultivation. The substrates used in this study can be considered practical and economically feasible due to their availability throughout the year at no cost in large quantities. Utilization of these agro-wastes for the production of *P. ostreatus* mushrooms could be more economical, ecological and can improve food quality and similarly reduce food scarcity.

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Figure 3. Culture of *Pleurotus ostreatus* on malt extract agar.

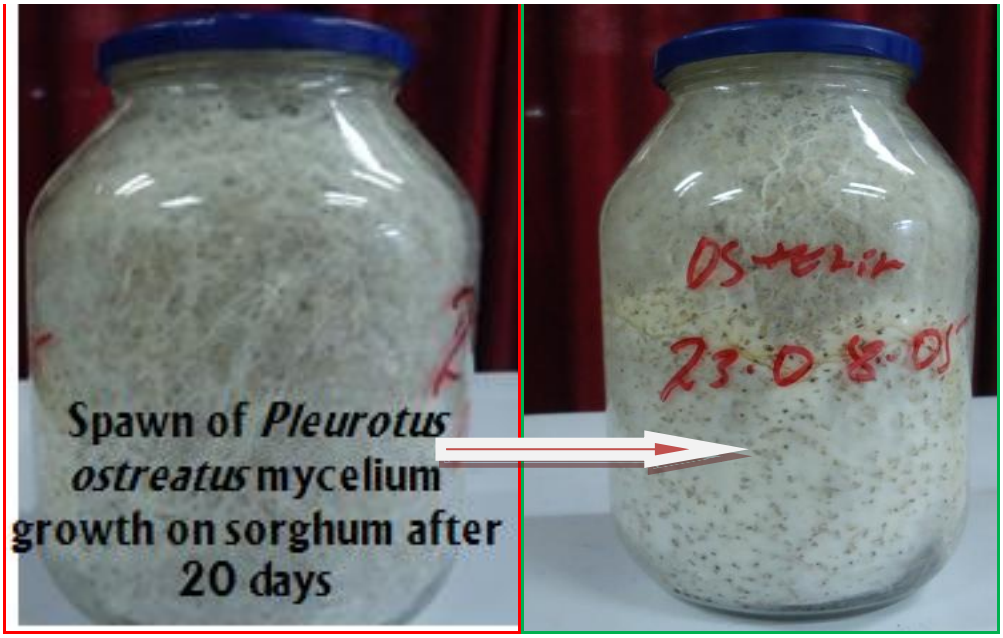

Figure 4. Full white Mycelium invasion of *Pleurotus ostreatus* was observed on Sorghum after 20 days of incubation.

Figure 5. The growing of fruiting body of *Pleurotus ostreatus* on coffee leaves substrate.

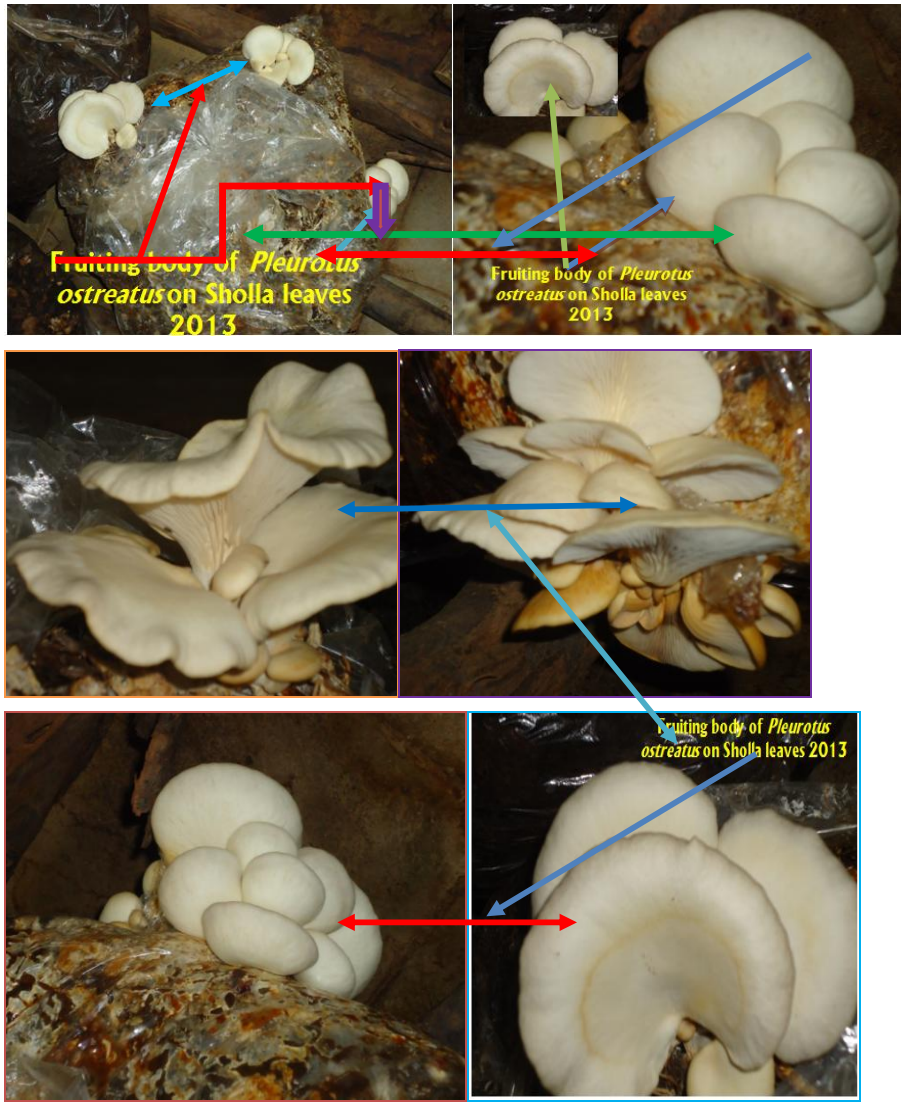

Figure 6. The growing of fruiting body of *Pleurotus ostreatus* on Sholla leaves substrate.

equipment during the whole period of this research work.

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