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USE OF THE TEA WASTES IN PLEUROTUS CULTIVATION AS AN ALTERNATIVE SUBSTRATE MATERIAL IN TURKEY UNDER CONVENTIONAL CONTROLLED CLIMATE

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Abstract - Oyster (Pleurotus ostreatus) mushroom is known as one of the most cultivated and consumed mushroom species in the world. The easy and rapid preparation of the substrate of this mushroom species is increased the interest of producers. The most commonly used substrate material in Pleurotus cultivation is sawdust. However, recently the difficulties in providing sawdust have led producers to search for alternative substrate materials. Therefore, different local agricultural wastes have started to be used in oyster mushroom cultivation in different countries. Tea is consumed as hot and soft drink in Turkish culture for long years. Therefore, tea wastes can be obtained in high quantities every year in the country. In this study, the effect of tea waste on cultivation of Pleurotus was investigated in Horticulture Department of Çukurova University between 2016 and 2017. The study was planned to be performed in two different climate conditions for mushroom growth room, since it is a well-known fact that climate conditions of the growth rooms directly affect the yield and the quality of the mushroom. In this paper the results of the room obtained with conventional climate control were given. In the study; poplar sawdust, oak sawdust, bran, wheat stalk and tea waste were mixed at different ratios: poplar sawdust:bran (2 w:1 w), oak sawdust:bran (2 w:1 w), wheat stalk:bran (5 w:0.25 w), tea waste: bran (3 w:1 w). High-temperature resistant polypropylene bags contained 1 kg substrate were used and 25 g mycelia were added to the each cultivation bag. At the end of the study, the highest yield was obtained from wheat stalk:bran and tea waste:bran mixtures with 210 g/1 kg substrate and 207.14 g/1 kg substrate, respectively. While 33 g/1 kg substrate was obtained from oak sawdust:bran mixture, poplar sawdust:bran mixture resulted with 74.11 g/1 kg substrate. The results obtained in the study clearly showed that tea waste can be used successfully as substrate material in Pleurotus cultivation.

Key words - Pleurotus ostreatus, cultivation, different substrates, tea waste

I. INTRODUCTION

Among the most cultivated and consumed edible mushrooms in the world, the order of Pleurotus varies between second and third. The most common cultivated species of Pleurotus genus is known as P. ostreatus. Many agricultural or forest waste materials are used in the production of Pleurotus species. The first studies on the cultivation of Pleurotus species known as poplar or beech mushroom in the Turkey started in the 1980s. Although there have been a lot of scientific researches on it, Pleurotus species are not still widely cultivated commercially in Turkey except small family productions. Unlike the Agaricus bisporus known as the most cultivated edible mushroom species in the world, Pleurotus species show significant differences in terms of the fact that the growing compost is non-fermented material and that it needs light during primordium formation. Cultivation of this mushroom is simpler and cheaper than other cultured mushroom species because it does not require compost preparation and it saves time and labor. In addition, since different species of Pleurotus can be produced at different temperature grades, they can be cultivated with low production cost year-round (Pekşen and Küçükomuzlu 2005; Kurt 2008). Nowadays rapid population growth, urbanization, industrialization, limitation of agricultural areas and destruction of the ecological landscape has reduced the sources of nutrients and as a result it has been seen to lead people to explore alternative sources of nutrients. In many countries, agricultural wastes such as stem, straw, bran and molasses during harvest of agricultural products and the processing of them with the industry are obtained. Most of these wastes are burned or left in the environment; the rest is regarded as animal feed. The burning of these wastes damages to the nature and the soil. When all this is taken into consideration, these wastes can easily be assessed in mushroom cultivation. The positive effects of mushroom consumption on human nutrition health are now clearly known by consumers. In many countries where agricultural production is intensive, many agricultural wastes, which can be provided at abundant and inexpensive costs, can also be used as substrate in mushroom cultivation without any preliminary treatment (Kara and Sezer 1992; Akyüz and Kırbağ 2009). Turkey is one of these countries with many agricultural wastes such as tea waste, viticulture waste, wheat straw, paddy straw, sesame straw and peanut shell. The wastes of some hot drinks such as coffee and tea have been used in mushroom cultivation in recent years. Filter coffee consumption is common in Europe and US, and for this reason coffee wastes can be used in mushroom cultivation in these countries (Velázquez-Cedeńo et al. 2002; Mata

et al. 2005). In Turkish culture, tea consumption is more common if we do not consider Turkish coffee. Tea wastes can be evaluated in mushroom cultivation in Turkey, as it is more difficult to collect Turkish coffee wastes. Tea wastes can obtain easily from cafes and restaurants. Also since tea brews on fire in Turkey, it does not need sterilization before use as substrate in mushroom cultivation. If the tea brewing wastes are collected quickly in the sterile boxes, they can be used without sterilization. These kinds of studies have been carried out in Turkey before. For example, tea waste was used in Ganoderma production by Peksen and Yakupoglu (2009) and the successful results were obtained. In this presented study, the effects and availability of different agricultural wastes, especially brewing tea waste on the mushroom cultivation were investigated.

II. MATERIAL AND METHOD

This study was carried out in the laboratories and mushroom growth room of Çukurova University, Adana, Turkey between 2016 and 2017. In the experiment, the mycelia of Pleurotus ostreatus species of Pleurotus genus were used. Different mixtures of oak sawdust, poplar sawdust, tea waste, wheat stalk and bran were tested as substrate. The ratios of mixtures were set as follows: : poplar sawdust:bran (2 w:1 w), oak sawdust:bran (2 w:1 w), wheat stalk:bran (5 w:0.25 w), tea waste: bran (3 w:1 w). The substrate mixtures prepared were filled into the high-temperature resistant polypropylene bags. One kg substrate was filled to the each bag and then the cultivation bags were sterilized in the autoclave at 121°C temperature under 1.2 atm pressure during two hours. Following the cooling of the compost, 25 g mycelia were added to the each bag in the laminar flow. After the mycelia planting, the bags were slightly shaken to allow the mycelia to come into contact with the substrate. Then cultivation bags were placed to the mushroom growth room kept at conventional climate conditions (25±2°C and 80-90% humidity). For this purpose, one of the mushroom growth rooms at Çukurova University was modernized and the air-conditioning system was changed. After mycelia development under dark condition, photoperiod was proved using 40 watt fluorescent lamp during 12 ours in a day. And again after mycelia development, the sides of bags were cut 5 cm wide and the mouths of bags were opened to induce primordium formation. Experiments were arranged in a complete randomized design with four applications and four replications contained three bags. Mycelia growth rate and total yield were measured during the experiments. Mycelia growth rate was calculated as “day number from the beginning of mycelia development to the end of mycelia development”. Total yield was measured as “weighing of mushrooms collected daily and calculation of the averages at the end of the experiment”.

III. RESULT AND DISCUSSION

It has been determined that the mycelia development periods of Pleurotus species cultured in different substrates changed between 18-55 days (Xiujin et al. 2001; Phillppoussis et al. 2000; Iwase et al. 2000) depending on the genetic structure of the variety cultured, the culture method, the biological structure of the plant materials used and the physical and chemical structure of the growing environment by different researchers (Akyüz and Kırbağ 2009; Kurt 2008). In our experiment, mycelia development periods were changed between 10-15 days. This period is shorter than previous studies, however may have been due to the use of smaller bags (1 kg) than previous studies. When we consider different substrate materials, the fastest mycelia development was observed in tea waste + bran and this was followed by wheat stalk + bran, poplar sawdust + bran and oak sawdust + bran (Table 1). Again primordium formation period in Pleurotus species is changed between 20 and 30 days depending on variety and subrate materials used (Khanna et al. 1992; Ragunathan et al. 1996; Yildiz et al. 1998; Ragunathan and Swaminathan 2003; Akyüz and Kırbağ 2009). In this study, first primordium formation period (Fig. 1) was observed in wheat stalk + bran after 22 days from mycelia planting and this followed with oak sawdust + bran and tea waste + bran (27 days) and poplar sawdust + bran (35 days) (Table 1). In a study carried out by Upadyay and Vijay (1991), it was determined that mycelial development of different Pleurotus species was completed at different times and that this period was 28-36 days in P. ostreatus (Küçükomuzlu and Pekşen 2005).

Compost materials	Mycelia Planting date	Mycelia development period order	Primordium formation (day)
Poplar sawdust + bran (2 w:1 w)	20.12.2016	3	35
Oak sawdust + bran (2 w:1 w)	21.12.2016	4	27
Wheat stalk + bran (5 w:0.25 w)	23.12.2016	2	22
Tea waste + bran (3 w:1 w)	22.12.2016	1	27

Table 1. Mycelia development and primordium formation periods in the different substrate material

Compost materials	Cultivation bag number	Total yield	Mushroom number	Yield (g)/ 1 kg kompost
Poplar sawdust + bran	9	667	50	74.11
Oak sawdust + bran	3	99	9	33
Wheat stalk + bran (5 w:0.25 w)	14	2940	147	210
Tea waste + bran (3 w:1 w)	7	1450	80	207.14

Table 2. Yields obtained from different substrate materials

Fig. 1. A picture of primordium formation

When we compared the yields obtained from different substrate materials, the highest yield was obtained from wheat stalk + bran with 210 g/1 kg compost, however the yield of tea waste + bran was found to be very close to wheat stalk + bran with 207.14 g/1 kg compost (Fig. 2). The lowest yield was observed in oak sawdust + bran with 33 g/1 kg compost (Table 2).

Different substrate materials have been tested in cultivation of Pleurotus species by different researchers. For example, coffee wastes in P. ostreatus and P. pulmonarius by Velázquez-Cedeño et al. (2002); banana leaves in P. osreatus and P. sajor-caju by Reddy et al. (2003); coffee grounds in Pleurotus spp. by Mata et al. (2005); rice stalk and coir fibre in P. florida by Shashirekha and Rajarathnam (2007); wheat straw and barley straw in P. ostreatus by Dahmardeh et al. (2010); date palm wastes in P. ostreatus by Alananbeh et al. (2014); pruned wax apple and indian jujube branches in P. eryngii (DC.:Fr.) Quél by Hwang et al. (2015); wheat straw, corn stalk, poplar sawdust, Ferula communis plant waste, wheat bran and rice bran by Kibar (2016); corn silage in P. ostreatus by Kibar et al. (2016); cassava peels, banana leaves and amended sawdust in P. pulmonarius and P. ostreatus by Garuba et al. (2017). Easily available and cheap substrate materials have been studied in these regional studies.

The first objective in this study was to reveal the effects of brewing tea waste on mushroom cultivation. For this reason, the results obtained were promising. Offering tea to guests in Turkey is one of the indicators of hospitality. In addition to serving tea to the guests in the houses, tea is also served to the customers after eating in the restaurants and cafes. Therefore, large quantities of brewing tea waste are emerging every year and are being thrown away in Turkey. All these brewing tea wastes can be collected in sterile boxes in restaurants and cafes and used in mushroom growing. Thus, both these wastes can be evaluated in the different agricultural activity and a different substrate material can be provided to prepare compost for mushroom production. It is also important to obtain positive results from wheat stalks in Turkey where wheat cultivation is carried out in abundant quantities.

Fig. 2. A picture of pleurotus mushroom before harvest.

This study is a small-scale initial research to investigate the effect of brewing tea waste on P. ostreatus. However the results obtained are promising for further research. Therefore, experiments will be repeated with more cultivation bags in the future studies.

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