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Short Communication

Potential of Shiitake mushroom (*Lentinula edodes*) cultivation in Algeria

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Fungi are the second largest group of organisms on the earth and play a key role in a large number of ecosystems (Floch, 2012). Fungi are a separate kingdom and these synthesize molecules that are unique and not found elsewhere in the living world. Mushrooms belong to Ascomycetes or Basidiomycetes class of kingdom fungi. Oak Lentin or Shiitake (*Lentinula edodes*) is the most cultivated mushroom and represents 25% of world mushroom production (Diallo *et. al.*, 2020). This mushroom *Lentinula edodes,* is intensively cultivated in Asia (in particular in China and Japan). *Lentinula edodes* is high in protein, vitamins and triterpenes (Diallo *et. al.*, 2020). This mushroom, although being the most consumed mushroom in the world but unfortunately its consumption by Africans, particularly in Algeria is negligible, regardless of its numerous benefits. This may be due to the high prices of imported mycelia, or perhaps the non-cultivation of shiitake in Algeria. The most obvious reason is the lack of consumer interest and awareness about their health benefits. This is why it is difficult to find this fungus in Algeria, The objectives of the study are to see the potential of the cultivation of this mushroom in Algeria.

Mushroom cultivation depends upon a source of pure mycelium on agar to process further (Par, 2012). The stages in cultivation of mushroom includes collection of spore prints, germination of spores on agar medium or culturing healthy tissue to get pure mycelium, preparation of inoculum (spawn) on suitable sterile substrate (wood chips, grain or oak wood), inoculation of the substrate (cut tree trunk, sterilized saw dust, straw with coffee ground or cereal) with spawn.

Pure culture preparation

The mother culture is made from a fresh and healthy fruit body in the laboratory or can be purchased from a reliable source. The pure culture is raised following Oei *et al.* (2005) on a culture medium following Impion (2010). The culture medium contains sliced potato (washed but not peeled) 200g; Dextrose 15g; Agar-agar 20g; water 1000 ml.

Preparation of inoculums (Spawn)

Spawn is prepared by transferring the culture on a secondary substrate (mostly sterile grain/wood pegs) under sterile conditions, which is incubated for two to three weeks till the substrate is completely covered with mycelium (Mudge, 2013).

Cultivation in saw-dust bags

The sawdust substrate contains saw dust (non-resinous) – 2.5 kg; rice bran – 100 g; corn or wheat flour- 50 g; $CaCO_3$- 2.5 g (Larosa, 1968). Sawdust soaked in lukewarm water to achieve a humidity level of 60-70% is mixed with all the ingredients and steam sterilized in polypropylene bags before it is inoculated with grain spawn.

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Cultivation on wood logs

In the wild, shiitake or *Letinula edodes* grows on the trunks and branches of dead deciduous trees of the Fagaceae family (Makoto, 2020). Healthy trees to be inoculated should be felled between late autumn and early spring (i.e. from early to mid-November in the region), this is the period of its dormancy because the bark adheres better to the tree and the concentration of sugar in the wood is higher. It is necessary to keep the bark intact as much as possible. Using freshly cut logs with a length of 80cm to 120cm, the denser the wood and the taller the diameter of the log, the longer and more abundant the harvest will be. So the shiitake likes thin (10-20 cm) and long (> 1m) logs (Sénéchal, 2008).

Seeding of logs by mycelium

Using a drill, a series of 8 mm holes are made in the fallen tree trunks. The sowing of the logs is done with pegs inoculated with mycelium, good humidity is maintained by watering during dry periods. Place logs in shade area to protect these from the wind and the sun. It takes months to complete the mycelia colonization and fruiting starts with giving cold shock to the logs (Makoto, 2020).

Humidity and temperature conditions

The logs remain arranged for the invasion phase of the mycelia for 1.5 to 2 years depending on the diameter and the species of the logs. Logs completely invaded by mycelium should be kept at 75-80% humidity, temperature (between 18 and 25°C) and diffused light (Demers, 2021). The logs are kept in a raised position. Water should be sprayed to maintain humidity (Piot, 1983).

Physiological requirements

The mycelial growth of shiitake and the development of the sporophore are markedly influenced by certain environmental factors such as: temperature, humidity, air, light and pH (Diallo *et. al.*, 2020).

Temperature: To induce the fruiting in mushrooms, it is often necessary to cause a sharp change in temperature. When temperatures are too high, enzymes are inactivated. As a result, the metabolism (therefore growth) is slowed down. Also, when temperatures are too low, nutrient absorption becomes difficult and mycelial growth decreases. The optimum temperature for growth of Shiitake mycelium is 24-27 ° C (Chang et al., 2004).

Humidity: Water is important and necessary for the growth and development of the shiitake, as it dissolves the nutrients before they are absorbed by the mycelium. When the water content in the substrate is less than 50%, the sporophore growth becomes difficult. On the other hand, when it is greater than 70%, the sporophore may rot before harvesting. The relative humidity in the cropping rooms should be maintained 80 to 90% (Chen, 2005).

Air: During growth and development, organic compounds are oxidized and the energy thus released is used in mycelial growth and fruiting. Different stages of shiitake production require different amounts of oxygen. During the formation of fruiting bodies, oxygen requirements are higher and the concentrations of carbon dioxide released are also higher (Chen, 2005).

Light: Light is a key factor in basidiocarp formation and development. During the fruiting phase, the optimum light level is 50-100 Lux. Prolonged exposure to intense light can reduce the number of sporophores, while a lack of light decreases the diameter and length of the stems (Chen, 2005).

pH: The best pH range for sporophore formation in shiitake is 3.5 - 4.5. The organic acids formed during mycelia growth lead to a decrease in the pH of the substrate. The wood and straw used for growing

shiitake are known to generally have the correct pH and not needed to be adjusted (Diallo *et. al.*, 2020).

Nutritional requirements

Nutritional needs (carbon source, nitrogen source, minerals, vitamins and trace elements) and environmental (temperature, humidity, oxygen-air, light and pH of the substrate) are determining factors in the cultivation of shiitake (Diallo *et. al.*, 2020) .

Nitrogen: Nitrogen is an essential element for the synthesis of proteins and other compounds and the basic and cellular structural elements of fungi. The bark of the wood contains 3.8% to 5% nitrogen, while the xylem contains only 0.4 to 0.5%. A substrate with a carbon / nitrogen ratio of 25: 1 is considered suitable for mycelial growth while a medium with C / N of 40: 1 is suitable for sporophore production (Chen, 2005).

Minerals and trace elements: Mineral elements play an important role metabolism of the organism. Phosphorus, sulfur, calcium and magnesium are the most important components. Phosphorus and potassium are useful not only for mycelial growth, but also promote good fruiting (Diallo *et. al.*, 2020). Magnesium activates enzymes responsible for the decomposition of lignocelluloses. Potassium and magnesium are also used to buffer the substrates (Chang et al., 2004).

Vitamin B_1: Generally the optimal growth of the fungus and its fruiting necessarily require a supply of vitamin such as thiamine (B_1). This vitamin, considered to be a carboxylase coenzyme, is known for its role in the regulation of carbohydrate metabolism by converting pyruvic acid to acetaldehyde and carbon dioxide. Vitamin B_1 is heat sensitive; it decomposes at high temperatures. Therefore, prolonged heating at very high temperatures should be avoided during substrate sterilization (Chang et al., 2004).

Harvest

The shiitake mycelium needs at least 16 months to develop sufficiently. Fruit body induction can be stimulated as long as the average temperature remains between 15 and 22°C. The logs are soaked in water overnight. To get beautiful mushrooms, the logs are placed inside or under shade with diffused light. After 7-10 days the fruit bodies appear followed by mature mushrooms ready to pick. A subsequent soak can be given 10 weeks later. This method of controlling the fruiting period is suitable only for shiitake. Thus, we can harvest mushrooms for 4 years, 2 or 3 times a year, from June to October. If logs are not soaked, the harvest can be spread over 7-10 years, but the quantities are lower. When cultivation is complete, the wood can be left to dry and can be used as fuel (Desbrosses, 1974).

CONCLUSION

Lentinula edodes is an edible mushroom, cultivated and marketed for centuries due to its nutritional and medicinal properties and its high protein, fiber, mineral content and low in calories. Today, the world population is trying to take more interest in nutrition by consuming more and more natural products and improving our consumption habits.

In addition to its availability and consumption of shiitake in China, Japan and other East Asian countries, it is available in the markets of Western countries in ample quantity while on the other hand its consumption in Africa and Algeria is almost zero. Abundance of the raw material for this mushroom means a great potential of its cultivation in Algeria and it can become a consumable product because of its food value. Sawdust as well as forest product is easily available in Algeria and if we can tap the potential of this mushroom for nutritional securities, it can provide several benefits to the people of the country.

Shiitake mushroom can be cultivated on wood log as well as synthetic saw dust bags in Algeria as forest products are available in ample in the country. The mushroom cultivation method on logs allow to use diverse forest products, additional sources of income for farmers, add value to available tree species such as beech, extend the period of employment of maple syrup workers ~~(Sénéchal, 2008).~~

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