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REVIEW PAPER

Biology and Cultivation of Black Ear Mushroom – *Auricularia* spp.

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ABSTRACT

The black ear mushroom comes under jelly fungi category. The term "Jelly fungi" is applied to species of fungi having gelatin like consistency. The fruiting body is distinguished by its noticeably earlike shape and brown to black colouration. It is widespread throughout temperate and subtropical zones worldwide. The mushroom *Auricularia* has well developed hyphae, primary, secondary and tertiary mycelia, dolipore septum and clamp connections. Cultivation of this mushroom involves two important methods like spawn production and fruiting body production. Mycelia obtained from tissue culture were used to produce grain spawns. Log method, artificial log method and Poly bag methods are the common methods for fruiting body production.

Key words *Auricularia spp, fruiting body, biological description, spawn and cultivation substrates*

Auricularia spp. known as the Jew's ear, wood ear, jelly ear or by a number of other common names, is a species of edible Auriculariales fungus found worldwide. The fruiting body is distinguished by its noticeably earlike shape and brown colouration, Its specific epithet is derived from the belief that Judas Iscariot hanged himself from an elder tree~ the common name "Judas's ear" eventually became "Jew's ear", while today "jelly ear" and other names are sometimes used. The fungus can be found throughout the year in temperate regions worldwide, where it grows upon both dead and living wood. Although it is not widely consumed in the West, it has long been popular in China, to the extent that Australia exported large volumes to China in the early twentieth century. Today, the fungus is a popular ingredient in many Chinese dishes, such as hot and sour soup, and also used in Chinese medicine (Chang and Miles, 2004). *Auricularia*, now widely cultivated in China, Taiwan, Thailand, Philippines, Indonesia and Malaysia, black fungus or wood ear mushrooms (*Auriculariaauricula* and *A. polytricha*) are widely considered to be the earliest cultivated mushrooms. Production of wood ear accounts for about 6% of the world's total output of mushrooms. Annual production of *Auricularia* spp. in China alone reached nearly 3.6 million t in 2010 making them the second most widely cultivated mushrooms in that country (Li, 2012).

Habitat, ecology and distribution

Auricularia spp. grows upon the wood of deciduous trees and shrubs, favouring elder. In up to 90% of cases, the mushroom is found on elder, but it is often incorrectly assumed to grow exclusively on elder. Recently, *A. auricula* has been recorded from semi evergreen to evergreen and wet evergreen shola forests in the Western Ghats, India. This species occurs scattered and in clusters on dead or dying branches of trees, on main trunk, decaying logs, etc. This species occurs during the monsoon period in large imbricate clusters and under high humid conditions produces exceptionally large sized basidiomes. (Harding and Patrick, 2008). Commonly growing solitarily, it can also be gregarious (in a group) or caespitose (in a tuft). It is widespread throughout temperate and subtropical zones worldwide (Ingold, 1985; Du *et al.,* 2011). In Kerala, *Auricularia* spp. were obtained from Thiruvananthapuram district. (Vidyaresmi, 2008; Geetha, 2011; Mohanan, 2011).

Biological description:

Somatic structures are having well developed hyphae with different zonations (Lowy, 1952). It bears 3 types of mycelium viz., primary, secondary and tertiary mycelia along with dolipore septum and clamp connections.

Fruiting bodies - characters:

The fruit body of *A auricula*is normally 3 to 8 centimetres (1.2to 3.1 in) across, but can be as much as 12 centimetres (4.7 in). Itis distinctively shaped, typically being reminiscent of a floppy ear, though the fruit bodies can also be cup shaped (Onyango *et al*., 2011a).It is normally attached to the substrate laterally and sometimes by a very short stalk. The species has a tough, gelatinous, elastic texture when fresh, but it dries hard and brittle. The outer surface is a bright reddish tan brown with a purplish hint, often covered in tiny, downy hairs of a grey colour (Mohanan, 2011). It can be smooth, as is typical of younger specimens, or undulating with folds and wrinkles. The colour becomes darker with age. The inner surface is a lighter grey brown in colour and smooth. It is sometimes wrinkled, again with folds and wrinkles, and may have "veins", making it appear even more earlike.(Sterry *et al.*, 2009)**.** The spores of *Auricularia* are long and sausage shaped, ranging in size from 16 to 18 micrometres (ìm) long by 6 to 8 ìm thick. The spores themselves are white, cream or yellowish, and arehyaline (Young *et al*., 2005). Basidia 60-72x47.5ìm~sterigmata lateral, well developed, 34.5ìmlong (Mohanan, 2011). Spores smooth, hyaline, reniform to allantoid, 14-18× 68ìm, guttulate (Philips and Roger, 1981).

Life cycle of *Auricularia* spp.:

Haploid basidiospores germinate in a suitable environment and grow into short lived haploid mycelia. Undifferentiated hyphae from two haploid mycelia of opposite mating type undergo plasmogamy, creating a dikaryotic mycelium that grows faster than, and ultimately crowds out, the parent haploid mycelium. Karyogamy occurs in the terminal dikaryotic cells. Each cell swells to form a

diploid basidium, which rapidly undergoes meiosis and yields four haploid nuclei. The basidium then grows four appendages (sterigmata), and one haploid nucleus enters each appendage and develops into a basidiospore. When mature, the basidiospores are ejected from the sterigmata (by releasing surface tension) in a process known as ballistospory. After the spores drop below the cap they are dispersed by the wind.

Cultivation of *Auricularia* spp.

Recorded 1st cultivated mushroom in China during 600 AD.*The Chinese MateriaMedica* – was a classical Chinese book, which showed the older method of wood ear cultivation in Tang dynasty. (Lou, 1978; Quimio, 1979). Cultivation involves two important steps like spawn preparation and fruiting body production.

Spawn production:

Mycelia obtained from tissue culture were used to develop grain spawns. The grains were soaked in water for four hours to soften before being utilized for spawn production. The weighed grains and brans were then thoroughly mixed by hand. Each grain formulation (300 g) was mixed with 10 g of $CaCO_3$ powder to regulate their pH. Grain combinations were put in 500 ml heat resistant glass bottles or Polypropelene covers and autoclaved for 1 hour at 121°C. Bottles were allowed to cool. The agar pieces were carefully transferred to upper surfaces of prepared grains. Inoculated grain bottles were tightly secured using moist cotton wool and covered with sterile aluminum foil and bottle lids. They were kept in dark sterile cabinets at ambient room temperatures for 7- 20 days until they were fully colonized to get mother spawn, then they are used to produce commercial spawns (Sinden, 1934) along with Paddy grains, Maize grain and Rubber saw dust were best substrate for spawn run with a minimum of 16 and 18 days respectively required for fluffy growth of mycelium in the grains. This is due to the nutrients are directly available to the fungus. (Vidyaresmi, 2008).The effect of the supplementation of the sawdust medium with 0.5% Mg carbonate and Mg hydroxide increased the mycelia growth. (Tabata and Ogura, 2003). Supplementation with rice and wheat bran provides a protein rich medium which can increase rate of mycelia growth two-fold. (Onyango *et al*., 2011b).The smaller size of crushed corn along with 60% moisture provides a larger surface, making the nutrients becomes more accessible for the mycelia hyphae, compared to intact corn (Razak, 2013).

Fruiting body production

a. Log method of cultivation:

After the trees are felled, the trunks are cut into logs. The length of logs is 30*15 cm the cut surfaces as well as scars on the logs are generally smeared with Bordeux mixture to prevent the attack of wood- decaying fungi. The logs were inoculated by spawn of *Auricularia* after boring the holes of 1 cm with a hand drill. The inoculated logs were covered with bark then smeared with wax in order to avoid the decay by letting water inside. The cultured logs were piled up, it takes longer time to produce the fruiting bodies (Cheng and Tu, 1978).The most prolific production was from kukui which had yields almost eight times greater than koa (Schenck and Dudley, 1999).

b. Artificial log method:

i. Cultivation in Sawdust: Sawdust -78%, Rice bran-28%, White sugar -1% and Calcium carbonate-1%. Saw dust has to be soaked in water for a day, excess water should be drained out, the material was sun dried and mixed with all the ingredients mentioned above and filled in polypropylene cover. The mixture has to be sterilized in an autoclave. After autoclaving, the beds has to be inoculated with spawn and incubated for complete mycelia run. The beds are cut open for inducing fruiting bodies (Stamets, 1993).

ii. Cultivation in Compost:

Raw materials: Sawdust -78%, Rice bran- 28%, White sugar -1% and Calcium carbonate-1%

Composting of sawdust for *Auricularia*cultivation usually takes five days to produce the type of compost required. Mix thoroughly the weighed raw materials indicated above and maintain moisture level at 65-70%. Pile the material in pyramid shape, turnings should give at 2 days interval then supplements are added. After completing compost preparation, sterilized and allowed to inoculation and fruiting body formation of *Auricularia* (Quimio, 1977).Rubber saw dust when used as a substrate for the growth of *Auricularia*gave maximum yield of 180.67 g in 3 harvests. (Vidyaresmi, 2008).The *Falcataria. moluccana*is the most suitable tree spp. that can be used for making the substrate for cultivation (Irawati *et al*., 2012).Composted substrates supplemented with 10% wheat bran supported higher yields in any substrates (Onyango *et al*., 2013).

c. Poly bag method:

Take good quality of wheat straw. Soak for 16-18 hours then drain out excess water. Mix 5% wheat bran (w/w). Fill 2kg substrate in each polypropylene bag and autoclave at 22 lbs pressure for 1-1.5hr. On cooling spawn the substrate at 2% and incubate at 25-26°C for spawn run for 20-25 days. On completion of spawn run give cross cut to give slits and hang the bags for fruiting at 25-26°C. Spray water twice on bags and maintain high relative humidity (85-90%) by spraying water in the room. Give 1-2 hrs. diffused light and aeration also. Fruit bodies will emerge in 10-12 days will mature for harvesting in the next 4-5 days. One can harvest 1.0-1.4 kg fresh mushroom per kg dry straw in 3-4 flushes. Mixing of wheat bran and rice bran with paddy straw at 3:1 ratio was found to induce faster growth of *A. polytricha*in beds (Devi *et al*., 2013)

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