BIOLUMINESCENCE – THE MYSTERY OF NATURE. RESEARCH ON CULTIVATION OF LUMINESCENT MUSHROOM

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Published 7th November 2006

In Vietnam, luminescent mushrooms have been put to unusual applications. For example during the Vietnam war, to avoid being spotted by enemy aircraft, the Vietnamese army used to wear luminescent chunks of rotting wood behind their hat to keep track of each other while operating at night in the forest. In these chunks, mycelia system of luminescent mushrooms grow strongly.

Luminescent mushrooms are widely distributed in Vietnam. They often appear in rainy and sunny months. Local people have collected and put luminescent fruit-bodies in plastic bags to use them for illumination at night.

In 2002, with investigations at a rubber tree area in Southeast Vietnam, we collected many strains of luminescent mushroom. The gene that is relatively widespread and successfully cultivated is taxonomically named *Omphalotus af. illudent.* They can emit light from whole of fruit-body (cap and mycelia), especially in their spores.

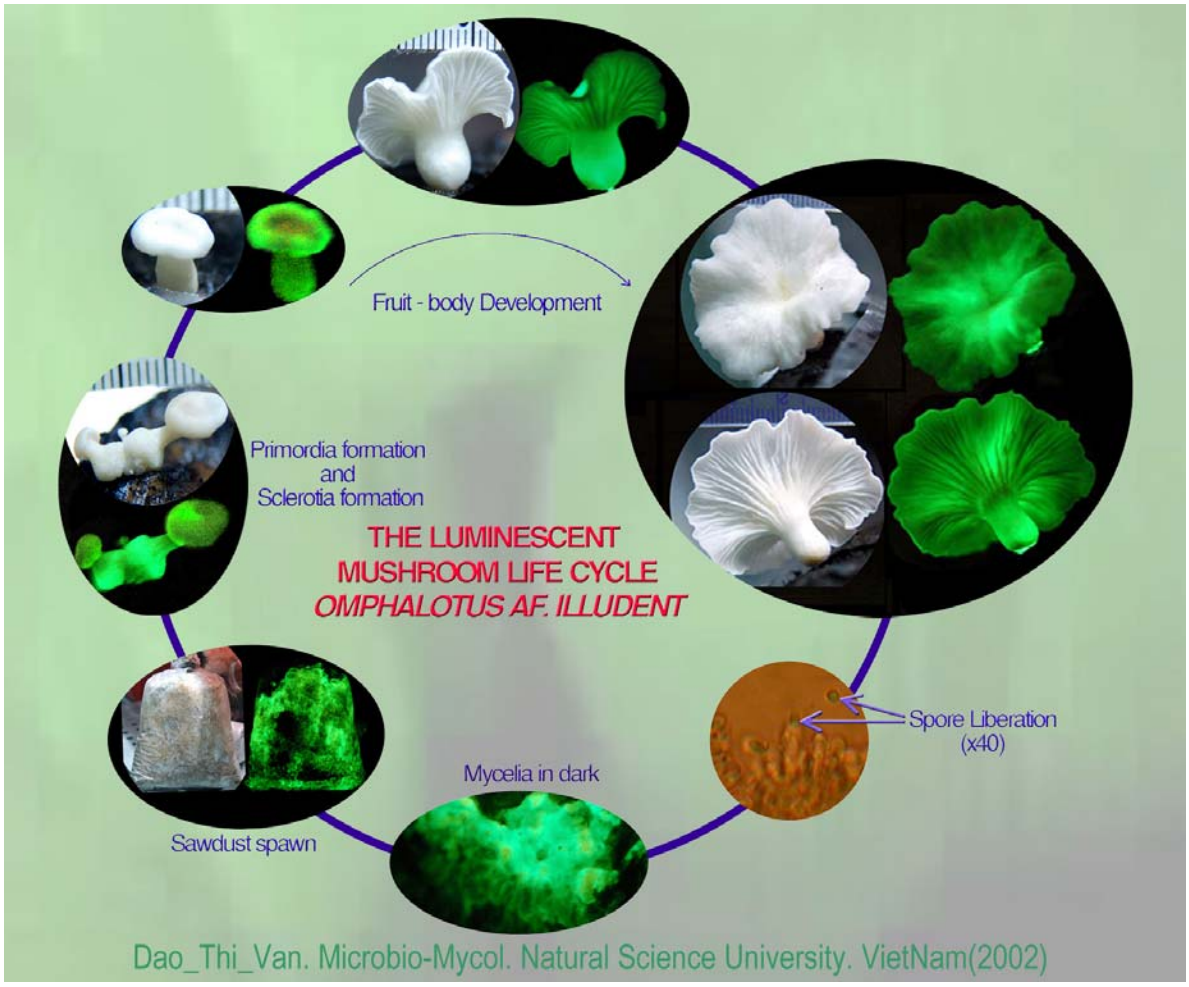
I. MORPHOLOGY CHARACTERISTICS AND ITS LIFE CYCLE

1.1 Morphology characteristics

- Fruit-body is white, cap is funnel form, 2,5-5cm in diameter of cap
- Stem is round, short, no ring, 7- 9cm in length.
- Gill is large and extends to the stem, 0,20- 0,25cm in width. There are 40- 50 gills in each cemtimetre.
- Spore is egg shaped, white and 1,8-2 x 1,2-1,3 μm in diameter.

They can emit light in darkness from cap, stem, gill and spore.

Figure1: fruit-body Figure 2 : operated fruit-body



The key of taxonomy by Jean Marie Polese (2000) was used to classify and name it *Omphalotus af. illudent,* Paxilaceae farmily, Boletales order, Basidiomycetes Class, Basidiomycotina Phylum. This mushroom has not been mentioned either in the mushroom collection in Vietnam or in the world.

I.2 Emitting-light capability of this gene

This strain is a tropical mushroom, easy for cultivation and fruit-body formation in pilot. Emitting light capability of this strain is particular :

- Both mycelia system and fruit-body are able to emit light.
- Parts of fruit-body included cap, gills, stem and spore are able to emit light.
- Light from fruit-body is continuous and pale-green in colour.

With these characteristics, this gene can be used as ideal material for research on bioluminescence.

II. CHARACTERISTICS OF CULTIVATION

II.1 Characteristics of cultivation

- Nutrious media is malt extract (MA): glucose 2g; malt extract 20g; peptone 1g; agar 20g; pure water 1000ml, is the best media for cultivation and multiplication.

- Composting media is rubber sawdust: sawdust is wetted with calcium carbonate (0,5%) solution and incubated in at least 24 hours. After incubating, compost pile is complemented ammonia (sulfate ammonia - concentration 3 – 5‰) or grain starch (10 – 15%). Humidity of sawdust pile is adjusted to 60%. After all, making sawdust bags and sterilization by hot steaming (95^{o}C) in 5 – 6 hours or 121^{o}C in 90 minutes.

During mycelia growth, optimal room temperature is 30^{o} ± 2^{o}C and illumination power (< 100 lux). Time for mycelia growth is 20 days with sawdust-300g bags and 25 days with sawdust-600g bags.

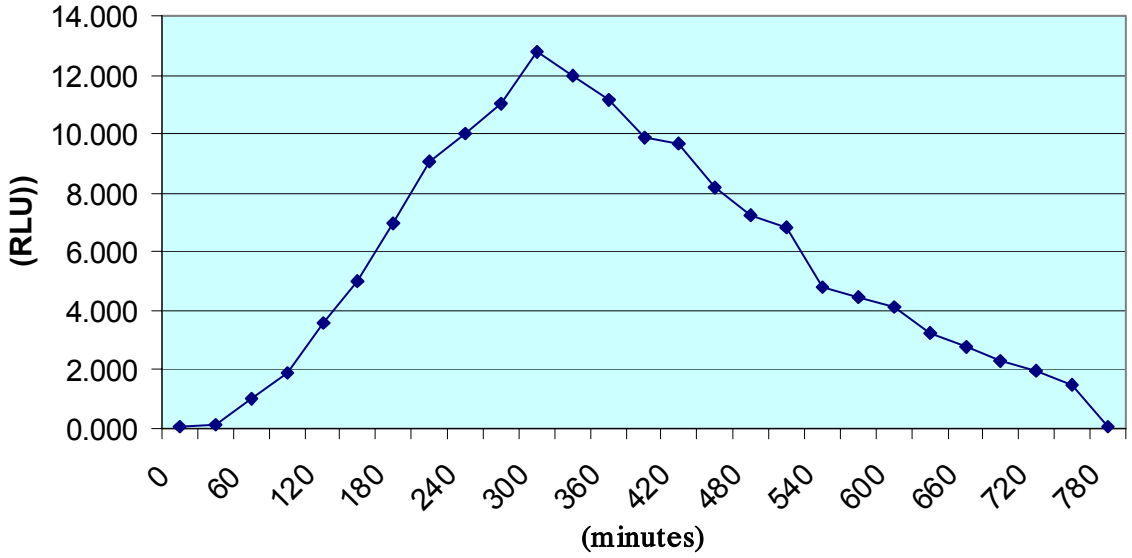
During fruiting body, the optimal conditions for fruit-body formation and development : temperature is 26^{o} – 30^{o}C, air moisture is 80 – 90%, illumination power through watering-room is 500 - 800 lux. Time for watering and fruiting is 21 days, time from fruit-body appears to fall off is 7 days.

II.2 Characteristics of luminescence

II.2.1 *In mycelia*

Observation of luminescence of mycelia in opened air (oxygen) following time is showed at Chart 1. After 5 hours in oxygen, glowing of mycelia is maximum and then fall down to 13th hour and stop emitting light.

Chart 1: Intensity of mycelia in opened air following time



Using a luminometer for accurately measuring light intensity from mycelia. RLU – relative light unit

Mycelia in sawdust spawn emitting light at night. It's very clearly in figure : 3a, 3b, 4a, 4b

Figure 3a : mycelia in sawdust spawn (under flashlamp)

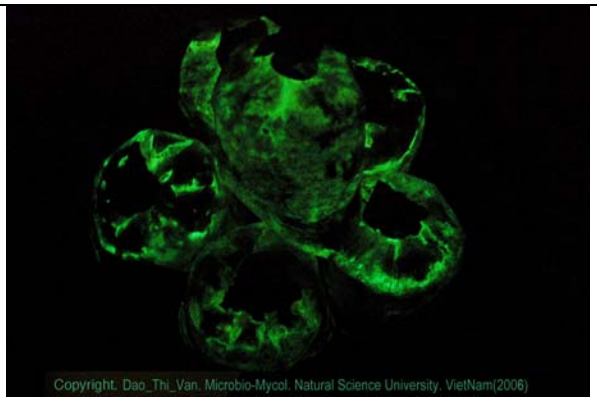


Figure 3b : mycelia in sawdust spawn (in darkness)

Figure 4a : mycelia in sawdust spawn (under flashlamp)

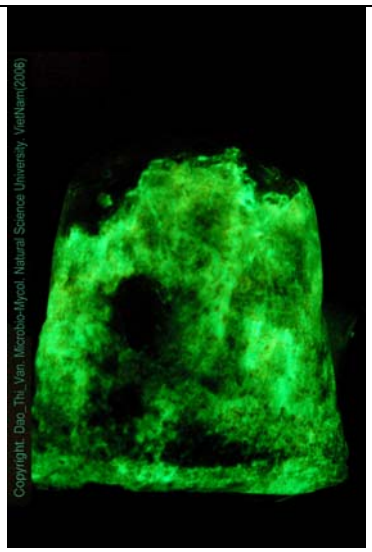


Figure 4b : mycelia in sawdust spawn (in darkness)

1.2.1 *In fruit-body*

After 4 days from fruit-body appearance, fruit-body start emitting light until fruit-body turn yellow colour, stop glowing.

This gene able to emit light during developing stage of fruit-body (in figure 5a, 5b, 6a, 6b)

Figure 5a : 4-day fruit-body (under flashlamp)

Figure 5b : 4-day fruit-body (in darkness)

Figure 6a : 5-day mature fruit-body (under flashlamp)

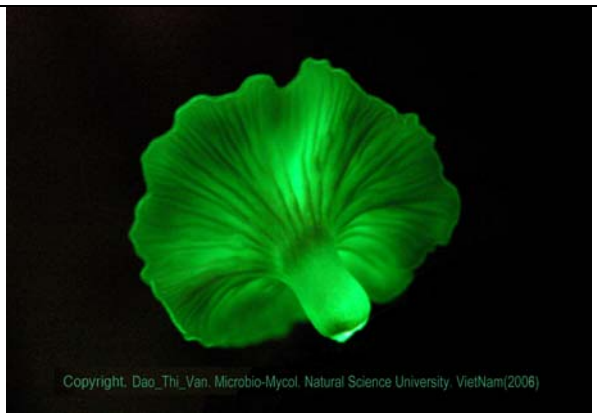


Figure 6b : 5-day mature fruit-body (in darkness)

III. APPLICATION POTENTIAL OF LUMINESCENT MUSHROOM

Continuously glowing cappability and higher intensity of the luminescent mushroom when comparing to other luminescent organisms is an interesting characteristic. Many scientific researchers have incorporated luminescent mushroom into applications in testing for pollutants (ions of mercury_Hg)in water supply when concentrations are too low to detect by conventional means. This gene can play important role as a biosensor. In addition to its particular characteristic (as a lux-gene), this gene can be used in lux – gene transformation into living organism to make desired luminescent organism. Today, luminescent mushroom is providing benefit to mankind, by bettering our lives especially in regard to it's biomedical application.

Futher research with bioluminescent fungi is being conducted on a world wide scale and include North America, Japan and Europe. Many of research results state that luminescent mushroom is interested in not only by its luminescent characteristic but also by its biomedical applications. Fungi are of special interest because like us, they are eucaryotes and our metabolism is more related to theirs than to that of the procaryotic bacteria. The metabolite from luminescent mushroom present the effectively bioactive in anti-mould, anti-bacteria, anti-virus and especially in inhibiting growth of cancer cell. Therefore, a number of metabolites were isolated from fungi which found their way into medical applications as natural products, starting material for pharmaceuticals or as lead structures for the development of pharmaceutical products.

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