THE EFFECT OF UV RADIATION ON THE MYCELIA GROWTH OF WHITE BUTTON MUSHROOM AND THE PATHOGENIC FUNGI OF CULTIVATED MUSHROOMS

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ABSTRACT

Agaricus bisporus (LANGE/IMBACH) is the most commonly cultivated edible mushroom of the world. Hungarian production of this species takes place mainly in limestone cellars and in no longer used stables. In most of these facilities the growing conditions are not always optimal; it is difficult to face the hygienic regulations and to ensure effective prevention. Two pathogenic fungi – *Verticillium fungicola var. fungicola* PREUSS (dry bubble disease) and *Mycogone perniciosa* MAGNUS (wet bubble disease) – are the most serious diseases occurring during the growing period.
The sterilizing ability of UV radiation is well known. In our experiment the effect of UV light on the in vitro tissue culture of white button mushroom and the two diseases were examined. The aim of the study was to determine which UV light range and irradiation time is more effective against the two pathogens. With proper application, UV irradiation could function as an additional technique in mushroom protection, by preventing diseases in growing houses and cellars.

INTRODUCTION

Agaricus bisporus (LANGE/IMBACH) is the most commonly cultivated edible mushroom of the world (FruitVeb, 2010). In Hungary, the cultivation of this species takes place mainly in limestone cellars and in no longer used stables.
In the recent years, many technological improvements were introduced. Growers started using new hybrid strains with higher productivity, improved casing soil mixtures, and the usage of Phase III. compost became widely common as well (Győrfi, 2002).
As most of the Hungarian growing facilities have been in operation for decades now without any technological modernization – many of them are not properly air-conditioned, and the growing conditions are not always optimal –, it is difficult to face the hygienic regulations (Győrfi, 2010).
Two pathogenic fungi – *Verticillium fungicola var. fungicola* PREUSS and *Mycogone perniciosa* MAGNUS – are the most serious diseases occurring during the growing period (Aponyiné et al., 1998; Fletcher – Gaze, 2008). In order to prevent their appearance, growers disinfect the rooms, sterilize the equipment, minimize human contact with the growing materials and use certain chemicals against mushroom flies which act as vectors of diseases (Rácz – Koronczyné, 2003, Győrfi, 2008a, b).
There are only a few chemicals which can be used against pathogens in mushroom cultures, thus it is necessary to focus on prevention (Győrfi, 2003). Before new crop, growers disinfect

the growing area, the surfaces and the equipment. They apply vector nets to prevent appearance of mushroom flies (*Sciaridae* and *Phoridae*) and other insects (Szili, 2008, Győrfi, 2009). Years of experience prove that in the traditional growing houses these mushroom protecting procedures are not effective enough by themselves; additional methods should be brought into the production.

There are ongoing researches focused on using UV radiation for enhancing the vitamin D content of mushrooms in the Department of Vegetable and Mushroom Growing. Part of this research is to examine the effect of UV light on the *in vitro* tissue culture of cultivated and pathogenic fungi. The sterilizing ability of UV radiation is well known, UV lamps are already used in laboratories for sterile work. In addition to the current mushroom protecting technologies, applying UV irradiation in the growing areas can enhance effectiveness. It is optimal for sterilizing materials like casing soil, which is often the source of the dry and wet bubble disease, or equipment which come contact with the mushroom culture.

The aim of the study was to determine which UV light range is more effective against *Verticillium fungicola var. fungicola* and *Mycogone perniciosa,* and to define the optimal irradiation time period for the two pathogens

MATERIALS and METHODS

The experiment was conducted in a laboratory, under controlled conditions.

The source of the cultivated mushroom and the two pathogens used in the study was the culture collection of the Department of Vegetable and Mushroom Growing.

Two wavelengths of the UV range were used: a Vilbert Lourmat 115M type UVB lamp operating on 312 nm and one on 245 nm were set up in a laboratory on a special stand, where the distance of the radiation source and the tissue culture can be adjusted.

For the growing substrate, 20 grams of agar-agar and 20 grams of malt extract were dissolved in 1 liter water. The solution was then sterilized in high pressure chamber on 121°C for 20 minutes. 39-39 pieces of 9 cm Petri-dishes was then filled with the growing substrate. The pathogens were inoculated on the Petri-dishes. After 16 days incubation, the widest and narrowest diameters of the tissue cultures were measured with caliper.

Both pathogens were irradiated in 3 repeats, on the two wavelengths. 6 different time periods (5, 10, 15, 20, 25 and 30 minutes) were applied in 3 repeats, this way the tissue cultures got 15, 30, 45, 60, 75 and 90 minutes irradiation. 24 hours passed between each repeat, for this time, the tissue cultures were incubated on 25°C. Diameters of the treated and untreated (control) cultures were measured before the first, and after the second and third treatments

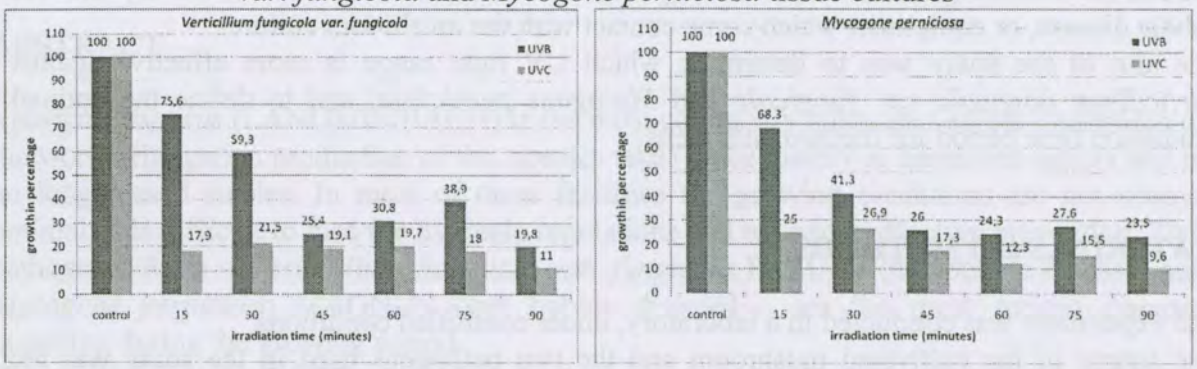
RESULTS

Diagram 1, 2 and *3* shows the changes in the tissue growth of the three species after UV treatments. The horizontal axis shows the different time lengths of treatments, while the growth in percentage is shown on the vertical axis. The total growth of the treated tissue cultures in percentage is correlated to the growth of the untreated control.

On *Diagram 1* we can see that UVB treatment caused a significant negative effect on mycelia growth of *Verticillium fungicola var. fungicola*. Even the shortest irradiation time (15 min) caused a 25 % setback compared to the growth of the untreated control. The culture treated for the longest time (90 min) became only the size around 20 % of the control. It can be seen that although every irradiation time period made the cultures grew significantly slower, no

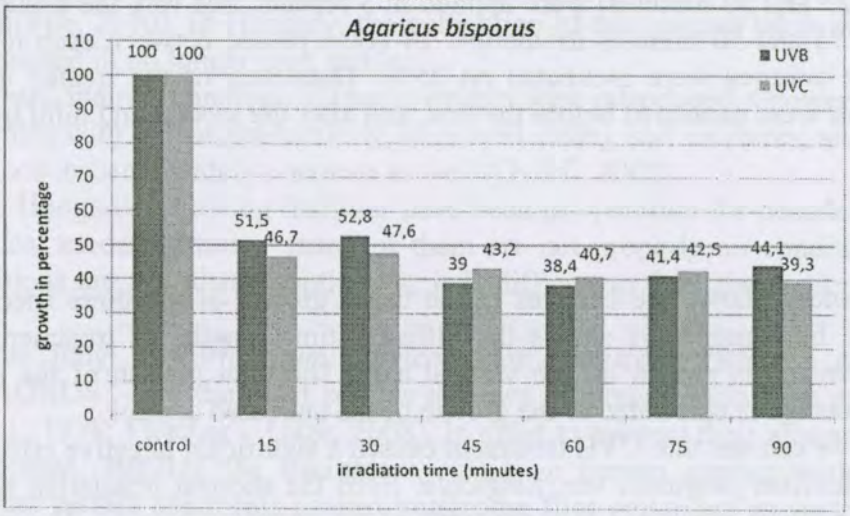
reverse proportionality can be drawn, since for example the 75 minutes treated cultures grew stronger than the 45 or 60 minutes treated.
Similar tendency can be observed in case of UVC treatments. 15 minutes of UVC irradiation caused a much effective setback than UVB irradiation. In this case, the cultures grew only to the size around 18 % of the control. By the end of the third day, the treated tissue cultures were 10 times smaller than the untreated ones.
Data on *Diagram 2* shows similar tendencies in case of *Mycogone perniciosa.* UVC proved to be better in blocking mycelia growth. The longest irradiation time had the most negative effect in case of both wavelengths.

Diagram 1, 2. The effect of UVB and UVC irradiation on the growth of *Verticillium fungicola var. fungicola* and *Mycogone perniciosa* tissue cultures



The mycelia growth of *Agaricus bisporus* is effected differently by UV irradiation. Due to data showed on *Diagram 3*, the mycelium of this cultivated mushroom is not as sensitive as the mycelia of dry and wet bubble disease. Not even the longest irradiation time can cause as much setback in tissue growth as it was seen in case of the pathogens. Another important difference is that UVB radiation proved to be more effective on three time periods (45, 60 and 75 minutes. The difference between each treatment is not as significant as in case of the pathogens mentioned before.

Diagram 3. The effect of UVB and UVC irradiation on the growth of *Agaricus bisporus* tissue cultures



CONCLUSION

Data shows that in case of both pathogens (irradiated on both wavelengths and for any time period), UV treatment caused significant setback in tissue-growth. UVC irradiation proved to be more efficient, as it caused 73,1-90,4% decline, while the UVB treated tissues grew only 24,4-80,2% less, than the untreated control. The two pathogens reacted the same; the rate of setback in tissue growth was similar.
UV irradiation effects the mycelia growth of the cultivated mushroom, *Agaricus bisporus* as well. If UV is applied in mushroom growing it is important to protect the compost, and only irradiate other materials (eg. casing soil) and the equipment.
Due to the data, both UV ranges are capable of significant inhibition of tissue growth. With correct application (proper irradiation time and distance), UV irradiation could function as an additional technique in mushroom protection, by preventing diseases in growing houses and cellars.

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