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COMPARISON OF GROWTH OF MYCELIUM OF *PLEUROTUS CYSTIDIOSUS* (MILLER) ON VARIOUS AGAR MEDIA

SUMMARY

Pleurotus cystidiosus occurs in natural areas on all continents except Antarctica and South America. Fruiting bodies of *P. cystidiosus* are valued as a source of nutrients and biologically active substances. *P. cystidiosus* has antitumor, anti-inflammatory and antioxidant, antihyperglycemic activity. This species is cultivated mainly in North America and Asia. The aim of the study was selection the best agar medium for the fastest mycelium growth and the best mycelium hyphal quality. In the experiment, two cultivars of *P. cystidiosus* from the collection of the Department of Vegetable Crops Poznan University of Life Sciences were used: B1 and B122. Growth of mycelium on five agar media: wheat, potato, synthetic Hansen's, maltose and sawdust was compared. Measure of this parameter was a diameter of agar medium overgrown by hyphae after 7, 10, 14 and 21 days of incubation. Experiment was conducted in Biological Laboratory of the Department of Vegetable Crops Poznan University of Life Sciences. It has been shown that growth of mycelium of tested strains on different agar media was different. Research of mutual dependence between morphological and qualitative characteristics of agar medium type allows production optimization. Development of low-cost, simple method for production of *P. cystidiosus* can contribute to introduction of this species into intensive cultivation in Poland.

Keywords: *Abalone oyster mushroom, summer oyster mushroom, cultivation of edible mushrooms, medicinal mushrooms, mycelium growth*

INTRODUCTION

Pleurotus cystidiosus belongs to the kingdom of *Fungi*, phylum *Basidiomycota*, class *Agaricomycetes*, order *Agaricales*, family *Pleurotaceae*, genus *Pleurotus*. This species was described first time in North America by O.K. Miller in 1969. It is widespread on angiosperm trees wood (Moncalvo 1995, Zervakis et al. 2004). Name Abalone oyster mushroom, Miller's oyster mushroom and summer oyster mushroom can be found in the literature, as well as Chinese name *bao yu gu* and Japanese *Ohiratake*. Caps of *Pleurotus cystidiosus* are convex to hollow with dark greyish to brown centre and yellowish

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brown smooth margins; stems are long and white (Hanelt 2001, Croan 2004, Lechner et al. 2004, Abdullah et al. 2012, Usami et al. 2014). *Pleurotus cystidiosus* produces darkly pigmented arthroconidia forming a black pigment on mycelium or basidiomata (Petersen et al. 1997, Zervakis 1998).

In natural conditions *Pleurotus cystidiosus* occurs on all continents except Antarctica and South America (Vilgalys et al. 1996, Zervakis and Balis 1996, Lechner et al. 2004). In natural environment it is encountered on dead tree stumps, especially deciduous trees. *Pleurotus cystidiosus* occurs often in form of groups consisting of several larger and smaller specimens that arise from a common base or imbricately are arranged one above the other. It can be grown on substrates prepared on base of straw and various types of agricultural, horticultural and forestry wastes (Cohen et al. 2002, Croan 2004, Lau et al. 2013, Usami et al. 2014). It is cultivated mainly in South-West Asia, especially in China (Hanelt 2001, Usami et al. 2014).

The genus of oyster mushroom (*Pleurotus*) is represented by many species (Vilgalys et al. 1996, Bao et al. 2004). The best-known oyster mushroom is *Pleurotus ostreatus*, which is widely cultivated in Poland. Poland is the largest producer and exporter of *Pleurotus ostreatus* in European Union. Oyster mushroom, beside common button mushrooms (*Agaricus* L.), is among the most frequently purchased and consumed mushrooms in Poland (Siwulski and Sobieralski 2004). In addition to culinary qualities of fruiting bodies of *Pleurotus cystidiosus* it has high nutritional value (proteins, fibre, vitamins, and minerals) and contain biologically active substances with proven health-promoting properties. The biological activity of these mushrooms has been confirmed in several laboratory tests and clinical trials, which showed among others their antibacterial, antiviral, antifungal, antitumor, immunomodulatory, antiallergic, anti-inflammatory, antiatherosclerotic, hepatoprotective, lowering blood sugar and blood cholesterol effect. This mushroom is low in calories due to the limited content of lipids. In China and many other countries it is considered a healthy and functional food (Manzi and Pizzoferrato 2000, Wasser 2002, Croan 2004, Rajewska and Bałasińska 2004, Bernaś et al. 2006, Thekkuttuparambil and Kainoor 2007, Kalbarczyk and Radzki 2009, Karaman et al. 2010, Abdullah et al. 2012, Patel et al. 2012, Lau et al. 2013, Siwulski et al. 2013, Siwulski et al. 2014, Usami et al. 2014).

During last several years there has been a very dynamic development of production of edible and medicinal mushrooms. This development was mainly caused by high availability of low-cost, waste materials from agricultural, textile and wood processing industry, which may pose a potential base for their cultivation including *Pleurotus cystidiosus* (Vilgalys et al. 1996, Usami et al. 2014). Poland, in comparison to European Union countries, is still an ecologically clean area. That is why our country has a great potential to use uncontaminated with heavy metals and pesticides substrates for growing mushrooms. *P. cystidiosus* is tolerant for high temperatures during growth and yielding, therefore can be grown in adverse to *P. ostreatus*, species requiring

lower temperatures. This feature makes *P. cystidiosus* an alternative for oyster mushroom producers and at the same time may diversify the market offer of edible mushrooms. (Siwulski and Sobieralski 2004, Zervakis et al. 2004, Selvakumar et. al. 2008, Usami et al. 2014). This feature is important because it allows cultivation in chambers without air conditioning during summer time, which is impossible for other oyster species of greatest economic importance. Introduction to commercial cultivation species of *P. cystidiosus* will be a perfect solution for small producers of oyster mushroom, who until now were forced to stop production in the summer time. Literature says that *P. cystidiosus* can be grown on a many different kinds of waste, such as: chopped cocoa pods, cotton wastes, chopped and corn stover, waste from palm oil production, tobacco straw, tea leaves, rice straw, bagasse, sawdust of different kinds of trees (Vilgalys et al. 1996, Croan 2004, Lau et al. 2013, Usami et al. 2014). Use of these waste materials in oyster mushroom production will significantly increase profitability of the crop and reduce its costs. There will also be a new solution for those waste disposal, which causes enormous problems in agricultural production.

Development of low-cost and simple method for production of *P. cystidiosus* can contribute to introduction of this species into commercial cultivation in Poland. Determination of morphological and qualitative characteristics of substrate type and growing conditions will allow optimizing production, in order to obtain the best yield of fruiting bodies with the best characteristics, for consumption and as raw material for obtaining biologically active substances.

Pleurotus cystidiosus is a species requiring evaluation. Currently in Poland this mushroom is unknown for large scale cultivation. Research of this project will aim to clarify mechanisms of growth of *P. cystidiosus* and the yield depending on various factors, especially the type of agar medium. The aim of experiment was selection of agar medium on which mycelium growth was the fastest and mycelium hyphae had the best quality.

MATERIALS AND METHODS

The subject of research in all experiments was two strains of *Pleurotus cystidiosus* from the Collection of Edible and Medicinal Mushrooms, Department of Vegetable Crops, Poznan University of Life Sciences – B1 and B122.

Laboratory experiments were conducted in Biological Laboratory of the Department of Vegetable Crops, Faculty of Horticulture and Landscape Architecture, Poznan University of Life Sciences. All laboratory experiments were established in fully randomized design, in 3 replications in 2 series.

Influence of type of agar medium for mycelium growth – five different agar media, was investigated: wheat – extract from 200 g of wheat grains, 22 g of agar, 3 g of glucose per 1 litre of medium; potato – extract from 200 g of potatoes, 22 g of agar, 3 g of glucose per 1 litre of medium; Hansen's – 0.3 g of KH_2PO_4 , 0.2 g of MgSO_4 , 22 g of agar, 5 g of glucose, 1 g of peptone per 1 litre of medium; maltose – 30 g of maltose, 22 g of agar, 5g of peptone per 1 litre of

medium; sawdust – extract from 200 g of sawdust of alder and sawdust of beech (1:1), 22 g of agar, 3 g of glucose per 1 liter of medium. The measure of this parameter was a diameter of agar medium overgrown by hyphae after 7, 10, 14 and 21 days of incubation.

The results of research were statistically analyzed. When comparing the experimental results, the analysis of variance for factorial experiments was applied (ANOVA, level of significance $\alpha=0.05$).

RESULTS AND DISCUSSION

Comparison of growth of mycelium of two strains of *Pleurotus cystidiosus* after 7, 10, 14 and 21 days of incubation is presented on Figure 1. It has been shown that growth of mycelium of strain B1 was significant fastest than strain B122. This is apparent especially after 14 and 21 days of incubation.

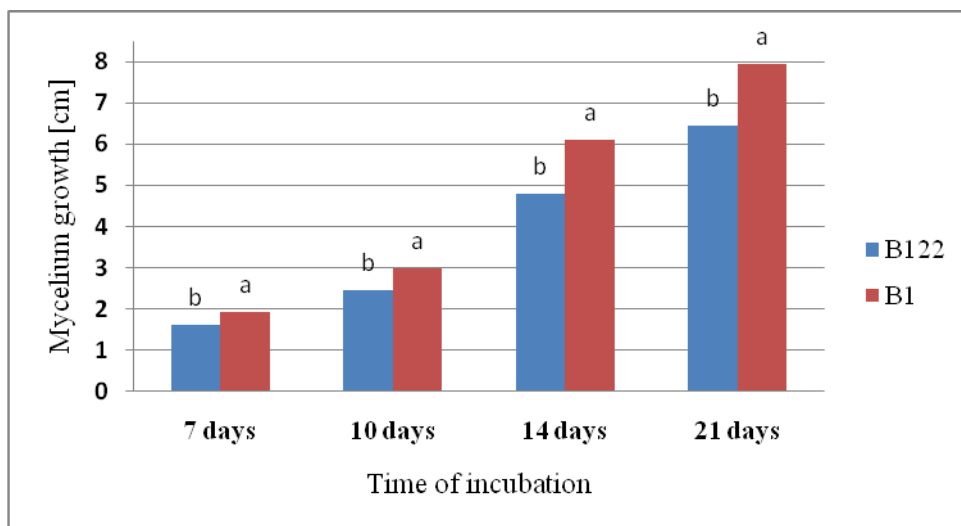


Figure 1. Growth of mycelium of two strains of *P. cystidiosus*

Comparison of mycelium growth of *Pleurotus cystidiosus* on various agar media after 7, 10, 14 and 21 days of incubation is presented on Figure 2. It has been shown that growth of mycelium on different agar media differed significantly. The best growth of mycelium after 7 days of incubation occurred on wheat agar medium. After 10 and 14 of incubation the best growth of mycelium occurred on wheat and sawdust agar media. After 21 days of incubation the best growth of mycelium occurred on wheat, sawdust and maltose agar media. It has been shown that growth of mycelium on wheat and sawdust agar media was significantly fastest than growth of mycelium on potato, Hansen's and maltose agar media. This may be due to the fact this mushroom in natural environment grows on dead wood, so sawdust is its natural habitat for growth. In potato agar medium may consist from too much starch and therefore ratio of nitrogen to carbon can be unfavourable for good mycelium growth. The

slowest growth of mycelium after 7, 10, 14 and 21 days of incubation occurred on Hansen's agar medium. This may be due to the fact, that Hansen's agar medium is a synthetic agar medium and it is low in nutrients.

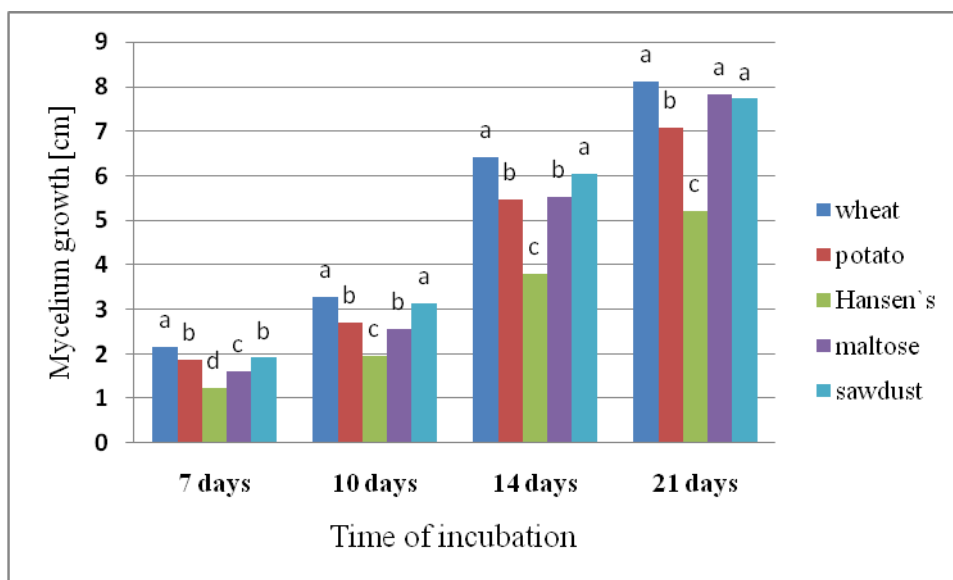


Figure 2. The growth of mycelium of *P. cystidiosus* on various agar media

Comparison of mycelium growth of two strains of *Pleurotus cystidiosus* on five various agar media are presented in Table 1. It has been shown that growth of mycelium of two strains – B122 and B1 – on different agar media was various.

Table 1. Growth of mycelium of two strains of *P. cystidiosus* on various agar media [cm]

Strain	Agar medium				
	Wheat	Potato	Hansen's	Maltose	Sawdust
After 7 days of incubation					
B122	1.93 a	1.63 b	0.91 c	1.61 b	1.91 a
B1	2.38 b	2.11 c	1.56 d	1.61 d	1.91 c
After 10 days of incubation					
B122	3.03 b	2.15 d	1.40 de	2.55 c	3.20 a
B1	3.53 c	3.28 d	2.51 e	2.58 e	3.06 de
After 14 days of incubation					
B122	6.05 a	4.45 c	2.45 d	5.05 b	5.98 a
B1	6.78 c	6.46 c	5.16 d	6.00 c	6.08 c
After 21 days of incubation					
B122	7.73 c	6.21 b	3.23 cd	7.16 c	7.91 a
B1	8.50 c	7.95 cd	7.18 d	8.50 c	7.53 d

It has been shown, that mycelium growth of strain B122 after 7 days of incubation was the fastest on wheat and sawdust agar media and the growth of mycelium of strain B1 was the fastest on wheat agar medium. After 10 days of incubation the growth of mycelium of strain B122 was the fastest on sawdust agar medium and strain B1 on wheat agar medium. After 14 days of incubation the growth of mycelium of strain B122 was the fastest on wheat and sawdust agar media and the growth of mycelium of strain B1 comparatively fast on all agar media except for the synthetic Hansen agar medium. After 21 days of incubation the growth of mycelium of strain B122 was the fastest on sawdust agar medium and the growth of mycelium of strain B1 on wheat and sawdust agar media.

For the reason the literature for this topic is limited, mycelial growth of *Pleurotus cystidiosus* was compared to the growth of mycelium of other species from the genus *Pleurotus*. According to the Sobieralski et al. (2012) mycelial growth of *Pleurotus eryngii* (DC.:Fr.) Quél was also the fastest on wheat agar medium. Comparing mycelial growth of various species of oyster mushrooms on potato agar medium and Hansen's agar medium has been shown, that *Pleurotus eryngii* and *Pleurotus precoce* (Fr.) Quél. grow faster on Hansen's agar medium. Whereas mycelial growth of *Pleurotus citrinopileatus* (Singer) and *Pleurotus djamor* (Rumph. ex Fr.) Boedijn was fastest on potato agar medium (Gapiński et al. 2007). According to Shen et al. (2005) mycelial growth of *Pleurotus nebrodensis* (Inzengae) Quél. was fastest on potato-corn agar medium.

The mycelium growth depends on many factors, among others genus, species, variety and agar medium this was also confirmed in research made by Ziombra (1998).

CONCLUSION

Strain B1 of *Pleurotus cystidiosus* due to faster growth of the mycelium shows a greater ability to be utilised in large scale cultivation, where it is important to obtain of mother spawn quickly.

Wheat and sawdust agar media due to faster mycelium growth of *Pleurotus cystidiosus* shows a greater ability to be used in commercial cultivation.

Strain B1 of *Pleurotus cystidiosus* showed the fastest growth on wheat agar medium and next on sawdust agar medium.

Strain B122 of *Pleurotus cystidiosus* showed fastest growth on sawdust agar medium and next on wheat agar medium.

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