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EFFECT OF ADDITION OF MAIDENHAIR TREE LEAVES TO SUBSTRATE ON YIELDING AND CHEMICAL COMPOSITION OF *PLEUROTUS OSTREATUS* (FR.) KUMM. CARPOPHORES

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Summary

The effect of addition of different amounts of maidenhair tree leaves to substrate on quantity and earliness of yield and chemical composition of oyster mushroom carpophores was investigated. The experiment was carried out at the Department of Vegetable Crops of the Poznan University of Life Sciences in the year 2008.

The subject of the studies was the 'P80' strain of *Pleurotus ostreatus*. Two cycles of cultivation were conducted. Alder sawdust supplemented with yellow and green maidenhair tree leaves in the amount of 0%, 1% and 10% in relation to dry matter of sawdust were used as experimental substrates. Cultivation was conducted in polypropylene bottles of capacity of 1 dm^3. Yield quantity and earliness as well as chemical composition of carpophores were determined.

It was found that quantity and earliness of *P. ostreatus* yield depended on the amount and kind of maidenhair tree leaves added to substrate. The highest and the earliest yield was obtained on substrate supplemented with 10% addition of green maidenhair tree leaves. The amount of maidenhair tree leaves added to substrate influenced the content of protein and carbohydrates in carpophores whereas it did not influence the content of dry matter, fat and ash. Carpophores obtained on the substrate supplemented with 10% addition of maidenhair tree leaves, independently of their kind, were characterized by the highest content of protein and carbohydrates.

key words: Oyster mushroom, *Ginkgo biloba*, supplement, yield, chemical composition

INTRODUCTION

After button mushroom, *Pleurotus ostreatus* (Fr.) Kumm. ranks as the second most important cultivated mushroom in Poland. Considerable interest in oyster

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mushroom comes from its nutritive value, high consumer assessment as well as salubrious properties (Stamets 1993, Chang & Miles 2004).

P. ostreatus can be cultivated on a wide range of easily-available waste materials derived from either agricultural or forest production but the most common materials used for their cultivation are cereal straw or sawdust from broad-leaved trees (Shah *et al*. 2004, Nivedita & Irabanta 2005). The species responds to the enrichment of the substrate with various additives by increased yield of carpophore. The most common additives include: soybean meal, chicken litter as well as mineral fertilisers containing $N\text{-}NH_4^+$ ions and manganese (Eder 1990, Curvetto *et al*. 2002).

Leaves of maidenhair tree contain numerous biologically active substances (De Feudis 1991, Huh & Staba 1992) and therefore they provide a valuable raw material for the pharmaceutical industry. Extracts prepared from leaves were containing over 60 such substances. A standard extract EGb 761 used in the pharmaceutical industry contained 24% flavonoids, 6% terpenoids and about 7% proanthocyanidin (Michel & Hosford 1988; De Feudis 1991). Preparations made from leaves of the maidenhair tree were found to have a positive influence on the growth of *P. ostreatus* mycelium (Gapiński *et al*. 1998, Siwulski *et al*. 2007).

The aim of the performed investigations was to determine the impact of the addition of maidenhair tree leaves to the substrate from sawdust on yielding and chemical composition of carpophores of *P. ostreatus*.

MATERIAL AND METHODS

Experiments were carried out at the Department of Vegetable Crops of the Poznan University of Life Sciences in 2008 using a strain of *P. ostreatus* (Fr.) Kumm. of the Italspawn Company designated as 'P80'. Two cycles of cultivation in the experiment were conducted. The substrate used in the experiment consisted of alder sawdust with the addition of chalk (1.5% in relation to the substrate dry matter). Moreover, the substrate was also supplemented with two kinds of leaves of *Ginkgo biloba* L.: yellow and green in the amount of 1% and 10% in relation to substrate dry matter (DM). Substrate without maidenhair supplementation was considered as the control. After mixing the components, the substrate was wetted up to 65% moisture content using tap water. Then it was placed in polypropylene containers of 1 dm^3 volume and subjected to sterilisation in an autoclave at the temperature of 121ºC for 1.5 hours. After cooling the substrate to the temperature of about 25ºC, it was inoculated with the oyster mushroom mycelium on wheat grains in the amount of about 3% in relation to the substrate DM. After inoculation, the substrate was subjected to incubation at the temperature of about 22ºC and air relative humidity of 80-85%. Once the substrate was completely covered with the mycelium, containers were transferred to the cultivation room where the temperature was maintained at 16ºC±1 and air relative humidity at 80-85%. The cultivation was additionally lighted using fluorescent light (Day-Light) of 500 lx intensity for 10 hours/day. The cultivation room was aired not to allow CO_2 concentration to exceed 1000 $mg \cdot L^{-1}$.

Carpophores were harvested in clumps at the moment when edges of the oldest caps began to straighten. They were collected from the first flush of yielding.

The performed analyses involved the assessment of the yield, estimation of the earliness of cropping by determining the number of days from the incubation to the first harvest for each treatment. The yield comprised carpophores together with their stipes cut at the length of 2 cm. In addition, dry matter (DM) content of whole carpophores was determined using the gravimetric method as well as the content of protein, fat, carbohydrates and ash employing methods described by Rutkowska (1981).

The trial was established in five replications in a random design in both cycles. The obtained results were subjected to the analysis of variance for two-factorial experiments. Mean comparisons were conducted using Duncan's test at P=0.05. The results were described as average values of the two cultivation cycles.

RESULTS AND DISCUSSION

The applied kind of *G. biloba* leaves did not influence significantly the yield of oyster mushrooms. On the other hand, it was found that the quantity of the maidenhair tree leaves added to the substrate, irrespective of their kind, influenced yields of *P. ostreatus* carpophores. The highest yield was recorded at 10% addition of *G. biloba* leaves to the substrate (54 g·100 g^{-1} DM of substrate). The yield of oyster mushrooms was significantly lower at 1% addition of *G. biloba* leaves to the substrate (39 g·100 g^{-1} DM of substrate) as well as in the case of substrate without any additives (33.5 g·100 g^{-1} DM of substrate). However, the obtained results indicate a tendency for increased yield with the rising quantity of leaves added to the substrate (Fig. 1).

The analysis of the impact of the experimental factors on *P. ostreatus* yield revealed the occurrence of interactions between the type and quantity of *G. biloba* leaves added to the substrate. The addition of 10% green maidenhair tree leaves to the substrate was found to increase significantly yield of carpophores (63 g·100 g^{-1} DM of substrate) in comparison with the substrate with 1% supplementation with green leaves (38 g·100 g^{-1} DM of substrate) as well as with the substrate without additives (33 g·100 g^{-1} DM of substrate). In the case of the addition of yellow *G. biloba* leaves, yield of oyster mushroom were similar for all the examined substrate supplementations (Fig. 2).

The performed experiments also aimed to establish the impact of the substrate supplementation with *G. biloba* leaves on earliness of *P. ostreatus* harvest. It was found that harvest earliness did not depend on the type of leaves added to the substrate but it did depend on their quantity. The earliest harvest was achieved on the substrate with 10% addition of maidenhair tree leaves (16.7 days), whereas in the case of the substrate with 1% addition after 18.4 days and without additives after 18.9 days (Fig. 3).

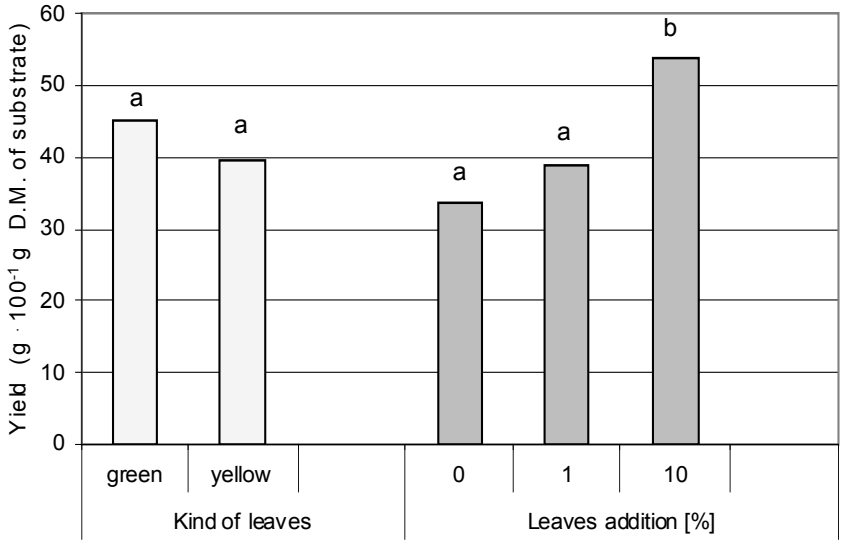


Fig. 1. The effect of kind and amount of maidenhair tree leaves added to substrate on yield of *Pleurotus ostreatus* 'P 80' strain

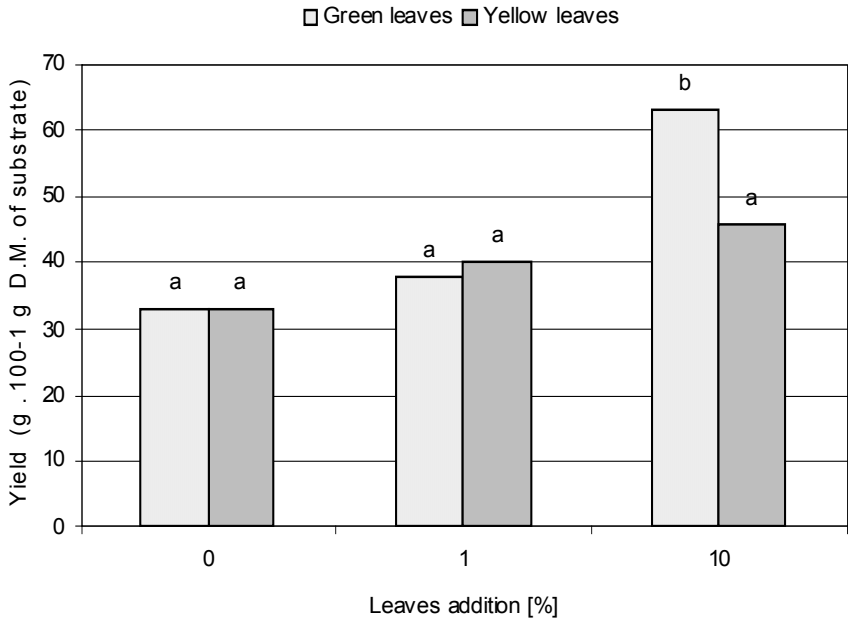


Fig. 2. The effect of maidenhair tree leaves addition to substrate on yield of *Pleurotus ostreatus* 'P 80' strain

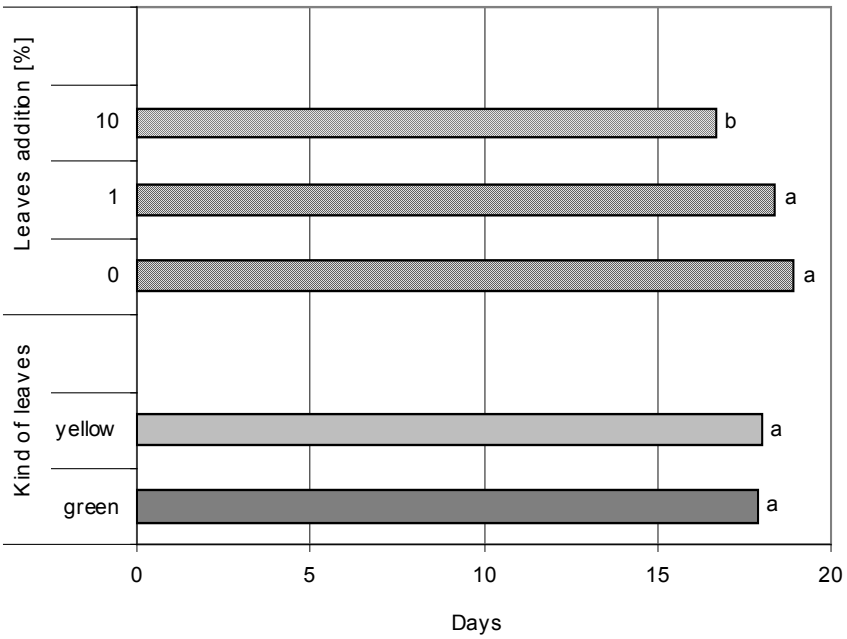


Fig. 3. The effect of kind and amount of maidenhair tree leaves added to substrate on yield earliness of *Pleurotus ostreatus* 'P 80' strain

In the available world literature on the subject, there is no information about the influence of the addition of *G. biloba* leaves to substrate on yield of cultivated mushrooms. However, there are reports on the effect of preparations from *G. biloba* leaves on the growth of *P. ostreatus* mycelium. According to Gapiński *et al*. (1998), the higher the proportion (at the range from 0.1 to 100 $mg \cdot L^{-1}$) in the medium of dried *G. biloba* leaves, the faster the growth of *P. ostreatus* mycelium. On the other hand, in experiments carried out by Siwulski *et al*. (2007), it was demonstrated that the addition of alcohol extract from *G. biloba* to the agar medium at 1 and 10 $mg \cdot L^{-1}$ concentrations exerted a stimulating impact on the growth of *Pleurotus precoce* and *Pleurotus citrinopileatus* mycelium. In our experiment the highest and the earliest yield was obtained on substrate supplemented with 10% addition of green maidenhair tree leaves. This could be a result of the presence of biologically active substances or other constituents in *G. biloba* leaves which provided an easily available source of carbon (e.g. carbohydrates). However, this hypothesis requires further experiments which would employ extracts from leaves or its individual constituents.

It was found that the addition to the cultivation substrate of *G. biloba* leaves did not influence the content of dry matter, fat and ash in carpophores, but it affected the content of protein and carbohydrates in them. The highest protein content in the carpophores was noted on the substrate supplemented with 10% *G. biloba* leaves (green leaves - 20.8 $g \cdot 100\ g^{-1}$ DM, yellow leaves - 21.1 $g \cdot 100\ g^{-1}$ DM). In the case of the remaining experimental treatments, no

significant differences were observed between the application of green and yellow leaves. Similar results were obtained in the case of carbohydrate content in the carpophores. It was the highest when 10% of *G. biloba* leaves were added to the substrate (green leaves - 64.1 g·100 g^{-1} DM, yellow leaves - 63.9 g·100 g^{-1} DM) (Table 1).

Table 1. Chemical composition of carpophores of *Pleurotus ostreatus* 'P80' strain in relation to the addition of maidenhair tree leaves to substrate (%)

Constituents	Green leaves			Yellow leaves		
	0%	1%	10%	0%	1%	10%
Dry matter	9.4 a	9.0 a	9.7 a	9.3 a	9.6 a	9.4 a
Crude protein	17.9 b	18.5 b	20.8 a	17.3 b	18.7 b	21.1 a
Fat	2.0 a	1.9 a	2.1 a	2.1 a	2.0 a	1.9 a
Carbohydrates	59.3 b	60.9 b	64.1 a	60.0 b	59.1 b	63.9 a
Ash	6.9 a	7.0 a	6.9 a	6.8 a	7.1 a	7.2 a

Note: Means in each row followed by the same letter do not differ significantly at P=0.05

CONCLUSIONS

1. The kind and quantity of *G. biloba* leaves added to the substrate had a positive influence on yield of *P. ostreatus* carpophores. The highest yield was recorded on the substrate supplemented with 10% addition of green *G. biloba* leaves.
2. Harvest earliness of *P. ostreatus* depended on the amount and kind of *G. biloba* leaves added to the substrate. The earliest harvest was achieved when 10% green *G. biloba* leaves were added to the substrate.
3. The addition of *G. biloba* leaves did not affect the content of dry matter, fat and ash in carpophores.
4. The content of protein and carbohydrates in *P. ostreatus* carpophores depended on the amount of *G. biloba* leaves added to the cultivation substrate but it did not depend on their kind. The highest quantities of protein and carbohydrates were found in carpophores from the substrate with 10% supplementation with *G. biloba* leaves.

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WPŁYW DODATKU LIŚCI MIŁORZĘBU DWUKLAPOWEGO NA PLONOWANIE I SKŁAD CHEMICZNY OWOCNIKÓW BOCZNIAKA OSTRYGOWATEGO *PLEUROTUS OSTREATUS* (FR.) KUMM.

Streszczenie

Badano wpływ dodatku do podłoża uprawowego różnych ilości liści miłorzębu dwuklapowego - *G. biloba* L. na wielkość i wczesność plonu oraz skład chemiczny owocników boczniaka ostrygowatego - *Pleurotus ostreatus* (Fr.) Kumm. Doświadczenie przeprowadzono w Katedrze Warzywnictwa Uniwersytetu Przyrodniczego w Poznaniu w 2008 roku.

Przedmiotem badań była odmiana boczniaka ostrygowatego P 80. W doświadczeniu użyto podłoża z trocin olszowych, wzbogaconego żółtymi oraz zielonymi liśćmi miłorzębu dwuklapowego w ilości 0%, 1%, i 10% w stosunku do suchej masy podłoża. Uprawę prowadzono w butelkach polipropylenowych o pojemności 1 dm^3. Oznaczono wielkość i wczesność plonu oraz skład chemiczny owocników.

Stwierdzono, że wielkość i wczesność plonu boczniaka zależały od ilości i rodzaju liści miłorzębu dwuklapowego dodanych do podłoża. Najwyższy i najwcześniejszy plon uzyskano na podłożu wzbogaconym 10% dodatkiem zielonych liści miłorzębu. Ilość liści miłorzębu dodanych do podłoża wpływała na zawartość białka i węglowodanów w owocnikach, nie miała natomiast wpływu na zawartość suchej masy, tłuszczu i popiołu. Największą zawartością białka i węglowodanów charakteryzowały się owocniki uzyskane na podłożu z 10% dodatkiem liści miłorzębu, niezależnie od ich rodzaju.