Assiut J. of Agric. Sci., 43(4) September (91-114)

Earliness, Biological Efficiency and Basidiocarp Yield of *Pleurotus ostreatus* and *P. columbinus* Oyster Mushrooms in Response to Different Sole and Mixed Substrates

Mohamed F. Mohamed, Dalia M. T. Nassef, Esmat A. Waly and Amira M. Kotb

Dept. Horticulture, Fac. Agric- Assiut University, Assiut 71526, Egypt.

Abstract:

The current indoor research trial was conducted in the mushroom research and production laboratory at the Department of Horticulture, the Faculty of Agriculture, Assiut University. Productivity of two oyster mushroom species (*Pleurotus ostreatus* and *P. columbinus*) was evaluated for ten different substrates. These included six sole and four blended substrate recipes. For the six sole substrates, three were target untraditionally used substrates studied against three commonly used substrates. The three target untraditional substrates were *Cynodon dactylon* grass weed (GW), African mahogany (*Khaya senegalensis*) tree leaves (TL) and Faba Bean (*Vicia faba* L.) straw (FBS). The three commonly used substrates were rice straw (RS), wheat straw (WS) and sugarcane bagasse (SCB). The four blended substrate recipes were prepared from equal weight of FBS and SCB with each of GW, TL, RS and WS. Data were recorded for days lapsed to visible pinheads formation (VPF), fruiting bodies yield (FBY), number of fruiting bodies per culture (NF), average fruiting body weight (FW) and biological efficiency (BE). Statistical analysis showed significance for variance due to substrate X mushroom cultivar for all the parameters studied. However, *Pleurotus ostreatus* mushroom was superior to *P. columbinus* mushroom exhibiting a magnificent FBY and BE and reduced VPF in both trials. Closely similar result was found for NF and FW with minute exceptions. The overall results suggest that *Cynodon dactylon* grass weed was superior to sugarcane bagasse, faba bean straw and African mahogany tree leaves and mostly similar to wheat straw. Therefore, *Cynodon dactylon* grass weed may be exploited as a potential substrate for production of oyster mushroom.

Keywords: African mahogany tree leaves, basidiomycetes, *Cynodon dactylon* grass weed, *Pleurotus columbinus*, *Pleurotus ostreatus*, substrate.

Introduction:

Oyster mushrooms (*Pleurotus spp*.) are a delicious gourmet mushroom. They are primarily

Received on: 15/9/2012 **Accepted for publication on**: 26/9/2012
Referees: Prof. Dr. Gamal Hussein, Prof. Dr. Mohamed.A.Farghly

wood decomposers grow in the forest but can be cultivated on a wide range of agricultural waste products. They usually grow in clusters and the entire cluster emerges from one point. The eaten part is a compact form of mycelium called cap or the fruit body. When become mature, the cap color and shape resemble an oyster shell. *Pleurotus spp*., is, therefore, known as "oyster mushroom", and also as "hiratake", "shimeji", or "houbitake"(Mizuno and Zhuang, 1995).

The edible macro fungi 'mushrooms' had long ago, back to the ancient time, known for human being as a nutritional food having important medicinal properties. In general, mushrooms contain about 85-95% water, 4% carbohydrates, 0.1% fats, 1% minerals and vitamins (Tewari, 1986). They are particularly good source of protein, vitamins and minerals (Khan et al., 1981). Almost one third of their dry weight is protein but content varies depending on the mushroom species (Crisan and Sands, 1978; Rajarathnam and Bano, 1989). Mushroom protein is intermediate between that of animals and vegetables proteins (Kurtzman, 1976). Mushrooms as a good source of essential vitamins (Subramanian, 1986) contain niacin, riboflavin and vitamin-C. They also contain folic acid, which is blood building vitamin and counteracts the pernicious anemia, and is also highly rich in minerals such as phosphorus,
potassium, copper and iron.

Naturally oyster mushrooms grow wild on tree woods and lignocellulosic remains in forests (Atkinson, 1961). Oyster mushrooms cultivation is a profitable agribusiness. They can recycle agricultural and agro-industry lignocellulosic wastes into food and the environment may be less endangered by pollution of such materials (Hayes, 1978). In fact, considering the estimated yearly available world waste in agriculture (500 billion kg) and forestry (100 billion kg), 360 billion kg of fresh mushrooms could be produced (Poppe. 2004). Oyster mushrooms are relatively simple to grow (Stamets, 1993) and this is an advantageous as compared to button mushrooms (*Agaricus bisporus*). They require no arable land for their production and abundant of agricultural wastes can be used for their cultivation offering feasibility for the production and more economical and environmentally friendly system (Philoppousis and Diamantoppulou, 2001; Kimenju et al., 2009)

Oyster mushrooms have been described as being aggressive biodegrader due to their distinctive capability to decompose almost every lignocellulosic material (Kimenju et al., 2009). These include rice (*Oryza sativa*), wheat (*Tritichum aestivum*), barley, oat straws, banana (*Musa spp.*), bean (*Phaseolus vulgaris*) sugarcane (*Saccharum officinar-*

um) and maize (*Zea mays*) leaves, empty corn cobs and cotton waste, sticks and boll locules, sugarcane baggasse, banana pseudostems, saw dust, logs, papers, manure etc. (Jiskani, 1999). However, growth and fruit bodies' yield and quality vary greatly depending on the utilized culture substrate (Tshinyangu, 1996; Shah et al., 2004; Iqbal et al., 2005; lbekwe et al., 2008). Rice and wheat straws and cotton wastes are widely agreed on as being among the top productive substrates (Kimenju et al., 2009). These materials constitute the most commonly utilized substrates. Other substrates may include sugarcane bagasse, bean straw and many other materials. Variation in physical properties and the components of lignocellulosic materials are responsible for their different productivity as substrate for mushroom cultivation and mixtures of two or more Substrate are recommended (Obodal and Johnson, 2002).

Choice of substrates, however, depends on their availability in the place or region where oyster mushroom is intended to be produced (Kimenju et al., 2009). For example, rice is not usually grown in the Upper Egypt and rice straw, therefore, may not be the most affordable substrate for production of oyster mushroom in this region. Accordingly, substantial research studies have been devoted to assess differential potential bioconversion of diverse lignocellulosic wastes as substrates for growing oyster mushrooms in various regions (Shah et al., 2004; Iqbal et al., 2005; Kimenju et al., 2009). Nevertheless, little information is available on the evaluation of materials like grass weeds (Kiran and Jandaik, 1989; Tshinyangu, 1996) and tree leaves. Such materials may exist in abundance and have no useful utilization. Toward establishing an integrated agricultural system, it would be valuable to recycle these materials in an environmentally friendly way.

The objective of the current study was to assess growth and fruit bodies' yield of two oyster mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) when grown on grass weed (*Cynodon dactylon*) or leaves of African mahogany trees (*Khaya senegalensis*) in contrast to some commonly used substrates (rice and wheat straws) and blends of each of them with sugarcane bagasse and faba bean (*Vicia faba*) straw.

Materials and Methods:

The current indoor research trial was conducted in the mushroom research and production laboratory furnished with iron racks, desert cooler, exhaust fan and florescent cool white light at the Department of Horticulture, the Faculty of Agriculture, Assiut University. Productivity of two cultivated oyster mushroom species (*Pleurotus ostreatus* and *Pleurotus columbinus*) was evaluated for ten different substrates. The ten substrates included six sole substrates and four blended

substrate recipes. For the six sole substrates, three were target untraditionally used substrates studied against three commonly used substrates (control treatments). The three target untraditional substrates were *Cynodon dactylon* grass weed, African mahogany (*Khaya senegalensis*) tree leaves and Faba Bean (*Vicia faba* L.) straw. The three commonly used substrates were rice straw, wheat straw and sugarcane bagasse. The four blended substrate recipes were designated to assess the effect of substrate properties. These recipes were made of equal weight from faba bean (*Vicia faba* L.) straw and sugarcane bagasse with each of *Cynodon dactylon* grass weed, African mahogany (*Khaya senegalensis*) tree leaves, rice straw and wheat straw.

Substrate Preparation

The substrates were chopped into small pieces of 1-3 cm to increase the surfaces where the mushroom mycelium can grow. The chopped substrates were moistened thoroughly by soaking in tap water overnight. The substrates were then stuffed 2 h in hot water at 80°C for pasteurization (Bahukhandi and Munjal, 1989; Balasubramanya and Kathe, 1996). Wheat bran (Soliman, 2011) and gypsum (calcium sulfate) were added at rate of 5% (on the substrate dry weight basis). The pasteurized substrate was left to cool down and to drain excessive water until mean moisture of 70%; calculated by drying 100 g pasteurized substrate samples in an electric oven at 60°C until constant weight. The pasteurized substrate was manually packaged into clear polyethylene bags of mean thickness 0.2 mm containing 300 g moistened pasteurized substrate.

Culture inoculation, incubation and mushroom cap harvest

The spawn was inoculated at rate of 5% (based on wet mass of the substrate). Spawn of oyster mushrooms used in this study was obtained from Agricultural Research Center, Food Technology Research Institute, Giza. The inoculated substrates were incubated for spawn running at 24-28º C in the darkness. After complete spawn running (~ 3 weeks), the mushroom cultures were transferred into fruiting room for fructification (basidiocarp formation). Polyethylene bags were removed and the cultures were kept at 23-27^{o}C under cool white light provided by fluorescent tubes for 12 h/ day. Electric fans were used 2 h and 4 h/day during incubation for spawn running and basidiocarp formation, respectively, to provide homogenous ventilation condition in the incubation room. The moisture of the culture in fruiting room was maintained by spraying with water 2 to 3 times a day during the whole cropping period. Mushroom fruiting bodies were harvested as soon as the gills were well formed and while the edge is still curled under (about a week after pinheads formation). The experiment was arrangement as split-

plot in randomized complete-blocks with 4 replicates. The main plots were for substrate type and the sub-plots contained the oyster mushroom cultivar. Each treatment per replicate was presented by 5 culture bags.

Measurements and statistical analyses

Data were recorded for days lapsed to visible pinheads (primordia) formation, fruiting bodies yield, number of fruiting bodies per culture and average fruiting body weight (g/fruit). Biological efficiency (BE) was calculated as follows: BE (%) = (weight of fresh fruiting bodies/ dry weight of substrate) x 100 (Ahmed, 1995; Kirbag and Akyüz. 2008). All data were subjected to analysis of variance (Gomez and Gomez, 1984). Means were separated using either "Duncan's Multiple Range Test" (DMRT) or "The Least Significant Difference" (LSD) Test, where appropriate, at 0.05 probability level.

Results:

Pinheads (primordia)formation

Variance due to trial X substrate X mushroom cultivar was significant for all the parameters studied. Number of days lapsed to appearance of pinheads were slightly greater for mushroom grown on sole *Cynodon dactylon* grass weed substrate than on sole wheat straw substrate (Table 1 A and B), except for *Pleurotus ostreatus* in the first trial where no difference between the two substrates were detected. Meanwhile, the two mushroom cultivars exhibited a significantly reduced number of days lapsed to visible pinhead formation when grown on sole *Cynodon dactylon* grass weed substrate comparing with sole sugarcane bagasse and faba bean straw in both trials. Obviously, the earliest to form visible pinheads were the mushroom grown on sole rice straw substrate. The *Pleurotus ostreatus* mushroom grown in the first trial and *Pleurotus columbinus* in the second trial were the latest to show visible pinheads when grown on sole African mahogany (*Khaya senegalensis*) tree leaves.

Number of days lapsed to the appearance of pinheads were significantly increased for both mushroom cultivars grown on *Cynodon dactylon* grass weed substrate mixed with faba bean straw and sugarcane bagasse as compared to sole *Cynodon dactylon* grass weed substrate. The number of days to visible pinhead formation for *Pleurotus ostreatus* mushroom did not significantly change whether grown on sole or mixed African mahogany tree leaves in the first trial. However, visible pinhead formation for this mushroom cultivar was delayed when used mixed as comparing with sole African mahogany tree leaves in the second trial. *Pleurotus columbinus* exhibited greater of days to visible pinhead formation when produced on mixed as comparing with sole African mahogany tree leaves in both trials. Visible pinheads formed later for both mushroom cultivars grown on

mixed rice or wheat straws than on sole rice or wheat straws in the two trials.

The differences between *Pleurotus ostreatus* and *Pleurotus columbinus* for each of the six sole and the four mixed substrates were significant (Table 1 A and B). Clearly, *Pleurotus ostreatus* was superior to *Pleurotus columbinus* exhibiting a magnificent reduced number of days lapsed to formation of visible pinheads in both trials.

Fruit bodies' yield and characteristics :

As shown in Table (2 A) for the six sole substrates, total fruiting bodies yield produced by *Pleurotus ostreatus* and *Pleurotus columbinus* when grown on *Cynodon dactylon* grass weed substrate was not significantly different from its yield obtained on wheat straw substrate in the first indoor trial. However, significant reduction in total fruiting bodies yield was detected in the second trial (Table 2 B), for both mushroom cultivars grown on sole *Cynodon dactylon* grass weed substrate comparing with sole wheat straw substrate. Consistently both mushroom cultivars in the two trials produced higher fruit bodies crop when grown on sole *Cynodon dactylon* grass weed (CW) substrate than on sole sugarcane bagasse. *Pleurotus columbinus* showed no difference between fruiting bodies yield obtained from culture on *Cynodon dactylon* grass weed substrate and faba bean straw substrate in the first trial. Whereas, higher fruit bodies yield was harvested from culture on sole *Cynodon dactylon* grass weed substrate in the second trial. On the contrary, *Pleurotus columbinus* produced higher fruiting bodies yield on *Cynodon dactylon* grass weed substrate in the first trial than faba bean straw substrate while no difference was detected between the two substrates in the second trial. Noticeably, the poorest fruiting bodied yield was obtained for both mushroom cultivars when they were grown on African mahogany tree leaves. On the other side, the highest fruiting bodies yield for the two mushroom cultivars was harvested from cultures on rice straw substrate.

Pleurotus ostreatus fruiting bodies yield was similar whether grown on sole *Cynodon dactylon* grass weed substrate or its mixture with faba bean straw and sugarcane bagasse substrates in the first trial (Table 2 A). However, the fruiting bodies of this mushroom cultivar significantly reduced on *Cynodon dactylon* grass weed substrate mixed with FBS and SCB substrates as compared to sole *Cynodon dactylon* grass weed substrate in the second trial (Table 2 B). Differently, *Pleurotus columbinus* fruiting bodies yield was similar whether grown on sole *Cynodon dactylon* grass weed substrate or its mixture with FBS and SCB substrates in the second trial (Table 2 B) while significantly reduced on *Cynodon dactylon* grass weed substrate mixed with FBS and

SCB substrates as compared to sole *dactylon* grass weed substrate in the first trial (Table 2 A). Mixing African mahogany tree leaves substrate with faba bean straw and sugarcane bagasse substrates significantly enhanced fruiting bodies yield as compared to sole African mahogany tree leaves, except for *Pleurotus col*um*binus* in the first trial. Faba bean straw and sugarcane bagasse substrates mixed with wheat straw substrate did not affect fruiting bodies yield for both mushroom cultivars in the first trial (Table 2 A) while significant depression for both mushroom cultivars was found in the second trial (Table 2 B). Mixing rice straw substrate with faba bean straw and sugarcane bagasse substrates consistently showed a significant reduction in fruiting bodies yield of both mushroom cultivars in the two trials (Table 2 A and B).

Pleurotus ostreatus grown on sole *Cynodon dactylon* grass weed substrate gave number of fruiting bodies similar to wheat straw, sugarcane bagasse, faba bean (*Vicia faba* L.) straw and African and tree leaf sole substrates in both trials (Table 3 A and B). This oyster mushroom cultivar produced its largest number of fruiting bodies when grown on sole rice straw as compared to other five sole substrates. *Pleurotus col*um*binus* exhibited contradictory results in the context in the two seasons. For example, growing tor his oyster mushroom cultivar on sole *Cynodon dactylon* grass weed gave larger number of fruiting bodies than wheat straw in the first trial but reduced number of fruiting bodies in the second trial. However, the two oyster mushroom cultivars produced its largest number of fruiting bodies when grown on sole rice straw as compared to the other five sole substrates.

Using *Cynodon dactylon* grass weed or African mahogany tree leaves or wheat straw mixed substrates for growing *Pleurotus ostreatus* increased the number of fruiting bodies in both trials comparing with the respective sole substrate (Table 3 A and B). For *Pleurotus col*um*binus* these mixed substrates either reduced (first trial) or did not affect the number of fruiting bodies (second trial). In comparison with sole rice straw, mixed rice straw substrate used for production of *Pleurotus ostreatus* showed increased number of fruiting bodies in the first trial but did not affect the number of fruiting bodies in the second trial. This latter substrate when used for production of *Pleurotus col*um*binus* mushroom reduced the number of fruiting bodies in the first trial while no significant differences were detected in the second trial.

Growing the oyster mushroom cultivars on sole *Cynodon dactylon* grass weed substrate gave fruiting bodies of greater weight than sugarcane bagasse and African mahogany tree leaves substrates in the two trails (Table 4 A and B). For sole

wheat straw substrate, *Pleurotus ostreatus* grown on sole *Cynodon dactylon* either had similar or reduced average fruiting body weight. For sole faba bean straw substrate, average fruiting body weight was either did not differ significantly or were greater comparing with sole *Cynodon dactylon* grass weed substrate. Rice straw substrate consistently produced mushroom fruiting bodies showing the greatest weight in both trials.

Mixed in contrast to sole *Cynodon dactylon* grass weed substrate utilized for production of *Pleurotus ostreatus* mushroom, reduced the average fruiting bodies weight (Table 4 A and B). The same result was found for mixed versus sole substrates of wheat and rice straws. On the other hand, no difference was detected between sole and mixed African mahogany tree leaves. *Pleurotus ostreatus* produced fruiting bodies of greater weight when grown on mixed African mahogany tree leaf substrate as compared to sole one in the two trials. However, no change occurred in fruiting body weight for mixed versus sole rice straw substrate. Regarding sole versus mixed *Cynodon dactylon* grass weed and wheat straw substrates, the average fruiting body weight either increased (first trial) or showed no significant changes (second trial).

Obviously,*Pleurotus ostreatus* mushroom was superior to *Pleurotus columbinus* mushroom concerning total fruiting body yield (Table 2 A and B). The differences between the two mushrooms were substantial for all the studied six sole and the four substrates in both trials. Closely similar result was found for number of fruit bodies (Table 3 A and B) and average fruit body weight (Table 4 A and B), with minute exceptions. These include the non-significant difference for number of fruiting bodies between the two mushroom cultivars on faba bean straw (in both trials), rice straw (first trial), sugarcane bagasse substrate (first trial) and *Cynodon dactylon* grass weed (second trial) (Table 3 A and B). Differences were not significant also for average fruit body weight of the two mushrooms grown on mixed rice straw (both trials) and mixed *Cynodon dactylon* grass substrate (first trial).

Mushroom Biological efficiency

Both mushroom cultivars grown on sole *Cynodon dactylon* grass weed substrate had higher biological efficiency than those cultured on sole sugarcane bagasse or sole African mahogany tree leaves (Table 5 A and B). In comparison with sole *Cynodon dactylon* grass weed substrate, *Pleurotus ostreatus* mushrooms grown on sole wheat straw showed a biological efficiency similar (first trial) or lower (second trial). This mushroom cultivar exhibited either elevated biological efficiency (second trial) or did not significantly differ (first trial) when grown on sole faba bean straw comparing with

sole *Cynodon dactylon* grass weed substrate. *Pleurotus col*um*binus* cultured on sole faba bean straw in contrast to sole *Cynodon dactylon* grass weed substrate showed either higher (first trial) or similar (second trial) biological efficiency.

Pleurotus ostreatus grown on mixed *Cynodon dactylon* grass weed substrate or wheat straw substrate exhibited no change (first trial) or reduced (second trial) biological efficiency comparing with relevant sole *Cynodon dactylon* grass weed and wheat straw substrates (Table 5 A and B). However, mixed African mahogany tree leaf substrate elevated the biological efficiency comparing with sole one in both trials. On the other hand, mixed rice straw reduced this parameter comparing with sole rice straw in both trials. *Pleurotus col*um*binus* cultured on mixed African mahogany tree leaves exhibited increased biological efficiency as compared with the sole one in both trials. Mixed wheat straw or mixed rice straw in contrast to their relevant sole substrate, reduced the biological efficiency in both trials. Regarding mixed versus sole *Cynodon dactylon* grass weed substrate the mushroom biological efficiency decreased on mixed substrate (first trial) or showed no change (second trial).

The differences between *Pleurotus ostreatus* and *Pleurotus columbinus* for each of the six sole and the four mixed substrates were significant (Table 5 A and B). Apparently, *Pleurotus ostreatus* was superior to *Pleurotus columbinus* exhibiting a magnificent elevated biological efficiency in both trials.

Discussion:

The current study substantiates the notion of the prominent role of the substrate type for mushroom fruiting bodies' yield (Shah et al., 2004; Iqbal et al., 2005; lbekwe et al., 2008; Kimenju et al., 2009). Among the six tested sole lignocellulosic materials in our assessment and in an agreement with others (Zhang et al., 2002; Kimenju et al., 2009), rice straw was markedly the top productive substrate. Oyster mushrooms grown on this substrate appreciably gave the highest basidiocarp (fruiting bodies) crop. The produced fruiting bodies were of larger size and the earliest to be harvested. Our data show that wheat straw substrate was second to rice straw substrate regarding mushroom fruiting bodies' yield. However, rice straw may not be the most available or affordable substrate in some regions such as in Upper Egypt. Wheat straw is regularly used for farm animal feeding. In general, it is always preferable to use lignocellulosic materials that have little food value for cattle and other ruminants. Tshinyangu (1996) compared fruit bodies of *P. ostreatus* var. *columbinus* grown on grass (undefined) hay and wheat straw substrates. The author reported an enhanced nutritional quality of fruit bodies harvested from grass substrate.

Cynodon dactylon grass weed substrate used in this study noticeably came after wheat straw regarding the fruit bodies' yield (Tables 2A and B). Its mushroom crop yield was higher than that yield of mushroom grown on more commonly utilized substrates sugarcane bagasse (Kimenju et al., 2009) and faba Bean (*Vicia faba* L.) straw. Similar result was also found concerning days lapsed to visible pinhead formation, biological efficiency, number of fruit bodies and average fruit body weight. It is worth to mention that mushroom crop yield of *Cynodon dactylon* grass weed substrate, though statistically lower, was competitive to the yield of mushroom grown on wheat straw substrate. *Cynodon dactylon* grass weed is a problem in production field of higher plant crop and has no economic utilization. Taking into account substrate affordability, producing oyster mushroom using *Cynodon dactylon* grass weed substrate would be fascinating way to recycle it into a human food. Oyster mushroom fruit bodies' crop yield was the least produced by the mushroom fungi grown on African mahogany (*Khaya senegalensis*) tree leaves. In spite of this result, growers with no affordable lignocellulosic material can make use of tree leaf waste for oyster mushroom growing.

The growth of *Pleurotus* mushrooms and the differential fungi crop productivity of lignocellulosic materials are affected largely by Carbon : Nitrogen ratio in the substrate (Azizi et al., 1990; Gupta and Vijay, 1991). It may be, therefore, possible to elevate crop yield of mushrooms grown on African mahogany (*Khaya senegalensis*) tree leaves by addition of nitrogen supplements and composting. Supplements of blackstrap (Soliman, 2011; Soliman et al., 2011) and mineral nutrients is claimed to be useful to enhance productivity of poor substrates. These approaches may also be used to get further enhancement in the mushrooms yield performance when grown on *Cynodon dactylon* grass weed substrate. Another strategy to improve cropping gain for these substrates could be via selection of *Pleurotus* mushroom species and strains. The present study demonstrates that *Pleurotus ostreatus* was superior to *P. columbinus* for all the studied fruit bodies' parameters. *P. ostreatus* (a wood-decomposing fungus) is the most frequently cultivated species of the genus *Pleurotus* (Kong, 2004). The species is quite adaptable to a range of climates and substrate materials, making itself the second most common mushroom produced worldwide following the button mushroom (Kong, 2004). The differential crop productivity of *Pleurotus* species may be attributed to differences in their capability to secreted hydrolyzing and oxidizing enzymes that degrade components of lignocellulosic material into simple soluble compounds (Ulezlo et al.,

1975; Toyama and Ogawa, 1976; Rajarathnam et al., 1979).

Another factor that controls the differential mushroom fungi crop productivity when grown on various lignocellulosic substrates is the substrate contents of lignin, cellulose and hemicellulose (McMillan 1994; Kimenju et al., 2009). As shown by Obodal and Johnson (2002), composted *T. Scleroxylon* sawdust mixed with other substrates significantly increased the yield of *P. ostreatus*. This may interpret the results obtained here from mixed substrates. Faba bean (*Vicia faba* L.) straw and sugarcane bagasse mixed with either one of the other substrates (rice straw, wheat straw or *Cynodon dactylon* grass weed) decreased their mushroom crop yield. Dissimilarly, faba bean (*Vicia faba* L.) straw and sugarcane bagasse mixed with African mahogany (*Khaya senegalensis*) tree leaf substrate increased its crop production.

In conclusion, *Cynodon dactylon* grass weed may be exploited as potential affordable substrate for production of oyster mushroom.

References

Ahmed, A. A. 1995. Scientific mushrooms encyclopedia: Mushroom cultivation (2). Arab House for Publishing and Distribution, p 248 (In Arabic)

Atkinson, G.F., 1961. *Studies of American fungi. Mushrooms, Edible, Posionous, etc*, p. 332. Ithaca, New York.

Azizi, K.A., T.R. Shamla and K.R. Sreekantiah. 1990. Cultivation of *Pleurotus sajor-caju* on certain agro-wastes and utilization of the residues for cellulose and D- xylanase production. *Mushroom J. Trop*. 10: 21-26.

Bahukhandi, D. and R.L. Munjal. 1989. Cultivation of *Pleurotus* species on different agricultural residues. Indian Phytopathol. 42: 492-495.

Balasubramanya, R.H. and A.A. Kathe. 1996. An inexpensive pretreatment of cellulosic materials for growing edible oyster mushrooms. Bioresource Technol., 57: 303-305

Crisan, E.V. and A. Sands, 1978. Nutritional value. *In:* Chang, S.T. and W.A. Hayee (Eds.). *The Biology and Cultivation of Edible Mushrooms.* CBS Publishers and Distributors, Delhi 110 032, India.

Gomez, K.A. and A.A. Gomez. 1984. Statistical procedures for agricultural research, 2nd ed., John Wiley, NY.

Gupta, Y. and B. Vijay.1991. Post composting supplementation in *Agaricus bisporus* under seasonal growing conditions. 13th International Congress of ISMS held at Dublin, Ireland (c.f,Singh,S. C.S., Kathmandu Univ J. of Sci., Engineering and Technology,5(II), 2009, pp 66-71)

Hayes, S., 1978. Ecology, resources and mushroom cultivation. Mush.J., 84: 515-525.

lbekwe, V.I., P.1. Azubuike, E.U. Ezeji and E.C. Chinakwe. 2008. Effects of nutrient sources and environmental factors on the cultivation and yield of oyster mush-

room (*Pleurotus ostreatus*). Pakistan J. Nutrition 7 (2):349-351.

Iqbal, S.H.M, C.H. Abdul Rauf and M.I. Sheikh. 2005. Yield performance of oyster mushroom on different substrates. Int. J. Agri. Biol., 7(6):900-903.

Jiskani, M.M., 1999. *A brief outline "The Fungi" (Cultivation of Mushrooms)*, p. 94. Izhar Pub. Tandojam– Pakistan (c.f., S.H.M Iqbal, et al. 2005, Int. J. Agri. Biol., 7(6):900-903).

Khan, S.M., A.G. Kausar and M.A. Ali, 1981. Yield performance of different strains of oyster mushroom (*Pleurotus* spp.) on paddy straw in Pakistan. Mush. Sci., 11: 675-8.

Kimenju, J.W., G.O.M Odero, E.W. Mutitu, P.M. Wachira, R.D. Narla and W.M. Muiru. 2009. Suitability of locally available substrates for oyster mushroom (*Pleurotus ostreatus*) cultivation in Kenya. Assian J. Plant Sci. 8 (7):510-514.

Kiran, B.M., and C.L. Jandaik. 1989. Cultivation of *Pleurotus sapidus* in India. Mushroom Science 12(2):179-185

Kirbag, S. and M. Akyüz. 2008. Evaluation of agricultural wastes for the cultivation of *Pleurotus eryngii* (DC. ex Fr.) Quel. var. *ferulae* Lanzi. African J. Biotech. 7(20):3660-3664.

Kong, W.S. 2004. Description of commercially important *Pleurotus* species. In: Rick Gush (ed). Mushroom Growers Handbook 1, Part II, Oyster Mushroom, p 55-61. Mushroom World, Aloha Medicinals Inc., Hawaii.

Kurtzman, R.H. Jr., 1976. Nutrition of *Pleurotus sapidus* effects of lipids. Mycologia, 68: 268-295.

McMillan J. D. 1994. Pretreatment of lignocellulosic biomass. In: Himmel M. E, Baker J. O., Overend R. P. (eds). Enzymatic conversion of biomass for fuels production. American Chemical Society, Washington, DC, pp. 292-324.

Mizuno, T. and C.H. Zhuang. 1995. *Pleurotus sajor-caju* – antitumor- activity and utilization. Food Reviews International, 11:185-187.

Obodal, M. and P.N.T. Johnson. 2002. The effect of nutrient supplements on the yield of *pleurotus ostreatus* mushroom grown on composted saw dust of *Triplochiton scleroxlon*. Tropical Sci. 42(2): 78-82.

Philoppousis, A. and Z.P. Diamantopoulou. 2001. Bioconversion of agricultural lignocellulosic wastes through the cultivation of the edible mushrooms agrobybe aegrita, *Vovariella volvaceae* and *Pleurotus* spp. World J. Microbiol. Biotechnol., 17:191-200.

Poppe, J. 2004. Agricultural wastes as substrates for oyster mushroom. In: Rick Gush (ed). Mushroom Growers Handbook 1. Part II Oyster

Mushroom, p 75-85. Mushroom World, Aloha Medicinals Inc., Hawaii.

Rajarathnam, S. and Z. Bano. 1989. *Pleurotus* mushrooms: Part III. Biotransformations of natural lignocellulosic wastes commercial applications and implications. Critical Reviews in Food Science and Nutrition, 28:31-113.

Rajarathnam, S., D. Wankhede and M. Patwardhen. 1979. Some chemical and biochemical changes in straw constituent during growth of *pleurotus flabellatus* (Berk B.) Sacc. European J. of Appl. Microbiol.Biotechnol., 8:125.

Shah, Z.A, M. Ashraf and M. Ishtiaq Ch. 2004. Comparative study on cultivation and yield performance of oyster mushroom (*Pleurotus ostreatus*) on different substrates (wheat straw, leaves, saw dust). Pakistan Journal of Nutrition. 3 (3): 158-160.

Soliman, M. M. 2011. Influence of substrate mix and enrichment supplements on oyster mushroom growth and yield. M.Sc. Thesis, Assiut University.

Soliman, M.M., M.F. Mohamed, M.H. Aboul-Nasr and A.G. Haridy. 2011. Influence of sucrose and blackstrap molasses supplemented to sawdust substrate on yield of oyster mushroom (*Pleurotus ostreatus*). Assiut J. Agric. Sci. 42:424-433(special issue, The 5th conf. Young Scientists, Faculty Agric, Assiut University, May 8th 2011.

Stamets, P. 1993. Growing gourmet and medicinal mushroom. A comparison guide to the mushrooms cultivation. 3rd ed., Ten Speed Press, California.

Subramanian, T.R., 1986. Nutritive Value. Mushroom Extension bulletin. Indian Institute of Horticulture Research, India, 8: 36.

Tewari, R.P., 1986. Mushroom cultivation. Extension Bulletin. Indian Institute of Horticulture Research, Banglore, India, 8: 36.

Toyama, N. and K. Ogawa. 1976. Comparative studies on cellulytic and oxidizing enzyme activities of edible and inedible wood rotters. Mushroom Sci. 9 (1): 745.

Tshinyangu, K. K. 1996. Effect of grass hay substrate on nutritional value of *Pleurotus ostreatus* var. *columbinus*., Nahrung / Food, 40 (2):79-83

Ulezlo, I., T. Uporva and R. Feniksova. 1975. Oxidative enzymes of the lignin-degrading fungus *Pleurotus ostreatus*. Prikl Biokhim. Microbiol. 11 (4): 535.

Zhang, R.H., L.I. Xiujin and J.G. Fadel. 2002. Oyster mushroom cultivation with rice and wheat straw. Bioresource Technology 82 (3) 277-284.

Table (1A). Days lapsed to visible pinhead formation of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates 2008/2009 (1st Trial) (1).

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbi-nus***	**fference**	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	16.0 c [3]	21.6 b	**5.6 ***	**18.8**
African mahogany (*Khaya sene-galensis*) tree leaves, (TL)	17.4 a	21.7 b	**4.3 ***	**19.6**
TL mixed with FBS & SCB [2]	17.5 a	22.4 a	**4.9 ***	**19.6**
***Cynodon dactylon* grass weed, (GW)**	15.1 de	20.5 c	**5.4 ***	**17.8**
GW mixed with FBS & SCB [2]	16.7 b	21.5 b	**4.8 ***	**19.1**
Rice Straw, (RS)	13.9 f	18.2 e	**4.3 ***	**16.1**
RS mixed with FBS & SCB [2]	15.3 d	20.5 c	**5.2 ***	**17.9**
Wheat Straw, (WS)	14.7 e	19.9 d	**5.2 ***	**17.3**
WS mixed with FBS & SCB [2]	15.5 d	21.3 b	**5.8 ***	**18.4**
Sugar cane bagasse, (SCB)	16.6 b	22.6 a	**6.0 ***	**19.6**
Mean	**15.9**	**21.0**	**5.2 ***	**18.5**
$LSD_{0.05}$				0.3 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates averaged over the two mushroom cultivars.

Table (1B). Days lapsed to visible pinhead formation of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2009/2010 (2nd Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbi-nus***	**Difference[4]**	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	15.2 d [3]	20.3 c	**5.1 ***	**17.8**
African mahogany (*Khaya sene-galensis*) tree leaves, (TL)	15.9 b	21.2 b	**5.3 ***	**18.6**
TL mixed with FBS & SCB [2]	16.3 a	22.3 a	**6.0 ***	**19.3**
***Cynodon dactylon* grass weed, (GW)**	14.6 e	19.5 d	**4.9 ***	**17.1**
GW mixed with FBS & SCB [2]	15.7 bc	20.6 c	**4.9 ***	**18.2**
Rice Straw, (RS)	13.2 g	16.5 f	**3.3 ***	**14.9**
RS mixed with FBS & SCB [2]	14.5 e	19.3 d	**4.8 ***	**16.9**
Wheat Straw, (WS)	13.7 f	18.7 e	**5.0 ***	**16.2**
WS mixed with FBS & SCB [2]	15.4 cd	20.5 c	**5.1 ***	**18.0**
Sugar cane bagasse, (SCB)	15.6 bc	20.6 c	**5.0 ***	**18.1**
Mean	**15.0**	**20.0**	**5.0 ***	**17.5**
$LSD_{0.05}$				0.3 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates average over the two mushroom cultivars.

Table (2A). Total fruit bodies' yield (g/300g moistened substrate) of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2008/2009 (1st Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba bean (*Vicia faba* L.) straw, (FBS)	18.12 def [3]	13.38 cd	4.74 *	15.75
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	12.79 g	10.17 e	2.62 *	11.48
TL mixed with FBS & SCB [2]	16.50 ef	12.46 de	4.04 *	14.48
***Cynodon dactylon* grass weed, (GW)**	19.72 cd	17.12 b	2.60 *	18.42
GW mixed with FBS & SCB [2]	18.60 de	14.42 cd	4.18 *	16.51
Rice Straw, (RS)	39.45 a	23.87 a	15.58 *	31.66
RS mixed with FBS & SCB [2]	25.59 b	17.69 b	7.90 *	21.64
Wheat Straw, (WS)	21.29 c	18.16 b	3.13 *	19.73
WS mixed with FBS & SCB [2]	19.42 cd	15.70 bc	3.72 *	17.56
Sugar cane bagasse, (SCB)	15.96 f	13.03 d	2.66 *	14.49
Mean	**20.72**	**15.6**	5.12 *	18.16
$LSD_{0.05}$				1.85 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates average over the two mushroom cultivars.

Table (2B).Total fruit bodies' yield (g/300g moistened substrate) of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus)grown indoors on different substrates in 2009/2010(2nd Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	16.50 e [3]	12.83 def	**3.67 ***	**14.67**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	12.07 g	8.73 g	**3.34 ***	**10.40**
TL mixed with FBS & SCB [2]	14.65 f	11.67 f	**2.98 ***	**13.16**
***Cynodon dactylon* grass weed, (GW)**	18.43 d	14.01 cd	**4.42 ***	**16.22**
GW mixed with FBS & SCB [2]	16.22 e	13.58 cde	**2.64 ***	**14.90**
Rice Straw, (RS)	36.79 a	22.39 a	**14.40 ***	**29.59**
RS mixed with FBS & SCB [2]	24.29 b	16.48 b	**7.81 ***	**20.39**
Wheat Straw, (WS)	20.26 c	16.44 b	**3.82 ***	**18.35**
WS mixed with FBS & SCB [2]	17.58 de	14.64 c	**2.94 ***	**16.11**
Sugar cane bagasse, (SCB)	14.34 f	12.43 ef	**1.91 ***	**13.39**
Mean	**19.11**	**14.32**	**4.79 ***	**16.72**
$LSD_{0.05}$				1.21 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates average over the two mushroom cultivars.

Table (3 A). Number of fruit bodies/300g moistened substrate of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2008/2009 (1st Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	3.5 d [3]	3.7 cd	**0.2 ns**	**3.6**
African mahogany (*Khaya senegalensis*) **tree leaves, (TL)**	3.5 d	4.2 bc	**0.7 ***	**3.9**
TL mixed with FBS & SCB [2]	4.6 c	2.7 e	**1.9 ***	**3.7**
***Cynodon dactylon* grass weed, (GW)**	3.8 d	4.8 ab	**1.0 ***	**4.3**
GW mixed with FBS & SCB [2]	4.8 bc	3.5 d	**1.3 ***	**4.2**
Rice Straw, (RS)	5.4 ab	5.4 a	**0.0 ns**[5]	**5.4**
RS mixed with FBS & SCB [2]	5.6 a	3.8 cd	**1.8 ***	**4.7**
Wheat Straw, (WS)	3.3 d	4.5 b	**1.2 ***	**3.9**
WS mixed with FBS & SCB [2]	5.4 ab	3.6 cd	**1.8 ***	**4.5**
Sugar cane bagasse, (SCB)	3.7 d	4.2 bc	**0.5 ***	**4.0**
Mean	**4.4**	**4.0**	**0.3 ***	**4.2**
$LSD_{0.05}$				0.5 [6]

[1] Variance due to mushroom cultivar X substrate was significant.

[2] 1:1:1 mixture (w/w).

[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).

[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.

[5] Non significant

[6] To compare means of the different substrates average over the two mushroom cultivars.

Table (3 B). Number of fruit bodies/300g moistened substrate of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2009/2010 (2nd Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	3.4 d [3]	3.7 bc	**0.3 ns**[5]	**3.6**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	3.2 d	2.7 d	**0.5 ***	**3.0**
TL mixed with FBS & SCB [2]	4.2 c	2.9 d	**1.3 ***	**3.6**
***Cynodon dactylon* grass weed, (GW)**	3.3 d	3.5 c	**0.2 ns**	**3.4**
GW mixed with FBS & SCB [2]	4.9 b	3.6 c	**1.3 ***	**4.3**
Rice Straw, (RS)	5.8 a	5.2 a	**0.6 ***	**5.5**
RS mixed with FBS & SCB [2]	5.8 a	3.7 bc	**2.1 ***	**4.8**
Wheat Straw, (WS)	3.3 d	4.0 b	**0.7 ***	**3.7**
WS mixed with FBS & SCB [2]	5.5 a	3.7 bc	**1.8 ***	**4.6**
Sugar cane bagasse, (SCB)	3.1 d	5.1 a	**2.0 ***	**4.1**
Mean	**4.3**	**3.8**	**0.4 ***	**4.0**
$LSD_{0.05}$				0.3 [6]

[1] Variance due to mushroom cultivar X substrate was significant.

[2] 1:1:1 mixture (w/w).

[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).

[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.

[5] Non significant

[6] To compare means of the different substrates average over the two mushroom cultivars.

Table (4 A). Average fruit body weight of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2008/2009 (1st Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	5.2 c [3]	3.6 d	**1.6 ***	**4.4**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	3.7 g	2.4 f	**1.2 ***	**3.1**
TL mixed with FBS & SCB [2]	3.6 g	4.7 ab	**1.1 ***	**4.2**
***Cynodon dactylon* grass weed, (GW)**	5.2 c	3.6 d	**1.6 ***	**4.4**
GW mixed with FBS & SCB [2]	4.0 f	4.1 c	**0.1 ns**[5]	**4.0**
Rice Straw, (RS)	7.3 a	4.4 ab	**2.9 ***	**5.9**
RS mixed with FBS & SCB [2]	4.6 d	4.7 a	**0.1 ns**	**4.7**
Wheat Straw, (WS)	6.4 b	4.1 c	**2.4 ***	**5.3**
WS mixed with FBS & SCB [2]	3.6 g	4.4 b	**0.8 ***	**4.0**
Sugar cane bagasse, (SCB)	4.3 e	3.1 e	**1.2 ***	**3.7**
Mean	**4.8**	**3.9**	**0.9 ***	**4.4**
$LSD_{0.05}$				0.2 [6]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] Non significant
[6] To compare means of the different substrates average over the two mushroom cultivars.

Table (4 B). Average fruit body weight of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2009/2010 (2nd Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	4.9 c [3]	3.5 de	**1.4 ***	**4.2**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	3.8 e	3.2 e	**0.6 ***	**3.5**
TL mixed with FBS & SCB [2]	3.5 ef	4.3 ab	**0.8 ***	**3.9**
***Cynodon dactylon* grass weed, (GW)**	5.6 b	4.0 bc	**1.7 ***	**4.8**
GW mixed with FBS & SCB [2]	3.3 f	3.7 cd	**0.5 ***	**3.5**
Rice Straw, (RS)	6.4 a	4.3 ab	**2.1 ***	**5.4**
RS mixed with FBS & SCB [2]	4.2 d	4.5 a	**0.3 ns**[5]	**4.3**
Wheat Straw, (WS)	6.2 a	4.2 ab	**2.0 ***	**5.2**
WS mixed with FBS & SCB [2]	3.2 f	4.0 bc	**0.8 ***	**3.6**
Sugar cane bagasse, (SCB)	4.7 c	2.4 f	**2.2 ***	**3.5**
Mean	**4.6**	**3.8**	**0.8 ***	**4.2**
$LSD_{0.05}$				0.3 [6]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] Non significant
[6] To compare means of the different substrates average over the two mushroom cultivars.

Table (5A). Biological Efficiency (%) of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2008/2009 (1st Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	14.5 def [3]	10.7 cd	**3.8 ***	**12.6**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	10.2 g	8.1 e	**2.1 ***	**9.2**
TL mixed with FBS & SCB [2]	13.2 ef	10.0 d	**3.2 ***	**11.6**
***Cynodon dactylon* grass weed, (GW)**	15.8 cd	13.7 b	**2.1 ***	**14.8**
GW mixed with FBS & SCB [2]	14.9 de	11.5 cd	**3.4 ***	**13.2**
Rice Straw, (RS)	31.6 a	19.1 a	**12.5 ***	**25.4**
RS mixed with FBS & SCB [2]	20.5 b	14.2 b	**3.6 ***	**17.4**
Wheat Straw, (WS)	17.0 c	14.5 b	**2.5 ***	**15.8**
WS mixed with FBS & SCB [2]	15.5 cd	12.6 bc	**2.9 ***	**14.1**
Sugar cane bagasse, (SCB)	12.8 f	10.4 d	**2.4 ***	**11.6**
Mean	**16.6**	**12.5**	**4.1***	**14.5**
$LSD_{0.05}$				1.48 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates average over the two mushroom cultivars.

Table (5B). Biological Efficiency (%) of two cultivated mushroom species (*Pleurotus ostreatus* and *P. col*umbinus) grown indoors on different substrates in 2008/2009 (2nd Trial) [1].

Substrate	Mushroom Cultivar (*Pleurotus spp*)			
	P. ostreatus	***P. columbinus***	**Difference**[4]	**Mean**
Faba Bean (*Vicia faba* L.) straw, (FBS)	13.2 e [3]	10.3 def	**2.9 ***	**11.8**
African mahogany (*Khaya senegalensis*) tree leaves, (TL)	9.7 g	7.0 g	**2.7 ***	**8.4**
TL mixed with FBS & SCB [2]	11.7 f	9.3 f	**2.4 ***	**10.5**
***Cynodon dactylon* grass weed, (GW)**	14.8 d	11.2 cd	**3.6 ***	**13.0**
GW mixed with FBS & SCB [2]	13.0 e	10.9 cde	**2.1 ***	**12.0**
Rice Straw, (RS)	29.4 a	17.9 a	**11.5 ***	**23.7**
RS mixed with FBS & SCB [2]	19.4 b	13.2 b	**6.2 ***	**16.3**
Wheat Straw, (WS)	16.2 c	13.2 b	**3.0 ***	**14.7**
WS mixed with FBS & SCB [2]	14.1 de	11.7 c	**2.4 ***	**12.9**
Sugar cane bagasse, (SCB)	11.5 f	10.0 ef	**1.5 ***	**10.8**
Mean	**15.3**	**11.5**	**3.8 ***	**13.4**
$LSD_{0.05}$				0.9 [5]

[1] Variance due to mushroom cultivar X substrate was significant.
[2] 1:1:1 mixture (w/w).
[3] Means followed by the same letter(s) within column are not significantly different at 0.05 probability level using Duncan's multiple range test (DMRT).
[4] Star donates a significant difference at 0.05 probability level between two mushroom cultivar means when grown on the same substrate.
[5] To compare means of the different substrates average over the two mushroom cultivars.

استجابة الاثمار المبكر والكفاءة البيولوجية والمحصول لنوعى عيش الغراب المحارى بوليروتس أوستراتس وبوليروتس كلومبينس لبيئات مختلفة منفرده اومخلوطة .

محمد فؤاد محمد ، داليا محمود طنطاوى ، عصمت عبد العظيم والي ، اميرة مصطفى قطب

قسم الخضر – كلية الزراعة – جامعة أسيوط

أجريت هذه الدراسة في معمل بحوث وانتاج عيش الغراب بقسم البساتين بكلية الزراعة – جامعة اسيوط. وتم فيها تقييم نوعين من عيش الغراب المحارى المزروع وذلك عند زراعته فى ١٠ بيئات مختلفه منها ٦ بيئات استخدمت منفرده والاربعة الباقية بيئات مخلوطة، والبيئات الست هم حشيشة النجيل واوراق شجر الماهوجنى الافريقى وتبن الفول وقش الارز وقش القمح ومصاصة قصب السكر . تم تحضير البيئات المخلوطة باوزان متساوية من قش الفول ومصاصة قصب السكر مع كلا من حشيشة النجيل واوراق شجر الماهوجنى وقش الارز وقش القمح.

سجلت بيانات عدد الايام لظهور اول بنز – المحصول الكلى – عدد الثمار – متوسط وزن الثمرة – الكفاءة الحيوية للفطرلكل بيئة ، وقد اظهر التحليل الاحصائى اختلافات معنوية فى كل الصفات المدروسة فيما يخص التفاعل بين فطر عيش الغراب (المشروم) والبيئات المستخدمه لزراعته. الا ان النوع بوليروتس اوستریاتس قد اظهر تفوقا معنويا على النوع بوليروتس كلومبينس واعطى اعلى محصول ثمرى كلى و اعلى كفاءة حيوية واقل عدد ايام لظهور اول بنز، وفيما عدا اختلافات قليلة فقد كانت نتائج عدد الثمار ومتوسط وزن الثمرة مشابهة فى هذا الشأن.

وفيما يخص الستة بيئات التى استخدمت منفرده ، فقد وجد ان عدد الايام اللازمة لظهور اول بنز والمحصول الكلى والكفاءة الحيوية للمشروم المزروع فى بيئة حشيشة النجيل اقل قليلا او مماثل للمزروع فى بيئة قش القمح، وظهر معنوية فى خفض عدد الايام لظهور اول بنز وزيادة المحصول والكفاءة الحيوية عند الزراعه فى بيئة حشيشة النجيل مقارنة ببيئة مصاصة قصب السكر ، وكذلك ظهر خفض معنوى فى عدد الايام لظهور اول بنز وزيادة او عدم اختلاف فى المحصول الكلى والكفاءة الحيوية عند الزراعه فى بيئة حشيشة النجيل مقارنه ببيئة تبن الفول ، وكان اقل محصول كلى وكفاءة حيوية عند الزراعه فى بيئة اوراق شجر الماهوجنى بينما كانت الاختلافات فى عدد الايام لظهور اول بنز متباينة .وقد كان اقل عدد ايام لظهور اول بنز واعلى محصول كلى وكفاءة حيوية عند الزراعة فى بيئة قش الازر.

واما فيما يخص الاربعة بيئات التى استخدمت مخلوطة ، فقد وجد فروق معنوية لزيادة عدد ايام ظهور اول بنز لنوعى غيش الغراب المزروع فى بيئة مخلوط حشيشة النجيل بالمقارنة ببيئة حشيشة النجيل بمفردها بينما المحصول الكلى والكفاءة الحيوية كانت متماثلة او اقل. عند الزراعه فى بيئة اوراق شجر الماهوجنى المخلوطة مقارنة باوراق شجر الماهوجنى المنفرده لم يلاحظ فروق معنوية لظهور أول بنز للنوع أوستراتس بينما اظهر النوع كلومبينس زيادة فى عدد ايام لظهوراول بنز ، وقد اظهر مخلوط اوراق الشجر اختلافات معنوية كذلك لصفة المحصول الكلى والكفاءة الحيوية بالمقارنة بالبيئة بمفردها . عند الزراعه فى مخلوط قش الارز أو مخلوط قش القمح زادت عدد ايام ظهور اول بنز وقل كلا من المحصول الكلى والكفاءة الحيوية لنوعى المشروم عن زراعتهما فى البيئات المنفرده لقش الارز وقش القمح.

نظرا للتفوق على بيئات شائعه الاستخدام فى انتاج عيش الغراب (تبن الفول ومصاصة قصب السكر) أوالتماثل معها (قش القمح وتبن الفول) ، فان حشيشة النجيل يمكن الاستفاده منها فى هذا الصدد بتحويلها إلى غذاء أدمى صحى.