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# Determination of Yield and Quality of Oyster Mushroom (*Pleurotus florida*) Using Different Substrates in Halabja, Kurdistan Reign-Iraq

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## ABSTRACT

This research was conducted in Agricultural Technical College of Halabja, Sulaimani Polytechnic University. The aim of this study was to evaluate the numbers of days taken for mycelium developing, initiation of primordia, pinheads, harvesting stages, yield, the biological efficiency (%), and percent quality (protein, carbohydrates, fiber, fat and moisture) contents of oyster mushroom (*Pleurotus florida*) on five different substrates: Wheat stalk alone and in combination with wheat bran, gypsum and soil. The highest rate of spawn run (21.50 day) discovered from control E and the lowest (14.75 days) was found in treatment C. The longest period of days taken for initiation of primordia from treatment E 100% wheat was (33.50 days), and the shortest (15.75 days) was found in treatments C and D. The highest yield (333.2±2 g) was obtained from tereatment A 88% wheat, which was not singnificantly higher than the other treatments. The total yield was collected from three flushes of harvested mushroom. The lowest yield (295.9±2 g) was observed from treatment D 52% wheat. Protein content in treatment D 52% wheat gave the highest value (24.28%), and the lowest protin content (17.35%) was shown by treatment E 100% wheat. Total fiber content in treatment E 100% wheat was significantly higher than other substrates, and the highest level of fiber (23.83%) was taken from treatment B 76% wheat, and the lowest (16.53%) was taken from treatment D 52% wheat.

**Keywords:** *Pleurotus florida*, nutrition analysis, substrate, wheat, soil, yield.

## INTRODUCTION

Mushroom is not a real vegetable crop, it is free from leaves, flowers and seeds, containing no chlorophylls to carbon synthesis. This kind of mushroom is completely different from those of fungus, and it is belonging to the Basidiomycetes. Light is not necessary to flash to the mushroom we search for, and it needs a dark place to grow(Aishah & Wan Rosil, 2013).

The total numbers of edible oyster mushrooms are about 18 species which are commercially cultivated (Kong, 2004), about eight species of them are identified in Kurdistan Reign-Iraq, such as *Pleurotus ostreatus*, *P. columbinus*, *P. florida*, *P. sajor-caju*, *P. populinus*, *P. cornucopiae*, *P. djamor* and *P. cryngii*. People around Halabja city-Kurdistan collected them from the nature to make cook and sale.

According to (Ahmed *et al.*, 2013), oyster mushroom contains lots of vital substances, such as protein, carbohydrate, fiber, and a few of fat. Consequently, it is a good resource of vitamin B2, C and B6, and lots of minerals demined by human body.

The nutritional composition of mushroom influenced by lots of factors, such as growth medium and the techniques used for cultivation (Khan *et al.*, 2008).

Most of the researchers had worked to found the best and economic substrate with a preferable way to cultivate oyster mushroom on the agricultural wastes. Oyster mushroom production is unsophisticated and cheap, which gives the highest yield and biological efficiency (Khan *et al.*, 2013).

There are several kinds of agricultural wastes which can be used for oyster mushroom production such as wheat straw, barley stalk, soybean flour, cow dung, sawdust, rice stake, paddy stalk, maize stalk and millet (Kong, 2004; Khan *et al.*, 2008; Ahmed *et al.*, 2013; Aishah & Wan Rosil, 2013; and Mamiro *et al.*, 2014). Different kinds of agricultural wastes are ripe for oyster mushroom cultivation in Kurdistan rigin-Iraq, and some various of agricultural wastes are applied as substrate, but have not been to impact the quality of mushroom. Thus, the aim of this study was to compare yield and quality of oyster mushroom (*Pleurotus florida*) on different mixtures of substartes and to find out the relationship between the substrate and the mushroom.

## MATERIALS AND METHODS

This research was conducted in Agricultural Technical College of Halabja, Sulaimani Polytechnic University during (2015). The assurance of this study was to examination of the impact of various kinds of substrate mixtures on the yield and quality of oyster mushroom (*Pleurotus florida*) by employing wheat stalk, wheat bran, and soil. The soil was obtained from the Expreimental Farm of the Agricultural Technical College of Halabja, the *Pleurotus florida* spawn was prepared in the microbiology lab of the college. Gypsum, auctoclaveable plastic bags, water, ring, rubber band, plastic basin, thermometer, and sprayer were also provided by the college.

Five mixtures of substrates were used in this trial for the cultivation of *Pleurotus florida*, such as A, B, C, D and E (Table1). Treatment E was selected as a control and labelled bags to recognize the replication and the treatment. The chemical properties of soil, wheat straw, wheat bran and gypsum were determined prior to use (Table 2). First wheat straw was wieghed on an electronic balanc for each teratment. After that, soil, gypsum and wheat bran were added. Then the substrate was moistened with 2.5 liter of water. Mixing of the materials was made by hand in a palstic basin. The pH was tested by paper pH indicator, and the pH was illustraed in (Table 3). The mixture was wieghed and put in the autocalvable plastic bags (1000g/bags) of "15X 30"size sealed by cotton. Next, the bags were aoutoclaved for 1 hour at 121 Counder 1.5 A pressure. After that, they were allowed to cool. Each bag was inoculated by 2% of spawn and then incubated at 22± 2 °C. After 20±2 days, the mycilum was fully colonized.

**Table1:The substrate mixtures used as the treatment of this parameter.**

| Material | A | | B | | C | | D | | E control | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | gm | % | gm | % | gm | % | gm | % | Gm |
| Wheat | 88 | 1320 | 76 | 1140 | 64 | 960 | 52 | 780 | 100 | 1500 |
| Wheat bran | 5 | 75 | 10 | 150 | 15 | 225 | 20 | 300 | - | - |
| Gypsum | 2 | 30 | 4 | 60 | 6 | 90 | 8 | 120 | - | - |
| Soil | 5 | 75 | 10 | 150 | 15 | 225 | 20 | 300 | - | - |

**Table 2: Some properties of the trial material.**

| Material | Moisture % | Nitrogen % |
|---|---|---|
| Soil | 23.3 | 2.1 |
| Wheat straw | 19.0 | 0.7 |
| Wheat bran | 15.0 | 3.4 |
| Gypsum | 4.0 | - |

**Table 3: pH values of the substrates used for each treatment.**

| Treatment | pH levels |
|---|---|
| A | 7.1 |
| B | 7.6 |
| C | 7.9 |
| D | 8.1 |
| E | 6.6 |

The second step, when mycelium was fully developed, the bags were transferred to the fruitting body room, and the tops of the bags were removed and spread three times a day, and the door was opened for air ventilation. The temperature of the room was adjusted at 15±5 °C and relative humidity at 85±5%.

Number of days taken for mycelium developing, initiation of primordia, pinheads, harvesting stages after primordia initiation, total yield of harvested mushroom (g), the biological efficiency (%), and the percent quality of mushroom (protein, carbohydrates, fiber, fat and moisture) were determined. The nutritional analysis of mushroom was done by utilizing the method of (AOAC, 2000).

The experiment was applied in a complete randomized design (CRD) with four replications for each treatment. The dates collected analyzed by oneway ANOVA (GraphPad Prism Version 5.00). The comparisons of the means were realized by the Dunnett range test at P≤0.05.

## RESULTS AND DISCUSSION

**Spawn run time:** The tiny weight thread like structures were appeared on the substrate after inoculation by spawn in could as mycelium. And the highest rate of spawn run was discovered from control E (21.50 days), and the lowest was found in treatments C (14.75 days), D (15.25 days), A and B (17.75 days), and spawn run time was significantly different at (P≤ 0.05) (Fig. 1). These results were similar to those of (Khan *et al.*, 2013) investigating the cultivation of *Plerotus spp*. on the cotton with a different live of lime and pH. They found that mycelium dvelopment time took two to three weeks after inoculation by spawn.

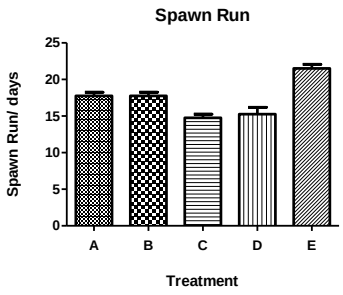


**Figure 1 : Mycelium development on substrate**

**Pinhead formation time:** Initiation of primordia (Pinhead formation) is the tiny weight of fruiting bodies of mushroom, in which greater size about (0.01 mm) of the substrate, and environment directly affected the sooner growth of pinhed formation. Date regarding numbers of days taken for pinhead fromation was illustarted in (Fig. 2). The longest period of days (33.50 day) was taken in treatment E followed by treatments A and B (19.25, 19.00 days), respectively and the shortest days were found in treatments C and D ( 15.75 days), respectively. The data were significantly different at (P≤ 0.05). Ahmed et al.(2013) studied the cultivation of oyster mushroom on conr industry waste,and concluded that *P. ostreatus* takes (17-20) days.

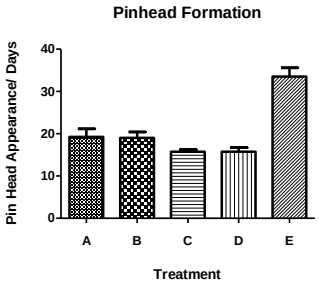


**Figure 2: Pinhead formation time**

**First Flush Appearance:** The days taken for fruitbodies formation were recorded after pinhead formation, and the data described in (Fig. 3) are about the numbers of first flush appearance. The highest number of days (13.00 days) was recorded from treatment E follwed by treatments B and A (9.75 and 8.25 days), respectively and the lowest (7.00 days) was taken from treatments D and C. The data were ignificantly different at (P≤ 0.05). Singh and Prasad (2012) investigated the cultivated *Plerotus spp*. on wheat straw and soybean supplements and found that first flush appearnce take place in (14-18) days.

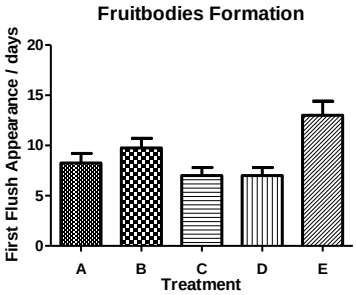


**Figure 3: First flush appearance**

**First harvesting time:** The numbers of days taken for harvesting time were recorded after first flush. The highest days were recorded from treatment B (6.00 days) followed by E, C, and D (5.5, 4,50. 4.25 days), respectively and the lowest were recorded from treatment A (4.00 days), and the data were significantly different at (P≤ 0.05). Khan *et al.* (2001) studied the cultivation of the oyster mushroom on different cellulosic substances and observed 10-12 days from culture to the first harvest.

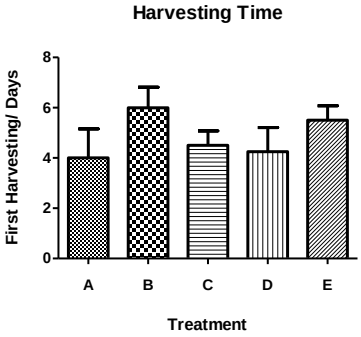


**Figure 4: First harvesting time**

**The Total yield:** In case of yield, the highest yield (333.2±2 g) was taken from tereatment A 88% wheat which was not singnificantly higher than the other treatments.The total yield was collected from three flushes of harvested mushroom. The lowest yields were observed from treatments D 52% wheat (295.9±2 ), E 100% wheat, B 76% wheat and C 64% wheat (326.9±2, 319.9±2 and 305.8±2 g), respectively. The data are not significantly different at (P≤ 0.05). Total yield was agreed with those of the researchers studying oyster mushroom (*P. florida*) (Oseni *et al*., 2012 & Khan *et al.*, 2013). The total yield is clarified from (Fig. 5).

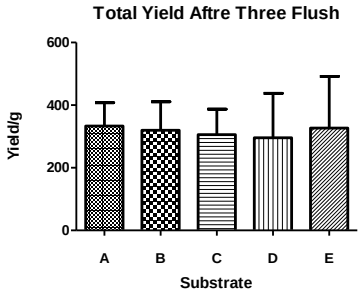


**Figure 5: The total yield taken from three flushes of harvested mushroom.**

**The Biological efficiency:** The results revealed that the biological efficiency% of the *P. florida* was affected by different substrates (Fig. 6). The maximum biological efficiency of *P. florida* was taken when it was cultivated on treatment A wheat 88% (88.84 %) and E, B, C and D (87.16%, 85.32%, 81.56%, and78.92%), respectively. The obtained results showed that there were no significant differences between treatments at (P≤ 0.05). The biological efficiency of the study agreed with those researches working on the wheat straw alone or in combination with other agricultural wastes ( Oseni *et al.*, 2012; Khan *et al.*, 2013; Ahmed *et al.*, 2013; Aishah & Wan Rosil, 2013 & Mamiro *et al.*, 2014).

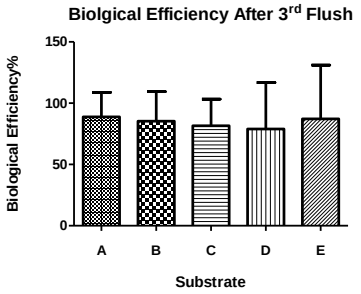


**Figure 6: Biological efficiency % obtained after three flushes and comparison the results by Dunnett range test at P≤0.05**

Protein content of *P. florida* mushroom in treatment D 52% wheat gave the highest value (24.28%), and later, B 76% wheat, A 88% wheat and C 64% wheat gave (23.83%, 23.72%, 22.89%) orderly recorded as the lowest rate of protein, and the lowest protein content (17.35%) was taken from treatment E 100% wheat. The results were significantly different in comparison with control at P≤ 0.05. Khan *et al.* (2008) also recorded a high protein contents of mushroom, and they revealed the potential of wheat straw alone or combination with other material like a good substrate for mushroom cultvation.

Total Fat content of mushroom was not significantly different as compared to control at P≤ 0.05.

Total carbohyadrate content of mushroom was not significantly different in comparison with control at P≤ 0.05. Total Ash content of mushroom was not significantly different when campared to control (P≤ 0.05).

Total fiber content of mushroom in teraetment E 100% wheat was significantly higher than other substrates. The heighet level of fiber (23.83%) was taken from treatment B 76% wheat, and the lowest (16.53%) was taken from treatment D 52% wheat. The displayed results are significantly different in comparison with control (P≤ 0.05).

Many factors may affect the variation among nutritional composition values of mushroom cultivated in different substrates. Adenipekun and Gbolagade (2006) stated that the quality and yield of mushroom changed by C:N ratio in substrate. In our study and previous studies on the *Pleurotus ostratus* and *Pleurotus florida,* in most of the sbstrates, the protein content substrate are nearly as the same as protein content in mushroom. The nutritional quality of harvested mushroom moisture, protein, carbohydrate, ash, fiber and fat contents in dry matter agreed with those of (Ananbeh and Almomany, 2005; Ali *et al*., 2000; Khan *et al*., 2008 and Cheung, 2008).

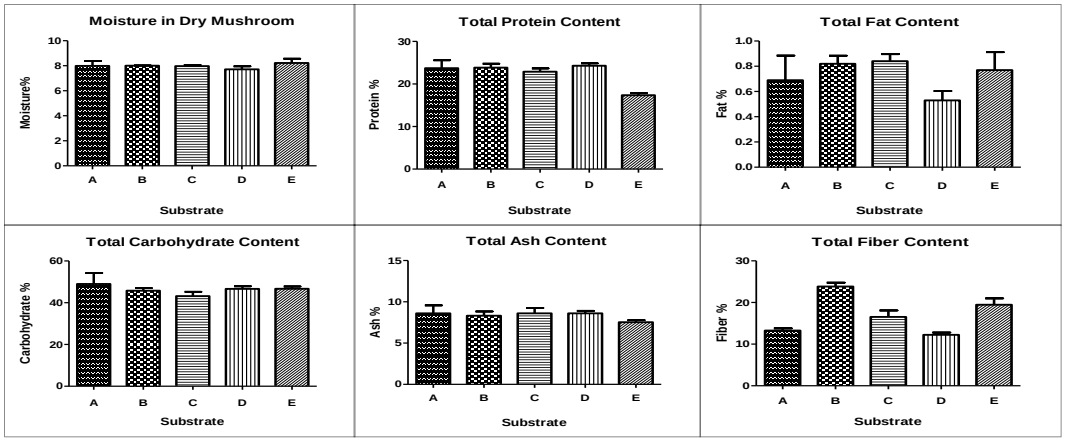


**Figure 7: Moisture, protein, fiber, ash, fats and carbohydrate contents of *Pleurotus florida* cltivated on different substrates. Results are mean±SEM. Values are significantly different at P≤ 0.05. A= 88%wheat, B= 76%wheat, C= 64%wheat, D=52% wheat, E= 100%wheat.**

## CONCLUSION

When soil and wheat straw are applied to grow mushroom, they led to greater results.The soil and wheat alone or mixing together are suitable for oyster mushroom production (*Pleurotus florida*). This study showed the best results and can be applied economically to cultivate mushroom. Thus, its applications is recommended to farmars in the studied region.

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## تقدير محصول وجودة فطر المحار ( محاري فلوريدا ) باستخدام مواد محتلفة في حلبجة اقليم كوردستان العراق

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**قسم البستنة- الكلية التقنية الزراعية – الجامعة التقنية بالسليمانية - العراق**

أجريت هذه الدراسة في الكلية التقنية الزراعية في حلبجة، جامعة السليمانية البوليتكنيك. وكان الهدف من هذه الدراسة تقييم عدد الأيام التي اتخذت لتطوير المشيجة، بدء من تكون البراعم الي مراحل الحصاد، والمحصول النهائي ، وكفاءة البيولوجية (٪)،ونسبة الجودة من محتويات (البروتين، والكربوهيدرات، والألياف والدهون والرطوبة) في فطر(محاري فلوريدا) على خمسة ركائز مختلفة: ساق القمح حده ، وبالاشتراك مع نخالة القمح والجبس والتربة. تم العثور على أعلى معدل انتاج خلال الفترة (٢١.٥٠ يوم) اكتشف من معاملة E و الأدنى (١٤.٧٥ يوما) في معاملة Cوكانت أطول فترة من الايام اتخذت لبدء البراعم المعامله ٪100 E القمح هي(٣٣.٥٠ يوما )، وأقصرفترة هي (١٥.٧٥ يوما) وقد وجدت في المعاملات C و D. تم الحصول على أعلى محصول (٣٣٣.٢ ± ٢ ج) من المعاملات و٨٨٪ والقمح، والذي لم يكن أعلى بكثير من المعاملات الأخرى. تم جمع المحصول الكلي من ثلاثة الإحمرار الفطر المقطوع . وقد لوحظ أدنى الغلة (٢٩٥.٩ ± ٢ ز) من المعاملة ٪52 D من القمح. ومحتوى البروتين في المعاملة ٪52 D من القمح أعطى أعلى قيمة وهي(٢٤.٢٨٪)، وادني محتوي من البروتين كان (١٧.٣٥٪) في المعاملة ٪100 E القمح. بلغ إجمالي محتوى الألياف في المعاملة ٪100 E القمح أعلى بكثير من المواد الاخرى، و أعلى مستوى من الألياف كان (٢٣.٨٣٪) في المعاملة ٪76 B من القمح، و أدنى مستوي كان (١٦.٥٣٪)في المعاملة ٪52 D من القمح .