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Effect of Some Substrates on Production of Oyster Mushroom

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ABSTRACT

This research was carried out at the Mushroom Research Laboratory, EL_Kassain Horticulture Research Station, Ismailia Governorate. The research was carried out for two successive seasons, 2016 and 2017. The object of this experiment was to study the effect of some of substrates (rice straw, wheat straw, bean straw, alfalfa hay and pea straw) on physical the yield and its components, of oyster mushroom (*Pleurotus florida)* fruit bodies. These parameters were measured during the experiment of Cap diameter (cm), Cap weight (gm), fruit body weight (gm), dry matter, early yield (gm), total yield (gm), NPK contents, carbohydrate content and protein content. The results revealed that, there were significant differences in all characters under study, the use of rice straw has achieved the highest results in most of these characters. With regard to chemical constituents of fruit bodies, using rice straw substrate enhanced the percentages of dry matter, phosphorus, potassium and total carbohydrates. On the other hand, the bena straw, pea straw and alfalfa hay were the highest values in nitrogen and crude protein. In generaly the results indicated that, the suitable substrates used for cultivation and production of oyster mushroom was rice straw of the substrate as compared to other substrates.

Keywords: *Pleurotus folrida*, organic substrates, growth, yield and quality.

INTRODUCTION

Oyster mushroom belongs to genus *Pleurotus* which is one of the most famous mushrooms in the Middle East Region and in the world. The world consumption amounts of oyster mushroom have come up to the fifth among edible fungi produced over 40 thousand tons per year (Ahmed, 1998).

Oyster mushroom, grow well on many agricultural substrates and is the easy to grow for a beginner grower.

In addition, it has a broad adaptability for growing under various climatic conditions and on various nutritive substrates (El-Bagori*, et al.* 1996).

Khattab (2000) demonstrated that, using rice straw as growing substrate gave the highest average weight of fruit body, number of fruit bodies, early yield, weight of caps, and He reported that cultivation of *Pleurotus ostreatus* on rice straw fence the highest percentage of biological efficiency compared with clover hay, also found that, total yield of fruit bodies for *Pleurotus ostreatus* strain 14 was at its maximum values when mushroom was cultivated on sweet potato vine, and rice straw,

statistical survey report in Sharkia Government in the year of 2000 indicated that there were over than 1.077.704 kg of rice straw, most of these quantities were burned by the Egyptian farmer which led to the problems of black cloud.

Hoechuba and Ngozika (2017) reported that growth yield parameters and days to fruit body formation were recorded. Cap diameter and fresh weight of mature mushrooms were also measured for a total count of four flushes. recorded the highest mean cap diameter, highest mean fresh weight, highest biological efficiency and highest production rate, when spawn grown on rice straw.

Hossain (2018) showed that the highest results conducted to evaluate spawn running, pin head and fruiting body formation, and yield performance of oyster mushroom (*Pleurotus ostreatus)* on different agro-substrates such as rice straw and wheat straw, amongst the substrates, the highest yield and biological efficiency was recorded in rice straw

Information about production of oyster mushroom under Egyptian conditions is not available. Therefore, the present study was conducted to investigate the effect of growth substrates to determine the suitable substrate to achieved the maximum yield and quality of mushroom fruit body.

MATERIALS AND METHODS

This experiment similar format carried out at the Mushroom Research Laboratory, EL-Kassain Horticulture Research station, Ismailia Governorate, Egypt., on mushroom (*Pleurotus florida)*. Mushroom was cultivated on rice straw (1), wheat straw (2), alfalfa hay (3), pea straw (4) and bean straw (5).

As an organic substrate in two growing seasons, the research was carried out for 2 successive seasons; 2016 and 2017

The experiment included five treatments as follow: rice straw (1), Wheat straw (2), Alfalfa hay (3), Pea straw (4) and Bean straw (5). Treatments were arranged in randomized complete block design system with three replicates, and each replicate consisted of six white polyethylene bags. Every bag contained 1 Kg dry weight; the dimensions of bags were 60 cm in depth × 40 cm diameter and manufactured from plastic thickness of 80 microns. This experiment was conducted in two seasons started in 28th November in both seasons 2016 and 2017.

Preparation of Organic Substrate:

All organic substrates (rice straw, wheat straw, alfalfa hay, pea straw and bean straw) were shopped into particles (4-5cm) and soaked in tap water for 12 hours then left to drain the excess water, after that it was pasteurized in life steam system at 80-90 ° C for 6 hours. After pasteurized substrates were left to reach to room temperature (Zadrazil, 1978).

The chemical analysis of substrates are shown in Table 1

Table 1. Chemical analysis of substrates.

Treatments	N%	P%	K%	C/N	protein	Carbohydrates
Rice straw	1.30	0.16	0.98	39.02	8.13	44.55
Wheat straw	1.19	0.17	1.10	35.90	7.44	39.66
Alfalfa hay	1.35	0.18	1.21	19.20	8.44	42.13
Bean straw	1.66	0.20	1.39	14.60	10.38	41.00
Pea straw	1.51	0.19	1.28	17.30	9.44	40.13

Spawning:

After the completion of the pasteurization process, the substrate was get out and spread in a thin layer until the temperature reached to 25 ± 3 °C. The substrate was applied in four layers (10 cm thick) into polyethylene bags. The spawn material was distributed over each layer at the rate of 5 % (w/w).

Mycelial Growth:

The inoculated polyethylene bags were transferred to incubation room at temperature 25 ± 3 °C till full colonization. Then the polyethylene bags were pinned and transferred to production room, where the temperature was 20 ± 3 °C and a relative humidity was maintained to about 80 – 90 % by using a foggy system.

Data Recorded:

Mature fruit bodies were picked up at the suitable stage (5 – 7 days intervals) and the following data were recorded:

A. Growth and Yield:

1. Total yield/ bag (gm).
2. Early yield (gm): yield of first flush (in the 15th days).
3. Biological efficiency (%): was estimated according to the following equation(Chang *et al*., 1981),
$$\frac{Freshweightoftotalyield}{Weightofdrysubstrate} \times 100$$
4. Fruit body weight (gm).
5. Cap weight (gm).
6. Cap diameter (cm).

B. Chemical constituents:

Samples were taken from the clusters of fruit bodies up to 50 (gm)/replicate.

1. Dry matter percentage (DM %)

It was determined by drying the samples in an electrical oven at 105 °C till constant weight, according to (A. O. A. C., 1980).

2. Total protein (%)

It was determined as nitrogen content converted to its equivalent protein content by multiplying with 6.25.

3. Total carbohydrates (%)

It was determined following the methods described by (Dubois *et al.,* 1956).

4. Minerals analysis

Nitrogen, phosphorus and potassium were determined according to the methods advocated by Bremner and Mulvaney (1982), Olsen and Sommers (1982), and Jackson (1970), respectively.

Statistical Analysis:

The data was subjected to proper statistical analysis of variance according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

1.Growth and yield of fruit bodies.

1. Cap diameter.

The effect of organic substrates (rice straw, wheat straw, alfalfa hay, pea straw and bean straw) on cap diameter (cm) At the end of the experiment. The results in Table 2, indicate a significant difference in cap diameter among the different substrates. Rice straw gave the highest cap diameter being(8.00 and 8.30 cm) in the both growth seasons, respectively followed by alfalfa hay as compared to other media growth substrates. On the other hand, growing of oyster mushroom on wheat straw had the lowest values of cap diameter in both growth seasons. Similar results were obtained by Zhang, *et al*. (2002), Radwan (2005), Attia (2006), El-Said, *et al*. (2008) and Mohamed (2008).

Table 2. Effect of some substrates on cap diameter, cap weight and fruit body weight of oyster mushroom in both seasons2016 and 2017.

Characters	Cap diameter (cm)		Cap weight (gm)		Fruit body weight (gm)	
	1st	2nd	1st	2nd	1st	2nd
Treat. season	Season 2016	Season2017	Season 2016	Season2017	Season 2016	Season2017
Rice straw	8.00 a	8.30 a	13.64 a	13.20 a	19.06 a	18.69 a
Wheat straw	6.51 e	6.00 e	12.50 e	9.60 d	15.80 e	13.40 d
Alfalfa hay	7.90 b	7.40 b	13.00 c	11.30 c	18.00 c	16.10 c
Bean straw	7.40 c	7.30 c	13.40 b	12.70 b	18.80 b	17.40 b
Pea straw	7.20 d	7.00 d	12.70 d	12.30 bc	16.90 d	17.30 b
L.S.D $_{0.05}$	0.84	0.23	0.08	0.99	0.12	1.18

2 Cap weight

The results in Table 2, indicated that rice straw gave the highest cap weight in both growth seasons, being 13.64 and 13.20 (gm), respectively, while wheat straw gave the lowest cap weight, these results are in harmony with those reported by, Arisha, *et al*. (2010), Mondal, *et al.* (2010), Mamiro (2011) and Hossain (2018).

3 Fruit body weight

Regarding the effect of organic substrates (rice straw, wheat straw, bean straw, alfalfa hay and pea straw). indicated that rice straw gave, on fruit body weight, the data in Table 2 indicate that, in fruit body weight substrates rice straw gave the highest fruit body weight, being 19.07 and 18.81 gm in the both growth seasons, on the other hand, growing oyster mushroom on wheat straw had the lowest values of fruit body weight in both growth seasons, Similar results were obtained by Radwan (2005), Attia (2006) and Mohamed (2008).

4 Early yield

Data recorded in Table 3, show the effect of substrates on early yield, the rice straw gave the highest early yield in both seasons as compared to other substrates, being (730.06 and 720.5 gm) in the both growth seasons, respectively, meanwhile, growing mushroom on pea straw recorded the lowest early yield. Similar results were obtained by Khattab (2000), Zhang, *et al.* (2002) and Obodai, *et al.* (2003).

5 Total yield

Data presented in Table 3 indicate the effect of some substrates on total yield. The highest yield was obtained by rice straw that being (1329 and 1320 gm) in the both growth seasons, respectively, as compared to other substrates. On the other hand, growing oyster mushroom on wheat straw had the lowest values of total yield both growth seasons Similar results were obtained by Khattab (2000), Arisha, *et al.* (2010), Mondal, *et al*. (2010), Mamiro (2011), Attia (2014), Nayak, *et al.* (2015), Nasr (2016), Hoechuba and Ngozika (2017) and Hossain (2018).

Table 3. Effect of some substrates on early yield (gm), total yield (gm) and biological efficiency of oyster mushroom in both seasons2016 and 2017.

Characters	Early yield/bag (gm)		Total yield/bag (gm)		Biological efficiency (%)	
	1st	2nd	1st	2nd	1st	2nd
Treat. season	Season 2016	Season 2017	Season 2016	Season 2017	Season 2016	Season 2017
Rice straw	730.07 a	720.50 a	1329.10 a	1320.00 a	132.90 a	132.00 a
Wheat straw	375.06 e	365.10 e	896.80 e	849.30 e	89.65 e	84.93 e
Alfalfa hay	660.00 b	610.03 b	1285.03 b	1133.32 c	128.50 b	113.33 c
Bean straw	613.06 c	600.00 c	1118.50 d	1110.00 d	111.83 d	111.00 d
Pea straw	580.07 d	570.00 d	1178.03 c	1250.00 b	117.80 c	125.00 b
L.S.D $_{0.05}$	0.04	8.32	3.35	4.20	1.84	2.82

6 Biological efficiency (%)

It is clear from the results in Table 3 that this character went along with those of total mushroom yield to substrate, where using rice straw gave the highest percentage of biological efficiency without significant differences among them, where as wheat straw recorded the lowest percentage of biological efficiency

The obtained results are in harmony with those obtained by Khattab (2000), Attia (2006) and Hossain (2018).

2. Chemical constituents of fruit bodies

Results represented in Table 4,5 revealed significant effect of substrate on chemical constituents of fruit bodies. using rice straw substrate seemed to be the most stimulative treatment for increasing the percentages of dry matter (DM), phosphorus, potassium and carbohydrates as compared to other substrates. on the other hand, the highest values of nitrogen and protein, were recorded when mushroom growing on alfalfa hay substrate in the both growth seasons, respectively.

Table 4. Effect of some substrates on nitrogen, phosphorus, potassium contents, of oyster mushroom fruit bodies in both seasons2016 and 2017.

Characters	N %		P %		K %	
	1st	2nd	1st	2nd	1st	2nd
Treat. season	Season 2016	Season 2017	Season 2016	Season 2017	Season 2016	Season 2017
Rice straw	3.31 e	3.02 e	0.93 a	0.98 a	4.00 a	3.96a
Wheat straw	3.34 d	3.22 d	0.89 b	0.91 b	3.46 e	3.40e
Alfalfa hay	4.00 a	4.03 a	0.88 c	0.88 c	3.09 b	3.70b
Bean straw	3.71 b	3.74 b	0.86 d	0.86 d	3.83 c	3.60c
Pea straw	3.40 c	3.60 c	0.84 e	0.84 e	3.76 d	3.50b
L.S.D $_{0.05}$	0.10	0.01	0.04	0.38	0.002	0.02

Table 5. Effect of some substrates protein % , carbohydrate%, and dry matter (%) of oyster mushroom fruits in both seasons2016 and 2017.

Characters	Protein %		Carbohydrates %		Dry matter (%)	
	1st	2nd	1st	2nd	1st	2nd
Treat. season	Season 2016	Season 2017	Season 2016	Season 2017	Season 2016	Season 2017
Rice straw	20.69 d	18.88 d	46.10 a	47.20 a	8.00 b	8.45 ab
Wheat straw	20.88 e	20.13 e	33.00 e	32.00 e	8.55 a	9.31 a
Alfalfa hay	25.00 a	25.19 a	37.61 b	36.61 c	7.00 cd	9.00 cd
Bean straw	23.19 b	23.38 b	35.82 c	34.82 d	7.61 c	8.26 d
Pea straw	21.25 c	22.50 c	34.40 d	36.70 b	7.11 c	7.89 c
L.S.D $_{0.05}$	0.01	0.05	0.04	0.38	0.84	0.84

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تأثير بعض البيئات على إنتاجية عيش الغراب المحارى

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تم إجراء هذا البحث لموسمين متتالين في معمل بحوث عيش الغراب، بمحطة بحوث البساتين بالقصاصين، محافظة الإسماعيلية. في الفترة، ٢٠١٦ و٢٠١٧. و الهدف من التجربة هو دراسة تأثير بعض البيئات الزراعية (قش الأرز، قش القمح، تبن الفول، قش البرسيم وقش البسلة) على الصفات الطبيعية والمحصول ومكوناته لعيش الغراب المحارى. الصفات التي تم قياسها هي قطر الغطاء، وزن الغطاء، وزن الجسم الثمري، المادة الجافة،المحصول المبكر، المحصول الكلى، والمحتوى من النتروجين والفوسفور والبوتاسيوم والمحتومن الكربوهيدرات والبروتين. لقد أوضحت النتائج وجود فروق معنوية في كل الصفات تحت الدراسة، فأستخدام قش الأرز أعطى أعلى القيم لمعظم الصفات، فيما يتعلق بالصفات الكميائية للأجسام الثمرية فإن أستخدام بيئة قش الأرز أعطت أعلى نسبة للمادة الجافة والمحتوى من الفوسفور والبوتاسيوم والكربوهيدرات، في حين أن بيئات العائلة البقولية أعطت أعلى القيم في كل من النتروجين والبروتين. وعموما تعتبر بيئة قش الأرز أفضل البيئات لانتاج عيش الغراب المحارى مقارنة بالبيئات الأخرى قيد الدراسة.