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EFFECT OF FERMENTATION PERIODS OF ORGANIC SUBSTRATES ON THE PRODUCTIVITY OF OYSTER MUSHROOM

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ABSTRACT: This work was carried out during two growing seasons of 2002 and 2003 in Mushroom Research Laboratory (MRL), Faculty of Agriculture, Zagazig University, to study the effect of fermentation periods (36, 24, 12 or 0 hours) of organic substrates (rice, wheat and broad bean straw) on the productivity of oyster mushroom.

Obtained results indicated that fermentation period for 36 h gave the highest values of total yield , biological efficiency (%), early yield ,percentage of early yield /total yield ,percentage of total yield /weight of wet substrate and average number of fruit bodies/bag. Rice straw substrate recorded maximum values of total yield , biological efficiency (%), early yield , early yield /total yield % , total yield /weight of wet substrate (%), average number of fruit bodies/bag and total carbohydrates in fruit bodies. Fermentation of rice straw for 36 h gave the highest values of total yield , biological efficiency (%), early yield ,percentages of both early yield /total yield and total yield /weight of wet substrate (%), average number of fruit bodies/bag and total carbohydrates in fruit bodies, while fermentation of broad bean straw for 36,24 or 12 h gave the highest values of protein content in fruit bodies.

Key words: Mushroom, fermentation, substrates, productivity.

INTRODUCTION

The 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 has come up to the fifth among edible fungi produced over 40 thousand tons per year (Ahmed, 1998). Oyster mushroom grows well on many agricultural substrates and 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).

In statistical survey report in Sharkia Governorat in the year of 2000 indicated that there were more than1.077.704 kg of rice straw , most of these quantities burned by the Egyptian farmer which led to the problems of black cloud.

Fermentation of substrates is a biological process achieved by microorganisms. The results of this process are the degradation of organic wastes which breakdown the complex components to simple ones to be useful for mushroom growth and production. Moreover, the killed microorganisms in the substrate are suitable as a sole N, C and minerals source for mushroom nutrition (Fermor and Wood, 1981).

Fermentation of organic substrates in water increased yield of oyster mushroom (Leong, 1980; Flegg and Randle, 1981;Randle , 1986; Randle and Smith 1986; Schics and Lelley, 1989). Rice straw substrate gave the highest yield of oyster mushroom (Bano *et al.*, 1978; Sivaprakasam *et al.*, 1987 ; Bahukhandi *et al.*, 1989 ; Radwan, 2005), percentage of biological efficiency (Ramesh and Ansari, 1987; El-Bagori *et al.*, 1996; Radwan, 2005), and protein content in fruit bodies (Hosni, 1996).

Therefore, the objective of this work was to study the effect of fermentation periods of organic substrates on the productivity of oyster mushroom.

MATERIALS AND METHODS

This work was carried out during two growing seasons of 2002 /2003 in Mushroom Research Laboratory (MRL), Faculty of Agriculture, Zagazig University, to study the effect of fermentation periods of organic substrates on the productivity of oyster mushroom .

This experiment included 12 treatments which were the combinations between four fermentation periods (36,24,12 and 0) and three organic substrates (rice, wheat and broad bean straw)

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These treatments were arranged as a split - plot in a complete randomized block design with three replications. The fermentation periods were randomly arranged in the main plots and organic substrates were randomly distributed in the sub plots. Every replicate consists of two white perforated polyethylene bags contained three kg substrates, the dimensions of bag were 50 cm depth x 35 cm diameter and was manufactured from plastic 80 microns thickness.

The chemical analyses of used substrates after supplemental were listed in Table 1 .

Table 1. Effect of interaction between fermentation periods and organic substrates on the chemical constituents in substrates after supplemental of oyster mushroom in 2003 season

Treatments		Mineral contents (%)			Carbohydrates (%)
F.P.	O.S.	N	P	K	
36 hours	R.S.	1.97	0.170	1.02	29.66
	W.S.	2.07	0.073	0.64	25.30
	B.S.	2.83	0.103	1.32	28.61
	Mean	2.29	0.116	0.99	27.86
24 hours	R.S.	2.32	0.147	1.08	24.87
	W.S.	2.06	0.073	0.78	26.36
	B.S.	2.84	0.083	1.02	25.83
	Mean	2.41	0.101	0.96	25.69
12 hours	R.S.	2.14	0.130	1.02	27.45
	W.S.	2.04	0.063	0.99	24.32
	B.S.	2.55	0.083	0.97	21.77
	Mean	2.24	0.092	0.99	24.51
0 (control)	R.S.	2.16	0.107	1.90	28.45
	W.S.	2.00	0.093	1.53	22.25
	B.S.	2.52	0.080	1.61	21.81
	Mean	2.22	0.093	1.68	24.17
R.S.		2.15	0.138	1.25	27.61
W.S.		2.04	0.076	0.98	24.56
B.S.		2.68	0.088	1.23	24.50
LSD for F.P.		N.S.	N.S.	0.26	2.16
LSD for O.S.		0.22	0.014	0.12	1.51
LSD F.P x O.S.		0.44	0.028	0.25	3.03

F.P.; fermentation period, O.S.; organic substrate , R.S.; Rice straw, W.S.; Wheat straw, B.S.; Broad bean straw.

This experiment was conducted in two growing seasons, started on 25th November of 2002 and 2003 seasons. The source of *Pleurotus ostreatus* was the Vegetable Crop Research institute , Kecskemet, Hungary

Preparation of Organic Substrates

All organic substrates; i.e., rice, wheat and broad bean straw were chopped particles (4-5cm) and soaked in tap water for different periods. The excess water was drained off and pasteurization of organic substrates was carried out using life steam at 80-90 °C for 6-8 hours.

Spawning

After the pasteurization process completed, the substrates were get out and spread in a 10 cm layer thickness until the temperature reached to 25 ± 3 °C. The substrate was placed in four layers (10 cm thick) into polyethylene bags in 50cm depth x 35cm diameter (3kg wet substrate/ bag). The spawn material was distributed on 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 (two weeks). 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 of all harvests were picked up at the marketable stage (5-7 days intervals) and the following data were recorded:

Yield and Its Components (average of all harvests)

1. Weight of total yield (g) per bag.

2. Biological efficiency (%): It was estimated according to the following equation (Chang *et al.*, 1981),

$$\frac{\text{Fresh weight of total yield}}{\text{Weight of dry substrate}} \times 100$$

3. Early yield (g) = yield of first flush (in the first 15 days)

4. Percentage of early yield to total yield was calculated according to the following equation:

$$\frac{\text{Yield of first flush}}{\text{Total yield of mushroom}} \times 100$$

5. Percentage of total mushroom yield to weight of wet substrate was calculated according to the following equation:

$$\frac{\text{Weight of total yield}}{\text{Weight of wet substrate}} \times 100$$

Physical Characters of Fruit Bodies

1. Average number of fruit bodies per bag.

2. Average diameter of cap (cm).

3. Average length of the stipe of fruit body(cm).

4 .Average thickness of the stipe of fruit body(cm).

Chemical Constituents

Minerals, protein and total carbohydrates

Samples of 50 gm fruit bodies from each replicate as well as samples of 200 g from all used substrates before spawning were taken, then dried (by using an electrical oven) at 70 °C till constant weight. The dried materials were grinded to a fine powder for the following chemical analysis:

Minerals determination: N,P and K were determined according to the methods advocated by Bremner and Mulvuney (1982), Olsen and Sommers (1982), and Jackson (1970), respectively.

Crude protein (%): It was determined as nitrogen content and multiplying by 6.25 to convert it to equivalent protein content.

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

Statistical Analysis

The data of this experiment were subjected to proper statistical analysis of variance according to Snedecor and Cochran (1982) and means separation were done according to L.S.D. at 0.05 level of probability.

RESULTS AND DISCUSSION

Yield and Its Components

Effect of fermentation period

The effect of fermentation period on total yield, biological efficiency (%), early yield, early yield /total yield (%) and total yield /weight of wet substrates (%) are presented in Table 2. Regarding total yield , the data in Table 2 and Fig. 1 show that fermentation of organic substrates in water for 36 h gave the highest total yield of oyster mushroom (775.11 and 1030.11 gm/3kg wet substrates) in the first and second season, respectively, however, without fermentation (check treatment) gave the lowest total yield (559.88 and 529.88 g/3 kg wet substrates) in the first and second season, respectively.

Fermentation of substrate is a biological process achieved by microorganisms. The results of this process is the degradation of agricultural wastes which breakdown the complex components to simple ones

Table 2 : Effect of fermentation periods (F.P.) on total yield , biological efficiency (%), early yield, early yield /total yield (%) and total yield /weight of wet substrate (%) of oyster mushroom in 2002 and 2003 seasons

Treatments	Total yield (g/3kg wet substrate)		Biological efficiency (%)		Early yield (g/3kg wet substrate)		Early yield/ total yield (%)		Total yield /weight of substrate (%)	
(F.P.)	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
36 hours	775.11	1030.11	77.51	103.01	339.55	500.00	42.74	47.93	25.83	34.33
24 hours	695.66	908.77	69.56	90.87	281.44	432.11	40.21	47.27	23.19	30.29
12 hours	619.66	845.77	61.96	84.57	236.66	378.77	38.12	44.33	20.65	28.19
0 (check)	559.88	529.88	55.98	52.98	206.44	239.44	37.12	38.94	18.66	17.66
LSD at 0.05 level	77.36	50.75	7.74	5.07	45.21	75.00	3.60	1.77	2.58	1.69

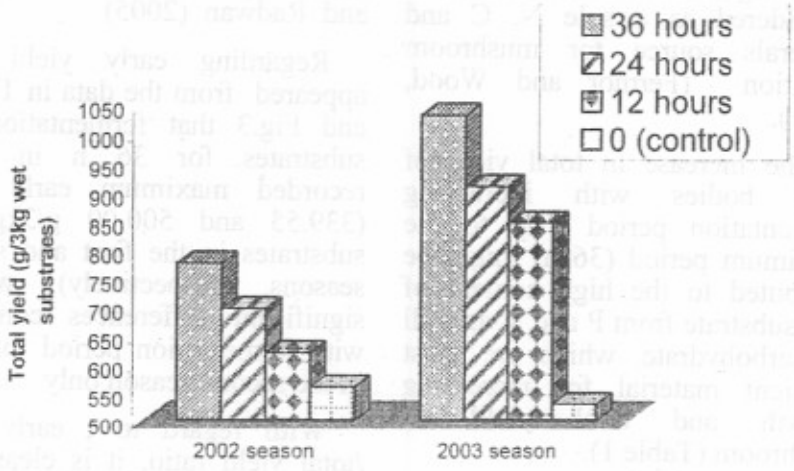

Fig.1. Effect of fermentation peroid on total yield of oyster mushroom in 2002 and 2003 seasons

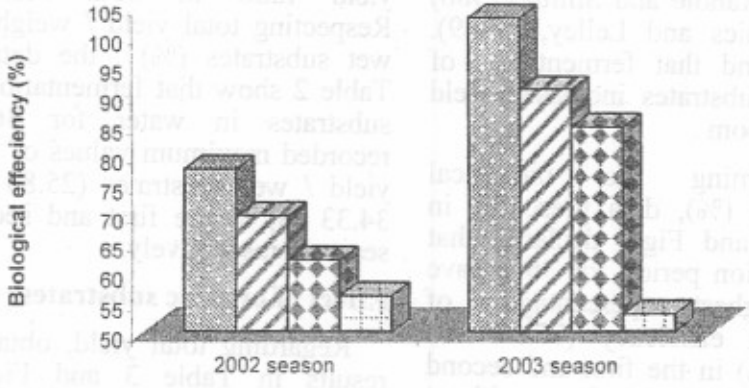

Fig.2. Effect of fermentation peroid on biological effeciency (%) of oyster mushroom in 2002 and 2003 seasons

affecting mushroom growth and production, Moreover, the killed microorganisms in the substrate is considered as a sole N, C and minerals source for mushroom nutrition (Fermor and Wood, 1981).

The increase in total yield of fruit bodies with increasing fermentation period up to the maximum period (36 h) might be attributed to the high content of this substrate from P and K as well as carbohydrate, which are most efficient material for increasing growth and total yield of mushroom (Table 1).

These results agree with those reported by Leong, (1980), Flegg and Randle (1981), Randle (1986), Randle and Smith (1986) and Schies and Lelley, (1989). They found that fermentation of organic substrates increased yield of mushroom .

Concerning the biological efficiency (%), data presented in Table 2 and Fig.2 declared that fermentation period for 36 h gave the highest percentage of biological efficiency (77.51 and 103.01 %) in the first and second seasons, respectively, without significant differences compared with fermentation of substrates for 24 h in the first season only, while check (without fermentation) gave the lowest biological efficiency (55.98 and 52.98 %) in the first and second seasons, respectively. These results agree with those reported by Ramesh and Ansari (1987), El-Bagori *et al.* (1996) and Radwan (2005).

Regarding early yield , it appeared from the data in Table 2 and Fig.3 that fermentation of substrates for 36 h in water recorded maximum early yield (339.55 and 500.00 g/3kg wet substrates in the first and second seasons, respectively) without significant differences compared with fermentation period for 24 h in the second season only.

With regard to , early yield /total yield ratio, it is clear from data presented in Table 3 that fermentation period for 36 or 24 h gave the highest early yield /total yield ratio in both seasons. Respecting total yield / weight of wet substrates (%) , the data in Table 2 show that fermentation of substrates in water for 36 h recorded maximum values of total yield / wet substrates (25.83 and 34.33 %) in the first and second seasons, respectively.

Effect of organic substrates

Regarding total yield, obtained results in Table 3 and Fig. 4 indicate that there were significant differences in total yield among the different substrates. Rice straw gave the highest total yield , being 752.75 and 1018.33 g/ 3kg wet substrates in the first and second seasons, respectively. In addition,

Table 3 : Effect of organic substrates on total yield , biological efficiency (%), early yield, early yield /total yield ration (%) and total yield /weight of wet substrate (%) of oyster mushroom in 2002 and 2003 seasons

Treatments	Total yield (g/ 3kg wet substrate)		Biological efficiency (%)		Early yield (g/3kg wet substrate)		Early yield/ total yield (%)		Total yield /weight of substrate (%)	
	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
Rice straw	752.75	1018.33	75.27	101.83	319.50	507.08	41.31	45.74	25.09	33.94
Wheat straw	625.16	726.33	62.51	72.63	238.75	320.00	38.04	43.48	20.83	24.21
Broad bean straw	609.83	741.25	60.98	74.12	239.83	335.66	39.29	44.62	20.32	24.70
LSD at 0.05 level	54.62	67.87	5.46	6.78	28.07	62.58	2.08	2.14	1.82	2.26

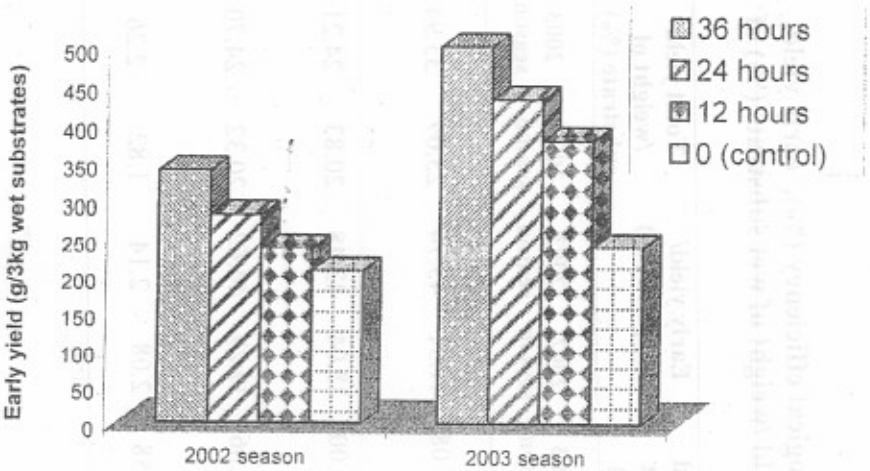

Fig.3. Effect of fermentation peroid on early yield of oyster mushroom in 2002 and 2003 seasons

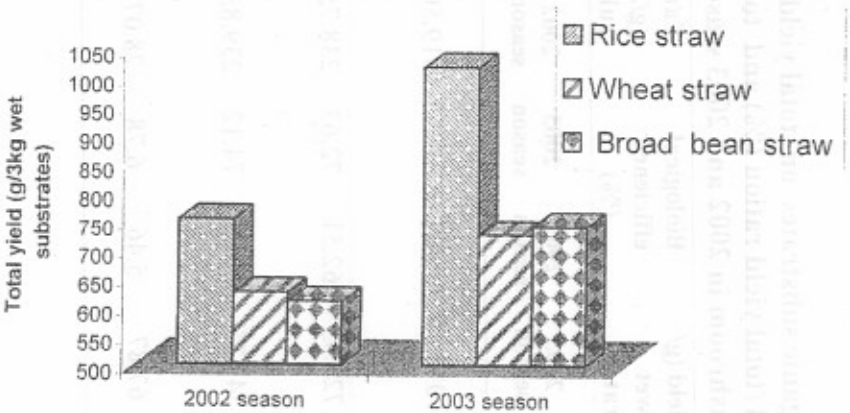

Fig.4. Effect of organic substrates on total yield of oyster mushroom in 2002 and 2003 seasons

total yield of fruit bodies obtained from wheat straw and broad bean straw substrates were 625.16 and 726.32 and 609.83 and 741.25 g/3 kg wet substrates in the first and second seasons, respectively.

Using rice straw for growing mushroom was the best substrate for increasing total yield , because of this substrate content high carbohydrate , which in the best material for mushroom growth and production compared to other used substrate (Table 1). These results agree with those reported by Bano *et al.* (1978), Sivaprakasam *et al.* (1987), Bahukhandi *et al.* (1989) and Radwan (2005). They found that the highest yield was obtained from rice straw substrates.

Concerning the biological efficiency (%), data in Table 3 and Fig.5 show that rice straw gave the highest percentage of biological efficiency , being 75.57 and 101.83 % in the first and second seasons, respectively , while wheat straw and broad bean straw, being 62.51 and 72.63 % and 60.98 and 74.12 % in the first and second seasons, respectively.

With regard to early yield, the result in Table 3 and Fig 6 indicate that rice straw gave the highest early yield in both seasons, being 319.50 and 507.08 g/3kg wet substrate in the first and second seasons, respectively, while wheat straw and broad bean straw gave the lowest early yield. These results are in harmony with those reported by Bhatti *et al.* (1987) who found that rice straw substrates induced higher early yield of oyster mushroom.

Respecting early yield /total yield ratio, the data from Table 3 indicated that rice straw and broad bean straw gave the highest ratio between early yield and total yield. With regard to total yield / weight of wet substrate ratio the obtained results in Table 3 show that , rice straw recorded maximum value of total yield / wet substrate ratio in both seasons compared with other two substrates, i.e., wheat straw and broad bean straw. Radwan (2005) found that mushroom total yield/ wet substrate gave the highest percentage (33.21%) when using rice straw as an organic substrate.

Effect of the interaction between fermentation period and organic substrates.

The interaction between fermentation period and organic substrates had significant effect on total yield , biological efficiency (%), early yield , early yield/ total yield (%) and total yield /weight of wet substrate (%) in both seasons (Table 4). Regarding total yield, the results in Table 4 show that fermentation of rice straw for 36 h gave the highest values of total yield, in both seasons, being

Table 4: Effect of interaction between fermentation periods and organic substrates on total yield, biological efficiency (%), early yield, early yield /total yield ration (%) and total yield /weight of wet substrate (%) of oyster mushroom in 2002 and 2003 seasons

Treatments		Total yield (g/3kg wet substrate)		Biological efficiency (%)		Early yield (g/3kg wet substrate)		Early yield/ total yield (%)		Total yield /weight of substrate (%)	
F.P.	O.S.	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
36 hours	R.S.	1001.66	1402.66	100.16	140.26	492.00	706.66	49.07	50.22	33.39	46.75
	W.S.	635.33	786.00	63.53	78.60	243.33	350.00	38.13	44.40	21.16	26.20
	B.S.	688.33	901.66	68.83	90.16	283.33	443.33	41.02	49.16	22.94	30.05
24 hours	R.S.	806.00	1084.33	80.60	108.43	338.00	530.00	41.80	48.86	26.86	36.14
	W.S.	668.33	814.33	66.83	81.43	263.33	383.33	39.31	46.70	22.28	27.14
	B.S.	612.66	827.66	61.26	82.76	243.00	383.00	39.52	46.26	20.42	27.59
12 hours	R.S.	638.33	1040.00	63.83	104.00	243.33	490.00	37.99	46.92	21.27	34.66
	W.S.	630.66	748.33	63.06	74.83	246.66	330.00	38.93	43.89	21.02	24.94
	B.S.	590.00	749.00	59.00	74.90	220.00	316.33	37.43	42.18	19.66	24.97
0 (check)	R.S.	565.00	546.33	56.50	54.63	204.66	301.66	36.37	36.99	18.83	18.21
	W.S.	566.33	556.66	56.63	55.66	201.66	216.66	35.79	38.95	18.87	18.55
	B.S.	548.33	486.66	54.83	48.66	213.00	200.00	39.19	40.88	18.28	16.22
LSD at 0.05 level		109.27	135.77	10.93	13.57	56.15	125.16	4.17	4.29	3.64	4.52

F.R.; fermentation period, O.S.; organic substrates, R.S.; Rice straw, W.S.;Wheat straw, B.S.; Broad bean straw.

1001.66 and 1402.66 g /3kg wet substrate in the first and second seasons, followed by fermentation of rice straw for 24 h.

Concerning the biological efficiency (%), the data show that fermentation of rice straw for 36 h recorded maximum values of percentage of biological efficiency (100.16 and 140.26 %) in the first and second season, followed by fermentation of rice straw for 24 hour.

Respecting early yield, the results in Table 4 indicate that the interaction between rice straw and fermentation period for 36 h gave the highest early yield, being 492.00 and 706.66 g/3kg wet substrate in the first and second season, respectively.

Regarding the percentages of early yield /total yield and total yield /weight of wet substrate, the data indicate that fermentation of rice straw for 36 h recorded maximum values of early yield/total yield ratio and total yield /weight of wet substrate in both seasons, followed by the fermentation of rice straw for 24 hour.

Physical Characters of Fruit Bodies

Effect of fermentation period

The effect of fermentation period on physical characters of fruit bodies are presented in Table 5.

Regarding average number of fruit bodies/bag, the data show that fermentation period at 36 or 24h gave the highest values of average number of fruit bodies/bag were (34.77 and 55.53) for 36 h and 32.22 and 51.33 for 24 h in the first and second seasons, respectively.

Respecting average diameter of cap , average length of stipe and average thickness of stipe , the results in Table 5 show that fermentation period had no significant effect on average diameter of cap, and average thickness of stipe, except average length of stipe in the second season only.

Effect of organic substrates

As presented in Table 6 it is clear that the organic substrates had significant effect on average number of fruit bodies/bag ,but had no significant effect on average diameter of cap, average length of stipe and average thickness of stipe, except average thickness of stipe in the second season. Regarding number of fruit bodies/bag, the data in Table 6 show that rice straw gave the highest values of number of fruit bodies/bag (32.25 and 56.25) in the first and second seasons, respectively) with no significant

Table 5: Effect of fermentation periods(F.P.) on average number of fruit bodies/bag, average diameter of cap , average length of stipe and average thickness of stipe of oyster mushroom in 2002 and 2003 seasons

Treatments (F.P.)	Average number of fruit bodies/bag		Average diameter of cap (cm)		Average length of stipe (cm)		Average thickness of stipe (cm)	
	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
36 hours	34.77	55.55	8.81	7.55	5.62	4.61	1.77	1.50
24 hours	32.22	51.33	8.37	7.40	5.47	5.01	1.73	1.62
12 hours	25.88	46.88	8.78	7.27	5.70	4.77	1.71	1.54
0 (check)	25.66	32.55	8.13	7.40	4.77	3.80	1.60	1.60
LSD at 0.05 level	3.99	6.59	N.S.	N.S.	N.S.	0.72	N.S.	N.S.

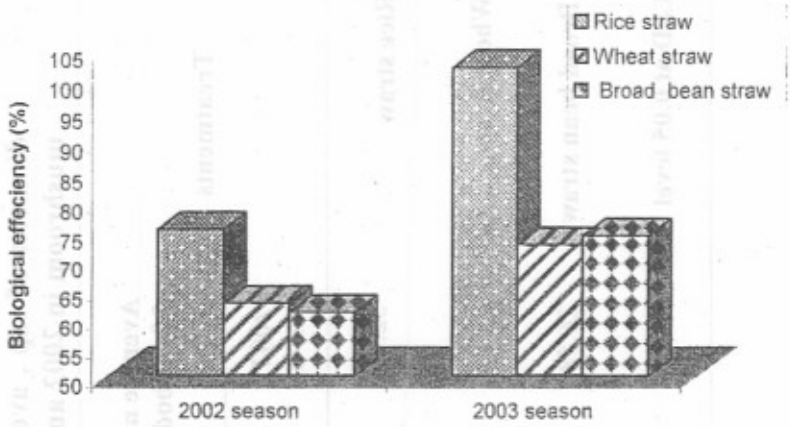

Fig.5. Effect of organic substrates on biological effeciency (%) of oyster mushroom in 2002 and 2003 seasons

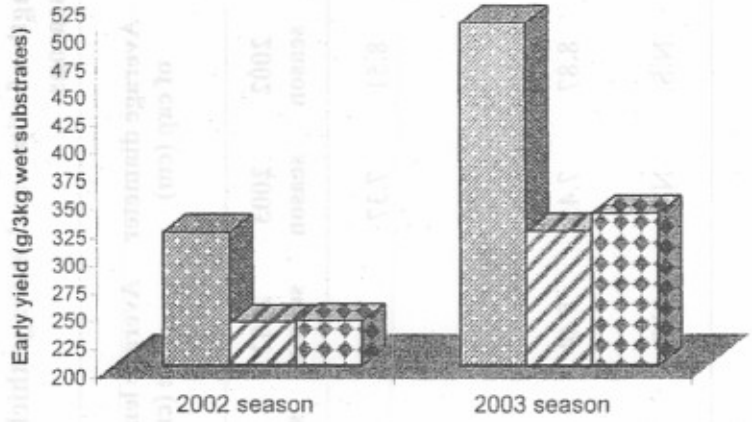

Fig.6. Effect of organic substrates on early yield of oyster mushroom in 2002 and 2003 seasons

Table 6: Effect of organic substrates on average number of fruit bodies/bag, average diameter of cap , average length of stipe and average thickness of stipe of oyster mushroom in 2002 and 2003 seasons

Treatments	Average number of fruit bodies/bag		Average diameter of cap (cm)		Average length of stipe (cm)		Average thickness of stipe (cm)	
	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
Rice straw	32.25	56.25	8.51	7.37	5.35	4.68	1.75	1.59
Wheat straw	30.08	42.33	8.19	7.40	5.39	4.61	1.56	1.46
Broad bean straw	26.58	41.16	8.87	7.45	5.44	4.35	1.79	1.64
LSD at 0.05 level	2.12	3.51	N.S.	N.S.	N.S.	N.S.	N.S.	0.07

differences compared with wheat straw in the first season only.

Effect of the interaction between fermentation period and organic substrates.

Presented data in Table 7 show that the interaction between fermentation periods and organic substrates had significant effect on average number of fruit bodies/bag and average thickness of stipe, but it had no significant effect on average diameter of cap and average length of stipe, except average length of stipe in the second season.

Regarding average number of fruit bodies/bag , fermentation of rice straw for 36 h gave the highest values of average number of fruit bodies/bag (37 and 71 fruit bodies/bag in the first and second seasons, respectively) with no significant differences with the interaction between fermentation of wheat straw for 36 h and fermentation of rice straw for 24 hours in the first season only. Concerning average thickness of stipe, data in Table 7 show that fermentation of broad bean straw gave the highest average thickness of stipe in both seasons as compared with wheat straw , except at fermentation period 0 and 12 h in the first season only.

Chemical Constituents of Fruit Bodies

Effect of fermentation period

Fermentation periods at 36, 24, 12 or 0 h had no significant effect on N, P,K, protein and carbohydrates contents (%) in fruit bodies of oyster mushroom (Table 8).

Effect of organic substrates

Organic substrates had significant effect on N, protein and carbohydrates contents , but it had no significant effect on P and K contents in fruit bodies (Table 9). The substrate of broad bean straw gave the highest N and protein content in fruit bodies, while rice straw gave the highest values of carbohydrate content in fruit bodies (Table 9 and Figs 7 and 8). Hosni (1996) found that the highest percentage of protein content in the fruit bodies was obtained from mushroom grown on the substrate water hyacinth followed by broad bean straw.

Effect of the interaction between fermentation period and organic substrates.

The interaction between fermentation period and organic substrates had significant effect on N, protein and carbohydrates contents in fruit bodies , while it had no significant effect on P and K contents (Table 10).

Fermentation of broad bean straw for 36, 24 or 12 h gave the highest values of N and protein contents in fruit bodies, while fermentation of rice straw for 36, 24, 12 or without fermentation gave the highest values of total carbohydrates contents in fruit bodies.

Table 7: Effect of interaction between fermentation periods and organic substrates on average number of fruit bodies/bag, average diameter of cap , average length of stipe and average thickness of stipe of oyster mushroom in 2002 and 2003 seasons

Treatments		Average number of fruit bodies/bag		Average diameter of cap (cm)		Average length of stipe (cm)		Average thickness of stipe (cm)	
F.P.	O.S.	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season	2002 season	2003 season
36 hours	R.S.	37.00	71.66	9.50	7.60	5.93	4.90	1.90	1.56
	W.S.	37.00	47.66	7.46	7.40	5.63	4.80	1.50	1.40
	B.S.	30.33	47.33	9.46	7.66	5.30	4.13	1.93	1.53
24 hours	R.S.	37.66	62.33	8.36	7.30	4.60	4.76	1.70	1.53
	W.S.	32.00	44.33	7.16	7.66	5.16	5.26	1.36	1.53
	B.S.	27.00	47.33	9.60	7.23	6.66	5.00	2.13	1.80
12 hours	R.S.	28.66	58.66	8.13	7.20	5.70	5.06	1.60	1.60
	W.S.	25.33	39.33	9.83	7.20	5.83	4.56	1.90	1.43
	B.S.	23.66	42.66	8.40	7.43	5.56	4.70	1.63	1.60
0 (check)	R.S.	25.66	32.33	8.06	7.40	5.16	4.00	1.83	1.66
	W.S.	26.00	38.00	8.30	7.33	4.93	3.83	1.50	1.50
	B.S.	25.33	27.33	8.03	7.46	4.23	3.56	1.46	1.63
LSD at 0.05 level		4.25	7.03	N.S.	N.S.	N.S.	0.60	0.51	0.15

F.R.; fermentation period, O.S.; organic substrates, R.S.;Rice straw, W.S.; Wheat straw, B.S.; Broad bean straw.

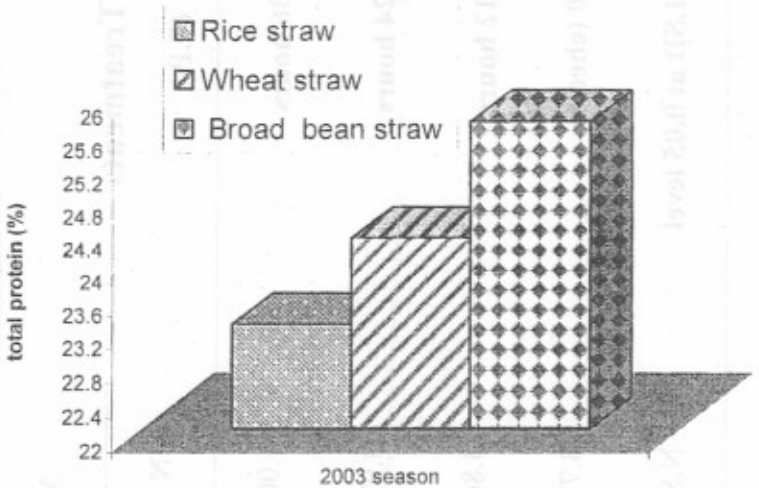

Fig.7. Effect of organic substrates on total protein (%) in fruit bodies of oyster mushroom in 2003 season

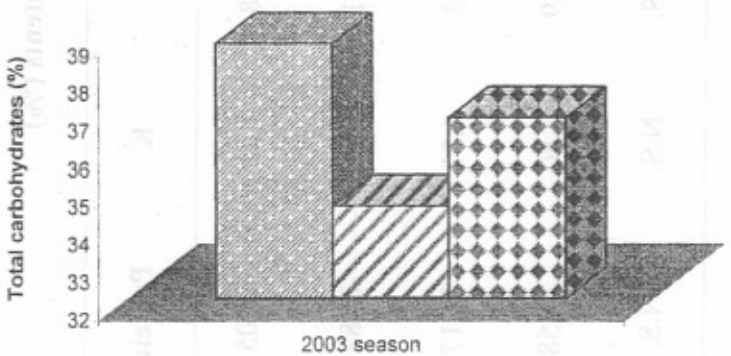

Fig.8. Effect of organic substrates on total carbohydrates (%) in fruit bodies of oyster mushroom in 2003 seasons

Table 8 : Effect of fermentation periods(F.P.) on N,P ,K , total protein and total carbohydrates contents of fruit bodies of oyster mushroom in 2003 season.

Treatments (F.P.)	Mineral contents (%)			Total (%)	
	N	P	K	Protein	Carbohydrates
36 hours	4.00	0.88	4.71	25.05	37.90
24 hours	3.97	0.91	5.02	24.82	36.25
12 hours	3.86	0.93	4.71	24.17	35.97
0 (check)	3.77	0.89	4.80	23.58	36.54
LSD at 0.05 level	N.S.	N.S.	N.S.	N.S.	N.S.

Table 9 : Effect of organic substrates on N,P ,K, total protein and total carbohydrates contents of fruit bodies of oyster mushroom in 2003 season

Treatments	Mineral contents (%)			Total (%)	
	N	P	K	Protein	Carbohydrates
Rice straw	3.72	0.91	4.80	23.24	38.75
Wheat straw	3.88	0.92	4.92	24.29	34.46
Broad bean straw	4.11	0.87	4.71	25.68	36.77
LSD at 0.05 level	0.15	N.S.	N.S.	0.99	1.75

Table 10 : Effect of interaction between fermentation periods and organic substrates on N,P ,K, total protein and total carbohydrates contents of fruit bodies of oyster mushroom in 2003 season

Treatments		Mineral contents (%)			Total (%)	
F.P.	O.S.	N	P	K	Protein	Carbohydrates
36 hours	R.S.	3.81	0.87	5.01	23.85	41.02
	W.S.	3.88	0.90	4.88	24.24	35.28
	B.S.	4.33	0.87	4.26	27.06	37.40
24 hours	R.S.	3.75	0.90	5.02	23.43	37.60
	W.S.	4.04	0.99	4.83	25.29	34.47
	B.S.	4.12	0.84	5.21	25.75	36.67
12 hours	R.S.	3.67	0.94	4.40	22.93	38.43
	W.S.	3.86	1.00	5.06	24.14	33.14
	B.S.	4.07	0.87	4.66	25.43	36.34
0 (check)	R.S.	3.64	0.96	4.77	22.76	37.97
	W.S.	3.76	0.79	4.92	23.50	34.96
	B.S.	3.92	0.91	4.71	24.49	36.69
LSD at 0.05 level		0.31	N.S.	N.S.	1.99	3.50

F.R.; fermentation period, O.S.; organic substrates, R.S.; Rice straw, W.S.; Wheat straw, B.S.; Broad bean straw.

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تأثير فترة تخمر البيئات العضوية على إنتاجية عيش الغراب المحارى

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أجرى هذا العمل فى وحدة أبحاث عيش الغراب – كلية الزراعة – جامعة الزقازيق خلال عامى ٢٠٠٢ و٢٠٠٣ بهدف دراسة تأثير فترات التخمر (٣٦ ، ٢٤ ، ١٢ ساعة ، معاملة الكنترول) للبيئات العضوية (قش الأرز، و قش القمح ، وقش الفول البلدى) على إنتاجية عيش الغراب المحارى .

وقد أوضحت النتائج المتحصل عليها أن فتره التخمر ٣٦ ساعة أعطت أعلى القيم لكل من المحصول الكلى ، النسبة المئوية للكفاءة البيولوجية، المحصول المبكر، والنسبة المئوية لكل من المحصول المبكر إلى المحصول الكلى ووزن المحصول الكلى إلى وزن البيئة الرطبة ، و متوسط عدد الأجسام الثمرية للكيس .

سجلت بيئة قش الأرز أعلى القيم لكل من المحصول الكلى ، النسبة المئوية للكفاءة البيولوجية، المحصول المبكر، والنسبة المئوية لكل من المحصول المبكر إلى المحصول الكلى و وزن المحصول الكلى إلى وزن البيئة الرطبة ، و متوسط عدد الأجسام الثمرية للكيس ، ومحتوى الأجسام الثمرية من الكربوهيدرات الكلية .

أعطى تخمر قش الأرز لمدة ٣٦ ساعة أعلى القيم لكل من المحصول الكلى ، النسبة المئوية للكفاءة البيولوجية، المحصول المبكر، والنسبة المئوية لكل من المحصول المبكر إلى المحصول الكلى و وزن المحصول الكلى إلى وزن البيئة الرطبة ، و متوسط عدد الأجسام الثمرية للكيس ، ومحتوى الأجسام الثمرية من الكربوهيدرات الكلية، بينما كانت معاملات التفاعل وهى تخمر قش الفول البلدى لمدة ٣٦ ، ٢٤ ، أو ١٢ ساعة هى افضل المعاملات حيث أعطت أعلى القيم لمحتوى الأجسام الثمرية من البروتين .