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PERFORMANCE OF *Pleurotus geesteranus* MUSHROOM GROWN ON DIFFERENT SUBSTRATES

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ABSTRACT

Different substrates such as sawdust, paddy straw, paper waste, pulse straw and sugarcane bagasse were used to evaluate their effects on the growth and yield of four different strains of *Pleurotus geesteranus* mushroom. The minimum days required from stimulation to primordia initiation (DRSPI) (3.75) and first harvest (DRSFH) (6.75) were recorded when PG-2 was cultivated on sugarcane bagasse and the maximum DRSPI (14.00) and (DRSFH) (18.00) were recorded when PG-3 was cultivated on pulse straw. The highest numbers of effective fruiting bodies (43.50) were found in PG-4 when cultivated on paper waste. The highest biological yield (248.30g) and efficiency (99.30 %) was recorded when PG-4 was cultivated on paper waste and the lowest biological yield (107.00g) and efficiency (42.80 %) was found when PG-3 was cultivated on pulse straw.

Keywords: *Pleurotus geesteranus*, substrates, yield attributes

INTRODUCTION

Pleurotus geesteranus, also known as ear ring handle, white ring handle ear. This moushrooms are succulent, crispy, rich of nutrition and are delicious in taste. This mushroom contains protein 3.65-3.88%, crude fat 1.13-1.18%, reducing sugars 0.87 1.80%, sugar 23.94 - 34.87%, lignin 2.64%, cellulose 12.85%, pectin 0.14% and are more valuable asset of amino acids containing threonine, lysine, leucine etc. (Chen *et al.*, 2010). Cultivation of this mushrooms are comparatively new in Bangladesh in comparison to other oyster mushroom. In Bangladesh different lignocellulosic materials are used for mushroom cultivation because cultivation on agricultural wastes enables to acquire substrate materials at low prices or even for free and to conserve our environment by recycling wastes. According to Donini, (2005) different lignocellulosic material such as cereal straws, sugarcane bagasse, dried leaves, banana leaves, sawdust etc. act as suitable base materials for mushroom production. Rice straw, cotton waste, coir, sugarcane leaves, sugarcane bagasse, water hyacinths and banana leaves can be implicated for oyster mushroom cultivation (Sarker *et al.*, 2008; Belewu and Belewu, 2005). But very few works has been carried out for the selection of suitable substrate for *Pleurotus geesteranus* mushroom though the selection of substrate is an important factor for mushroom cultivation because nutritional and chemical compositions of mushroom are affected by the composition of growth substrate (Benjamin, 1995). Ponmurugan *et al.*, 2007 and Sarker *et al.*, 2007, reported that various substrates have different effects on the growth, yield and quality of mushrooms. Xiong *et al.*, 2010, reported that cultivation of *pleurotus geesteranus* with cassava stalk as the main culture material showed excellent result. Chen *et al.*, 2010, observed that the greatest yield and the highest amino acid content in the *pleurotus geesteranus* mushrooms were obtained when equal amount of water hyacinth and sawdust in the medium were used. Declaire (1981) reported that cultivation of mushroom on different substrates makes it possible to get a non-waste technology, resulting in protein-rich food (fruit bodies) and organic fertilizer (mycelial biomass). In Bangladesh, sawdust, banana leaves, cotton waste, banana pseudo stem, paddy straw, sugarcane leaf and bagasse , coir pith, paper waste, pulse straw etc. are available but the suitability of these wastes as substrates of *Pleurotus geesteranus* is not yet tested. Therefore, it is very important to identify the suitable substrate for better yield and higher quality of *Pleurotus geesteranus* mushrooms. With this view, the present investigation was undertaken to find out the suitable wastes as substrate for *Pleurotus geesteranus* mushrooms.

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MATERIALS AND METHODS

Substrate preparation: In this experiment four different strains of *Pleurotus geesteranus* such as PG-1 (T_1), PG-2 (T_2), PG-3 (T_3), and PG-4 (T_4) were selected and was grown on different substrates such as Saw dust (S_1), paddy straw (S_2), paper waste (S_3), pulse straw (S_4) and sugarcane bagasse (S_5) .The plant materials were cut into small pieces (3-4 cm) and mixed with nutrient materials, wheat bran at the ratio of 4:1. Water was added to make the moisture content 65% and CaCO3 was added at the rate of 0.2% of the total mixture. Polypropylene bags of 7"×10" size were filled with 500g of substrate mixture and their mouth were plugged by water absorbing cotton and covered with brown paper and tied with a rubber band. Then bags were autoclaved at 121^0 C and 15 PSI for 2 hours and then allowed to cool. Each spawn packet was inoculated with the mother culture of the selected mushroom at the rate of two teaspoonfuls per packet. After inoculation when colonization was completed, the spawn packets were taken to the culture house and were opened by 'D' shaped cut on the shoulder side and removed the sheet. The relative humidity and the temperature of the culture house were recorded to 80-90% and 18-20°C respectively. Diffused day light and proper ventilation in culture house were maintained. After first harvest scraping was done again.

Statistical Analysis: The experiment was laid out following Completely Randomized Design (CRD) with 4 replications. Yield and yield parameters were taken on the basis of three flashes. Data on days required from stimulation to primordia initiation, days required from stimulation to first harvest, approximate number of primordia, number of effective fruiting body, length of stipe, diameter of stipe, diameter of pileus, thickness of pileus, Biological yield and efficiency were recorded. Biological efficiency was calculated according to the formula:

$$\text{Biological efficiency (\%)} = \frac{\text{Total biological yield (g)}}{\text{Total dry substrate used (g)}} \times 100$$

Data were analyzed following Gomez and Gomez (1984) using MSTAT-c computer program. Means separation were computed following Duncan's Multiple Range Test (DMRT) using the same computer program.

RESULTS AND DISCUSSION

The growth and yield of different strains of *Pleurotus geesteranus* mushroom varied significantly on different substrates.

Days Required from Stimulation to Primordia Initiation (DRSPI): The days required from stimulation to primordia initiation (DRSPI) ranged from 3.75 to 14.00 (Table1). The maximum DRSPI (14.00) was found in T_3S_4 followed by T_2S_4 (12.50) when PG-3 and PG-2 were cultivated on pulse straw. The minimum DRSPI (3.75) was found in T_2S_5 preceded by (4.25) in T_4S_5 when PG-2 and PG-4 were cultivated on sugarcane bagasse. The result agreed with Amin *et al.* (2008) who reported that the days required from stimulation to primordia initiation of oyster mushroom ranged from 3.25 to 13.50 days.

Days Required from Stimulation to First Harvesting: Significant variation on days required from stimulation to first harvesting (DRSFH) was observed on different substrates and was ranged from 6.75 to 18.00 days. The maximum DRSFH (18.00) was found in T_3S_4 followed by T_2S_4 (16.50) when PG-3 and PG-2 were cultivated on pulse straw. The minimum DRSFH (6.75) was found in T_2S_5 preceded by T_4S_5 (7.25) when PG-2 and PG-4 were cultivated on sugarcane bagasse. The result for days required from stimulation to first harvesting agreed with Amin *et al.* (2008).

Number of primordia: The number of primordia varried significantly in different treatments (Table 1). The highest numbers of primordia 134.80 were found in T_3S_2 followed by 117.50 in T_4S_3 when PG-3 and PG-4 were cultivated on rice straw and paper waste respectively. The lowest numbers of primordia 21.00 were found in T_3S_4 when PG-3 was cultivated on pulse straw preceded by 32.00 in T_4S_5 when PG-4 was cultivated on sugarcane bagasse.

Number of effective fruiting bodies: The number of effective fruiting bodies in different treatments differed significantly (Table 1). The highest numbers of effective fruiting bodies 43.50 were found in T_4S_3 followed by 37.50 in T_2S_3 when PG-4 and PG-2 were cultivated on paper waste. The lowest numbers of effective fruiting bodies 14.00 were found in T_3S_4 when PG-3 was cultivated on pulse straw. Ahmed (1998) also reported more or less similar number of effective fruiting bodies in sawdust, sugarcane bagasse and rice straw.

Table1. Days required from stimulation to primordia initiation and to first harvest, the number of primordia and effective fruit body of four different strains of pleurotus geesteranus mushroom grown on different substrates.

Treatments	Days Required from Stimulation to Primordia Initiation	Days Required from Stimulation to First Harvest	Number of primordia	Number of Effective Fruiting Body
T_1S_1	7.50 de	11.75 d	45.00 g	19.25 g
T_1S_2	4.75 hijk	8.00 fghij	67.75 e	30.00 d
T_1S_3	5.00 ghijk	8.00 fghij	83.75 d	29.75 d
T_1S_4	10.75 c	14.50 c	42.25 gh	15.75 h
T_1S_5	4.50 ijk	7.50 hij	40.00 ghi	16.00 h
T_2S_1	6.50 ef	9.50 e	44.50 g	16.50 h
T_2S_2	4.50 ijk	7.50 hij	80.75 d	27.25 e
T_2S_3	4.75 hijk	7.75 ghij	101.30 c	37.50 b
T_2S_4	12.50 b	16.50 b	36.50 ij	18.00 g
T_2S_5	3.75 k	6.75 j	44.75 g	22.00 f
T_3S_1	6.25 fg	9.25 ef	42.50 gh	16.50 h
T_3S_2	5.25 fghij	8.25 efghi	134.80 a	34.00 c
T_3S_3	5.75 fghi	8.75 efgh	100.50 c	26.50 e
T_3S_4	14.00 a	18.00 a	21.00 k	14.00 i
T_3S_5	6.00 fgh	9.00 efg	62.00 f	30.00 d
T_4S_1	8.00 d	11.25 d	38.50 hi	19.00 g
T_4S_2	4.75 hijk	7.75 ghij	103.00 c	34.25 c
T_4S_3	6.00 fgh	9.00 efg	117.50 b	43.50 a
T_4S_4	10.75 c	14.50 c	45.00 g	18.00 g
T_4S_5	4.25 jk	7.25 ij	32.00 j	16.00 h
CV (%)	11.82	7.80	5.05	3.65

In a column, means followed by a common letter are not significantly different at 5% level by DMRT.

Biological yield (g/packet): Significant variation was observed on biological yield (Table 2). The highest biological yield 248.30g was found in T_4S_3 followed by 244.80g in T_3S_5 when PG-4 and PG-3 were cultivated on paper waste and sugarcane bagasse respectively and the lowest biological yield 107.00g was found in T_3S_4 when PG-3 was cultivated on pulse straw preceded by T_1S_4 and T_4S_1 which was statistically similar with T_1S_1, T_2S_4 and T_4S_4.

Length of stipe (cm): The length of stipe ranged from 2.54 to 5.63 cm with significant difference (Table 2). The highest length of stipe 5.63 cm was found in T_2S_2 and T_3S_5 followed by 5.25 cm in T_1S_1, T_1S_3 and T_3S_3 the lowest length of stipe 2.54 cm was found in T_2S_4 which was statistically similar with most of the remaining treatments.

Diameter of stipe (cm): The diameter of stipe differed significantly and ranged from 0.88 to 1.80 cm (Table 2). The highest diameter 1.80 cm was found in T_2S_5 followed by 1.65 cm in T_1S_5. The lowest diameter 0.88 cm was found in T_1S_2 preceded by 0.90 cm in T_3S_2.

Diameter of pileus (cm): The diameter of pileus ranged from 6.25 to 10.63 cm with significant difference among the treatments (Table 2). The highest diameter of pileus 10.63 cm was found in T_1S_5 followed by 10.38 cm and 10.00 cm in T_2S_5 and T_1S_4 respectively. The lowest diameter of pileus 6.25 cm was found in T_3S_2 preceded by 6.88 cm in T_4S_1.

Thickness of pileus (cm): The thickness of pileus in different species differed significantly and ranged from 0.60 to 1.68 cm (Table 2). The highest thickness 1.68 cm was found in T_3S_5 followed by 1.44

and 1.40 in T_1S_5 and T_4S_5 respectively .The lowest thickness 0.60 cm was found in T_2S_3 preceded by 0.63 cm in T_1S_2.

Table 2. Effects of different substrates on the growth and yield of four strains of *pleurotus geesteranus* mushroom.

Treatments	Biological Yield (g)	Length of stipes (cm)	Diameter of Stipes (cm)	Diameter of Pileus (cm)	Thickness of Pileus (cm)
T_1S_1	130.50 i	5.25 ab	1.25 efgh	8.05 fghij	1.15 de
T_1S_2	223.00 b	4.38 abcde	0.88 k	7.25 ijk	0.63 i
T_1S_3	201.00 d	5.25 ab	1.15 fghij	7.38 hijk	0.68 i
T_1S_4	129.50 i	3.13 def	1.33 defg	10.00 abc	1.10 efg
T_1S_5	193.80 e	4.75 abc	1.65 ab	10.63 a	1.44 b
T_2S_1	143.50 h	3.50 cdef	1.00 ijk	8.70 cdefgh	1.00 fgh
T_2S_2	204.00 cd	5.63 a	1.30 efg	8.38 defghi	1.08 efgh
T_2S_3	207.80 c	4.75 abc	1.00 ijk	7.25 ijk	0.60 i
T_2S_4	131.30 i	2.54 f	1.35 cdef	8.25 efghi	0.98 gh
T_2S_5	222.50 b	3.63 cdef	1.80 a	10.38 ab	1.33 bc
T_3S_1	166.80 g	4.50 abcd	1.18 efghi	9.63 abcd	1.26 cd
T_3S_2	207.80 c	4.13 bcde	0.90 k	6.25 k	0.68 i
T_3S_3	187.00 f	5.25 ab	1.13 ghij	7.38 hijk	0.68 i
T_3S_4	107.00 j	3.88 bcde	1.23 efgh	8.50 defghi	1.20 cde
T_3S_5	244.80 a	5.63 a	1.53 bc	9.25 bcdef	1.68 a
T_4S_1	129.50 i	4.13 bcde	1.05 hijk	6.88 jk	1.13 def
T_4S_2	209.50 c	4.38 abcde	0.95 jk	7.38 hijk	0.95 h
T_4S_3	248.30 a	4.88 abc	1.25 efgh	7.75 ghij	0.73 i
T_4S_4	130.80 i	3.00 ef	1.38 cde	9.50 abcde	1.10 efg
T_4S_5	185.00 f	4.00 bcde	1.50 bcd	8.88 cdefg	1.40 b
CV (%)	2.29	19.06	10.30	9.83	8.53

In a column, means followed by a common letter are not significantly different at 5% level by DMRT.

Biological efficiency (%): Significant variation was observed on biological efficiency. The highest biological efficiency 99.30 % was found in T_4S_3 followed by 97.90 % in T_3S_5 when PG-4 and PG-3 were cultivated on paper waste and sugarcane bagasse respectively. The lowest biological efficiency 42.80 % was found in T_3S_4 preceded by 51.80 % in T_1S_4 and T_1S_4 T_4S_1 which was statistically similar with T_1S_1, T_2S_4 and T_4S_4.

The result agreed with Sarker et al. (2007) who used different substrates for oyster mushroom cultivation and reported that the biological yield and efficiency of this mushroom was found to be highest when it was cultivated on paper waste.

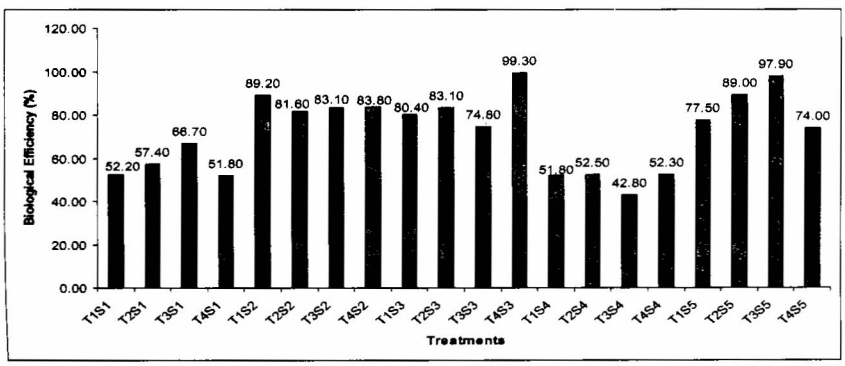

Fig. 1. Biological efficiency of four different strains of *pleurotus geesteranus* grown on different substrates

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