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PERFORMANCE OF OYSTER MUSHROOM (*Pleurotus ostreatus*) ON DIFFERENT PRETREATED SUBSTRATES

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ABSTRACT

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The experiment was conducted from April 20 to June 28, 2010 at Microbial Biotechnology Laboratory of Genetic Engineering and Biotechnology Department, Khulna University, Khulna, Bangladesh. Twelve different treatments with lime were evaluated to find out the growth and yield of mushroom. The mycelium running time and days required completion of full running of mycelium. Time required for the initiation of premordia to harvesting and number of premordia and number of effective premordia, Biological yield of mushroom were greatly influenced by different pretreated substrates. The highest yield (119gm) and return (12.85Tk) were obtained from the treatment of rice straw + 10% poultry litter + 1% lime. The highest mycelium running rate was observed in the treatment of banana leaf mid ribs + 10% horse dung + 1% lime. The minimum duration of mushroom production found in banana leaf mid ribs + 10% cow dung + 1% lime. However, the rice straw + 10% poultry litter + 1% lime and rice straw + 10% horse dung + 1% lime were the best treatments for the growing of oyster (*Pleurotus ostreatus*) mushroom and they are economically viable.

Key words: *Pleurotus ostreatus, highest yield, rice straw, horse dung, Bangladesh*

INTRODUCTION

Mushrooms contain about 85-95% water, 3% protein, 4% carbohydrates, 0.1% fats, 1% minerals and vitamins (Tewari 1986). It contains 19-35% protein on dry weight basis as compared to 7.3% in rice. 13.2% in wheat and 25.2% in milk (Chang and Miles, 1988). It is rich in essential minerals and trace elements (Chandha and Sharma, 1995). However, oyster mushroom (*Pleurotus oystreatus*) is an edible mushroom having excellent fragrant and taste. Wide spread malnutrition with ever increasing protein gap in our country has necessitated the search for alternative source of protein because the production of pulses has not kept pace with our requirement due to high population growth. Animal protein is beyond the reach of the most people in this country because most of the people (over 86%) live beyond poverty level (World Bank 1992). Edible mushrooms are recommended by the FAO as food, contributing to the protein nutrition of developing countries dependent largely on cereals. Cultivation of Mushroom is eco-friendly and profitable agribusiness but labour-intensive. (Chanda and Sharma, 1995). Mushroom cultivation represents the only current economically viable biotechnology process for the conversion of waste plant residues from forests and agriculture (Wood and Smith, 1987). The species of these genera show much diversity in their adaptation the varying agro-climatic condition which makes more cultivated species than other mushrooms (Zadrazil and Dube, 1992). The different species of pleurotus grow within a temperature range from 15-25^{o}C and it can be grown on various agricultural waste materials as substrate (Block *et al.* 1958). Compost of wheat and paddy straw, banana leaves, sugarcane bagasses and leaves, wheat barn, rich husk, sawdust etc. can be used as substrate for growing mushroom (Gupta 1986). *Pleurotus oystreatus* produce in large quantities in a short time and provides more protein per unit area than any other crop (Gupta 1986). The materials of these treatments used for mushroom production are available in our country and easy to collect. The present study was designed to evaluate the growth performance of different oyster Mushroom (*Pleurotus* spp.) varieties on different pretreated substrates and the costs benefit analysis of three cultivated oyster mushroom varieties.

MATERIALS AND METHODS

Collection of materials: The three varieties of oyster mushroom were collected from National Mushroom Development and Training Center, Sobhanbag, Savar, Dhaka. The different substrates were collected from various parts of Khulna city corporation area; such as rice straw, Mehegoni (*Swietenia mahagoni*) leaves and cow dung are collected from gollamari, Khulna University, poultry manure are collected from Mohammadnagar, Khulna. Horse dung is collected from rupsa, Khulna. Poly propylene bag, neck, $CaCO_3$ and rubber band are collected from mushroom foundation khalishpur, Khulna. Potato and Carew's bottle are collected from Bara bazar, Khulna. The experimental varieties were: V_1= *Pleurotus ostreatus* (Florida/FLO), V_2= *P. ostreatus* (PO2) and V_3= *P. ostreatus* (HK-51).

Media and culture: Potato dextrose agar (PDA) media was prepared by using dehydrated PDA medium. To obtain pure culture a small piece of the fruiting body of Mushroom and placed on the sterilized PDA media under aseptic condition. It was then kept for 7-10 days in an incubator under 25°C for sufficient growth. This pure culture was used for the entire experiment.

Mother culture: The mother culture substrates were prepared by using good quality of wheat grains and $CaCO_3$. At first, 5kg wheat grains were boiled in a saucepan for about 1 hour (30-45 min best). The pot was taken off from heat when wheat grains became brown and looked like a succulent grapes. It was then filtered wheat grains were spread out on a polythene sheet placed on the floor. After draining out of excessive water, l% $CaCO_3$ (50g) were mixed with wheat grains manually and packed tightly in 8×12 inch polypropylene (p.p.) bag. Each of the bags containing 250g was prepared by using plastic heat resistance neck and plugged the neck with cotton and covered with brown paper placing a rubber band to hold it in place. Then the packets were sterilized in an autoclave for one hour at 121°C and 1.5 kg/cm^2 atmospheric pressure. After sterilization these were kept 24 hours for cooling. Then a cut piece of pure culture was placed aseptically through the hole of the mother culture packet and again the packets were plugged with cotton and covered the brown paper with a rubber band. It was placed into the growth chamber at 25°C in dark place. After 15 to 21 days the packet of the mother culture became white due to complete the mycelium running and then it was ready for inoculating spawn packets.

Spawn culture: Compost is the substrate on which mushroom grows. The biochemical activities of a number of microorganisms make the substrate selective for the growth of mushroom, *A. bisporus.* The process of compost making is known as Composting. Composting is defined as indefinite microbial degradation of organic wastes. These wastes include vegetable and animal matter, banana leaf mid ribs, forest leaves, remains of stubbles and roots in the soil, green manure, straw, household garbage, sewage sludge, animal manure etc. The process of composting involves microbial decomposition of the organic materials, synthesis of microbial proteins and conditioning of the fibrous material to absorb and retain moisture. In addition, the microorganisms change the physical properties of compost and make the growth of the competitive microorganisms more difficult.

Preparation of substrates: The compost for spawn packets were prepared by using the method that was reported by several workers have studied the possibility of wheat straw, barley straw, rice straw, maize stem, banana leaf mid ribs, etc. mixed with organic and inorganic supplements as a replacement for making the synthetic compost (Lambert 1929; Sinden 1946; Stoller 1943; Edwards 1949; Gerrit 1974;). This experiment was carried out with three varieties and three replications. For this purpose, nine packets were prepared with each of the substrates. Each packet was weighted 500g. It is necessary to chop the straw, banana leaf mid ribs and Mehegoni leaves in order to facilitate the retention of heat and moisture both during the composting period and during the sweating out process. Chopped substrates are also easier to handle. Long substrates bind and are laborious to mix. Chopped substrates compost is better than substrates which are partial chopped or not chopped at all. The chopped straw, banana leaf mid ribs and Mehegoni leaves are soaked in water for 12 hours and then the substrates are removed from the excess water on the clean cemented floor. The moisture was maintained about 65-70% which was determined by pressing a handful of the mixture. If there was no water runoff and the materials were unchanged due to pressure, it was thought to 65% moisture content. Polythein papers are used for composting. The polythein paper flatted on the floor and 4.5 kg of each chopped substrates are heaped on the polythein paper. These composed substrates were filled in polypropylene bags (6×9 inches) the bags were filled with 500g prepared substrate and packed tightly. Plastic necks were used on the mouths of packets. A hole of 1 to 2 inch was made with pointed steel at the centre for space to put the inoculums. The packets were plugged by inserting water absorbing cotton with the help of plastic rings and covered with brown paper tied by rubber bands to prevent the displacement of brown paper. The packets were sterilized in the autoclave for 30 minutes at 121°C with 1.5 kg/1cm^2 pressure and were kept 24 hours for cooling. One teaspoonful of mother culture media containing mycelia was placed aseptically through the hole of each packet separately. Each treatment was replicated three times. The packets were then marked treatment wise with a marker pen and were kept on the shelf in an incubation room at 25±1°C under 80 to 85% relative humidity. The packets were allowed to become white in color with mycelial growth all over the substrates.

Culture of spawn packet: Various operations for culture of *Fleurotus* spp. were done as follows according to Jandaik (1976), Pal and Thapa (1979). After completion of the mycellium-run in the spawn packets, the cotton plug, brown paper and rubber band of the mouth of spawn packet were removed and the mouth was wrapped tightly with rubber band. Two opposite ends of bag at the upper position were opened with a blade by removing the plastic sheet in round shape. The opened surface of the substrate was scraped slightly with a tea spoon for removing the thin whitish mycelial layer. Then the spawn packets were soaked in water for 2-3 minutes. After that the packets were kept on the plastic tray for removing excess water. The spawn packets were placed according to experimental design on the culture shelf. Water was sprinkled on the round-shaped cut of spawn packet to maintain 80-85% relative

humidity. Water was spraying twice or thrice a day until the mushrooms were matured enough to be harvested. In the room temperature (ranges 26°C to 32°C), high relative humidity (80-85%) and proper ventilation were maintained for fruiting.

Harvesting of mushroom: The first primordia appear 2-4 days after scratching depending upon types of substrate, which were recorded. The harvesting date also varied depending upon types of substrate. Matured mushroom identified by curl margin of the cap was harvested by twisting to uproot from the base. Mushroom matured generally 48 hours after appearing the primordia.

Collection of data: The packets with growing mushrooms were observed frequently to record the characters of three varieties of mushroom at different stages of growth on different substrates. Data were collected periodically during the growing period and immediately after harvest. The data were recorded on the parameters: mycelium running time in bottle (days), mycelium running time in mother culture (days), mycelium running time in spawn packet (days), time required for primordia initiation (days), number of primordia (number), number of effective fruiting bodies (number), time required for harvesting (days), biological yield (g/packet), economical yield (g/packet), harvest index (%), biological efficiency (%), cost benefits analysis and statistical method SPSS was used for analysis.

RESULTS AND DISCUSSION

Mycelium running time: Mycelium running time in test tube, mother culture, spawn packet and number of days required from inoculation to harvesting of various substrates for three Oyster mushroom varieties showed significant difference among each other (Table 1).

Mycelium running time in test tube: Among these varieties, variety V_1 showed the fastest mycelium running time (9.33 days) followed by V_2 (l1.5 days), V_3 (12.66 days), that were significantly different. The slowest mycelium running time was found in V_3 (12.66 days) (Table 1).

Mycelium running time in mother culture: The quickest mycelium running time was found in V_1 (15.50 days) followed by V_2 (16.66 days), V_3 (17.83 days), but they were numerically different. V_3 showed the maximum time (17.83 days) for completion of mycelium running in mother culture (Table 1).

Mycelium running time in spawn packet: The earliest spawn running was found in V_1 (1.66 days). The maximum days required by V_3 (16.33 days). So, minimum total mycelium running time was found in V_1 (1.667 days) followed by V_2 (8.00 days), and V_3 (6.33 days) (Table 1 and Table 2). That means, variety V_2 required more than 7.00 days than that of the fast growing variety V_1 (Table 1 and Table 2). Mehta and Bhandal (1988) reported that, the mycelium growth rate was higher in *Pleurotus ostreatus* followed by *F. florida*, *F. sajor-caju*, *F. flabellatus and P. sapidus* at 25°C. The present study was showed the similar result *P. ostreatus* (FLO) offered mycelium quickly on different substrates and it was heavy in layer. Variety *P. ostreatus* (HK-51) showed average performance and give thin mycelium layer when it was grown on straw, Mehegoni leaves and Banana leaf mid ribs.

Table 1. Mycelium running time of different oyster mushroom varieties

Variety	Mycelium running time in test tube (days) Average	Mycelium running time in mother culture (days) Average	Minimum mycelium running time in spawn packet (days) Average	Total mycelium running time (days) Average	Total number of days required from inoculation to harvesting
V_1	9.33	15.50	5.66	16.934	31.32
V_2	11.5	16.66	7.00	20.00	31.65
V_3	12.66	17.83	10.50	22.00	43.75

Table 2. Interactions of yield contributing characters of three Oyster mushroom varieties

Treatments	Variety	Mycelium running time	Days of premordia initiation	Number of premordia	No. of effective fruiting bodies	Time of harvesting (days)	Biological Yield (g/pack)	Economic Yield (g)	Harvest Index (%)
T_1	V_1	8.667 de	32.33 ab	63.67 a-c	7.640 a-d	4.000 a-e	119.0 a	105.1 a	88.33 a
	V_2	12.67 a-d	11.67 d-f	99.33 a	8.500 ab	4.333 a-d	77.67 b-e	67.40 b-d	86.67 a
	V_3	8.333 de	30.67 a-c	36.67 b-h	6.277 a-f	3.833 a-e	112.3 ab	100.0 ab	89.00 a
T_2	V_1	8.000 de	26.33 a-e	33.33 b-h	6.057 a-f	3.390 a-e	88.33 abc	77.10 abc	87.33 a
	V_2	-	-	7.667 gh	-	2.333 def	-	-	-
	V_3	6.333 e	19.67 a-e	10.00 fgh	2.553 e-h	2.167 ef	25.33 f-j	21.87 e-i	61.00 ab
T_3	V_1	16.00 a	15.00 b-f	33.33 b-h	7.777 abc	4.167 a-e	36.67 e-j	32.08 d-i	87.33 a
	V_2	15.33 ab	21.33 a-e	47.00 b-g	5.000 b-g	4.667 ab	25.67 f-j	22.10 e-i	86.00 a
	V_3	9.667 cde	25.67 a-e	41.67 b-g	5.167 b-g	3.943 a-e	50.00 c-i	43.17 c-h	86.33 a
T_4	V_1	9.667 cde	32.33 ab	56.33 b-e	9.723 a	4.557 abc	63.67 c-g	55.59 c-f	87.33 a
	V_2	10.67 b-e	32.67 ab	70.67 ab	7.527 a-d	3.557 a-e	116.7 ab	99.53 ab	85.33 a
	V_3	14.33 abc	10.67 def	68.67 ab	6.943 a-e	4.443 a-d	81.67 abc	71.20 abc	87.33 a
T_5	V_1	6.667 e	35.33 a	42.00 b-g	7.223 a-d	4.500 abc	109.0 ab	93.72 ab	86.00 a
	V_2	8.000 de	36.33 a	34.00 b-h	5.443 a-f	3.557 a-e	80.67 a-d	67.61 bcd	83.67 a
	V_3	-	12.33 c-f	17.67 e-h	-	5.000 a	-	-	-
T_6	V_1	7.333 de	16.67 b-f	9.333 fgh	3.333 d-h	2.557 b-f	23.33 g-j	20.60 e-i	59.00 ab
	V_2	9.333 cde	27.33 a-d	60.33 bcd	7.167 a-d	3.833 a-e	40.00 d-j	34.78 d-i	86.67 a
	V_3	16.33 a	21.67 a-e	24.33 c-h	4.333 b-g	4.333 a-d	15.67 hij	13.62 ghi	87.00 a
T_7	V_1	9.667 cde	33.33 ab	34.33 b-h	6.497 a-e	3.890 a-e	63.67 c-f	56.31 cde	88.33 a
	V_2	9.667 cde	31.67 ab	32.00 b-h	5.447 a-f	4.000 a-e	65.67 c-f	56.70 cde	86.67 a
	V_3	9.667 cde	25.00 a-e	49.33 b-f	6.167 a-f	4.833 a	49.00 c-i	42.30 c-h	86.67 a
T_8	V_1	-	10.00 def	55.00 b-e	5.333 a-f	2.667 b-f	22.67 g-j	19.68 f-i	58.00 ab
	V_2	14.00 abc	21.67 a-e	39.00 b-h	3.833 c-h	4.167 a-e	53.33 c-h	46.67 c-g	58.00 ab
	V_3	8.333 de	11.00 def	21.67 d-h	1.000 gh	3.000 a-f	16.67 hij	14.83 ghi	29.67 bc
T_9	V_1	6.667 e	22.00 a-e	9.667 fgh	4.000 c-h	2.500 c-f	25.00 f-j	21.50 e-i	57.33 ab
	V_2	-	-	-	-	-	-	-	-
	V_3	16.67 a	13.00 c-f	21.00 d-h	3.667 c-h	2.667 b-f	40.00 d-j	34.23 d-i	57.00 ab
LSD value		4.423	15.12	32.63	3.583	1.732	34.37	29.95	45.22
Level of Significance		**	*	*	*	*	**	**	**

Here,
**=Significance at 1% level
*=Significance at 5% level
a-h= LSD lettering

Table 2. (Cont'd) Interactions of yield contributing characters of three Oyster mushroom varieties

Treatment	Variety	Mycelium running time	Days of premordia initiation	Number of premordia	No. of effective fruiting bodies	Time of harvesting (days)	Biological Yield (g/pack)	Economic Yield (g)	Harvest Index (%)
T_{10}	V_1	1.667 f	8.667 ef	8.333 gh	2.000 fgh	1.000 fg	11.67 ij	9.917 hi	28.33 bc
	V_2	11.67 a-e	26.00 a-e	36.67 b-h	7.667 a-d	2.667 b-f	50.00 c-i	43.40 c-h	58.00 ab
	V_3	15.00 ab	32.67 ab	40.00 b-h	5.667 a-f	3.333 a-e	58.33 c-g	51.83 c-f	89.00 a
T_{11}	V_1	-	-	-	-	-	-	-	-
	V_2	-	-	-	-	-	-	-	-
	V_3	-	-	-	-	-	-	-	-
T_{12}	V_1	-	-	-	-	-	-	-	-
	V_2	-	-	-	-	-	-	-	-
	V_3	-	-	-	-	-	-	-	-
LSD value		4.423	15.12	32.63	3.583	1.732	34.37	29.95	45.22
Level of Significance		**	*	*	*	*	**	**	**

Here,
**=Significance at 1% level
*=Significance at 5% level

Table 3. Cost benefits analysis of different substrates used in mushroom cultivation

Substrate	Variety	Production cost/packet(Tk)	Yield per packet (g)	Price/packet yield (Tk)	Profit/loss Per packet (Tk)
T_1	V_1	5.00	119.00	17.85	+12.85
	V_2	5.00	116.67	17.50	+12.50
	V_3	5.00	49.00	7.30	+2.35
T_2	V_1	5.00	77.67	11.65	+6.65
	V_2	5.00	81.67	12.25	+7.25
	V_3	5.00	22.67	3.40	-1.60
T_3	V_1	5.00	112.33	16.85	+11.85
	V_2	5.00	109.00	16.35	+11.35
	V_3	5.00	53.33	8.00	+3.00
T_4	V_1	5.00	88.33	13.25	+8.25
	V_2	5.00	80.67	12.10	+7.10
	V_3	5.00	16.67	2.50	-2.50
T_5	V_1	3.50	7.33	1.09	-2.40
	V_2	3.50	17.67	2.65	-0.85
	V_3	3.50	25.00	3.75	+0.25
T_6	V_1	3.50	25.33	3.80	+0.30
	V_2	3.50	23.33	3.50	+0.00
	V_3	3.50	-	-	-3.50
T_7	V_1	4.00	36.67	5.50	+1.50
	V_2	4.00	40.00	6.00	+2.00
	V_3	4.00	40.00	6.00	+2.00
T_8	V_1	4.00	25.67	3.85	-0.15
	V_2	4.00	15.67	2.35	-1.65
	V_3	4.00	11.67	1.75	-2.24
T_9	V_1	4.00	50.00	7.50	+3.50
	V_2	4.00	63.67	9.55	+5.55
	V_3	4.00	50.00	7.50	+3.50
T_{10}	V_1	4.00	63.67	9.55	+5.55
	V_2	4.00	65.67	9.85	+5.85
	V_3	4.00	58.33	8.74	+4.74
T_{11}	V_1	3.50	-	-	-
	V_2	3.50	-	-	-
	V_3	3.50	-	-	-
T_{12}	V_1	3.50	-	-	-
	V_2	3.50	-	-	-
	V_3	3.50	-	-	-

Table 4. Biological efficiency of oyster mushroom varieties on various substrates

Substrate	Variety	Weight of each spawn packet (g)	Total yield in (g/packet)	Biological efficiency (%)
T_1	V_1	175.00	119.00	68.00
	V_2	175.00	116.67	66.67
	V_3	175.00	49.00	28.00
T_2	V_1	175.00	77.67	44.38
	V_2	175.00	81.67	46.67
	V_3	175.00	22.67	12.95
T_3	V_1	175.00	112.33	64.18
	V_2	175.00	109.00	62.28
	V_3	175.00	53.33	30.47
T_4	V_1	175.00	88.33	50.47
	V_2	175.00	80.67	50.67
	V_3	175.00	16.67	9.52
T_5	V_1	175.00	7.33	4.19
	V_2	175.00	17.67	10.09
	V_3	175.00	25.00	14.28
T_6	V_1	175.00	25.33	14.47
	V_2	175.00	23.33	13.33
	V_3	175.00	-	-
T_7	V_1	175.00	36.67	20.95
	V_2	175.00	40.00	22.87
	V_3	175.00	40.00	22.87
T_8	V_1	175.00	25.67	14.67
	V_2	175.00	15.67	8.95
	V_3	175.00	11.67	6.67
T_9	V_1	175.00	50.00	28.57
	V_2	175.00	63.67	36.38
	V_3	175.00	50.00	28.57
T_{10}	V_1	175.00	63.67	36.38
	V_2	175.00	65.67	37.52
	V_3	175.00	58.33	33.34
T_{11}	V_1	175.00	-	-
	V_2	175.00	-	-
	V_3	175.00	-	-
T_{12}	V_1	175.00	-	-
	V_2	175.00	-	-
	V_3	175.00	-	-

Yield and yield contributing characters of three Oyster mushrooms: Three Oyster mushroom varieties showed various yield and yield contributing characters significantly (Table 2). The distinct difference among the varieties for time of primodia initiation was appeared. V_1 took the shortest time (8.66 days) for primordia initiation growing on rice straw and the highest time for primordia initiation was taken by V_2 (36.33 days) growing on banana leaf mid ribs. Chang and Miles (1988) stated that C & N ratio is important in primodia formation. The substrate containing C and N at a ratio of about 20:1 is suitable for good number of primodia initiation. Patra and Pani (1995) mentioned that Oyster mushroom took 3-8 days for initiation of fruiting bodies and this result was similar to the present experiment. Time of primodia initiation, therefore may considered as the important trait for varietals selection of Oyster mushroom.

Number of primodia initiation: Primodia initiation numbers were significantly different among the three varieties. Higher number of primodia were initiated in variety V_2 (99.33) growing on rice straw followed by V_2 (68.67) growing on rice straw and V_3 (63.67) growing on rice straw (Table 2). The least number of primordia were initiated on V_2 (7.67) when it was grown on mehegoni leaves. This might happen due the absence of glucose, fructose and trehalose in the substrate, reported by Kitamoto *et al.* (1995).

Number of effective fruiting body: There was significant variability in the number of effective fruiting bodies among the mushroom varieties under this study (Table 2). The highest number of effective fruiting bodies was produced by V_1 (9.72) growing on banana leaf mid ribs. V_3 showed the lowest number of effective fruiting bodies (1.00) growing on rice straw. Number of effective fruiting bodies and number of primordia initiation had a linear relationship (Table 2). In the present study some abnormal fruiting bodies were found. Those abnormal fruiting bodies may be caused due to the presence of glucose, fructose and trehalose in the substrate, reported by Kitamoto *et al*. (1995).

Harvesting time: Oyster mushroom varieties had shown significant variation in time of harvest after primordia initiation (Table 2). The shortest time (1.00days) was record in V_1 when they were grown on banana leaf mid ribs; whereas the longest time was taken by V_3 (5.00 days) growing on mehegoni leaves. Patra and Pani (1995) reported that *P. florida, P. sajor-caju, P. sapidus* and *P. flabellatus* took 4-8 days for harvesting and it was similar to these present study.

Biological yield: The crop of Oyster mushroom was harvested in three flushes. The maximum yield was obtained in first flush than the second and third flush. Biological yield means the total weight of fruiting bodies. The highest biological yield was obtained from the V_1 (119.00 g/packet) followed by V_2 (116.7 g/packet) when they were grown on rice straw + 10% poultry litter + 1% lime. The lowest biological yield was obtained from V_1 (11.67 g/packet) when they were grown on mehegoni leaves + 0.5%urea + 1% lime (Table 2).

Economical yield: Economical yield was about 80-90% of total biological yield. The highest yield (105.1g/packet) was found in V_1 growing on rice straw + 10% poultry litter + 1% lime. The lowest economical yield was obtained from V_3 (13.62g/packet) (Table 2). Badsha *et al.* (1992) investigated that the yield of Oyster mushroom (*Pleurotus* spp.) were ranged from 12.45g to 69.42g per 500g spawn packet on sawdust substrate and this was similar to this present studies.

Harvest index: The harvest index was ranged from 28.33% to 88.33% in V_1; 58.00% to 86.67% in V_2 and 29.67% to 89.00% in V_3 respectively. V_3 showed the highest harvest index (89.00%) growing on rice straw + 10% poultry litter + 1% lime and the lowest harvest index was obtained from V_1 (28.33%) (Table 2).

Biological efficiency: It is clear from the Table 4 that as a substrate rice straw showed the best biological efficiency (68.00%) in V_1 followed by rice straw (66.67%); banana leaf mid ribs (37.52%); mehegoni leaves (14.47%).

Cost benefits analysis: Cost benefits analysis of different substrates showed significant differences for three mushroom varieties (Table 3).Variety V_1 showed the best yield performance as well as the maximum profit (12.85Tk) growing on rice straw + 10% poultry litter + 1% lime, banana leaf mid ribs and mehegoni leaves also gave good results (Table 3).

CONCLUSION

P. ostreatus (FLO) showed the best result on Rice straw + 10% poultry litter + 1% lime as well as on other substrates followed by *P. ostreatus* (PO_2) and (HK-51) on Banana leaf mid ribs + 10% cow dung + 1% lime. The substrates used in this research work for mushroom production are as follows: straw, banana leaf mid ribs, mehegoni leaves, poultry litter, horse dung and cow dung. Mushroom cultivation can change the socio-economic condition of Bangladesh. From the cost benefit analysis it was observed that, the amount of benefit was more than double of investment by using straw and poultry litter, which are available in our country. Further research program using combination of two or more type of substrates for growing Mushroom is in progress. The main target of this research work is to demonstrate the substrate on which the mushroom is being produced at a high level with considering the availability of the substrate in the country. So, the farmers should come forward to cultivate edible mushrooms like *Pleurotus ostreatus* (Oyster mushroom) on commercial scale to fulfill the requirements of balanced diet.

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