PERFORMANCE OF DIFFERENT WOOD SHAVINGS AS A SUBSTRATE SUPPLEMENT OF OYESTER MUSHROOM

(Pleurotus ostreatus)

A THESIS
BY

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STUDENT ID: MS-110806
SESSION: 2010-11

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DECEMBER, 2017

Dedicated

To

My Beloved Parents

ABSTRACT

The experiment was carried out to investigate the performance of different wood shavings as substrates of Oyster mushroom during April-July 2013.The experiment was conducted at Horticulture centre, Daulatpur, Khulna. *Pleurotus ostreatus* variety and four substrates supplement viz. Shirish wood shaving, Neem wood shaving, Mahogoni wood shaving and Jam wood shaving were used in the study. *Pleurotus ostreatus* showed better performance in jam wood shaving substrate supplement regarding number of effective fruiting body, pileus thickness, pileus diameter, stalk length, stalk diameter, biological yield, economic yield and harvest index. On the other hand, *Pleurotus ostreatus* showed poor performance in neem wood shaving substrate supplement regarding the same parameters. The number of effective fruiting body, biological yield, economic yield and harvest index were on different substrates differed significantly. The highest number of effective fruiting body, the biological yield, the economic yield and harvest index per packet were recorded on jam wood shaving substrate supplement, which was significantly higher as compared to all other wood shaving substrates. The lowest number of effective fruiting body, the biological yield, the economic yield and harvest index per packet were observed in neem wood shaving substrate supplement. The number of effective fruiting body was positively correlated with biological yield and economic yield of oyster mushroom. Harvest index was positively correlated with biological yield and economic yield of oyster mushroom.

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Substrate type is one of the major factors affecting the yield and quality of oyster mushroom (*Pleurotus ostreatus*). Substrate of mushroom supplies nutrients for growth and development of fruiting body (Chang and Miles, 1988). *Pleurotus ostreatus*, the oyster mushroom, is a common edible mushroom and is now grown commercially around the world for food. Oyster mushrooms can also be used industrially for mycoremediation purposes. Oyster mushroom can make use of the largest variety of waste substrates with its fast mycelial growth as its multilateral enzyme can able to biodegrade nearly all types of available wastes (Poppe, 2000). Lignin and cellulose containing materials such as sawdust, coconut coir, sugarcane bagasse, wheat straw, rice straw and wood shaving are widely used for oyster mushroom production (Yildiz and Ertekin, 1996). Wood composition includes lignin. Only members of Basidiomycetes can decompose this complex compound and obtained nutrient from it, as a reason better grow on wood shavings supplement. It can be added to the basal medium to improve growth and yield of mushroom (Hadwan *et al.*, 1997). So there is a possibility that the wood shaving might be a good supplement of mushroom substrate and mushroom farmers can get yield from different wood shaving as a substrate supplement in our country. With these view the objective of the research was set as follow.

OBJECTIVE

To determine the suitable wood shavings as a supplement substrate for better growing of oyster mushroom.

CHAPTER TWO

REVIEW OF LITERATURE

Moonmoon (2010) studied king Oyster mushroom *Pieurotus eryngii* on saw dust and rice straw in Bangladesh and found that saw dust shows the highest biological efficiency (73.5%) than other strains. She has also reported on saw dust, the yield and efficiency were better than those cultivated on rice straw, however, on straw; the mushroom fruiting bodies were larger in size. This study shows the prospects of *P. eryngii* cultivation in Bangladesh and suggests further study in controlled environment for higher yield and production.

Islam *et al.* (2009) studied to find out suitable sawdust as substrate for growing oyster mushroom seven different types of substrate viz. Mango, jack fruit, coconut, jam, kadom, mahogany and shirish sawdust with wheat brain and $CaCO_3$. The maximum biological yield per packet was obtained with mango sawdust (150 g) followed by mahogany (148 g), shirish (146 g), kadom (136 g), jam (114 g), jack fruit (97 g) and coconut sawdust (83 g). Low yield was obtained in coconut sawdust.

Bugarski e*t al.* (2007) studied the effect of various substrates on the chemical composition of the mushroom: ash, proteins, cellulose, fats, sodium, potassium, magnesium, iron, manganese, copper and zinc. Substrates have been selected on the basis of previous investigations and available materials from the local crop production: wheat straw, soybean straw, corn stalks, sunflower stems, wheat straw 50% + soybean straw 50%, wheat straw 50% + corn stalks 50%, wheat straw 50% + sunflower stems 50%. Examining the chemical composition of oyster mushrooms grown on seven different substrates, we arrived at the conclusion that the substrates did not affect only the content of magnesium. The contents of ash, proteins, cellulose, fats, sodium, phosphorus, calcium, iron manganese, copper and zinc varied with the substrate.

Ponmurugan *et al.* (2007) studied the cultivation of oyster mushroom (*Pleurotus ostreatus)* on different bio waste such as paddy straw, sorghum straw, sugarcane molasses saw dust and paper waste. Favorable conditions were created to attain the maximum yield of mushrooms. The results reveled that mushroom growth was better in paddy straw followed by sugarcane molasses, wood saw dust and paper waste.

Zireva *et al.* (2007) conducted studied on effect of substrate quantity and shelf if position on yield of oyster mushroom (*Pteurotus sajor-caju*) using plastic tray culture. The experiment was laid out as 2-way factorial in a randomized block design with five substrates quantities (2, 4, 6, 8 and 10 kg of wheat straw per tray) and two shelf positions (0.5 and 1.2 m above ground). Mushroom yield increased with an increased substrate quantity of up to 6 kg and thereafter remained constant. Shelf position had no significant effect on mushroom yield. Biological efficiency decreased with an increase in substrate quantity per tray. It was concluded that 6 kg of substrate per tray would result in optimal yields. The height above the ground at which trays are placed in the growing room does not affect mushroom yields.

Rana *et al.* (2007) studied the effect of dried mango leaves aqueous extract (MLAE) upon radial mycelial growth of *Pleurotus ostreatus* and *Pleurotus florida* was evaluated on eight different waste substrate materials which included, mango leaves, wheat straw, sugarcane bagasse, waste cotton, waste paper, wood shavings, paddy straw, and coconut coir. Best growth was observed on dried mango leaves. Radial mycelial growth was significantly increased when sugarcane bagasse and coconut coir were supplemented with the extract of dried mango leaves. Maximum growth was observed in case of paddy straw and waste paper supplementation. Mango leaves

extract based agar medium was found to be better than Sabouraud's dextrose agar (SDA) medium.

Silva *et al.* (2005) reported that mycelium extension is related to bio availability of nitrogen when they found that eucalyptus residues supplemented with cereal barn supported fast growth. However, the low amount of available nitrogen (N) in the lingo-cellulosic substrate of wood components is often considered as a limitation to its use as mushroom substrate.

Oei (2003) reported that substrate having high quality lignin and cellulose contents takes a longer time to start pinning and fruit body formation.

Baysal (2003) investigated paper waste supplement with rice husk, chicken manure and peat for *Pleurotus ostreatus* cultivation. Highest yield for fresh weight was recorded as 350.2 g in the substrate containing 20% rice husk.

Obodai *et al.* (2002) reported that sawdust substrate for mushroom production should undergo a period of composting to breakdown the cellulose and lignin components of the wood in order to release the essential materials for the establishment of mushroom mycelium. The lingo-cellulosic materials in sawdust are generally low in protein content and thus insufficient for the cultivation of mushrooms and therefore require additional nitrogen, phosphate and potassium.

Kalita *et al.* (1997) studied some biochemical aspects of oyster mushroom. He found that optimum pH of substrate for the cultivation of *Pleurotus ostreatus* was 6.5. The pH below 5 and above 7 hindered the mycelial growth.

El-Kartan and Salama (1996) studied were carried on to evaluate legume waste and gypsum as possible additives to rice straw for the cultivation of the oyster mushrooms *Pleurotus florida* and *Pleurotus ostreatus*. Soaking in hot water, as a simplified heat treatment, was adapted for the preparation of the different combinations of the waste materials. Both yield and quality of oyster mushroom have been improved by supplementing rice straw with legume waste. The highest beneficial effect on yield was achieved when rice straw was supplemented with 50% legume waste.

Ragunathan *et al.* (1996) reported that the three species of *Pleurotus, P. sajor-caju. P. platypus and P. citrinopileatus*, were cultivated on various agro-residues such as paddy straw, maize Stover, sugarcane bagasse, coir pith and a mixture of these wastes. Primordial initiation was observed on 22nd-27th day after spawning. Maximum yield was obtained in *P. sajor-caju* cultivated on paddy straw. *P. platypus* yielded maximum on coir pith and *P. citrinopileatus* on sugarcane bagasse respectively.

Jadhav *et al.* (1996) studied the effects of different substrates on the yield oyster mushroom, which was cultivated on wheat straw, paddy straw, stalks and leaves of maize and cotton, jowar, soybean straw, groundnut creepers plus wheat straw- Cotton stalks and leaves gave the best results as compared to the other substrates.

Muhammad and Khan (1993) studied four strains of oyster mushroom (*Pleurotus sp.)* which was cultivated on cotton waste. Spawn running was fastest in the blue-gray strain of *P. ostreatus*, this strain of *P. ostreatus* gave the highest yields in the first and third flush. The yellow strain of sajor-caju gave the highest yield in the second flush.

Sohi and Upadhyay (1989) reported that unused wood residues can be converted into value-added products such as gourmet and medicinal mushrooms. In this study, wood waste was used to cultivate wood-inhabiting ligninolytic white-rot Basidiomycetes of the genus *Pleurotus*. Ligninolytic Basidiomycetes supplemented with low concentrations of dextrose readily colonized the wood waste fruiting bodies were produced in 3-8 weeks. After the fruiting bodies were harvested, the basidiomycetes degraded up to 38% Klaxon lignin and 45% acid-soluble lignin in the spent substrates. Lyophilization of cultures, which stimulated filamentous mycelial growth, accelerated fruiting. The results indicate that growing *Pleurotus* species on wood waste or unused wood residue associated with harvesting or thinning operations can enhance economic returns needed to support ecosystem management. These values include reducing fuels for fire, decreasing pest and disease outbreaks and increasing biodiversity.

Khan and Kausar (1981) reported that oyster mushroom can be grown on the agricultural wastes, of which sugarcane bagasse proved to be the best substrate for sporophore production. The study was made on various composts i.e. blow gutter, weaving sweeping cotton waste and straw. They concluded that when the fresh spawn was used to inoculate these composts i.e. blow gutter cotton gave higher yield followed by paddy straw and weaving cotton waste. The fresh spawn gave comparatively higher yield with blow gutter cotton waste than the older spawn.

Studies conducted by Tan (1981) revealed that cotton waste was the best substrate for the cultivation of *Pleurotus ostreatus*. Cereal bran rich in protein is usually added to the substrate in *P. ostreatus* cultivation to stimulate mycelia growth and increase the yield of mushroom.

Zadrazil & Brunnert (1981) stated that, Mushrooms, a highly priced delicacy for more than two thousand years, are now consumed by many people. Mushroom cultivation is profitable agribusiness. Many agricultural and industrial wastes can be utilized as substrates for production of *Pleurotus* species.

Ahmed (1980) said that, sawdust and sugarcane bagasse were the best substrates for growing of Oyster Mushroom than other agro-based substrates.

Han *et al.* (1977) stated that *Pleurotus ostreatus* strains obtained by interbreeding were cultivated under warm conditions (22-28 °C) with the aim to identify germplasm adequate to commercial production based on the radial growth rate of monokaryotic mycelia isolated from two *P. ostreatus* strains. A culture isolate was selected from each type of compatibility and interbreed to obtain *P. ostreatus* strains. Pasteurized barley straw was used as the substrate for mushroom production. The mean biological efficiency of the strains was 84.17% and the production rate was 1.76%. *In vitro* lactase activity was tested for both parental strains and the foremost productive strains of progeny. The main enzyme activity of the strains was 1.21 mg mol/disc/ABTS oxidized. These results show the high potential of these strains for their use in substrate delignification and the production of basidiocarps under natural environmental conditions of regions.

CHAPTER THREE

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials used and methodology followed in conducting the experiment.

3.1. Experimental site

The experiment was conducted at Horticulture center, Daulatpur, Khulna.

3.2. Duration

The experiment was conducted during April-July 2013.

3.3. Materials

3.3.1. Collection of materials

Mother culture was collected from Mushroom Development and Extension centre. Different substrate ingredients were collected from different location of Khulna city corporation area i.e. Saw dust and different wood shavings (Neem, Mahogoni, Jam, Shirish), were collected from Khulna Saw Mil and calcium carbonate, wheat bran, plastic neck, 7"×10" sized polyethylene bag, brown paper, rubber band, cotton were collected from Boro Bazar, Khulna.

- To prepare each packet saw dust was replaced by different wood shavings in different composition.

For preparing one spawn packet (500 g) on different wood shaving following ingredients were needed:

Table 1. List of the required substrates to conduct the experiment

Ingredient	**Composition for one spawn packet**
Saw dust	0.1 kg
wheat bran	0.075 kg
Calcium carbonate	1 g
Wood shaving	0%,25%,50%,75%,100% treatment
(Shirish, Neem, Mahogoni, Jam)	per substrate
Water	250ml per packet

Treatment

In the experiment, wood shavings (Shirish, Neem, Mahogoni, and Jam) were selected as substrate supplement. The experiment was laid out in Completely Randomized Design (CRD). Each of the substrates was experimented with five treatments (T_0-T_4) and four replications (R_1-R_4). The experiment was laid out into two factors -

Factor A = Supplement

S_1 = Shirish wood shaving

S_2 = Neem wood shaving

S_3 = Mahogoni wood shaving

S_4 = Jam wood shaving

Factor B = Treatment

T_0 = 0% Supplement

T_1 = 25% Supplement

T_2 = 50% Supplement

T_3 = 75% Supplement

T_4 = 100% Supplement

Treatment Combination:

- ✓ T_0S_1 = sawdust 100%+0% shirish wood shaving
- ✓ T_1S_1 = sawdust 75%+ 25% shirish wood shaving
- ✓ T_2S_1 = sawdust 50%+ 50% shirishwood shaving
- ✓ T_3S_1 = sawdust 25%+75% shirish wood shaving
- ✓ T_4S_1 = sawdust 0%+100% shirish wood shaving
- ✓ T_0S_2 = sawdust 100%+0% neem wood shaving
- ✓ T_1S_2 = sawdust 75%+25% neem wood shaving
- ✓ T_2S_2 = sawdust 50%+50% neem wood shaving
- ✓ T_3S_2 = sawdust 25%+75% neem wood shaving
- ✓ T_4S_2 = sawdust 0%+100% neem wood shaving
- ✓ T_0S_3 = sawdust 100%+0% mahogoni wood shaving
- ✓ T_1S_3 = sawdust 75%+25% mahogoni wood shaving
- ✓ T_2S_3 = sawdust 50%+50% mahogoni wood shaving
- ✓ T_3S_3 = sawdust 25%+75% mahogoni wood shaving
- ✓ T_4S_3 = sawdust 0%+100% mahogoni wood shaving
- ✓ T_0S_4 = sawdust 100%+0% jam wood shaving
- ✓ T_1S_4 = sawdust 75%+25% jam wood shaving
- ✓ T_2S_4 = sawdust 50%+50% jam wood shaving
- ✓ T_3S_4 = sawdust 25%+75% jam wood shaving
- ✓ T_4S_4 = sawdust 0%+100% jam wood shaving

3.4. METHODS

3.4.1. Preparation of 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 was placed on the sterilized PDA media for 7 days in an incubator under 25°C for sufficient growth. This pure culture was used for the entire experiment.

3.4.2. Preparation of mother culture

The mother culture substrates were prepared by using good quality of wheat grains and $CaCO_3$. At first, 5 kg wheat grains were boiled in a saucepan for about 1 hour. The pot was taken off from heat when wheat grains became brown and looked like a succulent grape. It was then filtered. Wheat grains were spread out on a polythene sheet placed on the floor. After draining out of excessive water, 1% $CaCO_3$ (50 g) were mixed with wheat grains manually and packed tightly in 8×12 inch polypropylene (p.p.) bag. Each of the bags containing 250 g 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 at 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 days the packet of the mother culture became white due to complete the mycelium running and then it was ready for inoculating spawn packets.

3.4.3. Preparation of substrates and spawn packets

Different substrates such as sawdust, wheat bran, $Caco_3$ and different wood shavings (Shirish, Neem, Mahogoni, Jam) were tested in the experiment. The wood shavings were cut into small pieces (0.5- 1 cm) and mixed preparing with nutrient materials, wheat bran at the ratio of 2:1. Water and $CaCO_3$ was added at the rate of 0.2% of the total mixture. For this purpose, 20 spawn packets were prepared with each of the substrate. Each packet was weighted 500 g. By the indicated amount of substrate such as saw dust, wheat bran, wood shavings, calcium carbonate and water were mixed properly by hand or mixer machine. Then 7"x10" size polypropylene (p.p) bag was used for preparing 500 g spawn packet. It was press at properly to make air tight the packet.

3.4.4. Sterilization

The packets were sterilized in an autoclave for 2 hours at 121°C with 1.5 kg/1cm^2 pressure and were kept 24 hours for cooling.

3.4.5. Culture of spawn packet

Two tea spoonfuls of prepared MC (mother culture) media containing mycelia was placed through the whole of each packet prepared earlier. The inoculated packets were again plugged and covered properly. The inoculated packets were kept on iron rack in an incubation room at 25±1°C temperature and relative humidity of 80 to 85% until the mycelium running completed.

After compilation of mycelium running spawn packet were open. To cut the opposite side of plastic bag in "D" shape with a blade after that the opened surface substrate was scraped slightly with a tea spoon for removing the thin whitish

mycelium layer. Then the spawn packets were soaked in water for 15 minutes and observe to remove excess water for another 15 minutes. The packets were placed separately side by side on the floor of the culture house.

3.4.6. Maintenance of moisture content

The moisture content was maintained about 65-70% by spraying water with the help of hand sprayer.

3.4.7. Inoculation

Two teaspoonfuls of mother culture media containing mycelia were placed aseptically through the hole of each packet separately. Each treatment was replicated one time. The packets were then marked treatment wise with a marker pen and was kept on the shelf in an incubation room at 25±1°C under 80 to 85% relative humidity. Twenty days were allowed to grow white mycelium.

The flow chart of spawn packet culture was presented below:

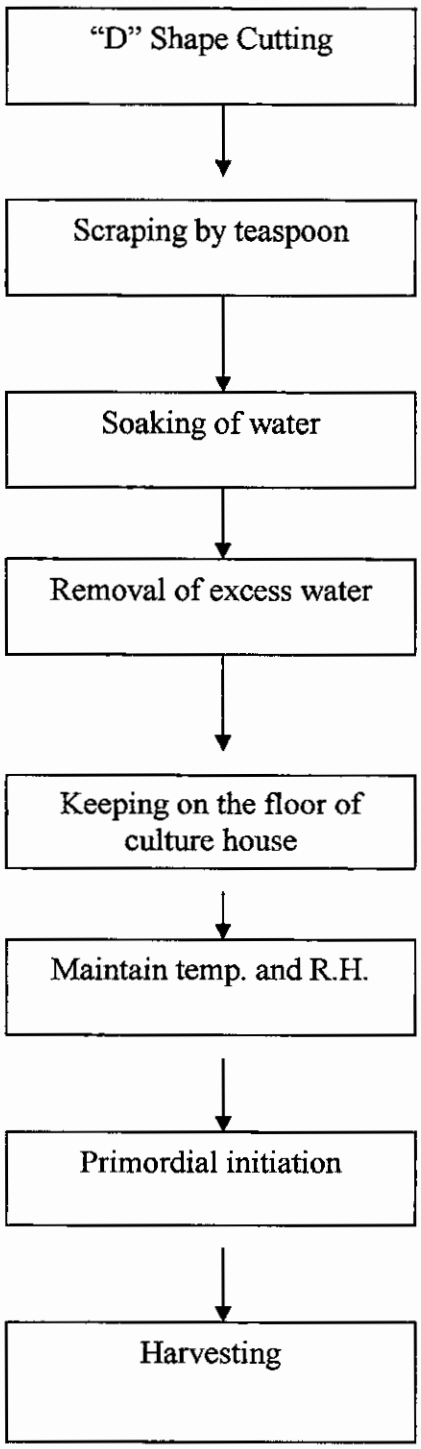


Fig. 1. Flow chart of culture of spawn packet

3.4.8. Cultivation of *Pleurotus ostreatus*

The brown paper, rubber bands, cotton plug and plastic neck of the spawn packets were removed and the mouths of polypropylene bags were wrapped and tied with rubber bands. Two ends, opposite to each other of the upper position of the plastic bag were opened by removing the plastic sheet with a scalpel making 'D' shape opening. The opened surface of the substrate was scraped slightly with a teaspoon for removing the thin whitish mycelial layer. The spawn packets were soaked in water for 15 minutes and inverted for another 15 minutes to remove excess water. The packets were placed separately side by side on the rack of Mushroom Culture House. The relative humidity and temperature of culture house were maintained at 80% and 30°C respectively by watering twice daily. Diffused daylight and proper ventilation in culture house were maintained for fruiting body development of *Pleurotus ostreatus.* The mushroom fruiting body was harvested by gentle twisting before the mushroom showed any splitting on the edges. After first harvest the scrapping and soaking were done again as done during first opening of the packet for subsequent harvests. Watering and other operations were done as mentioned before.

3.4.9. Harvesting:

Matured mushroom identified by curl margin of the cap was harvested by twisting by hand to uproot from the base. Data were recorded periodically during culture.

3.4.10. Collection of Data

The packets with growing mushrooms were observed frequently to record the characters of PO2 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: number of effective fruiting bodies (number), pileus thickness (cm), pileus diameter (cm), stalk length (cm), stalk diameter (cm), biological yield (g/packet), economic yield (g/packet) and harvest index (%).

3.4.11. Statistical analysis

The experiment was laid out in Completely Randomized Design (CRD) with four replications (R_1, R_2, R_3, and R4). Data analysis has been done by MSTAT-C computer programme and means were separated by Duncan's multiple range test (DMRT).

CHAPTER FOUR

RESULTS AND DISCUSSION

CHAPTER IV
RESULTS AND DISCUSSION

The results of the experiment have been presented and discussed in this chapter.

Time required for completing mycelium growth in spawn packet

Average 20 to 24 days were required to complete mycelium growth in spawn packet of *Pleurotus ostreatus* in different substrates, respectively.

Time required for primordia initiation

Average 3 to 5 days were required for *Pleurotus ostreatus* variety from spawning to primordia initiation in different substrates.

Time required for primordia initiation to primordia formation and harvesting

Average 3 to 5 days were required for *Pleurotus ostreatus* variety from primordia formation to harvesting in different substrates

4.1. Number of effective fruiting body/packet

Substrate

The numbers of effective fruiting body/packet of mushroom variety po_2 in different substrates were varied significantly at 1% level of significance (Table 2). The highest number of effective fruiting was obtained from jam (22.27) and shirish (22.07) wood and the lowest number of effective fruiting body was obtained from neem (17.20) wood shaving which was statistically significant. A large no. of effective fruiting body may reduce the size of fruiting body.

Table 2. Effect of substrate on the performance of oyster mushroom

Treatment	No. of effective fruiting body	Pileus thickness(cm)	Pileus diameter(cm)	Stalk length (cm)	Stalk Diameter (cm)	Biological yield (g)	Economic yield (g)	Harvest index
Shirish Wood shaving	22.07 a	0.87	6.63	4.76	3.92	99.87 bc	95.93 bc	95.91 ab
Neem Wood shaving	17.20 b	0.77	6.79	4.57	3.47	65.87 c	62.60 c	34.93 b
Mahogoni Wood shaving	18.47 b	0.80	6.63	4.77	3.74	109.3 ab	105.1 ab	96.00 ab
Jam Wood shaving	22.27 a	0.80	7.10	4.95	3.75	142.3 a	138.1 a	97.03a
Level of significant	**	NS	NS	NS	NS	**	**	**

**= Significant at 1% level, NS = Non Significant

Kitamol *et al.* (1995) reported that, glucose, fructose and trehalose containing substrate were producing the highest no. of fruiting body while glycerol, xylose, sucrose and fructose containing substrate produced abnormal fruiting bodies. The best fruiting body production was noticed in the presence of glucose and fructose present in the substrate. But 20-40% fruiting body became abnormal when only the fructose present in the substrate.

Treatment

The numbers of effective fruiting body/packet of mushroom variety *Pleurotus ostreatus* in different substrates were varied significantly at 1% level of significance. The highest number of effective fruiting body was obtained from T_0 treatment (27.83) and the lowest number of effective fruiting body was obtained from T_3 treatment which was statistically significant. (Table 2).

Treatment combination

The numbers of effective fruiting body/packet in different substrates were varied significantly at 5% level of significance. The highest number of effective fruiting body was obtained from shirish (34) wood shaving at T_0 treatment and the interaction was (T_0S_1) statistically significant with the lowest number of effective fruiting body was obtained from mahogoni (11) wood shaving at T_3 treatment and the interaction was T_3S_3 and also neem (11) wood shaving at T_4 treatment and the interaction was T_4S_2 (Table 4). Yoshida *et al.* (1993) reported that the number of effective fruiting body were lowest, but increase when the substrate was mixed with different supplements.

Table 3. Effect of treatment on the performance of oyster mushroom

Treatment	No. of effective fruiting body	Pileus thickness (cm)	Pileus diameter (cm)	Stalk length (cm)	Stalk Diameter (cm)	Biological yield (g)	Economic yield (g)	Harvest index (%)
T_0	27.83a	0.81	6.83	4.59b	4.11	137.8a	133.3 a	96.62 a
T_1	20.75ab	0.82	6.56	4.98ab	3.74	115.2ab	110.83ab	96.07 a
T_2	20.25ab	0.86	6.56	4.67 b	3.64	111.4ab	106.91ab	95.63 a
T_3	15.17 b	0.759	7.11	5.11 b	3.60	70.33 c	67.25 c	95.37 a
T_4	16.00b	0.81	6.87	4.43 b	3.53	87.00bc	83.91 bc	96.15 a
Level of significant	**	NS	NS	*	NS	**	**	**

**= Significant at 1% level, *= Significant at 5% and NS = Non Significant

Size of effective fruiting body

The size was consisted of diameter and thickness of pileus and length and diameter of the stalk.

4.2. Thickness of pileus

Substrate

The effects of different substrates on the thickness of pileus did not differ significantly. Shirish wood shaving produced the highest thickness (0.88 cm) and neem wood shavings produced the lowest thickness of (0.774 cm) pileus which was statistically significant (Table 2). Thickness of pileus is one of the yields contributing character of mushroom.

Treatment

The effects of treatment on the thickness of pileus did not differ significantly. The highest thickness was obtained from T_2 treatment (0.861 cm). The lowest thickness was obtained from T_3 treatment (0.758 cm) (Table 3).

Treatment combination

The effects of different substrates and treatment on the thickness of pileus were varied at 1% level of significance. Shirish wood shaving produced the highest thickness (1.001 cm) at T_4 treatment and the interaction was T_4S_1 and mahogoni wood shaving produced the lowest thickness (0.5967 cm) at T_3 treatment and the interaction was T_3S_3 (Table 4).

Table 4. Interaction of substrates and treatment on the performance of Oyster mushroom

Interaction	No. of effective fruiting body	Pileus thickness (cm)	Piieus diameter (cm)	Stalk length (cm)	Stalk diameter (cm)	Biological yield (g)	Economic yield (g)	Harvest index (%)
T_0S_1	34 a	0.875 abc	6.29 cde	4.64	4.94	137.0 bcde	132.7 bcd	96.80
T_0S_2	23 cde	0.793 abc	7.56 ab	4.45	3.67	111.0 efg	106.0 defg	95.48
T_0S_3	24.67 bcd	0.85 abc	6.54 abcde	4.33	3.87	142.0 bcd	137.0 bc	96.93
T_0S_4	29.67 ab	0.71 abc	6.93 abcd	4.94	3.96	161.0 ab	157.3 ab	97.26
T_1S_1	25 bc	0.80 abc	6.40cdef	4.81	3.75	114.0 defg	109.3 cdefg	95.80
T_1S_2	18.67 cdef	0.66 bc	6.00 de	4.75	3.39	72.00 h	68.33 hi	94.92
T_1S_3	18.67 cdef	1.00 a	7.08abcd	5.50	3.95	123.0 cdef	118.3 cde	96.20
T_1S_4	20.67 cdef	0.81 abc	6.72 abcde	4.84	3.83	151.0 abc	147.3 ab	97.34
T_2S_1	18 def	0.78abc	5.72 e	4.91	3.46	86.67 gh	82.33 gh	94.99
T_2S_2	18 def	0.80 abc	6.53 abcde	4.24	3.17	64.00 hi	60.67 hij	94.76
T_2S_3	20.67 cdef	0.93 ab	6.56 abcde	5.14	4.15	117.0 defg	112.0 cdefg	95.74
T_2S_4	24.33 bcd	0.92 abc	7.41abc	4.39	3.76	178.0 a	172.7 a	97.01
T_3S_1	18.33cdef	0.89 abc	7.09 abcd	4.91	3.72	74.33 h	71.00 h	95.47
T_3S_2	15.33 fg	0.82 abc	7.18abcd	4.83	3.53	43.00 i	40.67 ij	94.59
T_3S_3	11 g	0.59 c	6.54 abcde	4.99	3.49	60.00 hi	57.00 hij	95.00
T_3S_4	16 fg	0.71 abc	7.61 a	5.70	3.63	104.0 fg	100.3 efg	96.43
T_4S_1	15 fg	1.00 a	7.61 a	4.50	3.75	87.33 gf	84.33 fgh	96.48
T_4S_2	11 g	0.78 abc	6.65 abcde	4.58	3.58	39.33 i	37.33 j	94.90
T_4S_3	17.33 efg	0.64bc	6.40 bcde	3.87	3.20	105.3 fg	101.3 efg	96.11
T_4S_4	20.67 cdef	0.82 abc	6.82 abcde	4.77	3.56	116.0 defg	112.7 cdef	97.09
Level of significance	*	**	*	NS	NS	*	*	NS

** =Significant at 1% level, * =Significant at 5% level and NS = Non significant

Habib (2005) found that the thickness of pileus ranged from 0.45 cm to 0.70 cm due to different substrates.

4.3. Diameter of pileus

Substrate

The highest diameter (7.103 cm) of the pileus was observed in jam wood shaving and the lowest diameter (6.626 cm) was observed in shirish and (6.628 cm) in mahogoni wood shaving (Table 2). The diameter of pileus also increased the quality and yield of mushroom. Kurtzman and Zadrazil (1982) reported that higher concentration of co_2 (more than 600 ppm) present in the mushroom growing bag influenced the elongation of the stalk resulting the reduction of pileus size.

Treatment

The effects of treatment on the diameter of pileus did not differ significantly. The highest diameter of pileus was obtained from T_3 treatment (7.11 cm). The lowest diameter of pileus was obtained from T_1 treatment (6.56 cm) and T_2 treatment (6.56 cm) (Table 3).

Treatment combination

The effects of different substrates and treatment on the length of the stalk were varied at 5% level of significance. The highest diameter (7.612 cm) of the pileus was observed in shirish wood shaving at T_4 treatment and the interaction was T_4S_1 and also observed in jam wood shaving (7.611 cm) at T_3 treatment and the interaction was T_3S_4 and the lowest diameter (5.727 cm) of the pileus was observed in shirish wood shaving at T_2 treatment and the interaction was T_2S_1 (Table 4).

Habib (2005) mentioned that pileus diameter ranged from 0.74 cm to 1.05 cm due to different substrate.

4.4. Length of the stalk

Substrate

The length of the stalk in different substrates did not differ significantly. The longest stalk (4.958 cm) was observed in jam wood shaving and the shortest (4.573 cm) was observed in neem wood shaving (Table 2). The quality of Oyster mushroom (*Pleurotus ostreatus)* depends on the length of stalk, higher the length of stalk poor the quality of the mushroom (Zadrazil, 1992).

Treatment

The effects of treatment on the length of the stalk were varied significantly at 5% level of significance. The highest length of the stalk was obtained from T_3 treatment (5.11 cm). The lowest length of the stalk was obtained from T_4 treatment (4.43 cm) (Table 3).

Treatment combination

The length of the stalk in different substrates and treatment did not differ significantly. The longest stalk (5.704 cm) was observed in jam wood shaving at T_3 treatment and the interaction was T_3S_4. The shortest stalk (3.878 cm) was observed in mahogoni wood shaving at T_4 treatment and the interaction was T_4S_3 (Table 4). Sarker (2004) found that the length of the stalk varied from 1.93 cm to 2.97 cm due to different substrate.

4.5. Diameter of the stalk

Substrate

The diameter of stalk in different substrates was not varied significantly. Shirish wood shaving gave the highest diameter (3.927 cm) of the stalk and neem wood shaving gave the lowest diameter (3.474 cm) of the stalk (Table 2).

Treatment

The effects of treatment on the diameter of the stalk were not varied significantly. The highest diameter of the stalk was obtained from T_0 treatment (4.11 cm). The lowest diameter of the stalk was obtained from T_4 treatment (3.53 cm) (Table 3).

Treatment combination

The diameter of stalk in different substrates and treatment was not varied significantly. Shirish wood shaving gave the highest diameter (4.940 cm) of the stalk at T_0 treatment and the interaction was T_0S_1 and neem wood shaving gave the lowest diameter (3.179 cm) at T_2 treatment and the interaction was T_2S_2. (Table 4). Sarker (2004) found that the diameter of stalk ranged from 4.405 cm to 5.435 cm due to different substrate.

4.6. Biological yield

Substrate

The biological yield in different substrates was differed significantly at 1% level of significance. The highest biological yield was obtained from jam wood shaving (142.3 g) and the lowest biological yield was obtained from neem wood shaving (65.87 g) (Table 2).

Treatment

The effects of treatment on the biological yield were differed significantly at 1% level of significance. The highest biological yield was obtained from T_0 treatment (137.8 g). The lowest biological yield was obtained from T_3 treatment (70.33 g) (Table 3).

Treatment combination

The biological yield in different substrates and treatment was differed significantly at 5% level of significance. The highest biological yield was obtained from jam wood shaving (178.0 g) at T_2 treatment and the interaction was T_2S_4 and the lowest from neem wood shaving (39.33 g) at T_4 treatment and the interaction was T_4S_2 (Table 4). Amin et al. (2007) found the highest biological yield 247.3 g/packet on saw dust.

4.7. Economic yield

Substrate

The economic yield in different substrates was differed significantly at 1% level of significance. The highest economic yield was obtained from jam wood shaving (138.1

g) and the lowest economic yield was obtained from neem wood shaving (62.60 g) (Table 2).

Treatment

The effects of treatment on the economic yield were differed significantly at 1% level of significance. The highest economic yield was obtained from T_0 treatment (133.3 g). The lowest economic yield was obtained from T_3 treatment (67.25 g) (Table 3).

Treatment combination

The economic yield in different substrates and treatment was differed significantly at 5% level of significance. The highest economic yield was obtained from jam wood shaving (172.7 g) at T_2 treatment and the interaction was T_2S_4 and the lowest economic yield was obtained from neem wood shaving (37.33 g) at T_4 treatment and the interaction was T_4S_2 (Table 4). Amin *et al.* (2007) found that the economic yield corresponded with different supplements at different level. Payapanon *et al.* (1994) mentioned that suitable amount of supplements added to sawdust medium maximized economic yield of oyster mushroom at optimum production cost.

4.8. Harvest Index

Substrate

The harvest index in different substrates was differed significantly at 1% level of significance. Jam wood shaving gave numerically the highest index (97.03) and neem wood shaving gave the lowest lowest index (94.93) (Table 2).

Treatment

The effects of treatment on the harvest index were differed significantly at 1% level of significance. The highest harvest index was obtained from T_0 treatment (96.62). The lowest harvest index was obtained from T_3 treatment (95.37) (Table 3).

Treatment combination

The harvest index in different substrates and treatment was not varied significantly. Jam wood shaving gave numerically the highest harvest index (97.340) at T_1 treatment and the interaction was T_1S_4 and neem wood shaving gave the lowest harvest index (94.597) at T_3 treatment and the interaction was T_3S_2 (Table 4). Ahmed (1998) observed the highest harvest index on saw dust substrate.

Functional relationship among various attributes

Relationship between number of effective fruiting body and economic yield:

A positive linear relationship was observed between number of effective fruiting body and economic yield per packet. It was observed the equation y=8.918x-77.96 gave a medium fit to the data and the value of co-efficient of determination (R^2=0.539) showed that the fitted regression line had a significant regression co-efficient. So it indicated that economic yield per packet increased as the number of effective fruiting body increased.

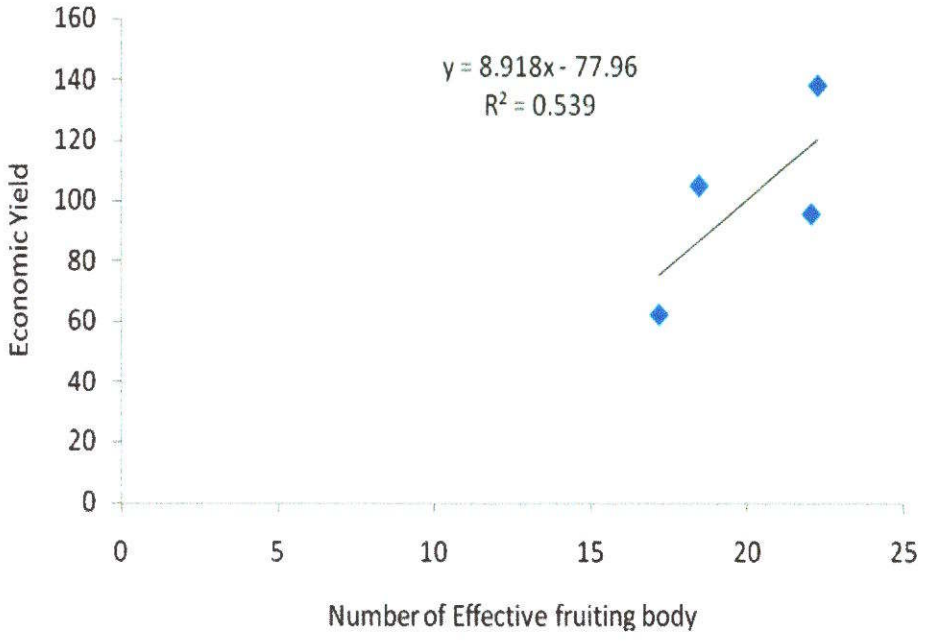
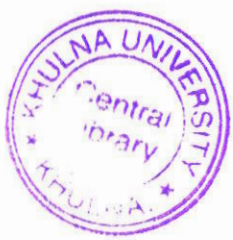


Fig. 3. Functional relationships between economic yield and number of effective fruiting body

Relationship between biological yield and harvest index:

A positive linear relationship was observed between biological yield per packet and harvest index. It was observed the equation y=36.06x-0.993 gave a good fit to the data and the value of co-efficient of determination (R^2=0.993) showed that the fitted regression line had a significant regression co-efficient. So it indicated that harvest index increased as the biological yield per packet increased. Highly significant positive correlation was observed between biological yield and harvest index.



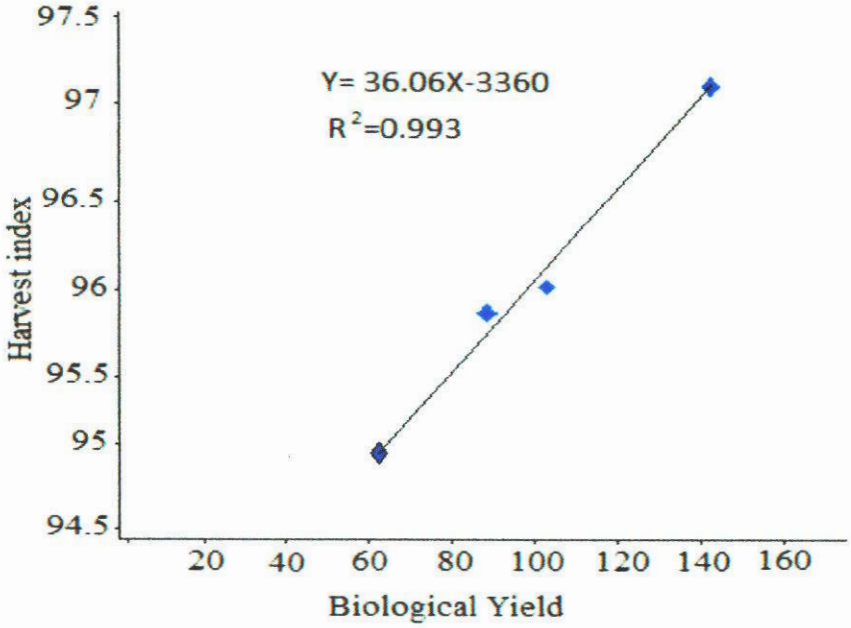


Fig. 4. Functional relationships between biological yield and harvest index

Relationship between economic yield and harvest index:

A positive linear relationship was observed between economic yield per packet and harvest index. It was observed the equation y=28.53x-5.265 gave a medium fit to the data and the value of co-efficient of determination (R^2=0.742) showed that the fitted regression line had a significant regression co-efficient. So it indicated that harvest index increased as the economic yield per packet increased.

CHAPTER FIVE

SUMMARY AND CONCLUSION

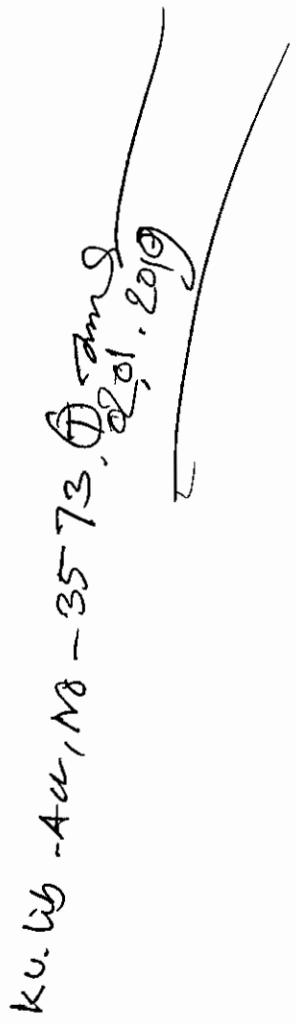
CHAPTER V
SUMMARY AND CONCLUSION

SUMMARY

The experiment was carried out to investigate performances of Oyster mushroom varies on different wood shavings as a supplement substrate during April - July 2013. The substrates used in this research work for mushroom production were as follows: saw dust, wheat bran, calcium carbonate, water and different wood shaving (Shirish, Neem, Mahogoni, Jam). The experiment was conducted at Horticulture centre, Daulatpur, Khulna.

The experiment was laid out in Completely Randomized Design (CRD). Each of the substrates was experimented with five treatments (T_0-T_4) and four replications (R_1-R_4). The experiment was laid out into two factors: factor A. supplement and factor B. treatment. 80 packets were prepared by substrates. Every spawn packet was prepared with 500 g substrate. Five treatments were prepared by using every substrate and saw dust replaced by wood shaving. *Pleurotus ostreatus* showed better performance in jam wood shaving and showed lower performance in neem wood shaving. The number of fruiting body, the biological yield, the economic yield and harvest index were on different substrates differed significantly. The highest number of fruiting body, the biological yield, the economic yield and harvest index per packet were recorded on Jam wood shaving substrate, which was significantly higher as compared to all other wood shaving substrates. The lowest number of fruiting body, the biological yield, the economic yield and harvest index were observed in neem wood shaving substrate supplement. The number of fruiting body was positively correlated with biological

yield and economic yield of oyster mushroom. Harvest index was positively correlated with biological yield and economic yield of oyster mushroom



CONCLUSION

From the study it can be concluded that, different wood shavings are only waste use, we can explore them as substrate supplement of Oyster mushroom production, which found comparatively effective use. So we can easily use the wood shavings as raw materials for mushroom cultivation. 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 different wood shavings on commercial scale to fulfill the requirements of balanced diet. *Pleurotus ostreatus* can be considered as income generating food for all of us.

CHAPTER SIX

REFERENCES

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REFERENCES

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