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Characteristics of Indoor Mushroom Cultivation of Grey Oyster (*Pleurotus pulmonarius)* by Different Stages of Humidifying Treatment

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Abstract: In view of the growing and nutritional importance of mushroom, this study has been initiated with the objective to examine the suitability of *Pleurotus pulmonarius* in indoor cultivation and to compare the morphology, quality and yield with natural indoor environment and indoor environment with high range of humidity. The mushroom (*Pleurotus pulmonarius*) was cultivated in three different environmental conditions including natural indoor environment (NIE), humidifying 80-90% till primordial initiation (HTPI) environmental condition and finally in continuous 80-90% humidity (CH), shown to have different morphology of fruitbodies, yield percentage and quality of mushrooms. The highest individual weight, number of fruitbodies, cap diameter, stalk height, quality, percentage of primordial initiation, mature fruitbody formation and the lowest dead primordia were found in continuous 80-90% indoor humidity condition. The lowest morphology, yield percentage and quality were found in natural indoor environment and humidifying 80-90% till primordial initiation condition. In CH condition the numbers of fruitbody was higher than another two conditions but not significantly. In HTPI condition, the lowest morphology, quality and yield were recorded although the primordial initiation was higher than NIE. This study provides evidence on adaptability and sustainability of *Pleurotus pulmonarius* in indoor environment and found the significant differences among the indoor and different stages of humidifying treatment where the morphology, quality and yield percentages are increased with the increased range of indoor humidity.

Key words: Environment · Temperature · Humidifying · Mushroom · Morphology · Yield percentage

INTRODUCTION

Mushroom cultivation in Malaysia is getting important because it has outstanding medicinal properties which are 100% vegetarian food and is good for the patients of diabetes and joint pains. *Pleurotus species* contain high range of protein, carbohydrate and energy [1], it also contain high potassium to sodium ratio with multivitamin including niacin, riboflavin, vitamin D, C, B1, B5 and B6 [2]. The demand for mushrooms especially the grey oyster mushroom (*Pleurotus pulmonarius*) is greater than their production because it offers high income to local growers due to its ability to grow and fruit in tropical region of Malaysia. Together with increasing in demand, mushroom growers are facing more challenges and difficulties to grow mushrooms due to the inconsistent environmental condition.

Oyster mushrooms are known to be sensitive to the climatic conditions, favourable temperature and moisture condition enhanced the production of mushrooms fruitbodies and yield [3, 4]. Mushrooms are farmed under ambient conditions designed to suit its growth, but can be

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found in all highly humid regions between spring and autumn [5]. Mycelial growth of all Oyster mushroom can take place between 20°C and 30°C. However, for fruiting, different species have different temperature requirements. *Pleurotus* spp. grows in wide range of temperature 15 -30°C [6, 7]. *Lentinus sajor-caju* was successfully cultivated in two temperature treatments 25±1°C and 28±2°C and 80-85% relative humidity [8]. The maximum yield of oyster mushroom (*Pleurotus sajor-caju*) was found during rainy seasons, when the temperature was nearly 20-26°C [9].

The humidity during the formation of primordia was at 80–90%, while 75–80% was the relative humidity for development of fruiting bodies [10]. For the *Grifola frondosa,* the humidity range for mycelial running 60-70%, for primordia initiation 80-90%, for fruiting development 85 to 95% [11]. The maximum yield of oyster mushroom (*Pleurotus sajor-caju*) was found during rainy seasons, when the relative humidity was nearly 70-90% [9]. *Pleurotus sajor-caju* was also successfully cultivated on different types of substrate under 20-30°C temperature and 80-95% humidity [12, 13].

According to the Official Portal Malaysian Meteorological Department (MMD), weather of Malaysia is generally hot and sunny all over the year especially during February to October. The environment of Malaysia is relatively hot like normal temperature 28-32°C and humidity 60% to 70%. Sometimes the temperature can rise up to 41°C which can caused low relative humidity by 58% during the hot season [14]. So, it is clear that temperature and humidity of Malaysia weather are far from optimal condition for oyster mushroom cultivation. With the traditional or conventional method used by most of cultivators, it is difficult to achieve the maximum yield as required. But there is no study about the conventional cultivation method compared with high ranges of humidity conditions for *Pleurotus* pulmonarius cultivation in tropical and subtropical region. Therefore this study had conducted to investigate growing performance of grey oyster mushroom in natural and controlled indoor environment where the growing performance was measured as the basis of mushrooms morphology, quality and yield percentages.

MATERIALS AND METHODS

Preparation of Mushroom Growing Bags: Substrate's for preparing mushroom bags were prepared by established mushroom cultivators. The substrates were formulated by the mixture of saw dust, rice bran and agricultural lime with the ratio of 100:10:1. The mixtures were packed in autoclavable polypropylene bags (6×9 inch) and sterilized at 121°C temperatures for 6 h to kill spore of bacteria, fungi and another microorganism. After sterilization, it was cooled to room temperature and injected with spawn prepared through tissue culture technique and left it vertically for 30-35 days in dark for mycelium colonization. Bags with complete colonization were transferred into a growing room inside a building. Cultivation period was counted from the 1st day of bags were transferred and arranged in the cultivation room.

Design of Indoor Cultivation Room: The indoor cultivation room was located inside a building at Taman Pauh Indah, Arau, Perlis, Malaysia with 5.8×4.57×2.74 m^3 in size. The wall was made by bricks at one side and gypsum particles for the other three sides. There were four rows of racks; each racks contained four iron bars side by side at 15 cm between each other and 55 cm distance between the racks (Figure 1).

The cultivation design is shown in Figure 1. The bags were hanged through the racks horizontally by using rope and made it tight by cable tie. The bags were arranged in 12 bags in one column of rope. The total 19 columns of rope were used to arrange 228 bags all together. The columns of rope were arranged side by side at 25 cm between each other. The distance of the highest bag from the ceiling was 76 cm and the lowest bag from the floor was 30 cm.

Treatment of Natural Indoor Environment (NIE): Once colonization was completed, the mushroom bags were transferred into the growing room and arranged as mentioned earlier. Thermohygrometer (HTC-1, Malaysia) was placed inside the room for monitoring temperature and humidity regularly. Temperature and humidity of the room were recorded at every 3 hours interval within 24 hours and continued to record until production of fruitbody. Data for fruitbody was recorded for its morphology, quality and yield percentages.

Treatment of Humidifying Environment: Cultivation in humidifying environmental condition was followed by two treatments including humidifying till primordial initiation (HTPI) and continuous humidifying (CH) treatment. For both treatments the indoor humidity was artificially maintained 80-90% by using Humidifier (TAY-RING TL-3600, TAIWAN).

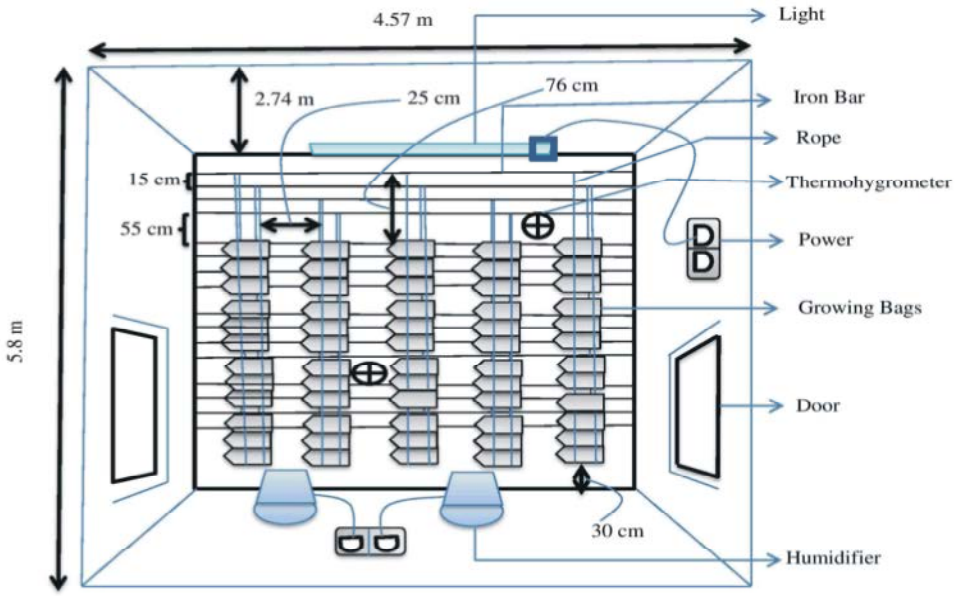

Fig. 1: Design and Arrangement of Mushroom Growing Bags inside the Cultivation Room

Optimize Humidifying Duration: The duration of humidifying was optimized in order to maintain the humidity values ranging between 80-90% by only humidifier. For this, a single humidifier was placed in the middle position between two racks and run to achieve maximum humidity surrounding the rack from initial range to higher than 90%. After that, the humidifying process was stopped and then, the humidity was monitored until the reading dropped to lower than 80%. The changes of humidity with time were measured at 5 minutes interval by Hygro-thermometer. The same procedure was used in all 4 replicates. The data from all replicates were analysed and a graph was plotted using duration of humidifying (Minutes) on the X-axis while the percentages of humidity (%) value on the Y-axis to obtain the equation for by which optimized the duration of humidifying for maintaining 80-90% of humidity.

Treatment of Humidifying till Primordial Initiation (HTPI): In this treatment, the indoor humidity was artificially maintained from 80% to 90% just for primordial initiation and allowed to mature in natural indoor environment. This treatment was followed by in two different periods, one was During Primordial Initiation (DPI) period and another one was During Fruiting (DF) period. In DPI period the humidity 80-90% was maintained by using humidifier. The humidifier was operated at duration suggested from the optimized results (Figure 2) obtained from optimization process mentioned earlier. Humidifying was carried out for 20 minutes and resumed for 60 minutes alternately during day time to maintain 80-90% humidity. During night time the humidity was defected and therefore no humidifier was needed. Temperature and humidity were recorded at every 3 hours within 24 hours. Humidifying was stopped when the primordia was appeared and the cultivation was continued in natural environmental condition which was considered DF period. Data for fruitbody was recorded for its morphology, quality and yield percentages.

Treatment of Continuous Humidifying (CH): In this treatment, the humidity was ensured to maintain at 80-90% by using humidifier machine throughout the cultivation period. The humidifier was operated at duration suggested from optimized results (Figure 2) obtained from optimization process mentioned earlier. Humidifying was carried out for 20 minutes and resumed for 60 minutes alternately during daytime. Temperature and humidity were recorded at every 3 hours within 24 hours. The humidifying regime was continued until mushroom was harvested and data was collected according to its morphology, quality and yield percentages.

Data Collection

Environment Factors: As temperature and humidity are the basic requirements for proper growth of mushroom, these factors were regularly monitored during the whole investigation period. The maximum and minimum temperature and humidity were regularly recorded on daily basis during the cultivation.

Morphology & Quality: The morphology of mushrooms involved the individual weight, numbers of fruiting bodies, cap diameter and stalk height. The weight of mushrooms was measured by weight machine as gram (g) then counted the number of fruitbodies and measured cap size and stalk height as centimetre (cm) of each fruitbody by metering scale.

The quality of mushroom was determined by using a four-level Likert scale including from 1 to 4 as very low, low, good and excellent respectively on the basis of softness, hardness, dryness and moisture content of fruitbodies.

Yields: The yield percentages including percentages of bags of primordial initiation, mature fruitbodies formation and dead primordia. The percentages of primordial initiation, mature fruitbodies formation and dead primordia were calculated to find out the highest yield of mushrooms. The yield percentages were calculated by following equation:

$$PPI(bag) = \frac{NBPI \times 100}{TNB} \quad (1)$$

PPI-Percentages of Primordial Initiation, NBBP-Number of Bags of Primordial Initiation, TNB- Total Number of Bags.

$$PMF(bag) = \frac{NBMF}{TNBPI} \quad (2)$$

PMF- Percentages of Mature Fruitbody, NBMF-Number of Bags of Mature Fruitbody, TNBBP-Total Number of Bags of Primordial Initiation.

$$PDP(bag) = \frac{NBDP \times 100}{TNBPI} \quad (3)$$

PDP- Percentages of Dead Primordia, NBDP- Number of Bags of Dead Primordia, TNBBP-Total Number of Bags of Primordial Initiation.

Statistical Analysis: Descriptive statistics was applied to find out maximum, minimum, mean and standard deviation (SD) in all collected data. Analysis of variance (ANOVA) techniques was employed to test the overall significance of data while the least significance differences (LSD) post hoc test was used to compare the differences among varieties means, where variations with a probability level of $p < 0.05$ were considered as significant. Correlation techniques was also used to find out significant relationship among the variables [15]. All of the statistical calculations were executed using the SPSS 10.0 for Windows® (SPSS Inc., Chicago, IL, USA) statistical package.

RESULTS AND DISCUSSION

Optimized Humidifying Duration: The data from the optimization process was plotted using duration of humidifying and after humidifying (Minutes) on the X-axis while the percentages of humidity (%) value on the Y-axis and obtained two equations one for humidity increasing and another one for humidity decreasing (Figure 2).

For increasing humidity, a graph equation was obtained as *eq-4* with the correlation coefficient, R^2 of 0.9148 which is acceptable as the value closed to 1.

$$y = 0.4848x + 73.091 \quad (4)$$

where y is the value of humidity (%) and x is the duration of humidifying (minutes)

For decreasing humidity, a graph equation was obtained as *eq-5* with the correlation coefficient, R^2 of 0.9511 which is acceptable as the value closed to 1.

$$y = -0.1633x + 101.41 \quad (5)$$

where negative indicated decreasing, y is the value of humidity (%) and x is the duration after humidifying (minutes).

From equation 4.1, the humidifying duration was calculated for 80% and 90% humidity and optimized 20.5 minutes humidifying duration to ensure 80-90% humidity inside the cultivation house. And for decreasing humidity for 90% and 80% was also calculated by the equation 4.2 and optimized 60.5 minutes for the decreasing period needed to reach 80% from 90% humidity. So, for the treatment of HTPI and CH, the humidifying procedure was optimized as 20 minutes humidifying by 60 minutes interval period throughout the cultivation process.

Indoor Environment: The temperature and relative humidity persisting at the experimental methods inside the cultivation room are presented in Table 1. The temperatures and humidity among the three different cultivation methods (NIE, HTPI and CH) were varied. The lowest mean temperature 28.86°C was obtained in CH cultivation method whereas the highest 30.31°C and 30.23°C were obtained in NIE and during fruiting (DF) period of HTPI cultivation methods respectively.

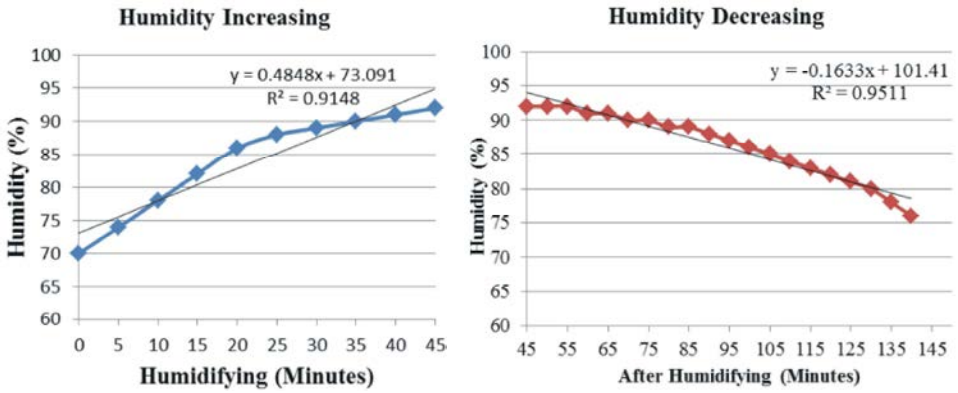

Fig. 2: Optimization of humidifying duration in indoor environment with ventilation system (System 3). Values are mean of 4 replicates

Table 1: Descriptive table of temperature, humidity, weight, numbers of fruitbody, cap diameter and stalk height in different cultivation methods

Parameters	Cultivation Methods		Mean	Std. Deviation	Std. Error	Min	Max
Temperature (°C)	NIE		30.31	.754	.151	29	32
	HTPI	DPI	29.30	0.72	.165	28.5	30.5
		DF	30.23	1.03	.162	29.0	31.8
	CH		28.86	.700	.140	28	30
Humidity (%)	NIE		57.80	6.19	2.170	48	72
	HTPI	DPI	84.00	3.68	2.338	80	90
		DF	57.30	7.49	2.628	45	70
	CH		84.20	3.252	.850	80	90
Individual weight (g)	NIE		32.04	19.241	3.848	3	61
	HTPI		26.84	14.625	2.925	5	55
	CH		61.60	23.752	4.750	14	100
Numbers of fruitbody (n)	NIE		5.68	2.155	.431	3	12
	HTPI		4.92	2.499	.500	1	10
	CH		7.16	3.424	.685	2	13
Cap diameter (cm)	NIE		4.420	1.7659	.3532	1.0	8.5
	HTPI		4.100	1.5275	.3055	1.0	6.5
	CH		6.440	1.8782	.3756	2.5	9.5
Stalk Height (cm)	NIE		3.820	.7757	.1551	2.0	5.0
	HTPI		3.680	.9777	.1955	2.0	5.0
	CH		7.060	2.6744	.5349	2.5	11.5

Table 2: One-way ANOVA Analysis of the Morphology and Quality of *Pleurotus pulmonarius* to identify the significant different among the different cultivation Methods

Parameters	Variance of Difference	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Individual weight (g)	Between Groups	17575.760	2	8787.880	22.960	.000
	Within Groups	27558.320	72	382.754		
	Total	45134.080	74			
Numbers of fruitbody	Between Groups	64.880	2	32.440	4.304	.017
	Within Groups	542.640	72	7.537		
	Total	607.520	74			
Cap diameter (cm)	Between Groups	80.487	2	40.243	13.446	.000
	Within Groups	215.500	72	2.993		
	Total	295.987	74			
Stalk Height (cm)	Between Groups	182.847	2	91.423	31.489	.000
	Within Groups	209.040	72	2.903		
	Total	391.887	74			
Quality	Between Groups	33.787	2	16.893	25.945	.000
	Within Groups	46.880	72	.651		
	Total	80.667	74			

On the other hand, the highest mean humidity 84% was obtained both in CH and during primordial initiation (DPI) period of HTPI cultivation methods whereas the lowest 57 % was found both in NIE and DF period of HTPI cultivation methods. Among the all systems, the mean temperature was varied about 1.0-1.45°C but the mean humidity was varied greatly about 27% (Table 1). From this study, it was found that the humidity was able to increase to the designated level by applying humidifier. However, the temperature was unable to reduce just by applying only humidifier. So it is clear that, it's possible to increase indoor humidity by using humidifier as much as needed but difficult to reduce temperature so much by using only humidifier.

Morphology and Quality

Individual Weight: Among the environmental conditions, continuous humidifying observed the highest individual weight 100g and mean weight 61.6±23.75g whereas the 61g of individual weight was found in natural environment with mean value 32.04±19.24g. The lowest individual weight of 55g was found in HTPI condition with mean value 26.84±14.62g (Table 1). The individual weight of mushrooms fruitbodies showed statistically significant in One-way ANOVA where the significant value was considered p □ 0.05 (Table 2).

Numbers of Fruitbody: The highest mean numbers of fruitbodies 7.16±3.42 was found in CH environmental condition whereas the lowest 4.92±2.49 was found in HTPI condition. The mean numbers of fruitbodies 5.68±2.15 was found in NIE condition which was higher than HTPI but lower than CH environmental condition (Table 1). The numbers of fruitbodies showed significant result at 0.017 level in One-way ANOVA where the significant value was considered p □ 0.05 (Table 2).

Cap Diameter: The cap diameter was found the highest mean 6.44±1.88cm in CH environmental condition whereas the lowest 4.10±1.52cm was found in HTPI cultivation. The cap diameter of 4.42±1.76cm was found in NIE cultivation which was also higher than HTPI but lower than CH cultivation method. The overall cap diameter was showed significant result in One-way ANOVA where the significant value was considered p □ 0.05 (Table 2).

Stalk Height: Different environmental conditions showed significant results in terms of stalk height in One-way ANOVA (Table 2). Continuous humidifying condition showed significant varied at maximum 11.50cm and mean 7.06±2.68cm of stalk height from both natural environment (maximum 5cm and mean 3.82±.78cm) and humidifying till primordial initiation environmental condition (maximum 5cm and mean 3.68±.98cm). Stalk height of NIE and HTPI were not significantly varied (Table 1).

The variations of environment seriously affected the weight, number, cap and stalk size of mushroom [16, 17]. In this present study the highest individual weight, cap diameter, stalk height and numbers of fruitbody was obtained from CH cultivation method because of high humidity and slightly lower temperature compared than another two systems. The environmental conditions of NIE and DF period of HTPI were same but HTPI produced lower level of morphology than NIE cultivation method. It's happened because in HTPI cultivation method, the environment was controlled by two different phases and those primordia were adopted with the DPI environmental conditions were not able to make their proper development in new DF environmental conditions of HTPI method. So this present study recommended that mushroom needs not only the high humidity and low temperature but also needs to maintain nearly same environmental conditions for both in primordial initiation and fruiting period. The stalk height, stalk diameter, cap size, number of fruitbody and fresh weight of mushrooms were found maximum in the region of low temperature and high humidity environmental conditions [18], which indicates the similar effects in this study.

The numbers of fruitbody in three different cultivation methods were not greatly varied. The humidity range of CH and DPI period of HTPI cultivation methods were high and nearly same but it found significant difference numbers of fruitbody between CH and HTPI methods. On the other hand the humidity was low both in NIE and DF period of HTPI cultivation methods and NIE showed insignificant deference with both CH and HTPI cultivation methods. So it is suggested that only high humidity not able to increase the numbers of fruitbody greatly, its need another factors to increase the numbers of fruitbody. Mushrooms requires high relative humidity to produce fruiting bodies and *Pleurotus pulmonarius* can grow well at 80 to 90% [19]. The mushrooms individual weight, numbers of fruitbody, cap size, stalk height and thickness started to decrease at lower than 80% humidity and decreased severely at 60% or less relative humidity [20] which is similar and support the result of this study.

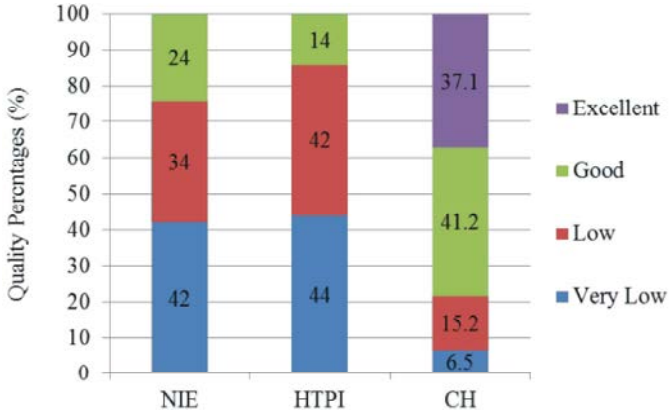

Fig. 3: Quality analysis of mushrooms fruitbodies in different cultivation method

Quality: The excellent 37.1% quality of fruitbodies was found only the CH cultivation method but the good quality was found in all the cultivation method at 41.2%, 24% and 14% in the cultivation of CH, NIE and HTPI respectively. The highest low (42%) and very low (40%) was found in HTPI cultivation method which was higher than NIE and CH method (Figure 3). The quality of mushroom showed highly statistically significance ($p \square 0.05$) among the different environmental conditions (Table 2).

Although the experimental procedure and environmental condition of NIE and DF period of HTPI was similar but HTPI produced the lowest quality because in DPI period of HTPI cultivation method the humidity was so high and the temperature was quite lower due to using humidifier. That's why the primordia was adopted with that condition but when the humidifier stopped suddenly and maintained natural environmental condition, then the fruitbodies were become more drier and harder than NIE cultivation method. Because at that condition, the growing fruitbody was contained more moisture than surrounding environment and the environment adsorbed the moisture from the growing fruitbody and then fruitbodies started to become dry and hard. The mushrooms fruitbodies is becoming dry, hard, cap turns into umbrella shape and stalk becoming thickness from lower than 80% humidity and its severely occurred at lower than 60% [21, 22] which is similar to this study but the humidity range should be similar in the all stages of mushroom growth.

Yield Percentage: The percentages of bags that produced perimodia, formation of mature fruitbodies and dead perimodia are presented in Figure 4. The highest percentage of primordial initiation (90.28%) was obtained from CH cultivation whereas the HTPI and NIE were 60.11% and 30.22% respectively. These differences of primordial initiation were found due to indoor humidity and temperature because in CH and DPI period of HTPI methods, the indoor humidity was higher and temperature was slightly lower than NIE.

The highest percentages of mature fruitbodies formation (85.20%) were found CH cultivation method whereas in NIE was 64.65% and the lowest was obtained 43.33% from HTPI cultivation method. The highest percentage of dead primordia (56.67%) was found in indoor environment with humidifying till primordial initiation methods whereas the lowest percentage of dead primordia (14.80%) was found in indoor environment with continuous humidifying (Figure 4).

So it is obvious that in HTPI cultivation method, the percentage of primordia initiation was higher than NIE but the percentages of dead primordia was found highest compared than NIE and CH cultivation methods. Because in DPI period of HTPI cultivation method, the humidity was high and the temperature was slightly lower than NIE (Table 1) and produced higher primordia than NIE but the dead primordia was maximum because in DF period of HTPI method the humidifier was suddenly stooped and the produced primordia those were adopted with that environment were dead due to low humidity. High humidity range from 80 to 90% is favoured for primordial initiation [10, 21] and when the relative humidity lowers than 80% the primordia started to die and fruiting bodies dry out easily [23, 24]. The maximum yield of *Pleurotus sajor-caju, P. ostreatus, P. djmor* when the relaive humidity of culture house was 80 to 90% [25].

Table 3: Correlation of humidity and temperature with individual weight, number of fruitbody, cap diameter, stalk height and quality of *Pleurotus pulmonarius*

Factors	Correlation Coefficients	Individul Weight	Number of Fruitbody	Cap Diameter	Stalk Height	Quality
Humidity	Pearson Correlation	.580**	.242*	.433**	.456**	.496**
	Sig.	.000	.036	.000	.000	.000
Temperature	Pearson Correlation	-.453**	-.202	-.335**	-.403**	-.392**
	Sig.	.000	.083	.003	.000	.001

**. Correlation is significant at the 0.01 level.

*. Correlation is significant at the 0.05 level.

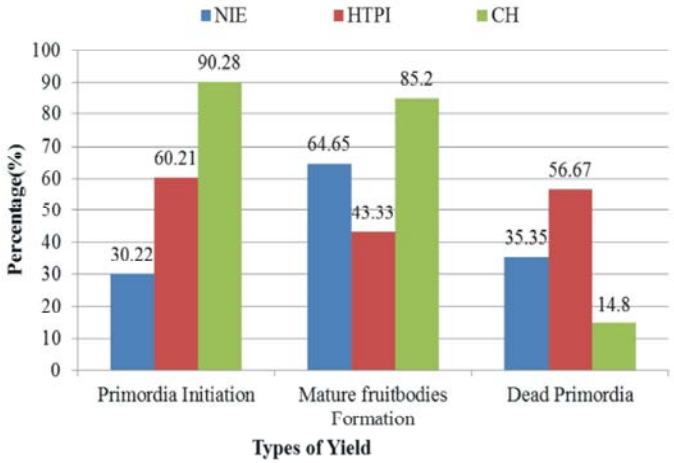

Fig. 4: The Percentages of Primodia Initiation, Mature Fruitbody Formation and Dead Primordia Formation in Different Environmental Conditions

Correlation: The environmental factors especially temperature and humidity are very sensitive to mushroom production. In this study, the humidity showed positively significant correlation with mushrooms individual weight, numbers of fruitbody, cap diameter, stalk height and quality. That means, the high range of humidity is associated with high score of mushrooms morphology, quality and yields. Whereas, the temperature showed negatively significant correlation with those parameters except numbers of fruitbody that showed negatively correlation with temperature but not significant. That means the high range of temperature is associated with low score of mushooms morphology, quality and yields (Table 3).

Hence the numbers of fruitbody showed insignificant negative correlation with temperature because the temperature differences among the three cultivation methods were very low. It would be showed significant if the temperature difference will varied greatly. Low temperature and high moisture containing environment enhanced the mushrooms morphology and yields [4, 26]. So, this result indicate that the individual weight, cap diameter, stalk height and quality of *Pleurotus pulmonarius* are too much sensitive to temperature and humidity than numbers of fruitbody and are increasing with the higher ranges of humidity associated with lower ranges temperature.

CONCLUSIONS

Based on the result of current study, it was concluded that the natural environmental conditions of Malaysia or in similar regions are not suitable for indoor mushrooms cultivation due to its low humidity and high temperature. This study has shown the significant difference of mushrooms morphology, quality and yield percentages between indoor natural and increased range of humidity environmental conditions. The yield percentages, quality and the morphology including individual weight, numbers of fruiting body, cap and stalk size of *Pleurotus pulmonarius* was increasing with the increasing of indoor humidity and have a strong correlation among them. The numbers of fruitbody production is not significantly increased with the increase of humidity and it is expected that other factors may influenced the production. It is also shown that the dead or dry primordia and fruitbodies were decreased with the increased of humidity. It was also found that successfully

initiated primordia in NIE condition were more able to survive throughout cultivation period into mature fruitbody than HTPI environmental condition. Therefore, it is important to ensure similar cultivation environment from primordial initiation stage towards fruitbody maturation stage. This study recommended that for indoor *P. pulmonarius* cultivation should be conducted at continuous 80-90% humidity for high yields and quality throughout the cultivation period.

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